Abstract
This white paper highlights the design consideration of disaster recovery for SQL Server 2019 database with Always On feature on VxFlex family.

March 2020
Revisions

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2020</td>
<td>Initial release</td>
</tr>
</tbody>
</table>

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Executive summary

In today’s enterprise database environments such as SQL Server 2019, organization demand un-interrupted operations with minimum downtime and SLAs. The hyperconverged infrastructure platform facilitates improved flexibility, productivity, performance, protection, and ease of infrastructure management.

Dell EMC VxFlex family (previously VxRack FLEX) is a rack-scale hyperconverged engineered system that delivers flexibility, scalability, and performance for the modern data center workloads. The VxFlex family is powered by software defined storage VxFlex OS, widely adopted enterprise virtualization technology running on enterprise class Dell PowerEdge servers.

This white paper briefs about SQL Server 2019 DR solution using Always On availability group on VxFlex family. SQL Server Always On feature offers comprehensive high availability and disaster recovery solutions.
1 Introduction

Modern data center workloads have varying business value and characteristics for the workload and data that govern the performance, throughput, capacity, availability, data protection, and data services requirements. Shrinking IT budgets, push for greater efficiency, and consolidation and workload requirements have made it necessary for the underlying infrastructure to deliver high performance, scalability, resiliency, and most importantly -- flexibility. VxFlex family is an engineered system for Dell EMC designed on five super power principals to meet the key infrastructure requirements. VxFlex delivers:

- Unmatched performance.
- Unprecedented scale (1000 nodes and 100s-PB storage capacity).
- Built in redundant hardware components and VxFlex OS mesh mirror architecture delivers unparalleled resiliency.
- Infrastructure flexibility: VxFlex is second to none. A VxFlex family has 1000s of hardware and software configuration option combinations that can co-exist freeing customers from T-shirt size, dedicated and siloed environments, and accelerating the data center consolidation.
- Engineered system with single call support and life cycle management.

1.1 Objective

This white paper demonstrates in detail about achieving SQL Server 2019 DR on VxFlex family using Always On feature.

1.2 Audience

This document is intended for decision makers, business leaders, architects, cloud administrators, SQL Server database administrators, hyperconverged infrastructure administrators, and technical administrators of IT environments responsible for deployment of SQL Server databases on Dell EMC VxFlex family with ESXi hypervisors.

The reader of this document must have a working knowledge of Dell EMC VxFlex family, VMware vSphere technologies, Microsoft SQL Server technologies, and should have a basic familiarity with storage, compute, and network technologies and topologies.
1.3 Terminology

The following table defines acronyms and terms that are used throughout this document:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDM</td>
<td>Meta Data Manager</td>
</tr>
<tr>
<td>SDS</td>
<td>Storage Data Server</td>
</tr>
<tr>
<td>SDC</td>
<td>Storage Data Client</td>
</tr>
<tr>
<td>SVM</td>
<td>Storage Virtual Machine</td>
</tr>
<tr>
<td>OS</td>
<td>Operating System</td>
</tr>
<tr>
<td>RCM</td>
<td>Release Certification Matrix</td>
</tr>
<tr>
<td>SSD</td>
<td>Solid-State Drive</td>
</tr>
<tr>
<td>IaaS</td>
<td>Infrastructure as a Service</td>
</tr>
<tr>
<td>PaaS</td>
<td>Platform as a Service</td>
</tr>
<tr>
<td>BaaS</td>
<td>Anything as a Service</td>
</tr>
<tr>
<td>RAC</td>
<td>Real Application Clusters</td>
</tr>
<tr>
<td>ASM</td>
<td>Automatic Storage Management</td>
</tr>
<tr>
<td>DAS</td>
<td>Direct Attached Storage</td>
</tr>
<tr>
<td>DR</td>
<td>Disaster Recovery</td>
</tr>
<tr>
<td>SSMS</td>
<td>SQL Server Management Studio</td>
</tr>
<tr>
<td>WSFC</td>
<td>Windows Server Failover Cluster</td>
</tr>
<tr>
<td>DDL</td>
<td>Data Definition Language</td>
</tr>
<tr>
<td>DML</td>
<td>Data Manipulation Language</td>
</tr>
</tbody>
</table>
2 Product overview

2.1 Dell EMC VxFlex family

The Dell EMC VxFlex family is an engineered system that provides the ultimate performance, reliability, scalability, agility, and flexibility for modern data center workloads, IaaS, and PaaS cloud infrastructure initiatives. The system is powered by Dell EMC VxFlex OS software-defined storage and based on industry-leading enterprise-class Dell EMC PowerEdge servers. It is a rack scale hyperconverged system that comes with a proprietary intelligent physical infrastructure (IPI) cabinet, offers integrated networking and dedicated system management control plane.

Figure 1  VxFlex family benefits
The modular design of VxFlex family enables you to add standardized units of infrastructure to the environment. With this scalable model, it is all about expanding the infrastructure in small increments, as applications require eliminating the over-provisioning that is experienced with other approaches. The following figure shows the overall VxFlex OS Architecture:

Figure 2  VxFlex family scalability

Each cabinet is equipped with redundant access switches (Cisco 93180YC-EX). A pair of aggregation switches is installed in the first cabinet and configured in access/aggregation network topology. If more than one cabinet exists, the aggregation switches can be spread across or installed in other cabinets.

The entire system is built and configured at the Dell EMC factory according to the proven and tested best practices. In addition to the unmatched performance, scalability and performance, customers also enjoy one-call support for all components and end to end life cycle management through a proven automated Release Certification Matrix (RCM) for all components including software and firmware.

### 2.1.1 VxFlex Manager

VxFlex Manager is a VxFlex family management and Orchestration (M&O) tool that provides a single pane of glass for provisioning, managing, monitoring, alerting, life cycle management, and reporting. It increases efficiency by reducing time-consuming manual operations that are required to implement, provision, and manage operations for your VxFlex family. Through automation, you can deploy and manage operations for your VxFlex family.

Using VxFlex Manager, you can:

- Quickly discover and inventory nodes in your VxFlex family deployment.
- Grow or shrink the VxFlex family environment by adding or removing nodes.
- Run your VxFlex family that is aligned to IT operations management practices.
- Monitor, alert, report, and troubleshoot technical issues.
- Support for the two-layer architecture.
- Ability to add or remove volumes within a service.
- Storing configurations as service templates for easy and consistent deployment.
2.2 VxFlex OS overview

VxFlex OS is a software defined block storage that uses servers’ local disks and network to create an IP-based virtual SAN that has all the benefits of external storage without the cost and complexity of fiber-channel. The software is purpose-built to deliver the ultimate performance, data reliability, and scalability expected of enterprise storage. The multiple-deployment options, on-demand scale capability, multi hypervisor support, and resilience make it suitable for virtually all type of workloads. For more details, see Technical support and resources.

For this paper, VxFlex family with hyperconverged deployment is considered.

2.3 SQL Server 2019

With SQL Server 2019, you can build intelligent, mission-critical applications using a scalable, hybrid database platform that has everything that is built in, from in-memory performance, and advanced security to database analytics.

The following are the new features that are provided by SQL Server 2019 release:

- Mission-critical security using Always Encrypted with secured enclave.
- Improved High Availability.
- Data virtualization with Kubernetes Orchestration.
- Intelligent database with In-Memory database, intelligent query processing, and performance.
- Improved developer experience and monitoring capabilities.
- Provides flexibility to choose platform of your choice with Linux and Container support.

2.3.1 Always On availability groups

SQL Server Always On is a feature that is available from SQL Server 2012 onwards. This feature enables to build comprehensive high availability and disaster recovery solutions through Always On availability groups.

Always On availability groups maximize the availability of the SQL server instances and databases. This can be accomplished by having single or group of primary databases on one node and multiple copies of secondary databases on the other nodes. Each of the nodes participating in availability group must be part of Windows Server Failover Cluster (WSFC).

Availability group can be configured in two modes:

- Asynchronous-commit mode
- Synchronous-commit mode

An availability group listener is a virtual network name (VNN), configured in order to connect all the clients to databases from primary or secondary replicas. This helps in faster application failover during database failover in availability groups.
2.3.2 Always On availability group with SQL Server 2019

SQL Server 2019 supports following enhanced features for Always On availability group:

Table 2: SQL Server 2019 feature for Always On availability group.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to nine availability replicas</td>
<td>Each availability group can support up to eight secondary replicas, with up to three synchronous-commit replicas.</td>
</tr>
<tr>
<td>Several forms of availability-group failover</td>
<td>Supports several forms of availability-group like automatic failover, manual failover, and forced failover.</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Supports availability group listener for each of the configured availability group with flexible failover policies and automatic page repair against page corruption.</td>
</tr>
<tr>
<td>Improved performance and security</td>
<td>Supports encryption and compression with high performing transport.</td>
</tr>
<tr>
<td>Enhanced set of tools</td>
<td>Provides improved integrated set of tools for better management of availability groups with advanced SSMS and Transact-SQL.</td>
</tr>
<tr>
<td>New Software Assurance benefits for Always On</td>
<td>SQL Server 2019 with new improved Software Assurance provides a robust business continuity plan with lower total cost of ownership (TCO).</td>
</tr>
</tbody>
</table>

2.3.3 Distributed availability group

Distributed availability group is an availability group that span two availability groups which can be in different locations, that is running on a physical or virtual environment, on-premises or public cloud, or anywhere that support SQL Always On feature. The distributed availability group can have maximum of eighteen replicas, nine replicas from each availability group. It is important to configure the listener for each of the participating availability group, because distributed availability group is configured using listener details of the availability groups it spans.

For more information about SQL Server 2019, Always On availability group and Software Assurance, see Technical support and resources.
3 SQL Server 2019 DR solution architecture

This section outlines the implementation of SQL Server 2019 Always On availability group across two VxFlex clusters that are built on different VxFlex integrated racks that are connected using LAN. Two VxFlex integrated racks were used as primary data center and the DR data center, to simulate the real-time scenario.

The availability group was created using four SQL Server replicas. First stand by replica was configured in sync mode, to achieve the high availability and load balancing. Second and third replicas from DR data center were configured in async mode, to achieve the DR. Two replicas in the DR data center were used to achieve HA and load balancing during the event of DR.

Figure 3  VxFlex family with SQL Server 2019 Always On Availability group

3.1 VxFlex family cluster components

The SQL Server 2019 DR solution was built on hyperconverged infrastructure platform-based Dell EMC VxFlex family. The VxFlex family HCI system is configured with ESXi 6.7 hypervisor for compute and network and VxFlex OS for software-defined storage.

Two VxFlex clusters were built on two VxFlex integrated rack systems as a primary data center and DR data center. Each of the VxFlex cluster was built using four VxFlex nodes. Each VxFlex family node has a Dell EMC Storage virtual machine (SVM) running on it, providing both storage clustering and storage services. For configuration details of VxFlex nodes that were used, see VxFlex family cluster details.
### 3.1.1 VxFlex storage

In VxFlex family with VMware vSphere 6.7 environment, the MDM, and SDS components were installed on a dedicated SVM, whereas the SDC was installed directly on the ESXi host. The VxFlex back-end storage consists of four SDS systems. The Storage Data Server (SDS) aggregates and serves raw local storage in a given node and shares that storage as part of VxFlex OS cluster.

A single protection domain was carved out of the SSDs on these four SDS systems. A single storage pool was configured, and multiple logical volumes were created to meet the SQL Server database requirements including volumes for data, log, and backup. These volumes were mapped to the ESXi cluster and added as a datastore and later mapped as disks drive to SQL Server virtual machine using VMware Paravirtual SCSI (PVSCSI) adapters.

### 3.1.2 Virtual machine

Four identical VMs were created, two VMs on primary data center and two VMs on DR data center respectively. Each of these VMs were installed with Windows 2019 server as guest operating system. Drives were mounted and created using NTFS 64KB block size. All necessary file system was created on both the windows VMs as per SQL Server best practices suggested for VxFlex family systems. For details, see [Best practices](#).

The configuration details of the VMs are listed in [Virtual machine details](#).

![Windows VM disks and file structure](image)

**Figure 4** Windows VM disks and file structure

SQL Server 2019 Enterprise Edition was installed, and single instance SQL Server systems were created on each of the four VMs. A user database was created on primary SQL instance with datafile and logfiles as listed below:

![SQL Server 2019 database data and log file structure](image)

**Figure 5** SQL Server 2019 database data and log file structure.

**Note:** SQL Server different editions have different maximums for number of replicas and additional capabilities. For more details, see [Technical support and resources](#).
3.2 VxFlex network design

The following figure demonstrates high-level network architecture for design of SQL Server 2019 DR solution on VxFlex family HCI system:

![Network Architecture Diagram]

**Architecture flow**

- VxFlex family uses a pair of Cisco Nexus 93180YC-EX as TOR switches.
- VxFlex family uses a pair of Cisco Nexus 9332PQ as Aggregation switches.
- Cisco Virtual Port Channel is configured between the TOR and Aggregation switches.
- Cisco Nexus 3172TQ switch is used for OOB traffic with 1 GbE dedicated network.
- Each node consists of four 25 GbE ports, two ports connected to each TOR (Cisco Nexus 93180YC-EX) switch.
- Both TOR (Cisco Nexus 93180YC-EX) switches have uplinks to aggregation (Cisco Nexus 9332PQ) switches for redundancy and network bandwidth aggregation.
- Both primary data center and DR data center were connected through LAN.
- Ensure to have isolated vLAN for public and private communication.
- For isolation of Always On replication traffic from regular traffic, it is recommended to use an additional dedicated vLAN.
- For network configurations details, see VxFlex networking details.
3.3 DR solution prerequisites

The SQL Server DR solution on VxFlex family was configured and built by following SQL Server recommended guidelines. The following are the pre-requisites for every VM in VxFlex cluster participating in SQL Server DR with Always On availability group:

Table 3  Prerequisites for SQL Server DR solution using availability group

<table>
<thead>
<tr>
<th>Type</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Ensure operating system installed, updated, and configured on all participating nodes are of the same version.</td>
</tr>
<tr>
<td>SQL Server Version</td>
<td>Ensure all the participating nodes in an availability group are of the same version. Always On availability groups are only supported in Enterprise Edition, starting from SQL server 2012. Only SQL Server 2016 standard edition is an exception to this as it supports basic availability group.</td>
</tr>
<tr>
<td>WSFC</td>
<td>All the SQL Server nodes that are participating in the availability group should be part of the single Windows Server Failover Cluster.</td>
</tr>
<tr>
<td>Windows Domain</td>
<td>Recommended to create dedicated domain user account for SQL Server service account. All the replicas in an availability group should be in same windows domain. Ensure that windows domain and active directory are configured as per the SQL server Always On guidelines.</td>
</tr>
<tr>
<td>Windows firewall</td>
<td>This must be set to allow the communication between each of the replicas in the availability group.</td>
</tr>
<tr>
<td>VxFlex family cluster</td>
<td>Ensure that enough disk space and hardware resources are available on standby instances. Data synchronization fails if disk runs out of space. Enough hardware resource at standby instance ensures that it can handle the same workload as primary instance during the failover.</td>
</tr>
</tbody>
</table>

Follow SQL Server recommended guidelines while configuring Always On availability groups. For more details, see Technical support and resources.

3.4 Solution design

VxFlex family-based SQL Server DR solution was built by creating an availability group using Always On. This availability group was created using four replicas, two replicas from primary data center and two replicas from DR data center with one user database. All the SQL Server instances were configured on same windows domain and were part of one WSFC. Active directory users were created for each replica and used for SQL Server service account.

The availability group was created with sync mode for first replica to achieve high availability within the primary data center. And async mode for third and fourth replicas from the DR data center to achieve SQL Server DR. SQL Server AUTO_SEEDING option was used to seed all three standby replicas. Initially the standby SQL Server instances were not having any user database in it. Once availability group was created, user database in the primary SQL Server instance was copied and created in standby SQL Server instances. There after the data were synchronized from primary replica to all three standby replicas created with SEEDING_MODE=AUTOMATIC.
The following figure illustrates solution architecture diagram of the setup used:

![Solution Architecture Diagram](image)

Figure 7  Solution architecture for SQL Server 2019 DR using Always On availability group on VxFlex family
SQL Server 2019 DR procedure and validation

SQL Server DR solution for VxFlex family was built using Always On availability group. This solution was built using four replicas and an availability group. The availability group was created with one primary and three standby replicas, with one standby replica from primary data center and two standby replicas from DR data center.

The real-time OLTP like workload was created on a single user database. The solution was then validated by simulating primary replica failure, VMware vSphere vMotion of SQL Server VM, by performing DDL/DML operations on the database and triggering the DR.

Configuration steps for availability group

This section discusses in detail about pre-configuration and configuration steps that are followed to build and validate Always On availability group for SQL Server 2019.

Pre-configuration steps

The following prerequisites were met before creating Always On availability group on VxFlex family.

- Two VxFlex clusters were built on VxFlex family systems to be used as primary and DR data center respectively.
- Configured the network between two clusters as per the network prerequisites.
- Created four VMs, two on primary data center and two on DR data center.
- Configured network between these four VMs to establish the communication using vLAN.
- Set the Windows domain and created AD users on all four VMs.
- Created four SQL Server instances by installing Microsoft SQL Server 2019 Enterprise Edition on all four VMs.
- Created WSFC for these four VMs.
- Created user database named production01 on primary SQL Server instance.
- Created OLTP workload on production01 database using Hammer DB.
- Enabled Always On feature on all four SQL Server instances.

Figure 8 Displays four SQL Server instances used for availability group
4.1.2 Configuration of availability group
To configure, connect to the primary SQL Server instance from SSMS and create an availability group from Always ON option.

Figure 9  Availability group creation for four replicas with Sync and Async mode

The primary site was hosted with two SQL Server 2019 instances SQL-PRIMARY\SQL_MASTER and SQL-PRIMARY2\SQL-MASTER. The DR site was hosted with two SQL Server 2019 instances SQL-SECOND\SQL_STANDBY and SQL-SECOND\SQL_STANDBYHA. An availability group that is named SQL2019_AG was configured between these four instances for Production01 database.

4.1.3 Test objectives
The validation of the SQL Server 2019 DR solution that is built using Always On availability group covers four major scenarios:

- Auto failover from primary replica to HA standby replica, when primary replica was down.
- Data synchronization between primary and standby replicas.
- VM migration was performed for VM hosting primary replica.
- Manual failover from primary data center replicas to DR data center replicas during primary data center was powered off.
4.1.4 Test activities and results

- **First scenario:** Up on bringing down the primary replica it was observed that, standby replica from the primary data center became the primary replica. This resulted in the continuation of all the transactions from old primary replica to new primary replica.

- **Second scenario:** Performed couple of DML and DDL operations on primary replica. During this it was observed, all the changes made on primary replica were synchronized instantaneously in to standby replicas.

- **Third scenario:** Migrated the VM hosting primary replica using VMware vSphere vMotion, to rule-out the impact of live migration of SQL VMs on Always On availability group. This scenario arises, during physical host failure or any hardware failure on the physical host hosting SQL VMs. During the vMotion, no impact on the availability group and replicas were found.

- **Fourth scenario:** The primary data center goes down making both the SQL Server replicas inaccessible, due to primary data center power off. The DR was triggered by triggering forced manual failover, and two SQL Server replicas in the DR data center was made available. First as a primary replica for all the transactions and second as a standby replica for HA and load balancing. To achieve this, the replica mode of the standby replica at DR data center was flipped to ‘Sync’ mode.

**Note:** Availability group that is configured in async mode will have some data loss while triggering forced manual failover. It is recommended to follow SQL Server 2019 Forced Manual Failover of an Always On Availability Group. For details, see Technical support and resources.
5 Best practices

It is recommended to follow the best practices and guidelines that are mentioned in the following documents:

- For cluster formation and network configuration, see Dell EMC VxFlex Family Overview - Transformation without trade-offs.

- For networking best practices and design consideration, see DELL EMC VXFLEX OS - Networking Best Practices and Design Considerations.

- For building the SQL VM and instances to achieve the optimal performance, see Microsoft SQL Server for Common Workload on Dell EMC VxFlex integrated rack White Paper.

- For configuring and creating Always On Availability group, see Prerequisites, Restrictions, and Recommendations for Always On availability groups.

- For ESXi 6.5 configuration on VxFlex OS hyperconverged platform, see Dell EMC VxFlex OS with ESXi 6.0, ESXi 6.5 and ESXi 6.7 (55323).

In addition, it is recommended to have isolated network for Always On replication traffic with an additional dedicated vLAN.
Conclusion

6 Conclusion

This paper gives the guidelines for SQL Server DR solution on VxFlex family using Always On feature. Also, it describes the VxFlex family HCI based system and recommended best practices for SQL Server DR using Always On.

SQL Server 2019 DR solution was successfully built by following all the best practices and recommendation from Microsoft. The solution was validated successfully by simulating multiple production systems like incidents.
A Appendix

A.1 VxFlex family cluster details

The following table summarizes the software resources that were used to carry out the performance tests.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Version</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell EMC Software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VxFlex OS</td>
<td>3.0</td>
<td>VxFlex OS software solution to create virtual SAN</td>
</tr>
<tr>
<td>VMware software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMware ESXi server</td>
<td>6.7</td>
<td>VMware hypervisor</td>
</tr>
<tr>
<td>VMware vCenter</td>
<td>6.7</td>
<td>VMware management</td>
</tr>
<tr>
<td>Microsoft software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsoft Windows</td>
<td>2019</td>
<td>Application virtual machine operating system</td>
</tr>
<tr>
<td>Server</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsoft SQL Server</td>
<td></td>
<td>Database Servers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A.2 VxFlex cluster node details

The following table summarizes the hardware details of each node in the VxFlex cluster that were used to carry out the performance tests.

<table>
<thead>
<tr>
<th>Model</th>
<th>CPU</th>
<th>Memory</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerEdge R640</td>
<td>2 x Intel(R) Xeon(R) Gold 6152 CPU @ 2.10 GHz</td>
<td>392,645 MB</td>
<td>10 x 1.92 TB Toshiba SSD</td>
</tr>
</tbody>
</table>
A.3 VxFlex network details

The following table summarizes the network details of VxFlex clusters that were used to carry out the performance tests.

<table>
<thead>
<tr>
<th>Components</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco Nexus 93180YC-EX</td>
<td>10 Gbps &amp; 25 Gbps TOR switches</td>
</tr>
<tr>
<td>Cisco Nexus 9332PQ</td>
<td>40 Gbps Aggregation switches</td>
</tr>
<tr>
<td>Cisco Nexus 3172TQ</td>
<td>1 Gbps &amp; 10 Gbps Management switches.</td>
</tr>
<tr>
<td>Data Domain</td>
<td>2 x 10 Gbps links</td>
</tr>
<tr>
<td>Application traffic</td>
<td>2 x 25 Gbps links</td>
</tr>
<tr>
<td>VxFlex storage traffic</td>
<td>2 x 25 Gbps links</td>
</tr>
</tbody>
</table>

A.4 Virtual machine details

The following table summarizes the VM details that were configured to carry out the performance tests.

<table>
<thead>
<tr>
<th>CPU</th>
<th>Memory</th>
<th>Storage</th>
<th>Guest OS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 core/vCPU</td>
<td>128 GB</td>
<td>2.4 TB vdisks</td>
<td>Windows Server 2019</td>
</tr>
</tbody>
</table>
Technical support and resources

B Technical support and resources

B.1 Related resources

See the following referenced or recommended resources that are related to this document:

Note: The following links are open to customers although some may require registration for access.

- SQL Server Central
- SQL Server 2019
- SQL Server Always On availability group technology and capabilities
- SQL Server Always On availability group prerequisites, restrictions, and recommendations
- SQL Server Always On distributed availability group
- SQL Server 2019 and Software Assurance Licensing Guide
- Blog - New high availability and disaster recovery benefits for SQL Server
- Hammer DB.
- SQL Server 2019 Forced Manual Failover of an Always On Availability Group

B.2 Additional resources

- Dell EMC Online Support site (registration required)
  https://www.dell.com/support
- Dell EMC Hyperconverged Infrastructure
  https://www.dell.com/hci
- Dell EMC VxFlex integrated systems
  https://www.dell.com/vxflex
- Dell EMC VxFlex product overview and white paper