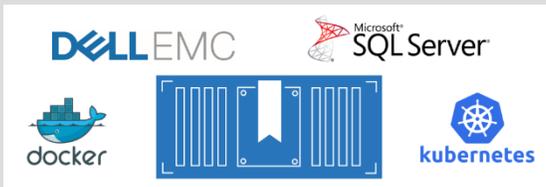# Ready Solutions for Microsoft SQL

Running SQL Server containers on Linux supported by Dell EMC's modern infrastructure.

Benefits of Containers

- Provides a flexible platform for even the most complex applications and databases

- Enables administrators to deploy updates and upgrades on-the-fly

- Empowers teams with portability -- build locally; deploy to the cloud; run anywhere

- Creates predictable environments that are isolated from other applications

Benefits of Microsoft SQL Server Containers

- Delivers secure, isolated development and test environments in seconds

- Enables greater productivity, improved security, and reduced maintenance and economies at scale

- Improves software release quality and frequency

Benefits of Dell EMC's Modern Infrastructure for Containerized Databases

- Creates persistent storage for stateful applications

- Simplifies provisioning, management and orchestration of container storage via Container Storage Interface (CSI) plug-ins

Containerization

Containers have reshaped the way companies think about developing, deploying, and maintaining applications and software. A container consists of an entire runtime environment: an application, plus all its dependencies, libraries and other binaries, and configuration files needed to run it, bundled into one package. Also, containers isolate software from its environment, enabling applications to run quickly and reliably from one computing environment to another.

Like that of virtualization via virtual machines (VMs) and hypervisors, containers were created with the goal of improving data center technologies and the speed and agility of application development. While both virtualization and containerization were developed to increase the efficiency of computer hardware investments by supporting multiple users and applications in parallel, containerization also:

- Makes it easy and fast to deploy applications and databases consistently across multiple environments since the core operating system (OS) can be configured independently from the application container.

- Improves the productivity of IT operations by simplifying application portability, making it possible to build and run applications and databases anywhere there is a compatible OS or control plane -- on-premises and in the cloud.

- Enables developers to create predictable environments that are isolated from other applications, so that they, and IT Operations teams, spend less time debugging and diagnosing differences in environments, and more time building new applications and competitive business services.

- Provides developers with a sandboxed view of the OS logically isolated from other applications which can reduce the number of fixes post release since developers know what was built in dev and test environments will hold true in production.

You will find little argument among developers as to the value of using containers for test and development of applications. As outlined above, speed, efficiency and portability are what agile development and Dev/Ops strategies embody. However, adoption of database containerization has been slower due in large part to the lack of support for persistent storage of database files separate from ephemeral container files and concerns over compatibility with infrastructure components and software.

Microsoft SQL Server on containers

As organizations embrace digital transformation, they are looking for technologies that drive innovation across their entire organization. Containers can help enterprises modernize legacy applications and create new cloud-native applications that are both scalable and agile in this new digital era. As a result, there has been an increase the adoption of containers.

Digital transformation has also been a driving force for evolving relational databases into the next generation of data management platforms capable of supporting advanced business intelligent applications, artificial intelligence (AI) and machine learning (ML) applications, and more agile application development platforms.

In response, Microsoft has been expanding its software offerings to include support for a broader range of operating systems, including Red Hat Linux (RHEL) and SUSE Linux Enterprise Server, and programing languages, R and Python. This has paved the way for Microsoft to offer SQL Server on Docker containers -- the world's leading containerization platform[2] tool for building, distributing, and running containers and runs natively on Linux.

Microsoft first introduced SQL Server containers on Linux with the release SQL Server 2017 and is expanding these capabilities with SQL Server 2019. In SQL Server 2019 Microsoft will make it even easier to adopt SQL Server in containers by enabling new high availability (HA) scenarios; Linux-based container images on Microsoft Container Registry; Red Hat-Certified Container Images; and the SQL Server operator for Kubernetes, which makes it easy to deploy an Availability Group.

## Containerized Databases: Test, Development and Production

Containers are designed to be "short-lived", or stateless, by nature which is why many organizations look to containers for test and development purposes. Application developers most often work outside of the server environments their programs need to run in. To minimize conflicts in library versions, dependencies and configuration settings, the production environment needs to be recreated multiple times for development, testing and pre-production integration. However, when it comes to building or updating databases, like SQL Server, the data needs to be persistent and must survive through the restart or re-scheduling or deletion a container. When containers are rescheduled the storage should also be shifted and made available on a new host, for the container to start without incident.

Containers can also be valuable for production SQL Server database environments. When it comes to production environments, high availability and disaster recovery are of great concern. The inability of applications to access data, or worse, loss of critical business data has far reaching financial and legal impacts. The idea of using an ephemeral container environment may not appear to be wise business decision. However, data platforms, such as Microsoft's SQL Server, have evolved to provide companies with the ability to achieve the benefits of database containerization in production environments. SQL Server 2019 builds on high availability and disaster recovery with containers orchestrated with Kubernetes and Always On Availability Groups. Companies can configure a SQL Server instance on Kubernetes with persistent storage for high availability. If the SQL Server instance fails, Kubernetes automatically re-creates it in a new pod – providing resiliency against a node failure. Also, Kubernetes orchestrates instances of SQL Server in container images that participate in a SQL Server Always On Availability Group providing improved health monitoring, faster recovery, rolling upgrades, offload backup, and read scale out. SQL Server container with Availability Groups, provides the enterprise-class high availability and disaster recovery capabilities need for production deployments.

Dell EMC CSI plug-ins: Integration for better orchestration, automation and management of container storage

Container engines such as Docker and orchestration frameworks such as Kubernetes, provide a standardized way to package applications — including the code, runtime and libraries — and to run them in a consistent manner across the entire software development life cycle. The Container Storage Interface (CSI) is a standard for exposing arbitrary block and file storage systems to containerized workloads on Container Orchestration Systems (COs) like Kubernetes.

To effectively address the challenges of stateless containers and the need for persistent storage, Dell EMC storage solutions -- such as
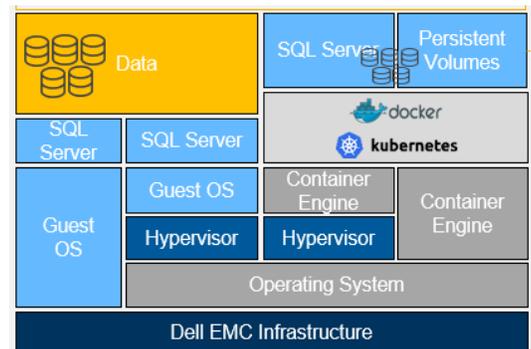
Source 1: Gartner, "6 Best Practices for Creating a Container Platform Strategy", Smarter With Gartner, April 23, 2019
Source 2: Software Testing Help, "Top 10 Best Container Software In 2019", July 2, 2019

XtremIO X2 and the VxFlex Family of products -- provide unique CSI Plug-ins which allow customers to deliver persistent storage for container-based applications for both development and production scale. The combination of the Kubernetes orchestration system and Dell EMC storage CSI plug-ins, like that of XtremIO X2, enables simplified provisioning of containers and persistent storage.

Dell EMC recently tested and validated a solution using Microsoft SQL Server 2019 containers for an application development and testing environment hosted on a Dell EMC platform. Kubernetes enhanced with the XtremIO X2 CSI plug-in provided the capability to attach and manage all-flash XtremIO X2 volumes to containerized applications. This solution demonstrated how developers are able leverage a familiar Kubernetes experience to create a copy of the SQL database and connect it to the SQL Server container. Developers can then modify the database and protect progress by using XtremIO Virtual Copies (snapshots) to save a copy of the database.

The integration capabilities of Dell EMC storage CSI plug-ins also make it possible for developers, database administrators and storage administrators to utilize interfaces they are most comfortable with -- such as command line interface (CLI), the Kubernetes dashboard, Microsoft Azure Data Studio and, in this example, the XtremIO X2 user interface (UI) -- to provision and manage persistent storage. A developer can provision storage without having to make requests to the storage administrator, making storage available in seconds vs. hours as seen with traditional and manual processes, while the storage administrator is still able to monitor the newly added storage resources.

Dell EMC's Modern Infrastructure for Containerized Databases

Dell EMC's designs and validates solutions for Microsoft SQL Server to help organizations jump start their application development transformation with a modern infrastructure, including realizing the benefits deploying containers for application and databases.

Key Component	Capabilities
Storage XtremIO X2	The Dell EMC XtremIO X2 of all-flash storage array is an ideal storage platforms for running online transaction processing (OLTP), online analytical processing (OLAP), or mixed workloads. It delivers impressively high IOPS, ultra-wide bandwidth, and consistent sub-millisecond latency for databases of all sizes. The XtremIO X2 CSI Plug-in provides Kubernetes technology with built-in enterprise-grade container storage, and uncompromising performance that extends Kubernetes' multi-cloud portability to the private cloud.
Hyper-converged VxFlex integrated rack and appliance	The VxFlex Family of offerings, create a server-based SAN by combining storage virtualization software, known as VxFlex OS, with Dell EMC PowerEdge servers to deliver flexibility, scalability, and capacity on demand. Local storage resources are combined to create a virtual pool of block storage with varying performance tiers. The Flex family enables you to start small (with as little as four nodes) and scale incrementally. The VxFlex family provides enterprise-grade data protection, multi-tenant capabilities, and add-on enterprise features such as QoS, thin provisioning, and snapshots. VxFlex OS offers true block storage as a service, making it an excellent complement to Kubernetes for stateful applications, such as databases, continuous integration, logging and monitoring platforms.
Server PowerEdge Family	Dell EMC PowerEdge servers provide a scalable business architecture, intelligent automation and integrated security for your high value data management and analytics workloads. Dell EMC offers one of the broadest selections of servers enabling customers to configure their compute to match business requirements. The vast configuration choices in using PowerEdge server means you can optimize per core licensing for containers, Docker's Enterprise Edition as an example. The key to getting the greatest return on your containerized environment is consolidation that maximizes the efficiency of CPU utilization.

Additional Software for Simplified Management	
CloudIQ ⊞ Integrated Dell Remote Access Controller	CloudIQ: A no cost, no maintenance cloud-based storage analytics application which uses near real-time intelligence, proactive monitoring, predictive analytics, and machine learning to deliver comprehensive health scores at-a-glance.
	Integrated Dell Remote Access Controller (iDRAC): Embedded within every Dell EMC PowerEdge server, it provides functionality that helps IT administrators deploy, update, monitor, and maintain servers with no need for any additional software to be installed. iDRAC functions regardless of operating system or hypervisor presence because from a pre-OS or bare-metal state because it is embedded within each server from the factory. iDRAC alerts administrators to server issues, helps them perform remote server management, and reduces the need for physical access to the server.

Microsoft and Dell EMC -- making database containerization a reality

Whether customers are looking to use containers for test and development purposes, like DevOps, or to deploy databases with container orchestrators such as Kubernetes, SQL Server in containers ensures a consistent, isolated and reliable behavior across environments, that is easy to use, start and stop. Customized content can be built on top of SQL Server containers, and run without being affected by the rest of the environment. This isolation makes SQL Server in containers ideal for test deployment scenarios as well as DevOps processes.

Dell EMC brings the power of persistent storage to a stateless platform. Dell EMC's storage and CSI plug-ins enable container orchestrators, like Kubernetes, to easily provision highly available and scalable container volumes for stateful containerized applications and databases.

IT professionals and application developers can leverage the advantages of Docker, Kubernetes, Microsoft SQL Server and Dell EMC storage, servers and network to improve the efficiency of production database environments, test and development processes, and shorten the time to value of new application development.