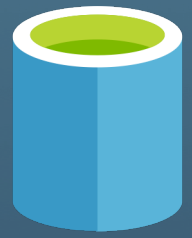
DBA MASTERY



Exploring SQL Server containers on Docker and Kubernetes

Microsoft® Most Valuable Professional

Carlos Robles

Principal Consultant, DBA Mastery

/croblesdba

@dbamastery

crobles@dbamastery.com

Experience

Microsoft Data Platform MVP
Over 10 years of experience
Multi platform DBA

Community

International speaker, author, blogger, mentor
Guatemala SQL Server community leader
Simple Talk, SQL Server Central and MSSQL Tips author

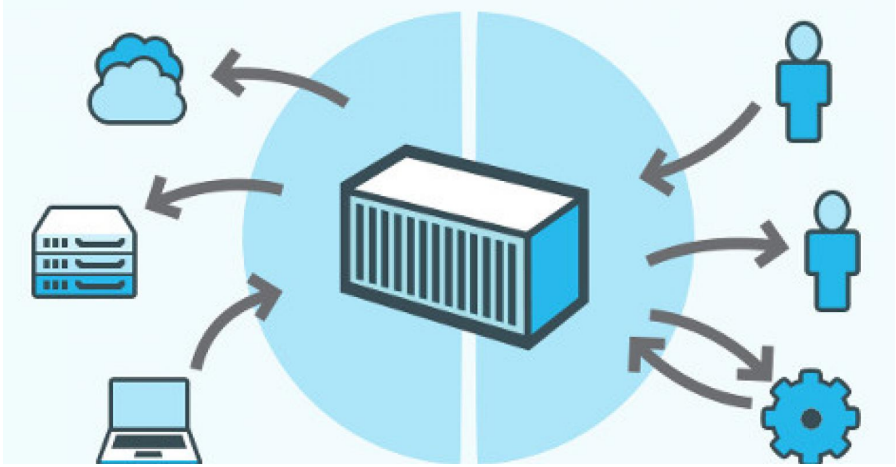
DBA Mastery

SQL Server tips, scripts, best practices and more

MAXDOP Calculator
Azure Data Studio wait stats widget
PerfMon for DBA's
MSDB tuning

AGENDA

- Introduction to Docker
  - Images
  - Containers
  - Docker architecture
  - VM’s vs Containers
  - Advantages
- The SQL Server docker image
- The SQL Server Dockerfile
- Running a SQL container
  - Managing containers
  - Demo (Linux \ Unix + Windows)
- Introduction Kubernetes
  - Kubernetes architecture
  - Advantages
  - Demo



Containers are the future!

DOCKER

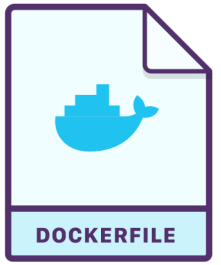
- From Docker docs:

  Docker is an open platform for developing, shipping, and running applications. Docker enables you to separate your applications from your infrastructure so you can deliver software quickly.

  With Docker, you can manage your infrastructure in the same ways you manage your applications.

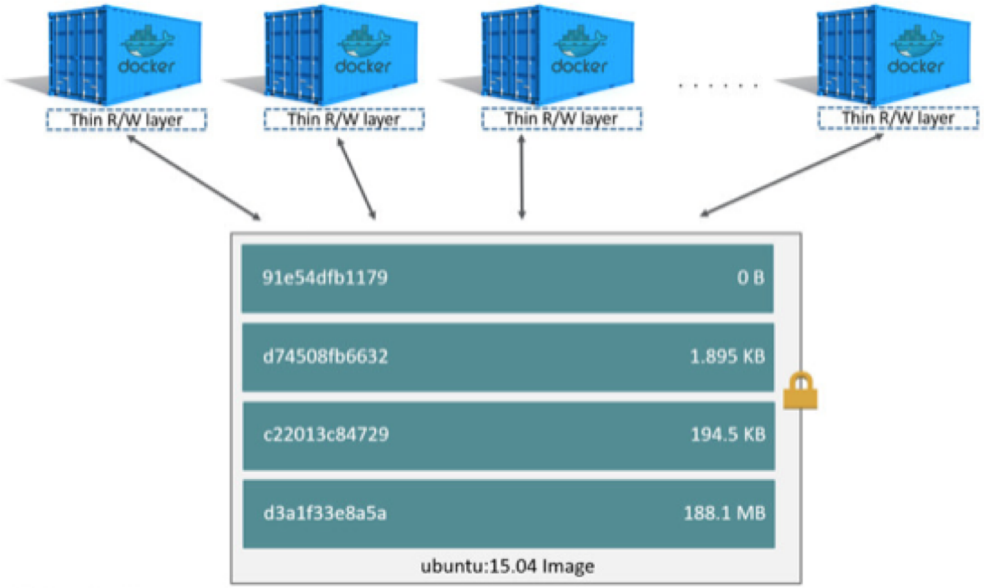
IMAGES

- Is a read-only template with instructions for creating a Docker container
- Images are created using a Dockerfile
- A snapshot of a set of files required to run an application
- Portable and consistent
- A new image can be created from an existing image (make your own)
  - SQL Server for example, based on Ubuntu or RedHat

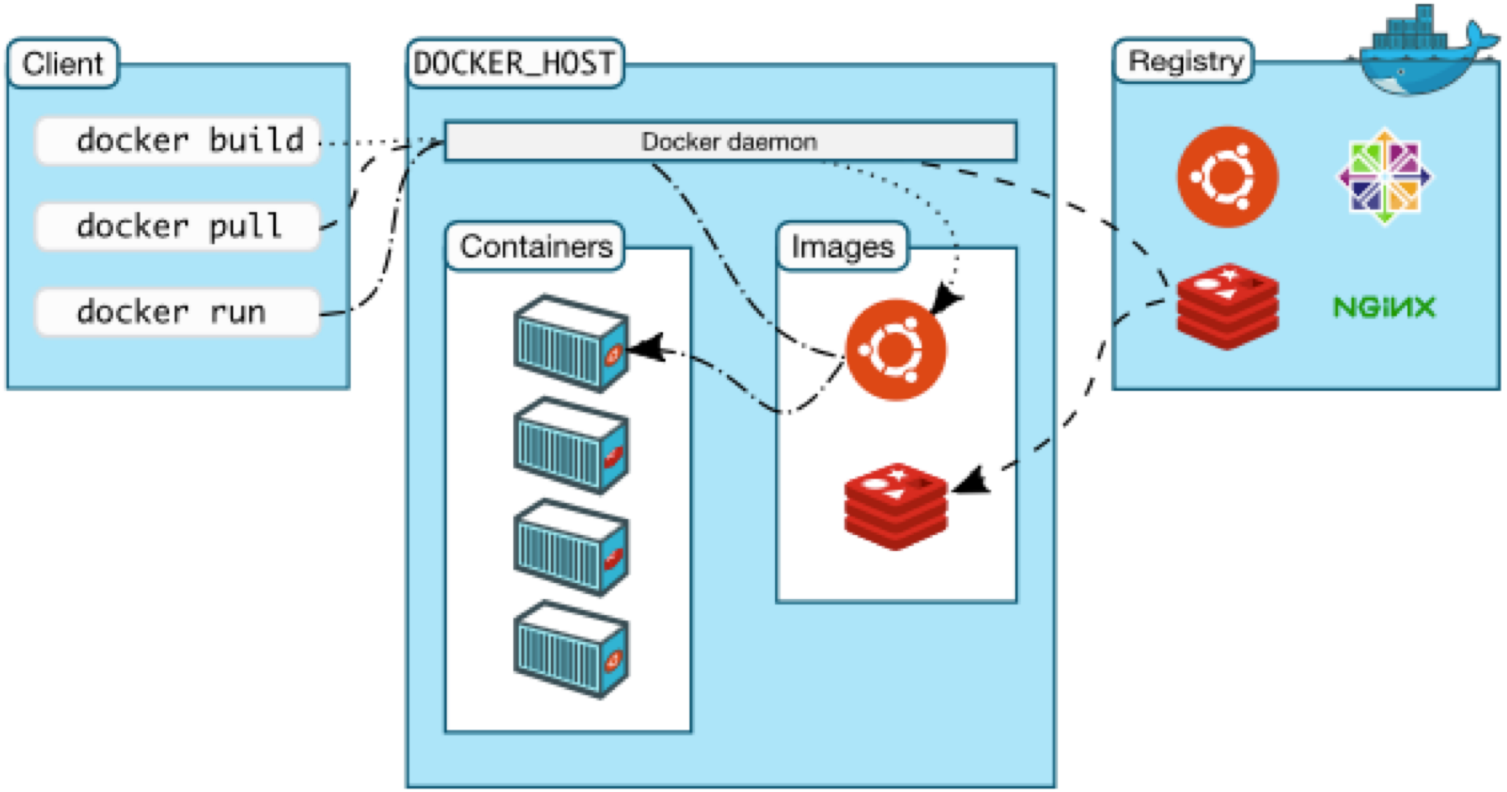


CONTAINERS

- The runnable instance of a Docker image
- A standardized unit of software
- Container is nothing more than a program
- Writable layer and shared read-only layer
  - Small storage footprint
- Containers has full access to all resources
- Volumes = Persistent storage



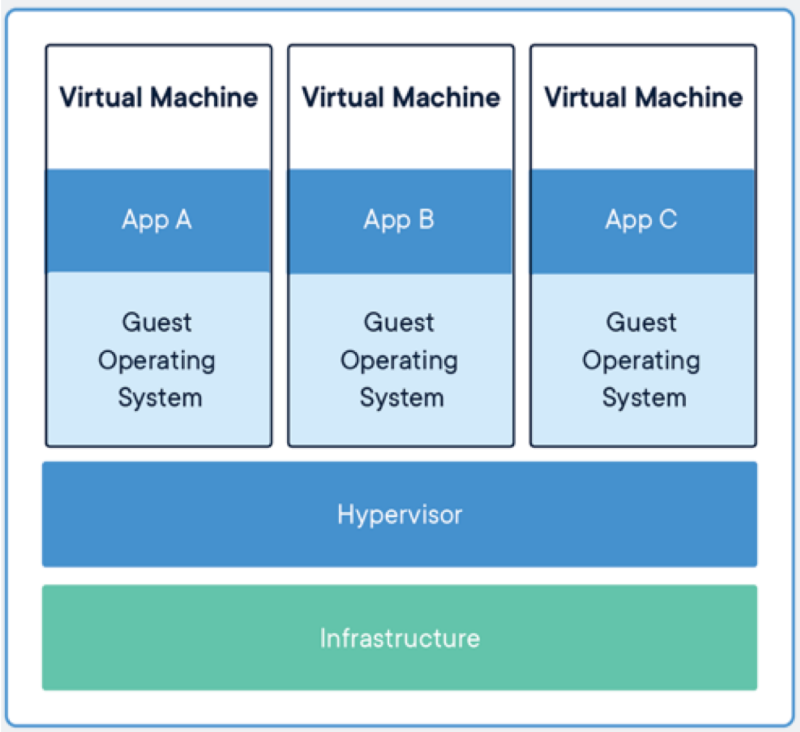
DOCKER ARCHITECTURE

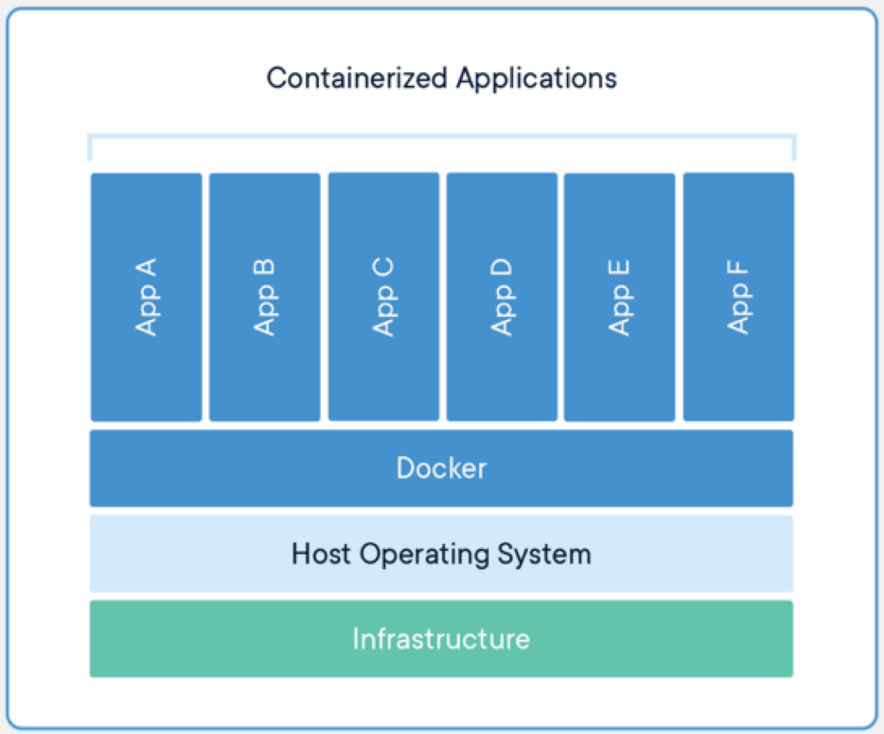


VM’S VS CONTAINERS

- Virtualization +15 years
- Sometimes heavyweight
- Hardware virtualization
- Each VM has an entire OS

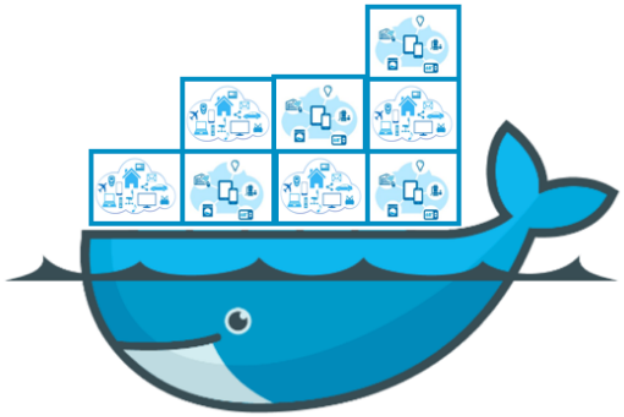
- No installation
- Lightweight
- OS virtualization
- All containers run in the same host OS


Virtual Machine
Virtual Machine
Virtual Machine
App A
App B
App C
Guest Operating System
Guest Operating System
Guest Operating System
Hypervisor
Infrastructure


Containerized Applications
App A
App B
App C
App D
App E
App F
Docker
Host Operating System
Infrastructure

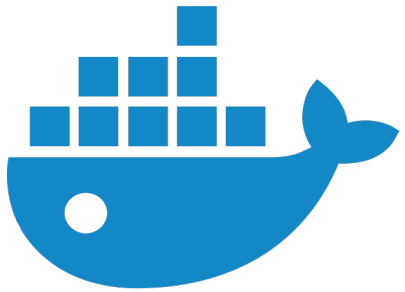
ADVANTAGES

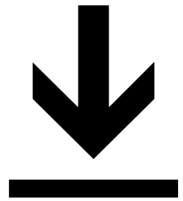
- Easy to use
- Agile application creation and deployment
- CI\CD – DevOps
- Resource isolation and better utilization
- Quick start \ stop time
- Cloud and OS portability
- Environmental consistency across all environments



SQL SERVER IMAGE

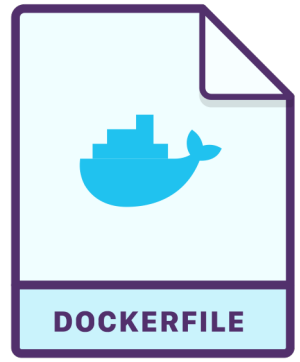
- Docker Hub – Microsoft container registry
- SQL Server 2017
  - Just Ubuntu from RTM to latest CU and GDR
- SQL Server 2019 (CTP)
  - Ubuntu and RedHat
  - From CTP 1.0 to latest
- SQL Server is pre-installed (standard)
- Backups are compatible between all platforms

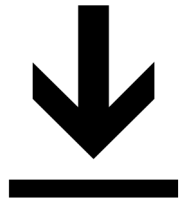


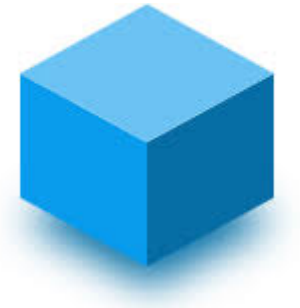


SQL SERVER DOCKERFILE

```
FROM ubuntu:16.04

EXPOSE 1433

COPY ./install /

CMD ["/opt/mssql/bin/sqlservr"]
```

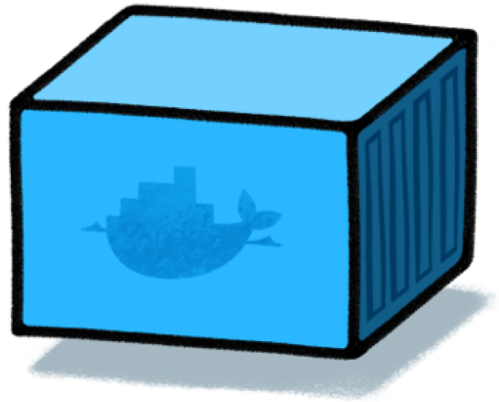






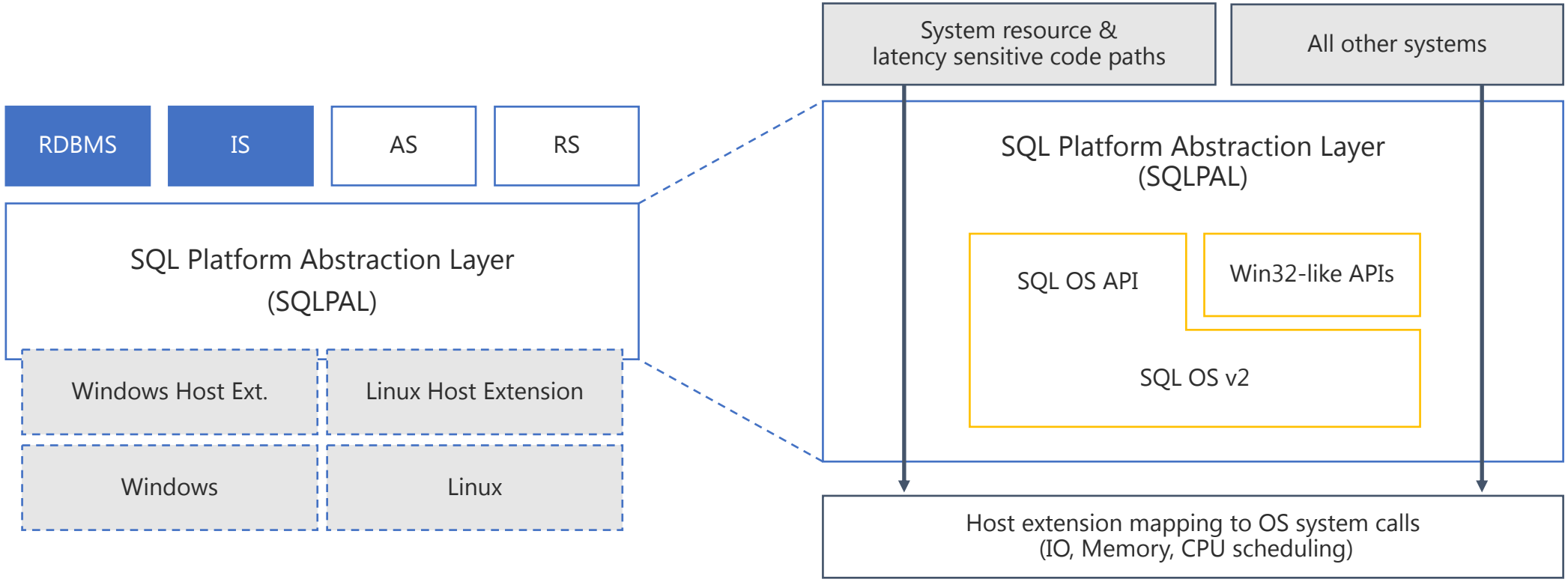
RUNNING A SQL CONTAINER

```
docker run \
--name TEC_GT \
--env 'ACCEPT_EULA=Y' \
--env 'MSSQL_SA_PASSWORD=T3cG7-R0cks' \
--publish 1400:1433\
--detach mcr.microsoft.com/mssql/server:2017-CU15-ubuntu
```



sqlservr gets forked → environment variables works as startup parameters → /var/opt/mssql structure created and populated → System databases and files extracted from .sfp files → Engine now runs as a process

SQL SERVER LINUX ARCHITECTURE



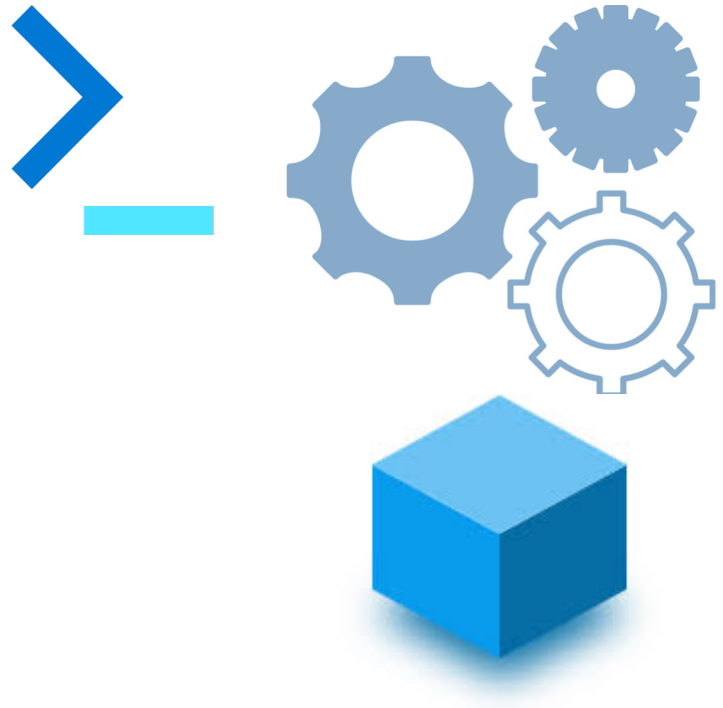
SQL SERVER 2019 ON LINUX

		Windows	Linux
Editions	Developer, Express, Web, Standard, Enterprise	●	●
Services	Database Engine**, Integration Services, SQL Server Agent**	●	●
	Analysis Services, Reporting Services, MDS, DQS	●	
Mission critical performance and HADR	Maximum number of cores	Unlimited	Unlimited
	Maximum memory utilized per instance	24 TB	12 TB
	Maximum database size	524 PB	524 PB
	Basic OLTP (Basic In-Memory OLTP, Basic operational analytics)	●	●
	Advanced OLTP (Advanced In-Memory OLTP, Advanced operational analytics, adaptive query processing)	●	●
	SQL Server Replication	●	● NEW
	Basic high availability (2-node single database failover, non-readable secondary)	●	●
	Advanced HA (Always On - multi-node, multi-db failover, readable secondaries)	●	●
Security	Basic security (Basic auditing, Row-level security, Data masking, Always Encrypted, **Active Directory Authentication**)	●	●
	Advanced security (Transparent Data Encryption)	●	●
Data warehousing	PolyBase	●	● NEW
	Basic data warehousing/data marts (Basic In-Memory ColumnStore, Partitioning, Compression)	●	●
	Advanced data warehousing (Advanced In-Memory ColumnStore)	●	●
	Advanced data integration (Fuzzy grouping and look ups)	●	●
Tools	Windows ecosystem: Full-fidelity Management & Dev Tool (SSMS & SSDT), command line tools	●	●
	Linux/OSX/Windows ecosystem: Dev tools (VS Code), DB Admin GUI tool, command line tools	●	●
Developer	Programmability (T-SQL, CLR, Data Types, JSON, Graph)	●	●
	Distributed Transactions	●	● NEW
	Machine Learning Services	●	● NEW

DEMO

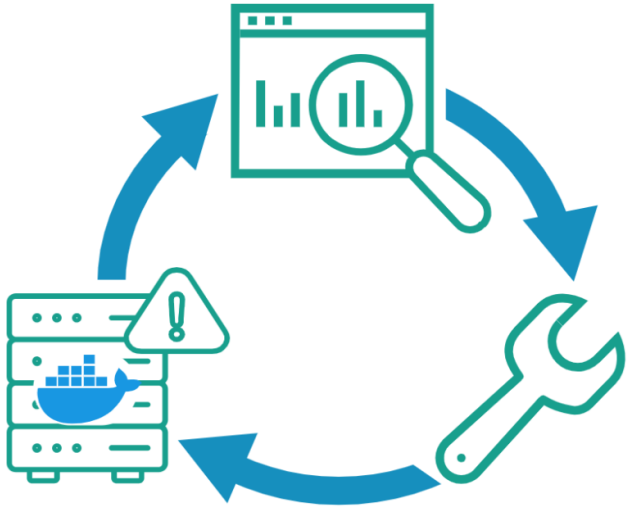
MANAGING CONTAINERS

```
docker pull

docker run

docker start | stop

docker image | container

docker rm | rmi

docker exec

docker build

docker logs

docker inspect

docker volume

docker save
```

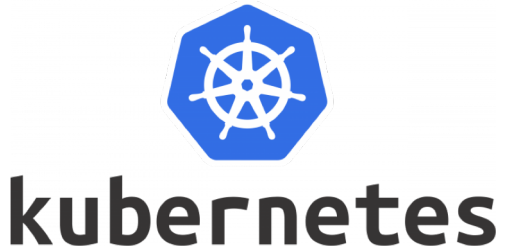


USE CASES

- Local development
- Troubleshooting
- Demonstrations
- Eliminates shared environments
- Eliminates resource contention
- Temporal environments
  - No installation \ patching



KUBERNETES



- From Kubernetes docs:

  Kubernetes is a portable, extensible open-source platform for managing containerized workloads and services, that facilitates both declarative configuration and automation.

  It also make possible the container orchestration for automating application deployment, scaling, and management.

KUBERNETES ARCHITECTURE

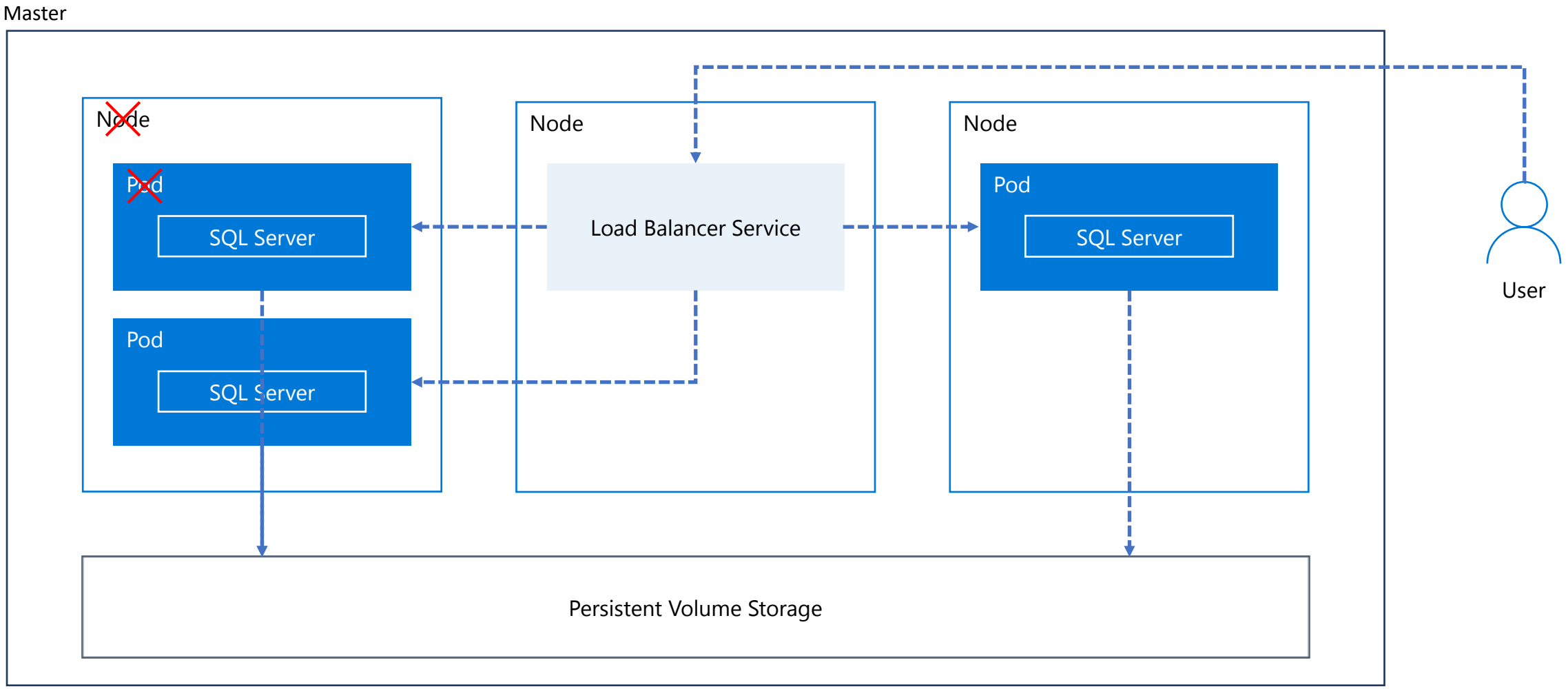
- Masters
  - Multiple moving parts \ processes
  - Runs on a single node in the cluster
  - Tells others what to do – desired state
- Nodes
  - Do the work, runs applications
  - Aka “minions”
  - Reports the state back up to the master

- Pods
  - Containers runs inside of pods
  - Can have one or more pods within a node
- Services
  - Hiding multiple pods behind a service IP address
- Deployments
  - Declarative model
    - Desired state (number of POD's)
  - Manifest file (YAML, JSON)

ADVANTAGES

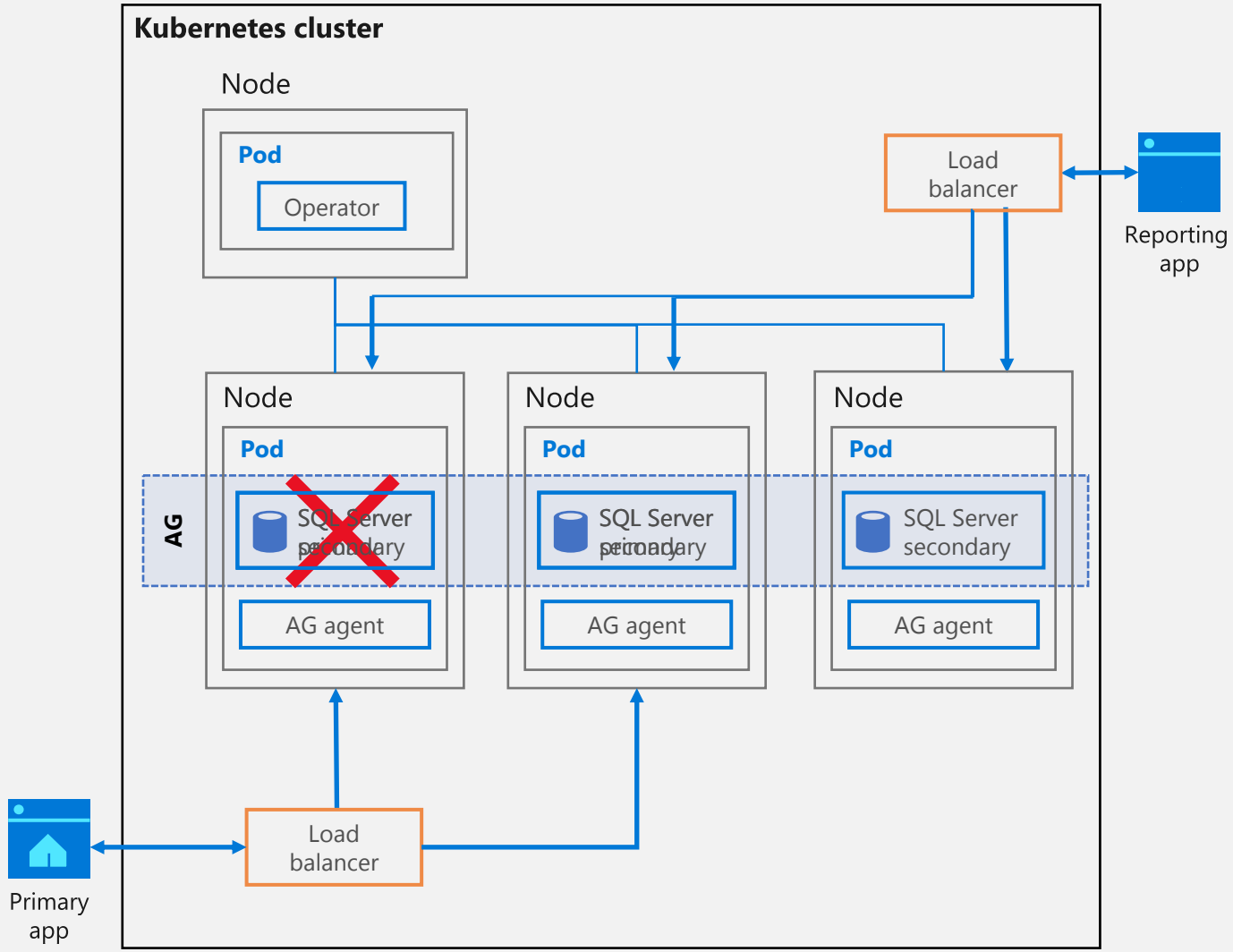
- Easy to use – Declarative configuration
- Self healing – Built in HA
- Auto scale
- Platform agnostic
- Compute and storage layer are separate
- Load balancing
- CI\CD – DevOps workflow

DEMO


Master
Node
Pod
SQL Server
Pod
SQL Server
Node
Load Balancer Service
Node
Pod
SQL Server
User
Persistent Volume Storage

- SQL Server/k8s failover integration
- Operator deployment
- AG concepts all apply
- Load Balancer for Primary App
- Load Balancer for Secondary Replica Readers

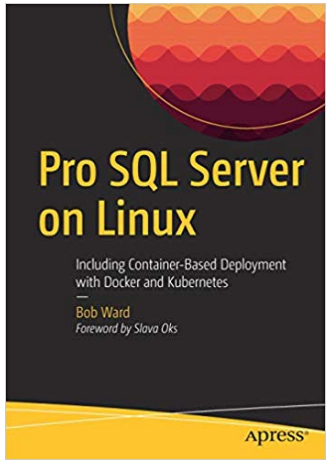
Availability groups on Kubernetes



QUESTIONS ?

REFERENCES

- **Official documentation**
  - Docker Docs
  - Kubernetes Docs
- **SQL Server**
  - SQL Server workshops
  - SQL Server samples
- **Books**
  - Docker Deep dive
  - The Docker book
  - Kubernetes: Up and Running
  - The Kubernetes book
  - Pro SQL Server On Linux by Bob Ward
- **Pluralsight Courses**
  - Getting Started with Docker
  - Docker Deep Dive
  - Docker and Kubernetes: The big picture
  - Kubernetes Installation and Configuration fundamentals
- **Microsoft Learning Courses**
  - Kubernetes Learning Path
  - SQL Workshops
- **Katacoda**
  - Docker
  - Kubernetes



MORE FROM CARLOS

- **24 Hours of PASS**
  - YouTube recording
- **Simple Talk**
  - SQL Server Docker Containers in macOS
- **SQL Server Central**
  - Creating Aliases for Docker commands
  - Managing SQL Server containers using Python – Part 1
  - Managing SQL Server containers using Python – Part 2 (**Coming soon**)
- **MSSQL Tips**
  - SQL Server 2019 CT2 RHEL Docker containers

croblesdba

@dbamastery

crobles@dbamastery.com

DBA Mastery

Thank you!!