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Technologies

Which One Is to Choose for Enterprise Container Storage: NAS vs. SAN

July 2022

Executive Summary: NAS and SAN Container Storage

- ***Reasons to choose container storage: NAS vs SAN***
  - **#1 reason is application type**, other reasons includes ease of O&M, reuse existing SAN/NAS, and orchestration integration etc.
    - **NAS** (object storage can also support these applications, the main differences are NAS perform better, share better, handle files with various sizes better)
      - Big data analytics
      - ML and deep learning
      - Video streaming and analysis
      - DevOps……
    - **SAN**
      - Database
      - New applications with large datastore, such as ElasticSearch, Casandra, and Couchbase.
- ***NAS and SAN container storage typical use cases***
  - **NAS**
    - **Industry:** MSP, Streaming Services, Health Care, and ADAS etc.
    - **Applications:** Big data analytics, ML/DL, Video Analysis and DevOps etc.
  - **SAN**
    - **Industry:** Banking, government, oil/gas etc.
    - **Applications:** RMDB, new application with large datastores like ElasticSearch etc.
- ***Why haven't I heard many NAS/SAN (especially from IT vendors) container storage use cases?***
  - **Adoption stage**: enterprises move quickly to modernize their applications first to containers, while data containerization for stateful application are still maturing
  - **Many started with public cloud object storage first**: since new application types like BDA, ML/DL etc. fit well with S3 type of object storage, naturally you will see more use cases in object storage, BUT, customers gradually found that the cloud object storage can't perform at the enterprise-grade, thus they are looking for new solutions, NAS and SAN become more popular with some high sharing, various file sizes, and mission critical.
  - **Public cloud competitions**: public cloud provide end-to-end services including Kubernetes/OpenShift/Tanzu clusters, serverless-based data services, application , app integrations (like app consistency support), thus IT vendors must find other advantages to compete, by providing specialized data services
- ***NAS and SAN are valid choice, what are market and product strategy to promote NAS and SAN container storage from IT vendors?***
  - **Provide specialized premium data services**: to compete with cloud vendors like AWS® EFS (file) and EBS (block), IT vendors must take advantages of faster hardware innovation cycles, provide premium services in new hardware like flash technologies, PMem, CXL, RDMA, xPUs and GPUDirect etc., enterprise-grade data availability, reliability and protections, better data reductions. This kind of products can be called "***high-performance enterprise Kubernetes storage NAS***"
  - **Improve end-to-end container ecosystem support**: it includes deep Kubernetes/OpenShift/Tanzu support, like app/crash consistency, dynamic provisioning, CAS (container attached storage like OpenEBS etc.), observability, storage system data service integration and abstractions (like Container Storage Module) etc.
  - **Continue research and promote near data processing**: adding ML algorithm in control path of Kubernetes to better compute/storage coordination's, resource mapping and optimization etc.
  - **Compete in multi- hybrid- cloud support**: IT vendors normally embrace more open systems, comparing to public cloud vendors. This will ease enterprises concern related to vendor lock-in. Container, Kubernetes, and container storage play important role to better support app and data mobility etc.

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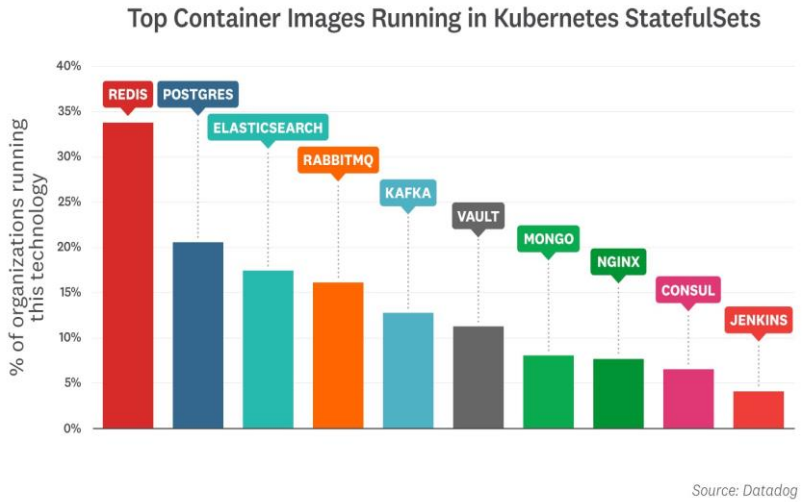
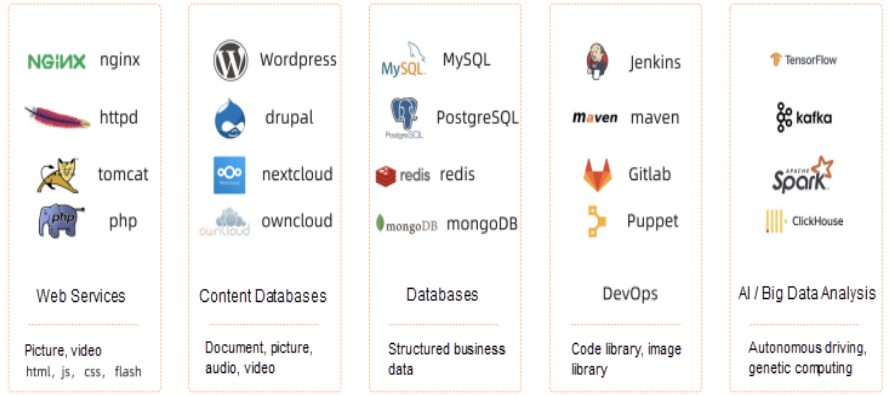
NAS and SAN Container Comparison: Reasons to choose NAS vs. SAN

1. **The application type**
   - SAN: (especially when the size the data in these application are expected to grow big) databases, modern data store platforms like ElasticSearch, Cassandra and Couchbase
   - NAS: (object and HCI are in the same category) the rest
2. **Operation and maintenance**
   - SAN: harder (might need FC switches)
   - NAS: easier
3. **Integration with orchestration tools**
   - No difference in choosing SAN and NAS, the full integration wins out (SAN is in general treated as more organic consumption within k8s, similar to VMWare® uses SAN, but NAS doesn't fall behind too much)
   - The full integration could mean container-native-storage (software defined, and k8s native like Portworx® to Pure Storage®) on top of the storage array, or array with vendor developed k8s data store and services like NetApp ® Astra
4. **Reusing existing SAN and NAS systems**
   - Leverage your investment in materials and process right away
   - Also take advantages of rich data services

As of October 2021, the most popular off-the-shelf container images



Which applications need to use persistent storage in a container environment



Acknowledgement: Image source

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NAS and SAN Container Comparison: Use Cases Examples

- NAS Containers: Industry
  - **Video Service & Industry 4.0 (factory floor video monitoring surveillance)**
    - High concurrency (file sharing), high traffic, low latency (for all flash NAS)
    - Container and orchestration make the high elastic (peak burst to cloud) possible
  - **ADAS**
    - Training: GPU access pictures in the training set repeatedly and randomly
    - high-IOPS file access(random access for small files) file access (good for all flash NAS)
    - Containers to support multiple clients to access multiple data nodes at the same time
  - **Health Care: Bioinformatics & Genome Computing**
    - Real time data from gene sequencer, historical data, intermediate data
    - All are in file format; some might need GPU access; good for all flash NAS
    - Container cluster to mount NFS for shared storage of high-performance computing for genome data analysis
  - **MSP: Compete with public loud like AWS Elastic File System (VastData® + Krystal® + Nvidia®)**
    - Cloud giant file services limit performance/TB, all flash NAS can have better performance
    - Containers are used for multi tenants to share files
- NAS Containers: Applications
  - **Web services**: Content management applications, such as WordPress, are scaled out to multiple instances for performance and redundancy and can share uploads, plugins, and templates across multiple instances.
  - **Software development tools**: Developer tools such as JIRA and Git need to share data between instances to achieve high availability, but the code is kept in multiple Alibaba Cloud zones for persistence.
  - **Big data analysis/processing and Machine/Deep Learning**: Machine learning frameworks, such as genetic data processing and Tensorflow, need to access data through file system interfaces and use shared persistent storage. This allows multiple users to use and run jobs on the same set of data in parallel.
  - **Enterprise applications**: Shared notebooks (such as JupyterHub) need to provide persistent storage for notebook data and user workplaces, and shared storage makes collaboration easy for data scientists.
- SAN Containers
  - **ERP, CRP, DB modernization**: Software vendors (SaaS and RMDB) stared to support containerization for cloud-native and elasticity. This could be an opportunity for all flash SAN.
  - **Mainframe modernization**: Many public cloud vendors started to provide such service, compute side uses mainframe emulators, the storage side uses containerized database to replace DB2.

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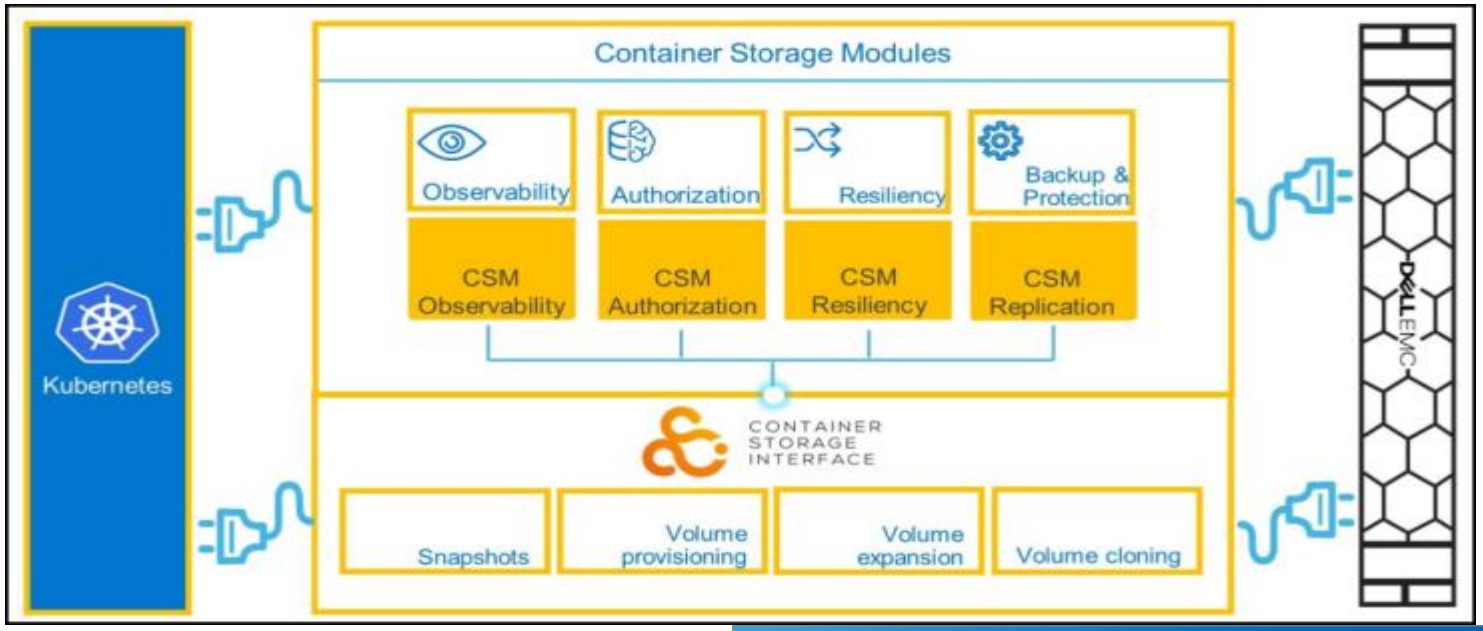
NAS and SAN Container Comparison: What features are customers looking for

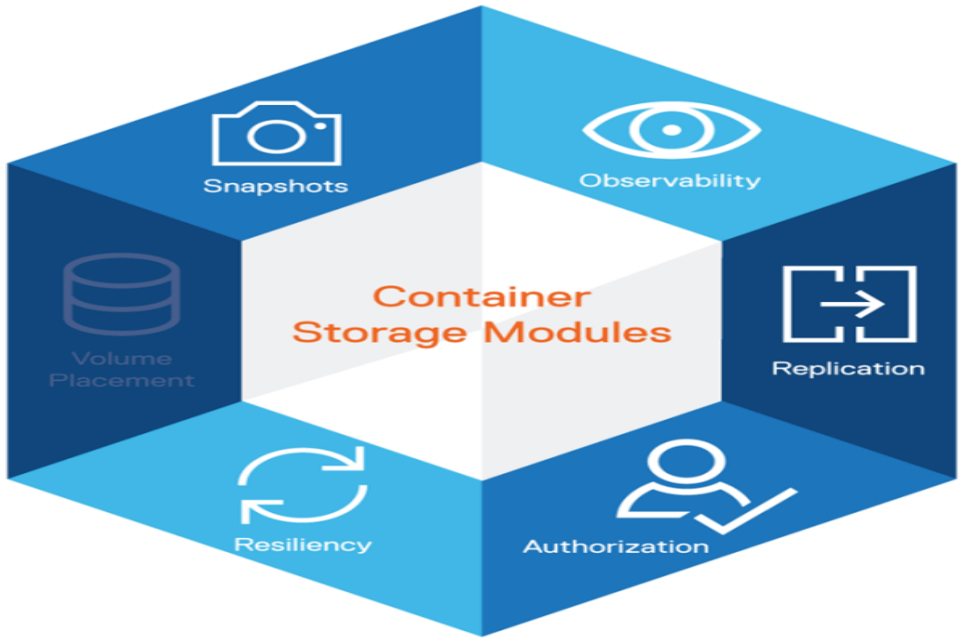
- NAS Container
  - Multi clients file sharing (one example is VAST Data ® used in MRI image processing, many research teams need to access images files repeatedly)
  - High performance: All flash, large global cache SCM), GPU (GPUDirect) integration, RDMA (FE&BE)
  - Versatility: can efficiently handle both large quantities of large files and small files
  - Many file protocols: many customers prefer NFS support
  - Unified file and object storage: for different applications, data protection to cloud etc.
  - Easy and non-disruptive scale-out: adding nodes, or even support cloud burst
  - K8S/OpenShift deep integration: not just simple CSI integration
  - Application deep integration (many applications like ES, MongoDB etc. natively replicate data, NAS can take advantage array replication/DR for AA multisite access by applications)
  - Easy O&M
- SAN Container
  - High performance: All flash, large global cache SCM), GPU (GPUDirect) integration, RDMA (FE&BE)
  - Extremely high reliability for mission critical applications
  - Easy and non-disruptive scale-out: adding nodes
  - K8S/OpenShift deep integration: not just simple CSI integration
  - Application deep integration
  - Easy O&M

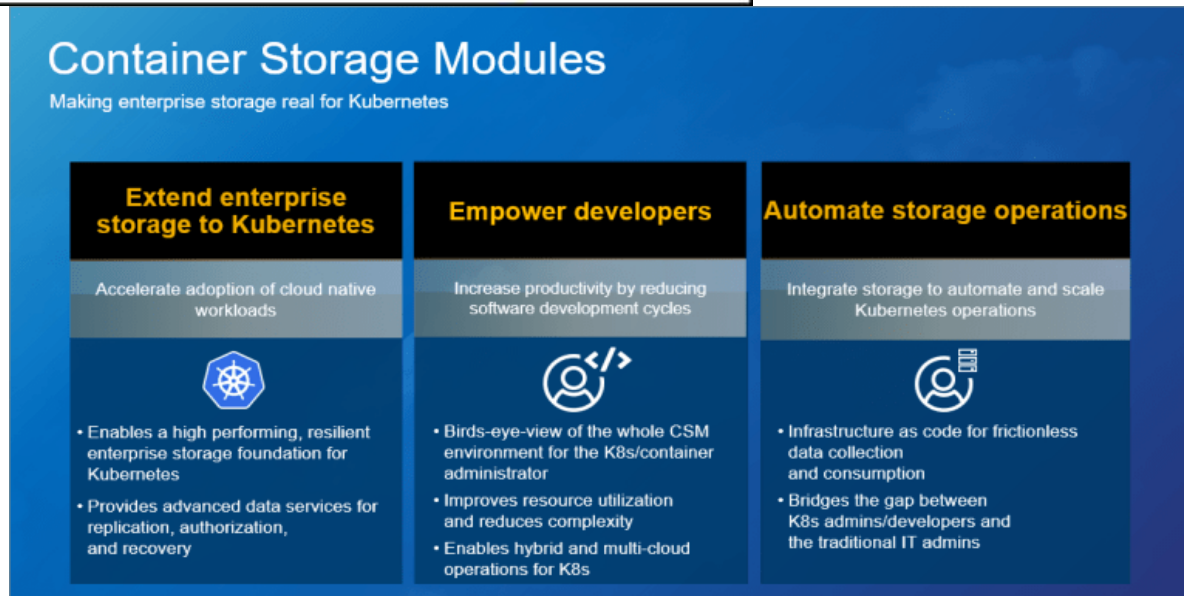
NSA and SAN Container Comparison: Vendor Offerings

- Large Vendors (Dell®, NetApp®, Pure®, HPE®)
  - Started with NAS and HCI, now offered both SAN and NAS arrays for container storage
    - Dell® : PowerMax ("Persistent Storage for Containerized Applications on Kubernetes with PowerMax SAN Storage")
  - Big efforts went into orchestration integration (adding storage features into k8s etc.)
    - Dell® : Container Storage Modules (CSM)
    - NetApp® : Astra/Trident
  - GPU/GPUDirect integration
    - Pure® AIRI (AI Ready Infrastructure, container based)
  - Storage-as-a-service
    - Dell® APEX container-as-a-services
    - HPE® Greenlake container-as-a-service
  - Deep application integration
    - Pure® + container based ElasticSearch: DR
- Startups (NAS vendors like VastData®, WekaIO®)
  - All flash with lower cost QLC (VastData®, NAS)
  - Share-everything architecture + scale out + NFS focus (NFS over RDMA)
  - AI and HPDA cloud-native platform (WekaIO®)
  - VastData® Plan to move up stack to applications and platforms

- Backup Slides







Acknowledgement: Container Storage Modules from Dell®. [Image source]

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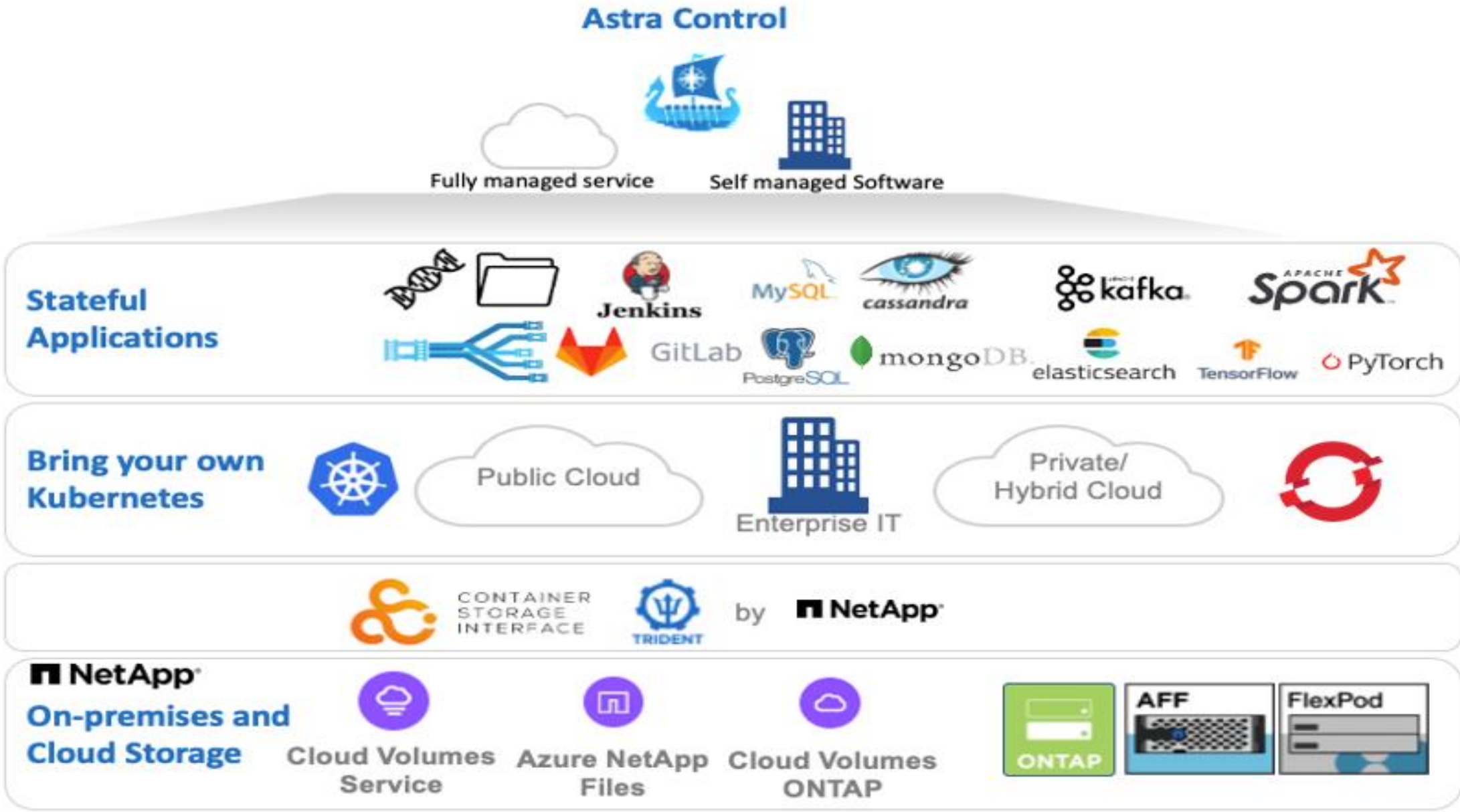

Acknowledgement: Astra from NetApp®. [Image source]

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Acknowledgement: Container storage from Pure Storage®. Image source

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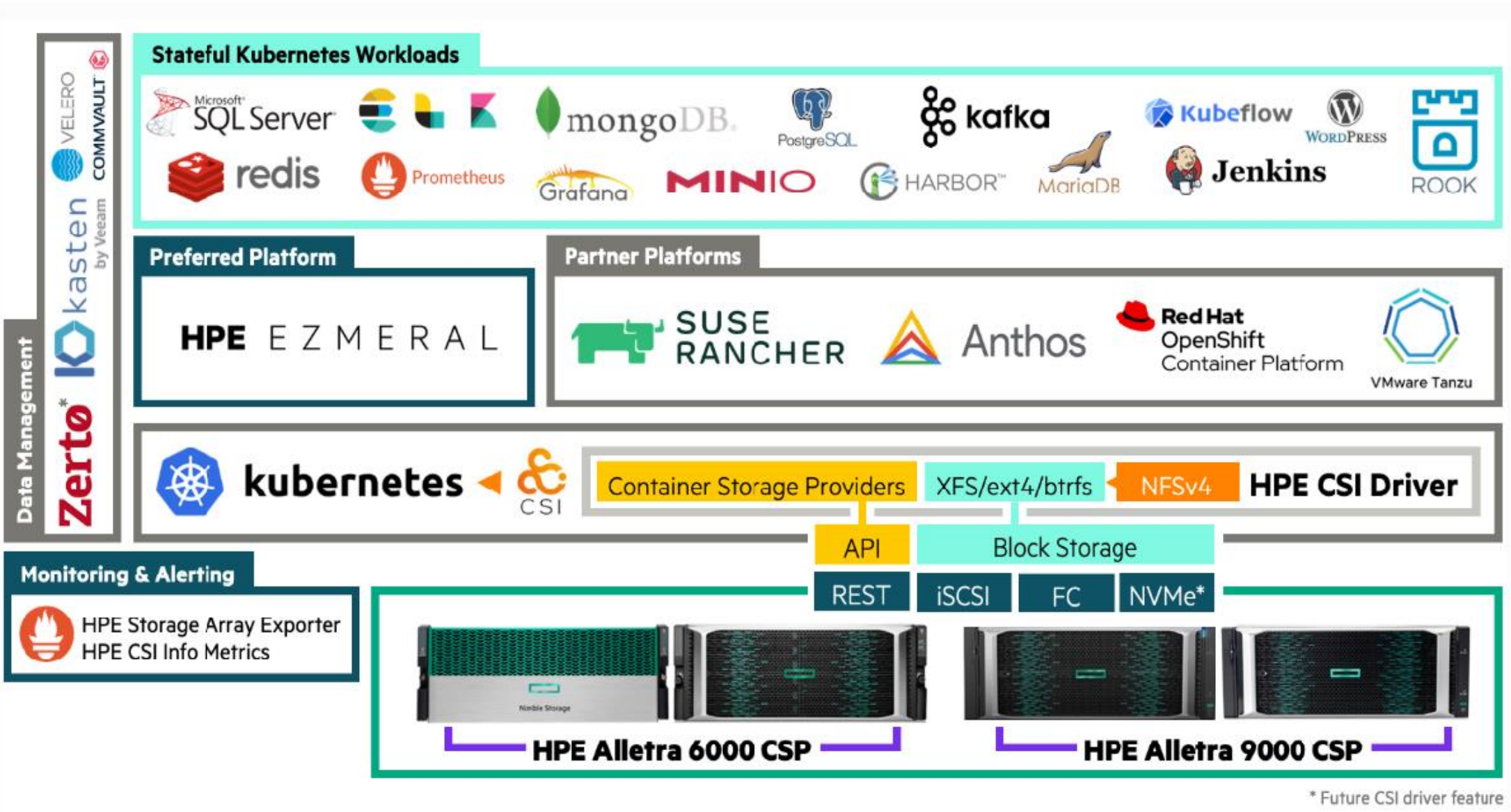

Acknowledgement: Container storage from HPE®. [Image source]

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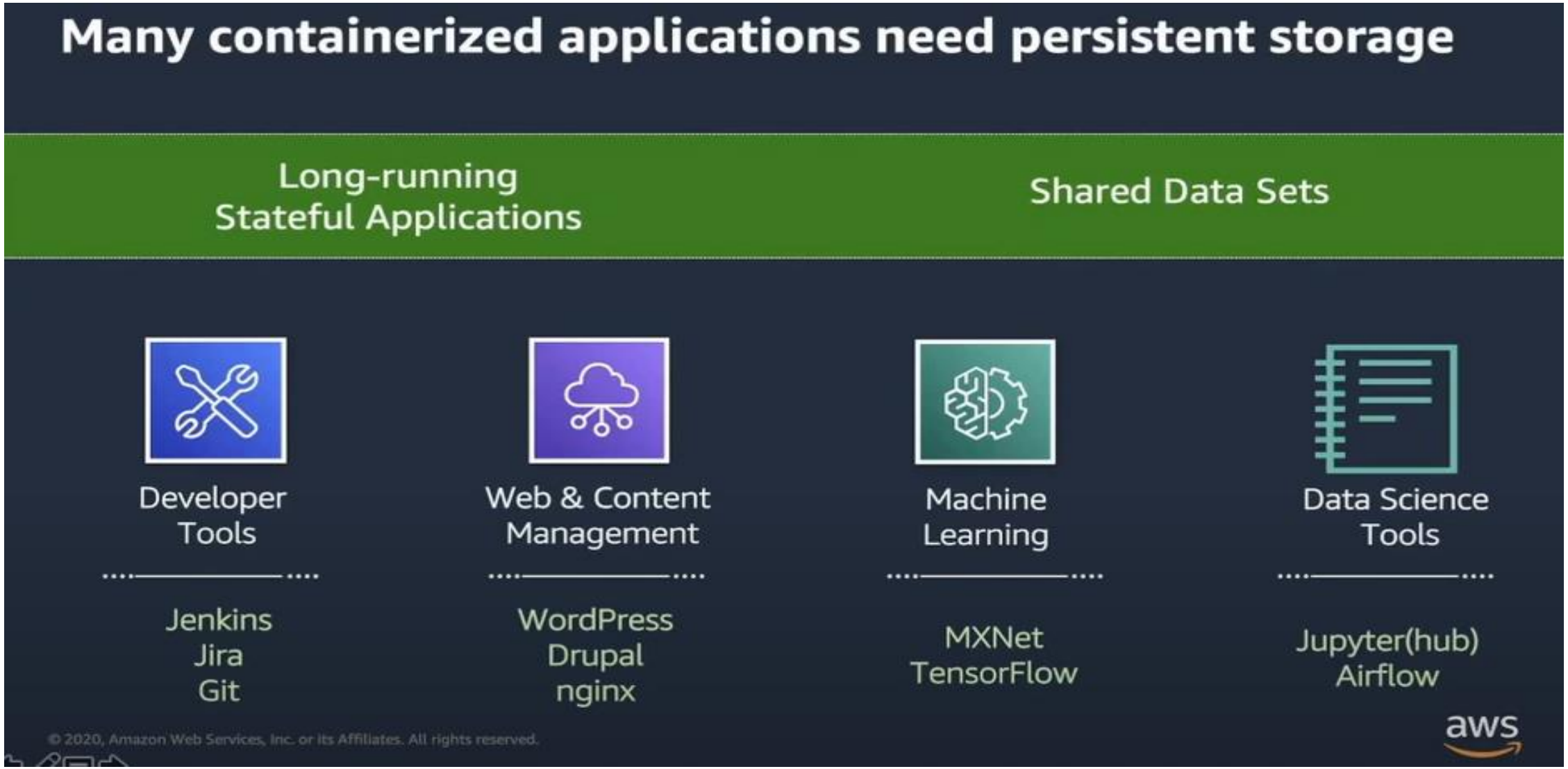

Acknowledgement: AWS EFS container storage from Amazon®. [Image source]

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Simplify Persistent Storage for Amazon EKS with Amazon EFS

Simple

Amazon EFS configuration is done from K8S-native objects (e.g. Persistent Volume), so developers can focus on their applications, not infrastructure.

Available and Durable

Amazon EKS, and Amazon EFS are regional services. Customers can build applications that span multiple availability zones, with automatic failover.

Elastic

Amazon EKS and Amazon EFS are elastic, scale up and down rapidly based on demand. Customers pay only for what they use.

Secure

Amazon EFS Access Points can enforce file system permissions when multiple apps share a file system.

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Acknowledgement: AWS EFS container storage from Amazon®. Image source

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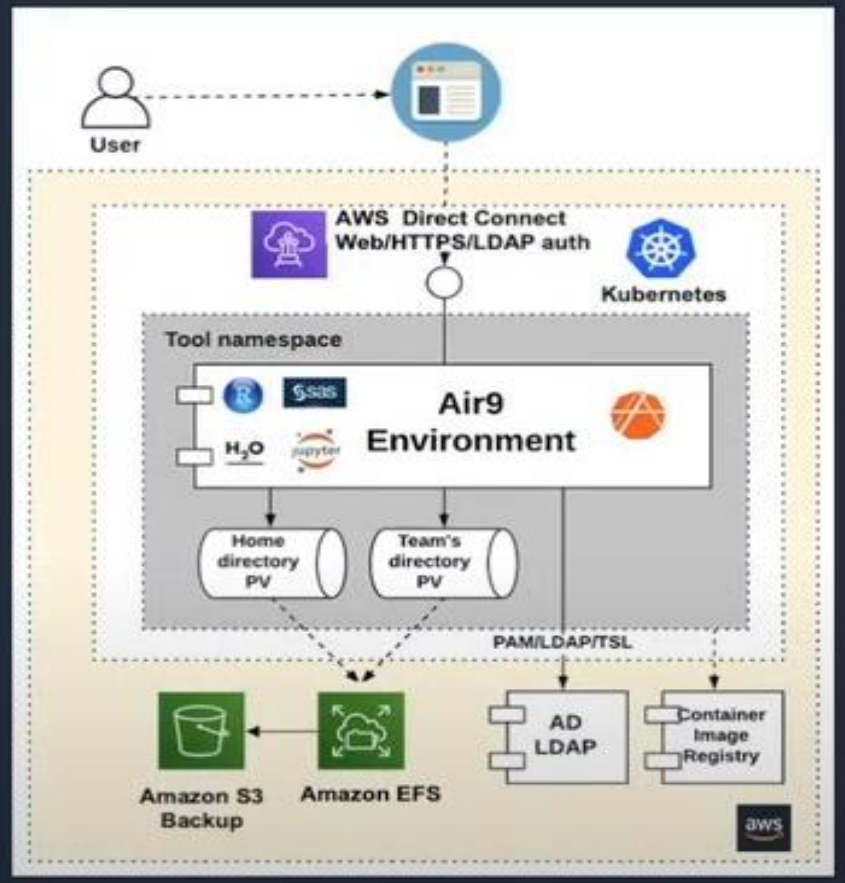
Journey to (and in) the cloud

DISCOVER



- Moved containerized data science environment to AWS for agility and cost benefits
- Enabled self-service provisioning of containerized analytics applications and compute resources
- Migrated to a managed service for better stability, application scaling and ease of operations, reducing storage management time by 90%

aws

Acknowledgement: AWS EFS container storage from Amazon®. Image source

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Storage recommendations

The following table summarizes the recommended and configurable storage technologies for the given OpenShift Container Platform cluster application.

Table 2. Recommended and configurable storage technology

Storage type	RWO [1]	ROX [2]	RWX [3]	Registry	Scaled registry	Monitoring	Logging	Apps
Block	Yes	Yes [4]	No	Configurable	Not configurable	Recommended	Recommended	Recommended
File	Yes	Yes [4]	Yes	Configurable	Configurable	Configurable [5]	Configurable [6]	Recommended
Object	Yes	Yes	Yes	Recommended	Recommended	Not configurable	Not configurable	Not configurable [7]

1. ReadWriteOnce
2. ReadOnlyMany
3. ReadWriteMany
4. This does not apply to physical disk, VM physical disk, VMDK, loopback over NFS, AWS EBS, Azure Disk and Cinder (the latter for block).
5. For monitoring components, using file storage with the ReadWriteMany (RWX) access mode is unreliable. If you use file storage, do not configure the RWX access mode on any persistent volume claims (PVCs) that are configured for use with monitoring.
6. For logging, using any shared storage would be an anti-pattern. One volume per logging-es is required.
7. Object storage is not consumed through OpenShift Container Platform's PVs or PVCs. Apps must integrate with the object storage REST API.

Other specific application storage recommendations

- OpenShift Container Platform Internal **etcd**: For the best etcd reliability, the lowest consistent latency storage technology is preferable.
- Databases: Databases (RDBMSs, NoSQL DBs, etc.) tend to perform best with dedicated block storage.

Acknowledgement: Red Hat® OpenShift Optimized Persistent Storage. Image source

Main References

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Thank You.