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Shoot yourself in the foot - Databases on Kubernetes. Fundamentals

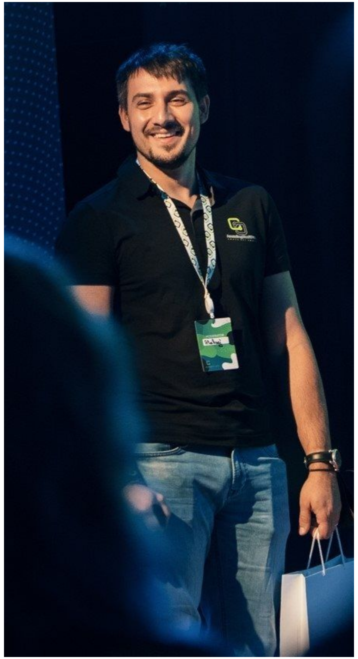
Sli.do event code:	**kuber46710**
Github repository:	**bit.ly/dbonk8s**
AmazingStuffPro Slack:	**bit.ly/slackamazingstuff**
Event hashtag:	**#amazingstuffpro**

Agenda:

● *Why do we need it?*	*15min.*
○ *QA*	*5 min.*
● *Storage for your database in k8s*	*~30min.*
● *Persistent data gravity with cross region/zone mobility*	*~15min.*
○ *QA*	*5 min.*

ALEKSEJ TROFIMOV

System Owner in Foundation Services team at Mambu



Why do we need it?

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Why?

- In-service difference
  - Different Cloud Providers support different service functionality, like MySQL in AWS not similar to MySQL in GCP or Azure;
  - Different IAM;
  - Different backup and restore procedures.
- Who wants a vendor-lock-in?
  - DR requirement between different Cloud providers;
- Service functional limitation:
  - Like database plugins;
- Cloud providers “lags” for a new technologies roll-out:
  - CockroachDB;
  - MongoDB;

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What do we have?

- “Old-school DBs”: PostgreSQL (Spilo, Stolon), MySQL (Galera from Percona/MariaDB) with some limitations:
    - wasn’t designed for Kubernetes;
    - lack of tooling;
    - poor support;
    - small community who run it in Kubernetes (why??);
- “Modern DBs”: CockroachDB, Vitess, TiDB, etc. Build with Kubernetes (operators) in mind. Looks pretty cool, tries to have interface (API) similar to PostgreSQL or MySQL, but not fully compatible with old-school DBs.

YOU REMIND ME OF A SOFTWARE UPDATE
WHENEVER I SEE YOU, I USUALLY THINK "NOT NOW"

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Any challenges?

- Modern databases - modern solution - e.g. easier to have one huge cluster instead of hundreds of small clusters.
- Kubernetes Storage layer looks stable but with some challenges.
  - Like performance (CSI plugins can provide a unified way across Cloud Providers but adds performance penalty; Performance of storage in different clouds are different) and support;
  - Tooling around and etc.;
  - Complexity;
- Different features for Storage layer in different clouds - Good news are encryption at rest and backups are supported in some flavour in main clouds.

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Storage for your database in k8s

Augustinas Stirbis

Director of Engineering

at cast

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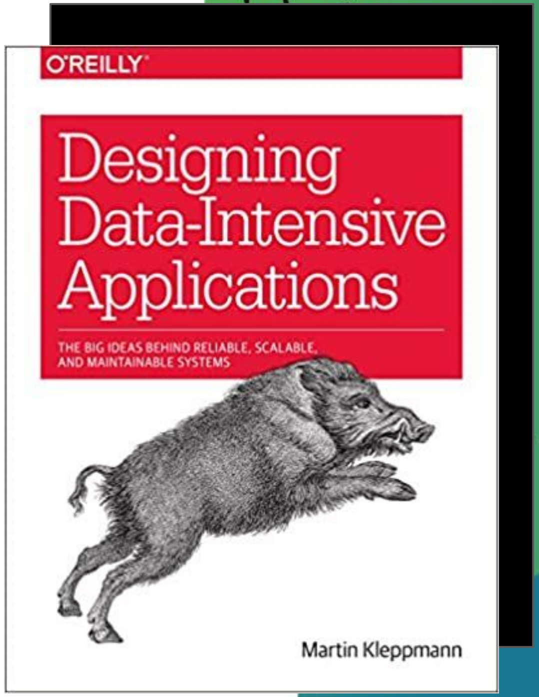
Why do you need storage for database in 2021

Different types of databases require different types of storage:

- Traditional RDBMS (MySQL / PostgreSQL / MS SQL)
- Distributed DBs (Cassandra / ElasticSearch / Yugabyte / Cockroach)
- In memory databases (Redis)



O'REILLY

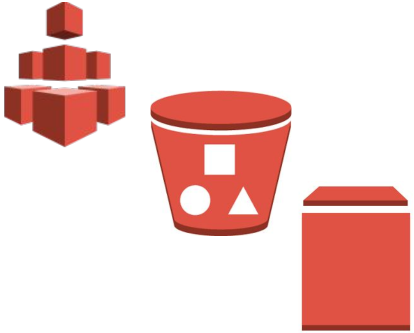
Designing Data-Intensive Applications

THE BIG IDEAS BEHIND RELIABLE, SCALABLE, AND MAINTAINABLE SYSTEMS

Martin Kleppmann

Type storage:

- File - AWS EFS
- Object - AWS S3
- Block - AWS EBS



Block based storage:

1. Local disks: SATA/SAS or very fast NVMe interfaces
2. Remote storage:
   a. Fiber Channel network - on premise DC expensive SAN with HBA cards
   b. TCP/IP network - iSCSI, various Software Defined Storage proprietary solutions (Tomas demo portworx)

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Storage for traditional server:

1. Understand your application storage requirements (size, IOps, throughput)
2. Provision Volume based of requirements
3. Attach Volume (insert disk / zoning-masking)
4. Create Partition (fdisk)
5. Format partition with filesystem (ext4)
6. Mount partition as dir
7. Configure Database to write to path
8. Profit, your database can retrieve written data!

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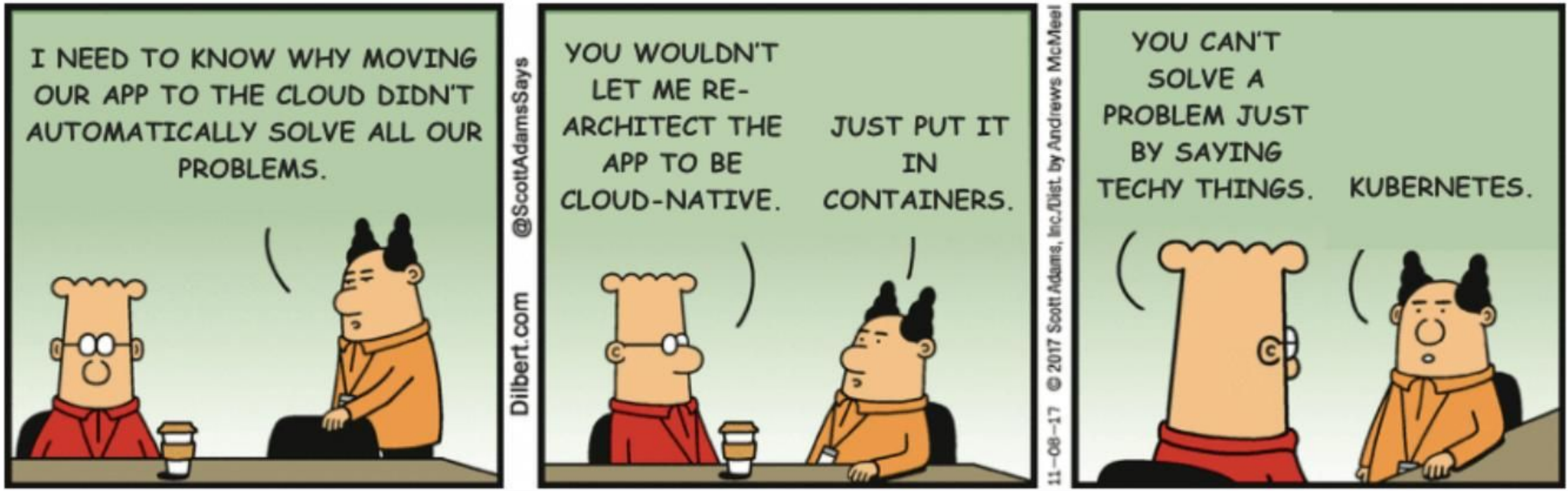
I NEED TO KNOW WHY MOVING OUR APP TO THE CLOUD DIDN'T AUTOMATICALLY SOLVE ALL OUR PROBLEMS.
YOU WOULDN'T LET ME RE-ARCHITECT THE APP TO BE CLOUD-NATIVE.
JUST PUT IT IN CONTAINERS.
YOU CAN'T SOLVE A PROBLEM JUST BY SAYING TECHY THINGS.
KUBERNETES.
Dilbert.com @ScottAdamsSays
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Storage for database on Kubernetes with CSI driver

1. Understand your application storage requirements (size, IOps, throughput)

~~2. Provision Volume based of requirements~~

~~3. Attach Volume (insert disk / zoning masking)~~

~~4. Create Partition (fdisk)~~

~~5. Format partition with filesystem (ext4)~~

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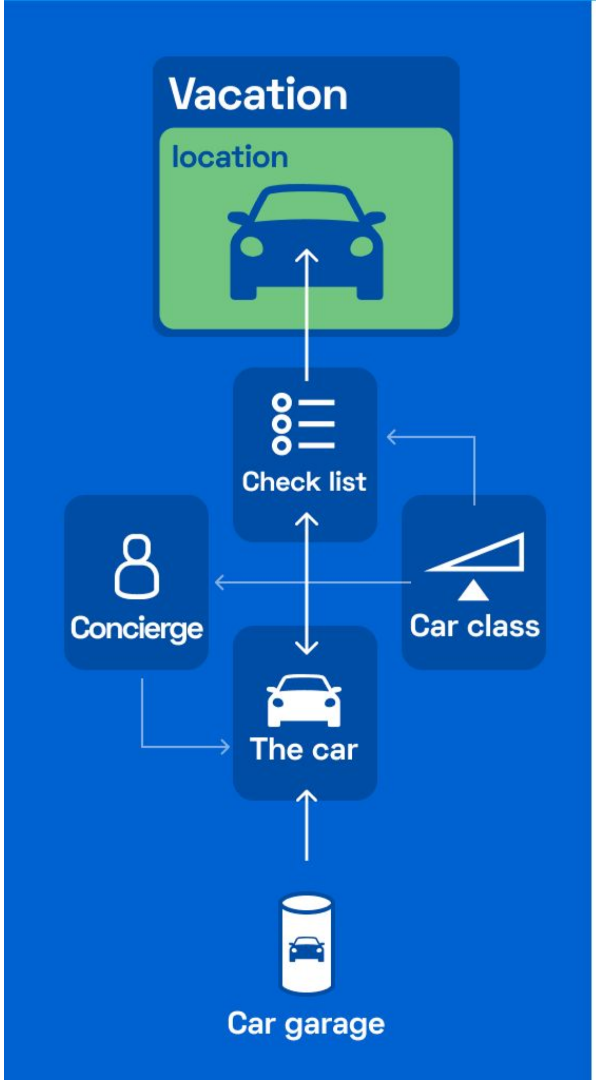

+ Car // Allocate storage

CONTAINER

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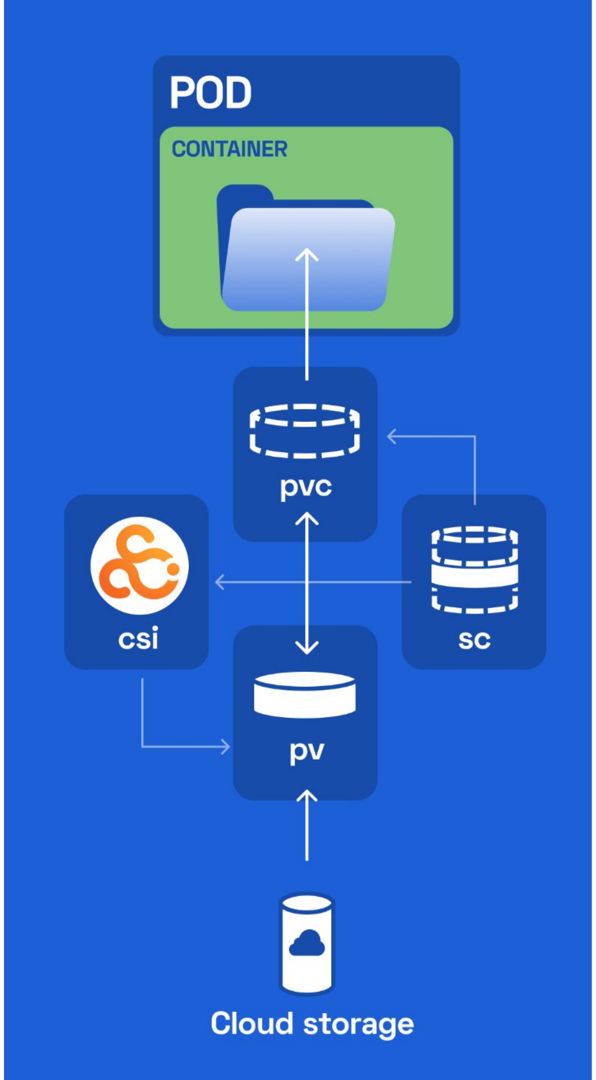
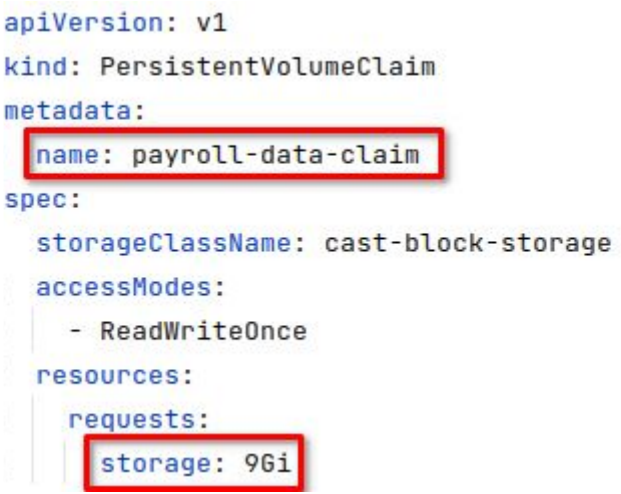


+ 5 persons // 500GB

+ Car

Persistent Volume Claim



```yaml
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: payroll-data-claim
spec:
  storageClassName: cast-block-storage
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 9Gi
```

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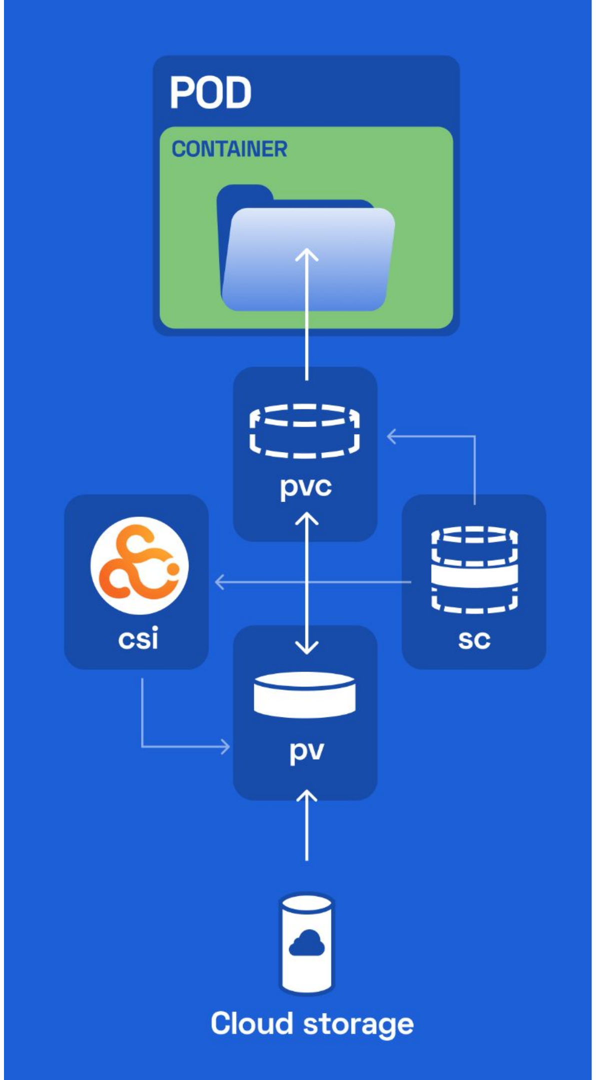

+ A class //SSD

- + 5 persons
- + Car

sc

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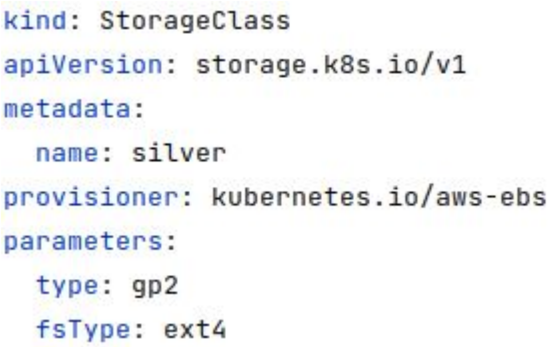
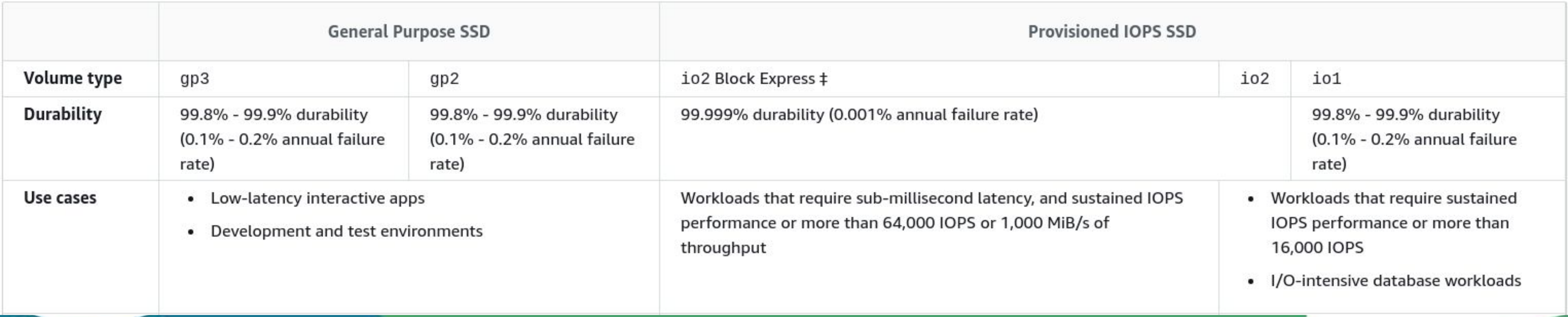
Storage Class - Bronze, Silver, Gold

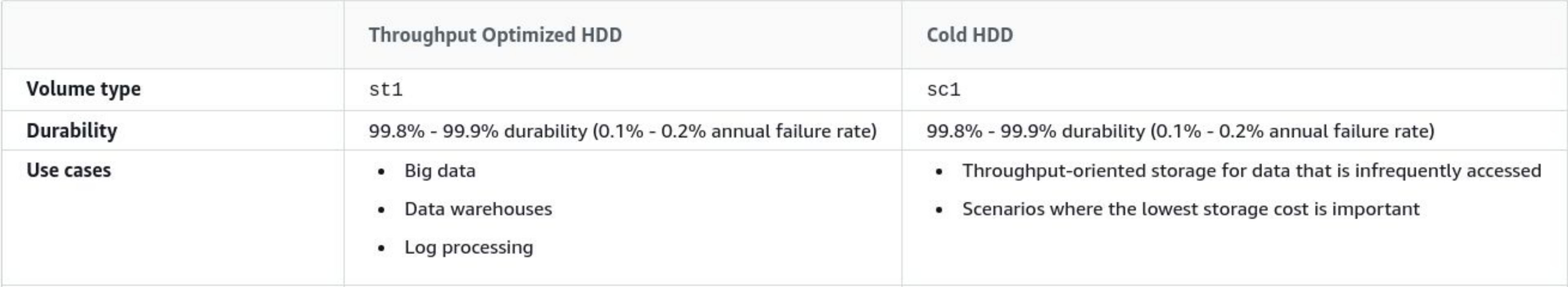


```yaml
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: silver
provisioner: kubernetes.io/aws-ebs
parameters:
  type: gp2
  fsType: ext4
```

7 volume types available in AWS EBS



	General Purpose SSD		Provisioned IOPS SSD		
Volume type	gp3	gp2	io2 Block Express ‡	io2	io1
Durability	99.8% - 99.9% durability (0.1% - 0.2% annual failure rate)	99.8% - 99.9% durability (0.1% - 0.2% annual failure rate)	99.999% durability (0.001% annual failure rate)		99.8% - 99.9% durability (0.1% - 0.2% annual failure rate)
Use cases	• Low-latency interactive apps • Development and test environments		Workloads that require sub-millisecond latency, and sustained IOPS performance or more than 64,000 IOPS or 1,000 MiB/s of throughput	• Workloads that require sustained IOPS performance or more than 16,000 IOPS • I/O-intensive database workloads	



	Throughput Optimized HDD	Cold HDD
Volume type	st1	sc1
Durability	99.8% - 99.9% durability (0.1% - 0.2% annual failure rate)	99.8% - 99.9% durability (0.1% - 0.2% annual failure rate)
Use cases	• Big data • Data warehouses • Log processing	• Throughput-oriented storage for data that is infrequently accessed • Scenarios where the lowest storage cost is important

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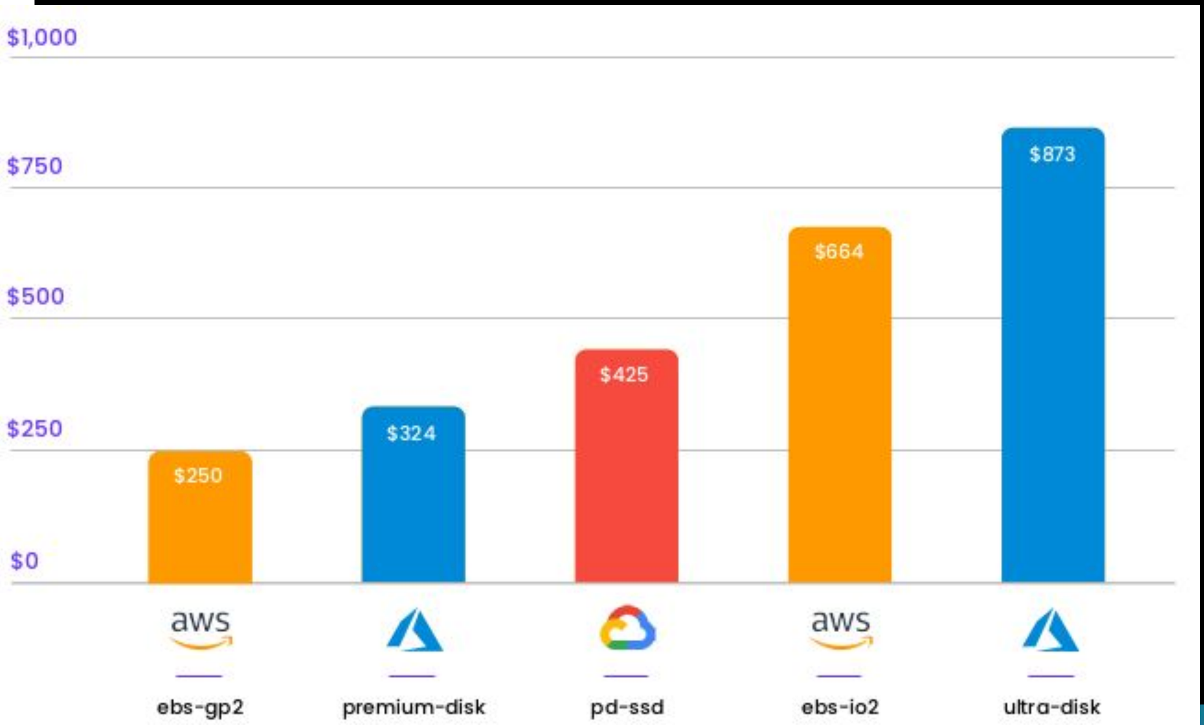
Storage prices



Cockroach Labs cloud report

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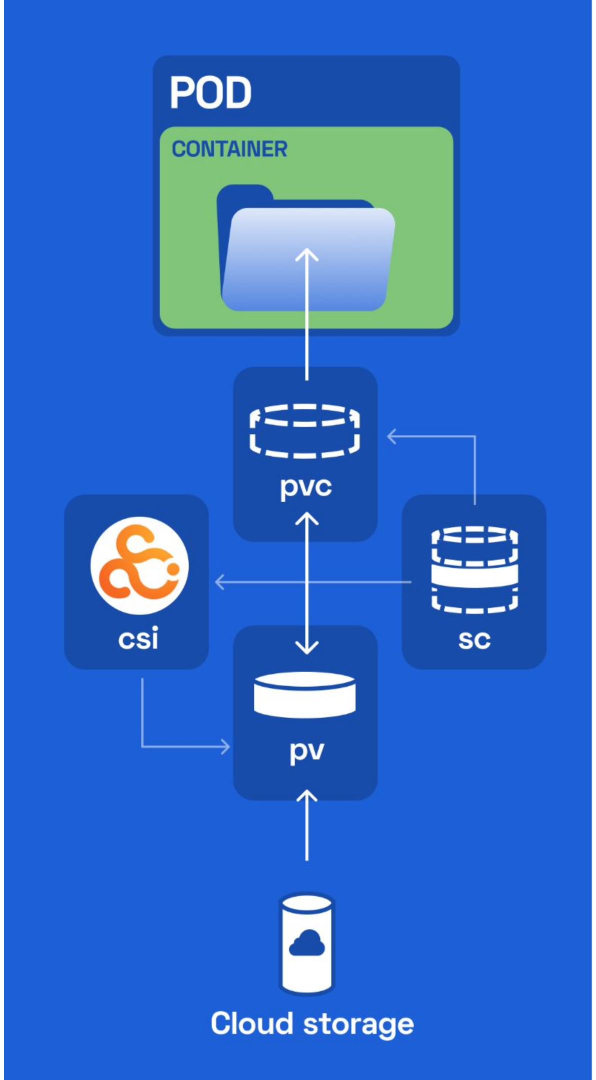

+ High durability //HA

- + A class
- + 5 persons
- + Car

SC

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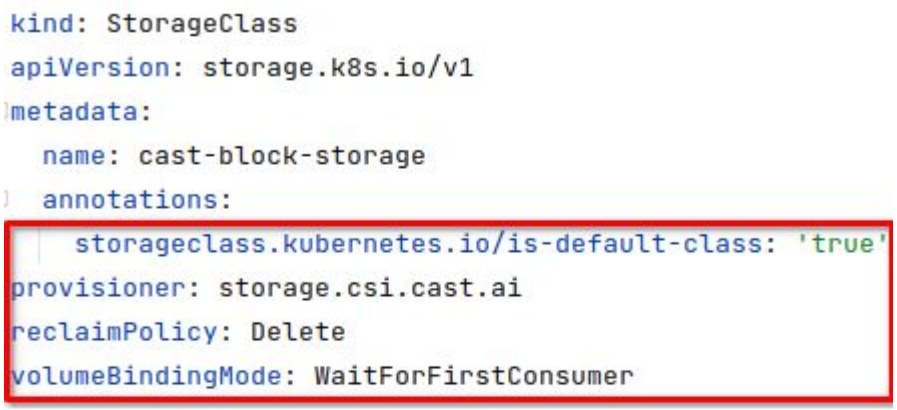
Advanced Storage Class options



```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: cast-block-storage
  annotations:
    storageclass.kubernetes.io/is-default-class: 'true'
provisioner: storage.csi.cast.ai
reclaimPolicy: Delete
volumeBindingMode: WaitForFirstConsumer
```

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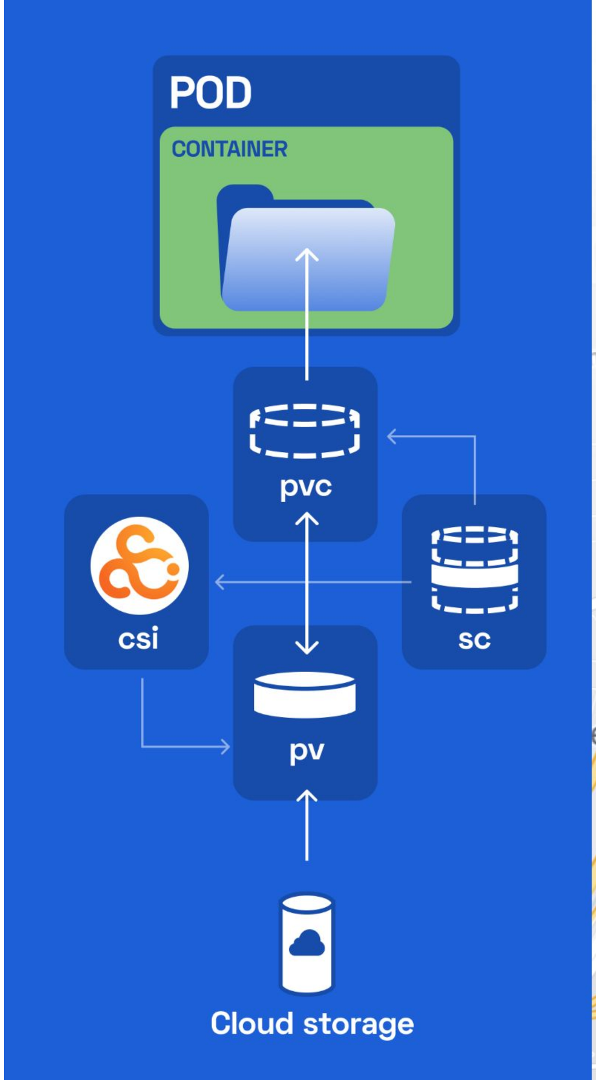
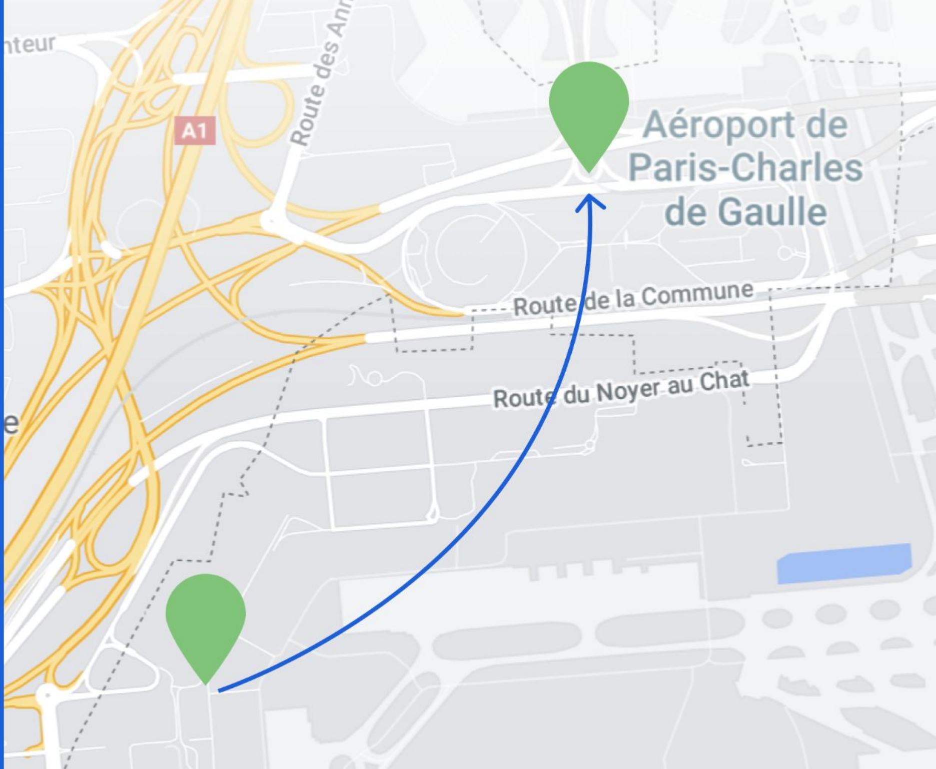


- + Full tank //Provision
- + Clean //Attach
- + Deliver //Format
- + Give keys //Mount



csi

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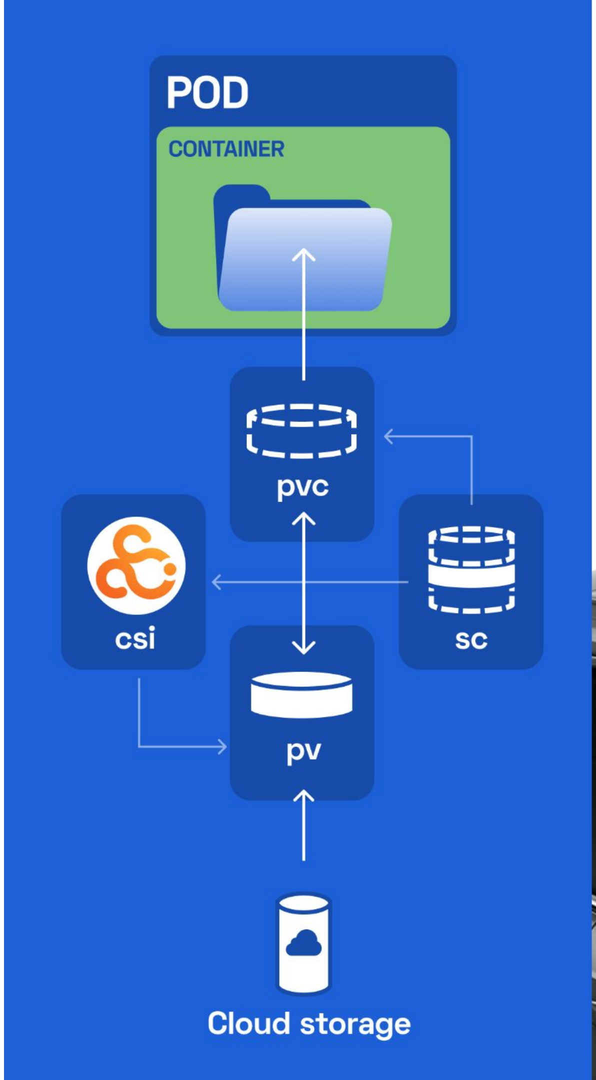

+ Expandable //+1TB

- + High durability
- + A class
- + 5 persons
- + Car

pvc

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Demo

or it does not exist!

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Questions?

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Persistent data gravity with cross region/zone mobility

Tomas Vaiciunas

SRE Core Platform at Mambu

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How to make sure your persistent storage can tolerate AZ failure?

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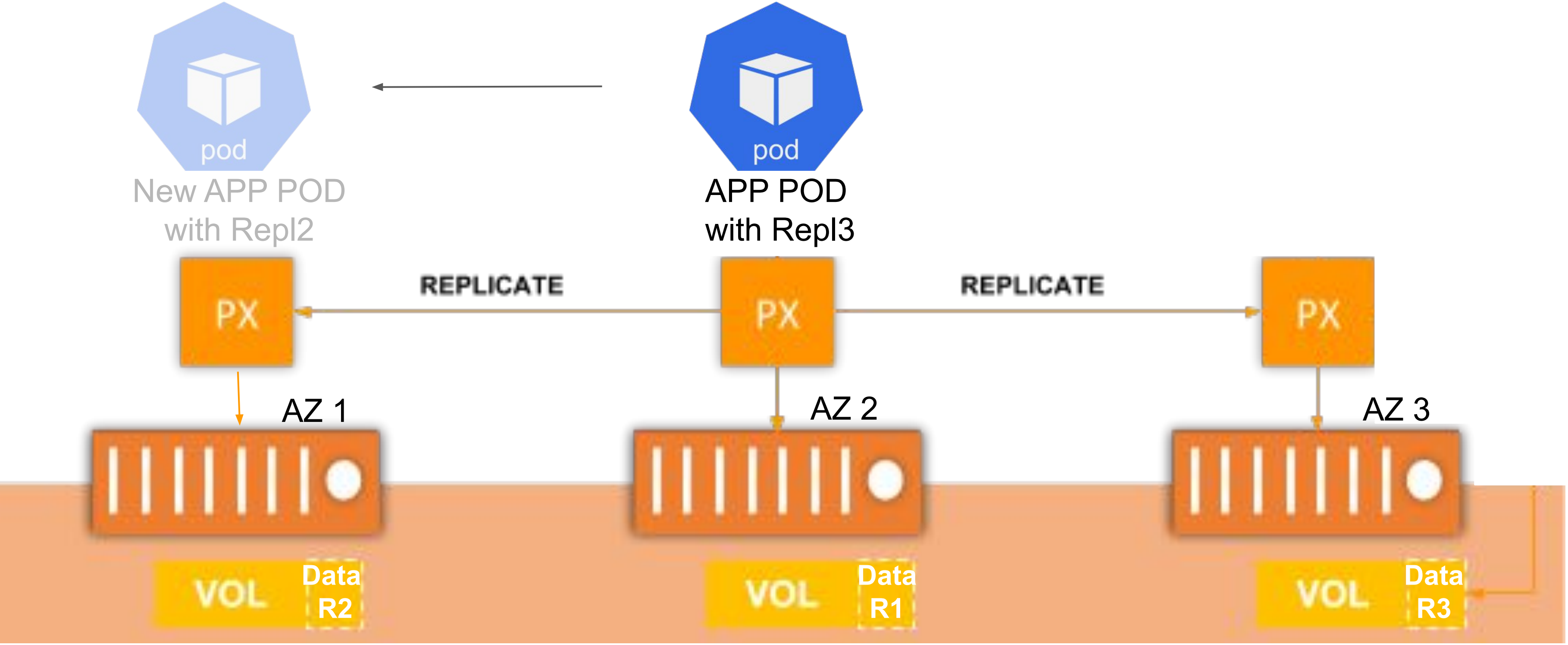

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You can use SLIDO

For your questions!

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Things to consider:

- Network latency
- Cluster topology (no single AZ)
- Amount of data copies you need
- Overhead latency that is going to be introduced
- More expensive because of pre allocated storage on other AZ's

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Why would you consider running storage replication on top of distributed application?

- Even if application is capable of performing replication of data on its own, it will be more time consuming to recover the node thereby resulting in a negative impact on the performance. Running Sync replication in the background will improve recovery time.

Downside:

- More storage will be needed to accommodate all copies = more expensive overall

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Demo context

Portworx + Minio

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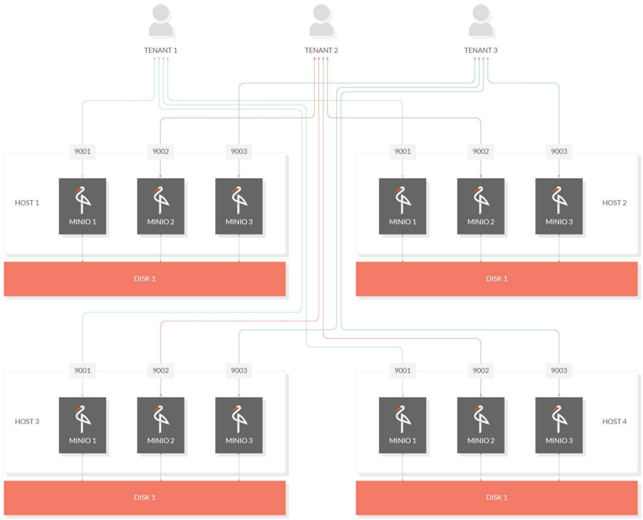
What is Minio?

MinIO is a High Performance Object Storage (like AWS S3). When running in distributed mode it ensures that data is replicated on multiple drives tolerating m/2 loss of servers



Example 3: 4 node distributed setup

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What is Portworx?

Portworx is a software defined persistent storage solution designed and purpose built for applications deployed as containers, via container orchestrators such as Kubernetes, Marathon and Swarm. It is a clustered block storage solution and provides a Cloud-Native layer from which containerized stateful applications programmatically consume block, file and object storage services directly through the scheduler.

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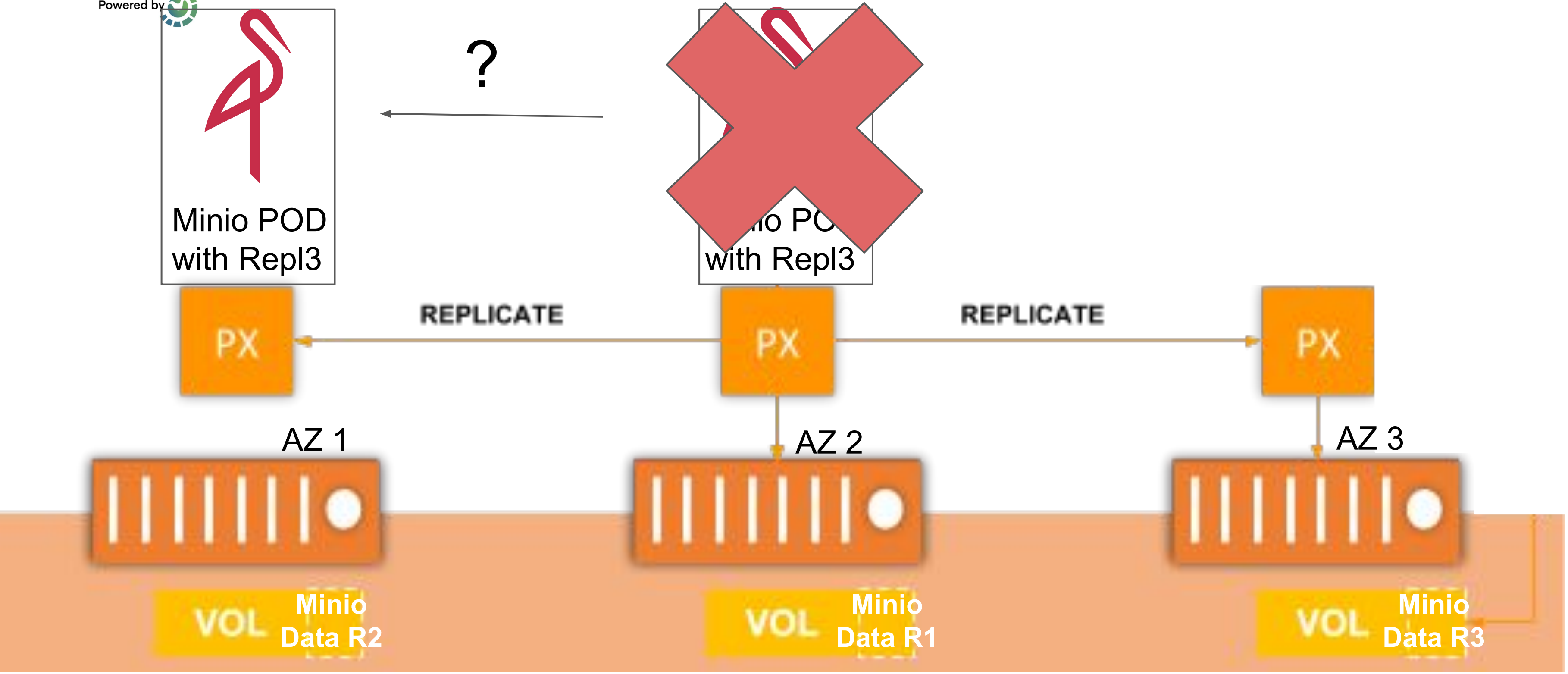
?
Minio POD
with Repl3
io PO
with Repl3
REPLICATE
REPLICATE
PX
PX
PX
AZ 1
AZ 2
AZ 3
VOL
Minio
Data R2
VOL
Minio
Data R1
VOL
Minio
Data R3

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Demo.

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Thank you!

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Upcoming
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Running Databases on Kubernetes

- Database operators - do they help?
- MySQL on Kubernetes (with demo)

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