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Cloud-Native PostgreSQL

Running PostgreSQL on Kubernetes

April 17, 2024
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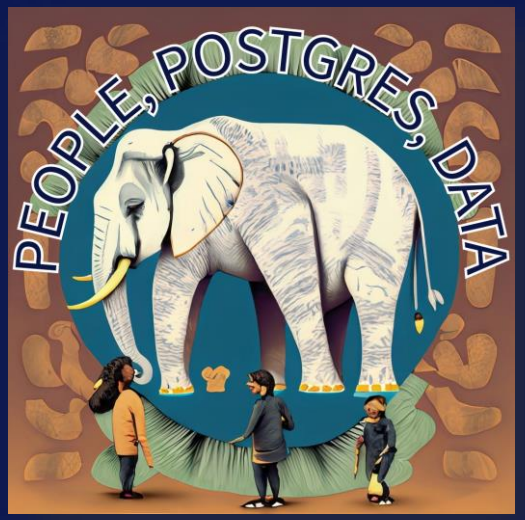
Founder, Percona



Big Picture

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Cloud

Proprietary Clouds bring Great Usability at Great Cost

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Have We Been Here Before?

2000s

2020s

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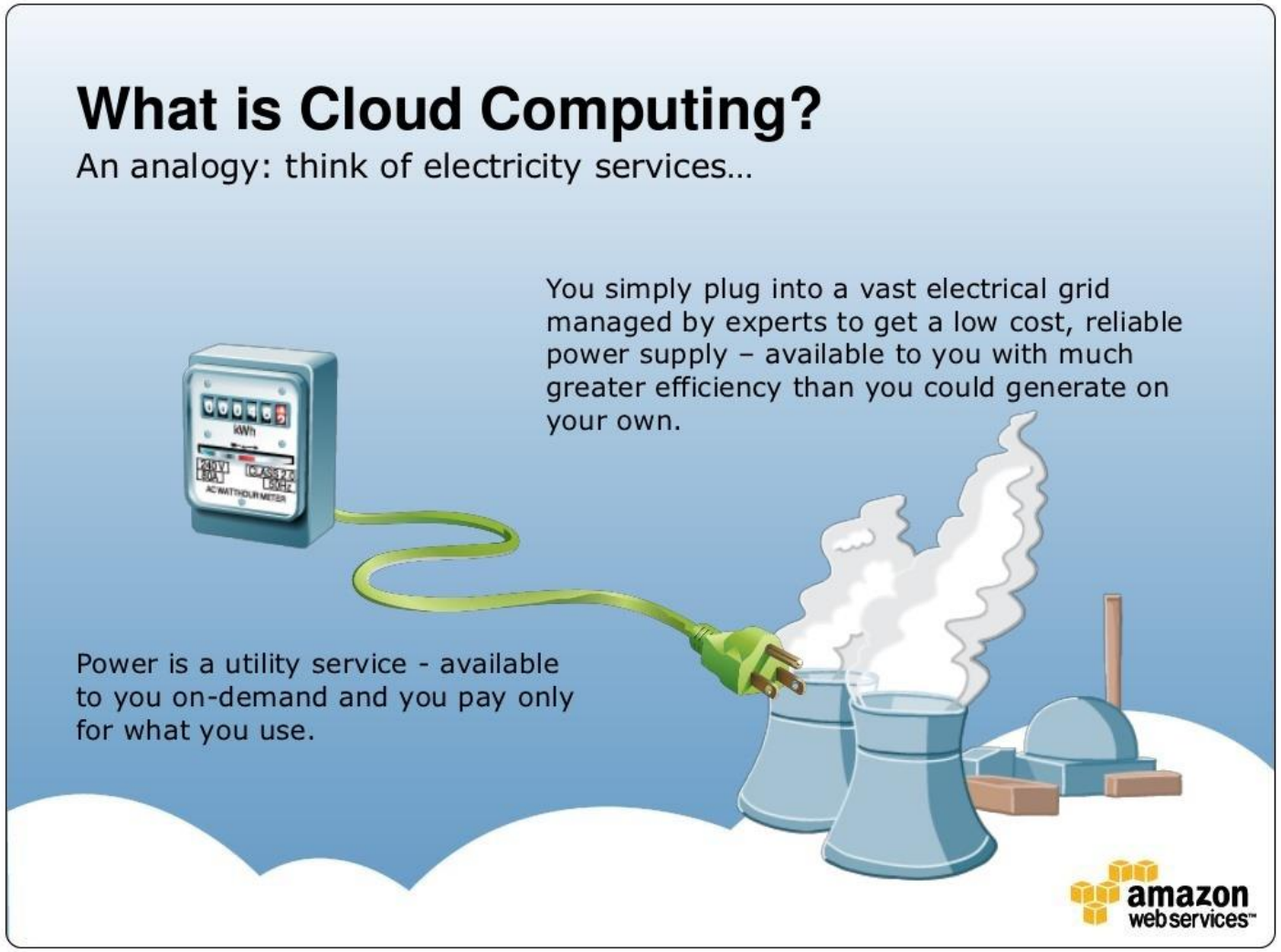
Operating Systems

Open Source Catches Up Again

- **Lock-in with Cloud Vendor**
- **Use Proprietary Solutions**
- **Highly Differentiated Cloud**

- **Freedom to Run Anywhere**
- **Use Open Source**
- **Cloud Is Commodity**
- **Customer**
- **Choice of Vendors**

Giving Cloud its Originally Intended Role of Commodity Infrastructure



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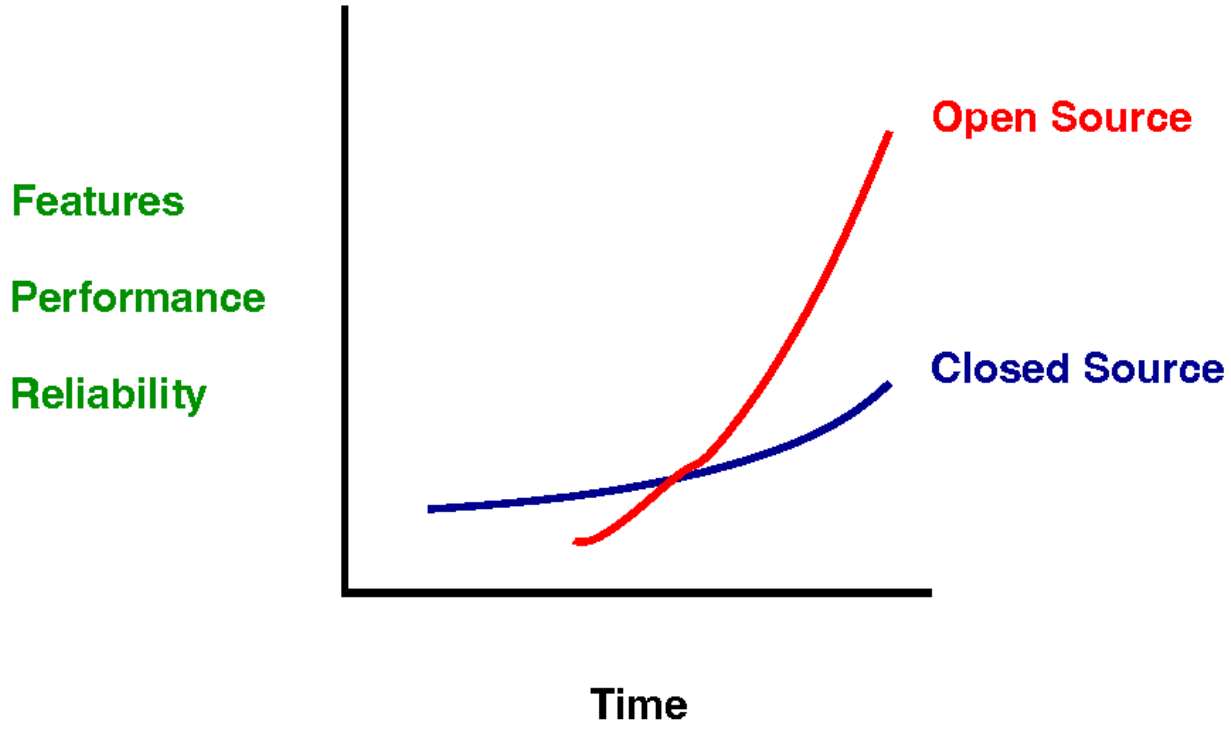
Open Source and Proprietary

Rise of Open Source



https://momjian.us/main/writings/pgsql/forever.pdf

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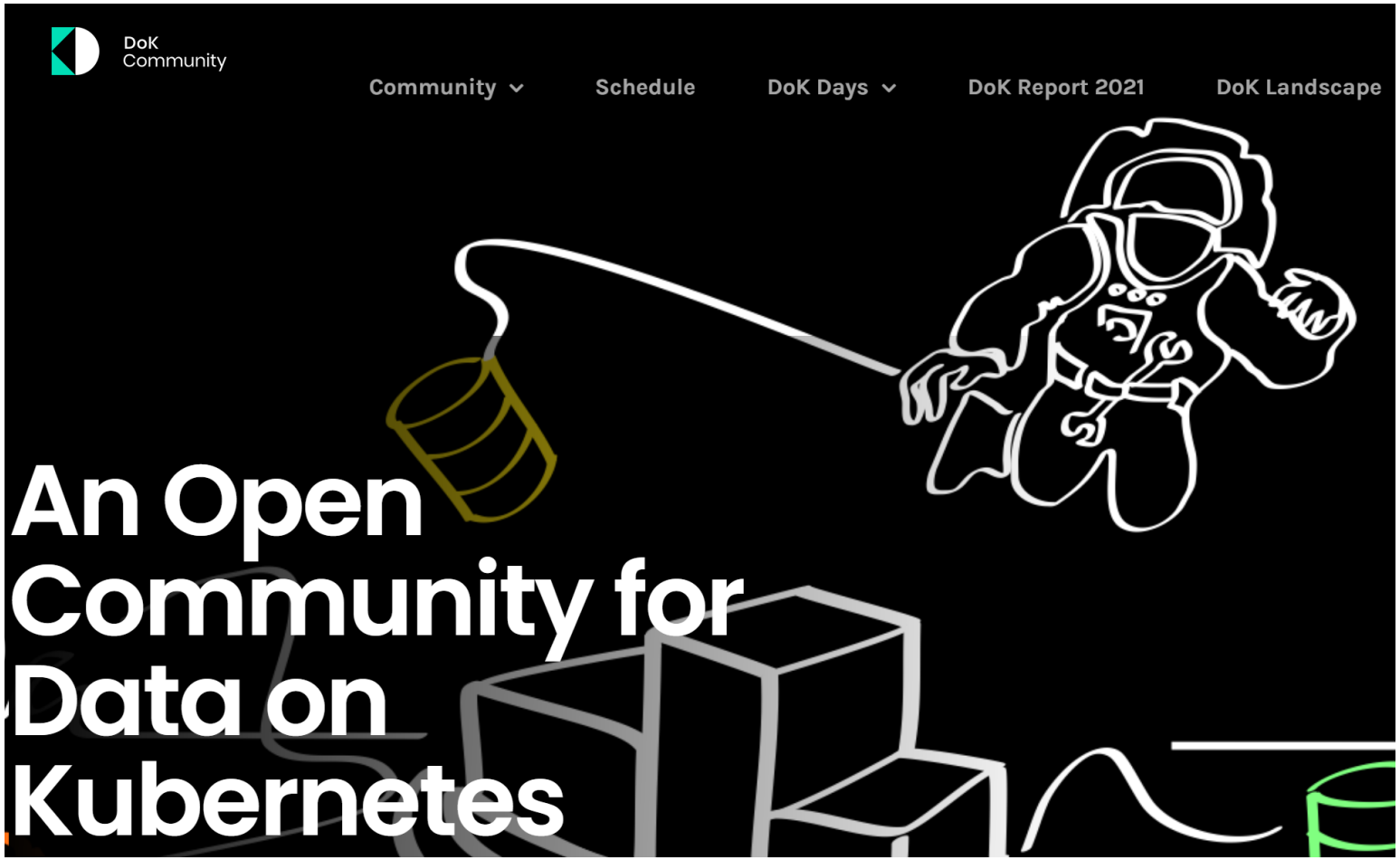
Kubernetes

Kubernetes is universally available

Kubernetes is getting better for stateful applications

Kubernetes Operators are available for most popular Open Source Databases

Data on Kubernetes



https://dok.community/

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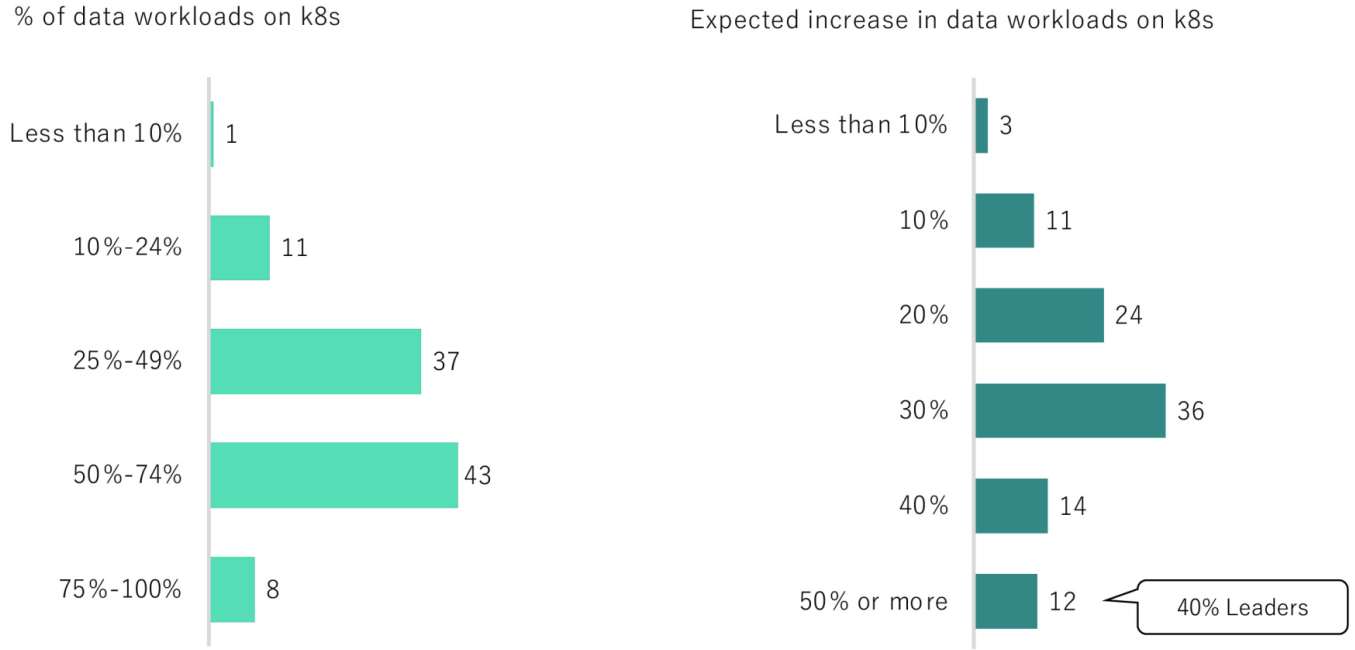
Data on Kubernetes

DoK workload %s are already high, and expected to increase

Leaders are chomping at the DoK bit



https://dok.community/wp-content/uploads/2022/10/DoK_Report_2022.pdf

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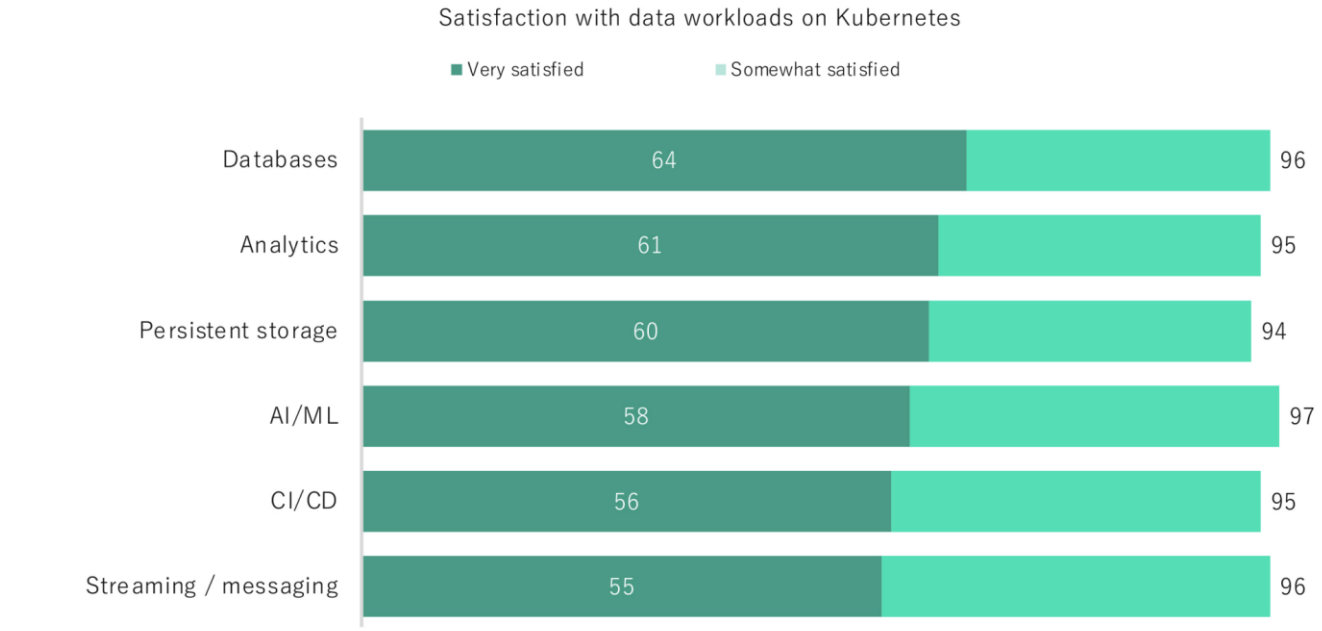
And Happy about That...

Satisfaction = Reality - Expectations

DoK is winning the expectations battle



Q. In general, how satisfied are you with using Kubernetes to run each of the following data workloads in your organization? Use a scale from 1 to 5 where 5 means "very satisfied" and 1 means "not at all

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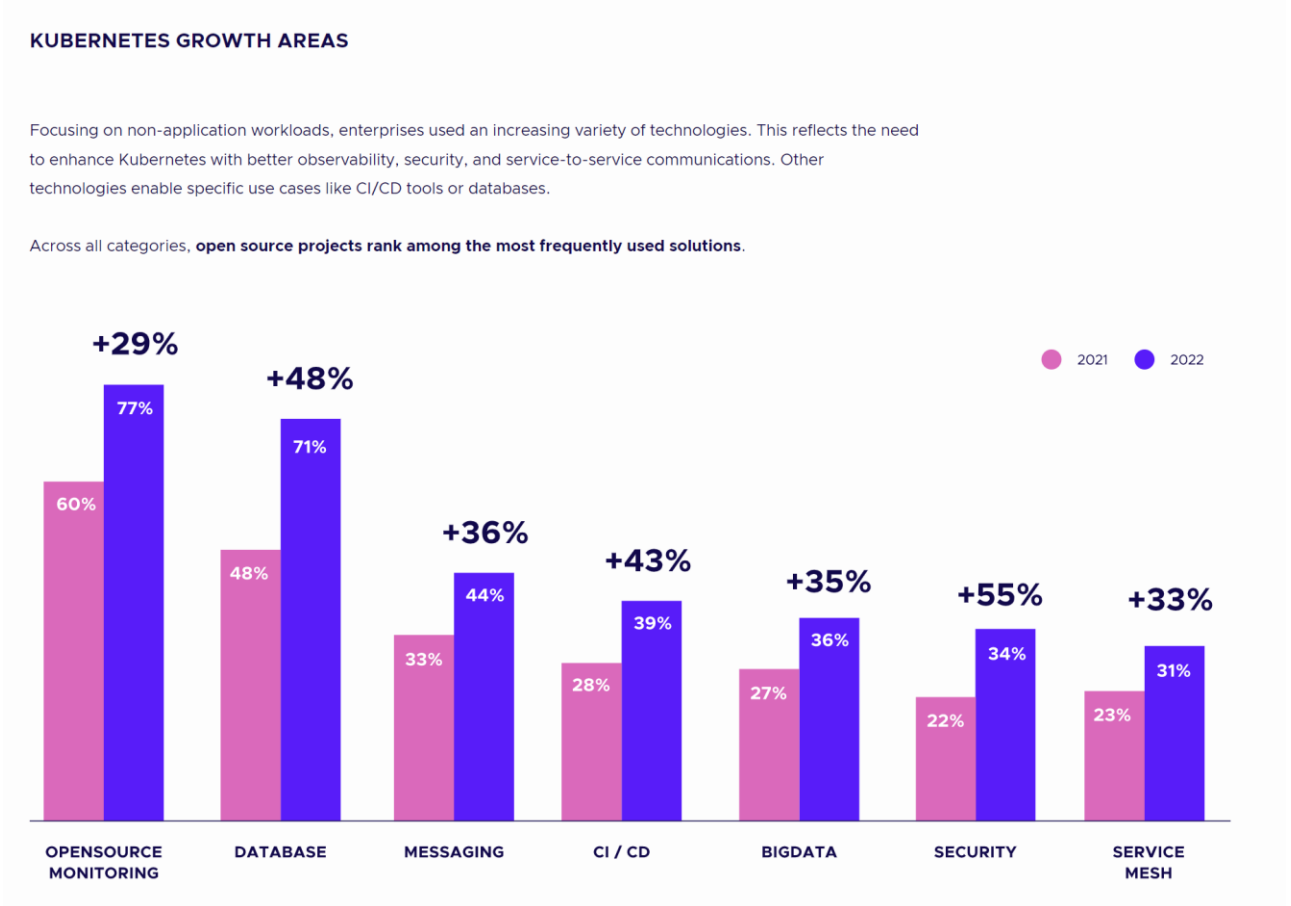
Quite a growth in Adoption!



https://www.cncf.io/reports/cncf-annual-survey-2022/

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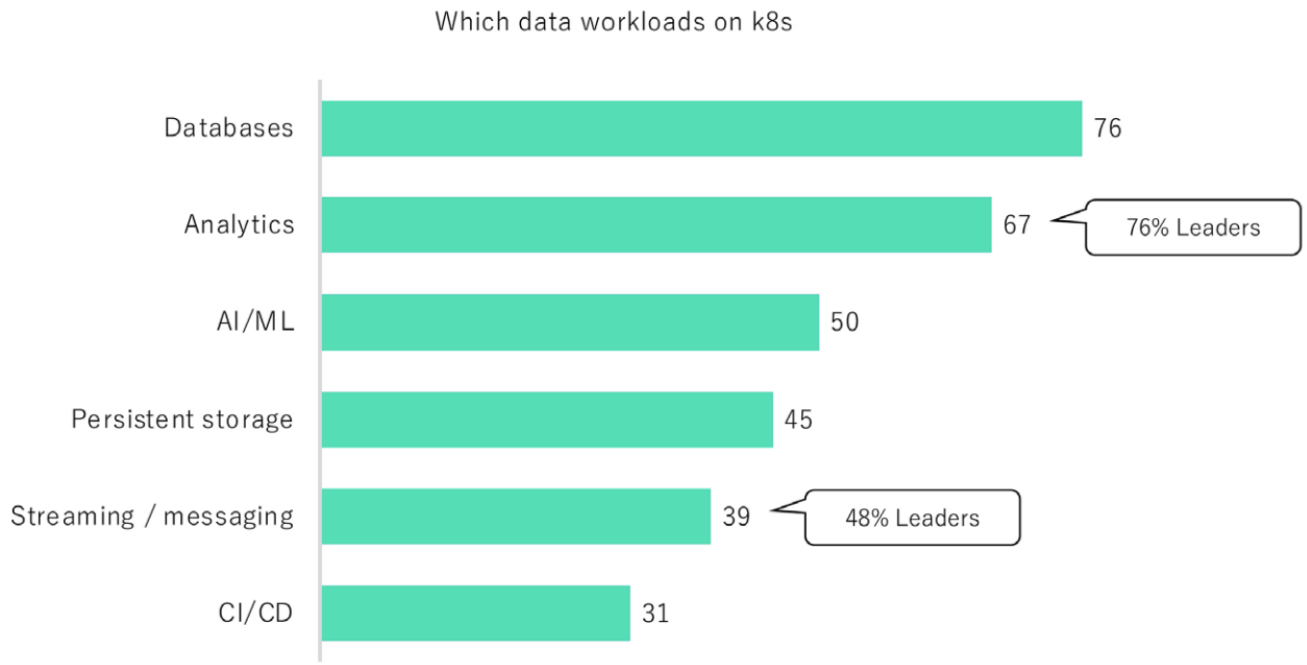
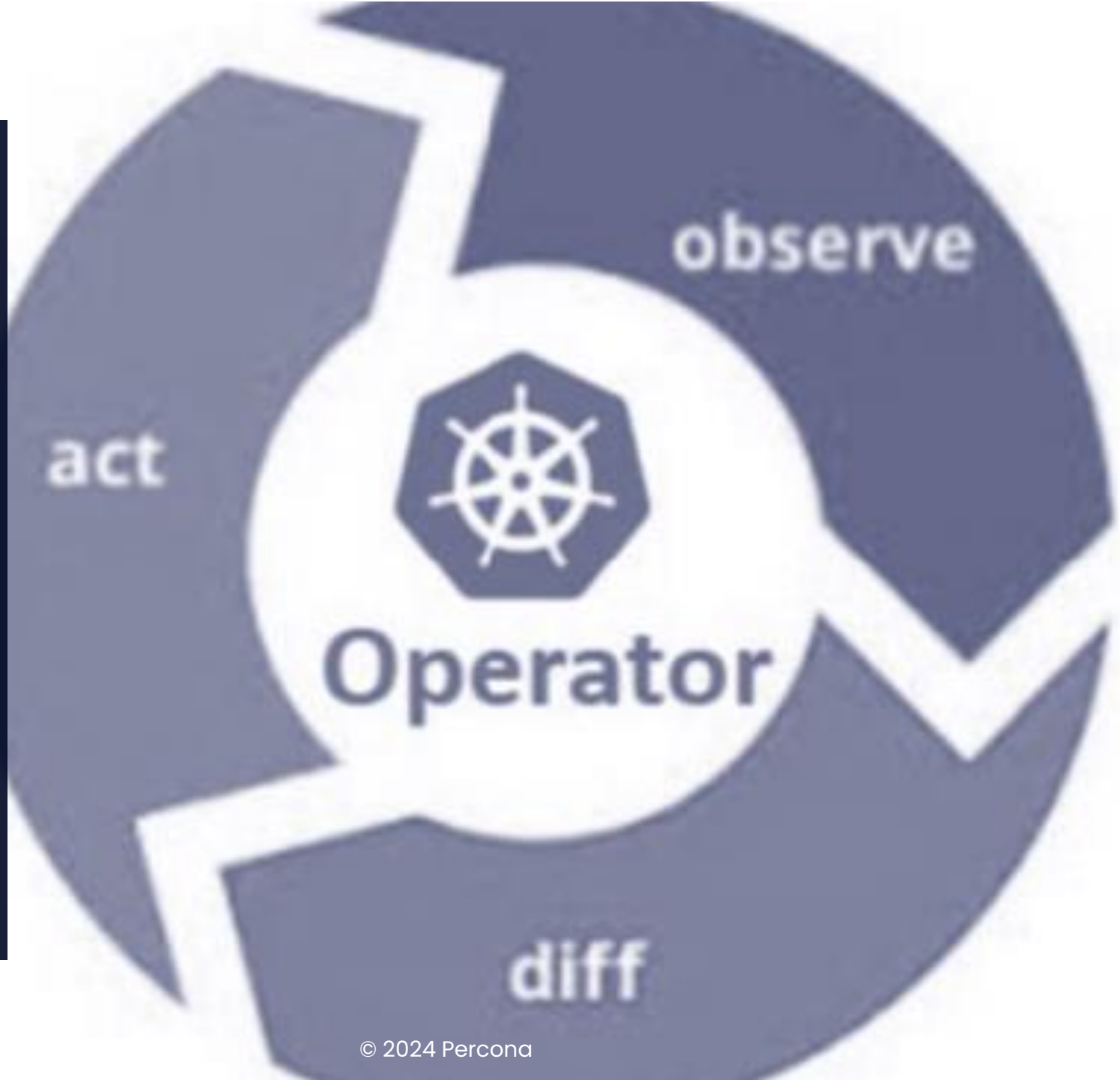


Databases on Kubernetes

Power of Kubernetes Operators



Power of Kubernetes Operators

- **Day One Automation**
  - Installation and Initial Configuration
- **Day Two Automation**
  - Backups, Scaling, Self Healing, Upgrades

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Many Modern DBaaS Are Built on Kubernetes Operators

Altinity

influxdata

MariaDB

crunchy data

BIG ANIMAL

planetscale

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PostgreSQL Choices

- CloudNativePG (EDB)
- Zalando PostgreSQL Operator
- Crunchy Data PostgreSQL Operator
- Stackgres
- Percona Operator for PostgreSQL

https://www.percona.com/blog/run-postgresql-in-kubernetes-solutions-pros-and-cons/

CloudNativePG

- **Built by EDB, Spun out as separate Project**
- **Apache 2.0**
- **Very Robust Feature Set**
- **Fantastic Documentation**
- **Bootstrap Cluster from Backup**
- **Not using Stateful Sets or Patroni**

Zalando PostgreSQL Operator

- **The Oldest PostgreSQL Operator**
- **MIT**
- **No Commercial Support from Creator**
- **Relies on Spilo (Docker PostgreSQL + Patroni)**
- **Extensive AWS EKS Support, like Volume Resize**

Zalando Gui

New PostgreSQL cluster

Cluster YAML definition

```yaml
kind: "postgresql"
apiVersion: "acid.zalan.do/v1"

metadata:
  name: "acid-"
  namespace: "default"
  labels:
    team: acid

spec:
  teamId: "acid"
  postgresql:
    version: "11"
  numberOfInstances: 2
  enableMasterLoadBalancer: true
  volume:
    size: "10Gi"
  users:
    app_user: []
  databases:
    app_db: app_user
  allowedSourceRanges:
    # IP ranges to access your cluster go here

  resources:
    requests:
      cpu: 100m
      memory: 1Gi
    limits:
      cpu: 1000m
      memory: 1Gi
```

New cluster configuration

Validate | Copy definiton | Create cluster

Name	new-cluster (can be 48 characters long)		
Namespace	default		
Owning team	acid		
PostgreSQL version	11		
DNS name:	acid-.default		
Number of instances	2		
Master load balancer	☑ Enable master ELB		
Replica load balancer	☐ Enable replica ELB		
Volume size	10	Gi	
Users	app_user		
Databases	app_db	app_user	
Resources	CPU	Request	100 m
		Limit	1000 m
	Memory	Request	1 Gi
		Limit	1 Gi

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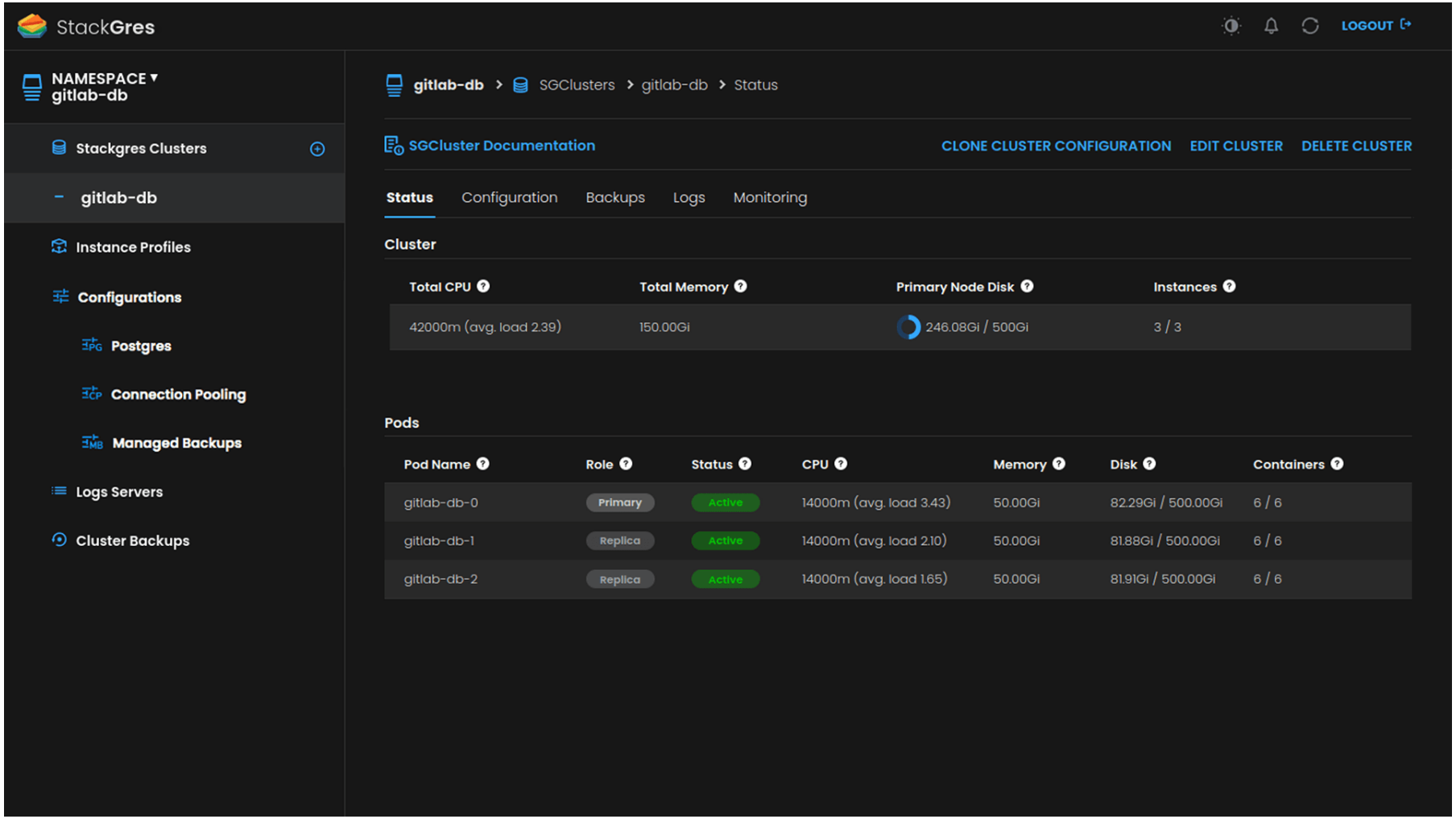
Crunchy Data PostgreSQL Operator

- **Second to Market after Zalando Operator**
- **Apache 2.0 for Operator but Subscription Needed for PostgreSQL Images**
- **Sync and Async Replication Support**
- **Extension and User Management though Kubernetes**
- **Additional components like TimescaleDB and pgAdmin 4**

Stackgres

- **UI or CRD For Every Functionality**
- **AGPLv3 for OSS + Proprietary Enterprise Version**
- **Babelfish, TimescaleDB, Citus, Supabase extension**
- **Envoy Proxy for Observability**
- **Cool features like Benchmarking**
- **Implemented in Java**

Stackgres UI



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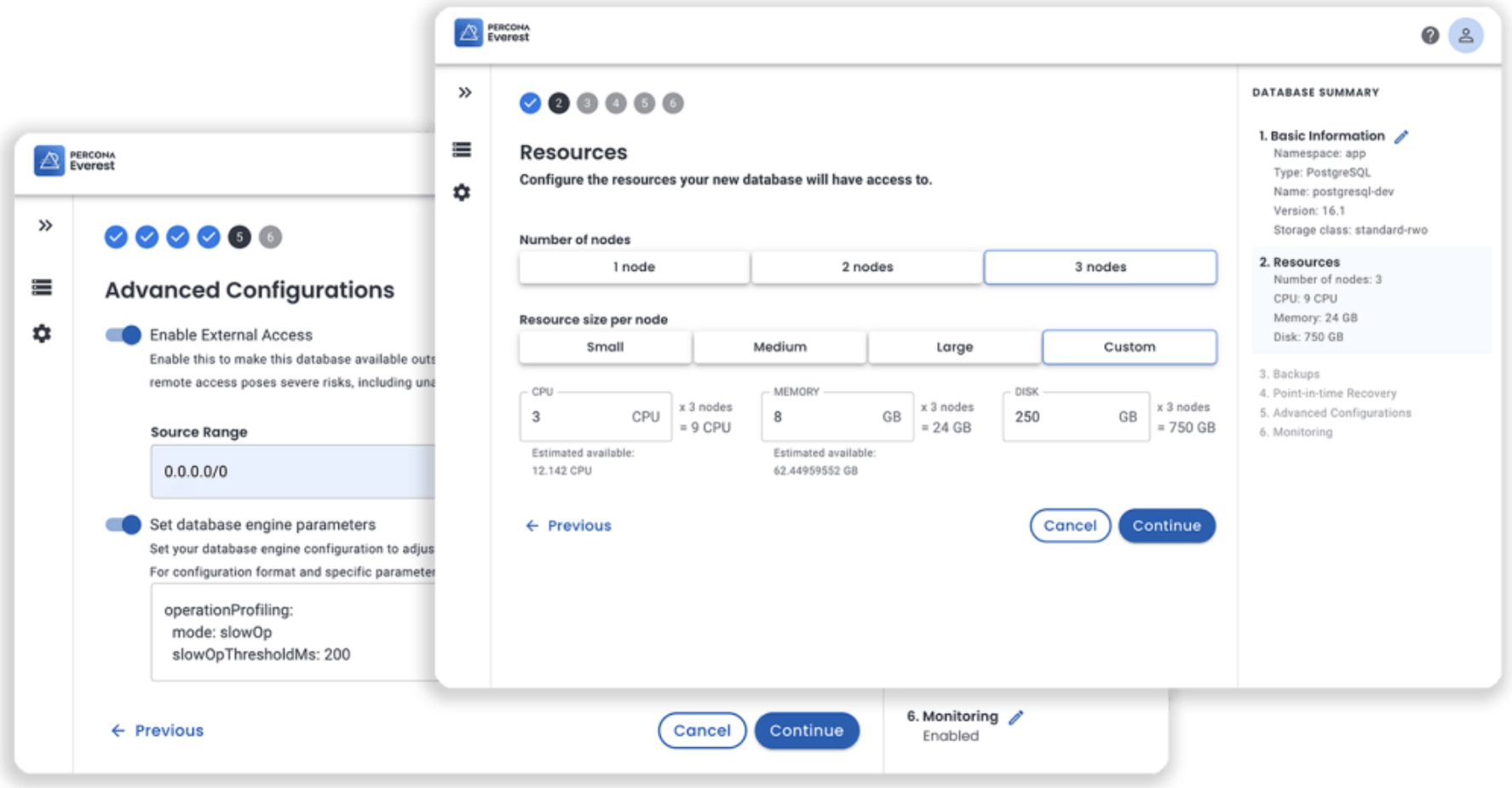
Percona PostgreSQL Operator

- **Initially based off Crunchy Data Operator**
- **Apache 2.0 (using Open Source Images)**
- **Namespace and Cluster wide Modes**
- **Support Integration with PMM (Percona Monitoring and Management)**
- **Advanced Topologies Support**

Percona Everest as GUI



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Best Practices

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#1 Use Operators

For Production Deployment you need to ensure great “Day 2” Automation

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#2 Setup High Availability

Relying on Single Instance in Kubernetes environment is even more dangerous

#3 Keep Persistent Data Persistent

Persistent Volumes; Local Disk or Fast Remote Storage

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#4 Keep Data per Pod Small

50TB of data connected to single POD is not a good idea

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#5 Use Appropriate Node Sizes

Kubernetes or Not Databases often need “Big Iron” more than Apps

#6 Configure Resource Requests and Limits

Or you may have non uniform Performance and Severe Impact on other Pods

#7 Use Proper Anti-Affinity

3 Node Cluster Running on Single Physical Node is not Great High Availability Solution

#8 Tune your Database

Database Configuration, Indexes, Queries needs to be taken care of as usually

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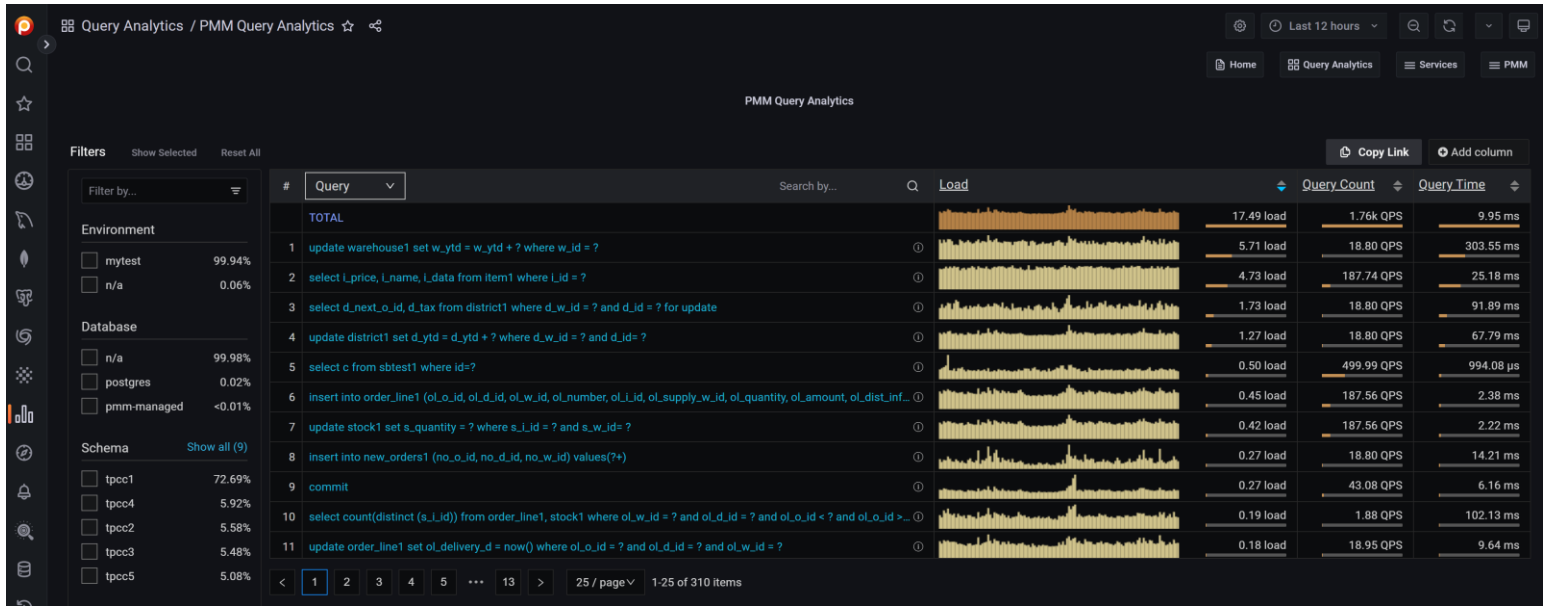
Query Analytics in Percona Monitoring and Management



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#9
Understand
How to Scale

Some Databases can be “Scaled Out” others only “Scaled-Up” and Scaled for Reads

#10 Control Eviction with Pod Priority

Rescheduling Database Pod Can be Expensive, so better ensure it does not happen too often

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#11 Do not Expose your Database unless you have to

Unintended Publicly Accessible Data is leading cause of Security Leaks

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#12 Enable Encryption

Data at Rest and Data in Transit. Does not cause huge Overhead those days

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#13 Use Kubernetes Secrets

Great way to pass database access credentials to your application

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#14 Do not forget Backups

Clustering Does not Eliminate need for backups. Do them. Good Operators make it Easy

#15 Consider New Generation Databases

Databases designed to be run on Cloud Native Infrastructure are Coming - Neon, Oriole, Yugabyte

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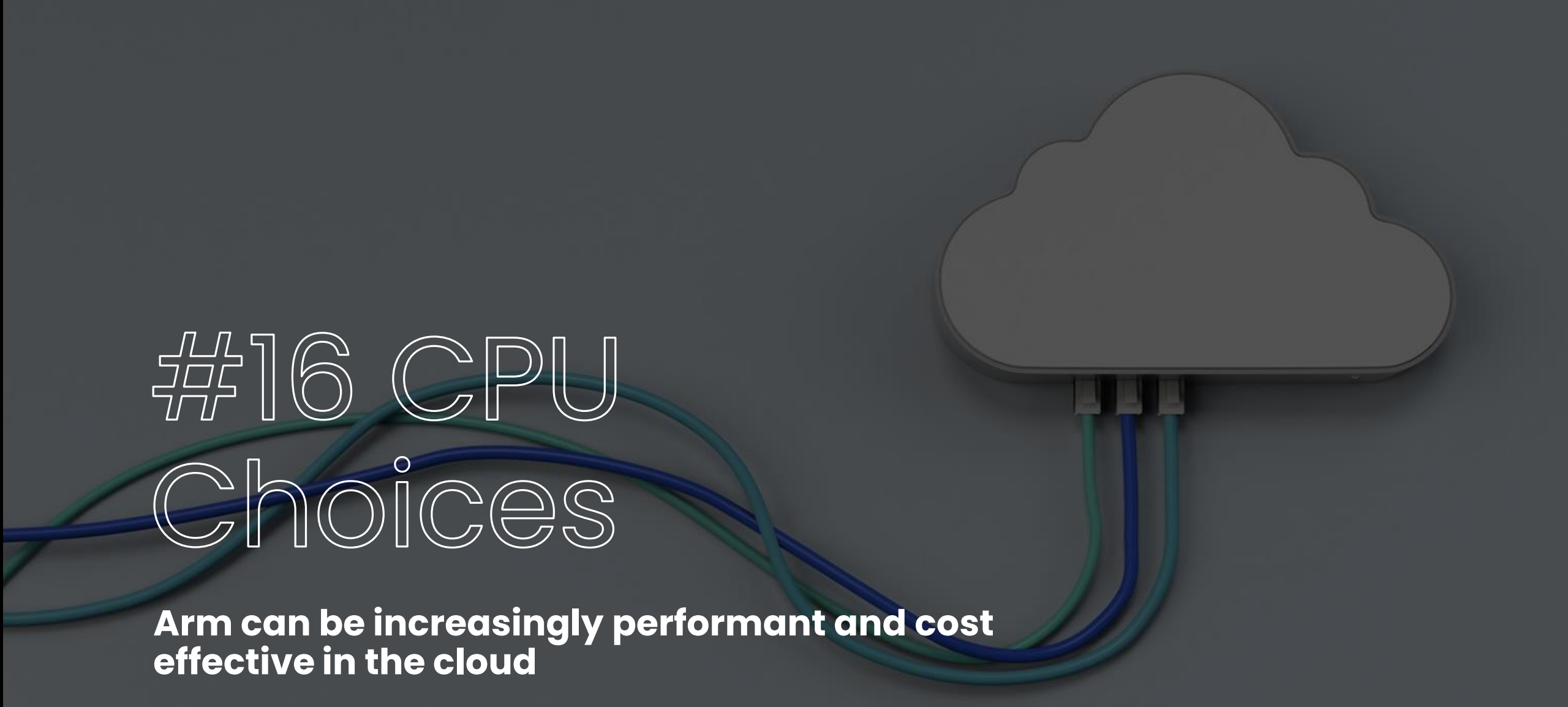
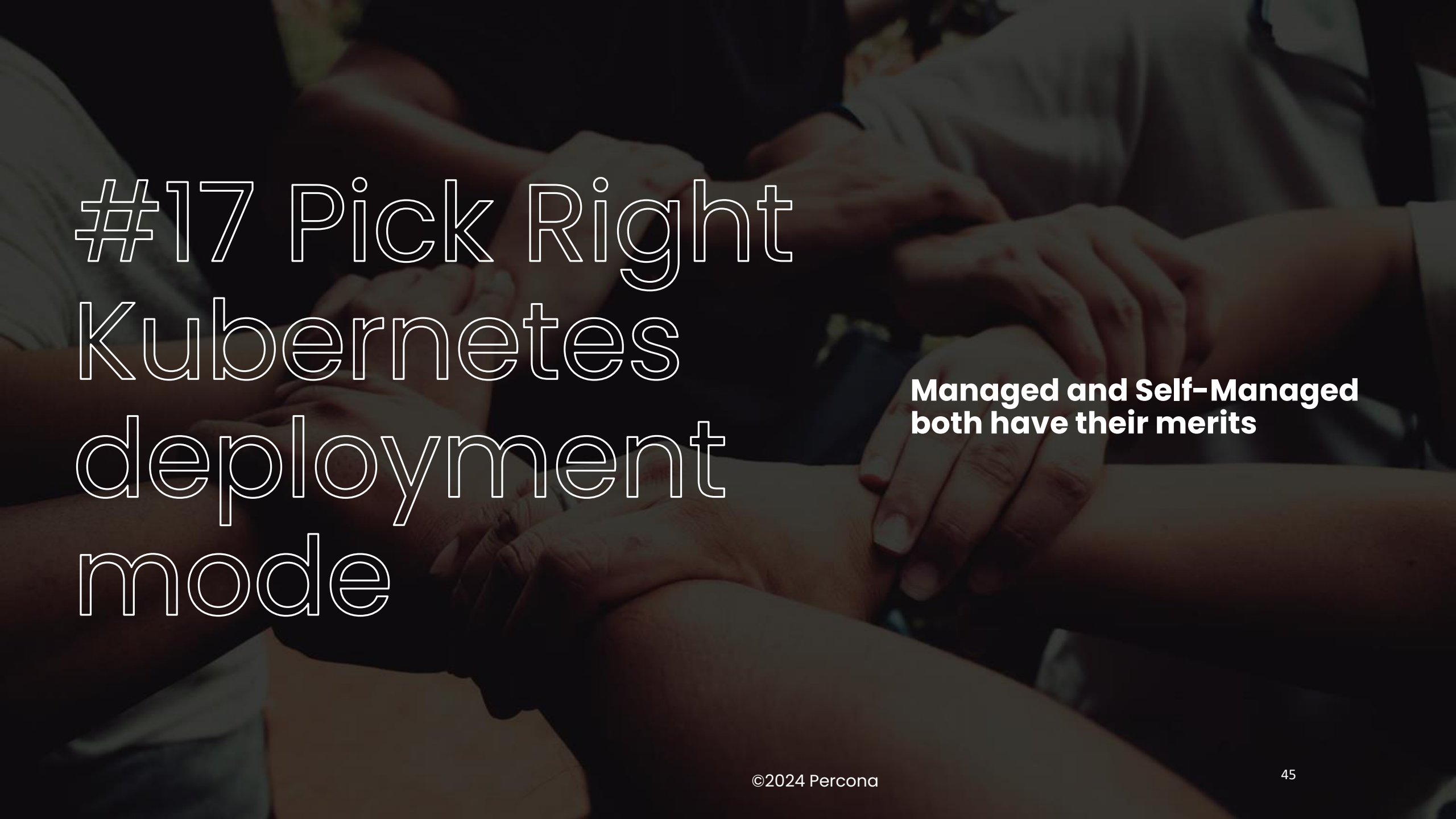
#16 CPU Choices

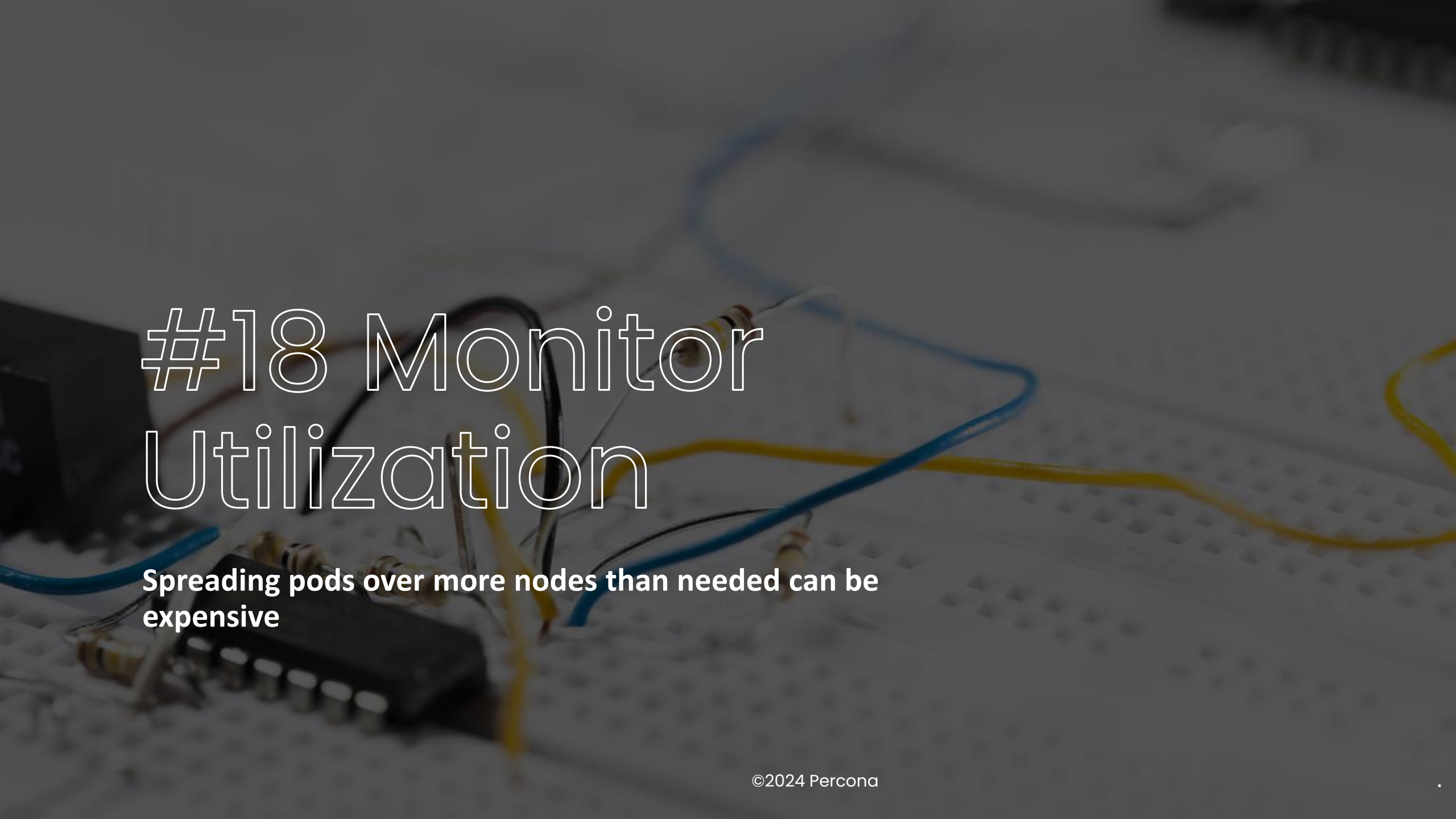


Arm can be increasingly performant and cost effective in the cloud



#17 Pick Right Kubernetes deployment mode

Managed and Self-Managed both have their merits



#18 Monitor Utilization

Spreading pods over more nodes than needed can be expensive

Thank you, Let's Connect!

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