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CloudNativeCon

THE LINUX FOUNDATION



China 2024

How to Manage Database Clusters Without a *Dedicated* Operator

About Us

Shanshan Ying

- KubeBlocks Maintainer, Apecloud
- Senior Engineer, Alibaba Cloud Database Group

Shu Ding

- KubeBlocks Contributor
- Senior Systems Architect, China Mobile Cloud

Manage Databases

Manage *Various* Databases



Manage *Various* Databases on *Kubernetes*



redis

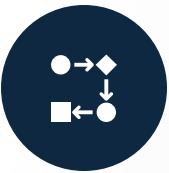


MongoDB[®]

Manage



PROVISIONING



SCALING



BACKUP AND
RESTORE



CONFIGURATION
(ESPECIALLY
PARAMETERS)



UPGRADING



VOLUME
EXPANSION

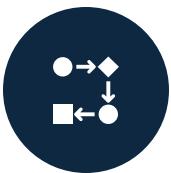


MONITOR

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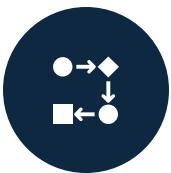
MONITOR

- A Team Consists of
 - Database Experts
 - Cloud-Native Experts
- Operators are delivered in different maturity levels

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Recap: Backup and Recover

- Backup Methods
 - Regular Full Backups
 - Adopting Database Specific Backup Tools
 - Taking Volume Snapshot
 - Continuous Archive Logs
- Backup Scheduler
 - Hourly, daily, or Weekly, or (at user-specified scale)
- Backup Repository
 - a storage location where backup files are kept (local PV, or object storage)
- Recovery
 - how to restore data (restore data before/after Pods start)



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Introduction to KubeBlocks

- Open Source, Cloud-Neutral
 - Mitigate the risk of vendor lock-in
 - ~2k stars, ~1 year
- Database Operator Framework (database-type agnostic)
 - Extensible
 - Flexible
 - Pluggable



Introduction to KubeBlocks

- Open Source, Cloud-Neutral
 - Mitigate the risk of vendor lock-in
 - ~2k stars, ~1 year
- Database Operator Framework (database-agnostic)
 - Extensible -- Unified APIs
 - provides the *Add-on* mechanism for integrating engines
 - Flexible
 - customize and compose your cluster topology
 - pick components from the `Add-on` market
 - Pluggable -- Modular design
 - Backup & Restore, Monitoring, Configuration are pluggable



A Concise Modeling of Database (1/3)

- Component
 - Refers to an indivisible database system or service.



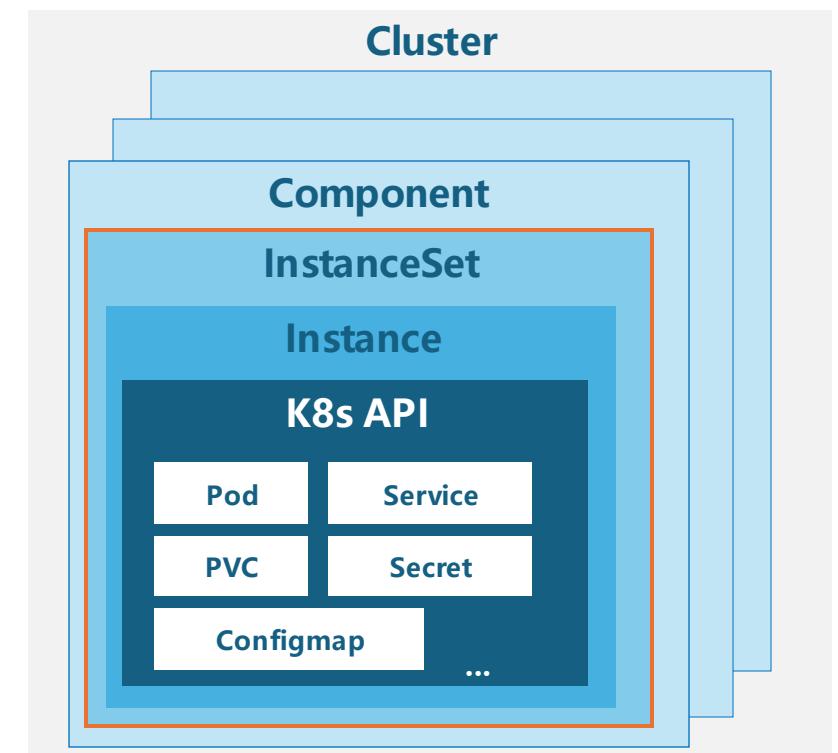
A Concise Modeling of Database (1/3)

- Cluster
 - A Collection of Components, that are interconnected, worked-together, to handle a task
- Component
 - Refers to an indivisible database system or service



A Concise Modeling of Database (1/3)

- Cluster
 - A Collection of Components, that are interconnected, worked-together, to handle a task
- Component
 - Refers to an indivisible database system or service
- InstanceSet: A **Role-Aware** Workload
 - Manage instances in specific **Role** order
 - Primary-Secondary, Leader-Follower-Learner..
- Instance
 - POD, and associated Resources



A Concise Modeling of Database (2/3)



Database Expert

KubeBlocks Developer

Cluster Definition

- Topologies
- Provision orders

Component Definition

- Engine Specific Behaviors

Component Version

- Images
- Service Versions
- Compatibility



Database Users

Cluster

- Components

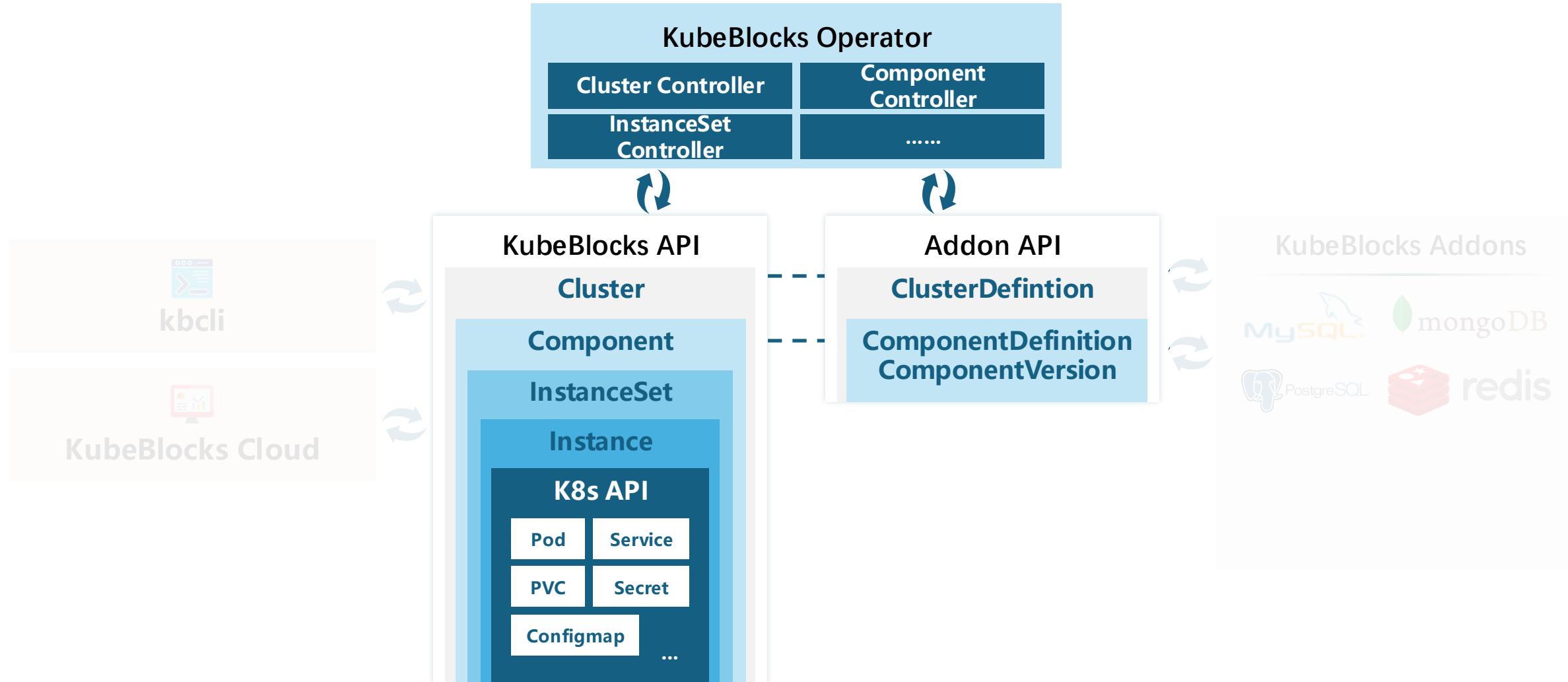
Component

- Resources
- Service Versions

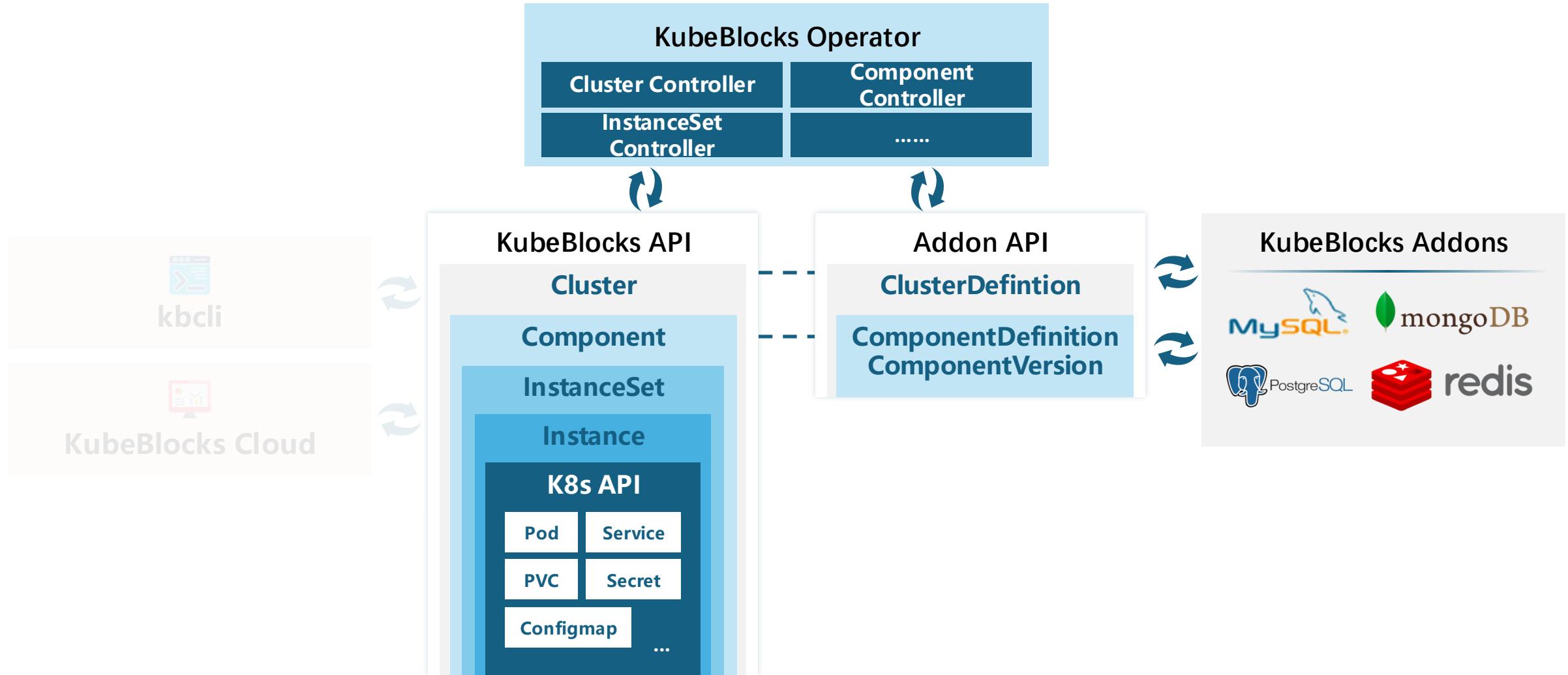
Lifecycle Actions -- *Database-I* (3/3)

							
Role-Probe triggered periodically to check <i>Role</i> of each replica	Switchover transition of leadership to a new replica	Member-Leave remove a replica from the replication group, invoked on scale-in	Member-Join add a new replica to the replication group, invoked on scale-out	Data-Dump procedure for exporting the data from a replica.	Data-Load procedure for importing data into a replica	Pre-Terminate hook to be executed prior to terminating a component	Post-Provision hook to be executed after a component's creation
Role-Based Management			Horizontal-Scaling In/Out			Component-Level	

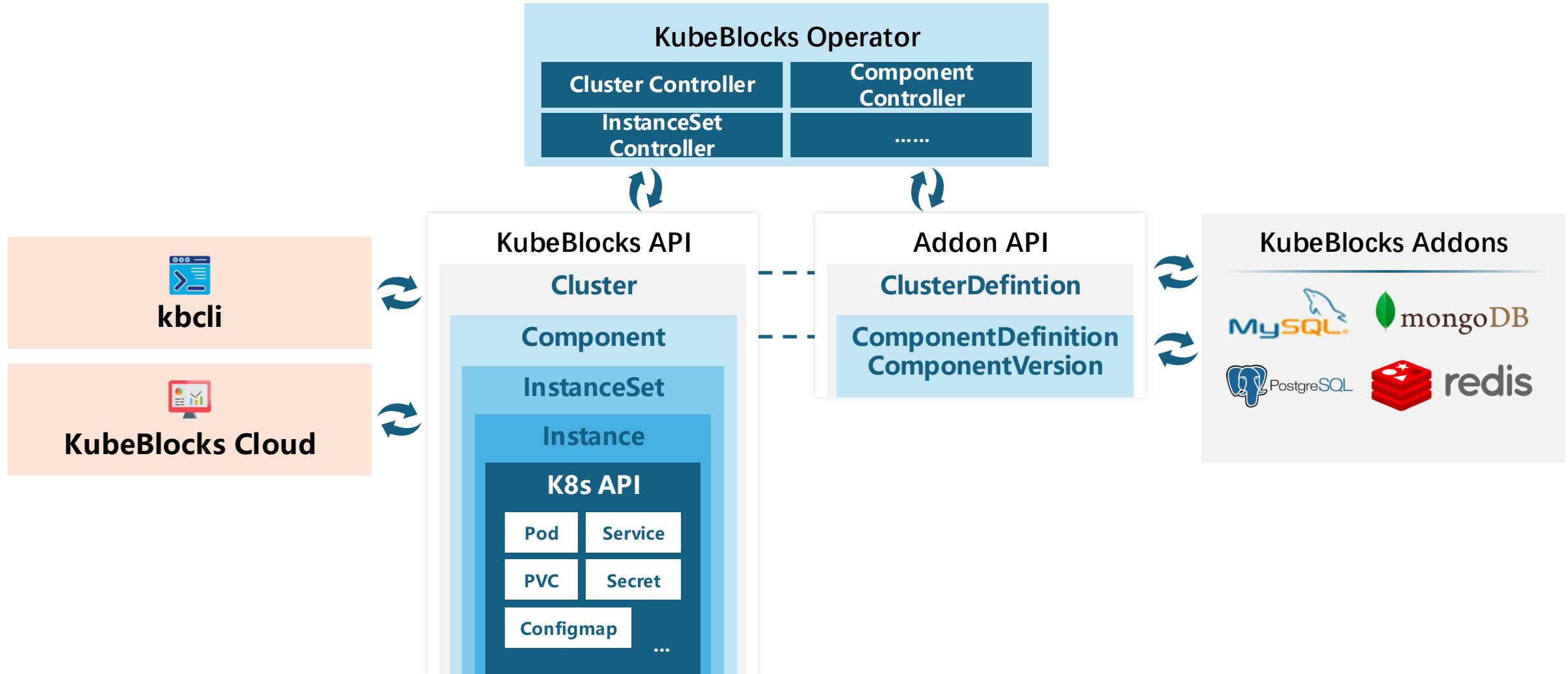
Database-Type Agnostic Operator



Database-Type Agnostic Operator



Database-Type Agnostic Operator



Conclusion

- Support *Various* Databases
 - *Unified APIs* for Clusters
 - *Database-I* for Lifecycle Actions
- KubeBlock 1.0 will be Released Soon!
 - Shardings
 - more actions
 - ...
- Join our community



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Recap: Backup and Recover



Database Expert

KubeBlocks Developer

BackupPolicyTemplate

- BackupMethods
- Pairs of Actions to Backup and Restore

Backup-ActionSet

- Engine Specific Behaviors



Database Users

BackupPolicy

BackupSchedule

BackupRepo



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How to Manage Database Clusters Without a *Dedicated Operator*

China Mobile Cloud Case

Shun Ding @ China Mobile Cloud

About China Mobile Cloud DBaaS



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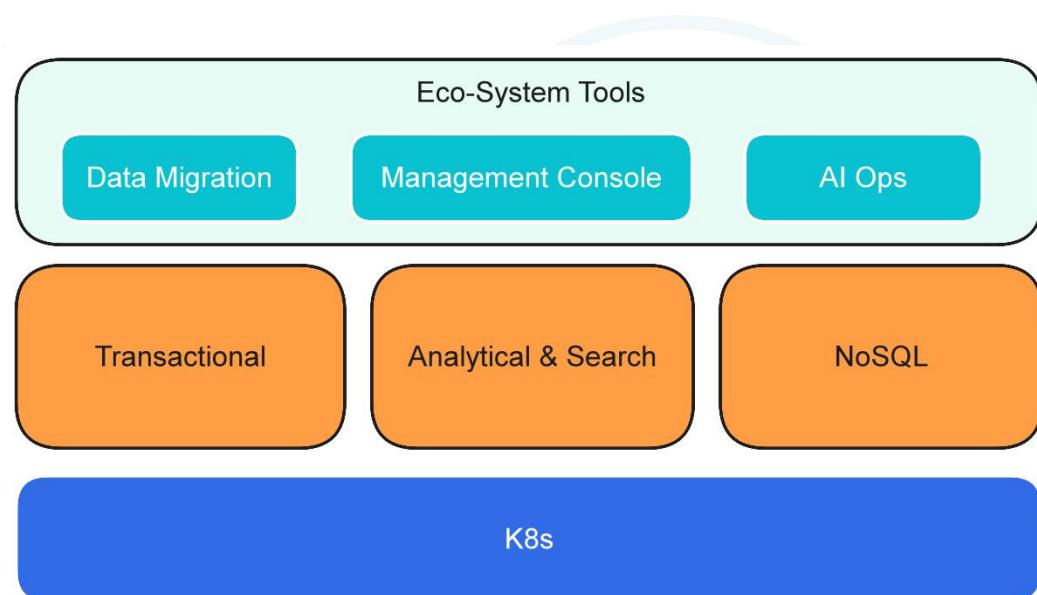


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- **Comprehensive Product Line**
 - Transactional, Analytical & Search, NoSQL, etc.
 - Open Source, 3rd Party, In-House DB Engines
- **35K+ Customers in 9 Key Industries**
- **130K+ Cloud Database Instances in 15 Lv.1 regions & 31 Lv. 2 regions**
- Most run in K8s Clusters!



Current Challenges



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Ineffective Developer Allocation

- Lack of a unified DBaaS architecture across different products
- Developers unable to be reused across products

High Requirements for Developers

- Developers need to know operator frameworks AND DB engine knowledges

Unable to Rapidly Deliver

- For new DB engines, need to develop a whole new dedicated K8s operator
- Unable to reuse logics for DB common operations

How KubeBlocks Solves Our Problems



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Universal Operator Framework

- ✓ Single operator / CRD set to maintain
- ✓ Sharable knowledge across developers
- ✓ Developers reusable on different products

Low-Code Development Model

- ✓ Writing Add-On rather than operator
- ✓ Developers only need to know DB engine stuffs
- ✓ Less code, accelerating delivery

Specially Designed for DB Workloads

- ✓ Operator covers most common operations for any DB engines
- ✓ Easy to extend

Successful Adoption Case: H-DB



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- Introduction to H-DB (placeholder name)
 - Fully In-House Developed
 - Cloud Native Distributed DB Engine
 - Separation of Computation & Storage



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ClusterDefinition & ClusterVersion Scaffold



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ConfigConstraint

Backup-Recovery Scripts & *ActionSet*

Bootstrapping Scripts & *ConfigMap* Template

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High Availability & Role Detection

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Observability Sidecars

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More ClusterVersions

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- Introduction to H-DB (placeholder name)
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- Finish DBaaS System in 2 months from scratch
- First successful KubeBlocks integration case in China Mobile Cloud

More ClusterVersions

Observability Sidecars

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KubeBlocks Add-On vs. Dedicated Operator



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	KubeBlocks Add-On	Dedicated Operator
Developer Resource Invested	2 person-months	6 person-months
Codes Written	2000+	7000+
Code Contents	<ul style="list-style-type: none">• CR Objects YAML• Functional Scripts	<ul style="list-style-type: none">• Design the CRD• Operator Golang Code• Functional Scripts
Developer Pre-Requirement	<ul style="list-style-type: none">• Dedicated DB Engine Knowledge• Scripting Knowledge	<ul style="list-style-type: none">• Dedicated DB Engine Knowledge• Golang Knowledge• K8s Operator Framework (Client-Go / Controller-Runtime)• Scripting Knowledge



Goal: Unified Cloud-Native DBaaS Platform



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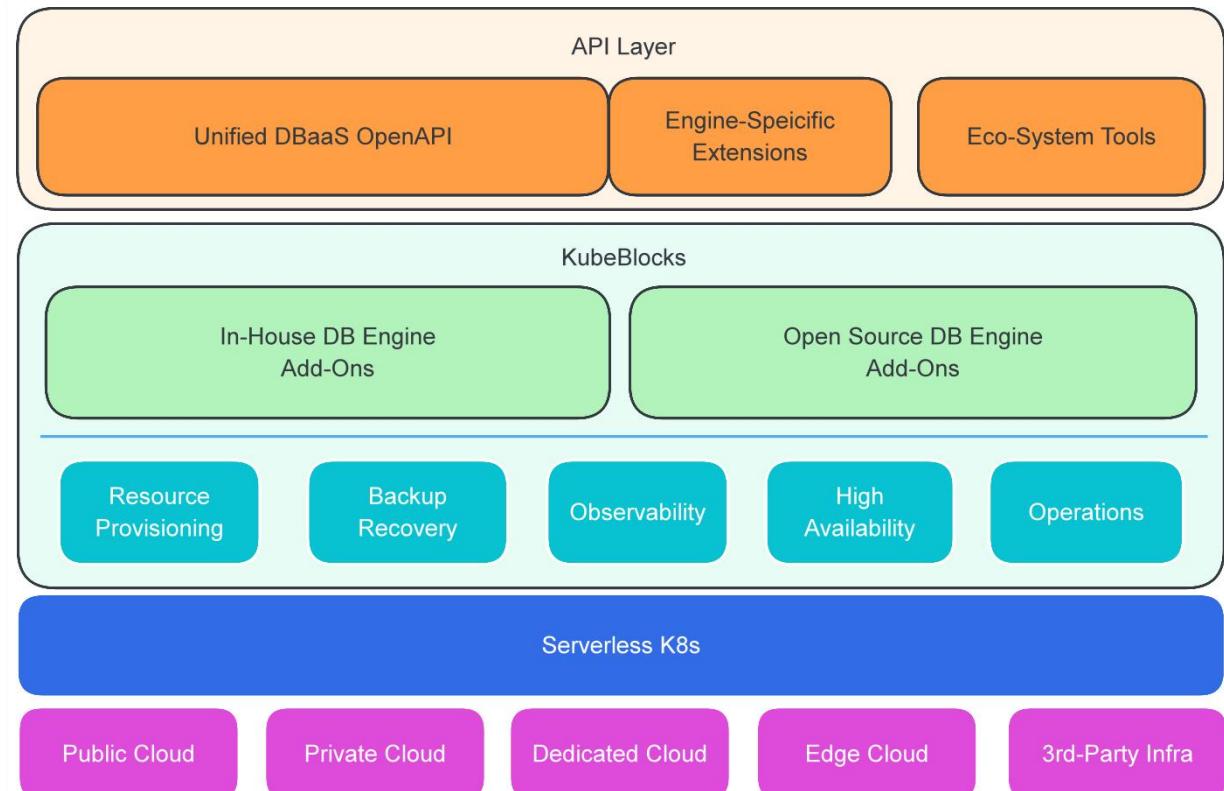
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- **Comprehensive restructuring based on KubeBlocks**
 - Integrate ALL DB engines as KB Add-Ons
 - Unified multi-cloud architecture
 - Serverless K8s
- **Unified database orchestration & management platform**
- **Reduce development resources by 50%**





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