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Fine-grained Cost Allocation in Multi-tenant Kubernetes Clusters

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Multi-tenant cluster has benefits

- Eases cluster management
 - Avoids the need of tools to create/update/delete clusters
 - Provides consistent environment
- Lowers control plane overhead
- Reduces resource fragmentation
- Allows quick provisioning for new tenant

Tenants share common resources

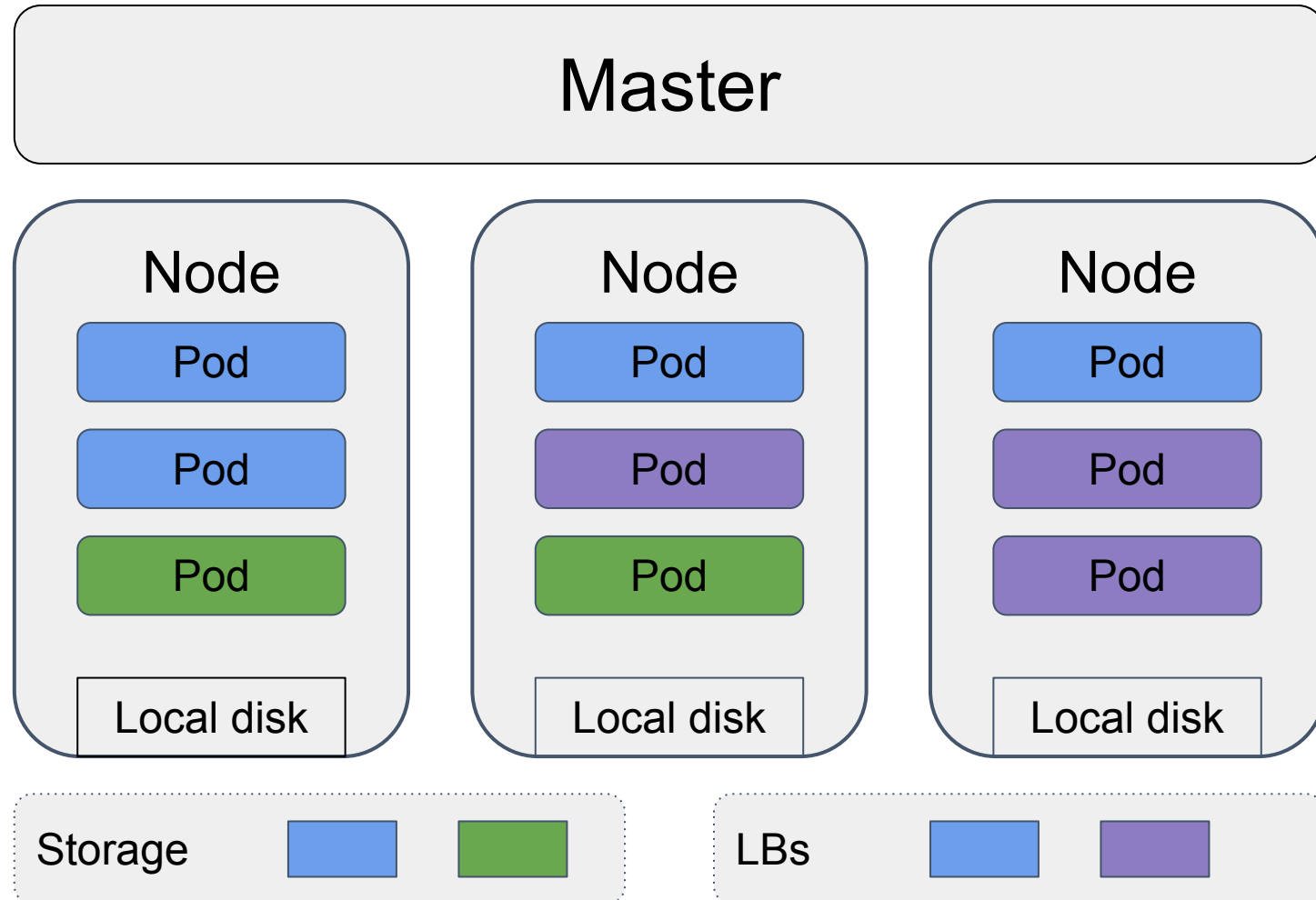


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Visibility into usage is lacking



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- Hard to know which resource is used by whom
- Difficult to understand and predict usage trend
- Susceptible to resource over-provisioning
- Challenging to pinpoint costs to a specific tenant

Why is visibility needed?



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Finance
department

Have basis for
planning, budgeting
and forecasting

Perform cost
allocation and
chargeback

SREs/
Admins

Catch unexpected
usage/bugs

Monitor network
traffic

IT Director/
Product manager

Understand usage
trends and drivers

Optimize resource
utilization

Usage metering provides visibility

- Monitor and report resource usage in a Kubernetes cluster
 - CPU, memory, GPU, storage, network traffic, *etc*
- Tie resource usage to Kubernetes concepts
 - pods, persistentVolumeClaims, namespaces, labels, *etc*

How to meter usage in Kubernetes

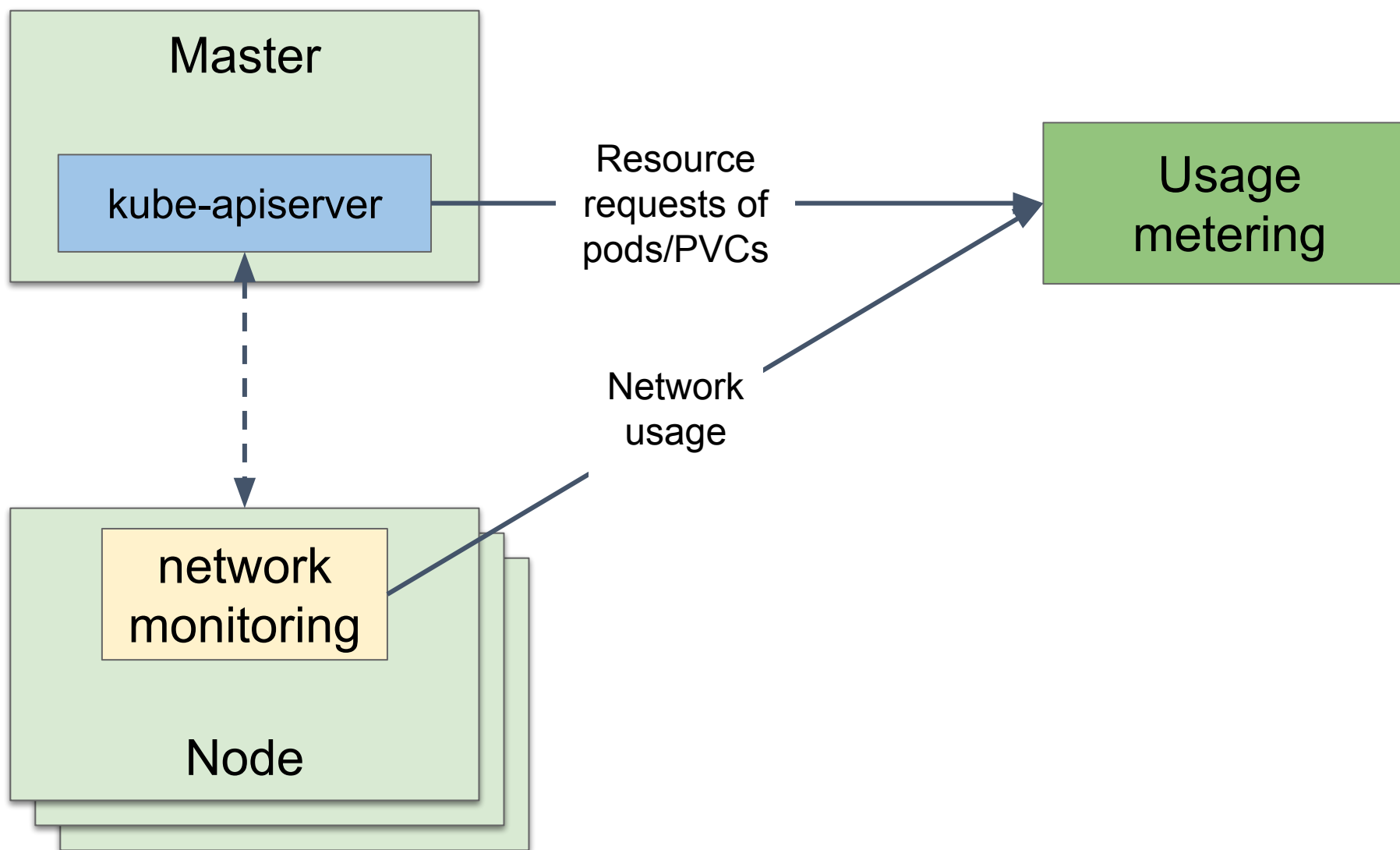


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Meter “request” as “usage” for CPU/memory



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- kube-scheduler
 - Uses request to decide whether pod fits on node
- cluster autoscaler
 - Adds nodes when there are pending pods
 - Removes nodes when possible to re-pack pods
- ResourceQuota
 - Constrains the aggregated resource requests

Utilization is still useful

- Tracks resources used by BestEffort/Burstable
- Allows understanding application behavior
 - For example, changes in tenant usage patterns
- Accounts network usage
 - Kubernetes does not (yet) support network bandwidth as a schedulable resource

Convert usage into cost



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- Dedicated resource (e.g., dynamically provisioned PDs)
 - Perform a simple lookup
- Shared resource (e.g., VM instances)
 - Allocate cost proportionally
 - Example:
 - Pod requests 200 milli-CPU and runs 30 minutes
 - Cost of a single-core VM is \$1 per hour
 - CPU cost for the pod == \$0.10

GKE Usage Metering

- Currently in Beta
- Enable/disable via `gcloud`
- Features
 - Reports usage by Kubernetes namespaces + labels
 - CPU, memory, dynamically provisioned disks, GPUs, and network egress

System Architecture

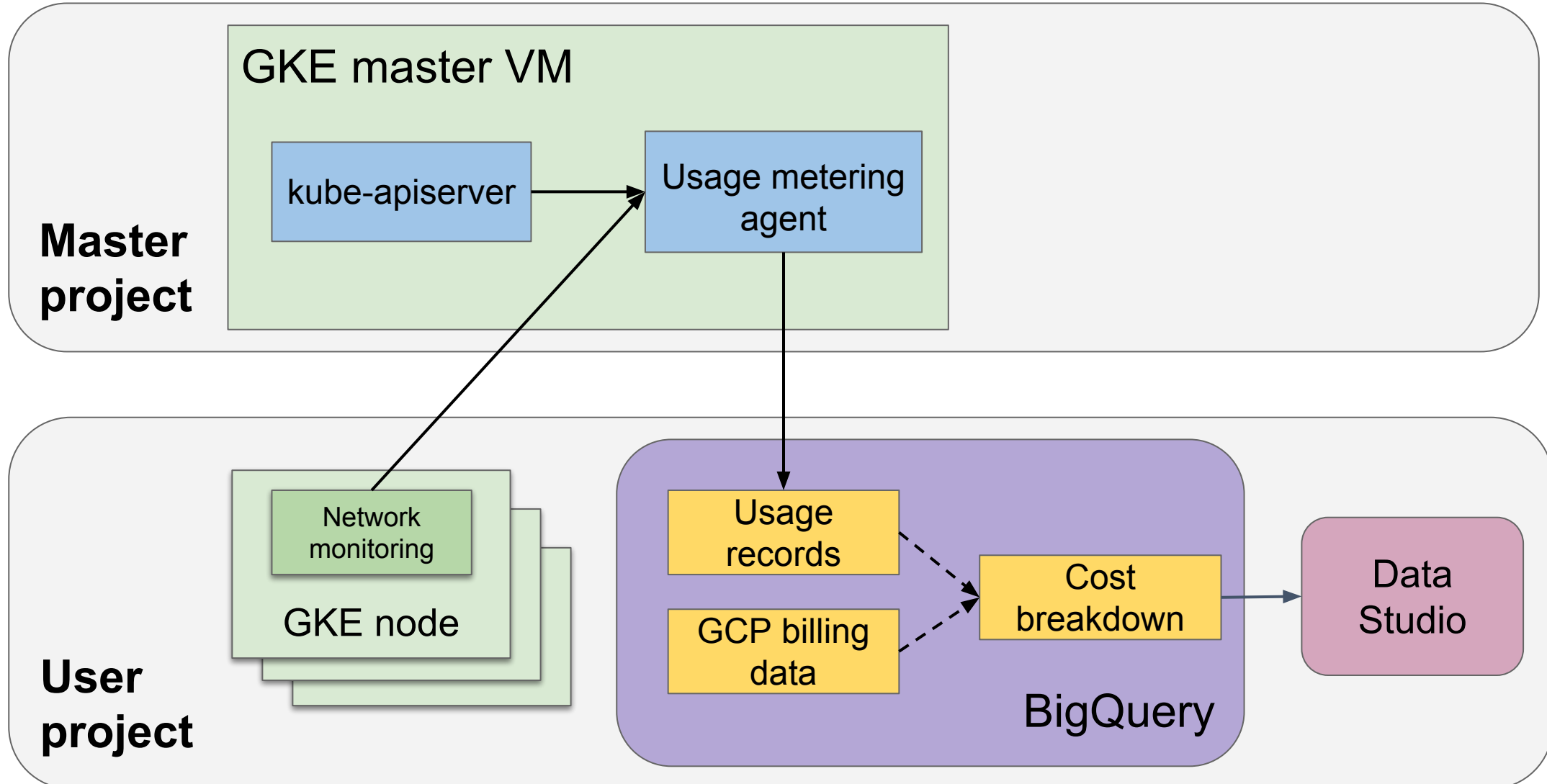


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Demo

Conclusion

- Multi-tenancy in Kubernetes
 - Eases cluster management and lowers cost
- Usage metering is thus needed to
 - Understand per-tenant resource usage
 - Perform cost allocation
- GKE usage metering
 - [Documentation](#)



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