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FAQ

Overview

Alauda Container Platform provides a unified interface to create, edit, delete, and manage cloud-native applications through both a web console and CLI (Command-Line Interface). Applications can be deployed across multiple namespaces with RBAC policies.

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Namespace Management

Namespaces provide logical isolation for Kubernetes resources. Key operations include:

- Creating Namespaces: Define resource quotas and pod security admission policies.
- Importing Namespaces: Importing existing Kubernetes namespaces into Alauda Container Platform provides full platform capabilities parity with natively created namespaces.

Application Lifecycle Management

Alauda Container Platform supports end-to-end lifecycle management including:

Application Creation Patterns

In Alauda Container Platform , applications can be created in multiple ways. Here are some common methods:

- Create from Images: Create custom applications using pre-built container images. This method supports creating complete application that include `Deployments` , `Services` , `ConfigMaps` , and other Kubernetes resources.
- Create from Catalog: Alauda Container Platform provides application catalogs, allowing users to select predefined application templates (Helm Charts or Operator Backed) for creation.
- Create from YAML: By importing a YAML file, create a custom application with all included resources in one step.
- Create from Code: Build images via Source to Image (S2I).

Application Operations

- Updating Applications: Update an application's image version, environment variables, and other configurations, or import existing Kubernetes resources for centralized management.
- Exporting Applications: Export applications in YAML, Kustomize, or Helm Chart formats, then import them to create new application instances in other namespaces or clusters.
- Version Management: Support automatically or manually creating application versions, and in case of issues, one-click rollback to a specific version is available for quick recovery.
- Deleting Applications: Delete an application, it simultaneously deletes the application itself and all of its directly contained Kubernetes resources. Additionally, this action severs any association the application might have had with other Kubernetes resources that were not directly part of its definition.

Application Observability

For continuous operation management, the platform provides logs, events, monitoring, etc.

- Logs: Supports viewing real-time logs from the currently running Pod, and also provides logs from previous container restarts.

- Events: Supports viewing event information for all resources within a namespace.
- Monitoring Dashboards: Provides namespace-level monitoring dashboards, including dedicated views for Applications, Workloads, and Pods, and also support customizing monitoring dashboards to suit specific operational requirements.

Kubernetes Workload Management

Support for core workload types:

- Deployments: Manage stateless applications with rolling updates.
- StatefulSets: Run stateful apps with stable network IDs.
- DaemonSets: Deploy node-level services (e.g., log collectors).
- CronJobs: Schedule batch jobs with retry policies.

Quick Start

Creating a simple application via image

> This technical guide demonstrates how to efficiently create, manage, and access containerized applications in Alauda Container Platform using Kubernetes-native methodologies.

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Introduction

Use Cases

- New users seeking to understand fundamental application creation workflows on Kubernetes platforms
- Practical exercise demonstrating core platform capabilities including:
  - Project/Namespace orchestration
  - Deployment creation
  - Service exposure patterns
  - Application accessibility verification

Time Commitment

Estimated completion time: 10-15 minutes

Important Notes

- This technical guide focuses on essential parameters - refer to comprehensive documentation for advanced configurations
- Required permissions:
  - Project/Namespace creation
  - Image repository integration
  - Workload deployment

Prerequisites

- Basic understanding of Kubernetes architecture and Alauda Container Platform platform concepts
- Pre-configured project following platform establishment procedures

Workflow Overview

No.	Operation	Description
1	Create Namespace	Establish resource isolation boundary
2	Configure Image Repository	Set up container image sources
3	Create application via Deployment	Create Deployment workload
4	Expose Service via NodePort	Configure NodePort service
5	Validate Application Accessibility	Test endpoint connectivity

Procedure

Create namespace

> Namespaces provide logical isolation for resource grouping and quota management.

Prerequisites

- Permissions to create, update, and delete namespaces(e.g., Administrator or Project Administrator roles)
- kubectl configured with cluster access

Creation Process

1. Log in, and navigate to **Project Management** > **Namespaces**
2. Select **Create Namespace**
3. Configure essential parameters:

** Parameter **	Description
Cluster	Target cluster from project-associated clusters
Namespace	Unique identifier (auto-prefixed with project name)

4. Complete creation with default resource constraints

Configure Image Repository

Alauda Container Platform supports multiple image sourcing strategies:

Method 1: Integrated Registry via Toolchain

1. Access **Administrator** > **Toolchain** > **Integration**

2. Initiate new integration:

Parameter	Requirement
Name	Unique integration identifier
API Endpoint	Registry service URL (HTTP/HTTPS)
Secret	Pre-existing or newly created credential

3. Allocate registry to target platform project

Method 2: External Registry Services

- Use publicly accessible registry URLs (e.g., Docker Hub)
- Example: `index.docker.io/library/nginx:latest`

Verification Requirement

- Cluster network must have egress access to registry endpoints

Create application via Deployment

> Deployments provide declarative updates for Pod replicasets.

Creation Process

1. From **Container Platform** view:

   - Use namespace selector to choose target isolation boundary

2. Navigate to **Workloads** > **Deployments**
3. Click **Create Deployment**
4. Specify image source:

   - Select integrated registry *or*
   - Input external image URL (e.g., `index.docker.io/library/nginx:latest`)

5. Configure workload identity and launch

Management Operations

- Monitor replica status
- View events and logs
- Inspect YAML manifests
- Analyze resource metrics, alerts

Expose Service via NodePort

Services enable network accessibility to Pod groups.

Creation Process

1. Navigate to **Networking** > **Services**

2. Click **Create Service** with parameters:

Parameter	**Value**
Type	NodePort
Selector	Target Deployment name
Port Mapping	Service Port: Container Port (e.g., 8080:80)

3. Confirm creation.

Critical

- Cluster-visible virtual IP
- NodePort allocation range (30000-32767)

Internal routes enable service discovery for workloads by providing a unified IP address or host port for access.

1. Click on **Network** > **Service**.
2. Click on **Create Service**.
3. Configure the **Details** based on the parameters below, keeping other parameters at their defaults.

Parameter	Description
Name	Enter the name of the Service.
Type	`NodePort`
Workload Name	Select the `Deployment` created previously.
Port	**Service Port**: The port number exposed by the Service within the cluster, i.e., Port, e.g., `8080`. **Container Port**: The target port number (or name) mapped by the service port, i.e., targetPort, e.g., `80`.

4. Click on **Create**. At this point, the Service is successfully created.

Validate Application Accessibility

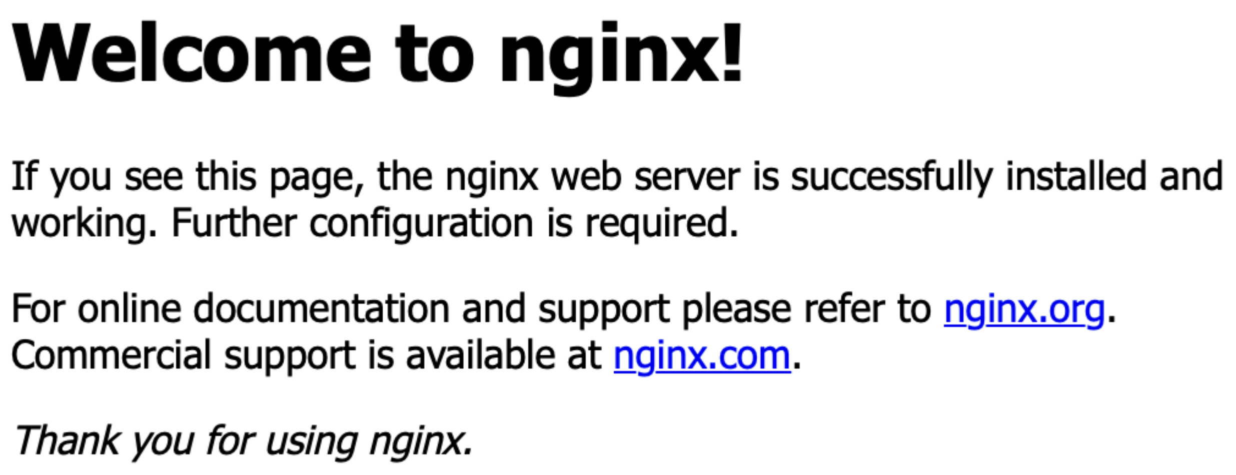
Verification Method

1. Obtain exposed endpoint components:

- **Node IP**: Worker node public address
- **NodePort**: Allocated external port

2. Construct access URL: `http://<Node_IP>:<NodePort>`

3. Expected result: Nginx welcome page



Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to nginx.org.
Commercial support is available at nginx.com.

Thank you for using nginx.

Building Applications

Build application architecture

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Build application architecture

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Introduction to build application

Alauda Container Platform is a platform for developing and running containerized applications. It is designed to allow applications and the data centers that support them to expand from just a few machines and applications to thousands of machines that serve millions of clients.

Built on Kubernetes, Alauda Container Platform leverages the same robust technology that powers large-scale telecommunications, streaming video, gaming, banking, and other critical applications. This foundation enables you to extend your containerized applications across hybrid environments - from on-premise infrastructure to multi-cloud deployments.

Core components

Archon

Provides advanced APIs for application and resource management operations. As a control plane component, `Archon` exclusively runs on the `global` cluster, serving as the central management interface for cluster-wide operations. Its API layer enables declarative configuration of applications, namespaces, and infrastructure resources across the entire platform.

Metis

Functions as the multi-purpose controller within `business clusters`, delivering critical cluster-level operations:

- **Webhook management**: Implements admission webhooks for resource validation, including `resources ratio` enforcement and `resource labeling` policies and so on.
- **Status synchronization**: Maintains consistency across distributed components through:
  - `Helm chart application` status reconciliation
  - `Project quota` synchronization
  - `Application` status updates (writing to application.status fields)

Captain controller manager

Serves as the `Helm chart` application lifecycle management controller operating exclusively on the `global cluster`. Its responsibilities include:

- **Chart installation**: Orchestrating deployment of `Helm chart` across clusters
- **Version management**: Handling seamless upgrades and rollbacks of `Helm chart` releases
- **Uninstallation**: Complete removal of `Helm chart` application and associated resources
- **Release tracking**: Maintaining state and history of all deployed `Helm chart` releases

Icarus

Provides the centralized web-based management interface for `Container Platform`. As the presentation layer component, `Icarus` :

- Delivers comprehensive dashboard visualizations for cluster health monitoring
- Enables GUI-based application deployment and management workflows

- **Implements Kubernetes RBAC-based multi-tenant management**:
  - Distinguishes tenant accounts through namespace isolation
  - Manages resource access permissions per tenant
  - Provides tenant-specific view isolation
- Exclusively runs on the `global cluster`, serving as the unified control point for multi-cluster operations

Concepts

Application Types

In the platform's **Container Platform > Applications**, the following types of applications can be created:

- **Custom Application**: A Custom Application represents a complete business application composed of one or more interconnected computing components (such as Workloads like Deployments or StatefulSets), internal networking configurations (Services), and other native Kubernetes resources. This type of application offers flexible creation methods, supporting direct UI editing, YAML orchestration, and templated deployments, making it suitable for development, testing, and production environments. To learn more about this application type, refer to Custom Application. Different types of native applications can be created in the following ways:
  - Create from Image: Quickly create applications using existing container images.
  - Create from YAML: Create applications using YAML configuration files.
  - Create from Code: Create applications using source code.
- **Helm Chart Application**: A Helm Chart Application allows you to deploy and manage applications packaged as Helm Charts. Helm Charts are bundles of pre-configured Kubernetes resources that can be deployed as a single unit, simplifying the installation and management of complex applications. To learn more about this application type, refer to Helm Chart Application
- **Operator Backed Application**: An Operator-Backed Application leverages the power of Kubernetes Operators to automate the lifecycle management of complex applications. By deploying an application backed by an Operator, you benefit from automated deployment, scaling, upgrades, and maintenance, as the Operator acts as an intelligent controller tailored to the specific application. To learn more about this application type, refer to Operator Backed Application.

Custom Applications

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UnderStanding Custom Applications

A Custom Application is an application paradigm built on native Kubernetes resources (e.g., Deployment, Service, ConfigMap), strictly adhering to Kubernetes declarative API design principles. Users can define and deploy applications through standard YAML files or direct Kubernetes API calls, enabling fine-grained control over the application lifecycle. These are created from sources such as Images, code, and YAML are classified as custom application in Alauda Container Platform. Its design core lies in balancing flexibility and standardization, ideal for scenarios requiring deeply customized management.

Core Capabilities

1. **Declarative API-Driven Management**

- Aggregates distributed resources (e.g., Deployment, Service, Ingress) into a logical application unit through Application CRD, enabling atomic operations.

1. **Application-Level Abstraction & State Aggregation**

- Masks low-level resource details (e.g., Pod replica status). Developers can monitor overall application health (e.g., ready endpoint ratio, version consistency) directly via the Application resource.
- Supports cross-component dependency declarations (e.g., database service must start before application service) to ensure resource initialization order and coordination.

1. **Full Lifecycle Governance**

- Version Control: Tracks historical configurations, enabling one-click rollback to any stable state.
- Dependency Resolution: Automatically identifies and manages version compatibility between components (e.g., matching Service API versions with Ingress controllers).

1. **Enhanced Observability**

- Aggregates status metrics of all associated resources (e.g., Deployment available replicas, Service traffic load), providing a global view through a unified Dashboard.

Design Value

Dimension	Value Proposition
Complexity Management	Encapsulates scattered resources (e.g., Deployment, Service) into a single logical entity, reducing cognitive and operational overhead.
Standardization	Unifies application description standards via Application CRD, eliminating management entropy caused by YAML fragmentation.
Ecosystem Compatibility	Ecosystem Compatibility Seamlessly integrates with native toolchains (e.g., kubectl, Kubernetes Dashboard) and supports Helm Chart extensions.
DevOps Efficiency	Implements declarative delivery through GitOps pipelines (e.g., Argo CD), accelerating CI/CD automation.

Custom Application CRD Architecture Design

The Custom Application module defines two core CRD resources, forming atomic abstraction units for application management:

Dimension	Value Proposition
Application	Describes metadata and component topology of logical application units, aggregating resources like Deployment/Service into a single entity.
ApplicationHistory	Records all application lifecycle operations (create/update/rollback/delete) as versioned snapshots, tightly coupled with the Application CRD to enable end-to-end change traceability.

Application CRD Define

The Application CRD uses the `spec.componentKinds` field to declare Kubernetes resource types (e.g., Deployment, Service), enabling cross-resource lifecycle management.

```
apiVersion: apiextensions.k8s.io/v1beta1
kind: CustomResourceDefinition
metadata:
  name: applications.app.k8s.io
spec:
  group: app.k8s.io
  names:
    kind: Application
    listKind: ApplicationList
    plural: applications
    singular: application
  scope: Namespaced
  subresources:
    status: {}
  validation:
    openAPIV3Schema:
      properties:
        apiVersion:
          description: 'APIVersion defines the versioned schema of this representation
            of an object. Servers should convert recognized schemas to the latest
            internal value, and may reject unrecognized values. More info:
https://github.com/kubernetes/community/blob/master/contributors/devel/sig-
architecture/api-conventions.md#resources'
          type: string
        kind:
          description: 'Kind is a string value representing the REST resource this
            object represents. Servers may infer this from the endpoint the client
            submits requests to. Cannot be updated. In CamelCase. More info:
https://github.com/kubernetes/community/blob/master/contributors/devel/sig-
architecture/api-conventions.md#types-kinds'
          type: string
        metadata:
          description: 'Metadata is a object value representing the metadata of the
kubernetes resource.
            More info:
https://github.com/kubernetes/community/blob/master/contributors/devel/sig-
architecture/api-conventions.md#metadata'
          type: object
        spec:
          properties:
            assemblyPhase:
              description: |
                The installer can set this field to indicate that the application's
```

```
components
                are still being deployed ("Pending") or all are deployed already
("Succeeded"). When the
                application cannot be successfully assembled, the installer can set this
field to "Failed".'
              type: string
            componentKinds:
              description: |
                This array of GroupKinds is used to indicate the types of resources that
the
                application is composed of. As an example an Application that has a
service and a deployment
                would set this field to [{"group":"core","kind": "Service"},
{"group":"apps","kind":"Deployment"}]
              items:
                description: 'The item of the GroupKinds, with a structure like \"
{"group":"core","kind": "Service"}\"'
                type: object
              type: array
            descriptor:
              properties:
                description:
                  description: 'A short, human readable textual description of the
Application.'
                  type: string
                icons:
                  description: 'A list of icons for an application. Icon information
includes the source, size, and mime type.'
                  items:
                    properties:
                      size:
                        description: 'The size of the icon.'
                        type: string
                      src:
                        description: 'The source of the icon.'
                        type: string
                      type:
                        description: 'The mime type of the icon.'
                        type: string
                    required:
                    - src
                    type: object
                  type: array
                keywords:
                  description: 'A list of keywords that identify the application.'
                  items:
                    type: string
                  type: array
                links:
                  description: 'Links are a list of descriptive URLs intended to be used
to surface additional documentation, dashboards, etc.'
                  items:
                    properties:
                      description:
                        description: 'The description of the link.'
                        type: string
                      url:
                        description: 'The url of the link.'
                        type: string
                    type: object
                  type: array
                maintainers:
                  description: 'A list of the maintainers of the Application. Each
maintainer has a
                    name, email, and URL. This field is meant for the distributors of the
Application
                    to indicate their identity and contact information.'
                  items:
                    properties:
                      email:
                        description: 'The email of the maintainer.'
                        type: string
                      name:
                        description: 'The name of the maintainer.'
                        type: string
                      url:
                        description: 'The url to contact the maintainer.'
                        type: string
                    type: object
                  type: array
                notes:
                  description: 'Notes contain human readable snippets intended as a quick
start
                    for the users of the Application. They may be plain text or
CommonMark markdown.'
                  type: string
                owners:
                  items:
```

```
          properties:
           email:
            description: 'The email of the owner.'
            type: string
           name:
            description: 'The name of the owner.'
            type: string
           url:
            description: 'The url to contact the owner.'
            type: string
          type: object
         type: array
        type:
         description: 'The type of the application (e.g. WordPress, MySQL,
Cassandra).
          You can have many applications of different names in the same
namespace.
          They type field is used to indicate that they are all the same type
of application.'
         type: string
        version:
         description: 'A version indicator for the application (e.g. 5.7 for
MySQL version 5.7).'
         type: string
       type: object
      info:
       description: 'Info contains human readable key-value pairs for the
Application.'
       items:
        properties:
         name:
          description: 'The name of the information.'
          type: string
         type:
          description: 'The type of the information.'
          type: string
         value:
          description: 'The value of the information.'
          type: string
         valueFrom:
          description: 'The value reference from other resource.'
          properties:
           configMapKeyRef:
            description: 'The config map key reference.'
```

```
                        properties:
                          key:
                            type: string
                        type: object
                      ingressRef:
                        description: 'The ingress reference.'
                        properties:
                          host:
                            description: 'The host of the ingress reference.'
                            type: string
                          path:
                            description: 'The path of the ingress reference.'
                            type: string
                        type: object
                      secretKeyRef:
                        description: 'The secret key reference.'
                        properties:
                          key:
                            type: string
                        type: object
                      serviceRef:
                        description: 'The service reference.'
                        properties:
                          path:
                            description: 'The path of the service reference.'
                            type: string
                          port:
                            description: 'The port of the service reference.'
                            format: int32
                            type: integer
                        type: object
                      type:
                        type: string
                    type: object
                type: object
              type: array
            selector:
              description: 'The selector is used to match resources that belong to the
Application.
                All of the applications resources should have labels such that they match
this selector.
                Users should use the app.kubernetes.io/name label on all components of
the Application
                and set the selector to match this label. For instance,
                {"matchLabels": [{"app.kubernetes.io/name": "my-cool-app"}]} should be
used as the selector
                for an Application named "my-cool-app", and each component should contain
a label that matches.'
              type: object
          type: object
        status:
          description: 'The status summarizes the current state of the object.'
          properties:
            observedGeneration:
              description: 'The observedGeneration is the generation most recently
observed by the component
                responsible for acting upon changes to the desired state of the
resource.'
              format: int64
              type: integer
          type: object
  version: v1beta1
  versions:
  - name: v1beta1
    served: true
    storage: true
```

ApplicationHistory Define

The ApplicationHistory CRD captures all lifecycle operations (e.g., creation, update, rollback) as version-controlled snapshots and is tightly integrated with the Application CRD to deliver end-to-end audit trails.

```yaml
apiVersion: apiextensions.k8s.io/v1beta1
kind: CustomResourceDefinition
metadata:
  name: applicationhistories.app.k8s.io
spec:
  group: app.k8s.io
  names:
    kind: ApplicationHistory
    listKind: ApplicationHistoryList
    plural: applicationhistories
    singular: applicationhistory
  scope: Namespaced
  validation:
    openAPIV3Schema:
      properties:
        apiVersion:
          description: 'APIVersion defines the versioned schema of this representation
            of an object. Servers should convert recognized schemas to the latest
            internal value, and may reject unrecognized values. More info:
https://github.com/kubernetes/community/blob/master/contributors/devel/sig-
architecture/api-conventions.md#resources'
          type: string
        kind:
          description: 'Kind is a string value representing the REST resource this
            object represents. Servers may infer this from the endpoint the client
            submits requests to. Cannot be updated. In CamelCase. More info:
https://github.com/kubernetes/community/blob/master/contributors/devel/sig-
architecture/api-conventions.md#types-kinds'
          type: string
        metadata:
          description: 'Metadata is a object value representing the metadata of the
kubernetes resource.
            More info:
https://github.com/kubernetes/community/blob/master/contributors/devel/sig-
architecture/api-conventions.md#metadata'
          type: object
        spec:
          properties:
            changeCause:
              description: 'The change cause of the application to generate the
ApplicationHistory.'
              type: string
            creationTimestamp:
              description: 'The creation timestamp of the application history.'
              format: date-time
              type: string
            resourceDiffs:
              description: 'The resource differences between the current and last version
of application. It contains 3 types of diff: `create`,
                `delete` and `update`. The item of the diff compose of the kind and name
of the diff resource object.'
              properties:
                create:
                  items:
                    properties:
                      kind:
                        description: 'The kind of the created resource.'
                        type: string
                      name:
                        description: 'The name of the created resource.'
                        type: string
                    type: object
                  type: array
                delete:
                  items:
                    properties:
                      kind:
                        description: 'The kind of the deleted resource.'
                        type: string
                      name:
                        description: 'The name of the deleted resource.'
                        type: string
                    type: object
                  type: array
                update:
                  items:
                    properties:
                      kind:
                        description: 'The kind of the updated resource.'
                        type: string
                      name:
                        description: 'The name of the updated resource.'
                        type: string
                    type: object
                  type: array
              type: object
            revision:
```

```
       description: |
        The revision number of the application history. It's an integer that will
be incremented on
        every change of the application.'
       type: integer
      user:
       description: 'The user name who triggered the change of the application.'
       type: string
      yaml:
       description: |
        The YAML string of the snapshot of the application and it's components.
       type: string
     type: object
    status:
     description: 'The status summarizes the current state of the object.'
     properties:
      observedGeneration:
       description: 'The observedGeneration is the generation most recently
observed by the component
        responsible for acting upon changes to the desired state of the
resource.'
       format: int64
       type: integer
     type: object
   type: object
 version: v1beta1
 versions:
 - name: v1beta1
  served: true
  storage: true
```

Workload Types

In addition to creating cloud-native applications via the Applications module, workloads can also be directly created in Container Platform > Workloads:

- Deployment: The most commonly used workload controller for deploying stateless applications. It ensures a specified number of Pod replicas are running, supporting rolling updates and rollbacks, ideal for stateless services like web servers and APIs.

- DaemonSet: Ensures a Pod runs on every node (or specific nodes) in the cluster. Pods are automatically created when nodes join and removed when nodes leave. Ideal for node-level tasks such as logging agents and monitoring daemons.

- StatefulSet: A workload controller for managing stateful applications. It provides stable network identities (hostname) and persistent storage for each Pod, ensuring data consistency even during rescheduling. Suitable for databases, distributed caches, and other stateful services.

- CronJob: Manages time-based Jobs using cron expressions. The system automatically creates Jobs at scheduled intervals, ideal for periodic tasks like backups, report generation, and cleanup jobs.

- Job: A workload for running finite tasks. It creates one or more Pods and ensures a specified number of successful completions before terminating. Suitable for batch processing, data migrations, and other one-time operations.

In addition to creating workloads via the web console, Kubernetes also supports direct management of lower-level resources via CLI tools::

- Pod: The smallest deployable unit in Kubernetes. A Pod can contain one or more tightly coupled containers sharing storage, network, and lifecycle. Pods are typically managed by higher-level controllers (e.g., Deployments).
- Container: A standardized unit encapsulating application code and dependencies, ensuring consistent execution across environments. Containers run within Pods and share the Pod's resources.

Understanding Parameters

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Overview

Parameters in Kubernetes refer to command-line arguments passed to containers at runtime. They correspond to the `args` field in Kubernetes Pod specifications and override the default CMD arguments defined in container images. Parameters provide a flexible way to configure application behavior without rebuilding images.

Core Concepts

What are Parameters?

Parameters are runtime arguments that:

- Override the default CMD instruction in Docker images
- Are passed to the container's main process as command-line arguments
- Allow dynamic configuration of application behavior
- Enable reuse of the same image with different configurations

Relationship with Docker

In Docker terminology:

- **ENTRYPOINT**: Defines the executable (maps to Kubernetes `command`)
- **CMD**: Provides default arguments (maps to Kubernetes `args`)
- **Parameters**: Override CMD arguments while preserving ENTRYPOINT

```
# Dockerfile example
FROM nginx:alpine
ENTRYPOINT ["nginx"]
CMD ["-g", "daemon off;"]
```

```yaml
# Kubernetes override
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: nginx
    image: nginx:alpine
    args: ["-g", "daemon off;", "-c", "/custom/nginx.conf"]
```

Use Cases and Scenarios

1. Application Configuration

Pass configuration options to applications:

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: web-server
spec:
  template:
    spec:
      containers:
      - name: app
        image: myapp:latest
        args:
        - "--port=8080"
        - "--log-level=info"
        - "--config=/etc/app/config.yaml"
```

2. Environment-Specific Deployment

Different parameters for different environments:

```
# Development
args: ["--debug", "--reload", "--port=3000"]

# Production
args: ["--optimize", "--port=80", "--workers=4"]
```

3. Database Connection Configuration

```
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: db-client
    image: postgres:13
    args:
    - "psql"
    - "-h"
    - "postgres.example.com"
    - "-p"
    - "5432"
    - "-U"
    - "myuser"
    - "-d"
    - "mydb"
```

CLI Examples and Practical Usage

Using kubectl run

```
# Basic parameter passing
kubectl run nginx --image=nginx:alpine --restart=Never -- -g "daemon off;" -c
"/custom/nginx.conf"

# Multiple parameters
kubectl run myapp --image=myapp:latest --restart=Never -- --port=8080 --log-level=debug

# Interactive debugging
kubectl run debug --image=ubuntu:20.04 --restart=Never -it -- /bin/bash
```

Using kubectl create

```
# Create deployment with parameters
kubectl create deployment web --image=nginx:alpine --dry-run=client -o yaml >
deployment.yaml

# Edit the generated YAML to add args:
# spec:
#   template:
#     spec:
#       containers:
#       - name: nginx
#         image: nginx:alpine
#         args: ["-g", "daemon off;", "-c", "/custom/nginx.conf"]

kubectl apply -f deployment.yaml
```

Complex Parameter Examples

Web Server with Custom Configuration

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-custom
spec:
  replicas: 3
  selector:
    matchLabels:
      app: nginx-custom
  template:
    metadata:
      labels:
        app: nginx-custom
    spec:
      containers:
      - name: nginx
        image: nginx:1.21-alpine
        args:
        - "-g"
        - "daemon off;"
        - "-c"
        - "/etc/nginx/custom.conf"
        ports:
        - containerPort: 80
        volumeMounts:
        - name: config
          mountPath: /etc/nginx/custom.conf
          subPath: nginx.conf
      volumes:
      - name: config
        configMap:
          name: nginx-config
```

Application with Multiple Parameters

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: myapp
spec:
  containers:
  - name: app
    image: mycompany/myapp:v1.2.3
    args:
    - "--server-port=8080"
    - "--database-url=postgresql://db:5432/mydb"
    - "--log-level=info"
    - "--metrics-enabled=true"
    - "--cache-size=256MB"
    - "--worker-threads=4"
```

Best Practices

1. Parameter Design Principles

- **Use meaningful parameter names**: `--port=8080` instead of `-p 8080`
- **Provide sensible defaults**: Ensure applications work without parameters
- **Document all parameters**: Include help text and examples
- **Validate input**: Check parameter values and provide error messages

2. Security Considerations

```yaml
# ❌ Avoid sensitive data in parameters
args: ["--api-key=secret123", "--password=mypass"]

# ✅ Use environment variables for secrets
env:
- name: API_KEY
  valueFrom:
    secretKeyRef:
      name: app-secrets
      key: api-key
args: ["--config-from-env"]
```

3. Configuration Management

```yaml
# ✅ Combine parameters with ConfigMaps
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    args:
    - "--config=/etc/config/app.yaml"
    - "--log-level=info"
    volumeMounts:
    - name: config
      mountPath: /etc/config
  volumes:
  - name: config
    configMap:
      name: app-config
```

Troubleshooting Common Issues

1. Parameter Not Recognized

```
# Check container logs
kubectl logs pod-name

# Common error: unknown flag
# Solution: Verify parameter syntax and application documentation
```

2. Parameter Override Not Working

```
# ❌ Incorrect: mixing command and args
command: ["myapp", "--port=8080"]
args: ["--log-level=debug"]

# ✅ Correct: use args only to override CMD
args: ["--port=8080", "--log-level=debug"]
```

3. Debugging Parameter Issues

```
# Run container interactively to test parameters
kubectl run debug --image=myapp:latest -it --rm --restart=Never -- /bin/sh

# Inside container, test the command manually
/app/myapp --port=8080 --log-level=debug
```

Advanced Usage Patterns

1. Conditional Parameters with Init Containers

```yaml
apiVersion: v1
kind: Pod
spec:
  initContainers:
  - name: config-generator
    image: busybox
    command: ['sh', '-c']
    args:
    - |
      if [ "$ENVIRONMENT" = "production" ]; then
        echo "--optimize --workers=8" > /shared/args
      else
        echo "--debug --reload" > /shared/args
      fi
    volumeMounts:
    - name: shared
      mountPath: /shared
  containers:
  - name: app
    image: myapp:latest
    command: ['sh', '-c']
    args: ['exec myapp $(cat /shared/args)']
    volumeMounts:
    - name: shared
      mountPath: /shared
  volumes:
  - name: shared
    emptyDir: {}
```

2. Parameter Templating with Helm

```
# values.yaml
app:
  parameters:
    port: 8080
    logLevel: info
    workers: 4

# deployment.yaml template
apiVersion: apps/v1
kind: Deployment
spec:
  template:
    spec:
      containers:
      - name: app
        image: myapp:latest
        args:
        - "--port={{ .Values.app.parameters.port }}"
        - "--log-level={{ .Values.app.parameters.logLevel }}"
        - "--workers={{ .Values.app.parameters.workers }}"
```

Parameters provide a powerful mechanism for configuring containerized applications in Kubernetes. By understanding how to properly use parameters, you can create flexible, reusable, and maintainable deployments that adapt to different environments and requirements.

Understanding Environment Variables

TOC

Overview

Environment variables in Kubernetes are key-value pairs that provide configuration data to containers at runtime. They offer a flexible and secure way to inject configuration information, secrets, and runtime parameters into your applications without modifying container images or application code.

Core Concepts

What are Environment Variables?

Environment variables are:

- Key-value pairs available to processes running inside containers
- Runtime configuration mechanism that doesn't require image rebuilds
- Standard way to pass configuration data to applications
- Accessible through standard operating system APIs in any programming language

Environment Variable Sources in Kubernetes

Kubernetes supports multiple sources for environment variables:

Source Type	Description	Use Case
Static Values	Direct key-value pairs	Simple configuration
ConfigMap	Reference to ConfigMap keys	Non-sensitive configuration
Secret	Reference to Secret keys	Sensitive data (passwords, tokens)
Field Reference	Pod/Container metadata	Dynamic runtime information

Source Type	Description	Use Case
Resource Reference	Resource requests/limits	Resource-aware configuration

Environment Variable Precedence

Environment variables override configuration in this order:

1. **Kubernetes env** (highest priority)
2. **Referenced ConfigMaps/Secrets**
3. **Dockerfile ENV instructions**
4. **Application default values** (lowest priority)

Use Cases and Scenarios

1. Application Configuration

Basic application settings:

```yaml
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: web-app
    image: myapp:latest
    env:
    - name: PORT
      value: "8080"
    - name: LOG_LEVEL
      value: "info"
    - name: ENVIRONMENT
      value: "production"
    - name: MAX_CONNECTIONS
      value: "100"
```

2. Database Configuration

Database connection settings using ConfigMaps and Secrets:

```yaml
apiVersion: v1
kind: ConfigMap
metadata:
  name: db-config
data:
  DB_HOST: "postgres.example.com"
  DB_PORT: "5432"
  DB_NAME: "myapp"
  DB_POOL_SIZE: "10"

---
apiVersion: v1
kind: Secret
metadata:
  name: db-secret
type: Opaque
data:
  DB_USER: bXl1c2Vy  # base64 encoded "myuser"
  DB_PASSWORD: bXlwYXNzd29yZA==  # base64 encoded "mypassword"

---
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    env:
    # From ConfigMap
    - name: DB_HOST
      valueFrom:
        configMapKeyRef:
          name: db-config
          key: DB_HOST
    - name: DB_PORT
      valueFrom:
        configMapKeyRef:
          name: db-config
          key: DB_PORT
    - name: DB_NAME
      valueFrom:
        configMapKeyRef:
          name: db-config
          key: DB_NAME
    # From Secret
    - name: DB_USER
      valueFrom:
        secretKeyRef:
          name: db-secret
          key: DB_USER
    - name: DB_PASSWORD
      valueFrom:
        secretKeyRef:
          name: db-secret
          key: DB_PASSWORD
```

3. Dynamic Runtime Information

Access Pod and Node metadata:

```yaml
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    env:
    # Pod information
    - name: POD_NAME
      valueFrom:
        fieldRef:
          fieldPath: metadata.name
    - name: POD_NAMESPACE
      valueFrom:
        fieldRef:
          fieldPath: metadata.namespace
    - name: POD_IP
      valueFrom:
        fieldRef:
          fieldPath: status.podIP
    - name: NODE_NAME
      valueFrom:
        fieldRef:
          fieldPath: spec.nodeName
    # Resource information
    - name: CPU_REQUEST
      valueFrom:
        resourceFieldRef:
          resource: requests.cpu
    - name: MEMORY_LIMIT
      valueFrom:
        resourceFieldRef:
          resource: limits.memory
```

4. Environment-Specific Configuration

Different configurations for different environments:

```yaml
# Development environment
apiVersion: v1
kind: ConfigMap
metadata:
  name: app-config-dev
data:
  DEBUG: "true"
  LOG_LEVEL: "debug"
  CACHE_TTL: "60"
  RATE_LIMIT: "1000"

---
# Production environment
apiVersion: v1
kind: ConfigMap
metadata:
  name: app-config-prod
data:
  DEBUG: "false"
  LOG_LEVEL: "warn"
  CACHE_TTL: "3600"
  RATE_LIMIT: "100"

---
# Deployment using environment-specific config
apiVersion: apps/v1
kind: Deployment
metadata:
  name: myapp
spec:
  template:
    spec:
      containers:
      - name: app
        image: myapp:latest
        envFrom:
        - configMapRef:
            name: app-config-prod  # Change to app-config-dev for development
```

CLI Examples and Practical Usage

Using kubectl run

```
# Set environment variables directly
kubectl run myapp --image=nginx --env="PORT=8080" --env="DEBUG=true"

# Multiple environment variables
kubectl run webapp --image=myapp:latest \
  --env="DATABASE_URL=postgresql://localhost:5432/mydb" \
  --env="REDIS_URL=redis://localhost:6379" \
  --env="LOG_LEVEL=info"

# Interactive pod with environment variables
kubectl run debug --image=ubuntu:20.04 -it --rm \
  --env="TEST_VAR=hello" \
  --env="ANOTHER_VAR=world" \
  -- /bin/bash
```

Using kubectl create

```
# Create ConfigMap from literal values
kubectl create configmap app-config \
  --from-literal=DATABASE_HOST=postgres.example.com \
  --from-literal=DATABASE_PORT=5432 \
  --from-literal=CACHE_SIZE=256MB

# Create ConfigMap from file
echo "DEBUG=true" > app.env
echo "LOG_LEVEL=debug" >> app.env
kubectl create configmap app-env --from-env-file=app.env

# Create Secret for sensitive data
kubectl create secret generic db-secret \
  --from-literal=username=myuser \
  --from-literal=password=mypassword
```

Complex Environment Variable Examples

Microservices with Service Discovery

```yaml
apiVersion: v1
kind: ConfigMap
metadata:
  name: service-config
data:
  USER_SERVICE_URL: "http://user-service:8080"
  ORDER_SERVICE_URL: "http://order-service:8080"
  PAYMENT_SERVICE_URL: "http://payment-service:8080"
  NOTIFICATION_SERVICE_URL: "http://notification-service:8080"

---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: api-gateway
spec:
  template:
    spec:
      containers:
      - name: gateway
        image: api-gateway:latest
        env:
        - name: PORT
          value: "8080"
        - name: ENVIRONMENT
          value: "production"
        envFrom:
        - configMapRef:
            name: service-config
        - secretRef:
            name: api-keys
```

Multi-Container Pod with Shared Configuration

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: multi-container-app
spec:
  containers:
  # Main application
  - name: app
    image: myapp:latest
    env:
    - name: ROLE
      value: "primary"
    - name: SHARED_SECRET
      valueFrom:
        secretKeyRef:
          name: shared-secret
          key: token
    envFrom:
    - configMapRef:
        name: shared-config

  # Sidecar container
  - name: sidecar
    image: sidecar:latest
    env:
    - name: ROLE
      value: "sidecar"
    - name: MAIN_APP_URL
      value: "http://localhost:8080"
    - name: SHARED_SECRET
      valueFrom:
        secretKeyRef:
          name: shared-secret
          key: token
    envFrom:
    - configMapRef:
        name: shared-config
```

Best Practices

1. Security Best Practices

```yaml
# ✅ Use Secrets for sensitive data
apiVersion: v1
kind: Secret
metadata:
  name: app-secrets
type: Opaque
data:
  api-key: <base64-encoded-value>
  database-password: <base64-encoded-value>

---
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    env:
    # ✅ Reference secrets
    - name: API_KEY
      valueFrom:
        secretKeyRef:
          name: app-secrets
          key: api-key
    # ❌ Avoid hardcoding sensitive data
    # - name: API_KEY
    #   value: "secret-api-key-123"
```

2. Configuration Organization

```yaml
# ✅ Organize configuration by purpose
apiVersion: v1
kind: ConfigMap
metadata:
  name: database-config
data:
  DB_HOST: "postgres.example.com"
  DB_PORT: "5432"
  DB_POOL_SIZE: "10"

---
apiVersion: v1
kind: ConfigMap
metadata:
  name: cache-config
data:
  REDIS_HOST: "redis.example.com"
  REDIS_PORT: "6379"
  CACHE_TTL: "3600"

---
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    envFrom:
    - configMapRef:
        name: database-config
    - configMapRef:
        name: cache-config
```

3. Environment Variable Naming

```yaml
# ✅ Use consistent naming conventions
env:
- name: DATABASE_HOST      # Clear, descriptive names
  value: "postgres.example.com"
- name: DATABASE_PORT      # Use underscores for separation
  value: "5432"
- name: LOG_LEVEL         # Use uppercase for environment variables
  value: "info"
- name: FEATURE_FLAG_NEW_UI  # Prefix related variables
  value: "true"

# ❌ Avoid unclear or inconsistent naming
# - name: db               # Too short
# - name: databaseHost     # Inconsistent casing
# - name: log-level        # Inconsistent separator
```

4. Default Values and Validation

```yaml
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    env:
    - name: PORT
      value: "8080"          # Provide sensible defaults
    - name: LOG_LEVEL
      value: "info"          # Default to safe values
    - name: TIMEOUT_SECONDS
      value: "30"            # Include units in names
    - name: MAX_RETRIES
      value: "3"             # Limit retry attempts
```

Understanding Startup Commands

TOC

Overview

Startup commands in Kubernetes define the primary executable that runs when a container starts. They correspond to the `command` field in Kubernetes Pod specifications and override the default ENTRYPOINT instruction defined in container images. Startup commands provide complete control over what process runs inside your containers.

Core Concepts

What are Startup Commands?

Startup commands are:

- The primary executable that runs when a container starts
- Override the ENTRYPOINT instruction in Docker images
- Define the main process (PID 1) inside the container
- Work in conjunction with parameters (args) to form the complete command line

Relationship with Docker and Parameters

Understanding the relationship between Docker instructions and Kubernetes fields:

Docker	Kubernetes	Purpose
ENTRYPOINT	`command`	Defines the executable
CMD	`args`	Provides default arguments

```
# Dockerfile example
FROM ubuntu:20.04
ENTRYPOINT ["/usr/bin/myapp"]
CMD ["--config=/etc/default.conf"]
```

```yaml
# Kubernetes override
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: myapp
    image: myapp:latest
    command: ["/usr/bin/myapp"]
    args: ["--config=/etc/custom.conf", "--debug"]
```

Command vs Args Interaction

Scenario	Docker Image	Kubernetes Spec	Resulting Command
Default	ENTRYPOINT + CMD	(none)	ENTRYPOINT + CMD
Override args only	ENTRYPOINT + CMD	`args: ["new-args"]`	ENTRYPOINT + new-args
Override command only	ENTRYPOINT + CMD	`command: ["new-cmd"]`	new-cmd
Override both	ENTRYPOINT + CMD	`command: ["new-cmd"]` `args: ["new-args"]`	new-cmd + new-args

Use Cases and Scenarios

1. Custom Application Startup

Run different applications using the same base image:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: web-server
spec:
  containers:
  - name: nginx
    image: ubuntu:20.04
    command: ["/usr/sbin/nginx"]
    args: ["-g", "daemon off;", "-c", "/etc/nginx/nginx.conf"]
```

2. Debugging and Troubleshooting

Override the default command to start a shell for debugging:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: debug-pod
spec:
  containers:
  - name: debug
    image: myapp:latest
    command: ["/bin/bash"]
    args: ["-c", "sleep 3600"]
```

3. Initialization Scripts

Run custom initialization before starting the main application:

```yaml
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    command: ["/bin/sh"]
    args:
    - "-c"
    - |
      echo "Initializing application..."
      /scripts/init.sh
      echo "Starting main application..."
      exec /usr/bin/myapp --config=/etc/app.conf
```

4. Multi-Purpose Images

Use the same image for different purposes:

```yaml
# Web server
apiVersion: apps/v1
kind: Deployment
metadata:
  name: web
spec:
  template:
    spec:
      containers:
      - name: web
        image: myapp:latest
        command: ["/usr/bin/myapp"]
        args: ["server", "--port=8080"]

---
# Background worker
apiVersion: apps/v1
kind: Deployment
metadata:
  name: worker
spec:
  template:
    spec:
      containers:
      - name: worker
        image: myapp:latest
        command: ["/usr/bin/myapp"]
        args: ["worker", "--queue=tasks"]

---
# Database migration
apiVersion: batch/v1
kind: Job
metadata:
  name: migrate
spec:
  template:
    spec:
      containers:
      - name: migrate
        image: myapp:latest
        command: ["/usr/bin/myapp"]
        args: ["migrate", "--up"]
      restartPolicy: Never
```

CLI Examples and Practical Usage

Using kubectl run

```
# Override command completely
kubectl run debug --image=nginx:alpine --command -- /bin/sh -c "sleep 3600"

# Run interactive shell
kubectl run -it debug --image=ubuntu:20.04 --restart=Never --command -- /bin/bash

# Custom application startup
kubectl run myapp --image=myapp:latest --command -- /usr/local/bin/start.sh --
config=/etc/app.conf

# One-time task
kubectl run task --image=busybox --restart=Never --command -- /bin/sh -c "echo 'Task
completed'"
```

Using kubectl create job

```
# Create a job with custom command
kubectl create job backup --image=postgres:13 --dry-run=client -o yaml -- pg_dump -h
db.example.com mydb > backup.yaml

# Apply the job
kubectl apply -f backup.yaml
```

Complex Startup Command Examples

Multi-Step Initialization

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: complex-init
spec:
  containers:
  - name: app
    image: myapp:latest
    command: ["/bin/bash"]
    args:
    - "-c"
    - |
      set -e
      echo "Step 1: Checking dependencies..."
      /scripts/check-deps.sh

      echo "Step 2: Setting up configuration..."
      /scripts/setup-config.sh

      echo "Step 3: Running database migrations..."
      /scripts/migrate.sh

      echo "Step 4: Starting application..."
      exec /usr/bin/myapp --config=/etc/app/config.yaml
    volumeMounts:
    - name: scripts
      mountPath: /scripts
    - name: config
      mountPath: /etc/app
  volumes:
  - name: scripts
    configMap:
      name: init-scripts
      defaultMode: 0755
  - name: config
    configMap:
      name: app-config
```

Conditional Startup Logic

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: conditional-app
spec:
  template:
    spec:
      containers:
      - name: app
        image: myapp:latest
        command: ["/bin/sh"]
        args:
        - "-c"
        - |
          if [ "$APP_MODE" = "worker" ]; then
            exec /usr/bin/myapp worker --queue=$QUEUE_NAME
          elif [ "$APP_MODE" = "scheduler" ]; then
            exec /usr/bin/myapp scheduler --interval=60
          else
            exec /usr/bin/myapp server --port=8080
          fi
        env:
        - name: APP_MODE
          value: "server"
        - name: QUEUE_NAME
          value: "default"
```

Best Practices

1. Signal Handling and Graceful Shutdown

```yaml
# ✅ Proper signal handling
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    command: ["/bin/bash"]
    args:
    - "-c"
    - |
      # Trap SIGTERM for graceful shutdown
      trap 'echo "Received SIGTERM, shutting down gracefully..."; kill -TERM $PID; wait $PID' TERM

      # Start the main application in background
      /usr/bin/myapp --config=/etc/app.conf &
      PID=$!

      # Wait for the process
      wait $PID
```

2. Error Handling and Logging

```yaml
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    command: ["/bin/bash"]
    args:
    - "-c"
    - |
      set -euo pipefail  # Exit on error, undefined vars, pipe failures

      log() {
        echo "[$(date '+%Y-%m-%d %H:%M:%S')] $*" >&2
      }

      log "Starting application initialization..."

      if ! /scripts/health-check.sh; then
        log "ERROR: Health check failed"
        exit 1
      fi

      log "Starting main application..."
      exec /usr/bin/myapp --config=/etc/app.conf
```

3. Security Considerations

```yaml
# ✅ Run as non-root user
apiVersion: v1
kind: Pod
spec:
  securityContext:
    runAsNonRoot: true
    runAsUser: 1000
    runAsGroup: 1000
  containers:
  - name: app
    image: myapp:latest
    command: ["/usr/bin/myapp"]
    args: ["--config=/etc/app.conf"]
    securityContext:
      allowPrivilegeEscalation: false
      readOnlyRootFilesystem: true
      capabilities:
        drop:
        - ALL
```

4. Resource Management

```yaml
apiVersion: v1
kind: Pod
spec:
  containers:
  - name: app
    image: myapp:latest
    command: ["/usr/bin/myapp"]
    args: ["--config=/etc/app.conf"]
    resources:
      requests:
        memory: "64Mi"
        cpu: "250m"
      limits:
        memory: "128Mi"
        cpu: "500m"
```

Advanced Usage Patterns

1. Init Containers with Custom Commands

```yaml
apiVersion: v1
kind: Pod
spec:
  initContainers:
  - name: setup
    image: busybox
    command: ["/bin/sh"]
    args:
    - "-c"
    - |
      echo "Setting up shared data..."
      mkdir -p /shared/data
      echo "Setup complete" > /shared/data/status
    volumeMounts:
    - name: shared-data
      mountPath: /shared
  containers:
  - name: app
    image: myapp:latest
    command: ["/bin/sh"]
    args:
    - "-c"
    - |
      while [ ! -f /shared/data/status ]; do
        echo "Waiting for setup to complete..."
        sleep 1
      done
      echo "Starting application..."
      exec /usr/bin/myapp
    volumeMounts:
    - name: shared-data
      mountPath: /shared
  volumes:
  - name: shared-data
    emptyDir: {}
```

2. Sidecar Containers with Different Commands

```yaml
apiVersion: v1
kind: Pod
spec:
  containers:
  # Main application
  - name: app
    image: myapp:latest
    command: ["/usr/bin/myapp"]
    args: ["--config=/etc/app.conf"]

  # Log shipper sidecar
  - name: log-shipper
    image: fluent/fluent-bit:latest
    command: ["/fluent-bit/bin/fluent-bit"]
    args: ["--config=/fluent-bit/etc/fluent-bit.conf"]

  # Metrics exporter sidecar
  - name: metrics
    image: prom/node-exporter:latest
    command: ["/bin/node_exporter"]
    args: ["--path.rootfs=/host"]
```

3. Job Patterns with Custom Commands

```yaml
# Backup job
apiVersion: batch/v1
kind: Job
metadata:
  name: database-backup
spec:
  template:
    spec:
      containers:
      - name: backup
        image: postgres:13
        command: ["/bin/bash"]
        args:
        - "-c"
        - |
          set -e
          echo "Starting backup at $(date)"
          pg_dump -h $DB_HOST -U $DB_USER $DB_NAME > /backup/dump-$(date +%Y%m%d-
%H%M%S).sql
          echo "Backup completed at $(date)"
        env:
        - name: DB_HOST
          value: "postgres.example.com"
        - name: DB_USER
          value: "backup_user"
        - name: DB_NAME
          value: "myapp"
        volumeMounts:
        - name: backup-storage
          mountPath: /backup
      restartPolicy: Never
      volumes:
      - name: backup-storage
        persistentVolumeClaim:
          claimName: backup-pvc
```

Startup commands provide complete control over container execution in Kubernetes. By understanding how to properly configure and use startup commands, you can create flexible, maintainable, and robust containerized applications that meet your specific requirements.

Resource Unit Description

- CPU: Optional units are: core, m (millicore). Where 1 core = 1000 m.
- Memory: Optional units are: Mi (1 MiB = 2^20 bytes), Gi (1 GiB = 2^30 bytes). Where 1 Gi = 1024 Mi.
- Virtual GPU (optional): This parameter is only effective when there are GPU resources under the cluster. The number of virtual GPU cores; 100 virtual cores equal 1 physical GPU core. It supports positive integers.
- Video Memory (optional): This parameter is only effective when there are GPU resources under the cluster. Virtual GPU video memory; 1 unit of video memory equals 256 Mi. It supports positive integers.

Menu

Namespaces

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Creating Namespaces

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Understanding namespaces

Refer to the official Kubernetes documentation: Namespaces ↗

> In Kubernetes, namespaces provide a mechanism for isolating groups of resources within a single cluster. Names of resources need to be unique within a namespace, but not across namespaces. Namespace-based scoping is applicable only for namespaced objects (e.g. Deployments, Services, etc.) and not for cluster-wide objects (e.g. StorageClass, Nodes, PersistentVolumes, etc.).

Creating namespaces by using web console

> Within the cluster associated with the project, create a new namespace aligned with the project's available resource quotas. The new namespace operates within the resource

> quotas allocated to the project (e.g., CPU, memory), and all resources in the namespace must reside within the associated cluster.

1. In the **Project Management** view, click on the ***Project Name*** for which you want to create a namespace.

2. In the left navigation bar, click on **Namespaces** > **Namespaces**.

3. Click on **Create Namespace**.

4. Configure **Basic Information**.

Parameter	Description
Cluster	Select the cluster linked to the project to host the namespace.
Namespace	The namespace name must include a mandatory prefix, which is the project name.

5. (Optional) Configure Resource Quota.

   Every time a resource limit (limits) for computational or storage resources is specified for a container within the namespace, or each time a new Pod or PVC is added, it will consume the quota set here.

   NOTICE:

   - The namespace's resource quota is inherited from the project's allocated quota in the cluster. The maximum allowable quota for a resource type cannot exceed the remaining available quota of the project. If any resource's available quota reaches 0, namespace creation will be blocked. Contact your platform administrator for quota adjustments.

   - **GPU Quota Configuration Requirements**:

     - GPU quotas (vGPU or pGPU) can only be configured if GPU resources are provisioned in the cluster.

     - When using vGPU, memory quotas can also be set.

     GPU Unit Definitions:

     - **vGPU Units**: 100 virtual GPU units (vGPU) = 1 physical GPU core (pGPU).

    - Note: pGPU units are counted in whole numbers only (e.g., 1 pGPU = 1 core = 100 vGPU).
  - **Memory Units**:
    - 1 memory unit = 256 MiB.
    - 1 GiB = 4 memory units (1024 MiB = 4 × 256 MiB).
- **Default Quota Behavior**:
  - If no quota is specified for a resource type, the default is unbounded.
  - This means the namespace can consume **all available resources of that type allocated to the project** without explicit limits.

Quota Parameter Description

Category	Quota Type	Value and Unit	Description
Storage Resource Quota	All	Gi	The total requested storage capacity of all Persistent Volume Claims (PVCs) in this namespace cannot exceed this value.
	Storage Class		The total requested storage capacity of all Persistent Volume Claims (PVCs) associated with the selected StorageClass in this namespace cannot exceed this value. **Note**: Please allocate StorageClass to the project that the namespace belongs to in advance.

Category	Quota Type	Value and Unit	Description
Extended Resources	Obtained from the configuration dictionary (ConfigMap); please refer to Extended Resources Quotas description for details.	-	This category will not be displayed if there is no corresponding configuration dictionary.
Other Quotas	Enter custom quotas; for specific input rules, please refer to Other Quota description.	-	To avoid problems of resource duplication, the following values are not allowed as quota types: • limits.cpu • limits.memory • requests.cpu • requests.memory • pods • cpu • memory

6. (Optional) Configure **Container Limit Range**; please refer to Limit Range for more details.

7. (Optional) Configure **Pod Security Admission**; please refer to Pod Security Admission for specific details.

8. (Optional) In the **More Configuration** area, add labels and annotations for the current namespace.

   Tip: You can define the attributes of the namespace through labels or supplement the namespace with additional information through annotations; both can be used to filter and sort namespaces.

9. Click on **Create**.

Creating namespace by using CLI

YAML file examples

example-namespace.yaml

```yaml
apiVersion: v1
kind: Namespace
metadata:
  name: example
  labels:
    pod-security.kubernetes.io/audit: baseline # Option, to ensure security, it is
recommended to choose the baseline or restricted mode.
    pod-security.kubernetes.io/enforce: baseline
    pod-security.kubernetes.io/warn: baseline
```

example-resourcequota.yaml

```yaml
apiVersion: v1
kind: ResourceQuota
metadata:
  name: example-resourcequota
  namespace: example
spec:
  hard:
    limits.cpu: '20'
    limits.memory: 20Gi
    pods: '500'
    requests.cpu: '2'
    requests.memory: 2Gi
```

example-limitrange.yaml

```
apiVersion: v1
kind: LimitRange
metadata:
  name: example-limitrange
  namespace: example
spec:
  limits:
    - default:
        cpu: 100m
        memory: 100Mi
      defaultRequest:
        cpu: 50m
        memory: 50Mi
      max:
        cpu: 1000m
        memory: 1000Mi
      type: Container
```

Create via YAML file

```
kubectl apply -f example-namespace.yaml
kubectl apply -f example-resourcequota.yaml
kubectl apply -f example-limitrange.yaml
```

Create via command line directly

```
kubectl create namespace example
kubectl create resourcequota example-resourcequota --namespace=example --
hard=limits.cpu=20,limits.memory=20Gi,pods=500
kubectl create limitrange example-limitrange --namespace=example --
default='cpu=100m,memory=100Mi' --default-request='cpu=50m,memory=50Mi' --
max='cpu=1000m,memory=1000Mi'
```

Importing Namespaces

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Overview

Namespace Lifecycle Management Capabilities:

- Cross-Cluster Namespace Import: Importing Namespaces into a Project centralizes their management across all Kubernetes Clusters provisioned by the platform. This provides administrators with unified resource governance and monitoring capabilities across distributed environments.

Namespace Disassociation:

- The Disassociate Namespace feature enables you to unlink a Namespace from its current Project, resetting its association for subsequent reassignment or cleanup.

- Importing a Namespace into a Project grants it capabilities equivalent to those of natively created Namespaces on the platform. This includes inherited Project-level Policies (e.g., Resource Quotas), unified monitoring, and centralized governance controls.

Important Notes:

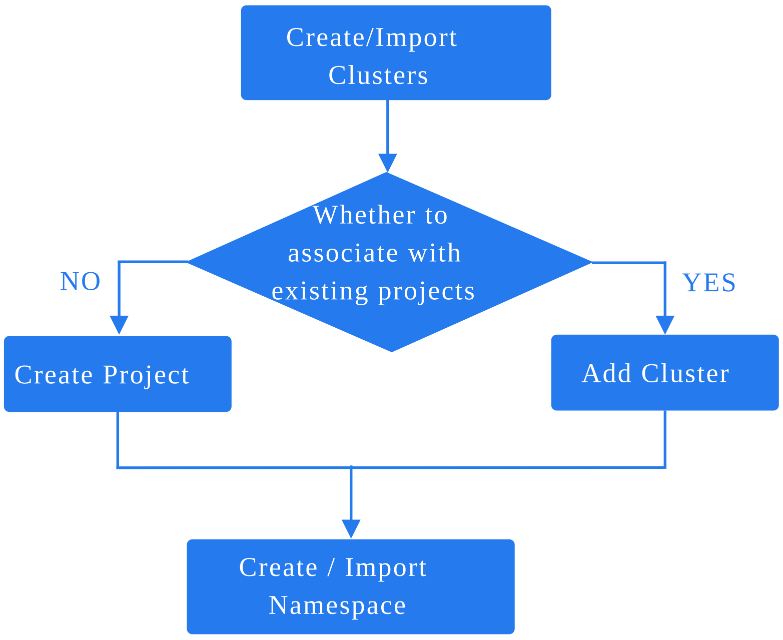
- A Namespace can only be associated with one Project at any given time.

- If a Namespace is already linked to a Project, it cannot be imported into or reassigned to another Project without first disassociating it from its original Project.

Use Cases

Common use cases for **Namespace** management include:

- Upon connecting a new **Kubernetes cluster** to the platform, you can utilize the **Import Namespace** feature to associate its existing **Kubernetes Namespaces** with a Project. Simply select the target Project and Cluster to initiate the import. This action grants the **project** governance over these **namespace**, encompassing **Resource Quotas**, monitoring, and policy enforcement.


Create/Import Clusters
Whether to associate with existing projects
NO
YES
Create Project
Add Cluster
Create / Import Namespace

- A **namespace** that has been disassociated from one **project** can be seamlessly re-associated with another project via the **Import Namespace** feature for continued centralized governance.
- Namespaces not currently managed by any **project** (e.g., those created via cluster-level scripts) must be linked to a target **project** using the **Import Namespace** feature to enable platform-level governance, including visibility and centralized management.

Prerequisites

- The Namespace is not currently managed by any existing Project within the platform.
- Namespaces can only be imported into a Project that is already associated with their target Kubernetes Cluster. If no such Project exists, you must first provision a Project linked to that Cluster.

Procedure

1. **Project Management**, click on the ***Project name*** where the namespace is to be imported.
2. Navigate to **Namespaces** > **Namespaces**.
3. Click on the **Dropdown** button next to **Create Namespace**, then select **Import Namespace**.
4. Refer to the Creating Namespaces documentation for parameter configuration details.
5. Click **Import**.

Resource Quota

Refer to the official Kubernetes documentation: Resource Quotas

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Understanding Resource Requests & Limits

Used to restrict resources available to a specific namespace. The total resource usage by all Pods in the namespace (excluding those in a `Terminating` state) must not exceed the quota.

Resource Requests: Define the minimum resources (e.g., CPU, memory) required by a container, guiding the Kubernetes Scheduler to place the Pod on a node with sufficient capacity.

Resource Limits: Define the maximum resources a container can consume, preventing resource exhaustion and ensuring cluster stability.

Quotas

Resource Quotas

> If a resource is marked as `Unlimited`, no explicit quota is enforced, but usage cannot exceed the cluster's available capacity.

Resource Quotas track the cumulative resource consumption (e.g., container limits, new Pods, or PVCs) within a namespace.

Supported Quota Types

Field	Description
Resource Requests	Total requested resources for all Pods in the namespace: • CPU • Memory
Resource Limits	Total limit resources for all Pods in the namespace: • CPU • Memory
Number of Pods	Maximum number of Pods allowed in the namespace.

Note:

- Namespace quotas are derived from the project's allocated cluster resources. If any resource's available quota is 0, namespace creation will fail. Contact the administrator.
- `Unlimited` implies the namespace can consume the project's remaining cluster resources for that resource type.

YAML file example

```yaml
# example-resourcequota.yaml
apiVersion: v1
kind: ResourceQuota
metadata:
  name: example-resourcequota
  namespace: <example>
spec:
  hard:
    limits.cpu: "20"
    limits.memory: 20Gi
    pods: "500"
    requests.cpu: "2"
    requests.memory: 2Gi
```

Create resouce quota by using CLI

Create via YAML file

```
kubectl apply -f example-resourcequota.yaml
```

Create via command line directly

```
kubectl create resourcequota example-resourcequota --namespace=<example> --
hard=limits.cpu=20,limits.memory=20Gi,pods=500
```

Storage Quotas

Quota Type:

- **All**: Total PVC storage capacity in the namespace.
- **Storage Class**: Total PVC storage capacity for a specific storage class.

Note: Ensure the storage class is pre-assigned to the project containing the namespace.

Hardware accelerator Resources Quotas

When `Alauda Build of Hami` or `NVIDIA GPU Device Plugin` installed, you will be able to use extended resources quotas about hardware accelerator.

Refer to Alauda Build of Hami and Alauda Build of NVIDIA GPU Device Plugin.

Other Quotas

The format for custom quota names must comply with the following specifications:

- If the custom quota name does not contain a slash (/): It must start and end with a letter or number, and can contain letters, numbers, hyphens (-), underscores (_), or periods (.), forming a qualified name with a maximum length of 63 characters.
- If the custom quota name contains a slash (/): The name is divided into two parts: prefix and name, in the form of: prefix/name. The prefix must be a valid DNS subdomain, while the name must comply with the rules for a qualified name.
- DNS Subdomain:
  - Label: Must start and end with lowercase letters or numbers, may contain hyphens (-), but cannot be exclusively composed of hyphens, with a maximum length of 63 characters.
  - Subdomain: Extends the rules of the label, allowing multiple labels to be connected by periods (.) to form a subdomain, with a maximum length of 253 characters.

Limit Range

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Understanding Limit Range

Refer to the official Kubernetes documentation: Limit Ranges

Using Kubernetes LimitRange as an admission controller is **resource limitations at the container or Pod level**. It sets default request values, limit values, and maximum values for containers or Pods created after the LimitRange is created or updated, while continuously monitoring container usage to ensure that no resources exceed the defined maximum values within the namespace.

> The resource request of a container is the ratio between resource limits and cluster overcommitment. Resource request values serve as a reference and criterion for the scheduler when scheduling containers. The scheduler will check the available resources for each node (total resources - sum of resource requests of containers within Pods scheduled on the node). If the total resource requests of the new Pod container exceed the remaining available resources of the node, that Pod will not be scheduled on that node.

LimitRange is an admission controller:

- It applies default request and limit values for all Containers that do not set compute resource requirements.
- It tracks usage to ensure it does not exceed resource maximum and ratio defined in any LimitRange present in the namespace.

Includes the following configurations

Resource	Field
CPU	• Default Request • Limit • Max
Memory	• Default Request • Limit • Max

Create Limit Range by using CLI

YAML file examples

```yaml
# example-limitrange.yaml
apiVersion: v1
kind: LimitRange
metadata:
  name: example-limitrange
  namespace: example
spec:
  limits:
    - default:
        cpu: 100m
        memory: 100Mi
      defaultRequest:
        cpu: 50m
        memory: 50Mi
      max:
        cpu: 1000m
        memory: 1000Mi
      type: Container
```

Create via YAML file

```
kubectl apply -f example-limitrange.yaml
```

Create via command line directly

```
kubectl create limitrange example-limitrange --namespace=example --
default='cpu=100m,memory=100Mi' --default-request='cpu=50m,memory=50Mi' --
max='cpu=1000m,memory=1000Mi'
```

Pod Security Admission

Refer to the official Kubernetes documentation: Pod Security Admission

Pod Security Admission (PSA) is a Kubernetes admission controller that enforces security policies at the namespace level by validating Pod specifications against predefined standards.

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Security Modes

PSA defines three modes to control how policy violations are handled:

Mode	Behavior	Use Case
Enforce	Denies creation/modification of non-compliant Pods.	Production environments requiring strict security enforcement.
Audit	Allows Pod creation but logs violations in audit logs.	Monitoring and analyzing security incidents without blocking workloads.

Mode	Behavior	Use Case
Warn	Allows Pod creation but returns client warnings for violations.	Testing environments or transitional phases for policy adjustments.

Key Notes:

- **Enforce** acts on Pods only (e.g., rejects Pods but allows non-Pod resources like Deployments).
- **Audit** and **Warn** apply to both Pods and their controllers (e.g., Deployments).

Security Standards

PSA defines three security standards to restrict Pod privileges:

Standard	Description	Key Restrictions
Privileged	Unrestricted access. Suitable for trusted workloads (e.g., system components).	No validation of `securityContext` fields.
Baseline	Minimal restrictions to prevent known privilege escalations.	Blocks `hostNetwork`, `hostPID`, privileged containers, and unrestricted `hostPath` volumes.
Restricted	Strictest policy enforcing security best practices.	Requires: - `runAsNonRoot: true` - `seccompProfile.type: RuntimeDefault` - Dropped Linux capabilities.

Configuration

Namespace Labels

Apply labels to namespaces to define PSA policies.

YAML file example

```yaml
apiVersion: v1
kind: Namespace
metadata:
  name: example-namespace
  labels:
    pod-security.kubernetes.io/enforce: restricted
    pod-security.kubernetes.io/audit: baseline
    pod-security.kubernetes.io/warn: baseline
```

CLI command

```bash
# Step 1: Update Pod Admission labels
kubectl label namespace <namespace-name> \
  pod-security.kubernetes.io/enforce=baseline \
  pod-security.kubernetes.io/audit=restricted \
  --overwrite

# Step 2: Verify labels
kubectl get namespace <namespace-name> --show-labels
```

Exemptions

Exempt specific users, namespaces, or runtime classes from PSA checks.

Example Configuration:

```yaml
apiVersion: pod-security.admission.config.k8s.io/v1
kind: PodSecurityConfiguration
exemptions:
  usernames: ['admin']
  runtimeClasses: ['nvidia']
  namespaces: ['kube-system']
```

UID/GID Assignment

In Kubernetes, each Pod runs with a specific User ID (UID) and Group ID (GID) to ensure security and proper access control. By default, Pods may run as the root user (UID 0), which can pose security risks. To enhance security, it's recommended to assign non-root UIDs and GIDs to Pods.

ACP allows to auto assign a namespace with specific UID and GID ranges to ensure that all Pods within the namespace run with the designated user and group IDs.

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Enable UID/GID Assignment

To enable UID/GID assignment for a namespace, follow these steps:

1. Enter **Project Management**.
2. In the left navigation bar, click **Namespace**.
3. Click on the target namespace.
4. Click **Actions** > **Upate Pod Security Policy**.
5. Change the **Enforce** option value to **Restricted**, click **Update**.

6. Click edit icon next to **Labels**, add a label with key `security.cpaas.io/enabled` and value `true`, click **Update**. (To disable, remove this label or set the value to `false`.)
7. Click **Save**.

Verify UID/GID Assignment

The UID/GID Range

In the namespace details page, you can view the assigned UID and GID ranges in the **Annotations**.

The **security.cpaas.io/uid-range** annotation specifies the range of UID/GIDs that can be assigned to Pods in the namespace, e.g. **security.cpaas.io/uid-range=1000002000-1000011999**, means the uid/gid range is between 1000002000 to 1000011999.

Verify the Pod UID/GID

If the pod does not specify `runAsUser` and `fsGroup` in the `securityContext`, the platform will automatically assign the first value from the assigned uid range.

1. Create a Pod in the namespace with the following YAML configuration:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: uid-gid-test-pod
spec:
  containers:
  - name: test-container
    image: busybox
    command: ["sleep", "3600"]
```

2. After the Pod is created, get the Pod yaml to check the assigned UID and GID:

```
kubectl get pod uid-gid-test-pod -n <namespace-name> -o yaml
```

the Pod YAML will show the assigned UID and GID in the `securityContext` section:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: uid-gid-test-pod
spec:
  containers:
  - name: test-container
    image: busybox
    command: ["sleep", "3600"]
    securityContext:
      runAsUser: 1000000
  securityContext:
    fsGroup: 1000000
```

If the pod specifies runAsUser and fsGroup in the securityContext, the platform will validate if the specified UID/GID are within the assigned range. If they are not, the Pod creation will fail.

1. Create a Pod in the namespace with the following YAML configuration:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: uid-gid-test-pod-invalid
spec:
  containers:
  - name: test-container
    image: busybox
    command: ["sleep", "3600"]
    securityContext:
      runAsUser: 2000000  # Invalid UID, outside the assigned range
  securityContext:
    fsGroup: 2000000  # Invalid GID, outside the assigned range
```

2. After applying the YAML, the Pod creation will fail with an error message indicating that the specified UID/GID are outside the assigned range.

Overcommit Ratio

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UnderStanding Namespace Resource Overcommit Ratio

Alauda Container Platform allows you to set a resource overcommit ratio (CPU and memory) per namespace. This manages the relationship between container limits (maximum usage) and requests (guaranteed minimum) within that namespace, optimizing resource utilization.

By configuring this ratio, you ensure user-defined container limits and requests remain within reasonable bounds, improving overall cluster resource efficiency.

Key Concepts

- Limits: The maximum resource a container can use. Exceeding limits can lead to throttling (CPU) or termination (memory).
- Requests: The guaranteed minimum resource a container needs. Kubernetes schedules containers based on these requests.
- Overcommit Ratio: Limits / Requests. This setting defines the acceptable range for this ratio within the namespace, balancing resource guarantees and preventing over-consumption.

Core Capabilities

- Enhance resource density and application stability within the namespace by setting an appropriate overcommit ratio to manage the balance between resource limits and requests.

Example

> Assuming the namespace overcommit ratio is set to 2, when creating an application and specifies a CPU limit of 4c, the corresponding CPU request value is calculated as:

CPU Request = CPU Limit / Overcommit ratio. Thus, the CPU request becomes 4c / 2 = 2c.

CRD Define

```yaml
# example-namespace-overcommit.yaml
apiVersion: resource.alauda.io/v1
kind: NamespaceResourceRatio
metadata:
  namespace: example
  name: example-namespace-overcommit
spec:
  cpu: 3 # Absence of this field indicates inheritance of the cluster overcommit ratio; 0 means no limitation.
  memory: 4 # Absence of this field indicates inheritance of the cluster overcommit ratio; 0 means no limitation.
status:
  clusterCPU: 2 # Cluster Overcommit Ratio
  clusterMemory: 3
```

Creating overcommit ratio by using CLI

```
kubectl apply -f example-namespace-overcommit.yaml
```

Creating/Updating Overcommit Ratio by using web console

Allows adjusting the **overcommit ratio** for a namespace to manage the ratio between resource limits and requests. This ensures container's resource allocations remain within defined bounds, improving cluster resource utilization.

Precautions

If the cluster uses node virtualization (e.g., virtual nodes), disable oversubscription at the cluster/namespace level before configuring it for virtual machines.

Procedure

1. Enter the **Project Management** and navigation to **Namespaces** > **Namespace** List.
2. Click the target ***Namespace name***.
3. Click **Actions** > **Update Overcommit**.
4. Select the appropriate overcommit ratio **configuration method** to set the CPU or memory overcommit ratio for the namespace.

Parameter	Description
Inherit from Cluster	• Namespace inherits the cluster's oversubscription ratio. • Example: If cluster CPU/memory ratio is 4, namespace defaults to 4. • Container requests = limit / cluster ratio. • If no limit is set, use the namespace's default container quota.
Custom	• Set a namespace-specific ratio (integer > 1). • Example: Cluster ratio = 4, namespace ratio = 2 → requests = limit / 2.

Parameter	Description
	• Leave empty to disable oversubscription for the namespace.

1. Click **Update**.

Note: Changes apply only to newly created Pods. Existing Pods retain their original requests until rebuilt.

Managing Namespace Members

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Importing Members

The platform supports bulk importing members into a namespace and assigning roles such as Namespace Administrator or Developer to grant corresponding permissions.

Constraints and Limitations

- Members can only be imported into the namespace from the **Project Members** of the namespace's project.
- The platform does not support importing default system-created admin users or the active user.

Prerequisites

To import users as namespace members, they must first be added to the namespace's project.

Procedure

1. **Project Management**, click on ***Project Name*** where the members to be imported are located.

2. Navigation to **Namespaces** > **Namespaces**.

3. Click on ***Namespace Name*** of the members to be imported.

4. In the **Namespace Members** tab, click **Import Members**.

5. Follow the procedures below to import all or some users from the list into the namespace.

   TIP

   You can select a user group using the dropdown box at the top right of the dialog and perform a fuzzy search by entering the username in the username search box.

   - Import all users in the list as namespace members and assign roles to users in bulk.

     1. Click the dropdown on the right side of the **Set Role** item at the bottom of the dialog, and select the role name to assign.

     2. Click **Import All**.

   - Import one or more users from the list as namespace members.

     1. Click the checkbox in front of the username/display name to select one or more users.

     2. Click the dropdown on the right side of the **Set Role** item at the bottom of the dialog, and select the role name to assign to the selected users.

     3. Click **Import**.

Adding Members

When the platform has added an OICD type IDP, OIDC users can be added as namespace members.

You can add valid OIDC accounts that meet the input requirements as namespace roles and assign the corresponding namespace roles to the user.

Note: When adding members, the system does not verify the validity of the accounts. Please ensure that the accounts you add are valid; otherwise, these accounts will not be able to log in to the platform successfully.

Valid OIDC accounts include: Valid accounts in the OIDC identity authentication service configured via IDP for the platform, including those that have successfully logged in to the platform and those that have not logged in to the platform.

Prerequisites

The platform has added an **OICD** type IDP.

Procedure

1. **Project Management**, click on ***Project Name*** where the member to be added is located.

2. Navigation to **Namespaces** > **Namespaces**.

3. Click on ***Namespace Name*** of the member to be added.

4. In the **Namespace Members** tab, click **Add Member**.

5. In the **Username** input box, enter a username for an existing third-party platform account supported by the platform.

   Note: Please confirm that the entered username corresponds to an existing account on the third-party platform; otherwise, that account will not be able to log in to this platform successfully.

6. In the **Role** dropdown, select the role name to configure for this user.

7. Click **Add**. After a successful addition, you can view the member in the namespace member list. At the same time, in the user list (**Platform Management > User Management**), you can view that user. Before the user successfully logs in or is synchronized to this platform, the source will be `-`, and it can be deleted; when the account successfully logs in or synchronizes to the platform, the platform will record the account's source information and display it in the user list.

Removing Members

Remove specified namespace members and delete their associated roles to revoke their namespace permissions.

Procedure

1. **Project Management**, click on ***Project Name*** where the member to be removed is located.
2. Navigation to **Namespaces** > **Namespaces**.
3. Click on ***Namespace Name*** of the member to be removed.
4. In the **Namespace Members** tab, click ⋮ on the right side of the record of the member to be removed > **Remove**.
5. Click **Remove**.

Updating Namespaces

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Updating Quotas

> Resource Quota

Updating a Resource Quota by using web console

1. **Project Management**, and navigate to **Namespaces** > **Namespace** List in the left sidebar.
2. Click the target ***namespace name***.
3. Click **Actions** > **Update Quota**.
4. Adjust resource quotas (CPU, Memory, Pods, etc.) and click **Update**.

Updating a Resource Quota by using CLI

> Resource Quota YAML file example

```
# Step 1: Edit the namespace quota
kubectl edit resourcequota <quota-name> -n <namespace-name>

# Step 2: Verify changes
kubectl get resourcequota <quota-name> -n <namespace-name> -o yaml
```

Updating Container LimitRanges

> Limit Range

Updating a LimitRange by using web console

1. **Project Management** view, and navigate to **Namespaces** > **Namespace** List in the left sidebar.
2. Click the target ***namespace name***.
3. Click **Actions** > **Update Container LimitRange**.
4. Adjust container limit range (`defaultRequest` , `default` , `max`) and click **Update**.

Updating a LimitRange by using CLI

> Limit Range YAML file example

```
# Step 1: Edit the LimitRange
kubectl edit limitrange <limitrange-name> -n <namespace-name>

# Step 2: Verify changes
kubectl get limitrange <limitrange-name> -n <namespace-name> -o yaml
```

Updating Pod Security Admission

> Pod Security Admission

Updating a Pod Security Admission by using web console

1. **Project Management** view, and navigate to **Namespaces** > **Namespace** List in the left sidebar.
2. Click the target ***namespace name***.
3. Click **Actions** > **Update Pod Security Admission**.
4. Adjust security standard (`enforce` , `audit` , `warn`) and click **Update**.

Updating a Pod Security Admission by using CLI

> Update Pod Security Admission CLI command

Deleting/Removing Namespaces

You can either delete a namespace permanently or remove it from the current project.

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Deleting Namespaces

Delete Namespace: Permanently deletes a namespace and all resources within it (e.g., Pods, Services, ConfigMaps). This action cannot be undone and releases allocated resource quotas.

```
kubectl delete namespace <namespace-name>
```

Removing Namespaces

Remove Namespace: Removing a namespace from the current project without deleting its resources. The namespace remains in the cluster and can be imported into other projects via Import Namespace.

NOTE

- This feature is exclusive to the Alauda Container Platform .
- Kubernetes does not natively support "removing" namespaces from projects.

```
kubectl label namespace <namespace-name> cpaas.io/project- --overwrite
```

Creating Applications

Creating applications from Image

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Prerequisites

Obtain the image address. The source of the images can be from the image repository integrated by the platform administrator through the toolchain or from third-party platforms' image repositories.

- For the former, the Administrator typically assigns the image repository to your project, and you can use the images within it. If the required image repository is not found, please contact the Administrator for allocation.

- If it is a third-party platform's image repository, ensure that images can be pulled directly from it in the current cluster.

Procedure 1 - Workloads

1. **Container Platform**, navigate to **Applications** > **Applications** in the left sidebar.
2. Click **Create**.
3. Choose **Create from Image** as the creation approach.
4. **Select** or **Input** an image, and click **Confirm**.

> **INFO**
>
> **Note**: When using images from the image repository integrated into web console, you can filter images by **Already Integrated**. The **Integration Project Name**, for example, images (docker-registry-projectname), which includes the project name projectname in this web console and the project name containers in the image repository.

1. Refer to the following instructions to configure the related parameters.

Workload 1 - Configure Basic Info

In the **Workload** > **Basic Info** section, configure declarative parameters for workloads

Parameters	Description
Model	Select a workload as needed: • **Deployment**: For detailed parameter descriptions, please refer to Creating Deployment. • **DaemonSet**: For detailed parameter descriptions, please refer to Creating DaemonSet. • **StatefulSet**: For detailed parameter descriptions, please refer to Creating StatefulSet.
Replicas	Defines the desired number of Pod replicas in the Deployment (default: `1`). Adjust based on workload requirements.
More > **Update Strategy**	Configures the `rollingUpdate` strategy for zero-downtime deployments: **Max surge** (`maxSurge`): • Maximum number of Pods that can exceed the desired replica count during an update. • Accepts absolute values (e.g., `2`) or percentages (e.g., `20%`). • Percentage calculation: `ceil(current_replicas × percentage)`. • Example: 4.1 → `5` when calculated from 10 replicas. **Max unavailable** (`maxUnavailable`): • Maximum number of Pods that can be temporarily unavailable during an update. • Percentage values cannot exceed `100%`. • Percentage calculation: `floor(current_replicas × percentage)`. • Example: 4.9 → `4` when calculated from 10 replicas. **Notes**: 1. **Default values**: `maxSurge=1`, `maxUnavailable=1` if not explicitly set. 2. **Non-running Pods** (e.g., in `Pending`/`CrashLoopBackOff` states)

Parameters	Description
	are considered unavailable. 3. **Simultaneous constraints**: • `maxSurge` and `maxUnavailable` cannot both be `0` or `0%`. • If percentage values resolve to `0` for both parameters, Kubernetes forces `maxUnavailable=1` to ensure update progress. **Example**: For a Deployment with 10 replicas: • `maxSurge=2` → Total Pods during update: `10 + 2 = 12`. • `maxUnavailable=3` → Minimum available Pods: `10 - 3 = 7`. • This ensures availability while allowing controlled rollout.

Workload 2 - Configure Pod

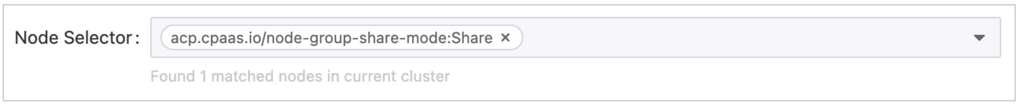
Note: In mixed-architecture clusters deploying single-architecture images, ensure proper Node Affinity Rules are configured for Pod scheduling.

1. **Pod** section, configure container runtime parameters and lifecycle management:

Parameters	Description
Volumes	Mount persistent volumes to containers. Supported volume types include `PVC`, `ConfigMap`, `Secret`, `emptyDir`, `hostPath`, and so on. For implementation details, see Storage Volume Mounting Instructions.
Image Credential	Required **only** when pulling images from third-party registries (via manual image URL input). **Note**: Images from the platform's integrated registry automatically inherit associated secrets.
More > **Close Grace Period**	Duration (default: `30s`) allowed for a Pod to complete graceful shutdown after receiving termination signal. - During this period, the Pod completes inflight requests and

Parameters	Description
	releases resources. - Setting `0` forces immediate deletion (SIGKILL), which may cause request interruptions.

1. **Node Affinity Rules**

Parameters	Description
More > Node Selector	Constrain Pods to nodes with specific labels (e.g., `kubernetes.io/os: linux`).  Node Selector: acp.cpaas.io/node-group-share-mode:Share × Found 1 matched nodes in current cluster
More > Affinity	Define fine-grained scheduling rules based on existing Pods. **Pod Affinity Types**: • **Inter-Pod Affinity**: Schedule new Pods to nodes hosting specific Pods (same topology domain). • **Inter-Pod Anti-affinity**: Prevent co-location of new Pods with specific Pods. **Enforcement Modes**: • **RequiredDuringSchedulingIgnoredDuringExecution**: Pods are scheduled *only* if rules are satisfied. • **PreferredDuringSchedulingIgnoredDuringExecution**: Prioritize nodes meeting rules, but allow exceptions. **Configuration Fields**: • `topologyKey`: Node label defining topology domains (default: `kubernetes.io/hostname`). • `labelSelector`: Filters target Pods using label queries.

1. **Network Configuration**

- Kube-OVN

Parameters	Description
Bandwidth Limits	Enforce QoS for Pod network traffic: • **Egress rate limit**: Maximum outbound traffic rate (e.g., `10Mbps`). • **Ingress rate limit**: Maximum inbound traffic rate.
Subnet	Assign IPs from a predefined subnet pool. If unspecified, uses the namespace's default subnet.
Static IP Address	Bind persistent IP addresses to Pods: • Multiple Pods across Deployments can claim the same IP, but only one Pod can use it concurrently. • **Critical**: Number of static IPs must ≥ Pod replica count.

- Calico

Parameters	Description
Static IP Address	Assign fixed IPs with strict uniqueness: • Each IP can be bound to **only one Pod** in the cluster. • **Critical**: Static IP count must ≥ Pod replica count.

Workload 3 - Configure Containers

1. **Container** section, refer to the following instructions to configure the relevant information.

Parameters	Description
Resource Requests & Limits	• **Requests**: Minimum CPU/memory required for container operation. • **Limits**: Maximum CPU/memory allowed during container execution. For unit definitions, see Resource Units. **Namespace overcommit ratio**: • **Without overcommit ratio**: If namespace resource quotas exist: Container requests/limits inherit namespace defaults (modifiable). No namespace quotas: No defaults; custom Request. • **With overcommit ratio**: Requests auto-calculated as `Limits / Overcommit ratio` (immutable). **Constraints**: • Request ≤ Limit ≤ Namespace quota maximum. • Overcommit ratio changes require pod recreation to take effect. • Overcommit ratio disables manual request configuration. • No namespace quotas → no container resource constraints.
Extended Resources	Configure cluster-available extended resources (e.g., vGPU, pGPU).
Volume Mount	Persistent storage configuration. See Storage Volume Mounting Instructions. **Operations**: • Existing pod volumes: Click **Add** • No pod volumes: Click **Add & Mount** **Parameters**:

Parameters	Description
	• `mountPath`: Container filesystem path (e.g., `/data`) • `subPath`: Relative file/directory path within volume. For `ConfigMap` / `Secret`: Select specific key • `readOnly`: Mount as read-only (default: read-write) See Kubernetes Volumes ↗.
Port	Expose container ports. **Example**: Expose TCP port `6379` with name `redis`. **Fields**: • `protocol`: TCP/UDP • `Port`: Exposed port (e.g., `6379`) • `name`: DNS-compliant identifier (e.g., `redis`)
Startup Commands & Arguments	Override default ENTRYPOINT/CMD: **Example 1**: Execute `top -b` - **Command**: `["top", "-b"]` - **OR** Command: `["top"]`, Args: `["-b"]` **Example 2**: Output `$MESSAGE`: `/bin/sh -c "while true; do echo $(MESSAGE); sleep 10; done"` See Defining Commands ↗.
More > **Environment Variables**	• Static values: Direct key-value pairs • Dynamic values: Reference ConfigMap/Secret keys, pod fields (`fieldRef`), resource metrics (`resourceFieldRef`) **Note**: Env variables override image/configuration file settings.
More > **Referenced ConfigMap**	Inject entire ConfigMap/Secret as env variables. Supported Secret types: `Opaque`, `kubernetes.io/basic-auth`.
More > **Health Checks**	• **Liveness Probe**: Detect container health (restart if failing)

Parameters	Description
	• **Readiness Probe**: Detect service availability (remove from endpoints if failing) See Health Check Parameters.
More > **Log File**	Configure log paths: - Default: Collect `stdout` - File patterns: e.g., `/var/log/*.log` **Requirements**: • Storage driver `overlay2`: Supported by default • `devicemapper`: Manually mount EmptyDir to log directory • Windows nodes: Ensure parent directory is mounted (e.g., `c:/a` for `c:/a/b/c/*.log`)
More > **Exclude Log File**	Exclude specific logs from collection (e.g., `/var/log/aaa.log`).
More > **Execute before Stopping**	Execute commands before container termination. **Example**: `echo "stop"` **Note**: Command execution time must be shorter than pod's `terminationGracePeriodSeconds`.

2. Click **Add Container** (upper right) OR **Add Init Container**.

   See Init Containers ↗. Init Container:

   1.1. Start before app containers (sequential execution).

   1.2. Release resources after completion.

   1.3. Deletion allowed when:

   - Pod has >1 app container AND ≥1 init container.
   - Not allowed for single-app-container pods.

3. Click **Create**.

Procedure 2 - Services

Parameters	Description
Service	Kubernetes **Service**, expose an application running in your cluster behind a single outward-facing endpoint, even when the workload is split across multiple backends.. For specific parameter explanations, please refer to Creating Services. **Note** The default name prefix for the internal routing created under the application is the name of the compute component. If the compute component type (deployment mode) is StatefulSet, it is advisable not to change the default name of the internal routing (the name of the workload); otherwise, it may lead to accessibility issues for the workload.

Procedure 3 - Ingress

Parameters	Description
Ingress	Kubernetes **Ingress**, make your HTTP (or HTTPS) network service available using a protocol-aware configuration mechanism, that understands web concepts like URIs, hostnames, paths, and more. The Ingress concept lets you map traffic to different backends based on rules you define via the Kubernetes API. For detailed parameter descriptions, please refer to Creating Ingresses. **Note**: The **Service** used when creating **Ingress** under the application must be resources created under the current application. However, ensure that the **Service** is associated with the workload under the application; otherwise, service discovery and access for workload will fail.

1. Click **Create**.

Application Management Operations

To modify application configurations, use one of the following methods:

1. Click the vertical ellipsis (⋮) on the right side of the application list.
2. Select **Actions** from the upper-right corner of the application details page.

Operation	Description
Update	<ul><li>**Update**: Modifies only the target workload using its defined update strategy (Deployment strategy shown as example). Preserves existing replica count and rollout configuration.</li><li>**Force Update**: Triggers full application rollout using each component's update strategy. 1. **Use cases**:<ul><li>Batch configuration changes requiring immediate cluster-wide propagation (e.g., ConfigMap/Secret updates referenced as environment variables).</li><li>Coordinated component restarts for critical security.</li></ul>2. **Warning Caution**:<ul><li>May cause temporary service degradation during mass restarts.</li><li>Not recommended for production environments without business continuity validation.</li></ul></li><li>**Network Implications**:<ul><li>Ingress Rule Deletion: External access remains available via `LB_IP:NodePort` if: 1) LoadBalancer Service uses default ports. 2) Surviving routing rules reference application components. Full external access termination requires Service deletion.</li></ul></li></ul>

Operation	Description
	• Service Deletion: Irreversible loss of network connectivity to application components. Associated Ingress rules become non-functional despite API object persistence.
Delete	• **Cascading Deletion**: 1. Removes all child resources including Deployments, Services, and Ingress rules. 2. Persistent Volume Claims (PVCs) follow retention policy defined in StorageClass • **Pre-deletion Checklist**: 1. Verify no active traffic through associated Services. 2. Confirm data backup completion for stateful components. 3. Check dependent resource relationships using `kubectl describe ownerReferences`.

Reference Information

Storage Volume Mounting Instructions

Type	Purpose
Persistent Volume Claim	Binds an existing PVC to request persistent storage. **Note**: Only bound PVCs (with associated PV) are selectable. Unbound PVCs will cause pod creation failures.
ConfigMap	Mounts full/partial ConfigMap data as files: • Full ConfigMap: Creates files named after keys under mount path • Subpath selection: Mount specific key (e.g., `my.cnf`)

Type	Purpose
Secret	Mounts full/partial Secret data as files: • Full Secret: Creates files named after keys under mount path • Subpath selection: Mount specific key (e.g., `tls.crt`)
Ephemeral Volumes	Cluster-provisioned temporary volume with features: • Dynamic provisioning • Lifecycle tied to pod • Supports declarative configuration **Use Case**: Temporary data storage. See Ephemeral Volumes
Empty Directory	Ephemeral storage sharing between containers in same pod: - Created on node when pod starts - Deleted with pod removal **Use Case**: Inter-container file sharing, temporary data storage. See EmptyDir
Host Path	Mounts host machine directory (must start with `/`, e.g., `/volumepath`).

Health Check Parameters

Common Parameters

Parameters	Description
Initial Delay	Grace period (seconds) before starting probes. Default: `300`.
Period	Probe interval (1-120s). Default: `60`.
Timeout	Probe timeout duration (1-300s). Default: `30`.

Parameters	Description
Success Threshold	Minimum consecutive successes to mark healthy. Default: `0`.
Failure Threshold	Maximum consecutive failures to trigger action: - `0`: Disables failure-based actions - Default: `5` failures → container restart.

Protocol-Specific Parameters

Parameter	Applicable Protocols	Description
Protocol	HTTP/HTTPS	Health check protocol
Port	HTTP/HTTPS/TCP	Target container port for probing.
Path	HTTP/HTTPS	Endpoint path (e.g., `/healthz`).
HTTP Headers	HTTP/HTTPS	Custom headers (Add key-value pairs).
Command	EXEC	Container-executable check command (e.g., `sh -c "curl -I localhost:8080 | grep OK"`). **Note**: Escape special characters and test command viability.

Creating applications from Chart

Based on Helm Chart represents a native application deployment pattern. A Helm Chart is a collection of files that define Kubernetes resources, designed to package applications and facilitate application distribution with version control capabilities. This enables seamless environment transitions, such as migrations from development to production environments.

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Precautions

When a cluster contains both Linux and Windows nodes, explicit node selection MUST be configured to prevent scheduling conflicts. Example:

```
spec:
    spec:
      nodeSelector:
        kubernetes.io/os: linux
```

Prerequisites

If the template is from a application and references relevant resources (e.g., secret dictionaries), ensure the to-be-referenced resources already exist in the current namespace before application deployment.

Procedure

1. **Container Platform**, navigate to **Applications** > **Applications** in the left sidebar.
2. Click **Create**.
3. Choose **Create from Catalog** as the creation approach.
4. Select a Chart and configure parameters, pick a Chart and configure the required parameters, such as `resources.requests` , `resources.limits` , and other parameters that are closely related to the chart.
5. Click **Create**.

The web console will redirect you to the **Application** > [**Native Applications**] details page. The process will take some time, so please be patient. In case of operation failure, follow the interface prompts to complete the operation.

Status Analysis Reference

Click on ***Application Name*** to display detailed status analysis of the Chart in the details information.

Type	Reason
Initialized	Indicates the status of Chart template download. • **True**: It indicates that the Chart template has been successfully downloaded. • **False**: It indicates that the Chart template download has failed; you can check the specific failure reason in the message column.

Type	Reason
	• `ChartLoadFailed` : Chart template download failed. • `InitializeFailed` : There was an exception in the initialization process before the Chart was downloaded.
Validated	Indicates the status of user permissions, dependencies, and other validations for the Chart template. • **True**: It indicates that all validation checks have passed. • **False**: It indicates that there are validation checks that have not passed; you can check the specific failure reason in the message column. • `DependenciesCheckFailed` : Chart dependency check failed. • `PermissionCheckFailed` : The current user lacks permission to perform operations on certain resources. • `ConsistentNamespaceCheckFailed` : When deploying applications through templates in native applications, the Chart contains resources that require cross-namespace deployment.
Synced	Indicates the deployment status of the Chart template. • **True**: It indicates that the Chart template has been successfully deployed. • **False**: It indicates that the Chart template deployment has failed; the reason column shows `ChartSyncFailed` , and you can check the specific failure reason in the message column.

WARNING

- If the template references cross - namespace resources, contact the Administrator for help with creation. Afterward, you can normally Updating and deleting Chart Applications on web console.

- If the template references cluster - level resources (e.g., StorageClasses), it's recommended to contact the Administrator for assistance with creation.

Creating applications from YAML

If you are proficient in YAML syntax and prefer to define configurations outside of forms or pre-defined templates, you can choose the one-click YAML creation method. This approach offers more flexible configuration of basic information and resources for your cloud-native application.

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Precautions

When both Linux and Windows nodes exist in the cluster, to prevent scheduling the application on incompatible nodes, you must configure node selection. For example:

```yaml
spec:
    spec:
      nodeSelector:
        kubernetes.io/os: linux
```

Prerequisites

Ensure the images defined in the YAML can be pulled within the current cluster. You can verify this using the `docker pull` command.

Procedure

1. **Container Platform**, and navigate to **Application** > **Applications**.
2. Click **Create**.
3. Select the **Create from YAML**.
4. Complete the configuration and click **Create**.
5. The corresponding **Deployment** can be viewed on the Details page.

```yaml
# webapp-deployment.yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webapp
  labels:
    app: webapp
    env: prod
spec:
  replicas: 3
  selector:
    matchLabels:
      app: webapp
  template:
    metadata:
      labels:
        app: webapp
        tier: frontend
    spec:
      containers:
      - name: webapp
        image: nginx:1.25-alpine
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: "100m"
            memory: "128Mi"
          limits:
            cpu: "250m"
            memory: "256Mi"
---
# webapp-service.yaml
apiVersion: v1
kind: Service
metadata:
  name: webapp-service
spec:
  selector:
    app: webapp
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
  type: ClusterIP
```

Creating applications from Code

Creating application from code is implemented using Source to Image(S2I) technology. S2I is an automated framework for building container images directly from source code. This approach standardizes and automates the application build process, allowing developers to focus on source code development without worrying about containerization details.

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Prerequisites

- Complete the installation of Alauda Container Platform Builds

Procedure

1. **Container Platform**, and navigate to **Application** > **Applications**.
2. Click **Create**.
3. Select the **Create from Code**.
4. For detailed parameter descriptions, please refer to Managing applications created from Code

5. After completing the parameter input, click **Create**.

6. The corresponding deployment can be viewed on the **Detail Information** page.

Creating applications from Operator Backed

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UnderStanding Operator Backed Application

An **Operator** is an extension mechanism built upon Kubernetes Custom Controllers and Custom Resource Definitions (CRDs), designed to automate the complete lifecycle management of complex applications. Within Alauda Container Platform, an Operator Backed Application refers to an application instance provisioned through pre-integrated or user-defined Operators, with its operational workflows managed by the Operator Lifecycle Manager (OLM). This encompasses critical processes such as installation, upgrades, dependency resolution, and access control.

Core Capabilities

1. **Automation of Complex Operations**: Operators overcome the inherent limitations of native Kubernetes resources (e.g., Deployment, StatefulSet) to address the complexities of managing stateful applications, including distributed coordination, persistent storage, and versioned rolling updates. Example: Operator-encoded logic enables autonomous operations for database cluster failover, cross-node data consistency, and backup recovery.

2. **Declarative, State-Driven Architecture**: Operators utilize YAML-based declarative APIs to define desired application states (e.g., spec.replicas: 5). Operators continuously reconcile the actual state with the declared state, providing self-healing capabilities. Deep integration with GitOps tools (e.g., Argo CD) ensures consistent environment configurations.

3. **Intelligent Lifecycle Management**:

   - Rolling Updates & Rollback: OLM's Subscription object subscribes to update channels (e.g., stable, alpha), triggering automated version iterations for both Operators and their managed applications.

   - Dependency Resolution: Operators dynamically identify runtime dependencies (e.g., specific storage drivers, CNI plugins) to ensure successful deployment.

4. **Standardized Ecosystem Integration**: OLM standardizes Operator packaging (Bundle) and distribution channels, enabling one-click deployment of production-grade applications (e.g., Etcd) from OperatorHub or private registries. Enterprise Enhancements: Alauda Container Platform extends RBAC policies and multi-cluster distribution capabilities to meet enterprise compliance requirements.

Operator Backed Application CRD

This Operator is designed and implemented by fully embracing open-source community standards and solutions. Its Custom Resource Definition (CRD) design thoughtfully incorporates established best practices and architectural patterns prevalent within the Kubernetes ecosystem. CRD design reference materials:

1. CatalogSource ↗: Defines the source of Operator packages available to the cluster, such as OperatorHub or custom Operator repositories.

2. ClusterServiceVersion (CSV) ↗: The core metadata definition for an Operator, containing its name, version, provided APIs, required permissions, installation strategy, and detailed lifecycle management information.

3. InstallPlan ↗: The actual execution plan for installing an Operator, automatically generated by OLM based on the Subscription and CSV, detailing the specific steps to create the Operator and its dependent resources.

4. OperatorGroup ↗: Defines a set of target namespaces where an Operator will provide its services and reconcile resources, while also limiting the scope of the Operator's RBAC

permissions.

5. Subscription ↗: Used to declare the specific Operator that a user wants to install and track in the cluster, including the Operator's name, target channel (e.g., stable, alpha), and update strategy. OLM uses the Subscription to create and manage the Operator's installation and upgrades.

Creating a Operator Backed Application by using web console

1. **Container Platform**, navigate to **Applications** > **Applications** in the left sidebar.
2. Click **Create**.
3. Choose **Create from Catalog** as the creation approach.
4. Select an Operator-Backed Instance and Configure **Custom Resource Parameters**. Select an Operator-managed application instance and configure its Custom Resource (CR) specifications in the CR manifest, including:
   - `spec.resources.limits` (container-level resource constraints).
   - `spec.resourceQuota` (Operator-defined quota policies). Other CR-specific parameters such as `spec.replicas`, `spec.storage.className`, etc.
5. Click **Create**.

The web console will navigate to **Applications** > **Operator Backed Apps** page.

INFO

Note: The Kubernetes resource creation process requires asynchronous reconciliation. Completion may take several minutes depending on cluster conditions.

Troubleshooting

If resource creation fails:

1. Inspect controller reconciliation errors:

```
kubectl get events --field-selector involvedObject.kind=<Your-Custom-Resource> --sort-by=.metadata.creationTimestamp
```

2. Verify API resource availability:

```
kubectl api-resources | grep <Your-Resource-Type>
```

3. Retry creation after verifying CRD/Operator readiness:

```
kubectl apply -f your-resource-manifest.yaml
```

Creating applications by using CLI

`kubectl` is the primary command-line interface (CLI) for interacting with Kubernetes clusters. It functions as a client for the Kubernetes API Server - a RESTful HTTP API that serves as the control plane's programmatic interface. All Kubernetes operations are exposed through API endpoints, and `kubectl` essentially translates CLI commands into corresponding API requests to manage cluster resources and application workloads (Deployments, StatefulSets, etc.).

The CLI tools facilitates application deployment by intelligently interpreting input artifacts (images, or Chart, etc.) and generating corresponding Kubernetes API objects. The generated resources vary based on input types:

- **Image**: Directly creates Deployment.
- **Chart**: Instantiates all objects defined in the Helm Chart.

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Prerequisites

The **Alauda Container Platform Web Terminal** plugin is installed, and the web-cli switch is enabled.

Procedure

1. **Contianer Platform**, click the terminal icon in the lower-right corner.

2. Wait for session initialization (1-3 sec).

3. Execute kubectl commands in the interactive shell:

   ```
   kubectl get pods -n ${CURRENT_NAMESPACE}
   ```

4. View real-time command output

Example

YAML

```yaml
# webapp.yaml
apiVersion: app.k8s.io/v1beta1
kind: Application
metadata:
  name: webapp
spec:
  componentKinds:
    - group: apps
      kind: Deployment
    - group: ""
      kind: Service
  descriptor: {}

# webapp-deployment.yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webapp
  labels:
    app: webapp
    env: prod
spec:
  replicas: 3
  selector:
    matchLabels:
      app: webapp
  template:
    metadata:
      labels:
        app: webapp
        tier: frontend
    spec:
      containers:
      - name: webapp
        image: nginx:1.25-alpine
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: "100m"
            memory: "128Mi"
          limits:
            cpu: "250m"
            memory: "256Mi"
---
# webapp-service.yaml
apiVersion: v1
kind: Service
metadata:
  name: webapp-service
spec:
  selector:
    app: webapp
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
  type: ClusterIP
```

kubectl commands

```
kubectl apply -f webapp.yaml -n {CURRENT_NAMESPACE}
kubectl apply -f webapp-deployment.yaml -n {CURRENT_NAMESPACE}
kubectl apply -f webapp-service.yaml -n {CURRENT_NAMESPACE}
```

Reference

- **Conceptual Guide**: kubectl Overview
- **Syntax Reference**: kubectl Cheat Sheet
- **Command Manual**: kubectl Commands

Operation and Maintaining Applications

Application Rollout

Status Description

KEDA(Kubernetes Event-driven Autoscaling)

Configuring HPA

Starting and Stopping Applications

Configuring VerticalPodAutoscaler (VPA)

Configuring CronHPA

Updating Applications

Exporting Applications

Updating and deleting Chart Applications

Version Management for Applications

Deleting Applications

Health Checks

Menu

Application Rollout

Installing Alauda Container Platform Argo Rollouts

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Prerequisites

1. **Download** the **Alauda Container Platform Argo Rollouts** cluster plugin installation package corresponding to your platform architecture.
2. **Upload** the installation package using the Upload Packages mechanism.
3. **Install** the installation package to the cluster using the cluster plugins mechanism.

INFO

Upload Packages: **Administrator** > **Marketplace** > **Upload Packages** page. Click **Help Document** on the right to get instructions on how to publish the cluster plugin to cluster. For more details, please refer to CLI.

Installing Alauda Container Platform Argo Rollouts

Procedure

1. Click **Marketplace** > **Cluster Plugins** to enter the **Cluster Plugins** list page.
2. Find the **Alauda Container Platform Argo Rollouts** cluster plugin, click **Install**, and navigate to the **Install Alauda Container Platform Argo Rollouts Plugin** page.
3. Simply click **Install** to complete the **Alauda Container Platform Argo Rollouts** cluster plugin installation.

Application Blue Green Deployment

In the modern world of software development, deploying new versions of applications is a crucial part of the development cycle. However, rolling out updates to production environments can be a risky proposition, as even small issues can result in significant downtime and lost revenue. Blue-Green Deployments are a deployment strategy that mitigates this risk by ensuring that new versions of applications can be deployed with zero downtime.

A Blue-Green Deployment is a deployment strategy where two identical environments, the “blue” environment and the “green” environment, are set up. The blue environment is the production environment, where the live version of the application is currently running, and the green environment is the non-production environment, where new versions of the application are deployed.

When a new version of the application is ready to be deployed, it is deployed to the green environment. Once the new version is deployed and tested, traffic is switched to the green environment, making it the new production environment. The blue environment then becomes the non-production environment, where future versions of the application can be deployed.

Benefits of Blue Green Deployments

- Zero Downtime: Blue-Green Deployments allow new versions of applications to be deployed with zero downtime, as traffic is switched from the blue environment to the green environment seamlessly.
- Easy Rollback: If a new version of the application has issues, rolling back to the previous version is easy, as the blue environment is still available.
- Reduced Risk: By using Blue-Green Deployments, the risk of deploying new versions of applications is reduced significantly. This is because the new version can be deployed and tested in the green environment before traffic is switched over from the blue environment. This allows for thorough testing and reduces the chance of issues arising in production.

- Increased Reliability: By using Blue-Green Deployments, the reliability of the application is increased. This is because the blue environment is always available, and any issues with the green environment can be quickly identified and resolved without affecting users.
- Flexibility: Blue-Green Deployments provide flexibility in the deployment process. Multiple versions of an application can be deployed side-by-side, allowing for easy testing and experimentation.

Blue Green Deployment with Argo Rollouts

Argo Rollouts is a Kubernetes controller and set of CRDs which provide advanced deployment capabilities such as blue-green, canary, canary analysis, experimentation, and progressive delivery features to Kubernetes.

Argo Rollouts (optionally) integrates with ingress controllers and service meshes, leveraging their traffic shaping abilities to gradually shift traffic to the new version during an update. Additionally, Rollouts can query and interpret metrics from various providers to verify key KPIs and drive automated promotion or rollback during an update.

With Argo Rollouts, you can automate blue green deployments on Alauda Container Platform (ACP) clusters. The typical process includes:

1. Defining Rollout resources to manage different application versions.
2. Configuring Kubernetes services to route traffic between blue (current) and green (new) environments.
3. Deploying the new version to the green environment.
4. Verifying and testing the new version.
5. Promoting the green environment to production by switching traffic.

This approach minimizes downtime and enables controlled, safe deployments.

> **Key Concepts:**
>
> - **Rollout**: A custom resource definition (CRD) in Kubernetes that replaces standard Deployment resources, enabling advanced deployment control such as blue-green, canary deployment.

TOC

Prerequisites

1. ACP (Alauda Container Platform).
2. Kubernetes Cluster managed by ACP.
3. Argo Rollouts installed in the cluster.
4. Argo Rollouts kubectl plugin.
5. A project to create a namespace in it.
6. A namespace in the cluster where the application will be deployed.

Procedure

1 Creating the Deployment

Start by defining the "blue" version of your application. This is the current version that users will access. Create a Kubernetes deployment with the appropriate number of replicas, container image version (e.g., `hello:1.23.1`), and proper labels such as `app=web`.

Use the following YAML:

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: web
spec:
  replicas: 2
  selector:
    matchLabels:
      app: web
  template:
    metadata:
      labels:
        app: web
    spec:
      containers:
        - name: web
          image: hello:1.23.1
          ports:
            - containerPort: 80
```

Explanation of YAML fields:

- `apiVersion` : The version of the Kubernetes API used to create the resource.
- `kind` : Specifies that this is a Deployment resource.
- `metadata.name` : The name of the deployment.
- `spec.replicas` : Number of desired pod replicas.
- `spec.selector.matchLabels` : Defines how the Deployment finds which pods to manage.
- `template.metadata.labels` : Labels applied to pods, used by Services to select them.
- `spec.containers` : The containers to run in each pod.
- `containers.name` : Name of the container.
- `containers.image` : Docker image to run.

- `containers.ports.containerPort` : Port exposed by the container.

Apply the configuration using `kubectl` :

```
kubectl apply -f deployment.yaml
```

This sets up the production environment.

Alternative, you could use helm chart to create the deployments and services.

2 Creating the Blue Service

Create a Kubernetes `Service` that exposes the blue deployment. This service will forward traffic to the blue pods based on matching labels. Initially, the service selector targets pods labeled with `app=web` .

```yaml
apiVersion: v1
kind: Service
metadata:
  name: web
spec:
  selector:
    app: web
  ports:
  - protocol: TCP
    port: 80
    targetPort: 80
```

Explanation of YAML fields:

- `apiVersion` : The version of the Kubernetes API used to create the Service.
- `kind` : Specifies this resource is a Service.
- `metadata.name` : Name of the Service.
- `spec.selector` : Identifies pods to route traffic to, based on labels.
- `ports.protocol` : The protocol used (TCP).
- `ports.port` : Port exposed by the Service.
- `ports.targetPort` : The port on the container to which the traffic is directed.

Apply it using:

```
kubectl apply -f web-service.yaml
```

This allows external access to the blue deployment.

3 Verify the Blue Deployment

Confirm that the `blue` deployment is running correctly by listing the pods:

```
kubectl get pods -l app=web
```

Check that all expected replicas (2) are in the `Running` state. This ensures the application is ready to serve traffic.

4 Verify Traffic Routing to Blue

Ensure that the `web` service is correctly forwarding traffic to the blue deployment. Use this command:

```
kubectl describe service web | grep Endpoints
```

The output should list the IP addresses of the blue pods. These are the endpoints receiving traffic.

5 Creating the Rollout

Next, creating the `Rollout` resource from Argo Rollouts with `BlueGreen` strategy.

```yaml
apiVersion: argoproj.io/v1alpha1
kind: Rollout
metadata:
  name: rollout-bluegreen
spec:
  replicas: 2
  revisionHistoryLimit: 2
  selector:
    matchLabels:
      app: web
  workloadRef:
    apiVersion: apps/v1
    kind: Deployment
    name: web
    scaleDown: onsuccess
  strategy:
    blueGreen:
      activeService: web
      autoPromotionEnabled: false
```

Explanation of YAML fields:

- `spec.selector`: Label selector for pods. Existing ReplicaSets whose pods are selected by this will be the ones affected by this rollout. It must match the pod template's labels.
- `workloadRef`: Specify the workload reference and scale down strategy to apply the rollouts.
  - `scaleDown`: Specifies if the workload (Deployment) is scaled down after migrating to Rollout. The possible options are:
    - "never": the Deployment is not scaled down.
    - "onsuccess": the Deployment is scaled down after the Rollout becomes healthy.
    - "progressively": as the Rollout is scaled up the Deployment is scaled down. If the Rollout fails the Deployment will be scaled back up.
- `strategy`: The rollout strategy, support `BlueGreen` and `Canary` strategy.
  - `blueGreen`: The `BlueGreen` rollout strategy definition.

- `activeService` : Specifies the service to update with the new template hash at time of promotion. This field is mandatory for the blueGreen update strategy.
- `autoPromotionEnabled` : autoPromotionEnabled disables automated promotion of the new stack by pausing the rollout immediately before the promotion. If omitted, the default behavior is to promote the new stack as soon as the ReplicaSet are completely ready/available. Rollouts can be resumed using: `kubectl argo rollouts promote ROLLOUT`

Apply it with:

```
kubectl apply -f rollout.yaml
```

This sets up the rollouts for the deployment with `BlueGreen` strategy.

6 Verify the Rollouts

After the `Rollout` was created, the Argo Rollouts will create a new ReplicaSet with same template of the deployment. While the pods of new ReplicaSet is healthy, the deployment is scaled down to 0.

Use the following command to ensure the pods are running properly:

```
kubectl argo rollouts get rollout rollout-bluegreen
Name:            rollout-bluegreen
Namespace:       default
Status:          ✔ Healthy
Strategy:        BlueGreen
Images:          hello:1.23.1 (stable, active)
Replicas:
  Desired:       2
  Current:       2
  Updated:       2
  Ready:         2
  Available:     2

NAME                                            KIND        STATUS     AGE  INFO
⟳ rollout-bluegreen                              Rollout     ✔ Healthy  95s
└──# revision:1
   └──⧉ rollout-bluegreen-595d4567cc           ReplicaSet  ✔ Healthy  18s
stable,active
      ├──□ rollout-bluegreen-595d4567cc-mc769  Pod         ✔ Running  8s
ready:1/1
      └──□ rollout-bluegreen-595d4567cc-zdc5x  Pod         ✔ Running  8s
ready:1/1
```

The service `web` will forward traffic to the pods created by rollouts. Use this command:

```
kubectl describe service web | grep Endpoints
```

7 Preparing Green Deployment

Next, prepare the new version of the application as the green deployment. Update the deployment `web` with the new image version (e.g., `hello:1.23.2`).

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: web
spec:
  replicas: 2
  selector:
    matchLabels:
      app: web
  template:
    metadata:
      labels:
        app: web
    spec:
      containers:
        - name: web
          image: hello:1.23.2
          ports:
            - containerPort: 80
```

Explanation of YAML fields:

- Identical to the original deployment, with the exception of:
  - `containers.image`: Updated to new image version.

Apply it with:

```
kubectl apply -f deployment.yaml
```

This sets up the new application version for testing.

The rollouts will create a new Replicaset to manage the green pods, and the traffic still forward to the blue pods. Use the following command to verify:

```
kubectl argo rollouts get rollout rollout-bluegreen
Name:            rollout-bluegreen
Namespace:       default
Status:          ॥ Paused
Message:         BlueGreenPause
Strategy:        BlueGreen
Images:          hello:1.23.1 (stable, active)
                 hello:1.23.2
Replicas:
  Desired:       2
  Current:       4
  Updated:       2
  Ready:         2
  Available:     2

NAME                                            KIND        STATUS     AGE  INFO
⟳ rollout-bluegreen                              Rollout     ॥ Paused   14m
├──# revision:2
│  └──⧉ rollout-bluegreen-776b688d57           ReplicaSet  ✔ Healthy  24s
│     ├──□ rollout-bluegreen-776b688d57-kxr66  Pod         ✔ Running  23s
ready:1/1
│     └──□ rollout-bluegreen-776b688d57-vv7t7  Pod         ✔ Running  23s
ready:1/1
└──# revision:1
   └──⧉ rollout-bluegreen-595d4567cc           ReplicaSet  ✔ Healthy  12m
stable,active
      ├──□ rollout-bluegreen-595d4567cc-mc769  Pod         ✔ Running  12m
ready:1/1
      └──□ rollout-bluegreen-595d4567cc-zdc5x  Pod         ✔ Running  12m
ready:1/1
```

Currently, there are 4 pods running, with blue and green version. And the active service is the blue version, the rollout process is paused.

If you use helm chart to deploy the application, use helm tool to upgrade the application to the green version.

8 Promoting the Rollout to Green

When the green version is ready, promote the rollout to switch traffic to the green pods. Use the following command:

```
kubectl argo rollouts promote rollout-bluegreen
```

To Verify if the rollout is completed:

```
kubectl argo rollouts get rollout rollout-bluegreen
Name:            rollout-bluegreen
Namespace:       default
Status:          ✔ Healthy
Strategy:        BlueGreen
Images:          hello:1.23.2 (stable, active)
Replicas:
  Desired:       2
  Current:       2
  Updated:       2
  Ready:         2
  Available:     2

NAME                                           KIND        STATUS         AGE
INFO
⟳ rollout-bluegreen                             Rollout     ✔ Healthy      3h2m
 ├──# revision:2
 │  └──⧉ rollout-bluegreen-776b688d57           ReplicaSet  ✔ Healthy      168m
stable,active
 │     ├──□ rollout-bluegreen-776b688d57-kxr66  Pod         ✔ Running      168m
ready:1/1
 │     └──□ rollout-bluegreen-776b688d57-vv7t7  Pod         ✔ Running      168m
ready:1/1
 └──# revision:1
    └──⧉ rollout-bluegreen-595d4567cc           ReplicaSet  • ScaledDown   3h1m
       ├──□ rollout-bluegreen-595d4567cc-mc769  Pod         ◌ Terminating  3h
ready:1/1
       └──□ rollout-bluegreen-595d4567cc-zdc5x  Pod         ◌ Terminating  3h
ready:1/1
```

If the active `Images` is updated to `hello:1.23.2`, and the blue ReplicaSet is scaled down to 0, that means the rollout is completed.

Application Canary Deployment

Canary Deployment is a progressive release strategy where a new application version is gradually introduced to a small subset of users or traffic. This incremental rollout allows teams to monitor system behavior, collect metrics, and ensure stability before a full-scale deployment. The approach significantly reduces risk, especially in production environments.

Argo Rollouts is a Kubernetes-native progressive delivery controller that facilitates advanced deployment strategies. It extends Kubernetes capabilities by offering features like Canary, Blue-Green Deployments, Analysis Runs, Experimentation, and Automated Rollbacks. It integrates with observability stacks for metric-based health checks and provides CLI and dashboard-based control over application delivery.

> **Key Concepts:**
>
> - **Rollout**: A custom resource definition (CRD) in Kubernetes that replaces standard Deployment resources, enabling advanced deployment control such as blue-green, canary deployment.
> - **Canary Steps**: A series of incremental traffic shifting actions, such as directing 25%, then 50% of traffic to the new version.
> - **Pause Steps**: Introduce wait intervals for manual or automatic validation before progressing to the next canary step.

Benefits of Canary Deployments

- **Risk mitigation**: By deploying changes to a small subset of servers initially, you can find issues and address them before the full rollout, minimizing the impact on users.
- **Incremental rollouts**: This approach allows gradual exposure to new features, which helps you effectively monitor performance and user feedback.
- **Real-time feedback**: Canary deployments provide immediate insights into the performance and stability of new releases under real-world conditions.

- **Flexibility**: You can adjust the deployment process based on performance metrics. This allows for a dynamic rollout that you can pause or roll back as needed.
- **Cost-effectiveness**: Unlike blue/green deployments, canary deployments don't require a separate environment, making them more resource-efficient.

Canary Deployments with Argo Rollouts

Argo Rollouts supports canary deployment strategy to rollout a deployment, and control the traffic through Gateway API Plugin. In ACP, you could use ALB to act as a Gateway API Provider to implement the traffic control for Argo Rollouts.

TOC

Prerequisites

1. Argo Rollouts with Gateway API plugin installed in the cluster.
2. Argo Rollouts kubectl plugin (Install from here ↗).
3. A project to create a namespace in it.
4. ALB deployed in the cluster and allocated to the project.
5. A namespace in the cluster where the application will be deployed.

Procedure

1 Creating the Deployment

Start by defining the "stable" version of your application. This is the current version that users will access. Create a Kubernetes deployment with the appropriate number of replicas, container image version (e.g., `hello:1.23.1`), and proper labels such as `app=web`.

Use the following YAML:

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: web
spec:
  replicas: 2
  selector:
    matchLabels:
      app: web
  template:
    metadata:
      labels:
        app: web
    spec:
      containers:
        - name: web
          image: hello:1.23.1
          ports:
            - containerPort: 80
```

Explanation of YAML fields:

- `apiVersion` : The version of the Kubernetes API used to create the resource.
- `kind` : Specifies that this is a Deployment resource.
- `metadata.name` : The name of the deployment.
- `spec.replicas` : Number of desired pod replicas.
- `spec.selector.matchLabels` : Defines how the Deployment finds which pods to manage.
- `template.metadata.labels` : Labels applied to pods, used by Services to select them.
- `spec.containers` : The containers to run in each pod.
- `containers.name` : Name of the container.
- `containers.image` : Docker image to run.
- `containers.ports.containerPort` : Port exposed by the container.

Apply the configuration using `kubectl` :

```
kubectl apply -f deployment.yaml
```

This sets up the production environment.

Alternative, you could use helm chart to create the deployments and services.

2 Creating the Stable Service

Create a Kubernetes `Service` that exposes the stable deployment. This service will forward traffic to the pods of stable version based on matching labels. Initially, the service selector targets pods labeled with `app=web` .

```yaml
apiVersion: v1
kind: Service
metadata:
  name: web-stable
spec:
  selector:
    app: web
  ports:
  - protocol: TCP
    port: 80
    targetPort: 80
```

Explanation of YAML fields:

- `apiVersion` : The version of the Kubernetes API used to create the Service.
- `kind` : Specifies this resource is a Service.
- `metadata.name` : Name of the Service.
- `spec.selector` : Identifies pods to route traffic to, based on labels.
- `ports.protocol` : The protocol used (TCP).
- `ports.port` : Port exposed by the Service.
- `ports.targetPort` : The port on the container to which the traffic is directed.

Apply it using:

```
kubectl apply -f web-stable-service.yaml
```

This allows external access to the stable deployment.

3 Creating the Canary Service

Create a Kubernetes `Service` that exposes the canary deployment. This service will forward traffic to the pods of canary version based on matching labels. Initially, the service selector targets pods labeled with `app=web` .

```yaml
apiVersion: v1
kind: Service
metadata:
  name: web-canary
spec:
  selector:
    app: web
  ports:
  - protocol: TCP
    port: 80
    targetPort: 80
```

Explanation of YAML fields:

- `apiVersion` : The version of the Kubernetes API used to create the Service.
- `kind` : Specifies this resource is a Service.
- `metadata.name` : Name of the Service.
- `spec.selector` : Identifies pods to route traffic to, based on labels.
- `ports.protocol` : The protocol used (TCP).
- `ports.port` : Port exposed by the Service.
- `ports.targetPort` : The port on the container to which the traffic is directed.

Apply it using:

```
kubectl apply -f web-canary-service.yaml
```

This allows external access to the canary deployment.

4 Creating the Gateway

Use `example.com` as the domain to access the service, create the gateway to expose the service with the domain:

```yaml
apiVersion: gateway.networking.k8s.io/v1
kind: Gateway
metadata:
  name: default
spec:
  gatewayClassName: exclusive-gateway
  listeners:
  - allowedRoutes:
      namespaces:
        from: All
    name: gateway-metric
    port: 11782
    protocol: TCP
  - allowedRoutes:
      namespaces:
        from: All
    hostname: example.com
    name: web
    port: 80
    protocol: HTTP
```

Use the command:

```
kubectl apply -f gateway.yaml
```

The gateway will be allocated an external IP address, get the IP address from the `status.addresses` of type `IPAddress` in the gateway resource.

```yaml
apiVersion: gateway.networking.k8s.io/v1
kind: Gateway
metadata:
  name: default
...
status:
  addresses:
  - type: IPAddress
    value: 192.168.134.30
```

5 **DNS Configuration**

Configure the domain in your dns server to resolve the domain to the IP address of the gateway. Verify the dns resolve with the command:

```
nslookup example.com
Server:         192.168.16.19
Address:        192.168.16.19#53

Non-authoritative answer:
Name:   example.com
Address: 192.168.134.30
```

It should return the address of the gateway.

6 Creating the HTTPRoute

```yaml
apiVersion: gateway.networking.k8s.io/v1
kind: HTTPRoute
metadata:
  name: web
spec:
  hostnames:
  - example.com
  parentRefs:
  - group: gateway.networking.k8s.io
    kind: Gateway
    name: default
    namespace: default
    sectionName: web
  rules:
  - backendRefs:
    - group: ""
      kind: Service
      name: web-canary
      namespace: default
      port: 80
      weight: 0
    - group: ""
      kind: Service
      name: web-stable
      namespace: default
      port: 80
      weight: 100
    matches:
    - path:
        type: PathPrefix
        value: /
```

Use the command:

```
kubectl apply -f httproute.yaml
```

7 Accessing the Stable service

Outside the cluster, use the command to access the service from the domain:

```
curl http://example.com
```

Or you can access `http://example.com` in the browser.

8 Creating the Rollout

Next, creating the `Rollout` resource from Argo Rollouts with `Canary` strategy.

```yaml
apiVersion: argoproj.io/v1alpha1
kind: Rollout
metadata:
  name: rollout-canary
spec:
  minReadySeconds: 30
  replicas: 2
  revisionHistoryLimit: 3
  selector:
    matchLabels:
      app: web
  strategy:
    canary:
      canaryService: web-canary
      maxSurge: 25%
      maxUnavailable: 0
      stableService: web-stable
      steps:
      - setWeight: 50
      - pause: {}
      - setWeight: 100
      trafficRouting:
        plugins:
          argoproj-labs/gatewayAPI:
            httpRoute: web
            namespace: default
  workloadRef:
    apiVersion: apps/v1
    kind: Deployment
    name: web
    scaleDown: onsuccess
```

Explanation of YAML fields:

- `spec.selector` : Label selector for pods. Existing ReplicaSets whose pods are selected by this will be the ones affected by this rollout. It must match the pod template's labels.
- `workloadRef` : Specify the workload reference and scale down strategy to apply the rollouts.
- `scaleDown` : Specifies if the workload (Deployment) is scaled down after migrating to Rollout. The possible options are:
  - "never": the Deployment is not scaled down.
  - "onsuccess": the Deployment is scaled down after the Rollout becomes healthy.
  - "progressively": as the Rollout is scaled up the Deployment is scaled down. If the Rollout fails the Deployment will be scaled back up.
- `strategy` : The rollout strategy, support `BlueGreen` and `Canary` strategy.
- `canary` : The `Canary` rollout strategy definition.
  - `canaryService` : Reference to a service which the controller will update to select canary pods. Required for traffic routing.
  - `stableService` : Reference to a service which the controller will update to select stable pods. Required for traffic routing.
  - `steps` : Steps define sequence of steps to take during an update of the canary. Skipped upon initial deploy of a rollout.
    - `setWeight` : Sets the ratio of canary ReplicaSet.
    - `pause` : Pauses the rollout indefinitely or for a time. Supported units: s, m, h. `{}` means indefinitely.
    - `plugin` : executes the configured plugin, here we configure it with the `gatewayAPI` plugin.

Apply it with:

```
kubectl apply -f rollout.yaml
```

This sets up the rollouts for the deployment with `Canary` strategy. It will set weight to 50 initially, and wait for the promoting. The 50% of the traffic will forward to the canary service. After promoting the rollout, the weight will be set to 100, and 100% of the traffic will forward to the canary service. Finally, the canary service will become the stable service.

9 Verify the Rollouts

After the `Rollout` was created, the Argo Rollouts will create a new ReplicaSet with same template of the deployment. While the pods of new ReplicaSet is healthy, the deployment is scaled down to 0.

Use the following command to ensure the pods are running properly:

```
kubectl argo rollouts get rollout rollout-canary
Name:            rollout-canary
Namespace:       default
Status:          ✔ Healthy
Strategy:        Canary
Step:          9/9
SetWeight:     100
ActualWeight:  100
Images:          hello:1.23.1 (stable)
Replicas:
Desired:       2
Current:       2
Updated:       2
Ready:         2
Available:     2

NAME                                        KIND        STATUS     AGE  INFO
⟳ rollout-canary                               Rollout     ✔ Healthy  32s
 └──# revision:1
   └──⧉ rollout-canary-5c9d79697b           ReplicaSet  ✔ Healthy  32s  stable
      ├──□ rollout-canary-5c9d79697b-fh78d  Pod         ✔ Running  32s  ready:1/1
      └──□ rollout-canary-5c9d79697b-rrbtj  Pod         ✔ Running  32s  ready:1/1
```

10 Preparing Canary Deployment

Next, prepare the new version of the application as the green deployment. Update the deployment `web` with the new image version (e.g., `hello:1.23.2`). Use the command:

```
kubectl patch deployment web -p '{"spec":{"template":{"spec":{"containers":
[{"name":"web","image":"hello:1.23.2"}]}}}}'
```

This sets up the new application version for testing.

The rollouts will create a new Replicaset to manage the canary pods, and the 50% traffic will forward to the canary pods. Use the following command to verify:

```
kubectl argo rollouts get rollout rollout-canary
Name:            rollout-canary
Namespace:       default
Status:          ॥ Paused
Message:         CanaryPauseStep
Strategy:        Canary
Step:          1/3
SetWeight:     50
ActualWeight:  50
Images:          hello:1.23.1 (stable)
                hello:1.23.2 (canary)
Replicas:
Desired:       2
Current:       3
Updated:       1
Ready:         3
Available:     3

NAME                                      KIND        STATUS     AGE  INFO
⟳ rollout-canary                             Rollout     ॥ Paused   95s
 ├──# revision:2
 │   └──⧉ rollout-canary-5898765588           ReplicaSet  ✔ Healthy  46s  canary
 │      └──□ rollout-canary-5898765588-ls5jk  Pod         ✔ Running  45s
ready:1/1
 └──# revision:1
    └──⧉ rollout-canary-5c9d79697b           ReplicaSet  ✔ Healthy  95s  stable
       ├──□ rollout-canary-5c9d79697b-fk269  Pod         ✔ Running  94s  ready:1/1
       └──□ rollout-canary-5c9d79697b-wkmcn  Pod         ✔ Running  94s  ready:1/1
```

Currently, there are 3 pods running, with stable and canary version. And the weight is 50, 50% of the traffic will forward to the canary service. The rollout process is paused to wait for the promoting.

If you use helm chart to deploy the application, use helm tool to upgrade the application to the canary version.

Accessing `http://example.com`, the 50% traffic will forward to the canary service. You should have different response from the URL.

11 Promoting the Rollout

When the canary version is tested ok, you could promote the rollout to switch all traffic to the canary pods. Use the following command:

```
kubectl argo rollouts promote rollout-canary
```

To Verify if the rollout is completed:

```
kubectl argo rollouts get rollout rollout-canary
Name:            rollout-canary
Namespace:       default
Status:          ✔ Healthy
Strategy:        Canary
Step:          3/3
SetWeight:     100
ActualWeight:  100
Images:          hello:1.23.2 (stable)
Replicas:
Desired:       2
Current:       2
Updated:       2
Ready:         2
Available:     2

NAME                                      KIND        STATUS         AGE    INFO
⟳ rollout-canary                            Rollout     ✔ Healthy      8m42s
├──# revision:2
│  └──⧉ rollout-canary-5898765588           ReplicaSet  ✔ Healthy      7m53s
stable
│     ├──□ rollout-canary-5898765588-ls5jk  Pod         ✔ Running      7m52s
ready:1/1
│     └──□ rollout-canary-5898765588-dkfwg  Pod         ✔ Running      68s
ready:1/1
└──# revision:1
   └──⧉ rollout-canary-5c9d79697b           ReplicaSet  • ScaledDown   8m42s
      ├──□ rollout-canary-5c9d79697b-fk269  Pod         ◌ Terminating  8m41s
ready:1/1
      └──□ rollout-canary-5c9d79697b-wkmcn  Pod         ◌ Terminating  8m41s
ready:1/1
```

If the stable `Images` is updated to `hello:1.23.2`, and the ReplicaSet of revision 1 is scaled down to 0, that means the rollout is completed.

Accessing `http://example.com`, the 100% traffic will forward to the canary service.

12 Aborting the Rollout (Optional)

If you found the canary version has some problems during rollout process, you can abort the process to switch all traffic to the stable service. Use the command:

```
kubectl argo rollouts abort rollout-canary
```

To verify the results:

```
kubectl argo rollouts get rollout rollout-canary
Name:            rollout-demo
Namespace:       default
Status:          ✖ Degraded
Message:         RolloutAborted: Rollout aborted update to revision 3
Strategy:        Canary
Step:          0/3
SetWeight:     0
ActualWeight:  0
Images:          hello:1.23.1 (stable)
Replicas:
Desired:       2
Current:       2
Updated:       0
Ready:         2
Available:     2

NAME                                      KIND        STATUS        AGE  INFO
⟳ rollout-canary                            Rollout     ✖ Degraded     18m
 ├──# revision:3
 │   └──⧉ rollout-canary-5c9d79697b           ReplicaSet  • ScaledDown  18m
canary,delay:passed
 └──# revision:2
   └──⧉ rollout-canary-5898765588           ReplicaSet  ✔ Healthy     17m
stable
     ├──□ rollout-canary-5898765588-ls5jk  Pod         ✔ Running     17m
ready:1/1
     └──□ rollout-canary-5898765588-dkfwg  Pod         ✔ Running     10m
ready:1/1
```

Accessing `http://example.com`, the 100% traffic will forward to the stable service.

Status Description

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Applications

The status of native applications and their corresponding meanings are as follows. The numbers following the status indicate the number of computing components.

Status	Meaning
Running	All computing components are in normal operation.
Partially Running	Some computing components are running, while others have stopped.
Stopped	All computing components have stopped.
Processing	At least one computing component is in a pending state.
No Computing Components	There are no computing components under the application.
Failed	Deployment has failed.

Note: Similarly, the numbers in the computing component status indicate the number of container groups.

Deployment

- Running: All Pods are in normal operation.
- Processing: There are Pods that are not in a running state.
- Stopped: All Pods have stopped.
- Failed: Deployment has failed.

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KEDA(Kubernetes Event-driven Autoscaling)

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Introduction

KEDA is a Kubernetes-based Event Driven Autoscaler. Home Page. With KEDA, you can drive the scaling of any container in Kubernetes based on the number of events needing to be processed.

KEDA is a single-purpose and lightweight component that can be added into any Kubernetes cluster. KEDA works alongside standard Kubernetes components like the Horizontal Pod Autoscaler and can extend functionality without overwriting or duplication. With KEDA, you can explicitly map the apps you want to use event-driven scale, with other apps continuing to function. This makes KEDA a flexible and safe option to run alongside any number of any other Kubernetes applications or frameworks.

See the official documentation for more details: Keda Documentation

Advantages

Core advantages of KEDA:

- **Autoscaling Made Simple:** Bring rich scaling to every workload in your Kubernetes cluster.
- **Event-driven:** Intelligently scale your event-driven application.
- **Built-in Scalers:** Catalog of 70+ built-in scalers for various cloud platforms, databases, messaging systems, telemetry systems, CI/CD, and more.
- **Multiple Workload Types:** Support for variety of workload types such as deployments, jobs & custom resources with **/scale** sub-resource.
- **Reduce environmental impact:** Build sustainable platforms by optimizing workload scheduling and scale-to-zero.
- **Extensible:** Bring-your-own or use community-maintained scalers.
- **Vendor-Agnostic:** Support for triggers across variety of cloud providers & products.
- **Azure Functions Support:** Run and scale your Azure Functions on Kubernetes in production workloads.

How KEDA works

KEDA monitors external event sources and adjusts your app's resources based on the demand. Its main components work together to make this possible:

1. **KEDA Operator** keeps track of event sources and changes the number of app instances up or down, depending on the demand.
2. **Metrics Server** provides external metrics to Kubernetes' HPA so it can make scaling decisions.
3. **Scalers** connect to event sources like message queues or databases, pulling data on current usage or load.
4. **Custom Resource Definitions (CRDs)**define how your apps should scale based on triggers like queue length or API request rates.

In simple terms, KEDA listens to what's happening outside Kubernetes, fetches the data it needs, and scales your apps accordingly. It's efficient and integrates well with Kubernetes to handle scaling dynamically.

KEDA Custom Resource Definitions (CRDs)

KEDA uses **Custom Resource Definitions (CRDs)** to manage scaling behavior:

- **ScaledObject**: Links your app (like a Deployment or StatefulSet) to an external event source, defining how scaling works.
- **ScaledJob**: Handles batch processing tasks by scaling Jobs based on external metrics.
- **TriggerAuthentication**: Provides secure ways to access event sources, supporting methods like environment variables or cloud-specific credentials.

These CRDs give you control over scaling while keeping your apps secure and responsive to demand.

ScaledObject Example:

The following example targets CPU utilization of entire pod. If the pod has multiple containers, it will be sum of all the containers in it.

```yaml
kind: ScaledObject
metadata:
  name: cpu-scaledobject
  namespace: <your-namespace>
spec:
  scaleTargetRef:
    name: <your-deployment>
  triggers:
  - type: cpu
    metricType: Utilization # Allowed types are 'Utilization' or 'AverageValue'
    metadata:
      value: "50"
```

Installing KEDA

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Prerequisites

KEDA is a tool that helps Kubernetes scale applications based on real-world events. With KEDA, you can adjust the size of your containers automatically, depending on the workload—like the number of messages in a queue or incoming requests.

1. **Download** the **KEDA** installation package from **Alauda Cloud**.
2. **Upload** the installation package using the Upload Packages mechanism.

INFO

Upload Packages: **Administrator** > **Marketplace** > **Upload Packages** page. Click **Help Document** on the right to get instructions on how to publish the operator to cluster. For more details, please refer to CLI.

Installing via Command Line

Installing KEDA Operator

Create namespace for KEDA operator if it does not exist:

```
kubectl apply -f - <<EOF
apiVersion: v1
kind: Namespace
metadata:
  name: "keda"
EOF
```

Run the following command to install KEDA Operator in your target cluster:

```
kubectl apply -f - <<EOF
apiVersion: operators.coreos.com/v1alpha1
kind: Subscription
metadata:
  annotations:
    cpaas.io/target-namespaces: ""
  labels:
    catalog: platform
  name: keda
  namespace: keda
spec:
  channel: stable
  installPlanApproval: Automatic
  name: keda
  source: custom
  sourceNamespace: cpaas-system
  startingCSV: keda.v2.17.2
EOF
```

Configuration Parameters:

Parameter	Recommended Configuration
metadata.name	`keda` : The Subscription name is set to **keda**.
metadata.namespace	`keda` : The Subscription namespace is set to **keda**.
spec.channel	`stable` : The default Channel is set to **stable**.
spec.installPlanApproval	`Automatic` : The **Upgrade** action will be executed automatically.
spec.name	`keda` : The operator package name, must be **keda**.
spec.source	`custom` : The catalog source of keda operator, must be **custom**.
spec.sourceNamespace	`cpaas-system` : The namespace of catalog source, must be **cpaas-system**.
spec.startingCSV	`keda.v2.17.2` : The starting CSV name of keda operator.

Creating the KedaController instance

Create KedaController resource named keda in namespace keda:

```
kubectl apply -f - <<EOF
apiVersion: keda.sh/v1alpha1
kind: KedaController
metadata:
  name: keda
  namespace: keda
spec:
  admissionWebhooks:
    logEncoder: console
    logLevel: info
  metricsServer:
    logLevel: "0"
  operator:
    logEncoder: console
    logLevel: info
  serviceAccount: null
  watchNamespace: ""
EOF
```

Installing via Web Console

Installing KEDA Operator

1. Log in, and navigate to the **Administrator** page.
2. Click **Marketplace** > **OperatorHub**.
3. Find the **KEDA** operator, click **Install**, and enter the **Install** page.

Configuration Parameters:

Parameter	Recommended Configuration
Channel	`stable`: The default Channel is set to **stable**.

Parameter	Recommended Configuration
Version	Please select the latest version.
Installation Mode	`Cluster`: A single Operator is shared across all namespaces in the cluster for instance creation and management, resulting in lower resource usage.
Installation Location	`Recommended`: It will be created automatically if it does not exist.
Upgrade Strategy	Please select the `Auto`. • the **Upgrade** action will be executed automatically.

1. On the **Install** page, select default configuration, click **Install**, and complete the installation of the **KEDA** Operator.

Creating the KedaController instance

1. Click on **Marketplace** > **OperatorHub**.
2. Find the installed **KEDA** operator, navigate to **All Instances**.
3. Click **Create Instance** button, and click **KedaController** card in the resource area.
4. On the parameter configuration page for the instance, you may use the default configuration unless there are specific requirements.
5. Click **Create**.

Verification

After the instance is successfully created, wait approximately 20 minutes, then checking if the KEDA components is already running with the command:

```
kubectl get pods -n keda
```

Additional Scenarios

Integrating ACP Log Collector

- Ensure **ACP Log Collector Plugin** is installed in target cluster. Refer to ACP Log Collector Plugin Install.
- Enable the **Platform** logging switch when installing the **ACP Log Collector Plugin**.
- Use the following command to add label to the **keda** namespace:

  ```
  kubectl label namespace keda cpaas.io/product=Container-Platform --overwrite
  ```

Uninstalling KEDA Operator

Removing the KedaController instance

```
kubectl delete kedacontroller keda -n keda
```

Uninstalling KEDA Operator via CLI

```
kubectl delete subscription keda -n keda
```

Uninstalling KEDA Operator via Web Console

To uninstall KEDA Operator, click on **Marketplace** > **OperatorHub**, select installed operator **KEDA**, and click **Uninstall**.

How To

Integrating ACP Monitoring with Prometheus Plugin

> This guide outlines how to configure integration with the **ACP Monitoring with Prometheus Plugin** to enable application autoscaling based on Prometheus metrics.

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Prerequisites

Before using this functionality, ensure that:

- Installing ACP Monitoring with Prometheus Plugin
- Retrieve the Prometheus endpoint URL and secretName for the current Kubernetes cluster:

```
PrometheusEndpoint=$(kubectl get feature monitoring -o
jsonpath='{.spec.accessInfo.database.address}')
```

- Retrieve the Prometheus secret for the current Kubernetes cluster:

```
PrometheusSecret=$(kubectl get feature monitoring -o
jsonpath='{.spec.accessInfo.database.basicAuth.secretName}')
```

- Create a deployment named `<your-deployment>` in the `<your-namespace>` namespace.

Procedure

- Configure Prometheus Authentication Secret in **keda** Namespace.

Steps to Copy Secret from cpaas-system to keda Namespace

```
# Get Prometheus auth info
PrometheusUsername=$(kubectl get secret $PrometheusSecret -n cpaas-system -o
jsonpath='{.data.username}' | base64 -d)
PrometheusPassword=$(kubectl get secret $PrometheusSecret -n cpaas-system -o
jsonpath='{.data.password}' | base64 -d)

# create secret in keda namespace
kubectl create secret generic $PrometheusSecret \
  -n keda \
  --from-literal=username=$PrometheusUsername \
  --from-literal=password=$PrometheusPassword
```

- Configure KEDA Authentication for Prometheus Access Using **ClusterTriggerAuthentication**.

To configure authentication credentials for KEDA to access Prometheus, define a ClusterTriggerAuthentication resource that references the Secret containing the username and password. Below is an example configuration:

```
kubectl apply -f - <<EOF
apiVersion: keda.sh/v1alpha1
kind: ClusterTriggerAuthentication
metadata:
  name: cluster-prometheus-auth
spec:
  secretTargetRef:
    - key: username
      name: $PrometheusSecret
      parameter: username
    - key: password
      name: $PrometheusSecret
      parameter: password
EOF
```

- Configure Autoscaling for Kubernetes Deployments Using Prometheus Metrics with **ScaledObject**.

To scale a Kubernetes Deployment based on Prometheus metrics, define a **ScaledObject** resource referencing the configured ClusterTriggerAuthentication. Below is an example configuration:

```
kubectl apply -f - <<EOF
apiVersion: keda.sh/v1alpha1
kind: ScaledObject
metadata:
  name: prometheus-scaledobject
  namespace: <your-namespace>
spec:
  cooldownPeriod: 300          # Time in seconds to wait before scaling down
  maxReplicaCount: 5           # Maximum number of replicas
  minReplicaCount: 1           # Minimum replicas (note: HPA may enforce a minimum of 1)
  pollingInterval: 30          # Interval (seconds) to poll Prometheus metrics
  scaleTargetRef:
    name: <your-deployment>    # Name of the target Kubernetes Deployment
  triggers:
    - authenticationRef:
        kind: ClusterTriggerAuthentication
        name: cluster-prometheus-auth  # Reference to the ClusterTriggerAuthentication
      metadata:
        authModes: basic       # Authentication method (basic auth in this case)
        query: 
sum(container_memory_working_set_bytes{container!="POD",container!="",namespace="<your-
namespace>",pod=~"<your-deployment-name>.*"})
        queryParameters: timeout=10s  # Optional query parameters
        serverAddress: $PrometheusEndpoint
        threshold: "1024000"   # Threshold value for scaling
        unsafeSsl: "true"      # Skip SSL certificate validation (not recommended for 
production)
      type: prometheus         # Trigger type
EOF
```

Verification

To verify that the ScaledObject has scaled the deployment, you can check the number of replicas of the target deployment:

```
kubectl get deployment <your-deployment> -n <your-namespace>
```

Or you can use the following command to check the number of pods:

```
kubectl get pods -n <your-namespace> -l <your-deployment-label-key>=<your-deployment-
label-value>
```

The number of replicas should increase or decrease based on the metrics specified in the ScaledObject. If the deployment is scaled correctly, you should see the number of pods have changed to `maxReplicaCount` value.

Other KEDA scalers

KEDA **scalers** can both detect if a deployment should be activated or deactivated, and feed custom metrics for a specific event source.

KEDA supports a wide range of additional **scalers**. For more details, see the official documentation: KEDA Scalers ↗.

Pausing Autoscaling in KEDA

KEDA allows you to pause autoscaling of workloads temporarily, which is useful for:

- Cluster maintenance.
- Avoiding resource starvation by scaling down non-critical workloads.

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Procedure

Immediate Pause with Current Replicas

Add the following annotation to your **ScaledObject** definition to pause scaling without changing the current replica count:

```yaml
metadata:
  annotations:
    autoscaling.keda.sh/paused: "true"
```

Pause After Scaling to a Specific Replica Count

Use this annotation to scale the workload to a specific number of replicas and then pause:

```yaml
metadata:
  annotations:
    autoscaling.keda.sh/paused-replicas: "<number>"
```

Behavior When Both Annotations are Set

If both **paused** and **paused-replicas** are specified:

- KEDA scales the workload to the value defined in **paused-replicas**.
- Autoscaling is paused afterward.

Unpausing Autoscaling

To resume autoscaling:

- Remove both paused and paused-replicas annotations from the ScaledObject.
- If only paused: "true" was used, set it to false:

  ```yaml
  metadata:
    annotations:
      autoscaling.keda.sh/paused: "false"
  ```

Scaling to Zero

Example ScaledObject Configuration:

```yaml
apiVersion: keda.sh/v1alpha1
kind: ScaledObject
metadata:
  name: example-scaledobject
  namespace: <your-namespace>
  annotations:
    autoscaling.keda.sh/paused-replicas: "0"  # Scale to 0 replicas and pause
```

Verification

To verify that the ScaledObject has scaled to zero, you can check the number of replicas of the target deployment:

```
kubectl get deployment <your-deployment> -n <your-namespace>
```

Or you can check the number of pods in the target deployment:

```
kubectl get pods -n <your-namespace> -l <your-deployment-label-key>=<your-deployment-
label-value>
```

The number of pods should be zero, indicating that the deployment has scaled to zero.

Configuring HPA

HPA (Horizontal Pod Autoscaler) automatically scales the number of pods up or down based on preset policies and metrics, enabling applications to handle sudden spikes in business load while optimizing resource utilization during low-traffic periods.

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Understanding Horizontal Pod Autoscalers

You can create a horizontal pod autoscaler to specify the minimum and maximum number of pods you want to run, as well as the CPU utilization or memory utilization your pods should target.

After you create a horizontal pod autoscaler, the platform begins to query the CPU and/or memory resource metrics on the pods. When these metrics are available, the horizontal pod autoscaler computes the ratio of the current metric utilization with the desired metric utilization, and scales up or down accordingly. The query and scaling occurs at a regular interval, but can take one to two minutes before metrics become available.

For replication controllers, this scaling corresponds directly to the replicas of the replication controller. For deployment configurations, scaling corresponds directly to the replica count of the deployment configuration. Note that autoscaling applies only to the latest deployment in the Complete phase.

The platform automatically accounts for resources and prevents unnecessary autoscaling during resource spikes, such as during start up. Pods in the unready state have 0 CPU usage when scaling up and the autoscaler ignores the pods when scaling down. Pods without known metrics have 0% CPU usage when scaling up and 100% CPU when scaling down. This allows for more stability during the HPA decision. To use this feature, you must configure readiness checks to determine if a new pod is ready for use.

How Does the HPA Work?

The horizontal pod autoscaler (HPA) extends the concept of pod auto-scaling. The HPA lets you create and manage a group of load-balanced nodes. The HPA automatically increases or decreases the number of pods when a given CPU or memory threshold is crossed.

The HPA works as a control loop with a default of 15 seconds for the sync period. During this period, the controller manager queries the CPU, memory utilization, or both, against what is defined in the configuration for the HPA. The controller manager obtains the utilization metrics from the resource metrics API for per-pod resource metrics like CPU or memory, for each pod that is targeted by the HPA.

If a utilization value target is set, the controller calculates the utilization value as a percentage of the equivalent resource request on the containers in each pod. The controller then takes the average of utilization across all targeted pods and produces a ratio that is used to scale the number of desired replicas.

Supported Metrics

The following metrics are supported by horizontal pod autoscalers:

Metric	Description
CPU Utilization	Number of CPU cores used. Can be used to calculate a percentage of the pod's requested CPU.
Memory Utilization	Amount of memory used. Can be used to calculate a percentage of the pod's requested memory.
Network Inbound Traffic	Amount of network traffic coming into the pod, measured in KiB/s.
Network Outbound Traffic	Amount of network traffic going out from the pod, measured in KiB/s.
Storage Read Traffic	Amount of data read from storage, measured in KiB/s.
Storage Write Traffic	Amount of data written to storage, measured in KiB/s.

> **Important**: For memory-based autoscaling, memory usage must increase and decrease proportionally to the replica count. On average:
>
> - An increase in replica count must lead to an overall decrease in memory (working set) usage per-pod.
> - A decrease in replica count must lead to an overall increase in per-pod memory usage.
> - Use the platform to check the memory behavior of your application and ensure that your application meets these requirements before using memory-based autoscaling.

Prerequisites

Please ensure that the monitoring components are deployed in the current cluster and are functioning properly. You can check the deployment and health status of the monitoring components by clicking on the top right corner of the platform ? > **Platform Health Status**..

Creating a Horizontal Pod Autoscaler

Using the CLI

You can create a horizontal pod autoscaler using the command line interface by defining a YAML file and using the `kubectl create` command. The following example shows autoscaling for a Deployment object. The initial deployment requires 3 pods. The HPA object increases the minimum to 5. If CPU usage on the pods reaches 75%, the pods increase to 7:

1. Create a YAML file named `hpa.yaml` with the following content:

```
apiVersion: autoscaling/v2 1
kind: HorizontalPodAutoscaler 2
metadata:
  name: hpa-demo 3
  namespace: default
spec:
  maxReplicas: 7 4
  minReplicas: 3 5
  scaleTargetRef:
    apiVersion: apps/v1 6
    kind: Deployment 7
    name: deployment-demo 8
  targetCPUUtilizationPercentage: 75 9
```

1 Use the autoscaling/v2 API.

2 The name of the HPA resource.

3 The name of the deployment to scale.

4 The maximum number of replicas to scale up to.

5 The minimum number of replicas to maintain.

6 Specify the API version of the object to scale.

7 Specify the type of object. The object must be a Deployment, ReplicaSet, or StatefulSet.

8 The target resource to which the HPA applies.

9 The target CPU utilization percentage that triggers scaling.

2. Apply the YAML file to create the HPA:

```
kubectl create -f hpa.yaml
```

Example output:

```
horizontalpodautoscaler.autoscaling/hpa-demo created
```

3. After you create the HPA, you can view the new state of the deployment by running the following command:

```
kubectl get deployment deployment-demo
```

Example output:

```
NAME              READY   UP-TO-DATE   AVAILABLE   AGE
deployment-demo   5/5     5            5           3m
```

4. You can also check the status of your HPA:

```
kubectl get hpa hpa-demo
```

Example output:

```
NAME       REFERENCE                    TARGETS   MINPODS   MAXPODS   REPLICAS   AGE
hpa-demo   Deployment/deployment-demo   0%/75%    3         7         3          2m
```

Using the Web Console

1. Enter **Container Platform**.

2. In the left navigation bar, click **Workloads** > **Deployments**.

3. Click on ***Deployment Name***.

4. Scroll down to the **Elastic Scaling** area and click on **Update** on the right.

5. Select **Horizontal Scaling** and complete the policy configuration.

Parameter	Description
Pod Count	After a deployment is successfully created, you need to evaluate the **Minimum Pod Count** corresponding to known and regular business volume changes, as well as the **Maximum Pod Count** that can be supported by the namespace quota under high business pressure. The maximum or minimum pod counts can be changed after setting, and it is recommended to first derive a more accurate value through performance testing and to continuously adjust during usage to meet business needs.
Trigger Policy	List the **Metrics** that are sensitive to business changes and their **Target Thresholds** to trigger scale-up or scale-down actions. For example, if you set *CPU Utilization = 60%*, once the CPU utilization deviates from 60%, the platform will start to automatically adjust the number of pods based on the current deployment's insufficient or excessive resource allocation. **Note**: Metric types include built-in metrics and custom metrics. Custom metrics only apply to deployments in native applications, and you must first add custom metrics .
Scale Up/Down Step (Alpha)	For businesses with specific scaling rate requirements, you can gradually adapt to changes in business volume by specifying **Scale-Up Step** or **Scale-Down Step**. For the scale-down step, you can customize the **Stability Window**, which defaults to 300 seconds, meaning that you must wait 300 seconds before executing scale-down actions.

6. Click **Update**.

Using Custom Metrics for HPA

Custom metrics HPA extends the original HorizontalPodAutoscaler by supporting additional metrics beyond CPU and memory utilization.

Requirements

- kube-controller-manager: horizontal-pod-autoscaler-use-rest-clients=true
- Pre-installed metrics-server
- Prometheus
- custom-metrics-api

Traditional (Core Metrics) HPA

Traditional HPA supports CPU utilization and memory metrics to dynamically adjust the number of Pod instances, as shown in the example below:

```yaml
apiVersion: autoscaling/v2
kind: HorizontalPodAutoscaler
metadata:
  name: nginx-app-nginx
  namespace: test-namespace
spec:
  maxReplicas: 1
  minReplicas: 1
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: nginx-app-nginx
  targetCPUUtilizationPercentage: 50
```

In this YAML, `scaleTargetRef` specifies the workload object for scaling, and `targetCPUUtilizationPercentage` specifies the CPU utilization trigger metric.

Custom Metrics HPA

To use custom metrics, you need to install prometheus-operator and custom-metrics-api. After installation, custom-metrics-api provides a large number of custom metric resources:

```json
{
  "kind": "APIResourceList",
  "apiVersion": "v1",
  "groupVersion": "custom.metrics.k8s.io/v1beta1",
  "resources": [
    {
      "name": "namespaces/go_memstats_heap_sys_bytes",
      "singularName": "",
      "namespaced": false,
      "kind": "MetricValueList",
      "verbs": ["get"]
    },
    {
      "name": "jobs.batch/go_memstats_last_gc_time_seconds",
      "singularName": "",
      "namespaced": true,
      "kind": "MetricValueList",
      "verbs": ["get"]
    },
    {
      "name": "pods/go_memstats_frees",
      "singularName": "",
      "namespaced": true,
      "kind": "MetricValueList",
      "verbs": ["get"]
    }
  ]
}
```

These resources are all sub-resources under MetricValueList. You can create rules through Prometheus to create or maintain sub-resources. The HPA YAML format for custom metrics differs from traditional HPA:

```yaml
apiVersion: autoscaling/v2beta1
kind: HorizontalPodAutoscaler
metadata:
  name: demo
spec:
  scaleTargetRef:
    apiVersion: extensions/v1beta1
    kind: Deployment
    name: demo
  minReplicas: 2
  maxReplicas: 10
  metrics:
    - type: Pods
      pods:
        metricName: metric-demo
        targetAverageValue: 10
```

In this example, `scaleTargetRef` specifies the workload.

Trigger Condition Definition

- `metrics` is an array type, supporting multiple metrics
- `metric type` can be: Object (describing k8s resources), Pods (describing metrics for each Pod), Resources (built-in k8s metrics: CPU, memory), or External (typically metrics external to the cluster)
- If the custom metric is not provided by Prometheus, you need to create a new metric through a series of operations such as creating rules in Prometheus

The main structure of a metric is as follows:

```
{
      "describedObject": {  # Described object (Pod)
        "kind": "Pod",
        "namespace": "monitoring",
        "name": "nginx-788f78d959-fd6n9",
        "apiVersion": "/v1"
      },
      "metricName": "metric-demo",
      "timestamp": "2020-02-5T04:26:01Z",
      "value": "50"
}
```

This metric data is collected and updated by Prometheus.

Custom Metrics HPA Compatibility

Custom metrics HPA YAML is actually compatible with the original core metrics (CPU). Here's how to write it:

```yaml
apiVersion: autoscaling/v2beta1
kind: HorizontalPodAutoscaler
metadata:
  name: nginx
spec:
  scaleTargetRef:
    apiVersion: extensions/v1beta1
    kind: Deployment
    name: nginx
  minReplicas: 2
  maxReplicas: 10
  metrics:
    - type: Resource
      resource:
        name: cpu
        targetAverageUtilization: 80
    - type: Resource
      resource:
        name: memory
        targetAverageValue: 200Mi
```

- `targetAverageValue` is the average value obtained for each Pod
- `targetAverageUtilization` is the utilization calculated from the direct value

The algorithm reference is:

```
replicas = ceil(sum(CurrentPodsCPUUtilization) / Target)
```

Updates in autoscaling/v2beta2

autoscaling/v2beta2 supports memory utilization:

```yaml
apiVersion: autoscaling/v2beta2
kind: HorizontalPodAutoscaler
metadata:
  name: nginx
  namespace: default
spec:
  minReplicas: 1
  maxReplicas: 3
  metrics:
    - resource:
        name: cpu
        target:
          averageUtilization: 70
          type: Utilization
      type: Resource
    - resource:
        name: memory
        target:
          averageUtilization:
          type: Utilization
      type: Resource
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: nginx
```

Changes: `targetAverageUtilization` and `targetAverageValue` have been changed to `target` and converted to a combination of `xxxValue` and `type` :

- `xxxValue`: AverageValue (average value), AverageUtilization (average utilization), Value (direct value)
- `type`: Utilization (utilization), AverageValue (average value)

Notes:

- For **CPU Utilization** and **Memory Utilization** metrics, auto-scaling will only be triggered when the actual value fluctuates outside the range of ±10% of the target threshold.
- Scale-down may impact ongoing business operations; please proceed with caution.

Calculation Rules

When business metrics change, the platform will automatically calculate the target pod count that matches the business volume according to the following rules and adjust accordingly. If the business metrics continue to fluctuate, the value will be adjusted to the set **Minimum Pod Count** or **Maximum Pod Count**.

- Single Policy Target Pod Count: ceil[(sum(actual metric values)/metric threshold)] . This means that the sum of the actual metric values of all pods divided by the metric threshold, rounded up to the smallest integer that is greater than or equal to the result. For example: If there are currently 3 pods with CPU utilizations of 80%, 80%, and 90%, and the set CPU utilization threshold is 60%. According to the formula, the number of pods will be automatically adjusted to: ceil[(80%+80%+90%)/60%] = ceil 4.1 = 5 pods.

  Note:

  - If the calculated target pod count exceeds the set **Maximum Pod Count** (for example *4*), the platform will only scale up to 4 pods. If after changing the maximum pod count the metrics remain persistently high, you may need to use alternate scaling methods, such as increasing the namespace pod quota or adding hardware resources.
  - If the calculated target pod count (in the previous example *5*) is less than the pod count adjusted according to the **Scale-Up Step** (for example *10*), the platform will only scale up to 5 pods.

- Multiple Policy Target Pod Count: Take the maximum value among the results of each policy calculation.

Starting and Stopping Applications

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Starting the Application

1. Access the **Container Platform**.
2. In the left navigation bar, click **Application** > **Applications**.
3. Click on the application name.
4. Click **Start**.

Stopping the Application

1. Access the **Container Platform**.
2. In the left navigation bar, click **Application** > **Applications**.
3. Click on the application name.
4. Click **Stop**.
5. Read the prompt message, and after confirming that everything is correct, click **Stop**.

Configuring VerticalPodAutoscaler (VPA)

For both stateless and stateful applications, VerticalPodAutoscaler (VPA) automatically recommends and optionally applies more appropriate CPU and memory resource limits based on your business needs, ensuring that pods have sufficient resources while improving cluster resource utilization.

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Understanding VerticalPodAutoscalers

You can create a VerticalPodAutoscaler to recommend or automatically update the CPU and memory resource requests and limits for your pods based on their historical usage patterns.

After you create a VerticalPodAutoscaler, the platform begins to monitor the CPU and memory resource usage of the pods. When sufficient data is available, the VerticalPodAutoscaler calculates recommended resource values based on the observed usage patterns. Depending on the configured update mode, VPA can either automatically apply these recommendations or simply make them available for manual application.

The VPA works by analyzing the resource usage of your pods over time and making recommendations based on this analysis. It can help ensure that your pods have the resources they need without over-provisioning, which can lead to more efficient resource utilization across your cluster.

How Does the VPA Work?

The VerticalPodAutoscaler (VPA) extends the concept of pod resource optimization. The VPA monitors the resource usage of your pods and provides recommendations for CPU and memory requests based on the observed usage patterns.

The VPA works by continuously monitoring the resource usage of your pods and updating its recommendations as new data becomes available. The VPA can operate in the following modes:

- **Off**: VPA only provides recommendations without automatically applying them.
- **Manual Adjustment**: You can manually adjust resource configurations based on VPA recommendations.

> **Important**: Elastic scaling can achieve horizontal or vertical scaling of Pods. When sufficient resources are available, elastic scaling can bring good results, but when cluster resources are insufficient, it may cause Pods to be in a Pending state. Therefore, please ensure that the cluster has sufficient resources or reasonable quotas, or you can configure alerts to monitor scaling conditions.

Supported Features

The VerticalPodAutoscaler provides resource recommendations based on historical usage patterns, allowing you to optimize your pod's CPU and memory configurations.

> **Important**: When manually applying VPA recommendations, pod recreation will occur, which can cause temporary disruption to your application. Consider applying

> recommendations during maintenance windows for production workloads.

Prerequisites

- Please ensure that the monitoring components are deployed in the current cluster and are functioning properly. You can check the deployment and health status of the monitoring components by clicking on the top right corner of the platform ? > **Platform Health Status**..
- The Alauda Container Platform Vertical Pod Autoscaler cluster plugin must be installed in your cluster.

Installing the Vertical Pod Autoscaler Plugin

Before using VPA, you need to install the Vertical Pod Autoscaler cluster plugin:

1. Log in and navigate to the **Administrators** page.
2. Click **Marketplace** > **Cluster Plugins** to access the **Cluster Plugins** list page.
3. Locate the Alauda Container Platform Vertical Pod Autoscaler cluster plugin, click Install, then proceed to the installation page.

Creating a VerticalPodAutoscaler

Using the CLI

You can create a VerticalPodAutoscaler using the command line interface by defining a YAML file and using the `kubectl create` command. The following example shows vertical pod autoscaling for a Deployment object:

1. Create a YAML file named `vpa.yaml` with the following content:

```yaml
apiVersion: autoscaling.k8s.io/v1 ①
kind: VerticalPodAutoscaler ②
metadata:
  name: my-deployment-vpa ③
  namespace: default
spec:
  targetRef:
    apiVersion: apps/v1 ④
    kind: Deployment ⑤
    name: my-deployment ⑥
  updatePolicy:
    updateMode: 'Off' ⑦
  resourcePolicy: ⑧
    containerPolicies:
      - containerName: '*' ⑨
        mode: 'Auto' ⑩
```

① Use the autoscaling.k8s.io/v1 API.

② The name of the VPA

③ Specify the target workload object. VPA uses the workload's selector to find pods that need resource adjustment. Supported workload types include DaemonSet, Deployment, ReplicaSet, StatefulSet, ReplicationController, Job, and CronJob.

④ Specify the API version of the object to scale.

⑤ Specify the type of object.

⑥ The target resource to which the VPA applies

⑦ Update policy that defines how VPA applies recommendations. The updateMode can be:

- Auto: Automatically sets resource requests when creating pods and updates current pods to recommended resource requests. Currently equivalent to "Recreate". This mode may cause application downtime. Once in-place pod resource updates are supported, "Auto" mode will adopt this update mechanism.
- Recreate: Automatically sets resource requests when creating pods and evicts current pods to update to recommended resource requests. Will not use in-place updates.
- Initial: Only sets resource requests when creating pods, no modifications afterward.

- Off: Does not automatically modify pod resource requests, only provides recommendations in the VPA object.

8 Resource policy that can set specific strategies for different containers. For example, setting a container's mode to "Auto" means it will calculate recommendations for that container, while "Off" means it won't calculate recommendations.

9 Apply policy to all containers in the pod.

10 Set the mode to Auto or Off. Auto means recommendations will be generated for this container, Off means no recommendations will be generated.

2. Apply the YAML file to create the VPA:

```
kubectl create -f vpa.yaml
```

Example output:

```
verticalpodautoscaler.autoscaling.k8s.io/my-deployment-vpa created
```

3. After you create the VPA, you can view the recommendations by running the following command:

```
kubectl describe vpa my-deployment-vpa
```

Example output (partial):

```
Status:
  Recommendation:
    Container Recommendations:
      Container Name:  my-container
      Lower Bound:
        Cpu:     100m
        Memory:  262144k
      Target:
        Cpu:     200m
        Memory:  524288k
      Upper Bound:
        Cpu:     300m
        Memory:  786432k
```

Using the Web Console

1. Enter **Container Platform**.
2. In the left navigation bar, click **Workloads** > **Deployments**.
3. Click on ***Deployment Name***.
4. Scroll down to the **Elastic Scaling** area and click **Update** on the right.
5. Select **Vertical Scaling** and configure the scaling rules.

Parameter	Description
Scaling Mode	Currently supports **Manual Scaling** mode, which provides recommended resource configurations by analyzing past resource usage. You can manually adjust according to the recommended values. Adjustments will cause pods to be recreated and restarted, so please choose an appropriate time to avoid impacting running applications. Typically, after pods have been running for more than 8 days, the recommended values will become accurate. Note that when cluster resources are insufficient, scaling may cause Pods to be in a Pending state. Please ensure that the cluster has sufficient resources or reasonable quotas, or configure alerts to monitor scaling conditions.

Parameter	Description
Target Container	Defaults to the first container of the workload. You can choose to enable resource limit recommendations for one or more containers as needed.

6. Click **Update**.

Advanced VPA Configuration

Update Policy Options

- `updateMode: "Off"` - VPA only provides recommendations without automatically applying them. You can manually apply these recommendations as needed.
- `updateMode: "Auto"` - Automatically sets resource requests when creating pods and updates current pods to recommended values. Currently equivalent to "Recreate".
- `updateMode: "Recreate"` - Automatically sets resource requests when creating pods and evicts current pods to update to recommended values.
- `updateMode: "Initial"` - Only sets resource requests when creating pods, no modifications afterward.
- `minReplicas: <number>` - Minimum number of replicas. Ensures this minimum number of pods remain available when the Updater evicts pods. Must be greater than 0.

Container Policy Options

- `containerName: "*"` - Apply policy to all containers in the pod.
- `mode: "Auto"` - Automatically generate recommendations for the container.
- `mode: "Off"` - Do not generate recommendations for the container.

Notes:

- VPA recommendations are based on historical usage data, so it may take several days of pod operation before recommendations become accurate.
- Pod recreation will occur when VPA recommendations are applied in Auto mode, which can cause temporary disruption to your application.

Follow-Up Actions

After configuring VPA, the recommended values for CPU and memory resource limits of the target container can be viewed in the **Elastic Scaling** area. In the **Containers** area, select the target container tab and click the icon on the right side of **Resource Limits** to update the resource limits according to the recommended values.

Configuring CronHPA

For stateless applications with periodic fluctuations in business usage, CronHPA (Cron Horizontal Pod Autoscaler) supports adjusting the number of pods based on the time policies you set, allowing you to optimize resource usage according to predictable business patterns.

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Understanding Cron Horizontal Pod Autoscalers

You can create a cron horizontal pod autoscaler to specify the number of pods you want to run at specific times according to a schedule, allowing you to prepare for predictable traffic patterns or reduce resource usage during off-peak hours.

After you create a cron horizontal pod autoscaler, the platform begins to monitor the schedule and automatically adjusts the number of pods at the specified times. This time-based scaling occurs independently of resource utilization metrics, making it ideal for applications with known usage patterns.

The CronHPA works by defining one or more schedule rules, each specifying a time (using crontab format) and a target number of replicas. When a scheduled time is reached, the CronHPA adjusts the pod count to match the specified target, regardless of the current resource utilization.

How Does the CronHPA Work?

The cron horizontal pod autoscaler (CronHPA) extends the concept of pod auto-scaling with time-based controls. The CronHPA lets you define specific times when the number of pods should change, allowing you to prepare for predictable traffic patterns or reduce resource usage during off-peak hours.

The CronHPA works by continuously checking the current time against the defined schedules. When a scheduled time is reached, the controller adjusts the number of pods to match the target replica count specified for that schedule. If multiple schedules trigger at the same time, the platform will use the rule with higher priority (the one defined earlier in the configuration).

Prerequisites

Please ensure that the monitoring components are deployed in the current cluster and are functioning properly. You can check the deployment and health status of the monitoring components by clicking on the top right corner of the platform ? > **Platform Health Status**..

Creating a Cron Horizontal Pod Autoscaler

Using the CLI

You can create a cron horizontal pod autoscaler using the command line interface by defining a YAML file and using the `kubectl create` command. The following example shows scheduled scaling for a Deployment object:

1. Create a YAML file named `cronhpa.yaml` with the following content:

```yaml
apiVersion: tkestack.io/v1 ①
kind: CronHPA ②
metadata:
  name: my-deployment-cronhpa ③
  namespace: default
spec:
  scaleTargetRef:
    apiVersion: apps/v1 ④
    kind: Deployment ⑤
    name: my-deployment ⑥
  crons:
    - schedule: '0 0 * * *' ⑦
      targetReplicas: 0 ⑧
    - schedule: '0 8 * * 1-5' ⑨
      targetReplicas: 3 ⑩
    - schedule: '0 18 * * 1-5' ⑪
      targetReplicas: 1 ⑫
```

① Use the tkestack.io/v1 API.

② The name of the CronHPA resource.

③ The name of the deployment to scale.

④ Specify the API version of the object to scale.

⑤ Specify the type of object. The object must be a Deployment, ReplicaSet, or StatefulSet.

⑥ The target resource to which the CronHPA applies.

⑦ The cron schedule in standard crontab format (minute hour day month weekday).

⑧ The target number of replicas to scale to when the schedule is triggered.

This example configures the deployment to:

- Scale down to 0 replicas at midnight every day
- Scale up to 3 replicas at 8:00 AM on weekdays (Monday-Friday)
- Scale down to 1 replica at 6:00 PM on weekdays

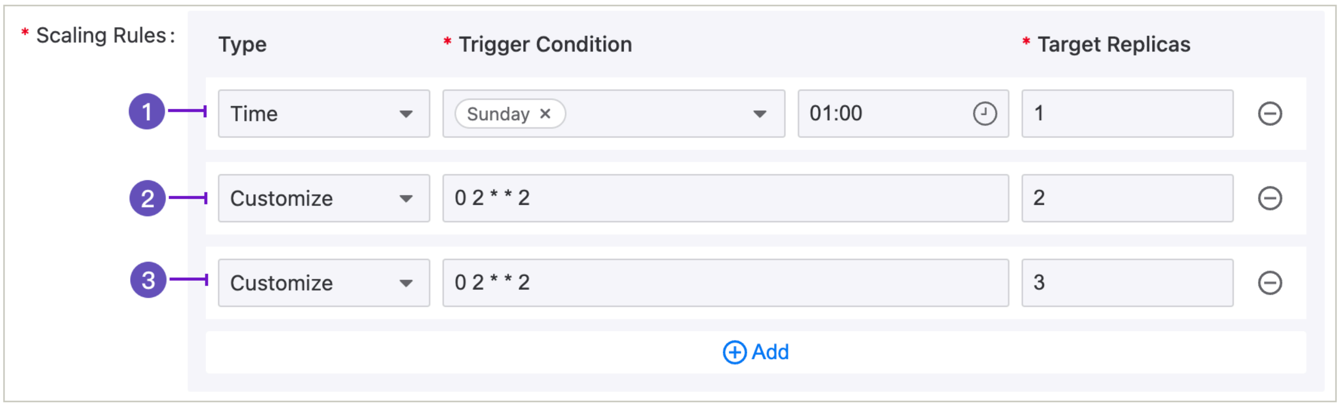
2. Apply the YAML file to create the CronHPA:

```
kubectl create -f cronhpa.yaml
```

Using the Web Console

1. Enter **Container Platform**.
2. In the left navigation bar, click **Workloads** > **Deployments**.
3. Click on ***Deployment Name***.
4. Scroll down to the **Elastic Scaling** section and click **Update** on the right.
5. Select **Scheduled Scaling**, and configure the scaling rules. When the type is **Custom**, you must provide a Crontab expression for the trigger condition, formatted as `minute hour day month week`. For detailed introduction, please refer to Writing Crontab Expressions.
6. Click **Update**.

Schedule Rule Explanation



	Type	* Trigger Condition		* Target Replicas
1	Time	Sunday ×	01:00	1
2	Customize	0 2 * * 2		2
3	Customize	0 2 * * 2		3

1. Indicates that starting from 01:00 AM every Monday, only 1 pod will be retained.
2. Indicates that starting from 02:00 AM every Tuesday, only 2 pods will be retained.
3. Indicates that starting from 02:00 AM every Tuesday, only 3 pods will be retained.

Important Notes:

- When multiple rules have the same trigger time (Examples 2 and 3), the platform will execute automatic scaling based only on the rule that is higher in priority (Example 2).

- CronHPA operates independently of HPA. If both are configured for the same workload, they may conflict with each other. Consider your scaling strategy carefully.
- The schedule uses the crontab format (`minute hour day month week`) and follows the same rules as Kubernetes CronJobs.
- Time is based on the cluster's timezone setting.
- For workloads with critical availability requirements, ensure that your scheduled scaling doesn't unexpectedly reduce capacity during high-traffic periods.

Updating Applications

Custom Applications greatly facilitate the unified management of workloads, networks, storage, and configurations, but not all resources belong to the application.

- Resources added during the application creation process, or added through application updates, are by default associated with the application and do not require additional importing.
- Resources created outside the application do not belong to the application and cannot be found in the application's details. However, as long as the resource definitions meet business requirements, the business can operate normally. In this case, it is recommended that you import the resources into the application for unified management.
- **Image Management**
  - Rollout new container images with tag/patch version control
  - Configure imagePullPolicy (Always/IfNotPresent/Never)
- **Runtime Configuration**
  - Modify environment variables via ConfigMaps/Secrets
  - Update resource requests/limits (CPU/Memory)
- **Resource Orchestration**
  - Import existing Kubernetes resources (Deployments/Services/Ingresses)
  - Synchronize configurations across namespaces using `kubectl apply -f`

Resources imported into the application can benefit from the following features:

Feature	Description
Version Snapshot	When creating a version snapshot for the application, a snapshot will also be generated for the resources within the application.

Feature	Description
	• If the application is rolled back, the resources will also roll back to the state in the snapshot. • If a specific version of the application is distributed, the platform will automatically create the resources recorded in the snapshot upon redeploying the application.
Deleted with Application	If an application is no longer needed, deleting the application will automatically remove all resources associated with the application, including computing components, internal routes, and inbound rules.
Easier to Find	In the application detail information, you can quickly view the resources associated with the application. For example: External traffic can access *Deployment D* through *Service S*, which belongs to *Application A*, but the corresponding access address can only be quickly found in the application details if *Service S* also belongs to *Application A*.

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Importing Resources

> Batch import related resources under the namespace where the application resides; a resource can belong to only one application.

1. Enter **Container Platform**.

2. In the left navigation bar, click **Application Management** > **Native Applications**.

3. Click on ***Application Name***.

4. Click **Actions** > **Manage Resources**.

5. In the **Resource Type** at the bottom, select the type of resources to be imported.

   Note: Common resource types include Deployment, DaemonSet, StatefulSet, Job, CronJob, Service, Ingress, PVC, ConfigMap, Secret, and HorizontalPodAutoscaler, which are displayed at the top; other resources are arranged in alphabetical order, and you can quickly query specific resource types by searching keywords.

6. In the **Resources** section, select the resources to be imported.

   Attention: For **Job** type resources, only tasks created through YAML are supported for import.

7. Click **Import Resources**.

Removing/Batch Removing Resources

> Removing / batch removing resources from an application only disassociates the application from the resources and does not delete the resources.

If there are interconnections between resources under an application, removing any resource from the application will not change the associations between the resources. For example, even if *Service S* is removed from *Application A*, external traffic can still access *Deployment D* through *Service S*.

1. Enter **Container Platform**.

2. In the left navigation bar, click **Application Management** > **Native Applications**.

3. Click on ***Application Name***.

4. Click **Actions** > **Manage Resources**.

5. Click **Remove** on the right side of a resource to remove it; or select multiple resources at once, and click **Remove** at the top of the table to batch remove resources.

Exporting Applications

To standardize the export process of applications between development, testing, and production environments, and to facilitate the rapid migration of business to new environments, you can export native applications as application templates (Charts) or export simplified YAML files that can be used directly for deployment. This allows the native application to run in different environments or namespaces. You can also export YAML files to a code repository to deploy applications across clusters quickly using GitOps functionality.

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Exporting Helm Charts

Procedure

1. Access the **Container Platform**.

2. In the left navigation bar, click on **Application Management** > **Native Applications**.

3. Click on the ***application name*** of the type `Custom Application`.

4. Click on **Actions** > **Export**; you can also export a specific version from the application detail page.

5. Choose one export method as needed and refer to the following instructions to configure the relevant information.

   - Exporting Helm Charts to a template repository with management permissions

     Note: The template repository is added by the platform administrator. Please contact the platform administrator to obtain a valid template repository of type **Chart** or **OCI Chart** with **Management** permissions.

Parameter	Description
Target Location	Select **Template Repository** to directly sync the template to a template repository of type **Chart** or **OCI Chart** with **Management** permissions. The project owner assigned to this **Template Repository** can directly use the template.
Template Directory	When the selected template repository type is OCI Chart, you need to select or manually input the directory for storing the Helm Chart. **Note**: When manually entering a new template directory, the platform will create this directory in the template repository, but there is a risk of the creation failing.
Version	The version number of the application template. The format should be `v<Major>.<Minor>.<Patch>`. The default value is the current application version or the current snapshot version.
Icon	Supports JPG, PNG, and GIF image formats, with a file size of no more than 500KB. Suggested dimensions are 80*60 pixels.

Parameter	Description
Description	The description will be displayed in the list of application templates within the application directory.
README	Description file. Supports editing in Markdown format and will be displayed on the details page of the application template.
NOTES	Template help file. Supports standard plaintext editing; after the deployment template is completed, it will be displayed on the template application details page.

- Exporting Helm Charts to local for manual upload to the template repository: Select **Local** as the target location and choose **Helm Chart** as the file format to generate a Helm Chart package which will be downloaded locally for offline transmission.

6. Click **Export**.

Follow-Up Actions

- If you export the Helm Chart to local, you will need to add the template to a template repository with management permissions.

- Regardless of the export method chosen, you can refer to Creating Native Applications - Template Method to create a `Template Application` type of native application in a **non-current** namespace.

Exporting YAML to Local

Steps

Method 1

1. Access the **Container Platform**.

2. In the left navigation bar, click on **Application Management** > **Native Applications**.

3. Click on ***application name***.

4. Click on **Actions** > **Export**; you can also export a specific version from the application detail page.

5. Select **Local** as the target location and **YAML** as the file format, at which point you can export a simplified YAML file that can be deployed directly in other environments.

6. Click **Export**.

Method 2

1. Access the **Container Platform**.

2. In the left navigation bar, click on **Application Management** > **Native Applications**.

3. Click on ***application name***.

4. Click on the **YAML** tab, configure settings as needed, and preview the YAML file.

Type	Description
Full YAML	By default, **Preview Simplified YAML** is not selected, displaying the YAML file with the **managedFields fields hidden**. You can preview it and export directly; you may also uncheck **Hide managedFields fields** to export the full YAML file. **Note**: Full YAML is primarily used for operations and troubleshooting and cannot be used to quickly create native applications on the platform.
Simplified YAML	Check **Preview Simplified YAML**, at which point you can preview and export a simplified YAML file that can be deployed directly in other environments.

5. Click **Export**.

Follow-Up Actions

After exporting the simplified YAML, you can refer to Creating Native Applications - YAML Method to create a `Custom Application` type of native application in a **non-current** namespace.

Exporting YAML to Code Repository (Alpha)

Precautions

- Only platform administrators and project administrators can directly export native application YAML files to the code repository.
- `Template Applications` do not support exporting Kustomize formatted application configuration files or directly exporting YAML files to the code repository; you can first **detach from the template** and convert it to a `Custom Application`.

Steps

1. Access the **Container Platform**.
2. In the left navigation bar, click on **Application Management** > **Native Applications**.
3. Click on the ***application name*** of type `Custom`.
4. Click on **Actions** > **Export**; you can also export a specific version from the application detail page.
5. Choose one export method as needed and refer to the following instructions to configure the relevant information.
   - Exporting YAML to a code repository:

Parameter	Description
Target Location	Select **Code Repository** to directly sync the YAML file to the specified Git code repository. The project owner assigned to this **Code Repository** can directly use the YAML file.
Integration Project Name	The name of the integration tool project assigned or associated with your project by the platform administrator.
Repository Address	The repository address assigned for your use under the integrated tool project.

Parameter	Description
Export Method	<ul><li>**Existing Branch**: Export the application YAML to the selected branch.</li><li>**New Branch**: Create a new branch based on the selected **Branch/Tag/Commit ID** and export the application YAML to the new branch.<ul><li>If **Submit PR (Pull Request)** is checked, the platform will create a new branch and submit a Pull Request.</li><li>If **Automatically delete source branch after merging PR** is checked, the source branch will be automatically deleted after you merge the PR in the Git code repository.</li></ul></li></ul>
File Path	The specific location where the file should be saved in the code repository; you can also input a file path, and the platform will create a new path in the code repository based on the input.
Commit Message	Fill in commit information to identify the content of this submission.
Preview	Preview the YAML file to be submitted and compare differences with the existing YAML in the code repository, displayed with color differentiation.

- Exporting Kustomize-type files to local for manual upload to the code repository: Select **Local** as the target location and choose **Kustomize** as the file format to export the Kustomize-type application configuration file locally. This file supports differentiated configurations and is suitable for cross-cluster application deployments.

6. Click **Export**.

Follow-Up Actions

After exporting the YAML to a Git code repository, you can refer to Creating GitOps Applications to create a `Custom Application` type of GitOps application across clusters.

Updating and deleting Chart Applications

Due to overlapping functionality between the current template applications and native applications, and the enhanced operational capabilities available under native applications, independent management of template applications will no longer be offered in future versions. Please upgrade your currently successfully deployed template applications to native applications as soon as possible.

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Important Notes

This feature is **going to be discontinued**. Please upgrade your currently successfully deployed template applications to native applications as soon as possible.

Prerequisites

Please contact the platform administrator to enable template application-related features.

Status Analysis Description

Click on ***Template Application Name*** to display detailed deployment status analysis of the Chart in the detail information.

Type	Reason
Initialized	Indicates the state of the Chart template download. • When the status is True, it indicates that the Chart template download was successful. • When the status is False, it indicates that the Chart template download has failed, and the reason for failure can be viewed in the message column. • ChartLoadFailed: Chart template download failed. • InitializeFailed: An exception occurred during initialization before downloading the Chart.
Validated	Indicates the state of user permissions and dependencies verification for the Chart template. • When the status is True, it indicates that all validation checks have passed. • When the status is False, it indicates that there are validation checks that have failed, and the reason for failure can be viewed in the message column. • DependenciesCheckFailed: Chart dependency check failed. • PermissionCheckFailed: The current user lacks permissions for certain resource operations. • ConsistentNamespaceCheckFailed: When deploying the template application as a native application, the Chart contains resources that require cross-namespace deployment.

Type	Reason
Synced	Indicates the state of the Chart template deployment. • When the status is True, it indicates that the Chart template deployment was successful. • When the status is False, it indicates that the Chart template deployment has failed, with the reason displayed as ChartSyncFailed, and the specific reason for failure can be viewed in the message column.

Version Management for Applications

After updating the application through the platform interface, a historical version record is automatically generated. For application updates triggered by non-interface operations, such as updating the application via API calls, you can manually create a version snapshot to record the changes.

Note: When the number of version snapshot entries exceeds 6, the platform retains only the latest 6 entries and automatically deletes the others, prioritizing the removal of the oldest version snapshot entries.

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Creating a Version Snapshot

Procedure

1. Access **Container Platform**.
2. In the left navigation bar, click **Application Management** > **Native Applications**.
3. Click on ***Application Name***.
4. In the **Version Snapshot** tab, click **Create Version Snapshot**.

5. Configure the information and click **Confirm**.

   Note: You can also Distribute the Application, which allows you to distribute the version snapshot of the application as a Chart, facilitating the rapid deployment of the same application across multiple clusters and namespaces on the platform.

Rolling Back to a Historical Version

Roll back the current application's configuration to a historical version.

Procedure

1. Access **Container Platform**.
2. In the left navigation bar, click **Application Management** > **Native Applications**.
3. Click on ***Application Name***.
4. In the **Historical Versions** tab, click on ***Version Number***.
5. Click ⋮ > **Roll Back to This Version**.
6. Click **Roll Back**.

Deleting Applications

Delete an application, it simultaneously deletes the application itself and all of its directly contained Kubernetes resources. Additionally, this action severs any association the application might have had with other Kubernetes resources that were not directly part of its definition.

Health Checks

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Understanding Health Checks

Refer to the official Kubernetes documentation:

- Liveness, Readiness, and Startup Probes ↗
- Configure Liveness, Readiness and Startup Probes ↗

> In Kubernetes, health checks, also known as probes, are a critical mechanism to ensure the high availability and resilience of your applications. Kubernetes uses these probes to determine the health and readiness of your Pods, allowing the system to take appropriate actions, such as restarting containers or routing traffic. Without proper health checks, Kubernetes cannot reliably manage your application's lifecycle, potentially leading to service degradation or outages.

Kubernetes offers three types of probes:

- `livenessProbe`: Detects if the container is still running. If a liveness probe fails, Kubernetes will terminate the Pod and restart it according to its restart policy.
- `readinessProbe`: Detects if the container is ready to serve traffic. If a readiness probe fails, the Endpoint Controller removes the Pod from the Service's Endpoint list until the probe succeeds.
- `startupProbe`: Specifically checks if the application has successfully started. Liveness and readiness probes will not execute until the startup probe succeeds. This is very useful for applications with long startup times.

Properly configuring these probes is essential for building robust and self-healing applications on Kubernetes.

Probe Types

Kubernetes supports three mechanisms for implementing probes:

HTTP `GET` Action

> Executes an HTTP `GET` request against the Pod's IP address on a specified port and path. The probe is considered successful if the response code is between 200 and 399.

- **Use Cases**: Web servers, REST APIs, or any application exposing an HTTP endpoint.
- **Example**:

```yaml
livenessProbe:
  httpGet:
    path: /healthz
    port: 8080
  initialDelaySeconds: 15
  periodSeconds: 20
```

`exec` Action

> Executes a specified command inside the container. The probe is successful if the command exits with status code 0.

- **Use Cases**: Applications without HTTP endpoints, checking internal application state, or performing complex health checks that require specific tools.
- **Example**:

```yaml
readinessProbe:
  exec:
    command:
      - cat
      - /tmp/healthy
  initialDelaySeconds: 5
  periodSeconds: 5
```

TCP `Socket` Action

> Attempts to open a TCP socket on the container's IP address and a specified port. The probe is successful if the TCP connection can be established.

- **Use Cases**: Databases, message queues, or any application that communicates over a TCP port but might not have an HTTP endpoint.
- **Example**:

```yaml
startupProbe:
  tcpSocket:
    port: 3306
  initialDelaySeconds: 5
  periodSeconds: 10
  failureThreshold: 30
```

Best Practices

- **Liveness** vs. **Readiness**:
  - **Liveness**: If your application is unresponsive, it's better to restart it. If it fails, Kubernetes will restart it.
  - **Readiness**: If your application is temporarily unable to serve traffic (e.g., connecting to a database), but might recover without a restart, use a Readiness Probe. This prevents traffic from being routed to an unhealthy instance.
- **Startup Probes for Slow Applications**: Use Startup Probes for applications that take a significant amount of time to initialize. This prevents premature restarts due to Liveness Probe failures or traffic routing issues due to Readiness Probe failures during startup.
- **Lightweight Probes**: Ensure your probe endpoints are lightweight and perform quickly. They should not involve heavy computation or external dependencies (like database calls) that could make the probe itself unreliable.
- **Meaningful Checks**: Probe checks should genuinely reflect the health and readiness of your application, not just whether the process is running. For example, for a web server, check if it can serve a basic page, not just if the port is open.
- **Adjust initialDelaySeconds**: Set initialDelaySeconds appropriately to give your application enough time to start before the first probe.
- **Tune periodSeconds and failureThreshold**: Balance the need for quick detection of failures with avoiding false positives. Too frequent probes or too low a failureThreshold can lead to unnecessary restarts or unready states.
- **Logs for Debugging**: Ensure your application logs clear messages related to health check endpoint calls and internal state to aid in debugging probe failures.
- **Combine Probes**: Often, all three probes (Liveness, Readiness, Startup) are used together to manage application lifecycle effectively.

YAML file example

```yaml
spec:
  template:
    spec:
      containers:
        - name: nginx
          image: nginx:1.14.2 # Container image
          ports:
            - containerPort: 80 # Container exposed port
          startupProbe:
            httpGet:
              path: /startup-check
              port: 8080
            initialDelaySeconds: 0 # Usually 0 for startup probes, or very small
            periodSeconds: 5
            failureThreshold: 60 # Allows 60 * 5 = 300 seconds (5 minutes) for startup
          livenessProbe:
            httpGet:
              path: /healthz
              port: 8080
            initialDelaySeconds: 5 # Delay 5 seconds after Pod starts before checking
            periodSeconds: 10 # Check every 10 seconds
            timeoutSeconds: 5 # Timeout after 5 seconds
            failureThreshold: 3 # Consider unhealthy after 3 consecutive failures
          readinessProbe:
            httpGet:
              path: /ready
              port: 8080
            initialDelaySeconds: 5
            periodSeconds: 10
            timeoutSeconds: 5
            failureThreshold: 3
```

Health Checks configuration parameters by using web console

Common parameters

Parameters	Description
Initial Delay	`initialDelaySeconds`: Grace period (seconds) before starting probes. Default: `300`.
Period	`periodSeconds`: Probe interval (1-120s). Default: `60`.
Timeout	`timeoutSeconds`: Probe timeout duration (1-300s). Default: `30`.
Success Threshold	`successThreshold`: Minimum consecutive successes to mark healthy. Default: `0`.
Failure Threshold	`failureThreshold`: Maximum consecutive failures to trigger action: - `0`: Disables failure-based actions - Default: `5` failures → container restart.

Protocol specific parameters

Parameter	Applicable Protocols	Description
Protocol	HTTP/HTTPS	Health check protocol
Port	HTTP/HTTPS/TCP	Target container port for probing.
Path	HTTP/HTTPS	Endpoint path (e.g., `/healthz`).
HTTP Headers	HTTP/HTTPS	Custom headers (Add key-value pairs).
Command	EXEC	Container-executable check command (e.g., `sh -c "curl -I localhost:8080 | grep OK"`). **Note**: Escape special characters and test command viability.

Troubleshooting probe failures

When a Pod's status indicates issues related to probes, here's how to troubleshoot:

Check pod events

```
kubectl describe pod <pod-name>
```

Look for events related to LivenessProbe failed, ReadinessProbe failed, or StartupProbe failed. These events often provide specific error messages (e.g., connection refused, HTTP 500 error, command exit code).

View container logs

```
kubectl logs <pod-name> -c <container-name>
```

Examine application logs to see if there are errors or warnings around the time the probe failed. Your application might be logging why its health endpoint isn't responding correctly.

Test probe endpoint manually

- **HTTP**: If possible, `kubectl exec -it <pod-name> -- curl <probe-path>:<probe-port>` or `wget` from within the container to see the actual response.
- **Exec**: Run the probe command manually: `kubectl exec -it <pod-name> -- <command-from-probe>` and check its exit code and output.
- **TCP**: Use `nc` (netcat) or `telnet` from another Pod in the same network or from the host if allowed, to test TCP connectivity: `kubectl exec -it <another-pod> -- nc -vz <pod-ip> <probe-port>`.

Review probe configuration

- Double-check the probe parameters (path, port, command, delays, thresholds) in your Deployment/Pod YAML. A common mistake is an incorrect port or path.

Check application code

- Ensure your application's health check endpoint is correctly implemented and truly reflects the application's readiness/liveness. Sometimes, the endpoint might return success even when the application itself is broken.

Resource constraints

- Insufficient CPU or memory resources could cause your application to become unresponsive, leading to probe failures. Check Pod resource usage (`kubectl top pod <pod-name>`) and consider adjusting `resources` limits/requests.

Network issues

- In rare cases, network policies or CNI issues might prevent probes from reaching the container. Verify network connectivity within the cluster.

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Understanding Deployments

Refer to the official Kubernetes documentation: Deployments ↗

> **Deployment** is a Kubernetes higher-level workload resource used to declaratively manage and update Pod replicas for your applications. It provides a robust and flexible way to define how your application should run, including how many replicas to maintain and how to safely perform rolling updates.

A **Deployment** is an object in the Kubernetes API that manages Pods and ReplicaSets. When you create a Deployment, Kubernetes automatically creates a ReplicaSet, which is then responsible for maintaining the specified number of Pod replicas.

By using Deployments, you can:

- Declarative Management: Define the desired state of your application, and Kubernetes automatically ensures the cluster's actual state matches the desired state.
- Version Control and Rollback: Track each revision of a Deployment and easily roll back to a previous stable version if issues arise.
- Zero-Downtime Updates: Gradually update your application using a rolling update strategy without service interruption.
- Self-Healing: Deployments automatically replace Pod instances if they crash, are terminated, or are removed from a node, ensuring the specified number of Pods are always available.

How it works:

1. You define the desired state of your application through a Deployment (e.g., which image to use, how many replicas to run).
2. The Deployment creates a ReplicaSet to ensure the specified number of Pods are running.
3. The ReplicaSet creates and manages the actual Pod instances.
4. When you update a Deployment (e.g., change the image version), the Deployment creates a new ReplicaSet and gradually replaces the old Pods with new ones according to the predefined rolling update strategy until all new Pods are running, then it removes the old ReplicaSet.

Creating Deployments

Creating a Deployment by using CLI

Prerequisites

- Ensure you have `kubectl` configured and connected to your cluster.

YAML file example

```yaml
# example-deployment.yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-deployment # Name of the Deployment
  labels:
    app: nginx # Labels for identification and selection
spec:
  replicas: 3 # Desired number of Pod replicas
  selector:
    matchLabels:
      app: nginx # Selector to match Pods managed by this Deployment
  template:
    metadata:
      labels:
        app: nginx # Pod's labels, must match selector.matchLabels
    spec:
      containers:
        - name: nginx
          image: nginx:1.14.2 # Container image
          ports:
            - containerPort: 80 # Container exposed port
          resources: # Resource limits and requests
            requests:
              cpu: 100m
              memory: 128Mi
            limits:
              cpu: 200m
              memory: 256Mi
```

Creating a Deployment via YAML

```bash
# Step 1: Create Deployment via yaml
kubectl apply -f example-deployment.yaml

# Step 2: Check the Deployment status
kubectl get deployment nginx-deployment # View Deployment
kubectl get pod -l app=nginx # View Pods created by this Deployment
```

Creating a Deployment by using web console

Prerequisites

Obtain the image address. The source of the images can be from the image repository integrated by the platform administrator through the toolchain or from third-party platforms' image repositories.

- For the former, the Administrator typically assigns the image repository to your project, and you can use the images within it. If the required image repository is not found, please contact the Administrator for allocation.
- If it is a third-party platform's image repository, ensure that images can be pulled directly from it in the current cluster.

Procedure - Configure Basic Info

1. **Container Platform**, navigate to **Workloads** > **Deployments** in the left sidebar.
2. Click on **Create Deployment**.
3. **Select** or **Input** an image, and click **Confirm**.

> **INFO**
>
> **Note**: When using images from the image repository integrated into web console, you can filter images by **Already Integrated**. The **Integration Project Name**, for example, images (docker-registry-projectname), which includes the project name projectname in this web console and the project name containers in the image repository.

4. In the **Basic Info** section, configure declarative parameters for Deployment workloads:

Parameters	Description
Replicas	Defines the desired number of Pod replicas in the Deployment (default: `1`). Adjust based on workload requirements.
More > **Update Strategy**	Configures the `rollingUpdate` strategy for zero-downtime deployments: **Max surge** (`maxSurge`):

Parameters	Description
	• Maximum number of Pods that can exceed the desired replica count during an update. • Accepts absolute values (e.g., `2`) or percentages (e.g., `20%`). • Percentage calculation: `ceil(current_replicas × percentage)`. • Example: 4.1 → `5` when calculated from 10 replicas. **Max unavailable** (`maxUnavailable`): • Maximum number of Pods that can be temporarily unavailable during an update. • Percentage values cannot exceed `100%`. • Percentage calculation: `floor(current_replicas × percentage)`. • Example: 4.9 → `4` when calculated from 10 replicas. **Notes**: 1. **Default values**: `maxSurge=1`, `maxUnavailable=1` if not explicitly set. 2. **Non-running Pods** (e.g., in `Pending`/`CrashLoopBackOff` states) are considered unavailable. 3. **Simultaneous constraints**: • `maxSurge` and `maxUnavailable` cannot both be `0` or `0%`. • If percentage values resolve to `0` for both parameters, Kubernetes forces `maxUnavailable=1` to ensure update progress. **Example**: For a Deployment with 10 replicas: • `maxSurge=2` → Total Pods during update: `10 + 2 = 12`. • `maxUnavailable=3` → Minimum available Pods: `10 - 3 = 7`. • This ensures availability while allowing controlled rollout.

Parameters	Description

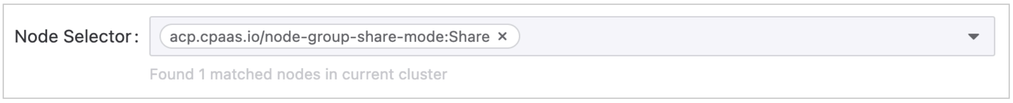
Procedure - Configure Pod

Note: In mixed-architecture clusters deploying single-architecture images, ensure proper Node Affinity Rules are configured for Pod scheduling.

1. **Pod** section, configure container runtime parameters and lifecycle management:

Parameters	Description
Volumes	Mount persistent volumes to containers. Supported volume types include `PVC`, `ConfigMap`, `Secret`, `emptyDir`, `hostPath`, and so on. For implementation details, see Volume Mounting Guide.
Pull Secret	Required **only** when pulling images from third-party registries (via manual image URL input). **Note**: Secret for authentication when pulling image from a secured registry.
Close Grace Period	Duration (default: `30s`) allowed for a Pod to complete graceful shutdown after receiving termination signal. - During this period, the Pod completes inflight requests and releases resources. - Setting `0` forces immediate deletion (SIGKILL), which may cause request interruptions.

1. **Node Affinity Rules**

Parameters	Description
More > **Node Selector**	Constrain Pods to nodes with specific labels (e.g. `kubernetes.io/os: linux`).  Node Selector: acp.cpaas.io/node-group-share-mode:Share × Found 1 matched nodes in current cluster
More > **Affinity**	Define fine-grained scheduling rules based on existing. **Affinity Types**:

Parameters	Description
	• **Pod Affinity**: Schedule new Pods to nodes hosting specific Pods(same topology domain). • **Pod Anti-affinity**: Prevent co-location of new Pods with specific Pods. **Enforcement Modes**: • `requiredDuringSchedulingIgnoredDuringExecution` : Pods are scheduled *only* if rules are satisfied. • `preferredDuringSchedulingIgnoredDuringExecution` : Prioritize nodes meeting rules, but allow exceptions. **Configuration Fields**: • `topologyKey` : Node label defining topology domains (default: `kubernetes.io/hostname`). • `labelSelector` : Filters target Pods using label queries.

3. **Network Configuration**

- Kube-OVN

Parameters	Description
Bandwidth Limits	Enforce QoS for Pod network traffic: • **Egress rate limit**: Maximum outbound traffic rate (e.g., `10Mbps`). • **Ingress rate limit**: Maximum inbound traffic rate.
Subnet	Assign IPs from a predefined subnet pool. If unspecified, uses the namespace's default subnet.
Static IP Address	Bind persistent IP addresses to Pods: • Multiple Pods across Deployments can claim the same IP, but only one Pod can use it concurrently.

Parameters	Description
	• **Critical**: Number of static IPs must ≥ Pod replica count.

- Calico

Parameters	Description
Static IP Address	Assign fixed IPs with strict uniqueness: • Each IP can be bound to **only one Pod** in the cluster. • **Critical**: Static IP count must ≥ Pod replica count.

Procedure - Configure Containers

1. **Container** section, refer to the following instructions to configure the relevant information.

Parameters	Description
Resource Requests & Limits	• **Requests**: Minimum CPU/memory required for container operation. • **Limits**: Maximum CPU/memory allowed during container execution. For unit definitions, see Resource Units. **Namespace overcommit ratio**: • **Without overcommit ratio**: If namespace resource quotas exist: Container requests/limits inherit namespace defaults (modifiable). No namespace quotas: No defaults; custom Request. • **With overcommit ratio**: Requests auto-calculated as `Limits / Overcommit ratio` (immutable). **Constraints**: • Request ≤ Limit ≤ Namespace quota maximum.

Parameters	Description
	• Overcommit ratio changes require pod recreation to take effect. • Overcommit ratio disables manual request configuration. • No namespace quotas → no container resource constraints.
Extended Resources	Configure cluster-available extended resources (e.g., vGPU, pGPU).
Volume Mounts	Persistent storage configuration. See Storage Volume Mounting Instructions. **Operations**: • Existing pod volumes: Click **Add** • No pod volumes: Click **Add & Mount** **Parameters**: • `mountPath` : Container filesystem path (e.g., `/data`) • `subPath` : Relative file/directory path within volume. For `ConfigMap` / `Secret` : Select specific key • `readOnly` : Mount as read-only (default: read-write) See Kubernetes Volumes ↗ .
Ports	Expose container ports. **Example**: Expose TCP port `6379` with name `redis` . **Fields**: • `protocol` : TCP/UDP • `Port` : Exposed port (e.g., `6379`) • `name` : DNS-compliant identifier (e.g., `redis`)
Startup Commands & Arguments	Override default ENTRYPOINT/CMD: **Example 1**: Execute `top -b`

Parameters	Description
	- **Command**: `["top", "-b"]` - **OR** Command: `["top"]`, Args: `["-b"]` **Example 2**: Output `$MESSAGE`: `/bin/sh -c "while true; do echo $(MESSAGE); sleep 10; done"` See Defining Commands ↗.
More > **Environment Variables**	• Static values: Direct key-value pairs • Dynamic values: Reference ConfigMap/Secret keys, pod fields (`fieldRef`), resource metrics (`resourceFieldRef`) **Note**: Env variables override image/configuration file settings.
More > **Referenced ConfigMaps**	Inject entire ConfigMap/Secret as env variables. Supported Secret types: `Opaque`, `kubernetes.io/basic-auth`.
More > **Health Checks**	• **Liveness Probe**: Detect container health (restart if failing) • **Readiness Probe**: Detect service availability (remove from endpoints if failing) See Health Check Parameters.
More > **Log Files**	Configure log paths: - Default: Collect `stdout` - File patterns: e.g., `/var/log/*.log` **Requirements**: • Storage driver `overlay2`: Supported by default • `devicemapper`: Manually mount EmptyDir to log directory • Windows nodes: Ensure parent directory is mounted (e.g., `c:/a` for `c:/a/b/c/*.log`)
More > **Exclude Log Files**	Exclude specific logs from collection (e.g., `/var/log/aaa.log`).

Parameters	Description
More > **Execute before Stopping**	Execute commands before container termination. **Example**: `echo "stop"` **Note**: Command execution time must be shorter than pod's `terminationGracePeriodSeconds`.

2. Click **Add Container** (upper right) OR **Add Init Container**.

   See Init Containers ↗. Init Container:

   1.1. Start before app containers (sequential execution).

   1.2. Release resources after completion.

   1.3. Deletion allowed when:

   - Pod has >1 app container AND ≥1 init container.
   - Not allowed for single-app-container pods.

3. Click **Create**.

Reference Information

Storage Volume Mounting instructions

Type	Purpose
Persistent Volume Claim	Binds an existing PVC to request persistent storage. **Note**: Only bound PVCs (with associated PV) are selectable. Unbound PVCs will cause pod creation failures.
ConfigMap	Mounts full/partial ConfigMap data as files: • Full ConfigMap: Creates files named after keys under mount path • Subpath selection: Mount specific key (e.g., `my.cnf`)
Secret	Mounts full/partial Secret data as files: • Full Secret: Creates files named after keys under mount path

Type	Purpose
	• Subpath selection: Mount specific key (e.g., `tls.crt`)
Ephemeral Volumes	Cluster-provisioned temporary volume with features: • Dynamic provisioning • Lifecycle tied to pod • Supports declarative configuration **Use Case**: Temporary data storage. See Ephemeral Volumes
Empty Directory	Ephemeral storage sharing between containers in same pod: • Created on node when pod starts • Deleted with pod removal **Use Case**: Inter-container file sharing, temporary data storage. See EmptyDir
Host Path	Mounts host machine directory (must start with `/`, e.g., `/volumepath`).

Heath Checks

- Health checks YAML file example
- Health checks configuration parameters in web console

Managing Deployments

Managing a Deployment by using CLI

Viewing a Deployment

- Check the Deployment was created.

```
kubectl get deployments
```

- Get details of your Deployment.

```
kubectl describe deployments
```

Updating a Deployment

Follow the steps given below to update your Deployment:

1. Let's update the nginx Pods to use the nginx:1 .16.1 image.

   ```
   kubectl set image deployment.v1.apps/nginx-deployment nginx=nginx:1.16.1
   ```

   or use the following command:

   ```
   kubectl set image deployment/nginx-deployment nginx=nginx:1.16.1
   ```

   Alternatively, you can edit the Deployment and change `.spec.template.spec.containers[0].image` from `nginx:1.14.2` to `nginx:1.16.1`:

   ```
   kubectl edit deployment/nginx-deployment
   ```

2. To see the rollout status, run:

   ```
   kubectl rollout status deployment/nginx-deployment
   ```

   Run kubectl get rs to see that the Deployment updated the Pods by creating a new ReplicaSet and scaling it up to 3 replicas, as well as scaling down the old ReplicaSet to 0 replicas.

   ```
   kubectl get rs
   ```

Running get pods should now show only the new Pods:

```
kubectl get pods
```

Scaling a Deployment

You can scale a Deployment by using the following command:

```
kubectl scale deployment/nginx-deployment --replicas=10
```

Rolling Back a Deployment

- Suppose that you made a typo while updating the Deployment, by putting the image name as `nginx:1.161` instead of `nginx:1.16.1`:

  ```
  kubectl set image deployment/nginx-deployment nginx=nginx:1.161
  ```

- The rollout gets stuck. You can verify it by checking the rollout status:

  ```
  kubectl rollout status deployment/nginx-deployment
  ```

Deleting a Deployment

Deleting a Deployment will also delete its managed ReplicaSet and all associated Pods.

```
kubectl delete deployment <deployment-name>
```

Managing a Deployment by using web console

Viewing a Deployment

You can view a deployment to get information of your application.

1. **Container Platform**, and navigate to **Workloads** > **Deployments**.

2. Locate the Deployment you wish to view.
3. Click the deployment name to see the **Details**, **Topology**, **Logs**, **Events**, **Monitoring**, etc.

Updating a Deployment

1. **Container Platform**, and navigate to **Workloads** > **Deployments**.
2. Locate the Deployment you wish to update.
3. In the **Actions** drop-down menu, select **Update** to view the Edit Deployment page.

Deleting a Deployment

1. **Container Platform**, and navigate to **Workloads** > **Deployments**.
2. Locate the Deployment you wish to delete.
3. In the **Actions** drop-down menu, Click the **Delete** button in the operations column and confirm.

Troubleshooting by using CLI

When a Deployment encounters issues, here are some common troubleshooting methods.

Check Deployment status

```
kubectl get deployment nginx-deployment
kubectl describe deployment nginx-deployment # View detailed events and status
```

Check ReplicaSet status

```
kubectl get rs -l app=nginx
kubectl describe rs <replicaset-name>
```

Check Pod status

```
kubectl get pods -l app=nginx
kubectl describe pod <pod-name>
```

View Logs

```
kubectl logs <pod-name> -c <container-name> # View logs for a specific container
kubectl logs <pod-name> --previous         # View logs for the previously terminated
container
```

Enter Pod for debugging

```
kubectl exec -it <pod-name> -- /bin/bash # Enter the container shell
```

Check Health configuration

Ensure livenessProbe and readinessProbe are correctly configured, and your application's health check endpoints are responding properly. Troubleshooting probe failures

Check Resource Limits

Ensure container resource requests and limits are reasonable and that containers are not being killed due to insufficient resources.

DaemonSets

TOC

Understanding DaemonSets

Refer to the official Kubernetes documentation: DaemonSets ↗

A **DaemonSet** is a Kubernetes controller that ensures all (or a subset of) cluster nodes run exactly one replica of a specified Pod. Unlike Deployments, DaemonSets are node-centric rather than application-centric, making them ideal for deploying cluster-wide infrastructure services such as log collectors, monitoring agents, or storage daemons.

WARNING

DaemonSet Operational Notes

1. **Behavior Characteristics**

   - **Pod Distribution**: A DaemonSet deploys exactly one **Pod** replica per schedulable **Node** that matches its criteria:

     - Deploys exactly **one Pod replica per schedulable node** matching:

       - Matches `nodeSelector` or `nodeAffinity` criteria (if specified).
       - Is not in the `NotReady` state.
       - Does not have `NoSchedule` or `NoExecute` **Taints** unless corresponding **Tolerations** are configured in the **Pod Template**.

   - **Pod Count Formula**: The **number of Pods** managed by a DaemonSet **equals** the **number of qualified Nodes**.

   - **Dual-Role Node Handling**: Nodes serving both **Control Plane** and **Worker Node** roles will only run one **Pod** instance of the DaemonSet, regardless of their role labels, provided they are schedulable.

2. **Key Constraints** (Excluded Nodes)

   - Nodes explicitly marked `Unschedulable: true` (e.g., via `kubectl cordon`).
   - Nodes with a `NotReady` status.

- Nodes having incompatible **Taints** without matching Tolerations configured in the DaemonSet's **Pod Template**.

Creating DaemonSets

Creating a DaemonSet by using CLI

Prerequisites

- Ensure you have `kubectl` configured and connected to your cluster.

YAML file example

```yaml
# example-daemonSet.yaml
apiVersion: apps/v1
kind: DaemonSet
metadata:
  name: fluentd-elasticsearch
  namespace: kube-system
  labels:
    k8s-app: fluentd-logging
spec:
  selector: # defines how the DaemonSet identifies its managed Pods. Must match
`template.metadata.label`s.
    matchLabels:
      name: fluentd-elasticsearch
  updateStrategy:
    type: RollingUpdate
    rollingUpdate:
      maxUnavailable: 1
  template: # defines the Pod Template for the DaemonSet. Each Pod created by this
DaemonSet will conform to this template
    metadata:
      labels:
        name: fluentd-elasticsearch
    spec:
      tolerations: # these tolerations are to have the daemonset runnable on control
plane nodes, remove them if your control plane nodes should not run pods
        - key: node-role.kubernetes.io/control-plane
          operator: Exists
          effect: NoSchedule
        - key: node-role.kubernetes.io/master
          operator: Exists
          effect: NoSchedule
      containers:
        - name: fluentd-elasticsearch
          image: quay.io/fluentd_elasticsearch/fluentd:v2.5.2
          resources:
            limits:
              memory: 200Mi
            requests:
              cpu: 100m
              memory: 200Mi
          volumeMounts:
            - name: varlog
              mountPath: /var/log
      # it may be desirable to set a high priority class to ensure that a DaemonSet Pod
      # preempts running Pods
      # priorityClassName: important
      terminationGracePeriodSeconds: 30
      volumes:
        - name: varlog
          hostPath:
            path: /var/log
```

Creating a DaemonSet via YAML

```
# Step 1: To create the DaemonSet defined in *example-daemonSet.yaml*, execute the
following command
kubectl apply -f example-daemonSet.yaml

# Step 2: To verify the creation and status of your DaemonSet and its associated Pods:
kubectl get daemonset fluentd-elasticsearch # View DaemonSet
kubectl get pods -l name=fluentd-elasticsearch -o wide # Check Pods managed by this
DaemonSet on specific nodes
```

Creating a DaemonSet by using web console

Prerequisites

Obtain the image address. The source of the images can be from the image repository integrated by the platform administrator through the toolchain or from third-party platforms' image repositories.

- For the former, the Administrator typically assigns the image repository to your project, and you can use the images within it. If the required image repository is not found, please contact the Administrator for allocation.
- If it is a third-party platform's image repository, ensure that images can be pulled directly from it in the current cluster.

Procedure - Configure Basic Info

1. **Container Platform**, navigate to **Workloads** > **DaemonSets** in the left sidebar.
2. Click **Create DaemonSet**.

3. **Select** or **Input** an image, and click **Confirm**.

> **INFO**
>
> **Note**: When using images from the image repository integrated into web console, you can filter images by **Already Integrated**. The **Integration Project Name**, for example, images (docker-registry-projectname), which includes the project name projectname in this web console and the project name containers in the image repository.

In the **Basic Info** section, configure declarative parameters for DaemonSet workloads:

Parameters	Description
More > **Update Strategy**	Configures the `rollingUpdate` strategy for zero-downtime updates of DaemonSet Pods. **Max unavailable** (`maxUnavailable`): The maximum number of Pods that can be temporarily unavailable during an update. Accepts absolute values (e.g., 1) or percentages (e.g., 10%). **Example**: If there are 10 nodes and maxUnavailable is 10%, then floor(10 * 0.1) = 1 Pod can be unavailable. **Notes:** • **Default Values**: If not explicitly set, `maxSurge` defaults to 0 and `maxUnavailable` defaults to 1 (or 10% if `maxUnavailable` is specified as a percentage). • **Non-running Pods**: Pods in states like `Pending` or `CrashLoopBackOff` are considered unavailable. • **Simultaneous Constraints**: `maxSurge` and `maxUnavailable` cannot both be 0 or 0%. If percentage values resolve to 0 for both parameters, Kubernetes forces `maxUnavailable=1` to ensure update progress.

Procedure - Configure Pod

Pod section, please refer to Deployment - Configure Pod

Procedure - Configure Containers

Containers section, please refer to Deployment - Configure Containers

Procedure - Create

Click **Create**.

After clicking **Create**, the DaemonSet will:

- ✅ Automatically deploy Pod replicas to all eligible Nodes meeting:
  - `nodeSelector` criteria (if defined).
  - `tolerations` configuration (allowing scheduling on tainted nodes).
  - Node is in `Ready` state and `Schedulable: true`.
- ❌ Excluded Nodes:
  - Nodes with a `NoSchedule` taint (unless explicitly tolerated).
  - Manually cordoned Nodes (`kubectl cordon`).
  - Nodes in `NotReady` or `Unschedulable` states.

Managing DaemonSets

Managing a DaemonSet by using CLI

Viewing a DaemonSet

- To get a summary of all DaemonSets in a namespace.

  ```
  kubectl get daemonsets -n <namespace>
  ```

- To get detailed information about a specific DaemonSet, including its events and Pod status

```
kubectl describe daemonset <daemonset-name>
```

Updating a DaemonSet

When you modify the **Pod Template** of a DaemonSet (e.g., changing the container image or adding a volume mount), Kubernetes automatically performs a rolling update by default (if `updateStrategy.type` is `RollingUpdate`, which is the default).

- First, edit the YAML file (e.g., `example-daemonset.yaml`) with the desired changes, then apply it:

  ```
  kubectl apply -f example-daemonset.yaml
  ```

- You can monitor the progress of the rolling update:

  ```
  kubectl rollout status daemonset/<daemonset-name>
  ```

Deleting a DaemonSet

To delete a DaemonSet and all the Pods it manages:

```
kubectl delete daemonset <daemonset-name>
```

Managing a DaemonSet by using web console

Viewing a DaemonSet

1. **Container Platform**, and navigate to **Workloads** > **DaemonSets**.
2. Locate the DaemonSet you wish to view.
3. Click the DaemonSet name to see the **Details**, **Topology**, **Logs**, **Events**, **Monitoring**, etc.

Updating a DaemonSet

1. **Container Platform**, and navigate to **Workloads** > **DaemonSets**.

2. Locate the DaemonSet you wish to update.

3. In the **Actions** drop-down menu, select **Update** to view the Edit DaemonSet page, you can update `Replicas`, `image`, `updateStrategy`, etc.

Deleting a DaemonSet

1. **Container Platform**, and navigate to **Workloads** > **DaemonSets**.

2. Locate the DaemonSet you wish to delete.

3. In the **Actions** drop-down menu, Click the **Delete** button in the operations column and confirm.

StatefulSets

TOC

Understanding StatefulSets

Refer to the official Kubernetes documentation: StatefulSets ↗

StatefulSet is a Kubernetes workload API object designed to manage stateful applications by providing:

- **Stable network identity**: DNS hostname `<statefulset-name>-<ordinal>.<service-name>.ns.svc.cluster.local`.
- **Stable persistent storage**: via `volumeClaimTemplates`.
- **Ordered deployment/scaling**: sequential Pod creation/deletion: Pod-0 → Pod-1 → Pod-N.
- **Ordered rolling updates**: reverse-ordinal Pod updates: Pod-N → Pod-0.

In distributed systems, multiple StatefulSets can be deployed as discrete components to deliver specialized stateful services (e.g., *Kafka brokers*, *MongoDB shards*).

Creating StatefulSets

Creating a StatefulSet by using CLI

Prerequisites

- Ensure you have `kubectl` configured and connected to your cluster.

YAML file example

```yaml
# example-statefulset.yaml
apiVersion: apps/v1
kind: StatefulSet
metadata:
  name: web
spec:
  selector:
    matchLabels:
      app: nginx # has to match .spec.template.metadata.labels
  serviceName: 'nginx' # this headless Service is responsible for the network identity of
the Pods
  replicas: 3 # defines the desired number of Pod replicas (default: 1)
  minReadySeconds: 10 # by default is 0
  template: # defines the Pod template for the StatefulSet
    metadata:
      labels:
        app: nginx # has to match .spec.selector.matchLabels
    spec:
      terminationGracePeriodSeconds: 10
      containers:
        - name: nginx
          image: registry.k8s.io/nginx-slim:0.24
          ports:
            - containerPort: 80
              name: web
          volumeMounts:
            - name: www
              mountPath: /usr/share/nginx/html
  volumeClaimTemplates: # defines PersistentVolumeClaim (PVC) templates. Each Pod gets a
unique PersistentVolume (PV) dynamically provisioned based on these templates.
    - metadata:
        name: www
      spec:
        accessModes: ['ReadWriteOnce']
        storageClassName: 'my-storage-class'
        resources:
          requests:
            storage: 1Gi
---
# example-service.yaml
apiVersion: v1
kind: Service
metadata:
  name: nginx
  labels:
    app: nginx
spec:
  ports:
    - port: 80
      name: web
  clusterIP: None
  selector:
    app: nginx
```

Creating a StatefulSet via YAML

```
# Step 1: To create the StatefulSet defined in *example-statefulset.yaml*, execute the following command
kubectl apply -f example-statefulset.yaml

# Step 2: To verify the creation and status of your StatefulSet and its associated Pods and PVCs:
kubectl get statefulset web # View StatefulSet
kubectl get pods -l app=nginx # Check Pods managed by this StatefulSet
kubectl get pvc -l app=nginx # Check PVCs created by volumeClaimTemplates
```

Creating a StatefulSet by using web console

Prerequisites

Obtain the image address. The source of the images can be from the image repository integrated by the platform administrator through the toolchain or from third-party platforms' image repositories.

- For the former, the Administrator typically assigns the image repository to your project, and you can use the images within it. If the required image repository is not found, please contact the Administrator for allocation.
- If it is a third-party platform's image repository, ensure that images can be pulled directly from it in the current cluster.

Procedure - Configure Basic Info

1. **Container Platform**, navigate to **Workloads** > **StatefulSets** in the left sidebar.

2. Click **Create StatefulSet**.

3. **Select** or **Input** an image, and click **Confirm**.

> **INFO**
>
> **Note**: When using images from the image repository integrated into web console, you can filter images by **Already Integrated**. The **Integration Project Name**, for example, images (docker-registry-projectname), which includes the project name projectname in this web console and the project name containers in the image repository.

In the **Basic Info** section, configure declarative parameters for StatefulSet workloads:

Parameters	Description
Replicas	Defines the desired number of Pod replicas in the StatefulSet (default: 1). Adjust based on workload requirements and expected request volume.
Update Strategy	Controls phased updates during StatefulSet rolling updates. The `RollingUpdate` strategy is default and recommended. **Partition** value: Ordinal threshold for Pod updates. • Pods with index ≥ `partition` update immediately. • Pods with index < `partition` retain previous spec. **Example**: • `Replicas=5` (Pods: web-0 ~ web-4) • `Partition=3` (Updates web-3 & web-4 only)
Volume Claim Templates	`volumeClaimTemplates` is a critical feature of StatefulSets that enables dynamic per-Pod persistent storage provisioning. Each Pod replica in a StatefulSet automatically gets its own dedicated PersistentVolumeClaim (PVC) based on predefined templates. • 1. **Dynamic PVC Creation**: Automatically creates unique PVCs for each Pod with a naming pattern: `<statefulset-name>-<claim-`

Parameters	Description
	`template-name>-<pod-ordinal>`. **Example**: `web-www-web-0`, `web-www-web-1`. • 2. **Access Modes**: Supports all Kubernetes access modes. • ReadWriteOnce (RWO - single-node read/write) • ReadOnlyMany (ROX - multi-node read-only) • ReadWriteMany (RWX - multi-node read/write). • 3. **Storage Class**: Specify the storage backend via storageClassName. It uses the cluster's default StorageClass if unspecified. Supports various cloud/on-prem storage types (e.g., SSD, HDD). • 4. **Capacity**: Configure storage capacity through resources.requests.storage. **Example**: 1Gi. Supports dynamic volume expansion if enabled by the StorageClass.

Procedure - Configure Pod

Pod section, please refer to Deployment - Configure Pod

Procedure - Configure Containers

Containers section, please refer to Deployment - Configure Containers

Procedure - Create

Click **Create**.

Heath Checks

- Health checks YAML file example
- Health checks configuration parameters in web console

Managing StatefulSets

Managing a StatefulSet by using CLI

Viewing a StatefulSet

You can view a StatefulSet to get information of your application.

- Check the StatefulSet was created.

```
kubectl get statefulsets
```

- Get details of your StatefulSet.

```
kubectl describe statefulsets
```

Scaling a StatefulSet

- To change the number of replicas for an existing StatefulSet:

```
kubectl scale statefulset <statefulset-name> --replicas=<new-replica-count>
```

- Example:

```
kubectl scale statefulset web --replicas=5
```

Updating a StatefulSet (Rolling Update)

When you modify the Pod template of a StatefulSet (e.g., changing the container image), Kubernetes performs a rolling update by default (if updateStrategy is set to RollingUpdate, which is the default).

- First, edit the YAML file (e.g., example-statefulset.yaml) with the desired changes, then apply it:

```
kubectl apply -f example-statefulset.yaml
```

- Then, you can monitor the progress of the rolling update:

```
kubectl rollout status statefulset/<statefulset-name>
```

Deleting a StatefulSet

To delete a StatefulSet and its associated Pods:

```
kubectl delete statefulset <statefulset-name>
```

By default, deleting a StatefulSet does not delete its associated PersistentVolumeClaims (PVCs) or PersistentVolumes (PVs) to prevent data loss. To also delete the PVCs, you must do so explicitly:

```
kubectl delete pvc -l app=<label-selector-for-your-statefulset> # Example: kubectl delete pvc -l app=nginx
```

Alternatively, if your `volumeClaimTemplates` use a `StorageClass` with a `reclaimPolicy` of `Delete`, the PVs and underlying storage will be deleted automatically when the PVCs are deleted.

Managing a StatefulSet by using web console

Viewing a StatefulSet

1. **Container Platform**, and navigate to **Workloads** > **StatefulSets**.
2. Locate the StatefulSet you wish to view.
3. Click the statefulSet name to see the **Details**, **Topology**, **Logs**, **Events**, **Monitoring**, etc.

Updating a StatefulSet

1. **Container Platform**, and navigate to **Workloads** > **StatefulSets**.
2. Locate the StatefulSet you wish to update.
3. In the **Actions** drop-down menu, select **Update** to view the Edit StatefulSet page, you can update `Replicas`, `image`, `updateStrategy`, etc.

Deleting a StatefulSet

1. **Container Platform**, and navigate to **Workloads** > **StatefulSets**.
2. Locate the StatefulSet you wish to delete.
3. In the **Actions** drop-down menu, Click the **Delete** button in the operations column and confirm.

CronJobs

TOC

Understanding CronJobs

Refer to the official Kubernetes documentation:

- CronJobs ↗
- Running Automated Tasks with a CronJob ↗

CronJob define tasks that run to completion and then stop. They allow you to run the same Job multiple times according to a schedule.

A **CronJob** is a type of workload controller in Kubernetes. You can create a CronJob through the web console or CLI to periodically or repeatedly run a non-persistent program, such as scheduled backups, scheduled clean-ups, or scheduled email dispatches.

Creating CronJobs

Creating a CronJob by using CLI

Prerequisites

- Ensure you have `kubectl` configured and connected to your cluster.

YAML file example

```yaml
# example-cronjob.yaml
apiVersion: batch/v1
kind: CronJob
metadata:
  name: hello
spec:
  schedule: "* * * * *"
  jobTemplate:
    spec:
      template:
        spec:
          containers:
          - name: hello
            image: busybox:1.28
            imagePullPolicy: IfNotPresent
            command:
            - /bin/sh
            - -c
            - date; echo Hello from the Kubernetes cluster
          restartPolicy: OnFailure
```

Creating a CronJobs via YAML

```
kubectl apply -f example-cronjob.yaml
```

Creating CronJobs by using web console

Prerequisites

Obtain the image address. Images can be sourced from an image registry integrated by the platform administrator via a toolchain, or from third-party image registries.

- For images from an integrated registry, the Administrator typically assigns the image registry to your project, allowing you to use the images within it. If the required image registry is not found, please contact the Administrator for allocation.
- If using a third-party image registry, ensure that images can be pulled directly from it within the current cluster.

Procedure - Configure basic info

1. **Container Platform**, navigate to **Workloads** > **CronJobs** in the left sidebar.

2. Click on **Create CronJob**.

3. **Select** or **Input** an image, and click **Confirm**.

   Note: Image filtering is available only when using images from the platform's integrated image registry. For example, an integrated project name like containers (docker-registry-projectname) indicates the platform's project name projectname and the image registry's project name containers.

4. In the **Cron Configuration** section, configure the task execution method and associated parameters.

   Execute Type:

   - **Manual**: Manual execution requires explicit manual triggering for each task run.

   - **Scheduled**: Scheduled execution requires configuring the following scheduling parameters:

Parameter	Description
Schedule	Define the cron schedule using Crontab syntax. The CronJob controller calculates the next execution time based on the selected timezone. **Notes**: • For Kubernetes clusters < v1.25: Timezone selection is unsupported; schedules MUST use UTC. • For Kubernetes clusters ≥ v1.25: Timezone-aware scheduling is supported (default: user's local timezone).
Concurrency Policy	Specify how concurrent Job executions are handled (`Allow` , `Forbid` , or `Replace` per K8s spec).

   Job History Retention:

- Set retention limits for completed Jobs:
  - **History Limits**: Successful jobs history limit (default: 20)
  - **Failed Jobs**: Failed jobs history limit** (default: 20)
- When retention limits are exceeded, the oldest jobs are garbage-collected first.

5. In the **Job Configuration** section, select the job type. A CronJob manages Jobs composed of Pods. Configure the Job template based on your workload type:

Parameter	Description
Job Type	Select Job completion mode (`Non-parallel` , `Parallel with fixed completion count` , or `Indexed Job` per K8s Job patterns ↗).
Backoff Limit	Set the maximum number of retry attempts before marking a Job as failed.

Procedure - Configure Pod

- **Pod** section, please refer to Deployment - Configure Pod

Procedure - Configure Containers

- **Container** section, please refer to Deployment - Configure Containers

Create

- Click **Create**.

Execute Immediately

Locate the CronJob resource

- **web console**: **Container Platform**, and navigate to **Workloads** > **CronJobs** in the left sidebar.
- **CLI**:

```
kubectl get cronjobs -n <namespace>
```

Initiate ad-hoc execution

- **web console**: **Execute Immediately**

  1. Click the vertical ellipsis (⋮) on the right side of the cronjob list.
  2. Click **Execute Immediately**. (Alternatively, from the CronJob details page, click Actions in the upper-right corner and select **Execute Immediately**).

- **CLI**:

  ```
  kubectl create job --from=cronjob/<cronjob-name> <job-name> -n <namespace>
  ```

Verify Job details:

```
kubectl describe job/<job-name> -n <namespace>
kubectl logs job/<job-name> -n <namespace>
```

Monitor execution status

Status	Description
Pending	The Job has been created but not yet scheduled.
Running	The Job Pod(s) are actively executing.
Succeeded	All Pods associated with the Job completed successfully (exit code 0).
Failed	At least one Pod associated with the Job terminated unsuccessfully (non-zero exit code).

Deleting CronJobs

Deleting CronJobs by using web console

1. **Container Platform**, and navigate to **Workloads** > **CronJobs**.
2. Locate the CronJobs you wish to delete.
3. In the **Actions** drop-down menu, Click the **Delete** button and confirm.

Deleting CronJobs by using CLI

```
kubectl delete cronjob <cronjob-name>
```

Jobs

TOC

Understanding Jobs

Refer to the official Kubernetes documentation: Jobs ↗

A **Job** provide different ways to define tasks that run to completion and then stop. You can use a Job to define a task that runs to completion, just once.

- **Atomic Execution Unit**: Each Job manages one or more Pods until successful completion.
- **Retry Mechanism**: Controlled by `spec.backoffLimit` (default: 6).
- **Completion Tracking**: Use `spec.completions` to define required success count.

YAML file example

```yaml
# example-job.yaml
apiVersion: batch/v1
kind: Job
metadata:
  name: data-processing-job
spec:
  completions: 1 # Number of successful completions required
  parallelism: 1 # Maximum parallel Pods
  backoffLimit: 3 # Maximum retry attempts
  template:
    spec:
      restartPolicy: Never # Job-specific policy (Never/OnFailure)
      containers:
        - name: processor
          image: alpine:3.14
          command: ['/bin/sh', '-c']
          args:
            - echo "Processing data..."; sleep 30; echo "Job completed"
```

Execution Overview

Each Job execution in Kubernetes creates a dedicated Job object, enabling users to:

- **Creating a job via**

  ```
  kubectl apply -f example-job.yaml
  ```

- **Track job lifecycle via**

  ```
  kubectl get jobs
  ```

- **Inspect execution details via**

  ```
  kubectl describe job/<job-name>
  ```

- **View Pod logs via**

```
kubectl logs <pod-name>
```

Pods

TOC

Understanding Pods

Refer to the official Kubernetes website documentation: Pod ↗

A **Pod** is the smallest deployable unit of computing that you can create and manage in Kubernetes. A **Pod** (as in a pod of whales or a pea pod) is a group of one or more containers (such as Docker containers), with shared storage and network resources, and a specification for how to run the containers. **Pods** are the fundamental building blocks on which all higher-level controllers (like **Deployments**, **StatefulSets**, **DaemonSets**) are built.

YAML file example

pod-example.yaml

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: my-nginx-pod
  labels:
    app: nginx
spec:
  containers:
    - name: nginx
      image: nginx:latest # The container image to use.
      ports:
        - containerPort: 80 # Container ports exposed.
      resources: # Defines CPU and memory requests and limits for the container.
        requests:
          cpu: '100m'
          memory: '128Mi'
        limits:
          cpu: '200m'
          memory: '256Mi'
```

Managing a Pod by using CLI

While Pods are often managed by higher-level controllers, direct kubectl operations on Pods are useful for troubleshooting, inspection, and ad-hoc tasks.

Viewing a Pod

- To list all Pods in the current namespace:

```
kubectl get pods
```

- To list all Pods across all namespaces:

```
kubectl get pods --all-namespaces
# Or a shorter version:
kubectl get pods -A
```

- To get detailed information about a specific Pod:

```
kubectl describe pod <pod-name> -n <namespace>

# Example
kubectl describe pod my-nginx-pod -n default
```

Viewing a Pod Logs

- To stream logs from a container within a Pod (useful for debugging):

```
kubectl logs <pod-name> -n <namespace>
```

- If a Pod has multiple containers, you must specify the container name:

```
kubectl logs <pod-name> -c <container-name> -n <namespace>
```

- To follow the logs (stream new logs as they appear):

```
kubectl logs -f <pod-name> -n <namespace>
```

Executing Commands in a Pod

To execute a command inside a specific container within a Pod (useful for debugging, like accessing a shell):

```
kubectl exec -it <pod-name> -n <namespace> -- <command>

# Example (to get a shell):
kubectl exec -it my-nginx-pod -n default -- /bin/bash
```

Port Forwarding to a Pod

To forward a local port to a port on a Pod, allowing direct access to a service running inside the Pod from your local machine (useful for testing or direct access without exposing the service externally):

```
kubectl port-forward <pod-name> <local-port>:<pod-port> -n <namespace>

#Example
kubectl port-forward my-nginx-pod 8080:80 -n default
```

After running this command, you can access the Nginx web server running in my-nginx-pod by visiting localhost:8080 in your web browser.

Deleting a Pod

- To delete a specific Pod:

  ```
  kubectl delete pod <pod-name> -n <namespace>

  # Example
  kubectl delete pod my-nginx-pod -n default
  ```

- To delete multiple Pods by their names:

  ```
  kubectl delete pod <pod-name-1> <pod-name-2> -n <namespace>
  ```

- To delete Pods based on a label selector (e.g., delete all Pods with the label app=nginx):

```
kubectl delete pods -l app=nginx -n <namespace>
```

Managing a Pod by using web console

Viewing a Pod

The platform interface provides various information about the pods for quick reference.

Procedure

1. **Container Platform**, navigate to **Workloads** > **Pods** in the left sidebar.
2. Locate the Pod you wish to view.
3. Click the deployment name to see the **Details**, **YAML**, **Configuration**, **Logs**, **Events**, **Monitoring**, etc.

Pod Parameters

Below are some parameter explanations:

Parameter	Description
Resource Requests & Limits	**Resource Requests** and **Limits** define the CPU and memory consumption boundaries for Containers within a Pod, which then aggregate to form the Pod's overall resource profile. These values are crucial for Kubernetes' scheduler to efficiently place Pods on Nodes and for the kubelet to enforce resource governance. • **Requests**: The minimum guaranteed CPU/memory required for a container to be **scheduled** and run. This value is used by the Kubernetes scheduler to decide which **Node** a Pod can run on. • **Limits**: The maximum CPU/memory a container is allowed to consume during its execution. Exceeding CPU limits results in

Parameter	Description
	throttling, while exceeding memory limits leads to the container being terminated (Out Of Memory - OOM Killed). For detailed unit definitions (e.g., `m` for milliCPU, `Mi` for mebibytes), refer to Resource Units. **Pod-Level Resource Calculation Logic** The effective CPU and memory Requests and Limits values for a Pod are derived from the sum and maximum of its individual container specifications. The calculation method for Pod-level Requests and Limits is analogous; this document illustrates the logic using Limit values as an example. When a Pod contains only standard containers (business containers): The Pod's effective CPU/Memory Limit value is the sum of the CPU/Memory Limit values of all containers within the Pod. **Example**: If a Pod includes two containers with CPU/Memory Limits of 100m/100Mi and 50m/200Mi respectively, the Pod's aggregated CPU/Memory Limit will be 150m/300Mi. When a Pod contains both initContainers and standard containers: The calculation steps for the Pod's CPU/Memory Limit values are as follows: • 1. Determine the maximum CPU/Memory Limit value among all initContainers. • 2. Calculate the sum of CPU/Memory Limit values of all standard containers. • 3. Compare the results from step 1 and step 2. The Pod's comprehensive CPU/Memory Limit will be the maximum of the CPU values (from initContainers max and containers sum) and the maximum of the Memory values (from initContainers max and containers sum). **Calculation Example**: If a Pod contains two initContainers with CPU/Memory Limits of 100m/200Mi and 200m/100Mi, the maximum effective CPU/Memory Limit for the initContainers would be 200m/200Mi. Simultaneously, if the Pod also contains two standard

Parameter	Description
	containers with CPU/Memory Limits of 100m/100Mi and 50m/200Mi, the total aggregated Limit for the standard containers will be 150m/300Mi. Therefore, the Pod's comprehensive CPU/Memory Limit would be max(200m, 150m) for CPU and max(200Mi, 300Mi) for Memory, resulting in 200m/300Mi.
Source	The Kubernetes workload controller that manages this Pod's life cycle. This includes **Deployments**, **StatefulSets**, **DaemonSets**, **Jobs**.
Restart	The number of times the Container within the **Pod** has restarted since the **Pod** was started. A high restart count often indicates an issue with the application or its environment.
Node	The name of the Kubernetes Node where the Pod is currently scheduled and running.
Service Account	A Service Account is a Kubernetes object that provides an identity for processes and services running inside a Pod, allowing them to authenticate and access the Kubernetes APIServer. This field is typically visible only when the currently logged-in user has the platform administrator role or the platform auditor role, enabling the viewing of the Service Account's YAML definition.

Deleting a Pod

Deleting pods may affect the operation of computing components; please proceed with caution.

Use Cases

- Restore the pods to its desired state promptly: If a pods remains in a state that affects business operations, such as `Pending` or `CrashLoopBackOff`, manually deleting the pods after addressing the error message can help it quickly return to its desired state, such as `Running`. At this time, the deleted pods will be rebuilt on the current node or rescheduled.
- Resource cleanup for operations management: Some podss reach a designated stage where they no longer change, and these groups often accumulate in large numbers,

complicating the management of other podss. The podss to be cleaned up may include those in the `Evicted` status due to insufficient node resources or those in the `Completed` status triggered by recurring scheduled tasks. In this case, the deleted podss will no longer exist.

Note: For scheduled tasks, if you need to check the logs of each task execution, it is not recommended to delete the corresponding `Completed` status podss.

Procedure

1. Go to **Container Platform**.
2. In the left navigation bar, click **Workloads** > **Pods**.
3. (Delete individually) Click the ⋮ on the right side of the pods to be deleted > **Delete**, and confirm.
4. (Delete in bulk) Select the podss to be deleted, click **Delete** above the list, and confirm.

Containers

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Understanding Containers

Refer to the official Kubernetes website documentation: Containers ↗.

A **container** is a lightweight, executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries, and settings. While Pods are the smallest deployable units, containers are the core components within Pods.

Understanding Ephemeral Containers

Debugging Containers with Refer to the official Kubernetes website documentation: Ephemeral Containers

The Kubernetes Ephemeral Containers feature provides a robust way to debug running containers by injecting specialized debugging tools (system, network, and disk utilities) into an existing Pod.

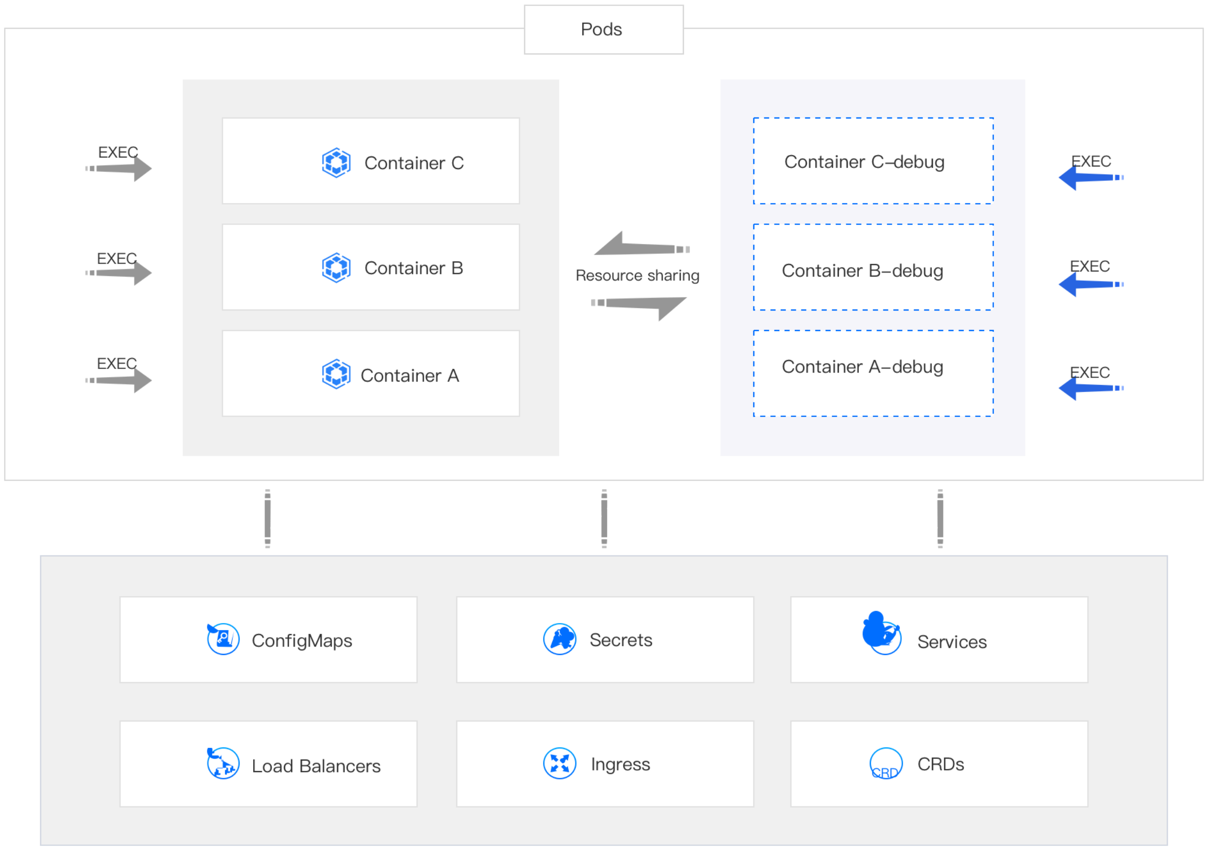
While you can often execute commands directly within a running container using kubectl exec, many production container images are intentionally minimal and may lack essential debugging utilities (e.g., bash, net-tools, tcpdump) to reduce image size and attack surface. Ephemeral Containers address this limitation by providing a pre-configured environment with a rich set of debugging tools, making them ideal for the following scenarios:

- **Fault Diagnosis**: When a primary application container experiences issues (e.g., unexpected crashes, performance degradation, network connectivity problems), beyond checking standard Pod events and logs, you often need to perform deeper, interactive troubleshooting directly within the Pod's runtime environment.
- **Configuration Tuning and Experimentation**: If the current application configuration exhibits suboptimal behavior, you might want to temporarily adjust component settings or test new configurations directly within the running container to observe immediate effects and devise improved solutions.

Implementation Principle: Leveraging Ephemeral Containers

The debugging functionality is implemented using **Ephemeral Containers**. An Ephemeral Container is a special type of container designed for introspection and debugging. It shares the Pod's network namespace and process namespace (if enabled) with the existing primary `containers` , allowing it to directly interact with and observe the application processes.

You can dynamically add an Ephemeral Container (e.g., `my-app-debug`) to a running Pod and utilize its pre-installed debugging tools. The diagnostic results from this Ephemeral Container are directly relevant to the behavior and state of the primary application `containers` within the same Pod.



:::Notes * You cannot add an Ephemeral Container by directly modifying a Pod's static manifest (PodSpec). The Ephemeral Containers feature is designed for dynamic injection into running Pods, typically via API calls (like kubectl debug). * **Ephemeral Containers** created via the debug feature do not have resource (CPU/Memory) or scheduling guarantees (i.e., they don't block Pod startup or get their own QoS class) and will not automatically restart if they exit. Therefore, avoid running persistent business applications within them; they are strictly for debugging purposes. * Exercise caution when using the debug feature if the Node where the Pod is located is experiencing high resource utilization or is nearing resource exhaustion. Injecting an Ephemeral Container, even with minimal resource footprint, could potentially contribute to Pod eviction under severe resource pressure. :::

Debugging Ephemeral Containers by using CLI

Kubernetes 1.25+ offers the `kubectl debug` command for creating ephemeral containers. This method provides a powerful command-line alternative for debugging.

Command

```
kubectl debug -it <pod-name> --image=<debug-image> --target=<target-container-name> -n
<namespace>
# --image: Specifies the debug image (e.g., busybox, ubuntu, nicolaka/netshoot)
containing necessary tools.
# --target: (Optional) Specifies the name of the container in the Pod to target. If
omitted, and there's only one container, it defaults to that. If multiple, it defaults to
the first.
# -n: Specifies the namespace.
```

Pod YAML file example

Example: Debugging `nginx` in `my-nginx-pod`

- First, ensure you have a Pod running:

  ```
  kubectl apply -f pod-example.yaml
  ```

- Now, create an ephemeral debug container named `debugger` inside `my-nginx-pod`, targeting my-nginx-container, using the `busybox` image:

  ```
  kubectl debug -it my-nginx-pod --image=busybox --target=nginx -- /bin/sh
  ```

  This command will attach you to a shell inside the debugger ephemeral container. You can now use busybox tools to debug my-nginx-container.

- To view the ephemeral containers attached to a Pod:

  ```
  kubectl describe pod my-nginx-pod
  ```

  Look for the `Ephemeral Containers` section in the output.

Debugging Ephemeral Containers by using web console

1. **Container Platform**, and navigate to **Workloads** > **Pods** in the left sidebar.

2. Locate the Pod you wish to view, and click ⋮ > **Debug**.

3. Choose the specific container within the Pod you wish to debug.

4. (Optional) If the interface prompts that **initialization is required** (e.g., for setting up necessary debug environment), click **Initialize**.

> **INFO**
>
> After initializing the Debug feature, as long as the pod is not recreated, you can directly enter the Ephemeral Container (for example, *Container A-debug*) for debugging.

5. Wait for the debugging terminal window to become ready, then begin your debugging operations. Tip: Click the "Command Query" option in the upper right corner of the terminal to view a list of common debugging tools and their usage examples.

> **INFO**
>
> Click the command query in the upper right corner to view common tools and their usage.

6. Once debugging is complete, close the terminal window.

Interacting with Containers

You can directly interact with the internal instance of a running container using the `kubectl exec` command, allowing you to execute arbitrary command-line operations. Additionally, Kubernetes provides convenient features for uploading and downloading files to and from containers.

Interacting with Containers by using CLI

Exec

To execute a command inside a specific container within a Pod (useful for getting a shell, running diagnostic commands, etc.):

```
kubectl exec -it <pod-name> -c <container-name> -n <namespace> -- <command>
# -it: Ensures interactive mode and a TTY (pseudo-terminal) for a shell session.
# -c: Specifies the target container name within the Pod. Omit if the Pod has only one
container.
# --: Separates kubectl arguments from the command to be executed in the container.
```

- **Example**: Getting a Bash shell in the `nginx` of `my-nginx-pod`

  ```
  kubectl exec -it my-nginx-pod -c nginx -n default -- /bin/bash
  ```

- **Example**: Listing files in `/tmp` of a container

  ```
  kubectl exec my-nginx-pod -c nginx -n default -- ls /tmp
  ```

Transfer Files

- To copy files from your local machine to a container within a Pod:

  ```
  kubectl cp <local-file-path> <namespace>/<pod-name>:<container-file-path> -c
  <container-name>
  # -c: (Optional) Specifies the target container name if the Pod has multiple
  containers.

  # Example: Uploading `my-config.txt` to Nginx's HTML directory
  kubectl cp my-config.txt default/my-nginx-pod:/usr/share/nginx/html/my-config.txt -c
  nginx
  ```

- To copy files from a container within a Pod to your local machine:

  ```
  kubectl cp <namespace>/<pod-name>:<container-file-path> <local-file-path> -c
  <container-name>

  # Example: Downloading Nginx access logs
  kubectl cp default/my-nginx-pod:/var/log/nginx/access.log ./nginx_access.log -c nginx
  ```

Interacting with Containers by using web console

Entering the Container through Applications

You can enter the internal instance of the container using the `kubectl exec` command, allowing you to execute command-line operations in the Web console window. Additionally, you can easily upload and download files within the container using the file transfer feature.

1. **Container Platform**, and navigate to **Application** > **Applications** in the life sidebar.
2. Click on ***Application Name***.
3. Locate the associated workload (e.g., Deployment, StatefulSet), click **EXEC**, and then select the specific *Pod Name* you wish to enter. **EXEC** > ***Contianer Name***.
4. Enter the command you wish to execute.
5. Click **OK** to enter the Web console window and execute command-line operations.
6. Click **File Transfer**.

- Enter an **Upload Path** to upload local files into the container (e.g., configuration files for testing).
- Enter a **Download Path** to download logs, diagnostic data, or other files from the container to your local machine for analysis.

Entering the Container through the Pod

1. **Container Platform**, and navigate to **Workloads** > **Pods**.
2. Locate the target Pod, click the vertical ellipsis (⋮) next to it, select EXEC, and then choose the specific Container Name within that Pod you wish to enter.
3. Enter the command you wish to execute.
4. Click **OK** to enter the Web console window and execute command-line operations.
5. Click **File Transfer**.

- Enter an **Upload Path** to upload local files into the container (e.g., configuration files for testing).

- Enter a **Download Path** to download logs, diagnostic data, or other files from the container to your local machine for analysis.

Working with Helm charts

TOC

1. Understanding Helm

Helm is a package manager that simplifies the deployment of applications and services on Alauda Container Platform clusters. Helm uses a packaging format called *charts*. A Helm chart is a collection of files that describe Kubernetes resources. Creating a chart in a cluster generates a chart running instance called a *release*. Each time a chart is created, or a release is upgraded or rolled back, an incremental revision is created.

1.1. Key features

Helm provides the ability to:

- Search for a large collection of charts in chart repositories
- Modify existing charts
- Create your own charts using Kubernetes resources
- Package applications and share them as charts

1.2. Catalog

The Catalog is built on Helm and provides a comprehensive Chart distribution management platform, extending the limitations of the Helm CLI tool. The platform enables developers to more conveniently manage, deploy, and use charts through a user-friendly interface.

Terminology Definitions

Term	Definition	Notes
Application Catalog	A one-stop management platform for Helm Charts	

Term	Definition	Notes
Helm Charts	An application packaging format	
HelmRequest	CRD. Defines the configuration needed to deploy a Helm Chart	Template Application
ChartRepo	CRD. Corresponds to a Helm charts repository	Template Repository
Chart	CRD. Corresponds to Helm Charts	Template

1.3 Understanding HelmRequest

In Alauda Container Platform, Helm deployments are primarily managed through a custom resource called **HelmRequest**. This approach extends standard Helm functionality and integrates it seamlessly into the Kubernetes native resource model.

Differences Between HelmRequest and Helm

Standard Helm uses CLI commands to manage releases, while Alauda Container Platform uses HelmRequest resources to define, deploy, and manage Helm charts. Key differences include:

1. **Declarative vs Imperative**: HelmRequest provides a declarative approach to Helm deployments, while traditional Helm CLI is imperative.
2. **Kubernetes Native**: HelmRequest is a custom resource directly integrated with the Kubernetes API.
3. **Continuous Reconciliation**: Captain continuously monitors and reconciles HelmRequest resources with their desired state.
4. **Multi-cluster Support**: HelmRequest supports deployments across multiple clusters through the platform.
5. **Platform Feature Integration**: HelmRequest can be integrated with other platform features, such as Application resources.

HelmRequest and Application Integration

HelmRequest and Application resources have conceptual similarities, and users may want to view them uniformly. The platform provides a mechanism to synchronize HelmRequest as Application resources.

Users can mark a HelmRequest to be deployed as an Application by adding the following annotation:

```
alauda.io/create-app: "true"
```

When this feature is enabled, the platform UI displays additional fields and links to the corresponding Application page.

Deployment Workflow

The workflow for deploying charts via HelmRequest includes:

1. **User** creates or updates a HelmRequest resource
2. **HelmRequest** contains chart references and values to apply
3. **Captain** processes the HelmRequest and creates a Helm Release
4. **Release** contains the deployed resources
5. **Metis** monitors HelmRequests with application annotations and synchronizes them to Applications
6. **Application** provides a unified view of deployed resources

Component Definitions

- **HelmRequest**: Custom resource definition that describes the desired Helm chart deployment
- **Captain**: Controller that processes HelmRequest resources and manages Helm releases (source code available at https://github.com/alauda/captain ↗)
- **Release**: Deployed instance of a Helm chart
- **Charon**: Component that monitors HelmRequests and creates corresponding Application resources
- **Application**: Unified representation of deployed resources, providing additional management capabilities

- **Archon-api**: Component responsible for specific advanced API functions within the platform

---

2 Deploying Helm Charts as Applications via CLI

2.1 Workflow Overview

Prepare chart → Package chart → Obtain API token → Create chart repository → Upload chart → Upload related images → Deploy application → Update application → Uninstall application → Delete chart repository

2.2 Preparing the Chart

Helm uses a packaging format called charts. A chart is a collection of files that describe Kubernetes resources. A single chart can be used to deploy anything from a simple pod to a complex application stack.

Refer to the official documentation: Helm Charts Documentation ↗

Example chart directory structure:

```
nginx/
├── Chart.lock
├── Chart.yaml
├── README.md
├── charts/
│   └── common/
│       ├── Chart.yaml
│       ├── README.md
│       ├── templates/
│       │   ├── _affinities.tpl
│       │   ├── _capabilities.tpl
│       │   ├── _errors.tpl
│       │   ├── _images.tpl
│       │   ├── _ingress.tpl
│       │   ├── _labels.tpl
│       │   ├── _names.tpl
│       │   ├── _secrets.tpl
│       │   ├── _storage.tpl
│       │   ├── _tplvalues.tpl
│       │   ├── _utils.tpl
│       │   ├── _warnings.tpl
│       │   └── validations/
│       │       ├── _cassandra.tpl
│       │       ├── _mariadb.tpl
│       │       ├── _mongodb.tpl
│       │       ├── _postgresql.tpl
│       │       ├── _redis.tpl
│       │       └── _validations.tpl
│       └── values.yaml
├── ci/
│   ├── ct-values.yaml
│   └── values-with-ingress-metrics-and-serverblock.yaml
├── templates/
│   ├── NOTES.txt
│   ├── _helpers.tpl
│   ├── deployment.yaml
│   ├── extra-list.yaml
│   ├── health-ingress.yaml
│   ├── hpa.yaml
│   ├── ingress.yaml
│   ├── ldap-daemon-secrets.yaml
│   ├── pdb.yaml
│   ├── server-block-configmap.yaml
│     ├──── serviceaccount.yaml
│     ├──── servicemonitor.yaml
│     ├──── svc.yaml
│     └──── tls-secrets.yaml
├──── values.descriptor.yaml
├──── values.schema.json
└──── values.yaml
```

Key file descriptions:

- `values.descriptor.yaml` (optional): Works with ACP UI to display user-friendly forms
- `values.schema.json` (optional): Validates values.yaml content and renders a simple UI
- `values.yaml` (required): Defines chart deployment parameters

2.3 Packaging the Chart

Use the `helm package` command to package the chart:

```
helm package nginx
# 输出: Successfully packaged chart and saved it to: /charts/nginx-8.8.0.tgz
```

2.4 Obtaining an API Token

1. In **Alauda Container Platform**, click the avatar in the top-right corner => **Profile**
2. Click **Add Api Token**
3. Enter appropriate Description & Remaining Validity
4. Save the displayed token information (only shown once)

2.5 Creating a Chart Repository

Create a local chart repository via API:

```
curl -k --request POST \
--url https://$ACP_DOMAIN/catalog/v1/chartrepos \
--header 'Authorization:Bearer $API_TOKEN' \
--header 'Content-Type: application/json' \
--data '{
  "apiVersion": "v1",
  "kind": "ChartRepoCreate",
  "metadata": {
    "name": "test",
    "namespace": "cpaas-system"
  },
  "spec": {
    "chartRepo": {
      "apiVersion": "app.alauda.io/v1beta1",
      "kind": "ChartRepo",
      "metadata": {
        "name": "test",
        "namespace": "cpaas-system",
        "labels": {
          "project.cpaas.io/catalog": "true"
        }
      },
      "spec": {
        "type": "Local",
        "url": null,
        "source": null
      }
    }
  }
}'
```

2.6 Uploading the Chart

Upload the packaged chart to the repository:

```
curl -k --request POST \
--url https://$ACP_DOMAIN/catalog/v1/chartrepos/cpaas-system/test/charts \
--header 'Authorization:Bearer $API_TOKEN' \
--data-binary @"/root/charts/nginx-8.8.0.tgz"
```

2.7 Uploading Related Images

1. Pull the image: `docker pull nginx`
2. Save as tar package: `docker save nginx > nginx.latest.tar`
3. Load and push to private registry:

```
docker load -i nginx.latest.tar
docker tag nginx:latest 192.168.80.8:30050/nginx:latest
docker push 192.168.80.8:30050/nginx:latest
```

2.8 Deploying the Application

Create Application resource via API:

```
curl -k --request POST \
--url
https://$ACP_DOMAIN/acp/v1/kubernetes/$CLUSTER_NAME/namespaces/$NAMESPACE/applications \
--header 'Authorization:Bearer $API_TOKEN' \
--header 'Content-Type: application/json' \
--data '{
  "apiVersion": "app.k8s.io/v1beta1",
  "kind": "Application",
  "metadata": {
    "name": "test",
    "namespace": "catalog-ns",
    "annotations": {
      "app.cpaas.io/chart.source": "test/nginx",
      "app.cpaas.io/chart.version": "8.8.0",
      "app.cpaas.io/chart.values": "{\"image\":{\"pullPolicy\":\"IfNotPresent\"}}"
    },
    "labels": {
      "sync-from-helmrequest": "true"
    }
  }
}'
```

2.9 Updating the Application

Update the application using PATCH request:

```
curl -k --request PATCH \
--url
https://$ACP_DOMAIN/acp/v1/kubernetes/$CLUSTER_NAME/namespaces/$NAMESPACE/applications/test
\
--header 'Authorization:Bearer $API_TOKEN' \
--header 'Content-Type: application/merge-patch+json' \
--data '{
  "apiVersion": "app.k8s.io/v1beta1",
  "kind": "Application",
  "metadata": {
    "annotations": {
      "app.cpaas.io/chart.values": "{\"image\":{\"pullPolicy\":\"Always\"}}"
    }
  }
}'
```

2.10 Uninstalling the Application

Delete the Application resource:

```
curl -k --request DELETE \
--url
https://$ACP_DOMAIN/acp/v1/kubernetes/$CLUSTER_NAME/namespaces/$NAMESPACE/applications/test
\
--header 'Authorization:Bearer $API_TOKEN'
```

2.11 Deleting the Chart Repository

```
curl -k --request DELETE \
--url https://$ACP_DOMAIN/apis/app.alauda.io/v1beta1/namespaces/cpaas-
system/chartrepos/test \
--header 'Authorization:Bearer $API_TOKEN'
```

3. Deploying Helm Charts as Applications via UI

3.1 Workflow Overview

Add templates to manageable repositories → Upload templates → Manage template versions

3.2 Prerequisites

Template repositories are added by platform administrators. Please contact the platform administrator to obtain the available Chart or OCI Chart type template repository names with **Management** permissions.

3.3 Adding Templates to Manageable Repositories

1. Go to **Catalog**.
2. In the left navigation bar, click **Helm Charts**.
3. Click **Add Template** in the upper right corner of the page, and select the template repository based on the parameters below.

Parameter	Description
Template Repository	Synchronize the template directly to a Chart or OCI Chart type template repository with **Management** permissions. Project owners assigned to this **Template Repository** can directly use the template.
Template Directory	When the selected template repository type is OCI Chart, a directory to store the Helm Chart must be selected or manually entered. **Note**: When manually entering a new template directory, the platform will create this directory in the template repository, but there is a risk of creation failure.

4. Click **Upload Template** and upload the local template to the repository.

5. Click **Confirm**. The template upload process may take a few minutes, please be patient.

   Note: When the template status changes from `Uploading` to `Upload Successful`, it indicates that the template has been uploaded successfully.

6. If the upload fails, please troubleshoot according to the following prompts.

   Note: An illegal file format means there is an issue with the files in the uploaded compressed package, such as missing content or incorrect formatting.

3.4 Deleting Specific Versions of Templates

If a version of a template is no longer applicable, it can be deleted.

Steps to Operate

1. Go to **Catalog**.

2. In the left navigation bar, click **Helm Charts**.

3. Click on the Chart card to view details.

4. Click **Manage Versions**.

5. Find the template that is no longer applicable, click **Delete**, and confirm.

   After deleting the version, the corresponding application will not be able to be updated.

Menu

Configurations

Configuring ConfigMap

Config maps allow you to decouple configuration artifacts from image content to keep containerized applications portable. The following sections define config maps and how to create and use them.

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Understanding Config Maps

Many applications require configuration by using some combination of configuration files, command-line arguments, and environment variables. In OpenShift Container Platform, these configuration artifacts are decoupled from image content to keep containerized applications portable.

The `ConfigMap` object provides mechanisms to inject containers with configuration data while keeping containers agnostic of OpenShift Container Platform. A config map can be used to store fine-grained information like individual properties or coarse-grained information like entire configuration files or JSON blobs.

The `ConfigMap` object holds key-value pairs of configuration data that can be consumed in pods or used to store configuration data for system components such as controllers. For example:

```yaml
# my-app-config.yaml
apiVersion: v1
kind: ConfigMap
metadata:
  name: my-app-config
  namespace: default
data:
  app_mode: "development"
  feature_flags: "true"
  database.properties: |-
    jdbc.url=jdbc:mysql://localhost:3306/mydb
    jdbc.username=user
    jdbc.password=password
  log_settings.json: |-
    {
      "level": "INFO",
      "format": "json"
    }
```

Note: You can use the `binaryData` field when you create a config map from a binary file, such as an image.

Configuration data can be consumed in pods in a variety of ways. A config map can be used to:

- Populate environment variable values in containers
- Set command-line arguments in a container
- Populate configuration files in a volume

Users and system components can store configuration data in a config map. A config map is similar to a secret, but designed to more conveniently support working with strings that do not contain sensitive information.

Config Map Restrictions

- A config map must be created before its contents can be consumed in pods.
- Controllers can be written to tolerate missing configuration data. Consult individual components configured by using config maps on a case-by-case basis.
- `ConfigMap` objects reside in a project.
- They can only be referenced by pods in the same project.
- The Kubectl only supports the use of a config map for pods it gets from the API server. This includes any pods created by using the CLI, or indirectly from a replication controller. It does not include pods created by using the OpenShift Container Platform node's `--manifest-url` flag, its `--config` flag, or its REST API because these are not common ways to create pods.

NOTE

A Pod can only use ConfigMaps within the same namespace.

Example ConfigMap

You can now use app-config in a `Pod`.

```yaml
# app-config.yaml
apiVersion: v1
kind: ConfigMap
metadata:
  name: app-config
  namespace: k-1
data:
  APP_ENV: "production"
  LOG_LEVEL: "debug"
```

Creating a ConfigMap by using the web console

1. Go to **Container Platform**.
2. In the left sidebar, click **Configuration** > **ConfigMap**.
3. Click **Create ConfigMap**.
4. Refer to the instructions below to configure the relevant parameters.

Parameter	Description
Entries	Refers to `key:value` pairs, supporting both **Add** and **Import** methods. • **Add**: You can add configuration items one by one, or you can paste one or multiple lines of key=value pairs in the Key input area to bulk add configuration items. • **Import**: Import a text file not larger than 1M. The file name will be used as the key, and the file content will be used as the value, filled into a configuration item.
Binary Entries	Refers to binary files not larger than 1M. The file name will be used as the key, and the file content will be used as the value, filled into a configuration item.

Parameter	Description
	Note: After creating a ConfigMap, the imported files cannot be modified.

Example of Bulk Add Format:

```
# One key=value pair per line, multiple pairs must be on separate lines, otherwise
they will not be recognized correctly after pasting.
key1=value1
key2=value2
key3=value3
```

5. Click **Create**.

Creating a ConfigMap by using the CLI

```
kubectl create configmap app-config \
  --from-literal=APP_ENV=production \
  --from-literal=LOG_LEVEL=debug
```

Or from a file:

```
kubectl apply -f app-config.yaml -n k-1
```

Operations

You can click the (⋮) on the right side of the list page or click **Actions** in the upper right corner of the detail page to update or delete the ConfigMap as needed.

Changes to the ConfigMap will affect the workloads that reference the configuration, so please read the operation instructions in advance.

Operations	Description
Update	• After adding or updating a ConfigMap, any workloads that have referenced this ConfigMap (or its configuration items) through environment variables need to rebuild their Pods for the new configuration to take effect. • For imported binary configuration items, only key updates are supported, not value updates.
Delete	After deleting a ConfigMap, workloads that have referenced this ConfigMap (or its configuration items) through environment variables may be adversely affected during Pod creation if they are rebuilt and cannot find the reference source.

View, Edit and Delete by using the CLI

```
kubectl get configmap app-config -n k-1 -o yaml
kubectl edit configmap app-config -n k-1
kubectl delete configmap app-config -n k-1
```

Ways to Use a ConfigMap in a Pod

As Environment Variables

```
envFrom:
  - configMapRef:
      name: app-config
```

Each key becomes an environment variable in the container.

As Files in a Volume

```
volumes:
  - name: config-volume
    configMap:
      name: app-config

volumeMounts:
  - name: config-volume
    mountPath: /etc/config
```

Each key is a file under `/etc/config`, and the file content is the value.

As Individual Environment Variables

```
env:
  - name: APP_ENV
    valueFrom:
      configMapKeyRef:
        name: app-config
        key: APP_ENV
```

ConfigMap vs Secret

Feature	ConfigMap	Secret
Data Type	Non-sensitive	Sensitive (e.g., passwords)
Encoding	Plaintext	Base64-encoded
Use Cases	Configs, flags	Passwords, tokens

Configuring Secrets

TOC

Understanding Secrets

In Kubernetes (k8s), a Secret is a fundamental object designed to store and manage sensitive information, such as passwords, OAuth tokens, SSH keys, TLS certificates, and API keys. Its primary purpose is to prevent sensitive data from being directly embedded in Pod definitions or container images, thereby enhancing security and portability.

Secrets are similar to ConfigMaps but are specifically intended for confidential data. They are typically base64-encoded for storage and can be consumed by pods in various ways, including being mounted as volumes or exposed as environment variables.

Usage Characteristics

- **Enhanced Security**: Compared to plaintext configuration maps (Kubernetes ConfigMap), Secrets offer better security by storing sensitive information using Base64 encoding. This mechanism, combined with Kubernetes' ability to control access, significantly reduces the risk of data exposure.
- **Flexibility and Management**: Using Secrets provides a more secure and flexible approach than hardcoding sensitive information directly into Pod definition files or container images. This separation simplifies the management and modification of sensitive data without requiring changes to application code or container images.

Supported Types

Kubernetes supports various types of Secrets, each tailored for specific use cases. The platform typically supports the following types:

- **Opaque**: A general-purpose Secret type used to store arbitrary key-value pairs of sensitive data, such as passwords or API keys.
- **TLS**: Specifically designed to store TLS (Transport Layer Security) protocol certificate and private key information, commonly used for HTTPS communication and secure ingress.
- **SSH Key**: Used to store SSH private keys, often for secure access to Git repositories or other SSH-enabled services.
- **SSH Authentication (kubernetes.io/ssh-auth)**: Stores authentication information for data transmitted over the SSH protocol.
- **Username/Password (kubernetes.io/basic-auth)**: Used to store basic authentication credentials (username and password).
- **Image Pull Secret (kubernetes.io/dockerconfigjson)**: Stores the JSON authentication string required for pulling container images from private image repositories (Docker Registry).

Usage Methods

Secrets can be consumed by applications within pods through different methods:

- **As Environment Variables**: Sensitive data from a Secret can be injected directly into a container's environment variables.
- **As Mounted Files (Volume)**: Secrets can be mounted as files within a pod's volume, allowing applications to read sensitive data from a specified file path.

Note: Pod instances in workloads can only reference Secrets within the same namespace. For advanced usage and YAML configurations, refer to the Kubernetes official documentation ↗.

Creating an Opaque type Secret

```
kubectl create secret generic my-secret \
  --from-literal=username=admin \
  --from-literal=password=Pa$$w0rd
```

YAML

```yaml
apiVersion: v1
kind: Secret
metadata:
  name: my-secret
type: Opaque
data:
  username: YWRtaW4= # base64 of "admin"
  password: UGEkJHcwcmQ= # base64 of "Pa$$w0rd"
```

You can decode them like:

```
echo YWRtaW4= | base64 --decode  # output: admin
```

Creating a Docker registry type Secret

```
kubectl create secret docker-registry my-docker-creds \
  --docker-username=myuser \
  --docker-password=mypass \
  --docker-server=https://index.docker.io/v1/ \
  --docker-email=my@example.com
```

YAML

```
apiVersion: v1
kind: Secret
metadata:
  name: my-docker-creds
type: kubernetes.io/dockerconfigjson
data:
  .dockerconfigjson:
eyJhdXRocyI6eyJodHRwczovL2luZGV4LmRvY2tlci5pby92MS8iOnsidXNlcm5hbWUiOiJteXVzZXIiLCJwYXNzd29y
```

K8s automatically converts your username, password, email, and server information into the Docker standard login format:

```
{
  "auths": {
    "https://index.docker.io/v1/": {
      "username": "myuser",
      "password": "mypass",
      "email": "my@example.com",
      "auth": "bXl1c2VyOm15cGFzcw=="  # base64(username:password)
    }
  }
}
```

This JSON is then base64 encoded and used as the data field value of the Secret.

Use it in a Pod:

```yaml
imagePullSecrets:
  - name: my-docker-creds
```

Creating a Basic Auth type Secret

```yaml
apiVersion: v1
kind: Secret
metadata:
  name: basic-auth-secret
type: kubernetes.io/basic-auth
stringData:
  username: myuser
  password: mypass
```

Creating a SSH-Auth type Secret

Use Case: Store SSH private keys (e.g., for Git access).

```yaml
apiVersion: v1
kind: Secret
metadata:
  name: ssh-key-secret
type: kubernetes.io/ssh-auth
stringData:
  ssh-privatekey: |
    -----BEGIN OPENSSH PRIVATE KEY-----
    ...
    -----END OPENSSH PRIVATE KEY-----
```

Creating a TLS type Secret

Use Case: TLS certs (used by Ingress, webhooks, etc.)

```
kubectl create secret tls tls-secret \
--cert=path/to/tls.crt \
--key=path/to/tls.key
```

YAML

```
apiVersion: v1
kind: Secret
metadata:
  name: tls-secret
type: kubernetes.io/tls
data:
  tls.crt: <base64>
  tls.key: <base64>
```

Creating a Secret by using the web console

1. Go to **Container Platform**.
2. In the left navigation bar, click **Configuration** > **Secrets**.
3. Click **Create Secret**.
4. Configure the parameters.

   Note: In the form view, sensitive data such as the input username and password will automatically be encoded in Base64 format before being stored in the Secret. The converted data can be previewed in the YAML view.

5. Click **Create**.

How to Use a Secret in a Pod

As Environment Variables

```yaml
env:
  - name: DB_USERNAME
    valueFrom:
      secretKeyRef:
        name: my-secret
        key: username
```

From the secret named `my-secret`, take the value with the key `username` and assign it to the environment variable `DB_USERNAME`.

As Mounted Files (Volume)

```yaml
volumes:
  - name: secret-volume
    secret:
      secretName: my-secret

volumeMounts:
  - name: secret-volume
    mountPath: "/etc/secret"
```

Follow-up Actions

When creating workloads for native applications in the same namespace, you can reference the Secrets that have already been created.

Operations

You can click the (⋮) on the right side of the list page or click **Actions** in the upper right corner of the details page to update or delete the Secret as needed.

Operation	Description
Update	After adding or updating a Secret, workloads that have referenced this Secret (or its configuration items) via environment variables need to have their Pods rebuilt for the new configuration to take effect.
Delete	• After deleting a Secret, workloads that have referenced this Secret (or its configuration items) via environment variables may be impacted due to the inability to find the reference source when rebuilding Pods. • Please do not delete the Secrets automatically generated by the platform, as this may prevent the platform from functioning properly. For example: Secrets of type service-account-token that contain authentication information for namespace resources and Secrets in system namespaces (such as kube-system).

Application Observability

Monitoring Dashboards

- Supports viewing resource monitoring data for workload components on the platform for the past 7 days (with configurable monitoring data retention period). Includes statistics for applications, workloads, pods, and trends/rankings of CPU/memory usage.
- Supports Namespace-Level monitoring.
- Supported Workload-Level Monitoring: **Applications**, **Deployments**, **DaemonSets**, **StatefulSets**, and **Pods**

TOC

Prerequisites

- Installation of Monitoring Plugins

Namespace-Level Monitoring Dashboards

Procedure

1. **Container Platform**, click **Observe** > **Dashboards**.

2. View monitoring data under the namespace. Three dashboards are provided: **Applications Overview**, **Workloads Overview**, and **Pods Overview**.

3. Switch between dashboards to monitor target **Overview**.

Creating Namespace-Level Monitoring Dashboard

1. **Administrator**, create a dedicated monitoring dashboard by referring to Creating Monitoring Dashboard to create a dedicated monitoring dashboard.

2. Configure the following labels to display the Namespace-Level Monitoring dashboard on the **Container Platform**:

- `cpaas.io/dashboard.folder: container-platform`
- `cpaas.io/dashboard.tag.overview: "true"`

Workload-Level Monitoring

> This procedure demonstrates how to view pod monitoring through the Deployment interface.

Default Monitoring Dashboard

Procedure

1. **Container Platform**, click **Workloads** > **Deployments**.

2. Click a Deployment name from the list.

3. Navigate to the **Monitoring** tab to view default monitoring metrics.

Metric interpretation

Monitoring Resource	Metric Granularity	Technical Definition
CPU	**Utilization/Usage**	**Utilization** = Usage/Limit (limits) Assess container limit configuration. High utilization indicates insufficient limits. **Usage** represents actual resource consumption.
Memory	**Utilization/Usage**	**Utilization** = Usage/Limit (limits) Evaluation method same as CPU. High rate may cause component instability.
Network Traffic	**Inflow Rate/Outflow Rate**	Network traffic (bytes/sec) flowing into/out of pods.
Network Packet	**Receiving Rate/Transmit Rate**	Network packets (count/sec) received/sent by pods.
Disk Rate	**Read/Write**	Read/write throughput (bytes/sec) of mounted volumes per workload.
Disk IOPS	**Read/Write**	Input/Output Operations Per Second (IOPS) of mounted volumes per workload.

Custom Monitoring Dashboard

1. Click the **Toggle Icon** to switch to custom dashboards. Refer to Add Panel in Custom Dashboard to create dedicated **Workload-Level** monitoring dashboard.

INFO

Hover over chart curves to view per-pod metrics and PromQL expressions at specific timestamps. If exceeding 15 pods, only top 15 entries sorted in descending order are displayed.

Logs

Aggregate container runtime logs with visual query capabilities. When applications, workloads, or other resources exhibit abnormal behavior, log analysis helps diagnose root causes.

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Procedure

> This procedure demonstrates how to view container runtime logs through the Deployment interface.

1. **Container Platform**, click **Workloads** > **Deployments**.
2. Click a Deployment name from the list.
3. Navigate to the **Logs** tab to view detailed records.

Operation	Description
Pod/Container	Switch between Pods and Containers using the dropdown selector to view the corresponding logs.
Previous Logs	View logs from terminated containers (available when container restartCount > 0).
Lines	Configure display log buffer size: 1k/10k/100k lines.
Wrap Line	Toggle line wrapping for long log entries (enabled by default).

Operation	Description
Find	Full-text search with highlight matching and Enter-to-navigate.
Raw	Unprocessed log streams directly captured from container runtime interfaces (CRI) without formatting, filtering, or truncation.
Export	Download raw logs.
Full Screen	Click truncated line to view full content in modal dialog.

WARNING

- **Truncation Handling**: Log entries exceeding 2000 characters will be truncated with an ellipsis `...`
  - Trimmed portions cannot be matched by the page's find function.
  - Click the ellipsis `...` marker in truncated lines to view full content in a modal dialog.
- **Copy Reliability**: Avoid direct copying from rendered log viewer when seeing truncation markers (...) or ANSI color codes. Always use **Export**, **Raw** function for complete logs.
- **Retention Policy**: Live logs follow Kubernetes log rotation configuration. For historical analysis, use Logs under Observe.

Events

Event information generated by Kubernetes resource state changes and operational status updates, with integrated visual query interface.When applications, workloads, or other resources encounter exceptions, real-time event analysis helps troubleshoot root causes.

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Procedure

> This procedure demonstrates how to view container runtime evens through the Deployment interface.

1. **Container Platform**, click **Workloads** > **Deployments**.
2. Click a Deployment name from the list.
3. Navigate to the **Events** tab to view detailed records.

Event records interpretation

Resource event records: Below the event summary panel, all matching events within the specified time range are listed. Click event cards to view complete event details. Each card displays:

- **Resource Type**: Kubernetes resource type represented by icon abbreviations:
  - `P` = Pod
  - `RS` = ReplicaSet
  - `D` = Deployment
  - `SVC` = Service
- **Resource Name**: Target resource named.
- **Event Reason**: Kubernetes-reported reason (e.g., FailedScheduling).
- **Event Level**: Event severity.
  - `Normal` : Informational
  - `Warning` : Requires immediate attention
- **Time**: Last Occurrence time, Occurrence Count.

INFO

Kubernetes allows administrators to configure event retention periods through the Event TTL controller with a default retention period of 1 hour. Expired events are automatically purged by the system. For comprehensive historical records, access the All Events.

Menu

How To

Setting Scheduled Task Trigger Rules

The scheduled task trigger rules support the input of Crontab expressions.

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Time Conversion

Time conversion rule: Local time - time zone offset = UTC

Taking **Beijing time to UTC time** as an example:

Beijing is in the East Eight Time Zone, with a time difference of 8 hours between Beijing time and UTC. The time conversion rule is:

`Beijing Time - 8 = UTC`

Example 1: Beijing time 9:42 converts to UTC time: 42 09 - 00 08 = 42 01, which means the UTC time is 1:42 AM.

Example 2: Beijing time 4:32 AM converts to UTC time: 32 04 - 00 08 = -68 03. If the result is negative, it indicates the previous day, requiring another conversion: -68 03 + 00 24 = 32 20, which means the UTC time is 8:32 PM of the previous day.

Writing Crontab Expressions

Basic format and value range of Crontab: `minute hour day month weekday`, with the corresponding value ranges as shown in the table below:

Minute	Hour	Day	Month	Weekday
[0-59]	[0-23]	[1-31]	[1-12] or [JAN-DEC]	[0-6] or [SUN-SAT]

The special characters allowed in the `minute hour day month weekday` fields include:

- `,`: Value list separator, used to specify multiple values. For example: `1,2,5,7,8,9`.
- `-`: User-defined value range. For example: `2-4`, which represents 2, 3, 4.
- `*`: Represents the entire time period. For example, when used for minutes, it means every minute.
- `/`: Used to specify the increment of values. For example: `n/m` indicates starting from n, increasing by m each time.

Conversion tool reference ↗

Common Examples:

- Input `30 18 25 12 *` indicates a task triggers at `18:30:00 on December 25th`.
- Input `30 18 25 * 6` indicates a task triggers at `18:30:00 every Saturday`.
- Input `30 18 * * 6` indicates a task triggers at `18:30:00 on Saturdays`.
- Input `* 18 * * *` indicates a task triggers every minute starting from `18:00:00` (including `18:00:00`).
- Input `0 18 1,10,22 * *` indicates a task triggers at `18:00:00 on the 1st, 10th, and 22nd of every month`.
- Input `0,30 18-23 * * *` indicates a task triggers at `00 minutes and 30 minutes of each hour between 18:00 and 23:00 daily`.
- Input `* */1 * * *` indicates a task triggers every minute.
- Input `* 2-7/1 * * *` indicates a task triggers every minute between 2 AM and 7 AM daily.
- Input `0 11 4 * mon-wed` indicates a task triggers at `11:00 AM on the 4th of every month and on every Monday to Wednesday`.

Images

Overview of images

How To

Overview of images

TOC

Understanding containers and images

Containers and images are important concepts to understand when you set out to create and manage containerized software. An image holds a set of software that is ready to run, while a container is a running instance of a container image. Those different versions are represented by different tags on the same image name.

Images

Containers in Alauda Container Platform are based on OCI- or Docker-formatted container images. An image is a binary that includes all of the requirements for running a single container, as well as metadata describing its needs and capabilities.

You can think of it as a packaging technology. Containers have access only to resources defined in the image unless granted additional access at creation time. By deploying the same image in multiple containers across multiple hosts and load balancing between them, Alauda Container Platform can provide redundancy and horizontal scaling for a service packaged into an image.

You can use the `nerdctl` or `docker` CLI directly to build images, but Alauda Container Platform also supplies builder images that assist with creating new images by adding your code or configuration to existing images.

Because applications develop over time, a single image name can actually refer to many different versions of the same image. Each different image is referred to uniquely by its hash, a long hexadecimal number such as fd44297e2ddb050ec4f…, which is usually shortened to 12 characters, such as fd44297e2ddb.

Image registry

An image registry is a content server that can store and serve container images. For example:

- Docker Hub ↗
- Quay.io Container Registry ↗
- Alauda Container Platform Registry

A registry contains a collection of one or more image repositories, which contain one or more tagged images. Alauda Container Platform can supply its own image registry for managing custom container images.

Image repository

An image repository is a collection of related container images and tags identifying them. For example, the Alauda Container Platform Jenkins images are in the repository:

```
docker.io/alauda/jenkins-2-centos7
```

Image tags

An image tag is a label applied to a container image in a repository that distinguishes a specific image from other images in an image stream. Typically, the tag represents a version number of some sort. For example, here :v3 .11.59-2 is the tag:

```
docker.io/alauda/jenkins-2-centos7:v3.11.59-2
```

You can add additional tags to an image. For example, an image might be assigned the tags :v3 .11.59-2 and :latest .

Image IDs

An image ID is a SHA (Secure Hash Algorithm) code that can be used to pull an image. A SHA image ID cannot change. A specific SHA identifier always references the exact same container image content. For example:

```
docker.io/alauda/jenkins-2-centos7@sha256:ab312bda324
```

Containers

The basic units of Alauda Container Platform applications are called containers. Linux container technologies are lightweight mechanisms for isolating running processes so that they are limited to interacting with only their designated resources. The word container is defined as a specific running or paused instance of a container image.

Many application instances can be running in containers on a single host without visibility into each others' processes, files, network, and so on. Typically, each container provides a single service, often called a micro-service, such as a web server or a database, though containers can be used for arbitrary workloads.

The Linux kernel has been incorporating capabilities for container technologies for years. The Docker project developed a convenient management interface for Linux containers on a host. More recently, the Open Container Initiative ↗ has developed open standards for container formats and container runtimes. Alauda Container Platform and Kubernetes add the ability to orchestrate OCI- and Docker-formatted containers across multi-host installations.

Though you do not directly interact with container runtimes when using Alauda Container Platform, understanding their capabilities and terminology is important for understanding their role in Alauda Container Platform and how your applications function inside of containers.

How To

Creating images

Learn how to create your own container images, based on pre-built images that are ready to help you. The process includes learning best practices for writing images, defining metadata for images, testing images, and using a custom builder workflow to create images to use with Alauda Container Platform Registry. After you create an image, you can push it to the **Alauda Container Platform Registry**.

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Learning container best practices

When creating container images to run on Alauda Container Platform there are a number of best practices to consider as an image author to ensure a good experience for consumers of those images. Because images are intended to be immutable and used as-is, the following guidelines help ensure that your images are highly consumable and easy to use on Alauda Container Platform.

General container image guidelines

The following guidelines apply when creating a container image in general, and are independent of whether the images are used on Alauda Container Platform.

Reuse images

Wherever possible, base your image on an appropriate upstream image using the FROM statement. This ensures your image can easily pick up security fixes from an upstream image when it is updated, rather than you having to update your dependencies directly.

In addition, use tags in the FROM instruction, for example, `alpine:3.20`, to make it clear to users exactly which version of an image your image is based on. Using a tag other than latest ensures your image is not subjected to breaking changes that might go into the latest version of an upstream image.

Maintain compatibility within tags

When tagging your own images, try to maintain backwards compatibility within a tag. For example, if you provide an image named image and it currently includes version `1.0`, you might provide a tag of `image:v1`. When you update the image, as long as it continues to be compatible with the original image, you can continue to tag the new image `image:v1`, and downstream consumers of this tag are able to get updates without being broken.

If you later release an incompatible update, then switch to a new tag, for example `image:v2`. This allows downstream consumers to move up to the new version at will, but not be inadvertently broken by the new incompatible image. Any downstream consumer using `image:latest` takes on the risk of any incompatible changes being introduced.

Avoid multiple processes

Do not start multiple services, such as a database and `SSHD`, inside one container. This is not necessary because containers are lightweight and can be easily linked together for orchestrating multiple processes. Alauda Container Platform allows you to easily colocate and co-manage related images by grouping them into a single pod.

This colocation ensures the containers share a network namespace and storage for communication. Updates are also less disruptive as each image can be updated less frequently and independently. Signal handling flows are also clearer with a single process as you do not have to manage routing signals to spawned processes.

Use exec in wrapper scripts

Many images use wrapper scripts to do some setup before starting a process for the software being run. If your image uses such a script, that script uses `exec` so that the script's process is replaced by your software. If you do not use `exec`, then signals sent by your container runtime go to your wrapper script instead of your software's process. This is not what you want.

If you have a wrapper script that starts a process for some server. You start your container, for example, using `docker run -i`, which runs the wrapper script, which in turn starts your process. If you want to close your container with `CTRL+C`. If your wrapper script used `exec` to start the server process, `docker` sends SIGINT to the server process, and everything works as you expect. If you did not use `exec` in your wrapper script, `docker` sends SIGINT to the process for the wrapper script and your process keeps running like nothing happened.

Also note that your process runs as `PID 1` when running in a container. This means that if your main process terminates, the entire container is stopped, canceling any child processes you launched from your `PID 1` process.

Clean temporary files

Remove all temporary files you create during the build process. This also includes any files added with the `ADD` command. For example, run the `yum clean` command after performing `yum install` operations.

You can prevent the `yum` cache from ending up in an image layer by creating your `RUN` statement as follows:

```
RUN yum -y install mypackage && yum -y install myotherpackage && yum clean all -y
```

Note that if you instead write:

```
RUN yum -y install mypackage
RUN yum -y install myotherpackage && yum clean all -y
```

Then the first `yum` invocation leaves extra files in that layer, and these files cannot be removed when the `yum clean` operation is run later. The extra files are not visible in the final image, but they are present in the underlying layers.

The current container build process does not allow a command run in a later layer to shrink the space used by the image when something was removed in an earlier layer. However, this may change in the future. This means that if you perform an `rm` command in a later layer, although the files are hidden it does not reduce the overall size of the image to be downloaded. Therefore, as with the `yum clean` example, it is best to remove files in the same command that created them, where possible, so they do not end up written to a layer.

In addition, performing multiple commands in a single `RUN` statement reduces the number of layers in your image, which improves download and extraction time.

Place instructions in the proper order

The container builder reads the `Dockerfile` and runs the instructions from top to bottom. Every instruction that is successfully executed creates a layer which can be reused the next time this or another image is built. It is very important to place instructions that rarely change at the top of your `Dockerfile`. Doing so ensures the next builds of the same image are very fast because the cache is not invalidated by upper layer changes.

For example, if you are working on a `Dockerfile` that contains an `ADD` command to install a file you are iterating on, and a `RUN` command to `yum install` a package, it is best to put the `ADD` command last:

```
FROM foo
RUN yum -y install mypackage && yum clean all -y
ADD myfile /test/myfile
```

This way each time you edit `myfile` and rerun `docker build`, the system reuses the cached layer for the `yum` command and only generates the new layer for the `ADD` operation.

If instead you wrote the Dockerfile as:

```
FROM foo
ADD myfile /test/myfile
RUN yum -y install mypackage && yum clean all -y
```

Then each time you changed `myfile` and reran `docker build`, the `ADD` operation would invalidate the `RUN` layer cache, so the `yum` operation must be rerun as well.

Mark important ports

The `EXPOSE` instruction makes a port in the container available to the host system and other containers. While it is possible to specify that a port should be exposed with a `docker run` invocation, using the `EXPOSE` instruction in a `Dockerfile` makes it easier for both humans and software to use your image by explicitly declaring the ports your software needs to run:

- Exposed ports show up under `docker ps` associated with containers created from your image.
- Exposed ports are present in the metadata for your image returned by `docker inspect`.
- Exposed ports are linked when you link one container to another.

Set environment variables

It is good practice to set environment variables with the `ENV` instruction. One example is to set the version of your project. This makes it easy for people to find the version without looking at the `Dockerfile`. Another example is advertising a path on the system that could be used by another process, such as `JAVA_HOME`.

Avoid default passwords

Avoid setting default passwords. Many people extend the image and forget to remove or change the default password. This can lead to security issues if a user in production is assigned a well-known password. Passwords are configurable using an environment variable instead.

If you do choose to set a default password, ensure that an appropriate warning message is displayed when the container is started. The message should inform the user of the value of the default password and explain how to change it, such as what environment variable to set.

Avoid sshd

It is best to avoid running `sshd` in your image. You can use the `docker exec` command to access containers that are running on the local host. Alternatively, you can use the `docker exec` command to access containers that are running on the Alauda Container Platform cluster. Installing and running `sshd` in your image opens up additional vectors for attack and requirements for security patching.

Use volumes for persistent data

Images use a volume for persistent data. This way Alauda Container Platform mounts the network storage to the node running the container, and if the container moves to a new node the storage is reattached to that node. By using the volume for all persistent storage needs, the content is preserved even if the container is restarted or moved. If your image writes data to arbitrary locations within the container, that content could not be preserved.

All data that needs to be preserved even after the container is destroyed must be written to a volume. Container engines support a `readonly` flag for containers, which can be used to strictly enforce good practices about not writing data to ephemeral storage in a container. Designing your image around that capability now makes it easier to take advantage of it later.

Explicitly defining volumes in your `Dockerfile` makes it easy for consumers of the image to understand what volumes they must define when running your image.

See the Kubernetes documentation ↗ for more information on how volumes are used in Alauda Container Platform.

> **Note:**
> Even with persistent volumes, each instance of your image has its own volume, and the filesystem is not shared between instances. This means the volume cannot be used to share state in a cluster.

Including metadata in images

Defining image metadata helps Alauda Container Platform better consume your container images, allowing Alauda Container Platform to create a better experience for developers using your image. For example, you can add metadata to provide helpful descriptions of your image, or offer suggestions on other images that may also be needed.

This topic only defines the metadata needed by the current set of use cases. Additional metadata or use cases may be added in the future.

Defining image metadata

You can use the `LABEL` instruction in a `Dockerfile` to define image metadata. Labels are similar to environment variables in that they are key value pairs attached to an image or a container. Labels are different from environment variable in that they are not visible to the running application and they can also be used for fast look-up of images and containers.

See the Docker documentation ↗ for more information on the `LABEL` instruction.

The label names are typically namespaced. The namespace is set accordingly to reflect the project that is going to pick up the labels and use them. For Kubernetes the namespace is io.k8s.

See the Docker custom metadata documentation ↗ for details about the format.

Managing images

With Alauda Container Platform you can interact with images, depending on where the registries of the images are located, any authentication requirements around those registries, and how you want your builds and deployments to behave.

Image pull policy

Each container in a pod has a container image. After you have created an image and pushed it to a registry, you can then refer to it in the pod.

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Image pull policy overview

When Alauda Container Platform creates containers, it uses the container `imagePullPolicy` to determine if the image should be pulled prior to starting the container. There are three possible values for `imagePullPolicy`:

Table `imagePullPolicy` values:

Value	Description
Always	Always pull the image.
IfNotPresent	Only pull the image if it does not already exist on the node.
Never	Never pull the image.

If a container imagePullPolicy parameter is not specified, Alauda Container Platform sets it based on the image tag:

1. If the tag is latest, Alauda Container Platform defaults imagePullPolicy to Always.
2. Otherwise, Alauda Container Platform defaults imagePullPolicy to IfNotPresent.

Using image pull secrets

If you are using the Alauda Container Platform image registry, then your pod service account should already have the correct permissions and no additional action should be required.

However, for other scenarios, such as referencing images across Alauda Container Platform projects or from secured registries, additional configuration steps are required.

Allowing pods to reference images from other secured registries

To pull a secured container from other private or secured registries, you must create a pull secret from your container client credentials, such as `Docker`, and add it to your service account.

Docker use a configuration file to store authentication details to log in to secured or insecure registry:

By default, Docker uses $HOME/.docker/config.json.

These files store your authentication information if you have previously logged in to a secured or insecure registry.

Creating a pull secret

You can obtain the image pull secret to pull an image from a private container image registry or repository. You can refer to Pull an Image from a Private Registry ↗.

Using a pull secret in a workload

You can use a pull secret to allow workloads to pull images from a private registry with one of the following methods:

- By linking the secret to a `ServiceAccount`, which automatically applies the secret to all pods using that service account.
- By defining `imagePullSecrets` in the pod specification, which is useful for environments like GitOps or ArgoCD.

You can use a secret for pulling images for pods by adding the secret to your service account. Note that the name of the service account should match the name of the service account that pod uses.

Example output:

```yaml
apiVersion: v1
imagePullSecrets:
- name: default-dockercfg-123456
- name: <pull_secret_name>
kind: ServiceAccount
metadata:
  name: default
  namespace: default
secrets:
- name: <pull_secret_name>
```

Instead of linking the secret to a service account, you can alternatively reference it directly in your pod or workload definition. This is useful for GitOps workflows such as ArgoCD. For example:

Example pod specification:

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: <secure_pod_name>
spec:
  containers:
  - name: <container_name>
    image: your.registry.io/my-private-image
  imagePullSecrets:
  - name: <pull_secret_name>
```

Example ArgoCD workflow:

```yaml
apiVersion: argoproj.io/v1alpha1
kind: Workflow
metadata:
  generateName: <example_workflow>
spec:
  entrypoint: <main_task>
  imagePullSecrets:
  - name: <pull_secret_name>
```

Registry

Introduction

Install

How To

Introduction

Building, storing and managing container images is a core part of the cloud-native application development process. Alauda Container Platform(ACP) provides a high-performance, highly-available, built-in container image repository service designed to provide users with a secure and convenient image storage and management experience, greatly simplifying application development, continuous integration/continuous deployment (CI/CD) and application deployment processes within the platform. CD) and application deployment processes within the platform.

Deeply integrated into the platform architecture, Alauda Container Platform Registry provides tighter platform collaboration, simplified configuration, and greater internal access efficiency than an external, independently deployed image repository.

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Principles and namespace isolation

Alauda Container Platform's built-in image repository, as one of the core components of the platform, runs inside the cluster in a highly-available manner and utilizes the persistent storage capabilities provided by the platform to ensure that the image data is secure and reliable.

One of its core design concepts is logical isolation and management based on Namespace. Within the Registry, image repositories are organized by namespace. This means that each namespace can be considered as a separate “zone” for images belonging to that namespace, and images between different namespaces are isolated by default, unless explicitly authorized.

Authentication and authorization

The authentication and authorization mechanism of Alauda Container Platform Registry is deeply integrated with ACP's platform-level authentication and authorization system, enabling access control as granular as the namespace:

Authentication

Users or automated processes (e.g., CI/CD pipelines on the platform, automated build tasks, etc.) do not need to maintain a separate set of account passwords for the Registry. They are authenticated through the platform's standard authentication mechanisms (e.g., using platform-provided API tokens, integrated enterprise identity systems, etc.). When accessing Alauda Container Platform Registry through the CLI or other tools, it is common to utilize existing platform login sessions or ServiceAccount tokens for transparent authentication.

Authorization

Authorization control is implemented at the namespace level. Pull or Push permissions for an image repository in Alauda Container Platform Registry depend on the platform role and permissions that the user or ServiceAccount has in the corresponding namespace.

- **Typically**, the owner or developer role of a namespace is automatically granted Push and Pull permissions to image repositories under that namespace.
- **Users in other namespaces or users who wish to pull images across namespaces** need to be explicitly granted the appropriate permissions by the administrator of the target

namespace (e.g., bind a role that allows pulling of images via RBAC) before they can access images within that namespace.

- **This namespace-based authorization** mechanism ensures isolation of images between namespaces, improving security and avoiding unauthorized access and modification.

Advantages

Core advantages of Alauda Container Platform Registry:

- **Ready-to-Use:** Rapidly deploy a private image registry without complex configurations.
- **Flexible Access:** Supports both intra-cluster and external access modes.
- **Security Assurance:** Provides RBAC authorization and image scanning capabilities.
- **High Availability:** Ensures service continuity through replication mechanisms.
- **Production-Grade:** Validated in enterprise environments with SLA guarantees.

Application Scenarios

- **Lightweight Deployment:** Implement streamlined registry solutions in low-traffic environments to accelerate application delivery.
- **Edge Computing:** Enable autonomous management for edge clusters with dedicated registries.
- **Resource Optimization:** Demonstrate full workflow capabilities through integrated Source to Image (S2I) solutions when underutilizing infrastructure.

Install

Install Via YAML

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When to Use This Method?

Recommended for:

- **Advanced users** with Kubernetes expertise who prefer a manual approach.
- **Production-grade deployments** requiring enterprise storage (NAS, AWS S3, Ceph, etc.).
- Environments needing **fine-grained control** over TLS, ingress.
- **Full YAML customization** for advanced configurations.

Prerequisites

- **Install** the **Alauda Container Platform Registry** cluster plugin to a target cluster.
- **Access** to the target Kubernetes cluster with kubectl configured.
- **Cluster admin permissions** to create cluster-scoped resources.
- Obtain a registered **domain** (e.g., registry.yourcompany.com) Create a Domain
- Provide valid **NAS storage** (e.g., NFS, GlusterFS, etc.).
- (Optional) Provide valid **S3 storage** (e.g., AWS S3, Ceph, etc.). If no existing S3 storage is available, deploy a MinIO (Built-in S3) instance in the cluster Deploy MinIO.

Installing Alauda Container Platform Registry via YAML

Procedure

1. **Create a YAML configuration file** named registry-plugin.yaml with the following template:

```yaml
apiVersion: cluster.alauda.io/v1alpha1
kind: ClusterPluginInstance
metadata:
  annotations:
    cpaas.io/display-name: internal-docker-registry
  labels:
    create-by: cluster-transformer
    manage-delete-by: cluster-transformer
    manage-update-by: cluster-transformer
  name: internal-docker-registry
spec:
  config:
    access:
      address: ""
      enabled: false
    fake:
      replicas: 2
    global:
      expose: false
      isIPv6: false
      replicas: 2
      oidc:
        ldapID: ""
      resources:
        limits:
          cpu: 500m
          memory: 512Mi
        requests:
          cpu: 250m
          memory: 256Mi
    ingress:
      enabled: true
      hosts:
        - name: <YOUR-DOMAIN>    # [REQUIRED] Customize domain
          tlsCert: <NAMESPACE>/<TLS-SECRET>  # [REQUIRED] Namespace/SecretName
      ingressClassName: "<INGRESS-CLASS-NAME>"  # [REQUIRED] IngressClassName
      insecure: false
    persistence:
      accessMode: ReadWriteMany
      nodes: ""
      path: <YOUR-HOSTPATH>  # [REQUIRED] Local path for LocalVolume
      size: <STORAGE-SIZE>  # [REQUIRED] Storage size (e.g., 10Gi)
      storageClass: <STORAGE-CLASS-NAME>  # [REQUIRED] StorageClass name
```

```
        type: StorageClass
      s3storage:
        bucket: <S3-BUCKET-NAME>             # [REQUIRED] S3 bucket name
        enabled: false                        # Set false for local storage
        env:
          REGISTRY_STORAGE_S3_SKIPVERIFY: false  # Set true for self-signed certs
        region: <S3-REGION>                        # S3 region
        regionEndpoint: <S3-ENDPOINT>  # S3 endpoint
        secretName: <S3-CREDENTIALS-SECRET>            # S3 credentials Secret
      service:
        nodePort: ""
        type: ClusterIP
    pluginName: internal-docker-registry
```

2. **Customize the following fields** according to your environment:

```
spec:
  config:
    global:
      oidc:
        ldapID: "<LDAP-ID>"                   # LDAP ID
    ingress:
      hosts:
        - name: "<YOUR-DOMAIN>"               # e.g., registry.your-company.com
          tlsCert: "<NAMESPACE>/<TLS-SECRET>"   # e.g., cpaas-system/tls-secret
      ingressClassName: "<INGRESS-CLASS-NAME>"  # e.g., cluster-alb-1
    persistence:
      size: "<STORAGE-SIZE>"                    # e.g., 10Gi
      storageClass: "<STORAGE-CLASS-NAME>"      # e.g., cpaas-system-storage
    s3storage:
      bucket: "<S3-BUCKET-NAME>"                # e.g., prod-registry
      region: "<S3-REGION>"                    # e.g., us-west-1
      regionEndpoint: "<S3-ENDPOINT>"          # e.g., https://s3.amazonaws.com
      secretName: "<S3-CREDENTIALS-SECRET>"     # Secret containing
AWS_ACCESS_KEY_ID/AWS_SECRET_ACCESS_KEY
      env:
        REGISTRY_STORAGE_S3_SKIPVERIFY: "true"  # Set "true" for self-signed certs
```

3. **How to create a secret** for S3 credentials:

```
kubectl create secret generic <S3-CREDENTIALS-SECRET> \
  --from-literal=access-key-id=<YOUR-S3-ACCESS-KEY-ID> \
  --from-literal=secret-access-key=<YOUR-S3-SECRET-ACCESS-KEY> \
  -n cpaas-system
```

Replace `<S3-CREDENTIALS-SECRET>` with the name of your S3 credentials secret.

4. Apply the configuration to your cluster:

```
kubectl apply -f registry-plugin.yaml
```

Configuration Reference

Mandatory Fields

Parameter	Description	Example Value
`spec.config.global.oidc.ldapID`	LDAP ID for OIDC authentication	`ldap-test`
`spec.config.ingress.hosts[0].name`	Custom domain for registry access	`registry.yourcompany.com`
`spec.config.ingress.hosts[0].tlsCert`	TLS certificate secret reference (namespace/secret-name)	`cpaas-system/registry-tls`
`spec.config.ingress.ingressClassName`	Ingress class name for the registry	`cluster-alb-1`
`spec.config.persistence.size`	Storage size for the registry	`10Gi`
`spec.config.persistence.storageClass`	StorageClass name for the registry	`nfs-storage-sc`

Parameter	Description	Example Value
`spec.config.s3storage.bucket`	S3 bucket name for image storage	`prod-image-store`
`spec.config.s3storage.region`	AWS region for S3 storage	`us-west-1`
`spec.config.s3storage.regionEndpoint`	S3 service endpoint URL	`https://s3.amazonaws.com`
`spec.config.s3storage.secretName`	Secret containing S3 credentials	`s3-access-keys`

Verification

1. Check plugin:

```
kubectl get clusterplugininstances internal-docker-registry -o yaml
```

2. Verify registry pods:

```
kubectl get pods -n cpaas-system -l app=internal-docker-registry
```

Updating/Uninstalling Alauda Container Platform Registry

Update

Execute the following command on the global cluster and update the values in the resource according to the parameter descriptions provided above to complete the update:

```
# <CLUSTER-NAME> is the cluster where the plugin is installed
kubectl edit -n cpaas-system \
  $(kubectl get moduleinfo -n cpaas-system -l cpaas.io/cluster-name=<CLUSTER-
NAME>,cpaas.io/module-name=internal-docker-registry -o name)
```

Uninstall

Execute the following command on the global cluster:

```
# <CLUSTER-NAME> is the cluster where the plugin is installed
kubectl get moduleinfo -n cpaas-system -l cpaas.io/cluster-name=<CLUSTER-
NAME>,cpaas.io/module-name=internal-docker-registry -o name | xargs kubectl delete -n
cpaas-system
```

Install Via Web UI

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When to Use This Method?

Recommended for:

- **First-time users** who prefer a guided, visual interface.
- **Quick proof-of-concept setups** in non-production environments.
- Teams with **limited Kubernetes expertise** seeking a simplified deployment process.
- Scenarios requiring **minimal customization** (e.g., default storage configurations).
- **Basic networking setups** without specific ingress rules.
- **StorageClass** configurations for high availability.

Not Recommended for:

- Production environments requiring advanced storage(S3 storage) configurations.
- Networking setups needing specific ingress rules.

Prerequisites

- **Install** the **Alauda Container Platform Registry** cluster plugin to a target cluster using the Cluster Plugin mechanism.

Installing Alauda Container Platform Registry cluster plugin using the web console

Procedure

1. Log in and navigate to the **Administrator** page.
2. Click **Marketplace** > **Cluster Plugins** to access the **Cluster Plugins** list page.
3. Locate the **Alauda Container Platform Registry** cluster plugin, click **Install**, then proceed to the installation page.
4. Configure parameters according to the following specifications and click **Install** to complete the deployment.

The parameter descriptions are as follows:

Parameter	Description
Expose Service	Once enabled, administrators can manage the image repository externally using the access address. This poses significant security risks and should be enabled with extreme caution.
Enable IPv6	Enable this option when the cluster uses IPv6 single-stack networking.
NodePort	When Expose Service is enabled, configure NodePort to allow external access to the Registry via this port.
Storage Type	Select a storage type. Supported types: LocalVolume and StorageClass.

Parameter	Description
Nodes	Select a node to run the Registry service for image storage and distribution. (Available only when Storage Type is LocalVolume)
StorageClass	Select a StorageClass. When replicas exceed 1, select storage with RWX (ReadWriteMany) capability (e.g., File Storage) to ensure high availability. (Available only when Storage Type is StorageClass)
Storage Size	Storage capacity allocated to the Registry (Unit: Gi).
Replicas	Configure the number of replicas for the Registry Pod: • **LocalVolume**: Default is 1 (fixed) • **StorageClass**: Default is 3 (adjustable)
Resource Requirements	Define CPU and Memory resource requests and limits for the Registry Pod.

Verification

1. Navigate to **Marketplace** > **Cluster Plugins** and confirm the plugin status shows **Installed**.
2. Click the plugin name to view its details.
3. Copy the **Registry Address** and use the Docker client to push/pull images.

Updating/Uninstalling Alauda Container Platform Registry

You can update or uninstall the **Alauda Container Platform Registry** plugin from either the list page or details page.

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How To

Common CLI Command Operations

The Alauda Container Platform provides command line tools for users to interact with the Alauda Container Platform Registry. The following are some examples of common operations and commands:

Let's assume that Alauda Container Platform Registry for the cluster has a service address of registry.cluster.local and the namespace you are currently working on is my-ns.

> Contact technical services to acquire the kubectl-acp plugin and ensure it is properly installed in your environment.

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Logging in Registry

Log in to the cluster's Registry by logging in to the ACP.

```
kubectl acp login <ACP-endpoint>
```

Add namespace permissions for users

Add namespace pull permission for a user.

```
kubectl create rolebinding <binding-name> --clusterrole=system:image-puller --user=
<username> -n <namespace>
```

Add namespace push permissions to a user.

```
kubectl create rolebinding <binding-name> --clusterrole=system:image-pusher --user=
<username> -n <namespace>
```

Add namespace permissions for a service account

Add namespace pull permission for a service account.

```
kubectl create rolebinding <binding-name> --clusterrole=system:image-puller --
serviceaccount=<namespace>:<serviceaccount-name> -n <namespace>
```

Add namespace push permission for a service account.

```
kubectl create rolebinding <binding-name> --clusterrole=system:image-pusher --
serviceaccount=<namespace>:<serviceaccount-name> -n <namespace>
```

Pulling Images

Pulls an image from the registry to inside the cluster (e.g., for Pod deployment).

```
# Pull the image named my-app, labeled latest, from the Registry of the current namespace
(my-ns)
kubectl acp pull registry.cluster.local/my-ns/my-app:latest

# Pull images from other namespaces (e.g. shared-ns) (requires permission to pull from
the shared-ns namespace)
kubectl acp pull registry.cluster.local/shared-ns/base-image:latest
```

This command verifies your identity and pull permissions in the target namespace, and then pulls the image from the Registry.

Pushing Images

Pushes locally built images or images pulled from elsewhere to a specific namespace in the registry.

You need to first tag (tag) the local image with the address and namespace format of the target Registry using a standard container command line tool such as docker.

```
# Tag it with the target address:
docker tag my-app:latest registry.cluster.local/my-ns/my-app:v1

# Use the kubectl command to push it to the Registry for the current namespace (my-ns)
kubectl acp push registry.cluster.local/my-ns/my-app:v1
```

Pushes an image from a remote image repository to a specific namespace in the Alauda Container Platform Registry.

```
# If your remote image repository has an image remote.registry.io/demo/my-app:latest
# Use the kubectl command to push it to the namespace(my-ns) of the registry
kubectl acp push remote.registry.io/demo/my-app:latest registry.cluster.local/my-ns/my-
app:latest
```

This command verifies your identity and push permissions within the my-ns namespace, and then uploads the locally tagged image to Registry.

Using Alauda Container Platform Registry in Kubernetes Clusters

The Alauda Container Platform (ACP) Registry provides secure container image management for Kubernetes workloads.

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Registry Access Guidelines

- **Internal Address Recommended**: For images stored in the cluster's registry, always prioritize using the internal service address `internal-docker-registry.cpaas-system.svc` when deploying within the cluster. This ensures optimal network performance and avoids unnecessary external routing.
- **External Address Usage**: The external ingress domain (e.g. `registry.cluster.local`) is primarily intended for:
  - Image pushes/pulls from outside the cluster (e.g., developer machines, CI/CD systems)
  - Cluster-external operations requiring registry access

Deploy Sample Application

1. Create an application named `my-app` in the `my-ns` namespace.
2. Store the application image in the registry at `internal-docker-registry.cpaas-system.svc/my-ns/my-app:v1`.
3. The **default** ServiceAccount in each namespace is automatically configured with an imagePullSecret for accessing images from `internal-docker-registry.cpaas-system.svc`.

Example Deployment:

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: my-app
  namespace: my-ns
spec:
  replicas: 3
  selector:
    matchLabels:
      app: my-app
  template:
    metadata:
      labels:
        app: my-app
    spec:
      containers:
      - name: main-container
        image: internal-docker-registry.cpaas-system.svc/my-ns/my-app:v1
        ports:
        - containerPort: 8080
```

Cross-Namespace Access

To allow users from `my-ns` to pull images from `shared-ns`, the administrator of `shared-ns` can create a role binding to grant the necessary permissions.

Example Role Binding

```
# Access images from shared namespace (requires permissions)
kubectl create rolebinding cross-ns-pull \
  --clusterrole=system:image-puller \
  --serviceaccount=my-ns:default \
  -n shared-ns
```

Best Practices

- **Registry Usage**: Always use `internal-docker-registry.cpaas-system.svc` for deployments to ensure security and performance.
- **Namespace Isolation**: Leverage namespace isolation for better security and management of images.
  - Use namespace-based image paths: `internal-docker-registry.cpaas-system.svc/<namespace>/<image>:<tag>`.
- **Access Control**: Use role bindings to manage cross-namespace access for users and service accounts.

Verification Checklist

1. Validate image accessibility for the default ServiceAccount in `my-ns`:

   ```
   kubectl auth can-i get images.registry.alauda.io --namespace my-ns --
   as=system:serviceaccount:my-ns:default
   ```

2. Validate image accessibility for a user in `my-ns`:

   ```
   kubectl auth can-i get images.registry.alauda.io --namespace my-ns --as=<username>
   ```

Troubleshooting

- **Image Pull Errors**: Check the imagePullSecrets in the pod spec and ensure they are correctly configured.
- **Permission Denied**: Ensure the user or ServiceAccount has the necessary role bindings in the target namespace.
- **Network Issues**: Verify network policies and service configurations to ensure connectivity to the internal registry.
- **DNS Failures**: Check the content of `/etc/hosts` file on the node, ensure DNS resolution for the `internal-docker-registry.cpaas-system.svc` is correctly configured.
  - Verify node's /etc/hosts configuration to ensure correct DNS resolution of `internal-docker-registry.cpaas-system.svc`
  - Example showing registry service mapping (ClusterIP of internal-docker-registry service):

    ```
    # /etc/hosts
    127.0.0.1   localhost localhost.localdomain
    10.4.216.11 internal-docker-registry.cpaas-system internal-docker-registry.cpaas-system.svc internal-docker-registry.cpaas-system.svc.cluster.local # cpaas-generated-node-resolver
    ```

  - **How to get `internal-docker-registry` current ClusterIP**:

    ```
    kubectl get svc -n cpaas-system internal-docker-registry -o jsonpath='{.spec.clusterIP}'
    ```

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Overview

Introduction

Alauda Container Platform Builds is a cloud-native container tool provided by Alauda Container Platform that integrates Source to Image (S2I) capabilities with automated pipelines. It accelerates enterprise cloud-native journeys by enabling fully automated CI/CD pipelines that support multiple programming languages, including Java, Go, Python, and Node.js. Additionally, Alauda Container Platform Builds offers visual release management and seamless integration with Kubernetes-native tools like Helm and GitOps, ensuring efficient application lifecycle management from development to production.

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Source to Image Concept

Source to Image (S2I) is a tool and workflow for building reproducible container images from source code. It injects the application's source code into a predefined builder image and automatically completes steps such as compilation and packaging, ultimately generating a runnable container image. This allows developers to focus more on business code development without worrying about the details of containerization.

Core Features

Alauda Container Platform Builds facilitates a full-stack, cloud-native workflow from code to application, enabling multi-language builds and visual release management. It leverages Kubernetes-native capabilities to convert source code into runnable container images, ensuring seamless integration into a comprehensive cloud-native platform.

- **Multi-language Builds**: Supports building applications in various programming languages such as Java, Go, Python, and Node.js, accommodating diverse development needs.
- **Visual Interface**: Provides an intuitive interface that allows you to easily create, configure, and manage build tasks without deep technical knowledge.
- **Full Lifecycle Management**: Covers the entire lifecycle from code commit to application deployment, automating build, deployment, and operational management.
- **Deep Integration**: Seamlessly integrates with your Container Platform product, providing a seamless development experience.
- **High Extensibility**: Supports custom plugins and extensions to meet your specific needs.

Core Benefits

- **Accelerated Development**: Streamlines the build process, speeding up application delivery.
- **Enhanced Flexibility**: Supports building in multiple programming languages.
- **Improved Efficiency**: Automates build and deployment processes, reducing manual intervention.
- **Increased Reliability**: Provides detailed build logs and visual monitoring for easy troubleshooting.

Application scenarios

The main application scenarios for S2I are as follows:

- Web applications

  S2I supports various programming languages, such as Java, Go, Python, and Node.js. By leveraging the Alauda Container Platform application management capabilities, it allows for rapid building and deployment of web applications simply by entering the code repository URL.

- CI/CD

  S2I integrates seamlessly with DevOps pipelines, leveraging Kubernetes-native tools like Helm and GitOps to automate the image building and deployment processes. This enables continuous integration and continuous deployment of applications.

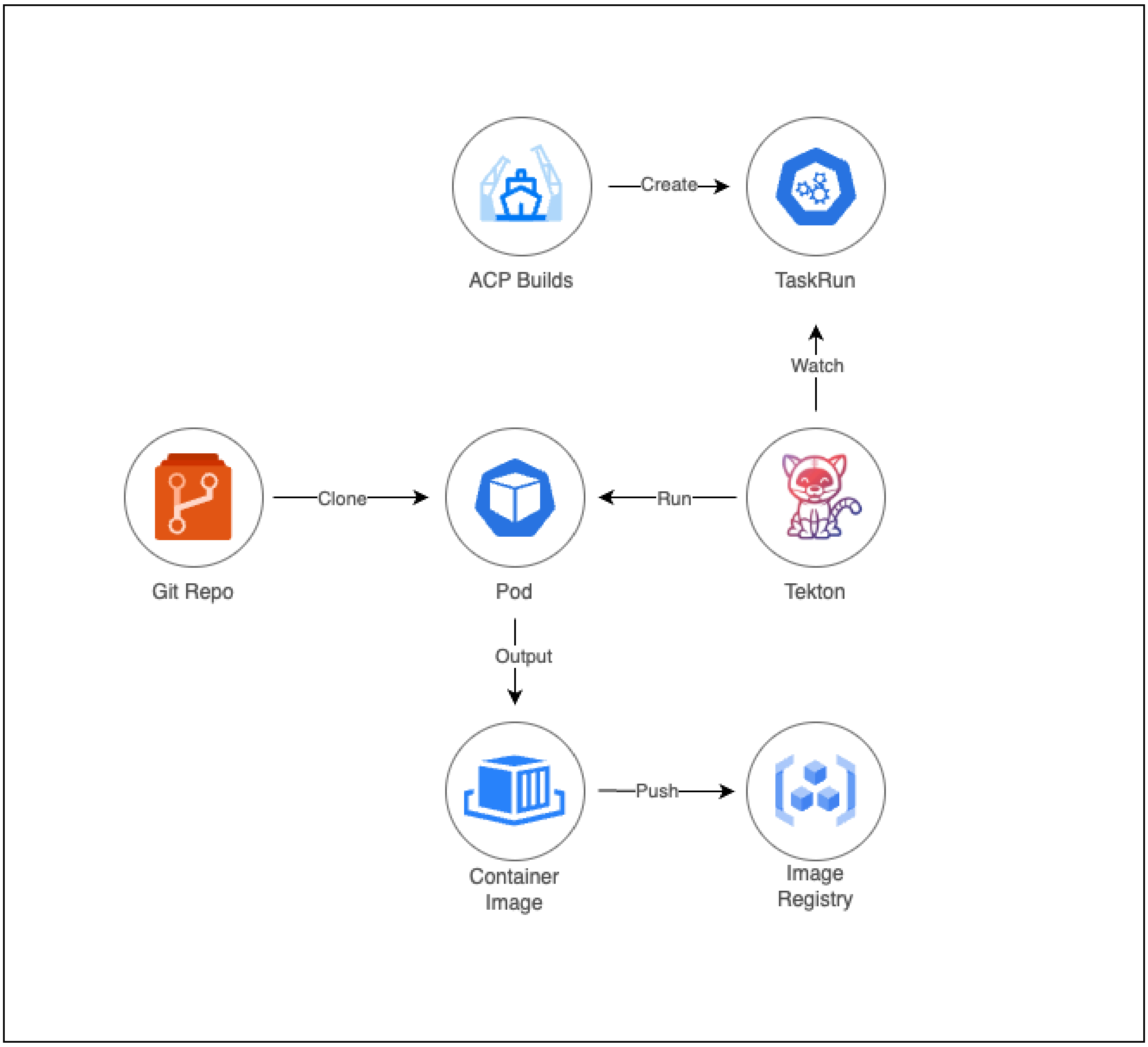
Usage Limitations

> The current version only supports Java, Go, Python, and Node.js languages.

WARNING

Prerequisites: Alauda DevOps Pipelines operator ↗ is now available in the cluster OperatorHub.

Architecture



Source to Image (S2I) capability is implemented through the **Alauda Container Platform Builds** operator, enabling automated container image builds from Git repository source code and subsequent pushes to a designated image registry. The core components include:

- **Alauda Container Platform Builds** operator: Manages the end-to-end build lifecycle and orchestrates Tekton pipelines.
- **Tekton** pipelines: Executes S2I workflows via Kubernetes-native `TaskRun` resources.

Release Notes

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Alauda Container Platform Builds Release Notes

The release notes for the **Alauda Container Platform Builds** operator describe new features and enhancements, deprecated features, and known issues.

INFO

The **Alauda Container Platform Builds** operator is provided as an installable component, with a distinct release cycle from the core Alauda Container Platform . The Alauda Container Platform Builds operator Lifecycle Policy outlines release compatibility.

Supported Versions

Version	Alauda Container Platform Version	Alauda DevOps Pipelines Version
v1.1.0	**v4.1**	**v4.1**

---

v1.1 Release Notes

v1.1.0

1. Security Vulnerability Remediation.
2. Independently Releasable.

Lifecycle Policy

Version Lifecycle Timeline

Below is the lifecycle schedule for released versions of the Alauda Container Platform Builds Operator:

Version	Release Date	End of Life
v1.1.0	2025-08-15	2027-08-15

Install

Installing Alauda Container Platform Builds

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Prerequisites

> Alauda Container Platform Builds is a container tool offered by Alauda Container Platform that integrates building (capable of Source to Image) and create application.

1. Download the latest version package of **Alauda Container Platform Builds** that matches your platform. If the **Alauda DevOps Pipelines** operator has not been installed on the Kubernetes cluster, it is recommended to download it together.
2. Utilize the `violet` CLI tool to upload **Alauda Container Platform Builds** and **Alauda DevOps Pipelines** packages to your target cluster. For detailed instructions on using `violet`, please refer to the CLI.

Procedure

Install the Alauda Container Platform Builds Operator

1. Log in, and navigate to the **Administrator** page.
2. Click **Marketplace** > **OperatorHub**.
3. Find the **Alauda Container Platform Builds** operator, click **Install**, and enter the **Install** page.

Configuration Parameters:

Parameter	Recommended Configuration
Channel	`Alpha` : The default Channel is set to **alpha**.
Version	Please select the latest version.
Installation Mode	`Cluster` : A single Operator is shared across all namespaces in the cluster for instance creation and management, resulting in lower resource usage.
Namespace	`Recommended` : It is recommended to use the **shipyard-operator** namespace; it will be created automatically if it does not exist.
Upgrade Strategy	Please select the `Manual` . • `Manual` : When a new version is available in the OperatorHub • the **Upgrade** action will not be executed automatically.

1. On the **Install** page, select default configuration, click **Install**, and complete the installation of the **Alauda Container Platform Builds** Operator.

Install the Shipyard instance

1. Click on **Marketplace** > **OperatorHub**.
2. Find the installed **Alauda Container Platform Builds** operator, navigate to **All Instances**.
3. Click **Create Instance** button, and click **Shipyard** card in the resource area.
4. On the parameter configuration page for the instance, you may use the default configuration unless there are specific requirements.
5. Click **Create**.

Verification

- After the instance is successfully created, wait approximately 20 minutes, then navigate to **Container Platform** > **Applications** > **Applications** and click **Create**.
- You should see the entry for **Create from Code**. At this time, the installation of Alauda Container Platform Builds is successful, and you can start your S2I journey with the Creating an application from Code.

Upgrade

Upgrading Alauda Container Platform Builds

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Prerequisites

> Alauda Container Platform Builds is a container tool offered by Alauda Container Platform that integrates building (capable of Source to Image) and create application.

1. Download the new version package of **Alauda Container Platform Builds** that matches your platform.
2. Utilize the `violet` CLI tool to upload **Alauda Container Platform Builds** and **Alauda DevOps Pipelines** packages to your target cluster. For detailed instructions on using `violet`, please refer to the CLI.

Procedure

Upgrading the Alauda Container Platform Builds Operator

INFO

If you are upgrading from version v4.0 and earlier, first migrate the **Alauda DevOps Tekton v3** to **Alauda DevOps Pipelines**↗.

1. Log in, and navigate to the **Administrator** page.
2. Click **Marketplace** > **OperatorHub**.
3. In the navigation bar, select the cluster where the operator is installed.
4. Find the **Alauda Container Platform Builds** operator and open its **Details** page.
5. Click **Confirm** to start the upgrade, and wait until the operator finishes upgrading.

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Managing applications created from Code

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Key Features

- Input the code repository URL to trigger the S2I process, which converts the source code into a image and publishes it as an application.
- When the source code is updated, initiate the **Rebuild** action via the visual interface to update the application version with a single click.

Advantages

- Simplifies the process of creating and upgrading applications from code.
- Lowers the barrier for developers, eliminating the need to understand the details of containerization.
- Provides a visual construction process and operational management, facilitating problem localization, analysis, and troubleshooting.

Prerequisites

- Installing Alauda Container Platform Builds is completed.
- Access to a image repository is required; if unavailable, contact the Administrator to Installing Alauda Container Platform Registry

Procedure

1. **Container Platform**, navigate to **Application** > **Application**.
2. Click **Create**.
3. Select the **Create from Code**.
4. Refer to the parameter descriptions below to complete the configuration.

Region	Parameter	Description
Code Repository	**Type**	• **Platform Integrated**: Choose a code repository that is integrated with the platform and already allocated for the current project; the platform supports GitLab, GitHub, and Bitbucket. • **Input**: Use a code repository URL that is not integrated with the platform.
	Integrated Project Name	The name of the integration tool project assigned or associated with the current project by the Administrator.
	Repository Address	Select or input the address of the code repository that stores the source code.

	Version Identifier	Supports creating applications based on branches, tags, or commits in the code repository. Among them: • When the version identifier is a branch, only the latest commit under the selected branch is supported for creating applications. • When the version identifier is a tag or commit, the latest tag or commit in the code repository is selected by default. However, you can also choose other versions as needed.
	Context dir	Optional directory for the source code, used as a context directory for build.
	Secret	When using an input code repository, you can add an authentication secret as needed.
	Builder Image	• An image that includes specific programming language runtime environments, dependency libraries, and S2I scripts. Its main purpose is to convert source code into runnable application images. • The supported builder images, include: Golang, Java, Node.js, and Python.
	Version	Select the runtime environment version that is compatible with your source code to ensure smooth application execution.

Build	**Build Type**	Currently, only the **Build** method is supported for constructing application images. This method simplifies and automates the complex image building process, allowing developers to focus solely on code development. The general process is as follows: 1. After installed Alauda Container Platform Builds and creating the Shipyard instance, the system automatically generates cluster-level resources, such as ClusterBuildStrategy, and defines a standardized build process. This process includes detailed build steps and necessary build parameters, thereby enabling Source-to-Image (S2I) builds. For detailed information, refer to: Installing Alauda Container Platform Builds 2. Create Build type resources based on the above strategies and the information provided in the form. These resources specify build strategies, build parameters, source code repositories, output image repositories, and other relevant information. 3. Create BuildRun type resources to initiate specific build instances, which coordinate the entire build process. 4. After completing the BuildRun creation, the system will automatically generate the corresponding TaskRun resource instance. This TaskRun instance triggers the Tekton pipeline build and creates a Pod to execute the build process. The Pod is responsible for the actual build work, which includes: Pulling the source code from the code repository.

		Calling the specified builder image. Executing the build process.
	Image URL	After the build is complete, specify the target image repository address for the application.
Application	-	Fill in the application configuration as needed. For specific details, refer to the parameter descriptions in the Creating applications from Image documentation.
Network	-	• **Target Port**: The actual port that the application inside the container listens on. When external access is enabled, all matching traffic will be forwarded to this port to provide external services. • **Other Parameters**: Please refer to the parameter descriptions in the CreatingIngress documentation.
Label Annotations	-	Fill in the relevant labels and annotations as needed.

5. After filling in the parameters, click on **Create**.

6. You can view the corresponding deployment on the **Details** page.

Related operations

Build

After the application has been created, the corresponding information can be viewed on the details page.

Parameter	Description
Build	Click the link to view the specific build (Build) and build task (BuildRun) resource information and YAML.
Start Build	When the build fails or the source code changes, you can click this button to re-execute the build task.

How To

Creating an application from Code

> Using the powerful capabilities of Alauda Container Platform Builds installation to achieve the entire process from Java source code to create an application, and ultimately enable the application to run efficiently in a containerized manner on Kubernetes.

TOC

Prerequisites

Before using this functionality, ensure that:

- Installing Alauda Container Platform Builds
- There is an accessible image repository on the platform. If not, please contact the Administrator to Installing ACP Registry

Procedure

1. **Container Platform**, click **Applications** > **Applications**.
2. Click **Create**.
3. Select the **Create from Code**.

4. Complete the configuration according to the parameters below:

Parameter	Recommended Configuration
Code Repository	**Type**: `Input` **Repository URL**: `https://github.com/alauda/spring-boot-hello-world`
Build Method	`Build`
Image Repository	Contact the Administrator.
Application	**Application**: `spring-boot-hello-world` **Name**: `spring-boot-hello-world` **Resource Limits**: Use the default value.
Network	**Target Port**: `8080`

5. After filling in the parameters, click **Create**.

6. You can check the corresponding application status on the **Details** page.

Node Isolation Strategy

Node Isolation Strategy provides a project-level node isolation strategy that allows projects to exclusively use cluster nodes.

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Introduction

Node Isolation Strategy provides a project-level node isolation strategy that allows projects to exclusively use cluster nodes.

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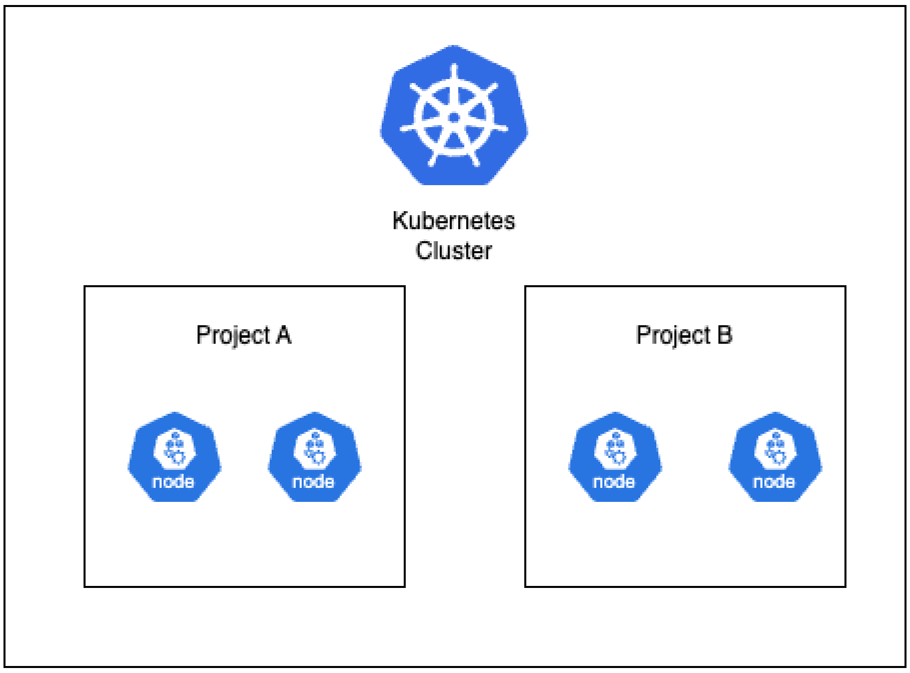
Advantages

Conveniently allocate nodes to projects in an exclusive or shared manner, preventing resource contention between projects.

Application Scenarios

Node Isolation Strategy is suitable for scenarios where enhanced resource isolation between projects is required, and where there is a desire to prevent other projects' components from occupying nodes, which could lead to resource constraints or inability to meet performance requirements.

Architecture



Node Isolation Strategy is implemented based on the Container Platform Cluster Core component, providing the capability of node isolation between projects by allocating nodes on each workload cluster. When containers are created in a project, they are forcibly scheduled to the nodes allocated to that specific project.

Concepts

Core Concepts

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Node Isolation

Node Isolation refers to isolating nodes in a cluster to prevent containers from different projects from simultaneously using the same node, thereby avoiding resource contention and performance degradation.

Guides

Create Node Isolation Strategy

Create Node Isolation Strategy

Create a node isolation policy for the current cluster, allowing specified projects to have exclusive access to the nodes of grouped resources within the cluster, thereby restricting the runnable nodes for Pods under the project, achieving physical resource isolation between projects.

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Create Node Isolation Strategy

1. In the left navigation bar, click on **Security** > **Node Isolation Strategy**.
2. Click on **Create Node Isolation Strategy**.
3. Refer to the instructions below to configure the relevant parameters.

Parameter	Description
Project Exclusivity	Whether to enable or disable the switch for the nodes contained in the project isolation policy configured in the strategy; click to toggle on or off, default is on. When the switch is on, only Pods under the specified project in the policy can run on the nodes included in the policy; when off, Pods under other projects in the current cluster can also run on the nodes included in the policy apart from the specified project.

Parameter	Description
Project	The project that is configured to use the nodes in the policy. Click the **Project** dropdown selection box, and check the checkbox before the project name to select multiple projects. **Note**: A project can only have one node isolation policy set; if a project has already been assigned a node isolation policy, it cannot be selected; Supports entering keywords in the dropdown selection box to filter and select projects.
Node	The IP addresses of the compute nodes allocated for use by the project in the policy. Click the **Node** dropdown selection box, and check the checkbox before the node name to select multiple nodes. **Note**: A node can belong to only one isolation policy; if a node already belongs to another isolation policy, it cannot be selected; Supports entering keywords in the dropdown selection box to filter and select nodes.

4. Click **Create**.

   Note:

   - After the policy is created, existing Pods in the project that do not comply with the current policy will be scheduled to the nodes included in the current policy after they are rebuilt;

   - When **Project Exclusivity** is on, currently existing Pods on the nodes will not be automatically evicted; manual scheduling is required if eviction is needed.

Delete Node Isolation Strategy

Note: After the node isolation policy is deleted, the project will no longer be restricted to run on specific nodes, and the nodes will no longer be exclusively used by the project.

1. In the left navigation bar, click on **Security** > **Node Isolation Strategy**.

2. Locate the node isolation policy, click ⋮ > **Delete**.

Permissions

Function	Action	Platform Administrator	Platform auditors	Project Manager	Namespace Administrator
nodegroups `acp-nodegroups`	View	✓	✓	✓	✓
	Create	✓	✕	✕	✕
	Update	✓	✕	✕	✕
	Delete	✓	✕	✕	✕

FAQ

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Why shouldn't multiple ResourceQuotas exist in a namespace when importing it?

When importing a namespace, if the namespace contains multiple ResourceQuota resources, the platform will select the smallest value for each quota item among all ResourceQuotas and merge them, ultimately creating a single ResourceQuota named `default`.

Example:

The namespace `to-import` to be imported contains the following `resourcequota` resources:

```yaml
---
apiVersion: v1
kind: ResourceQuota
metadata:
  name: a
  namespace: to-import
spec:
  hard:
    requests.cpu: "1"
    requests.memory: "500Mi"
    limits.cpu: "3"
    limits.memory: "1Gi"
---
apiVersion: v1
kind: ResourceQuota
metadata:
  name: b
  namespace: to-import
spec:
  hard:
    requests.cpu: "2"
    requests.memory: "300Mi"
    limits.cpu: "2"
    limits.memory: "2Gi"
```

After importing the `to-import` namespace, the following `default` ResourceQuota will be created in that namespace:

```yaml
apiVersion: v1
kind: ResourceQuota
metadata:
  name: default
  namespace: to-import
spec:
  hard:
    requests.cpu: "1"
    requests.memory: "300Mi"
    limits.cpu: "2"
    limits.memory: "1Gi"
```

For each ResourceQuota, the quotas of resources is the minimum value between `a` and `b`.

When multiple ResourceQuotas exist in a namespace, Kubernetes validates each ResourceQuota independently. Therefore, after importing a namespace, it is recommended to delete all ResourceQuotas except for the `default` one. This helps avoid complications in quota calculations due to multiple ResourceQuotas, which can easily lead to errors.

Why shouldn't multiple LimitRanges exist in a namespace when importing it?

When importing a namespace, if the namespace contains multiple LimitRange resources, the platform cannot merge them into a single LimitRange. Since Kubernetes independently validates each LimitRange when multiple exist, and the behavior of which LimitRange's default values Kubernetes selects is unpredictable.

If the namespace only contains a single LimitRange, the platform will created a LimitRange named `default` with the values from that LimitRange.

Therefore, before importing a namespace, only a single LimitRange should exist in the namespace. And after the namespace is imported it is recommended to delete the LimitRanges except for the one named `default` to avoid unpredictable behavior caused by multiple LimitRanges.