Alibaba Cloud
Container Service for Kubernetes

Product Introduction

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Generic conventions

Table -1: Style conventions

Style	Description	Example
	This warning information indicates a situation that will cause major system changes, faults, physical injuries, and other adverse results.	 **Danger:** Resetting will result in the loss of user configuration data.
	This warning information indicates a situation that may cause major system changes, faults, physical injuries, and other adverse results.	 **Warning:** Restarting will cause business interruption. About 10 minutes are required to restore business.
	This indicates warning information, supplementary instructions, and other content that the user must understand.	 **Note:** Take the necessary precautions to save exported data containing sensitive information.
	This indicates supplemental instructions, best practices, tips, and other content that is good to know for the user.	 **Note:** You can use **Ctrl** + **A** to select all files.
>	Multi-level menu cascade.	**Settings** > **Network** > **Set network type**
Bold	It is used for buttons, menus, page names, and other UI elements.	Click **OK**.
`Courier font`	It is used for commands.	Run the `cd /d C:/windows` command to enter the Windows system folder.
Italics	It is used for parameters and variables.	`bae log list --instanceid` *Instance_ID*
[] or [a|b]	It indicates that it is a optional value, and only one item can be selected.	`ipconfig` *[-all|-t]*
{} or {a|b}	It indicates that it is a required value, and only one item can be selected.	`swich` *{stand | slave}*

Contents

1 What is Container Service for Kubernetes

Container Service for Kubernetes provides the high-performance and scalable container application management service, which enables you to manage the lifecycle of enterprise-class containerized applications by using Kubernetes. By simplifying the setup and capability expansion of cluster and integrating with the Alibaba Cloud abilities of virtualization, storage, network, and security, Container Service for Kubernetes makes an ideal running cloud environment for Kubernetes containers. As a service provider certified by Kubernetes and the world's first platform service that has passed Kubernetes consistency certification, Container Service provides you with professional support and services.

Container Service for Kubernetes contains the classic dedicated Kubernetes mode and the serverless Kubernetes mode for you to choose on demand.

- Classic dedicated Kubernetes mode: You can get more fine-grained control over cluster infrastructure and container applications, for example, select the host instance specification and the operating system, specify Kubernetes version, custom Kubernetes attribute switch settings, and more. Alibaba Cloud Container Service for Kubernetes is responsible for creating the underlying cloud resources for the cluster, upgrading and other automated operations for the cluster. You need to plan, maintain, and upgrade the server cluster. You can add servers to or remove servers from the cluster manually or automatically.
- Serverless Kubernetes mode: You do not need to create the underlying virtualization resource. To launch the application directly, use Kubernetes commands to specify the application container image, CPU and memory requirements as well as external service methods.

Features

Cluster management

- You can create a classic dedicated Kubernetes cluster through the console within ten minutes. GPU instances and ECS Bare Metal (EBM) Instance are supported. You can also create a highly available cluster that is across zones.
- Provides OS images for optimizing containers, and the Kubernetes and Docker versions of **stability testing and security hardening**.
- Supports multi-cluster management, highly available clusters across zones, and cluster federation management.

One-stop container lifecycle management

- **Network**

  Provides the high performance Virtual Private Cloud (VPC) and elastic network interfaces (ENI) network plug-in optimized for Alibaba Cloud, which is 20% better than the average network solution.

  Supports container access policies and flow control restrictions.

- **Storage**

  Container Service integrates with Alibaba Cloud cloud disk, Network Attached Storage (NAS), and Object Storage Service (OSS), and provides the standard FlexVolume drive.

  Supports dynamic creation and migration of storage volumes.

- **Logs**

  Supports high-performance automatic log collection and integrating with Alibaba Cloud Log Service.

  You can also integrate Container Service with third-party open-source log solutions.

- **Monitoring**

  Supports the monitoring at the level of containers and virtual machines (VMs). You can also integrate Container Service with third-party open-source monitoring solutions.

- **Permission**

  Supports Resource Access Management (RAM) authorization and management at the level of clusters.

  Supports permission configuration management at the level of applications.

- **Application management**

  Support gray release and blue-green release.

  Support application monitoring and application elastic scaling.

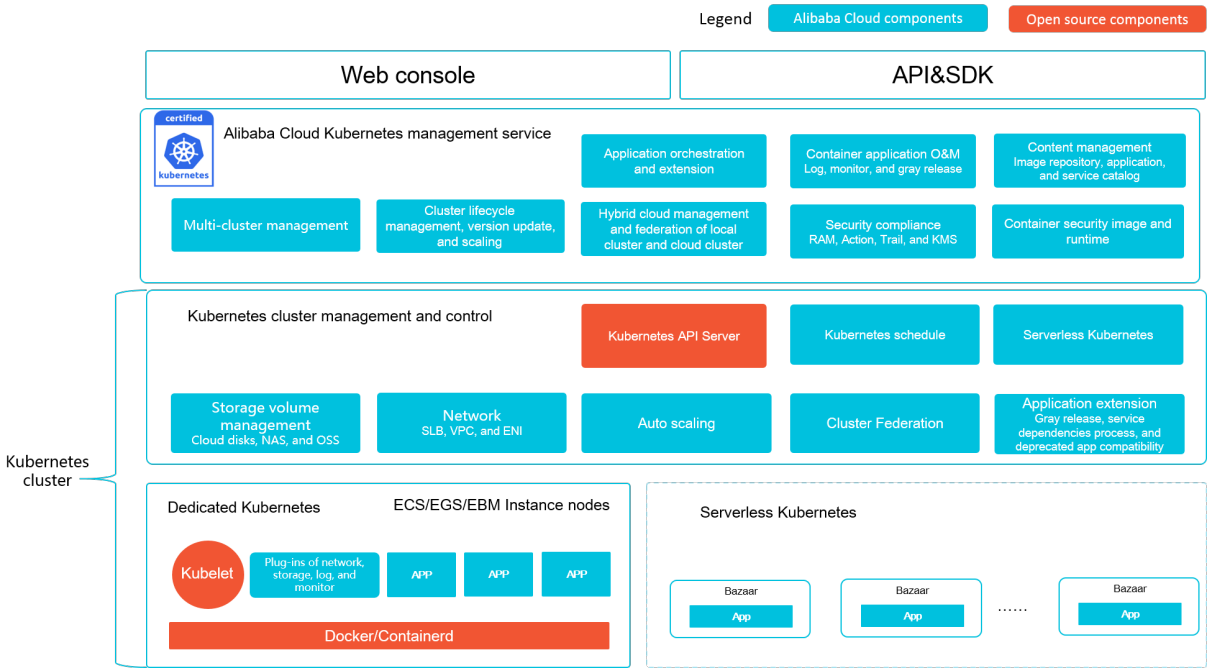
  Supports one-click deployment of the Helm application by the built-in application store.
  Supports the directory of services to simplify cloud service integration.

Easily deal with upstream and downstream delivery process by using high-availability scheduling policy

- Supports affinity policy and horizontal scaling of services.
- Supports high availability across zones and disaster recovery.

- Supports the APIs for cluster and application management to easily interconnect with the continuous integration and private deployment system.

2 Architecture



Description

Container Service for Kubernetes is adapted and enhanced on the basis of native Kubernetes. This service simplifies cluster creation and expansion, and integrates Alibaba Cloud capabilities in virtualization, storage, network, and security, providing an improved running environment for Kubernetes containerized applications.

Features	Description
Multiple Kubernetes clusters	Integrated with Alibaba Cloud virtualization technology, Container Service for Kubernetes supports the Dedicated cluster and Serverless cluster. • Dedicated: Elastic Compute Service (ECS), Elastic GPU Service (EGS), and ECS Bare Metal Instance can be used as cluster nodes. The instance specifications can be configured flexibly and support a wide range of plug-ins. • Serverless: Provides Kuberntes Serverless services which are free of server management, simplifies the underlying resource management, supports flexible

Features	Description
	capacity expansion, and reduces resource overhead.
Alibaba Cloud Kubernetes cluster management and control service	Support powerful network, storage, hybrid cluster management, horizontal capacity expansion, application extension, and other features.
Alibaba Cloud Kubernetes management service	Supports secure images and Helm tools, and is highly integrated with Alibaba Cloud Resource Access Management (RAM), Key Management Service (KMS), log, monitoring and other products to provide a secure and compliant Kubernetes solution that provides you with enhanced capabilities such as hybrid cloud, container security, CI/CD, DevOps and more.
Convenient and efficient use	Container Service for Kubernetes provides Web console, API&SDK.

3 Advantages

Advantages of Container Service for Kubernetes

Ease of use

- Supports creating Kubernetes clusters with one click in the Container Service console.
- Supports upgrading Kubernetes clusters with one click in the Container Service console.

  You may have to deal with self-built Kubernetes clusters of different versions at the same time , including version 1.8.6, 1.9.4, 1.10, and later. Upgrading clusters each time brings you great adjustments and Operation & Maintenance (O&M) costs. Container Service upgrade solution performs rolling update by using images and uses the backup policy of complete metadata, which allows you to conveniently roll back to the previous version.
- Supports expanding or contracting Kubernetes clusters conveniently in the Container Service console.

  Container Service Kubernetes clusters allow you to expand or contract the capacity vertically with one click to respond to the peak of the data analysis business quickly.

Powerful functions

Function	Description
Network	• High-performance Virtual Private Cloud (VPC) network plug-in. • Supports network policy and flow control. Container Service provides you with continuous network integration and the best network optimization.
Server Load Balancer	Supports creating Internet or intranet Server Load Balancer instances. If your self-built Kubernetes clusters are implemented by using the self-built Ingress, releasing the business frequently may cause pressure on Ingress configuration and higher error probabilities. The Server Load Balancer solution of Container Service supports Alibaba Cloud native high-availability Server Load Balancer, and can automatically modify and update the network configurations. This solution has been used by a large number of

Function	Description
	users for a long time, which is more stable and reliable than self-built Kubernetes.
Storage	Container Service integrates with Alibaba Cloud cloud disk, Network Attached Storage (NAS), and block storage, and provides the standard FlexVolume drive. Self-built Kubernetes clusters cannot use the storage resources on the cloud. Alibaba Cloud Container Service provides the best seamless integration.
O&M	• Integrates with Alibaba Cloud Log Service and CloudMonitor. • Supports auto scaling.
Image repository	• High availability. Supports high concurrency. • Supports speeding up the pull of images. • Supports P2P distribution. The self-built image repository may crash if you pull images from millions of clients at the same time. Enhance the reliability of the image repository by using the image repository of Alibaba Cloud Container Service, which reduces the O&M burden and upgrade pressure.
Stability	• The dedicated team guarantees the stability of the container. • Each Linux version and Kubernetes version are provided to you after strict tests. Container Service provides the Docker CE to reveal all the details and promotes the repair capabilities of Docker. If you have issues such as Docker Engine hangs, network problems, and kernel compatibility, Container Service provides you with the best practices.
High availability	• Supports multiple zones. • Supports backup and disaster recovery.

Function	Description
Technical support	• Provides the Kubernetes upgrade capabilities. Supports upgrading a Kubernetes cluster to the latest version with one click. • Alibaba Cloud container team is responsible for solving problems about containers in your environment.

4 Scenarios

DevOps continuous delivery

Optimal continuous delivery process

Working with Jenkins, Container Service encompasses the complete process of DevOps from code submission to application deployment in an automated fashion. It makes sure that only codes passing the automated test can be delivered and deployed, and efficiently replaces the traditional method of complicated deployment and slow iteration in the industry.

Container Service can implement:

- Automation of DevOps.

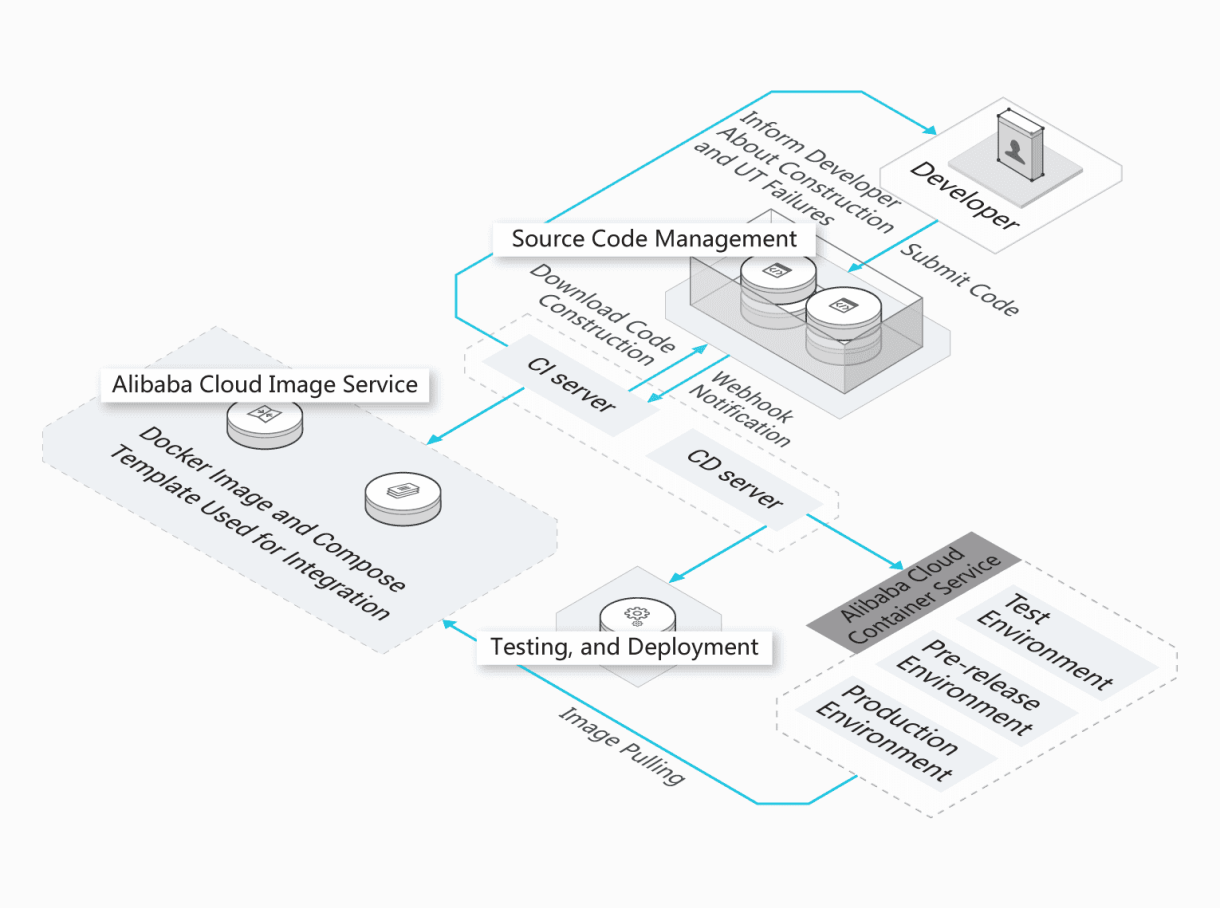
  The automation of the full process from code changes to code building, image building, and application deployment.
- Consistency of environment.

  Container Service allows you to deliver not only code but also a running environment based on the immutable architecture.
- Continuous feedback

  Results of each integration or delivery are fed back in real time.

We recommend that you use

Elastic Compute Service (ECS) and Container Service together.



Microservice architecture

Implement agile development and deployment to accelerate business iteration of enterprise s

In the production environment of enterprises, microservices are divided reasonably and each microservice application is stored in the Alibaba Cloud image repository. You only have to iterate each microservice application, and Alibaba Cloud provides the capabilities of scheduling, orchestration, deployment, and gated launch.

Container Service can implement:

- Server Load Balancer and service discovery.

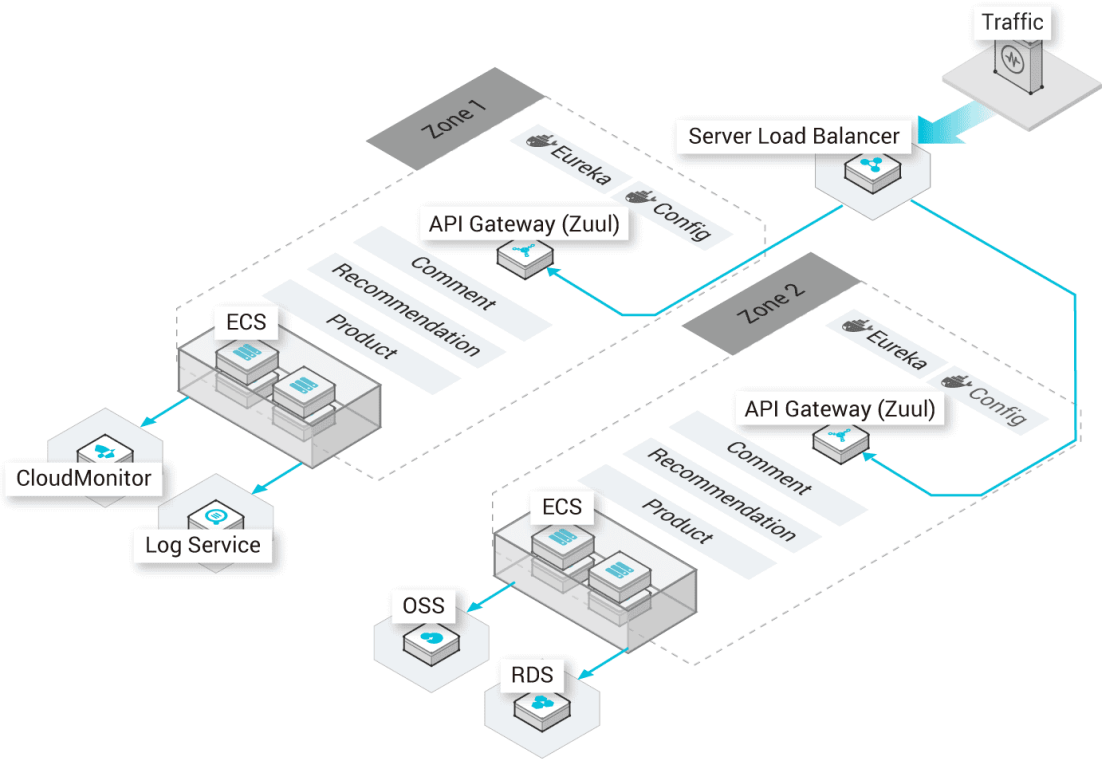
  Supports Layer-4 and Layer-7 request forwarding and backend binding.
- Many policies of scheduling and exception recovery.

  Supports affinity scheduling at the level of services. Supports cross-zone high-availability and disaster recovery.
- Microservice monitoring and auto scaling.

Supports the monitoring at the level of microservices and containers. Supports auto scaling of microservices.

We recommend that you use

ECS, Relational Database Service (RDS), Object Storage Service (OSS), and Container Service together.



Hybrid cloud architecture

Unified Operation and Maintenance of multiple cloud resources

Manage resources on and off the cloud at the same time in the Container Service console, without switching between multiple cloud consoles. Deploy applications on and off the cloud at the same time by using the same image and orchestration based on the characteristics unrelated to the container infrastructure.

Container Service supports:

- Scaling in and out applications on the cloud.

Expand the capacity rapidly on the cloud at the business peak period to bring some business traffic to the cloud.

- Disaster recovery on the cloud.

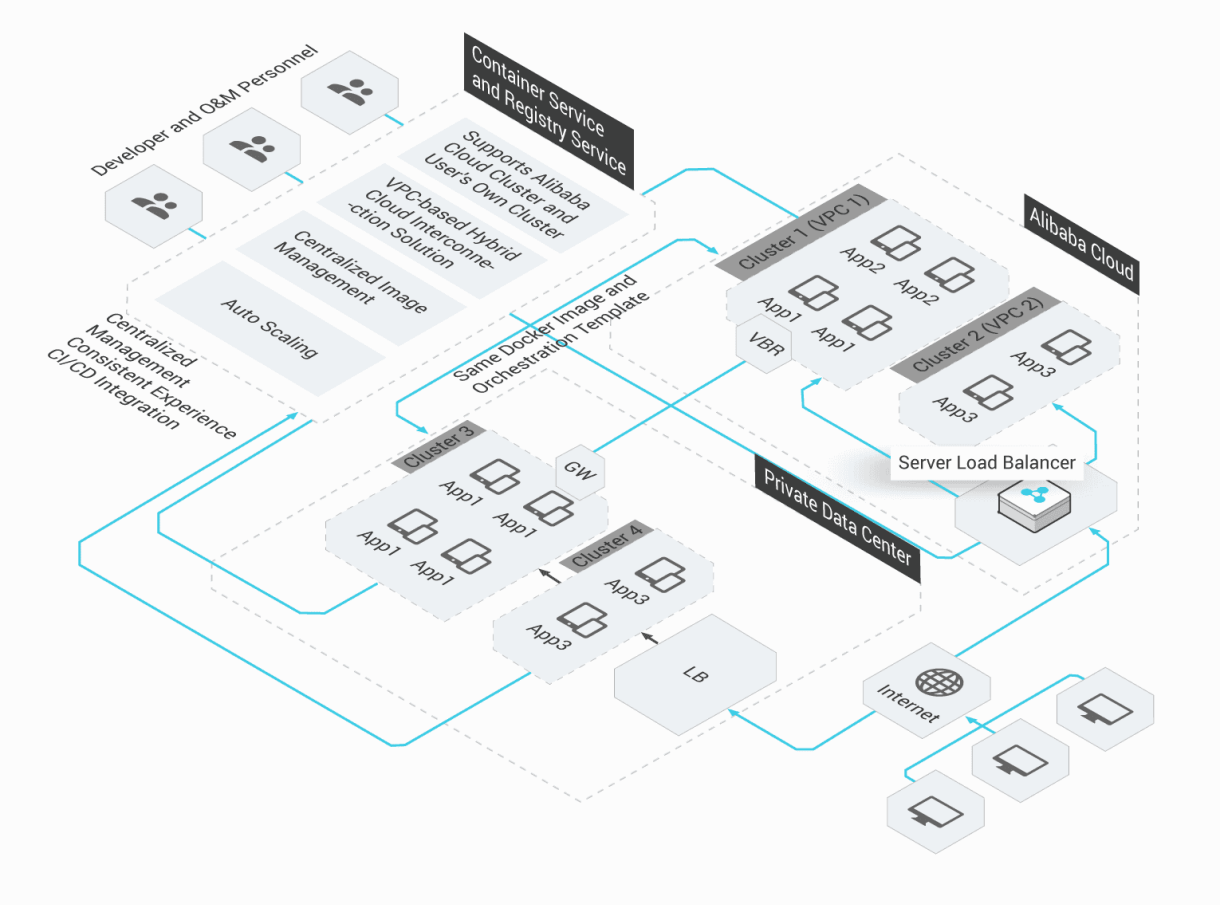
  Deploy business systems on and off the cloud at the same time to provide services off the cloud and provide disaster recovery on the cloud.

- Development and test off the cloud.

  Release the applications seamlessly on the cloud after the development and test off the cloud.

We recommend that you use

ECS, Virtual Private Cloud (VPC), and Express Connect together.



Auto scaling architecture

Automatic expansion/contraction for the business according to the business traffic

Container Service can automatically expand or contract the business according to the business traffic, without manual intervention. In this way, the system is not down because of traffic surge and not timely expansion, and the waste due to a large number of idle resources is avoided.

Container Service can implement:

- Rapid response.

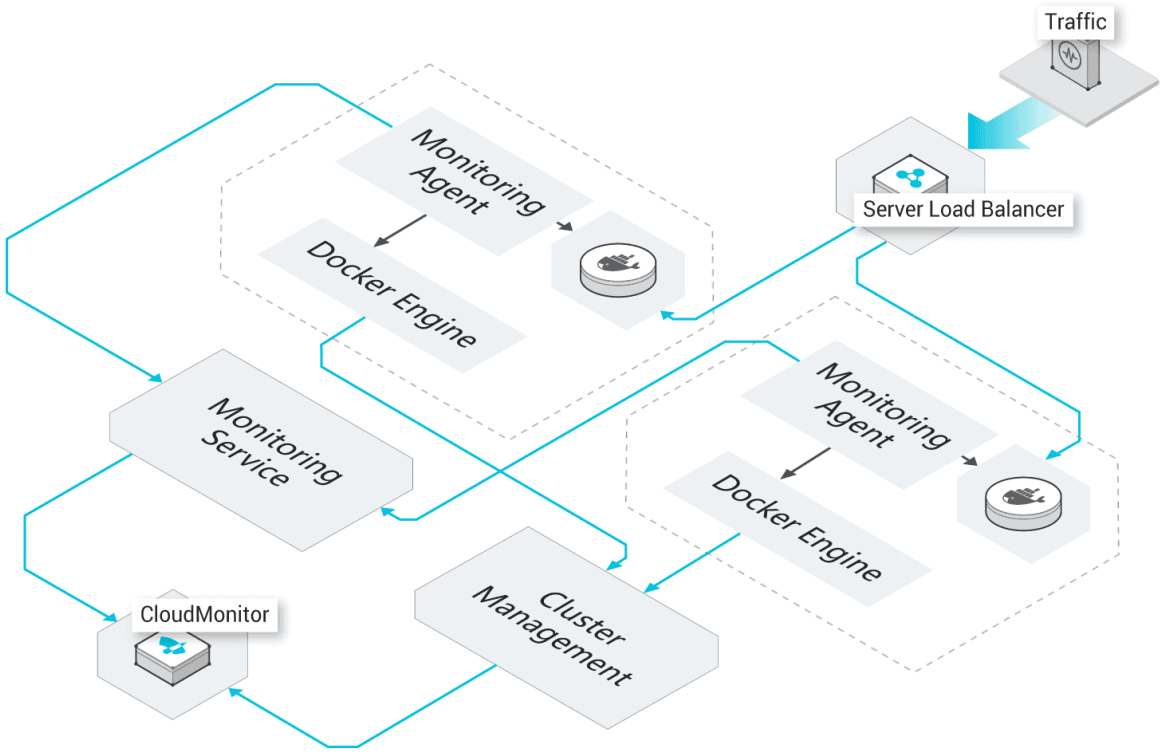
  Trigger the container expansion in seconds when the business traffic reaches the expansion indicator.
- Full automation.

  The expansion or contraction process is fully automated, without manual intervention.
- Low cost.

  Contract the capacity automatically when the traffic is reduced to avoid the waste of resources.

We recommend that you use

ECS and CloudMonitor together.



5 Limits

Limits for Alibaba Cloud Container Service Kubernetes clusters are as follows.

Clusters

- By default, you can create up to five clusters in all regions and add up to 40 nodes to each cluster. To create more clusters or add more nodes to a cluster, please open a ticket.
- Currently, Kubernetes clusters only support Linux containers. The support for Windows containers is planned.
- Currently, Kubernetes clusters only support Virtual Private Cloud (VPC). You can create a VPC or use an existing VPC when creating a Kubernetes cluster.
- Currently, Elastic Compute Service (ECS) instances support the following two billing methods : Pay-As-You-Go and Subscription. You can change the billing method of your instance from Pay-As-You-Go to Subscription in the ECS console. Other resources such as Server Load Balancer (SLB) instances support only the Pay-As-You-Go billing method.

ECS instances

- Only support the CentOS operating system.
- Limits for adding an existing node:
  - The ECS instance to be added must be in the same region as the cluster and use VPC.
  - When adding an existing ECS instance, make sure that your ECS instance has an Elastic IP (EIP) for the network type VPC. Otherwise, the ECS instance will fail to be added.
  - The ECS instance to be added must be under the same account as the cluster.

Cluster expansion and contraction

- The number of worker nodes must be in the range of 1 to 37.
- Manual and automatic cluster elastic scaling are supported.
- Currently, master nodes in a Kubernetes cluster cannot be expanded automatically.
- According to the Resource Orchestration Service (ROS) rules, elastic contraction does not contract the nodes created when the cluster is created or the nodes manually added to the cluster, but only contracts the nodes manually expanded by you. The contraction rule is based on the creation time. When you contract a cluster, the worker nodes are removed from the cluster in the order that they are added when you expand the cluster.
- Nodes added through cluster expansion are Pay-As-You-Go nodes.

6 Terms

Basic terms

Clusters

A collection of cloud resources that are required to run containers. It associates with several server nodes, Server Load Balancer instances, Virtual Private Cloud (VPC), and other cloud resources.

Nodes

A server (either an Elastic Compute Service (ECS) instance or a physical server) that has a Docker Engine installed and is used to deploy and manage containers. The Agent program of Container Service is installed in a node and registered to a cluster. The number of nodes in a cluster is scalable.

Container

A running instance created by using a Docker image. A single node can run multiple containers.

Image

A standard packaging format of a container application in Docker. You can specify an image to deploy containerized applications. The image can be from the Docker Hub, Alibaba Cloud image service, or your private registry. An image ID is uniquely identified by the URI of the image repository and the image tag (latest by default).

Kubernetes terms

Node

Nodes in Kubernetes clusters provide the computing power and are the active servers where all the pods are running. The active servers can be physical machines or virtual machines. Containers that are running on the kubelet management nodes must run on the active servers.

Namespace

The namespace provides the virtual isolation for Kubernetes clusters. By default, Kubernetes clusters have three namespaces: the default namespace default, the system namespaces kube-system, and kube-public. The administrator can also create new namespaces to meet the requirements.

Pod

The minimum basic unit of Kubernetes that is used to deploy applications or services. A pod can encapsulate one or multiple containers, storage resources, an independent network IP address, and policy options of managing and controlling the running method of containers.

Replication Controller

Replication Controller (RC) makes sure that a specified number of pod replicas are running in a Kubernetes cluster at any time Replication Controller (RC) makes sure that a specified number of pod replicas are running in a Kubernetes cluster at any time by monitoring the running pod. One or more pod replicas can be specified. If the number of pod replicas is less than the specified number, RC starts to run new pod replicas. If the number of pod replicas exceeds the specified number, RC starts to stop the redundant pod replicas.

Replica Set

The upgraded version of RC. The only difference between Replica Set (RS) and RC is the support for selector. RS supports more types of matching modes. Generally, the RS objects are not used independently, but are used as the deployment parameters in the ideal status.

Deployment

The deployment indicates an update operation for a Kubernetes cluster by users, has a wider application range than RS, and can create a service, update a service, and perform a rolling update of a service. Performing a rolling update of a service actually creates a new RS, gradually adds the number of replicas in the new RS to the ideal status, and reduces the number of replicas in the old RS to zero. Such a compound operation cannot be described well by an RS, but can be described by a more common deployment. We do not recommend that you manually mange and use the RS created by the deployment.

Service

The basic operation unit of Kubernetes. As the abstract of real application service, each service has many containers to provide the support. The port of Kube-Proxy and service selector determine the service request to pass to the backend container, and a single access interface is displayed externally. The external is not required to know how the backend works, which is good for expanding or maintaining the backend.

Labels

Essentially a collection of key-value pairs that are attached to the resource objects. Labels are used to specify the attributes of objects that are meaningful for users, but do not have any direct

significance for kernel systems. You can add a label directly when creating an object or modify the label at any time. Each object can have more labels, but the key value must be unique.

Volume

The volumes in Kubernetes clusters are similar to the Docker volumes. The only difference is that the range of Docker volumes is a container, while the lifecycle and range of Kubernetes volumes are a pod. The volumes declared in each pod are shared by all the containers in the pod. You can use the Persistent Volume Claim (PVC) logical storage, and ignore the actual storage technology in the backend. The specific configurations about Persistent Volume (PV) are completed by the storage administrator.

PV and PVC

PV and PVC allow the Kubernetes clusters to have the abstract logical capabilities of storage, and you can ignore the configurations of actual backend storage technology in the pod configuration logic, leaving the configurations to the PV configurator. The relationship between PV and PVC of storage is similar to that between node and pod of computing. PV and node are the resource provider, changed according to the cluster infrastructure, and configured by the Kubernetes cluster administrator. PVC and pod are the resource user, changed according to the business and service requirements, and configured by the Kubernetes cluster user, namely, the service administrator.

Ingress

A collection of rules that authorize the inbound access to the cluster. You can provide the externally accessible URL, Server Load Balancer, SSL, and name-based virtual host by using the Ingress configurations. You can request the Ingress by posting Ingress resources to API servers. The Ingress Controller is used to implement Ingress by using Server Load Balancer generally, and can configure the edge router and other frontends, which helps you handle the traffic in the HA method.

Related documents.

- *Docker glossary*
- *Kubernetes concepts*

7 Serverless Kubernetes cluster

Introduction

Alibaba Cloud serverless Kubernetes allows you to quickly create Kubernetes container applications without having to manage and maintain clusters and servers. Based on to the amount of CPU and memory resources actually used by the applications, Pay-as-you-go is applied. By using serverless Kubernetes, you can focus on designing and building applications, rather than managing the infrastructure on which your applications run. It is based on the Alibaba Cloud flexible computing infrastructure and is fully compatible with the Kubernetes API, combining the security, elasticity, and Kubernetes ecosystem of virtualized resources.

Alibaba Cloud Kubernetes service has two modes: one is the classic cluster approach, and the other is the serverless mode.

- In the classic Kubernetes cluster mode, you can get more fine-grained control over cluster infrastructure and container applications. For example, select the host instance specification (ECS/EGS/EBM) and the operating system, and specify the Kubernetes version, custom Kubernetes attribute switch settings, use different network models, and more. The Alibaba Cloud Kubernetes service is responsible for creating the underlying cloud resources for the cluster, upgrading the cluster and other automated operations. It monitors CPU, memory, and other resources in the cluster, and finds the server that best fits the container according to the resource requirements you specify. You need to plan, maintain, and upgrade the server cluster . You can also add or remove servers in the cluster manually or automatically by monitoring the resource usage of the application container.
- In serverless mode, you do not need to create the underlying virtualization resource. You can launch the application directly by using the Kubernetes command to indicate application container image, CPU and memory requirements, and external service methods.

Benefits

- **Easy to use**: Second-level application deployment. No need to manage the Kubernetes cluster infrastructure for high availability and security.
- **Compatibility**: You can deploy container applications by using the familiar Kubernetes command line and API that support Kubernetes typical application scenarios without modification. You can also easily migrate your applications to a running platform that supports Kubernetes, such as the Alibaba Cloud Kubernetes cluster.

- **Secure isolation**: Based on the flexible computing infrastructure of the Alibaba Cloud, application containers are isolated from each other to prevent interference.
- **On-demand capacity expansion**: You do not need to worry about horizontal expansion of cluster nodes. Based on application load, you can easily and flexibility to scale up the resources needed for your application.
- **Connectivity**: Supports seamless integration of container applications with Alibaba Cloud basic services. Supports direct interaction with existing applications and databases in your Virtual Private Cloud (VPC); supports the connection of containers with virtual machine applications.

Architecture

The comparison architecture of serverless Kubernetes Container Service and Kubernetes Container Service is shown below.

Scenarios

Serverless Kubernetes has a wide range of application scenarios. The high portability and flexibility based on containers, and the high elasticity and isolation of Infrastructure as a Service (IaaS) provide a powerful base operating facility for serverless applications. Serverless applications include multimedia processing, captured data modification, IoT sensor data processing, streaming computing, chat robotics, batch computing, web applications, mobile application backend services, business logic processing, and continuous integration.