Alibaba Cloud Container Service

Best Practices

Issue: 20190124

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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.	 **Notice:** Take the necessary precautions to save exported data containing sensitive information.
	This indicates supplemental instructio ns, 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 Comparison between Swarm and Kubernetes cluster functions

2 Run TensorFlow-based AlexNet in Alibaba Cloud Container Service

AlexNet is a CNN network developed in 2012 by Alex Krizhevsky using five-layer convolution and three-layer ReLU layer, and won the ImageNet competition (ILSVRC). AlexNet proves the effectiveness in classification (15.3% error rate) of CNN, against the 25% error rate by previous image recognition tools. The emergence of this network marks a milestone for deep learning applications in the computer vision field.

AlexNet is also a common performance indicator tool for deep learning framework. TensorFlow provides the *alexnet_benchmark.py* tool to test GPU and CPU performance. This document uses AlexNet as an example to illustrate how to run a GPU application in Alibaba Cloud Container Service easily and quickly.

Prerequisite

Create a GN5 GPU cluster in Container Service console.

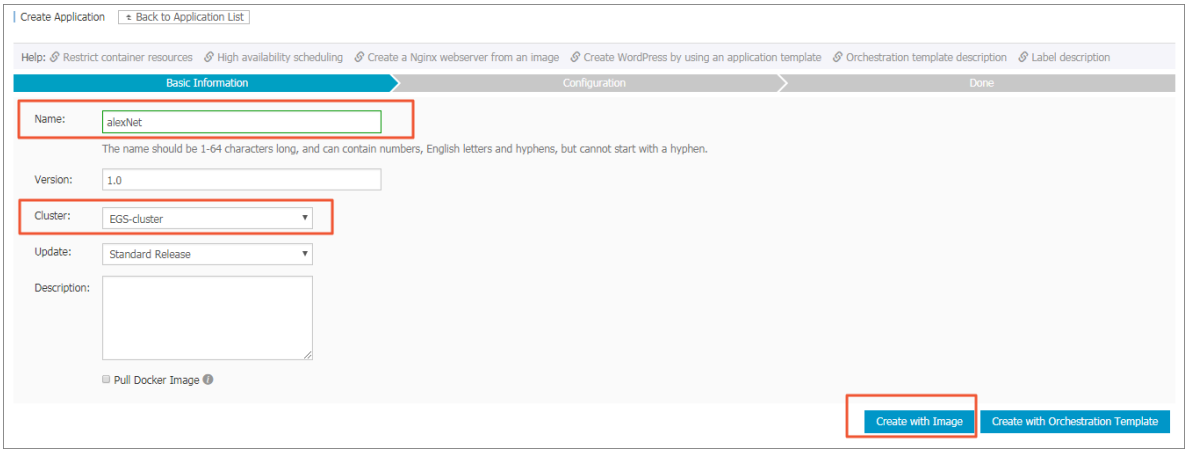
#unique_5

Prerequisite

This operation is based on the Container Service Beijing HPC or GN4 type GPU ECS instance.

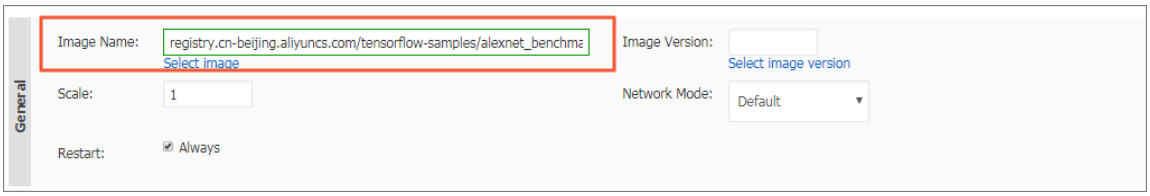
Procedure

1. Log on to the *Container Service console*.
2. Click**Images and Templates >** > **Image**in the left-side navigation pane.
3. Enter the application name (**alexNet** in the example) and select the Beijing HPC or GN4 ECS cluster, and click **Next step**.

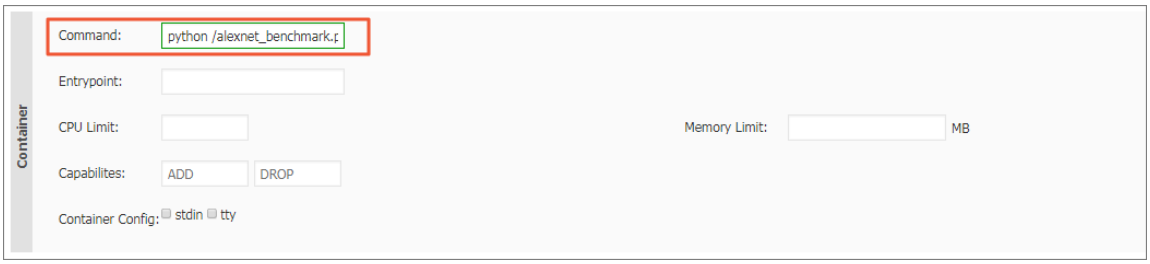


4. Configure the application.

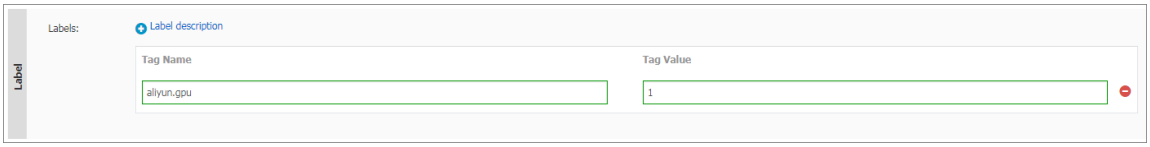
   a. Enter `registry.cn-beijing.aliyuncs.com/tensorflow-samples/alexnet_benchmark:1.0.0-devel-gpu` in the Image Name field.



   b. In the Container section, enter the command in the Command field. For example, enter `python /alexnet_benchmark.py --batch_size 128 -num_batches 100`.

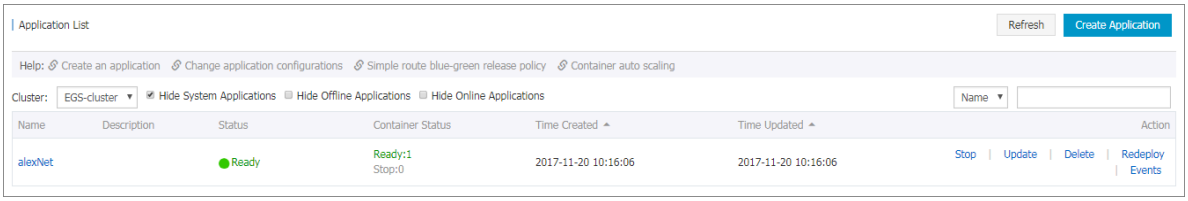


   c. Click the button in the **Label** section. Enter the Alibaba Cloud `gpu` extension label. Enter `aliyun.gpu` in the Tag Name field, and the number of scheduling GPUs (`1` in this example) in the Tag Value field.



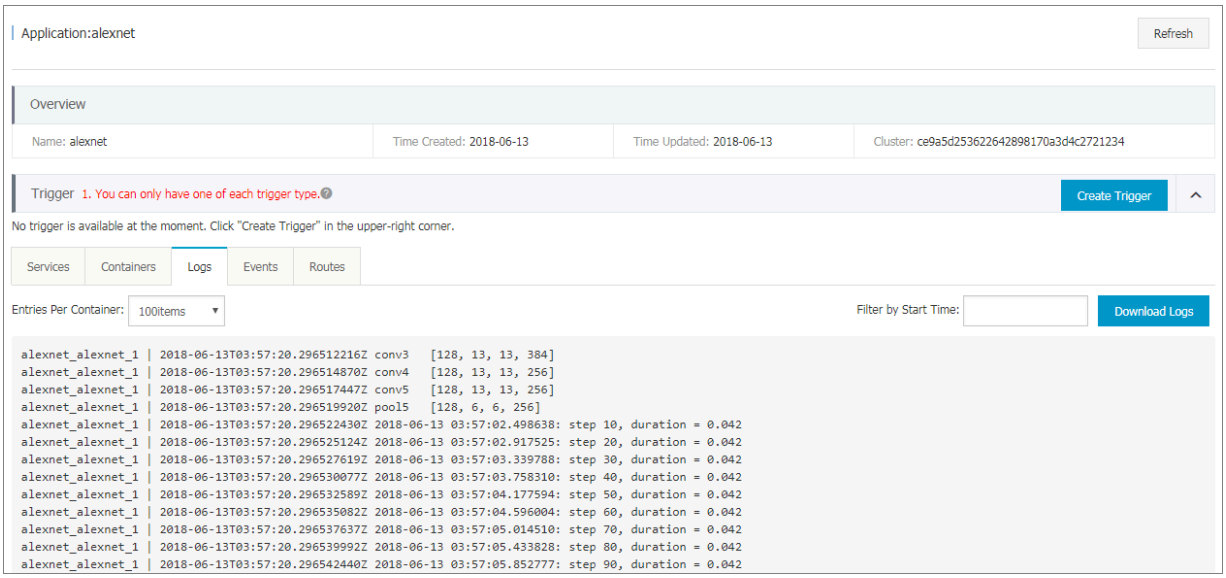
5. Click **Create** after completing the settings.

   You can view the created alexNet application on the **Application List** page.



In this way, you can check the performance of AlexNet on EGS or HPC by means of the container Log Service in Container Service console.

On the Application List page, click the application name **alexNet.** Then, click the **Container List**, and click **Logs** on the right.


Application:alexnet
Refresh
Overview
Name: alexnet
Time Created: 2018-06-13
Time Updated: 2018-06-13
Cluster: ce9a5d253622642898170a3d4c2721234
Trigger 1. You can only have one of each trigger type.
Create Trigger
No trigger is available at the moment. Click "Create Trigger" in the upper-right corner.
Services
Containers
Logs
Events
Routes
Entries Per Container: 100items
Filter by Start Time:
Download Logs
alexnet_alexnet_1 | 2018-06-13T03:57:20.296512216Z conv3 [128, 13, 13, 384]
alexnet_alexnet_1 | 2018-06-13T03:57:20.296514870Z conv4 [128, 13, 13, 256]
alexnet_alexnet_1 | 2018-06-13T03:57:20.296517447Z conv5 [128, 13, 13, 256]
alexnet_alexnet_1 | 2018-06-13T03:57:20.296519920Z pool5 [128, 6, 6, 256]
alexnet_alexnet_1 | 2018-06-13T03:57:20.296522430Z 2018-06-13 03:57:02.498638: step 10, duration = 0.042
alexnet_alexnet_1 | 2018-06-13T03:57:20.296525124Z 2018-06-13 03:57:02.917525: step 20, duration = 0.042
alexnet_alexnet_1 | 2018-06-13T03:57:20.296527619Z 2018-06-13 03:57:03.339788: step 30, duration = 0.042
alexnet_alexnet_1 | 2018-06-13T03:57:20.296530077Z 2018-06-13 03:57:03.758310: step 40, duration = 0.042
alexnet_alexnet_1 | 2018-06-13T03:57:20.296532589Z 2018-06-13 03:57:04.177594: step 50, duration = 0.042
alexnet_alexnet_1 | 2018-06-13T03:57:20.296535082Z 2018-06-13 03:57:04.596004: step 60, duration = 0.042
alexnet_alexnet_1 | 2018-06-13T03:57:20.296537637Z 2018-06-13 03:57:05.014510: step 70, duration = 0.042
alexnet_alexnet_1 | 2018-06-13T03:57:20.296539992Z 2018-06-13 03:57:05.433828: step 80, duration = 0.042
alexnet_alexnet_1 | 2018-06-13T03:57:20.296542440Z 2018-06-13 03:57:05.852777: step 90, duration = 0.042

3 Best practices for restarting nodes

Restarting nodes directly may cause an exception in clusters. In the context of Alibaba Cloud use cases, this document introduces the best practices for restarting nodes in the situations such as performing active Operation & Maintenance (O&M) on Container Service.

Check the high availability configurations of business

Before restarting Container Service nodes, we recommend that you check or modify the following business configurations. In this way, restarting nodes cannot cause the exception of a single node and the business availability cannot be impaired.

- **Data persistence policy of configurations**

  We recommend the data persistence for external volumes of important data configurations such as configurations of logs and business. In this way, after the container is restructured, deleting the former container cannot cause the data loss.

  For how to use the Container Service data volumes, see *Manage data volumes*.

- **Restart policy of configurations**

  We recommend that you configure the `restart: always` restart policy for the corresponding business services so that containers can be automatically pulled up after the nodes are restarted.

- **High availability policy of configurations**

  We recommend that you integrate with the product architecture to configure the affinity and mutual exclusion policies, such as *high availability scheduling (availability:az propery)*, *specified node scheduling (affinity and constraint properties)* , and *specified nodes scheduling (constraint property)*, for the corresponding business. In this way, restarting nodes cannot cause the exception of a single node. For example, for the database business, we recommend the active-standby or multi-instance deployment, and integrating with the preceding characteristics to make sure that different instances are on different nodes and related nodes are not restarted at the same time.

Best practices

We recommend that you check the high availability configurations of business by reading the preceding instructions. Then, follow these steps in sequence **on each node. Do not perform operations on multiple nodes at the same time**.

1. **Back up snapshots**

   We recommend that you create the latest snapshots for all the related disks of the nodes and then back up the snapshots. When starting the shut-down nodes, an exception occurs because the server is not restarted for a long time and the business availability is impaired. However, by backing up the snapshots, this can be avoided.

2. **Verify the container configuration availability of business**

   For a swarm cluster, restarting the corresponding business containers on nodes makes sure that the containers can be pulled up again normally.

3. **Verify the running availability of Docker Engine**

   Try to restart Docker daemon and make sure that the Docker Engine can be restarted normally.

4. **Perform related O&M**

   Perform the related O&M in the plan, such as updating business codes, installing system patches, and adjusting system configurations.

5. **Restart nodes**

   Restart nodes normally in the console or system.

6. **Check the status after the restart**

   Check the health status of the nodes and the running status of the business containers in the *Container Service console* after restarting the nodes.

4 Use OSSFS data volumes to share WordPress attachments

This document introduces how to share WordPress attachments across different containers by creating OSSFS data volumes in Alibaba Cloud Container Service.

Scenarios

Docker containers simplify WordPress deployment. With *Alibaba Cloud Container Service*, you can use an orchestration template to deploy WordPress with one click.

Note:

For more information, see *Create WordPress with an orchestration template*.

In this example, the following orchestration template is used to create an application named **wordpress**.

```
web:
  image: registry.aliyuncs.com/acs-sample/wordpress:4.3
  ports:
    - '80'
  environment:
    WORDPRESS_AUTH_KEY: changeme
    WORDPRESS_SECURE_AUTH_KEY: changeme
    WORDPRESS_LOGGED_IN_KEY: changeme
    WORDPRESS_NONCE_KEY: changeme
    WORDPRESS_AUTH_SALT: changeme
    WORDPRESS_SECURE_AUTH_SALT: changeme
    WORDPRESS_LOGGED_IN_SALT: changeme
    WORDPRESS_NONCE_SALT: changeme
    WORDPRESS_NONCE_AA: changeme
  restart: always
  links:
    - 'db:mysql'
  labels:
    aliyun.logs: /var/log
    aliyun.probe.url: http://container/license.txt
    aliyun.probe.initial_delay_seconds: '10'
    aliyun.routing.port_80: http://wordpress
    aliyun.scale: '3'
db:
  image: registry.aliyuncs.com/acs-sample/mysql:5.7
  environment:
    MYSQL_ROOT_PASSWORD: password
  restart: always
  labels:
    aliyun.logs: /var/log/mysql
```

This application contains a MySQL container and three WordPress containers (`aliyun.scale: '3'` is the extension label of Alibaba Cloud Container Service, and specifies the number of

containers. For more information about the labels supported by Alibaba Cloud Container Service, see *Label description*). The WordPress containers access MySQL by using a link. The `aliyun.routing.port_80: http://wordpress` label defines the load balancing among the three WordPress containers (for more information, see *Simple routing - Supports HTTP and HTTPS*).

In this example, the application deployment is simple and the deployed application is of complete features. However, the attachments uploaded by WordPress are stored in the local disk, which means they cannot be shared across different containers or opened when requests are routed to other containers.

Solutions

This document introduces how to use OSSFS data volumes of Alibaba Cloud Container Service to share WordPress attachments across different containers, without any code modifications.

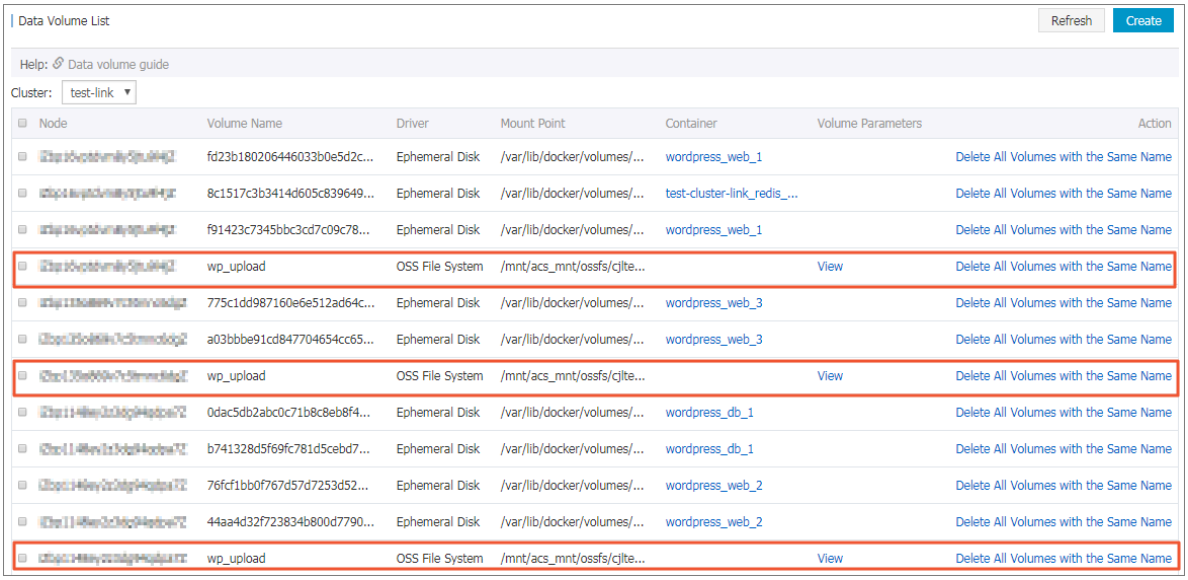
OSSFS data volume, a third-party data volume provided by Alibaba Cloud Container Service, packages various cloud storages (such as Object Storage Service (OSS)) as data volumes and then directly mounts them to the containers. This means the data volumes can be shared across different containers and automatically re-mounted to the containers when the containers are restarted or migrated.

Procedure

1. Create OSSFS data volumes.
   a. Log on to the *Container Service console*. Under Swarm, click **Data Volumes** in the left-side navigation pane.
   b. Select the cluster in which you want to create data volumes from the Cluster drop-down list. Click **Create** in the upper-right corner to create the OSSFS data volumes.

      For how to create OSSFS data volumes, see *Create an OSSFS data volume*.

   In this example, the created OSSFS data volumes are named **wp_upload**. Container Service uses the same name to create data volumes on each node of a cluster. As shown in the following figure.

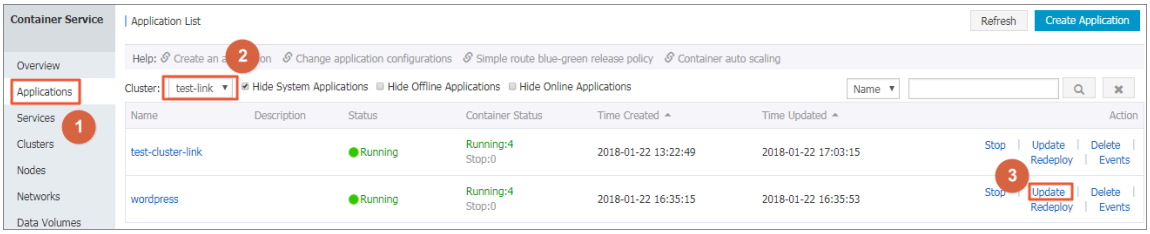


2. Use the OSSFS data volumes.

   The WordPress attachments are stored in the `/var/www/html/wp-content/uploads` directory by default. In this example, map OSSFS data volumes to this directory and then an OSS bucket can be shared across different WordPress containers.

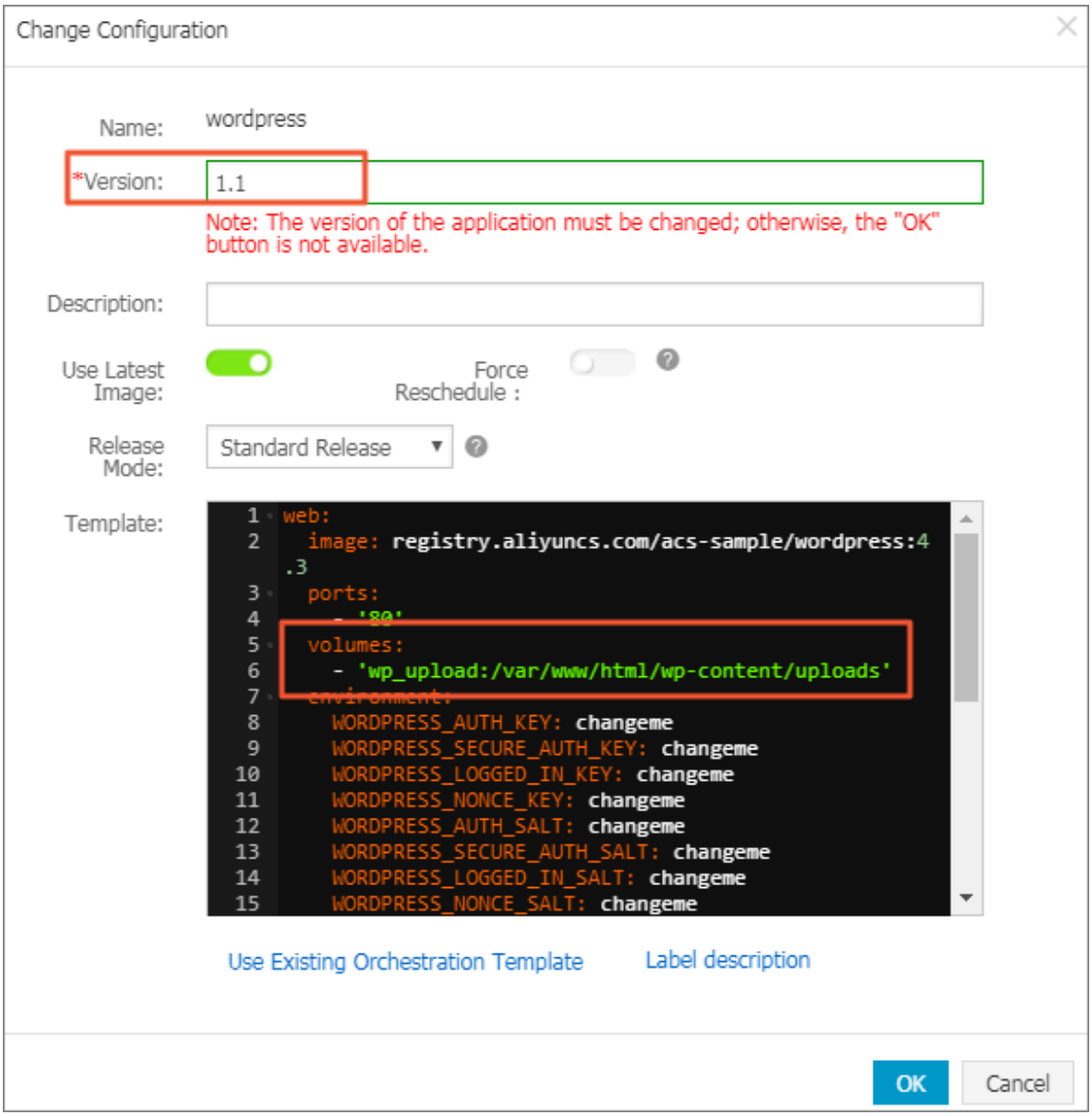
   a. Log on to the *Container Service console*. Under Swarm, Click **Applications** in the left-side navigation pane.

   b. Select the cluster used in this example from the Cluster drop-down list. Click **Update** at the right of the application **wordpress** created in this example.



   c. In the Template field, add the mapping from OSSFS data volumes to the WordPress directory.

> **Note:**
> You must modify the **Version**. Otherwise, the application cannot be redeployed.



d. Click **OK** to redeploy the application.

3. Open WordPress and upload attachments. Then, you can see the uploaded attachments in the OSS bucket.

5 Use Docker Compose to test cluster network connectivity

This document provides a simple Compose file used to realize one-click deployment and you can test the container network connectivity by visiting the service access endpoint.

Scenarios

When deploying interdependent applications in a Docker cluster, you must make sure that the applications can access each other to realize cross-host container network connectivity. However, sometimes containers on different hosts cannot access each other due to network problems. If this happens, it is difficult to troubleshoot the problem. Therefore, an easy-to-use Compose file can be used to test the connectivity among cross-host containers within a cluster.

Solutions

Use the provided image and orchestration template to test the connectivity among containers.

```
web:
  image: registry.aliyuncs.com/xianlu/test-link
  command: python test-link.py
  restart: always
  ports:
      - 5000
  links:
      - redis
  labels:
      aliyun.scale: '3'
      aliyun.routing.port_5000: test-link;
redis:
  image: redis
  restart: always
```

This example uses Flask to test the container connectivity.

The preceding orchestration template deploys a Web service and a Redis service. The Web service contains three Flask containers and these three containers will be evenly distributed to three nodes when started. The three containers are on different hosts and the current network can realize cross-host container connectivity if the containers can ping each other. The Redis service runs on one of the three nodes. When started, each Flask container registers to the Redis service and reports the container IP address. The Redis service has the IP addresses of all the containers in the cluster after the three Flask containers are all started. When you access any of the three Flask containers, the container will send ping command to the other two containers and you can check the network connectivity of the cluster according to the ping command response.

Procedure

1. Create a cluster which contains three nodes.

   In this example, the cluster name is **test-link**. For how to create a cluster, see *Create a cluster*.

   > **Note:**
   > Select to create a Server Load Balancer instance when creating the cluster.

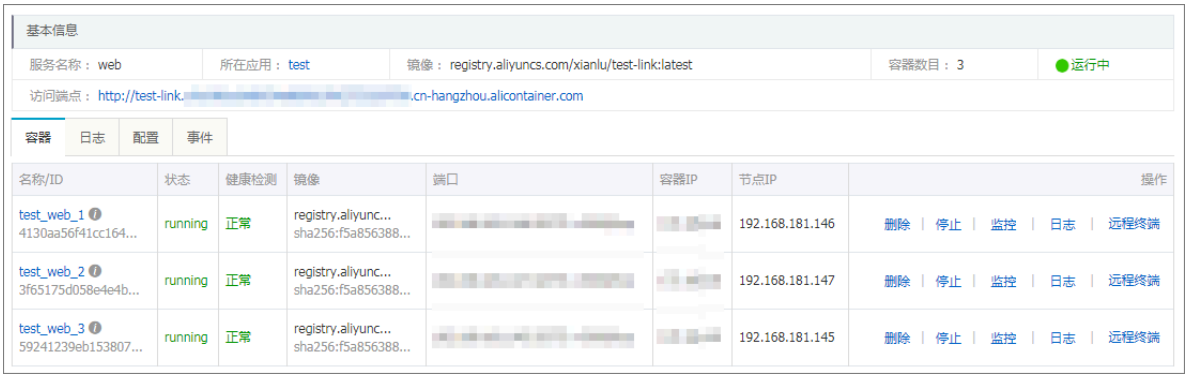
2. Use the preceding template to create an application (in this example, the application name is **test-cluster-link**) to deploy the **web** service and **redis** service.

   For how to create an application, see *Create an application*.

3. On the **Application List** page, click the application name to view the created services.

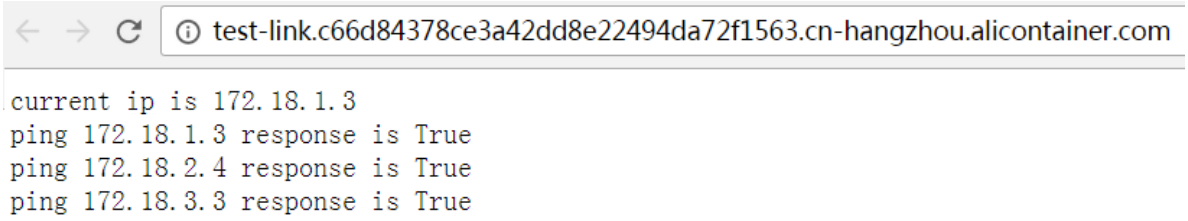
4. Click the name of the **web** service to enter the service details page.

   You can see that the three containers (**test-cluster-link_web_1**, **test-cluster-link_web_2**, and **test-cluster-link_web_3**) are all started and distributed on different nodes.

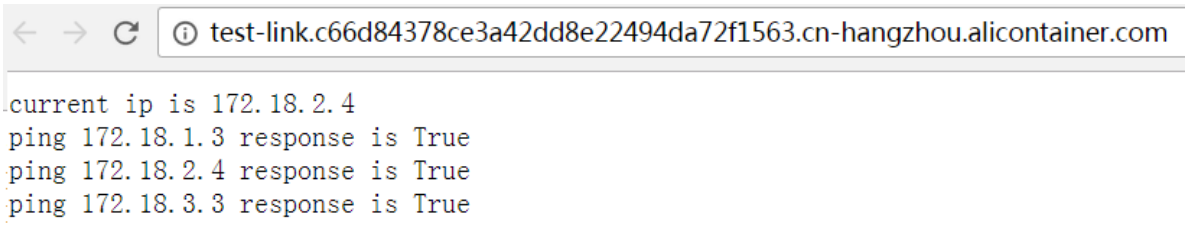


5. Visit the access endpoint of the **web** service.

   As shown in the following figure, the container **test-cluster-link_web_1** can access the container **test-cluster-link_web_2** and container **test-cluster-link_web_3**.



Refresh the page. As shown in the following figure, the container **test-cluster-link_web_2** can access the container **test-cluster-link_web_1** and container **test-cluster-link_web_3**.



As the preceding results show, the containers in the cluster can access each other.

6 Log

6.1 Use ELK in Container Service

Background

Logs are an important component of the IT system.

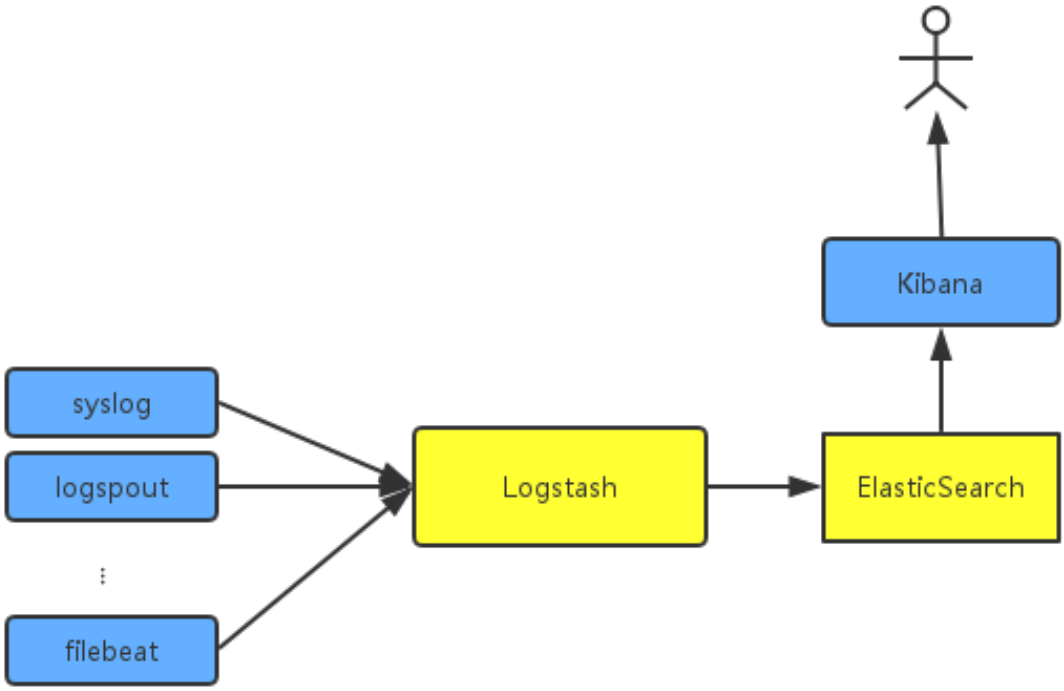
They record system events and the time when the events occur. We can troubleshoot system faults according to the logs and make statistical analysis.

Logs are usually stored in the local log files. To view logs, log on to the machine and filter keywords by using grep or other tools. However, when the application is deployed on multiple machines, viewing logs in this way is inconvenient. To locate the logs for a specific error, you have to log on to all the machines and filter files one after another. That is why concentrated log storage has emerged. All the logs are collected in Log Service and you can view and search for logs in Log Service.

In the Docker environment, concentrated log storage is even more important. Compared with the traditional operation and maintenance mode, Docker usually uses the orchestration system to manage containers. The mapping between container and host is not fixed and containers might be constantly migrated between hosts. You cannot view the logs by logging on to the machine and the concentrated log becomes the only choice.

Container Service integrates with Alibaba Cloud Log Service and automatically collects container logs to Log Service by using declarations. However, some users might prefer the This document introduces how to use ELK in Container Service. ELK (Elasticsearch+ Logstash+ Kibana) combination. This document introduces how to use ELK in Container Service.

Overall structure



An independent Logstash cluster must be deployed. Logsteins are heavy and resource-intensive , so they don't run logstroudsburg on every machine, not to mention every docker. To collect the container logs, syslog, Logspout, and filebeat are used. You might also use other collection methods.

To try to fit the actual scenario, two clusters are created here: one is the **testelk** cluster for deploying ELK, and the other is the **app** cluster for deploying applications.

Procedure

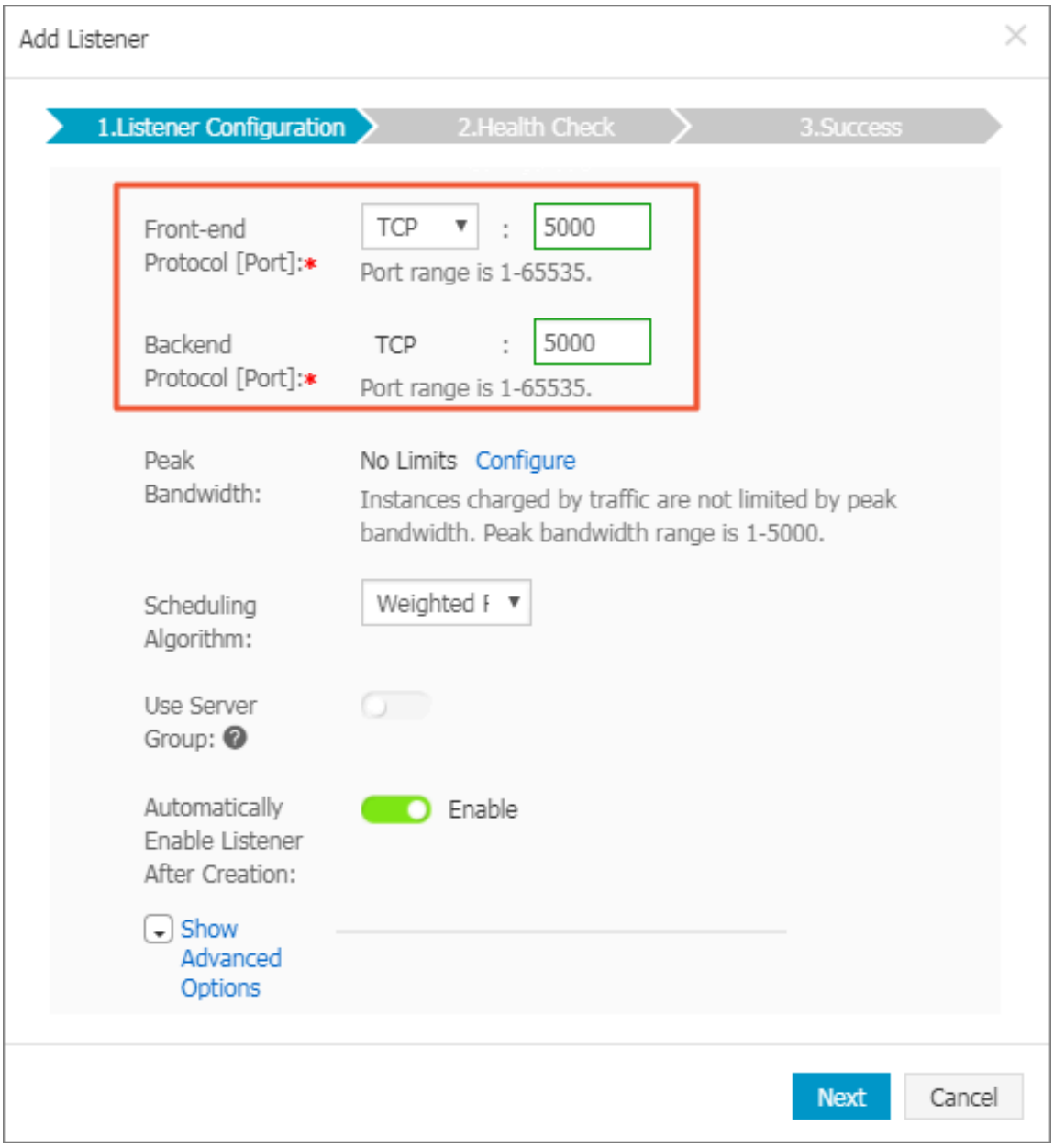
Note:
The clusters and Server Load Balancer instance created in this document must be in the same region.

Step 1. Create a Server Load Balancer instance

To enable other services to send logs to Logstash, create and configure a Server Load Balancer instance before configuring Logstash.

1. Log on to the *Server Load Balancer console* before creating an application.

2. Create a Server Load Balancer instance whose Instance type is **Internet**.
3. Add 2 listeners for the created Server Load Balancer instance. The frontend and backend port mappings of the 2 listeners are 5000: 5000 and 5044: 5044 respectively, with no backend server added.



Step 2. Deploy ELK

1. Log on to the *Container Service console*. Create a cluster named **testelk**.

   For how to create a cluster, see *Create a cluster*.

Note:

The cluster and the Server Load Balancer instance created in step 1 must be in the same region.

2. Bind the Server Load Balancer instance created in step 1 to this cluster.

   On the Cluster List page, Click Bind Server Load Balancer. Select the created Server Load Balancer instance from the Server Load Balancer ID list and then click OK. click **Manage** at the right of **testelk**. Click **Load Balancer Settings** in the left-side navigation pane. > Click Bind **Server Load Balancer**. Select the created Server Load Balancer instance from the Server Load Balancer ID list and then click **OK**.

3. Deploy ELK by using the following orchestration template. In this example, an application named **elk** is created.

   For how to create an application by using an orchestration template, see *Create an application*.

   Note:
   Replace `${SLB_ID}` in the orchestration file with the ID of the Server Load Balancer instance created in step 1.

```
version: '2'
 services:
   elasticsearch:
     image: elasticsearch
   kibana:
     image: kibana
     environment:
       ELASTICSEARCH_URL: http://elasticsearch:9200/
     labels:
       aliyun.routing.port_5601: kibana
     links:
       - elasticsearch
   logstash:
     image: registry.cn-hangzhou.aliyuncs.com/acs-sample/logstash
     hostname: logstash
     ports:
       - 5044:5044
       - 5000:5000
     labels:
       aliyun.lb.port_5044: 'tcp://${SLB_ID}:5044' #Create a Server
Load Balancer instance first.
       aliyun.lb.port_5000: 'tcp://${SLB_ID}:5000'
     links:
       - elasticsearch
```

   In this orchestration file, the official images are used for Elasticsearch and Kibana, with no changes made. Logstash needs a configuration file, so make an image on your own to include the configuration file. The image source codes can be found in *demo-logstash*.

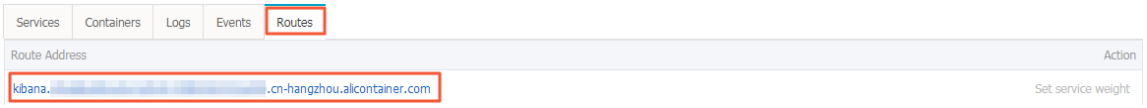
The Logstash configuration file is as follows. This is a simple Logstash configuration. Two input formats, syslog and filebeats, are provided and their external ports are 5044 and 5000 respectively.

```
input {
     beats {
         port => 5044
         type => beats

     tcp {
         port => 5000
         type => syslog


 filter {

 output {
     elasticsearch {
         hosts => ["elasticsearch:9200"]

     stdout { codec => rubydebug }
```

4. Configure the Kibana index.

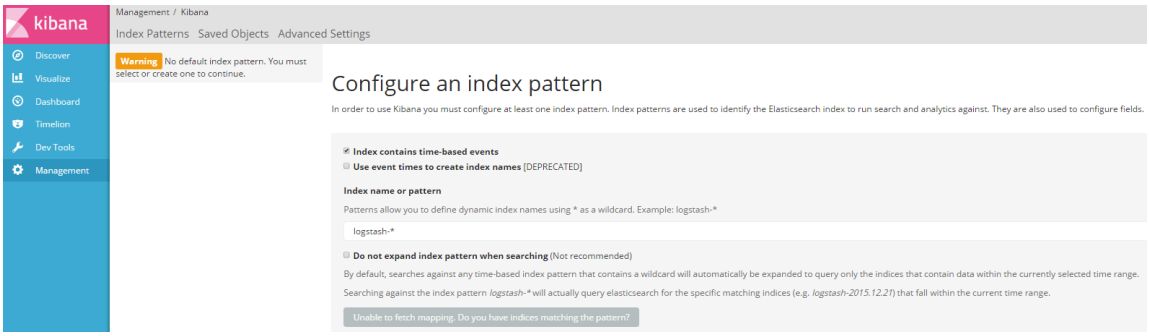
   a. Access Kibana.

      The URL can be found under the Routes tab of the application. On the Application List page, click the application name **elk**. Click the **Routes** tab and then click the route address to access Kibana.



   b. Create an index.

      Configure the settings as per your needs and then click Create.



Step 3. Collect logs

In Docker, the standard logs adopt Stdout file pointer. The following example first demonstrates how to collect Stdout to ELK. If you are using file logs, you can use filebeat directly. WordPress

is used for the demonstration. The following is the orchestration template of WordPress. An application **wordpress** is created in another cluster.

1. Log on to the *Container Service console*. Create a cluster named **app**.

   For how to create a cluster, see *Create a cluster*.

   > **Note:**
   > The cluster and the Server Load Balancer instance created in step 1 must be in the same region.

2. Create the application **wordpress** by using the following orchestration template.

   > **Note:**
   > Replace `${SLB_IP}` in the orchestration file with the IP address of the Server Load Balancer instance created in step 1.

```
version: '2'
 services:
   mysql:
     image: mysql
     environment:
       - MYSQL_ROOT_PASSWORD=password
   wordpress:
     image: wordpress
     labels:
       aliyun.routing.port_80: wordpress
     links:
       -MySQL: MySQL
     environment:
       - WORDPRESS_DB_PASSWORD=password
     logging:
       driver: syslog
       options:
         syslog-address: 'tcp://${SLB_IP}:5000'
```

   After the application is deployed successfully, click the application name wordpress on the Application List page. Click the Routes tab and then click the route address to access the WordPress application. click the application name **wordpress** on the Application List page. Click the **Routes** tab and then click the route address to access the WordPress application.

3. On the Application List page, click the application name **elk**. Click the **Routes** tab and then click the route address

   to access Kibana and view the collected logs.

6.2 A new Docker log collection scheme: log-pilot

This document introduces a new log collection tool for Docker: log-pilot. Log-pilot is a log collection image we provide for you. You can deploy a log-pilot instance on each machine to collect all the Docker application logs. Docker of Linux version is supported, while Docker of Windows or Mac version is not supported.

Log-pilot has the following features:

- A separate log process collects the logs of all the containers on the machine. No need to start a log process for each container.
- Log-pilot supports file logs and stdout logs. Docker log driver or Logspout can only process stdout, while log-pilot supports collecting the stdout logs and the file logs.
- Declarative configuration. When your container has logs to collect, log-pilot will automatically collect logs of the new container if the path of the log file to be collected is declared by using the label. No other configurations need to be changed.
- Log-pilot supports multiple log storage methods and can deliver the logs to the correct location for powerful Alibaba Cloud Log Service, popular ElasticSearch combination, or even Graylog.
- Open-source. Log-pilot is fully open-sourced. You can download the codes from *log-pilot GitHub project*. If the current features cannot meet your requirements, welcome to raise an issue.

Quick start

See a simple scenario as follows: start a log-pilot and then start a Tomcat container, letting log-pilot collect Tomcat logs. For simplicity, here Alibaba Cloud Log Service or ELK is not involved. To run locally, you only need a machine that runs Docker.

First, start log-pilot.

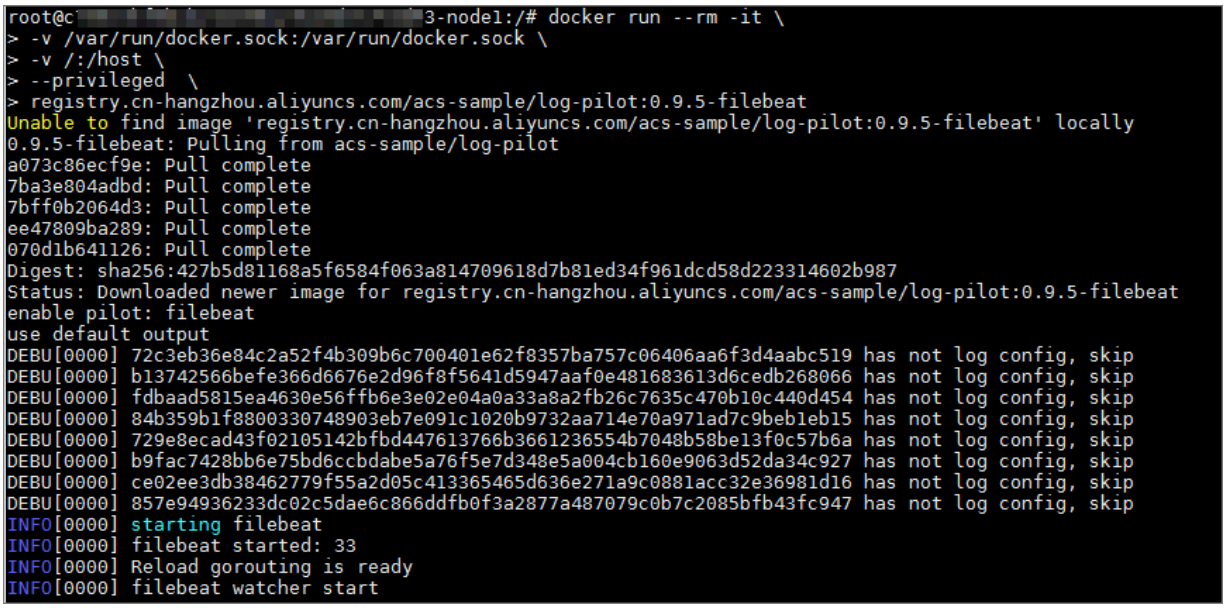
Note:

When log-pilot is started in this way, all the collected logs will be directly output to the console because no log storage is configured for backend use. Therefore, this method is mainly for debugging.

Open the terminal and enter the following commands:

```
docker run --rm -it \
    -v /var/run/docker.sock:/var/run/docker.sock \
    -v /:/host \
    --privileged \
    registry.cn-hangzhou.aliyuncs.com/acs-sample/log-pilot:0.1
```

You will see the startup logs of log-pilot.



Do not close the terminal. Open a new terminal to start Tomcat. The Tomcat image is among the few Docker images that use stdout and file logs at the same time, and is suitable for the demonstration here.

```
docker run -it --rm -p 10080:8080 \
-v /usr/local/tomcat/logs \
--label aliyun.logs.catalina=stdout \
--label aliyun.logs.access=/usr/local/tomcat/logs/localhost_access_log
. *.txt \
tomcat
```

Note:

- `aliyun.logs.catalina=stdout` tells log-pilot that this container wants to collect stdout logs.
- `aliyun.logs.access=/usr/local/tomcat/logs/localhost_access_log. *.txt` indicates to collect all log files whose names comply with the *`localhost_access_log. *.`*

`txt` format under the `/usr/local/tomcat/logs/` directory in the container. The label usage will be introduced in details later.

Note:

If you deploy Tomcat locally, instead of in the Alibaba Cloud Container Service, specify `-v /usr/local/tomcat/logs`. Otherwise, log-pilot cannot read log files. Container Service has implemented the optimization and you do not need to specify `-v` on your own.

Log-pilot will monitor the events in the Docker container. When it finds any container with `aliyun.logs.xxx`, it will automatically parse the container configuration and start to collect the corresponding logs. After you start Tomcat, you will find many contents are output immediately by the log-pilot terminal, including the stdout logs output at the Tomcat startup, and some debugging information output by log-pilot itself.

You can access the deployed Tomcat in the browser, and find that similar records are displayed on the log-pilot terminal every time you refresh the browser. Wherein, the contents after `message` are the logs collected from `/usr/local/tomcat/logs/localhost_access_log.XXX.txt`.

Use ElasticSearch + Kibana

Deploy ElastichSearch + Kibana. See *Use ELK in Container Service* to deploy ELK in Alibaba Cloud Container Service, or deploy them directly on your machine by following the ElasticSearch/ Kibana documents. This document assumes that you have deployed the two components.

If you are still running the log-pilot, close it first, and then start it again by using the following commands:

Note:

Before running the following commands, replace the two variables `ELASTICSEARCH_HOST` and `ELASTICSEARCH_PORT` with the actual values you are using. `ELASTICSEARCH_PORT` is generally 9200.

```
docker run --rm -it \
    -v /var/run/docker.sock:/var/run/docker.sock \
    -v /:/host \
    --privileged \
    -e FLUENTD_OUTPUT=elasticsearch \
    -e ELASTICSEARCH_HOST=${ELASTICSEARCH_HOST} \
    -e ELASTICSEARCH_PORT=${ELASTICSEARCH_PORT}
    registry.cn-hangzhou.aliyuncs.com/acs-sample/log-pilot:0.1
```

Compared with the previous log-pilot startup method, here three environment variables are added:

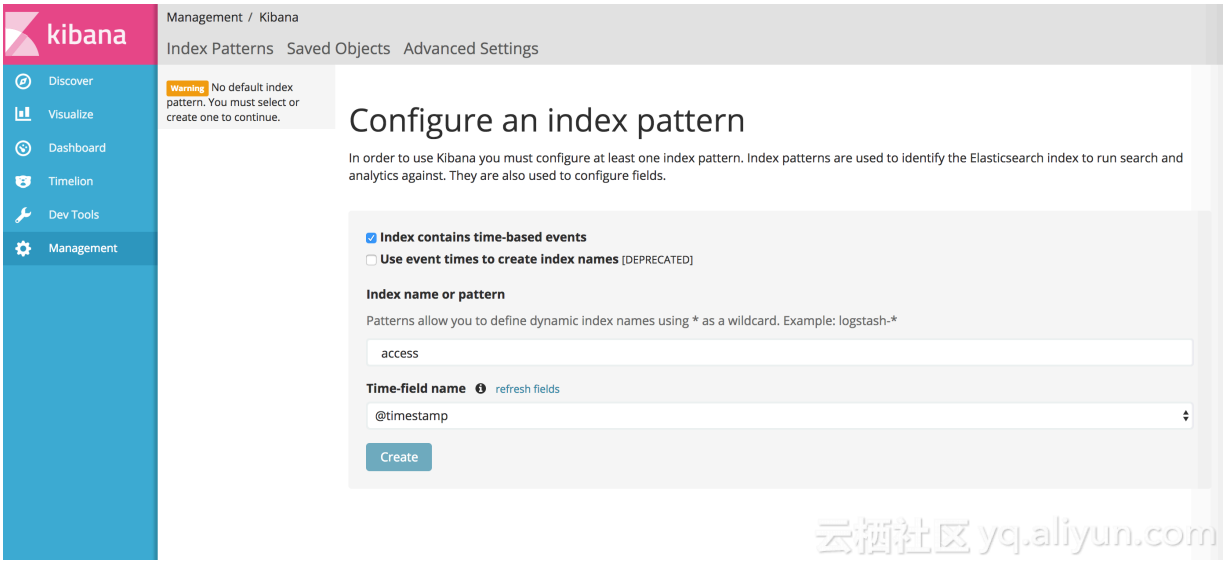
- `FLUENTD_OUTPUT=elasticsearch`: Send the logs to ElasticSearch.
- `ELASTICSEARCH_HOST=${ELASTICSEARCH_HOST}`: The domain name of ElasticSearch.
- `ELASTICSEARCH_PORT=${ELASTICSEARCH_PORT}`: The port number of ElasticSearch.

Continue to run the Tomcat started previously, and access it again to make Tomcat generate some logs. All these newly generated logs will be sent to ElasticSearch.

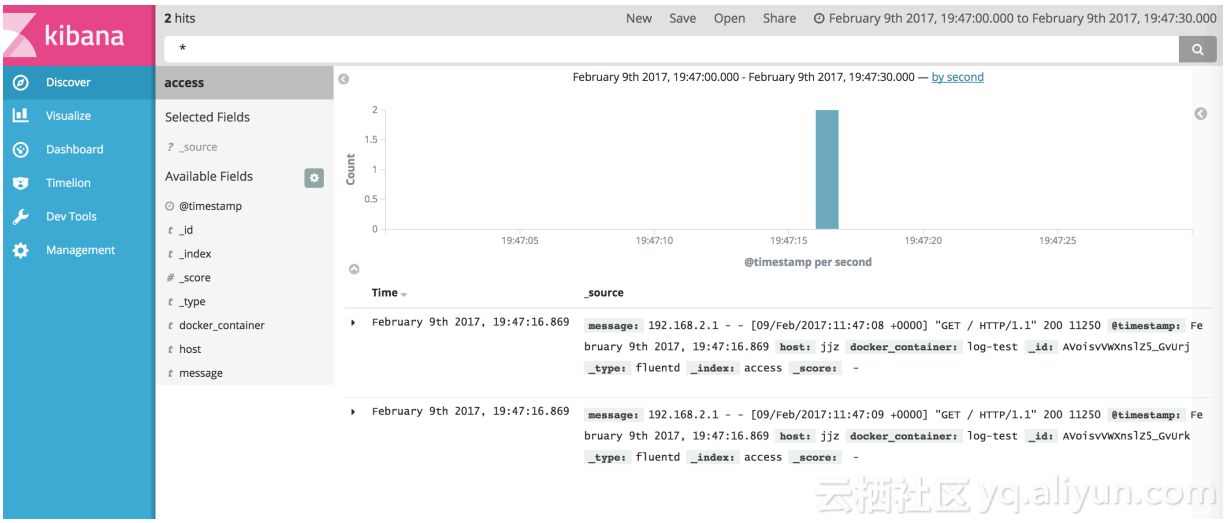
Open Kibana, and no new logs are visible yet. Create an index first. Log-pilot will write logs to the specific index of ElasticSearch. The rules are as follows:

If label `aliyun.logs.tags` is used in the application, and `tags` contains `target`, use `target` as the index of ElasticSearch. Otherwise, use `XXX` in the label `aliyun.logs.XXX` as the index.

In the previous example about Tomcat, the label `aliyun.logs.tags` is not used, so `access` and `catalina` are used by default as the index. First create the index `access`.



After the index is created, you can view the logs.



Use log-pilot in Alibaba Cloud Container Service

Container Service makes some special optimization for log-pilot, which adapts to running log-pilot best.

To run log-pilot in Container Service, create an application by using the following orchestration file. For how to create an application, see *Create an application*.

```
pilot:
  image: registry.cn-hangzhou.aliyuncs.com/acs-sample/log-pilot:0.1
  volumes:
    - /var/run/docker.sock:/var/run/docker.sock
    - /:/host
  privileged: true
  environment:
    FLUENTD_OUTPUT: elasticsearch #Replace based on your requirements

    ELASTICSEARCH_HOST: ${elasticsearch} #Replace based on your
requirements
    ELASTICSEARCH_PORT: 9200
  labels:
    aliyun.global: true
```

Then, you can use the `aliyun.logs.xxx` label on the application that you want to collect logs.

Label description

When Tomcat is started, the following two labels are declared to tell log-pilot the location of the container logs.

```
--label aliyun.logs.catalina=stdout
--label aliyun.logs.access=/usr/local/tomcat/logs/localhost_access_log
. *.txt
```

You can also add more labels on the application container.

- `aliyun.logs.$name = $path`

  - The variable `name` is the log name and can only contain 0–9, a–z, A–Z, and hyphens (-).
  - The variable `path` is the path of the logs to be collected. The path must specify the file, and cannot only be a directory. Wildcards are supported as part of the file name, for example, `/var/log/he.log` and `/var/log/*.log` are both correct. However, `/var/log` is not valid because the path cannot be only a directory. `stdout` is a special value, indicating standard output.
- `aliyun.logs.$name.format`: The log format. Currently, the following formats are supported.
  - none: Unformatted plain text.
  - json: JSON format. One complete JSON string in each line.
  - csv: CSV format.
- `aliyun.logs.$name.tags`: The additional field added when the logs are reported. The format is `k1=v1,k2=v2`. The key-value pairs are separated by commas, for example, `aliyun.logs.access.tags="name=hello,stage=test"`. Then, the logs reported to the storage will contain the `name` field and the `stage` field.

  If ElasticSearch is used for log storage, the `target` tag will have a special meaning, indicating the corresponding index in ElasticSearch.

Log-pilot extension

For most users, the existing features of log-pilot can meet their requirements. If log-pilot cannot meet your requirements, you can:

- Submit an issue at *https://github.com/AliyunContainerService/log-pilot*.
- Directly change the codes and then raise the PR.

7 Health check of Docker containers

In a distributed system, the service availability is frequently checked by using the health check to avoid exceptions when being called by other services. Docker introduced native health check implementation after version 1.12. This document introduces the health check of Docker containers.

Process-level health check checks whether or not the process is alive and is the simplest health check for containers. Docker daemon automatically monitors the PID1 process in the container. If the `docker run` command specifies the restart policy, closed containers can be restarted automatically according to the restart policy. In many real scenarios, process-level health check alone is far from enough. For example, if a container process is still alive, but is locked by an app deadlock and fails to respond to user requests, such problems won't be discovered by process monitoring.

Kubernetes provides Liveness and Readness probes to check the container and its service health respectively. Alibaba Cloud Container Service also provides a similar *Service health check*.

Docker native health check capability

Docker introduced the native health check implementation after version 1.12. The health check configurations of an application can be declared in the Dockerfile. `The HEALTHCHECK` instruction declares the health check command that can be used to determine whether or not the service status of the container master process is normal. This can reflect the real status of the container.

`HEALTHCHECK` instruction format:

- `HEALTHCHECK [option] CMD <command>`: The command that sets the container health check.
- `HEALTHCHECK NONE`: If the basic image has a health check instruction, this line can be used to block it.

Note:

The `HEALTHCHECK` can only appear once in the Dockerfile. If multiple HEALTHCHECK instructions exist, only the last one takes effect.

Images built by using Dockerfiles that contain `HEALTHCHECK` instructions can check the health status when instantiating Docker containers. Health check is started automatically after the container is started.

HEALTHCHECK supports the following options:

- `--interval=<interval>`: The time interval between two health checks. The default value is 30 seconds.
- `--timeout=<interval>`: The timeout for running the health check command. The health check fails if the timeout is exceeded. The default value is 30 seconds.
- `--retries=<number of times>`: The container status is regarded as unhealthy if the health check fails continuously for a specified number of times. The default value is 3.
- `--start-period=<interval>`: The initialization time of application startup. Failed health check during the startup is not counted. The default value is 0 second (introduced since version 17.05).

The command after `HEALTHCHECK [option] CMD` follows the same format as `ENTRYPOINT`, in either the shell or the exec format. The returned value of the command determines the success or failure of the health check:

- 0: Success.
- 1: Failure.
- 2: Reserved value. Do not use.

After a container is started, the initial status is `starting`. Docker Engine waits for a period of `interval` to regularly run the health check command. If the returned value of a single check is not 0 or the running lasts longer than the specified `timeout` time, the health check is considered as failed. If the health check fails continuously for `retries` times, the health status changes to `unhealthy`.

- If the health check succeeds once, Docker changes the container status back to Healthy.
- Docker Engine issues a health_status event if the container health status changes.

Assume that an image is a simple Web service. To enable health check to determine whether or not its Web service is working normally, `curl` can be used to help with the determination and the HEALTHCHECK instruction in its Dockerfile can be written as follows:

```
FROM elasticsearch:5.5
HEALTHCHECK --interval=5s --timeout=2s --retries=12 \
  CMD curl --silent --fail localhost:9200/_cluster/health || exit 1
```

```
docker build -t test/elasticsearch:5.5 .
docker run --rm -d \
    --name=elasticsearch \
```

```
    test/elasticsearch:5.5
```

You can use `docker ps`. After several seconds, the Elasticsearch container changes from the Starting status to Healthy status.

```
$ docker ps
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
c9a6e68d4a7f test/elasticsearch:5.5 "/docker-entrypoin..." 2 seconds
ago Up 2 seconds (health: starting) 9200/tcp, 9300/tcp elasticsearch
$ docker ps
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
c9a6e68d4a7f test/elasticsearch:5.5 "/docker-entrypoin..." 14 seconds
ago Up 13 seconds (healthy) 9200/tcp, 9300/tcp elasticsearch
```

Another method is to directly specify the health check policy in the `docker run` command.

```
$ docker run --rm -d \
    --name=elasticsearch \
    --health-cmd="curl --silent --fail localhost:9200/_cluster/health
 || exit 1" \
    --health-interval=5s \
    --health-retries=12 \
    --health-timeout=2s \
    elasticsearch:5.5
```

To help troubleshoot the issue, all output results of health check commands (including stdout and stderr) are stored in health status and you can view them with the docker inspect command. Use the following commands to retrieve the health check results of the past five containers.

```
docker inspect --format='{{json . State.Health}}' elasticsearch
```

Or

```
docker inspect elasticsearch | jq ".[]. State.Health"
```

The sample result is as follows:

```
{
  "Status": "healthy",
  "FailingStreak": 0,
  "Log": [
    {
      "Start": "2017-08-19T09:12:53.393598805Z",
      "End": "2017-08-19T09:12:53.452931792Z",
      "ExitCode": 0,
      "Output": "..."
    },
    ...
}
```

Generally, we recommend that you declare the corresponding health check policy in the Dockerfile to facilitate the use of images because application developers know better about the application SLA. The application deployment and Operation & Maintenance personnel can adjust the health

check policies as needed for deployment scenarios by using the command line parameters and REST API.

The Docker community provides some instance images that contain health check. Obtain them in the following project: *https://github.com/docker-library/healthcheck*.

Note:

- Alibaba Cloud Container Service supports Docker native health check and Alibaba Cloud extension health check.
- Currently, Kubernetes does not support Docker native health check.

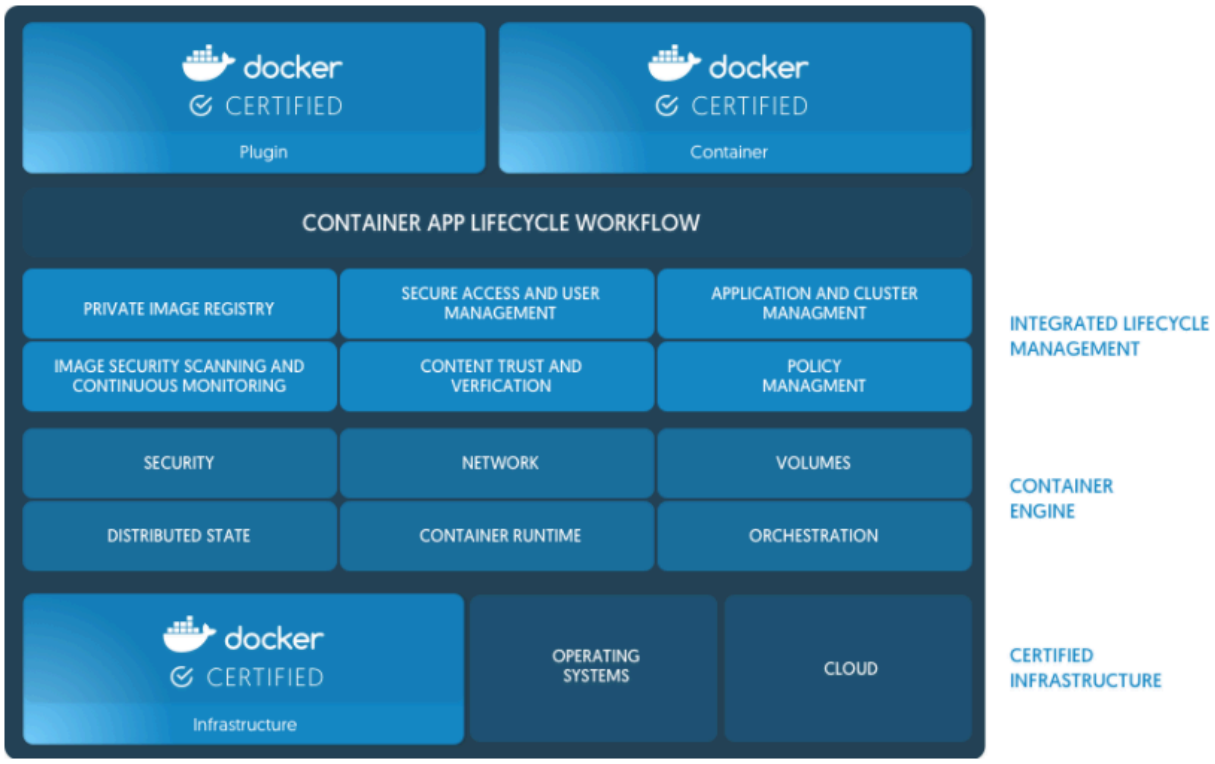
8 One-click deployment of Docker Datacenter

About DDC

Docker Datacenter (DDC) is an enterprise-level container management and service deployment package solution platform released by Docker. DDC is composed of the following three components:

- Docker Universal Control Plane (Docker UCP): A set of graphical management interfaces.
- Docker Trusted Registry (DTR): A trusted Docker image repository.
- Docker Engine Enterprise Edition: The Docker Engine providing technical support.

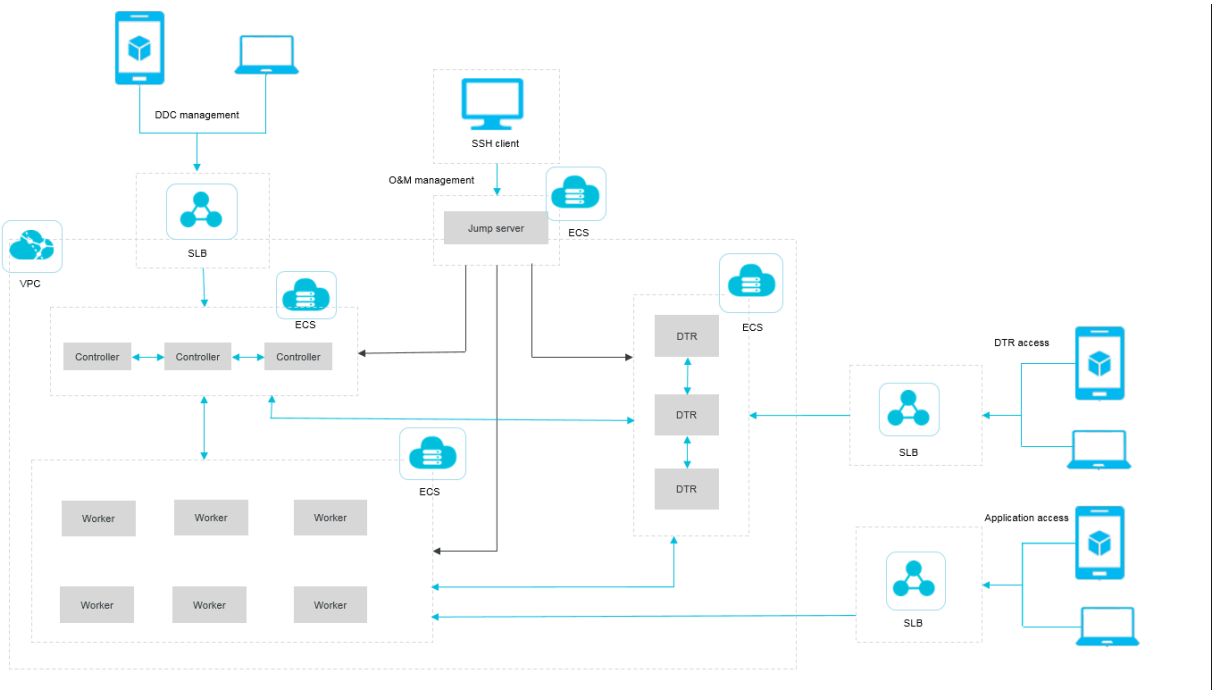
DDC is available on the Docker official website *https://www.docker.com/products/docker-datacenter*.



DDC is a counterpart of Docker Cloud, another online product of the Docker company. However, DDC primarily targets enterprise users for internal deployment. You can register your own Docker image to DTR and use UCP to manage the entire Docker cluster. Both components provide web interfaces.

You must purchase a license to use DDC, but the Docker company provides a free license for a one-month trial. You can download the trial license from the Docker official website after signing up.

DDC deployment architecture



In the preceding basic architecture figure, Controller primarily runs the UCP component, DTR runs the DTR component, and Worker primarily runs your own Docker service. The entire DDC environment is deployed on the Virtual Private Cloud (VPC) and all Elastic Compute Service (ECS) instances are in the same security group. Every component provides a Server Load Balancer instance for extranet access. Operations and maintenance are implemented by using the jump server. To enhance the availability, the entire DDC environment is deployed for high availability, meaning at least two Controllers and two DTRs exist.

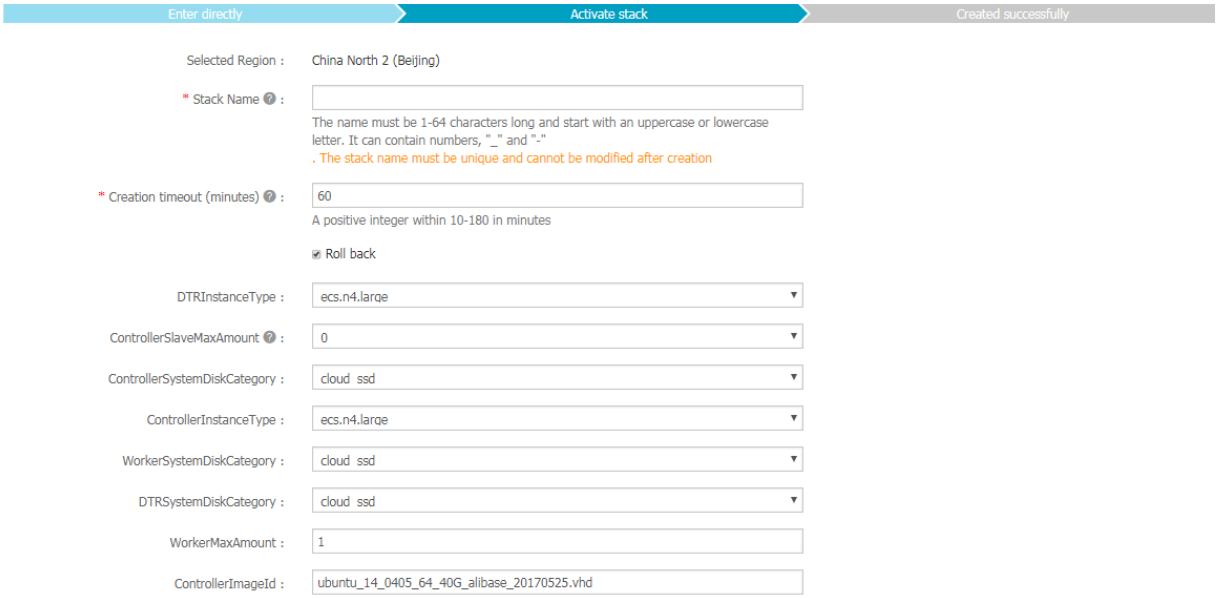
One-click deployment of DDC

You can use Alibaba Cloud Resource Orchestration Service (ROS) to deploy DDC in one click at the following link.

One-click deployment of DDC

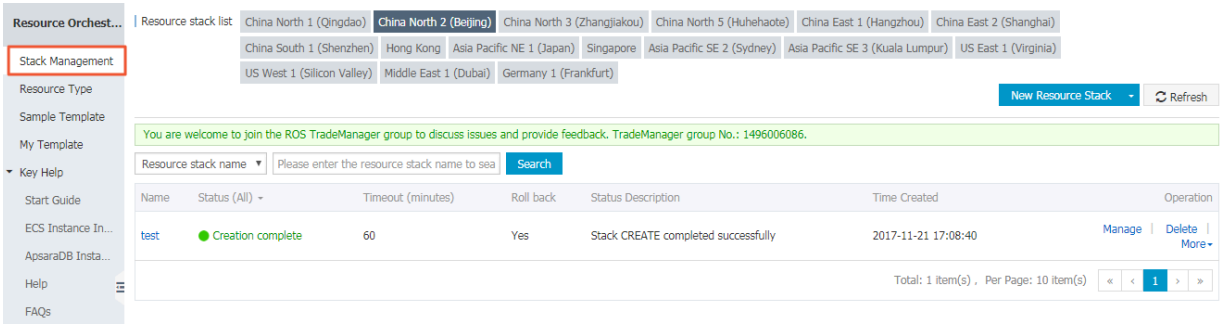
In the preceding orchestration template, DDC is deployed in the region China North 2 (Beijing) by default. To change the region for deployment, click **Back** in the lower-right corner of the page. Select your region and then click **Next**.

Complete the configurations. Click **Create** to deploy a set of DDC.



DDC access

After creating DDC successfully by using ROS, you can enter the ROS stack management page by clicking Stack Management in the left-side navigation pane. Find the created stack, and then click the stack name or **Manage** at the right of the stack. The Stack Overview page appears.



You can view the addresses used to log on to UCP and DTR in the Output section.

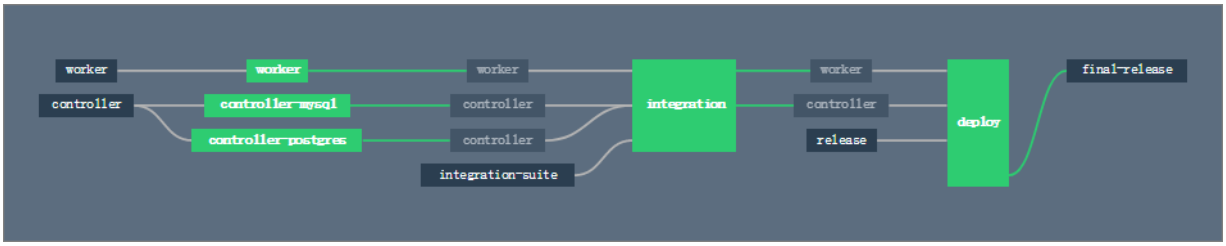
Enter the UCP address in the browser and the UCP access page appears. Enter the administrator account and password created when installing UCP and the system prompts you to import the license file. Import the license file and then enter the UCP control interface.


Docker Universal Control Plane
admin
Dashboard
Dashboard
RESOURCES
Applications
Containers
Nodes
Volumes
Networks
Images
UCP ADMIN
Users & Teams
Settings
Overview
Applications
0
Containers
7
Images
7
Nodes
1
Resources
CPU
CPU
0%
Memory
Memory
0%
Cluster Controllers
Scheduling Strategy: spread
STATUS
CONTROLLER URL
SWARM MANAGER

9 Build Concourse CI in Container Service in an easy way

Concourse CI, a CI/CD tool whose charm lies in the minimalist design, is widely applied to the CI/CD of each Cloud Foundry module. Concourse CI officially provides the standard Docker images and you can use Alibaba Cloud Container Service to deploy a set of Concourse CI applications rapidly.

Get to know the principle of Concourse if you are not familiar with the Concourse CI tool. For more information, see *Concourse official website*.

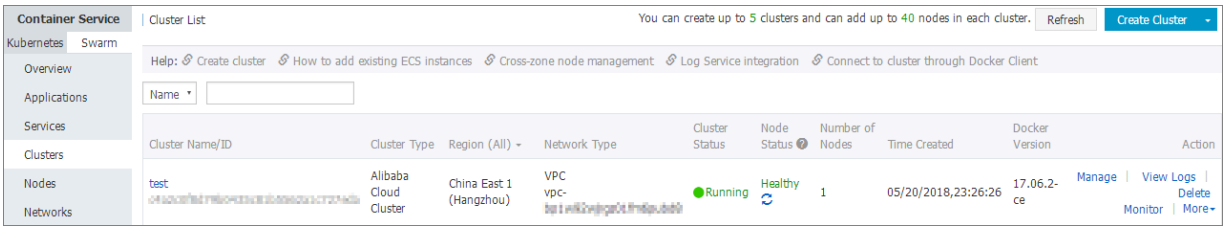


Create a swarm cluster

Log on to the *Container Service console* to create a cluster. In this example, create a swarm cluster with one node.

For how to create a cluster, see *Create a cluster*.

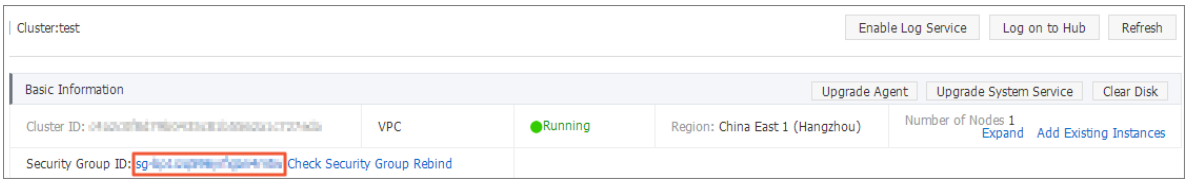
Note:
You must configure the external URL for Concourse, which allows you to access the Web service of Concourse from the current machine. Therefore, retain the Elastic IP (EIP) when creating a cluster.



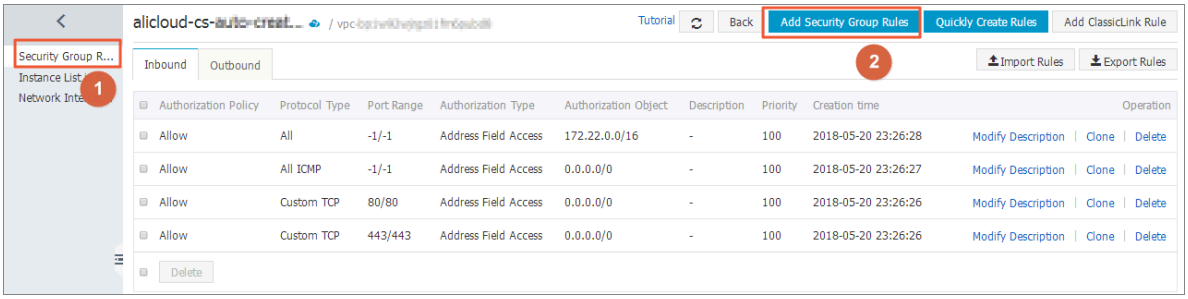
Configure security group rules

The Concourse component ATC listens to the port 8080 by default. Therefore, you must configure the inbound permissions of port 8080 for the cluster security group.

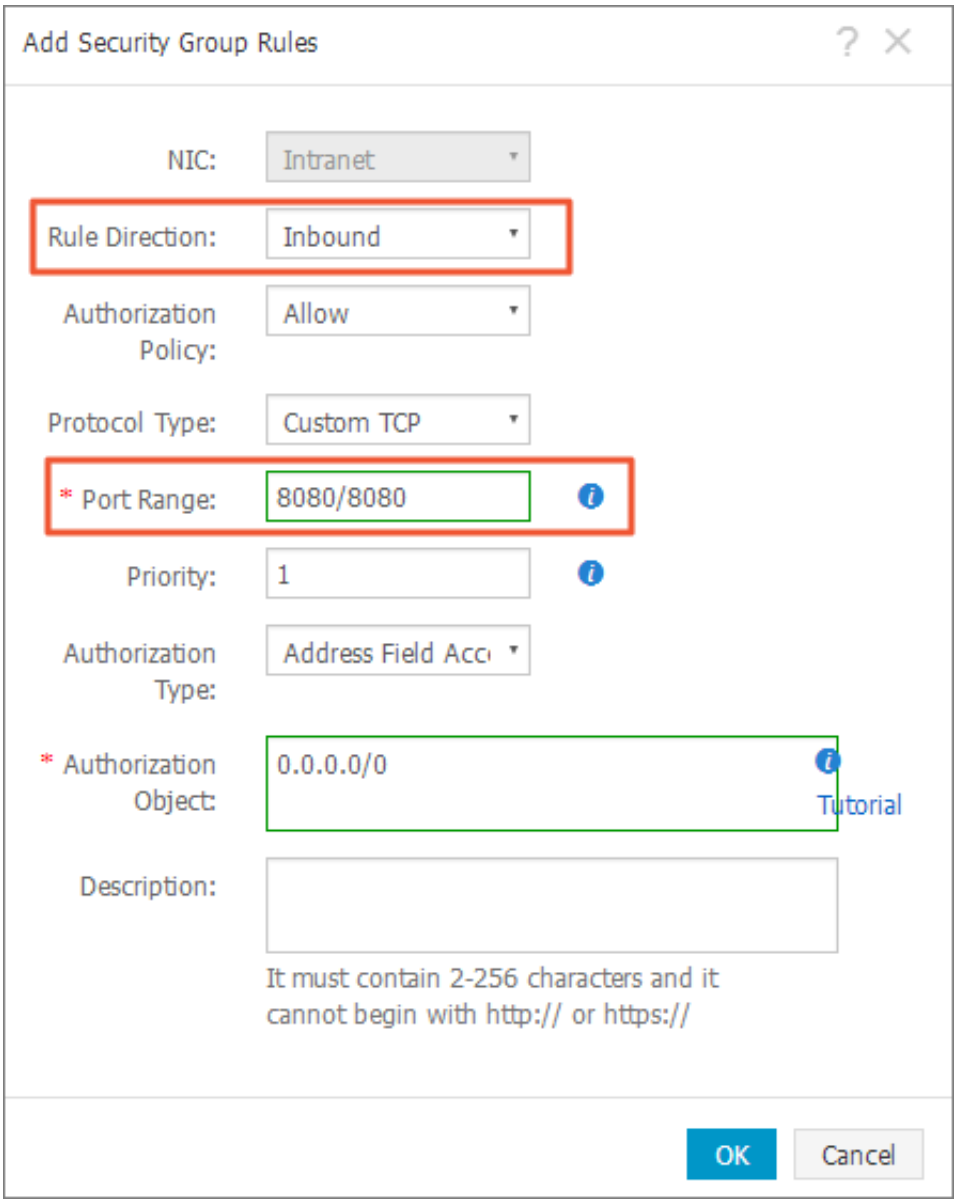
1. In the *Container Service console*, click Swarm > Clusters in the left-side navigation pane. Click **Manage** at the right of the created cluster.
2. On the Basic Information page, click the security group ID.



3. Click **Security Group Rules** in the left-side navigation pane. Click **Add Security Group Rules** in the upper-right corner.



4. Configure the inbound permissions of port 8080 for the security group and then click **OK**.



Create keys in the ECS instance

You must generate three private keys for running Concourse safely.

1. Log on to the Elastic Compute Service (ECS) instance. In the root directory, create the directories *keys/web* and *keys/worker* . You can run the following command to create these two directories rapidly.

```
mkdir -p keys/web keys/worker
```

2. Run the following commands to generate three private keys.

```
ssh-keygen -t rsa -f tsa_host_key -N ''
ssh-keygen -t rsa -f worker_key -N ''
```

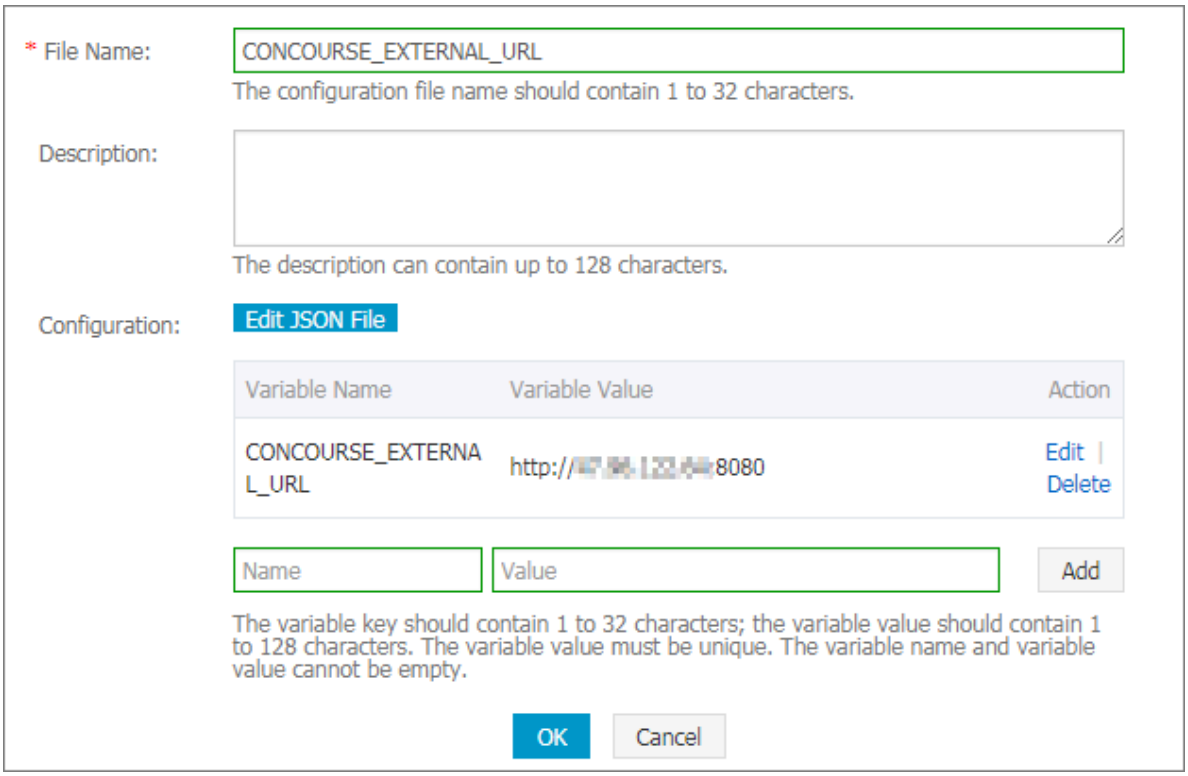
```
ssh-keygen -t rsa -f session_signing_key -N ''
```

3. Copy the certificate to the corresponding directory.

```
cp ./keys/worker/worker_key.pub ./keys/web/authorized_worker_keys
cp ./keys/web/tsa_host_key.pub ./keys/worker
```

Deploy Concourse CI

1. Log on to the *Container Service console*.
2. Click Swarm > **Configurations** in the left-side navigation pane. Click Create in the upper-right corner. Enter CONCOURSE_EXTERNAL_URL as the Variable Name and `http://your-ecs-public-ip:8080` as the Variable Value.

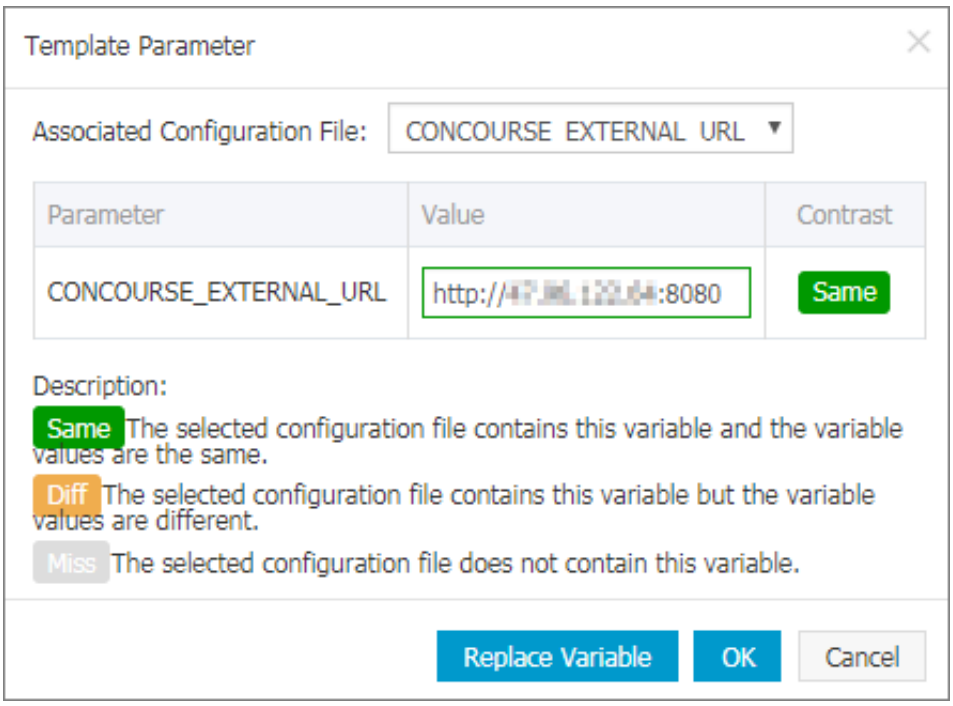


3. Click **Applications** in the left-side navigation pane. Select the cluster used in this example from the Cluster drop-down list. Click **Create Application** in the upper-right corner.
4. Enter the basic information for the application you are about to create. Select **Create with Orchestration Template**. Use the following template:

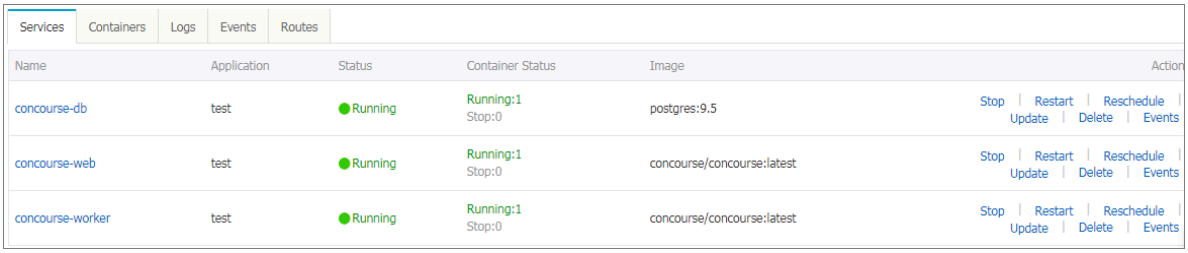
```
version: '2'
 services:
   concourse-db:
     image: postgres:9.5
     privileged: true
     environment:
       POSTGRES_DB: concourse
       POSTGRES_USER: concourse
       POSTGRES_PASSWORD: changeme
       PGDATA: /database
   concourse-web:
```

```
    image: concourse/concourse
    links: [concourse-db]
    command: web
    privileged: true
    depends_on: [concourse-db]
    ports: ["8080:8080"]
    volumes: ["/root/keys/web:/concourse-keys"]
    restart: unless-stopped # required so that it retries until
conocurse-db comes up
    environment:
      CONCOURSE_BASIC_AUTH_USERNAME: concourse
      CONCOURSE_BASIC_AUTH_PASSWORD: changeme
      CONCOURSE_EXTERNAL_URL: "${CONCOURSE_EXTERNAL_URL}"
      CONCOURSE_POSTGRES_HOST: concourse-db
      CONCOURSE_POSTGRES_USER: concourse
      CONCOURSE_POSTGRES_PASSWORD: changeme
      CONCOURSE_POSTGRES_DATABASE: concourse
  concourse-worker:
    image: concourse/concourse
    privileged: true
    links: [concourse-web]
    depends_on: [concourse-web]
    command: worker
    volumes: ["/keys/worker:/concourse-keys"]
    environment:
      CONCOURSE_TSA_HOST: concourse-web
    dns: 8.8.8.8
```

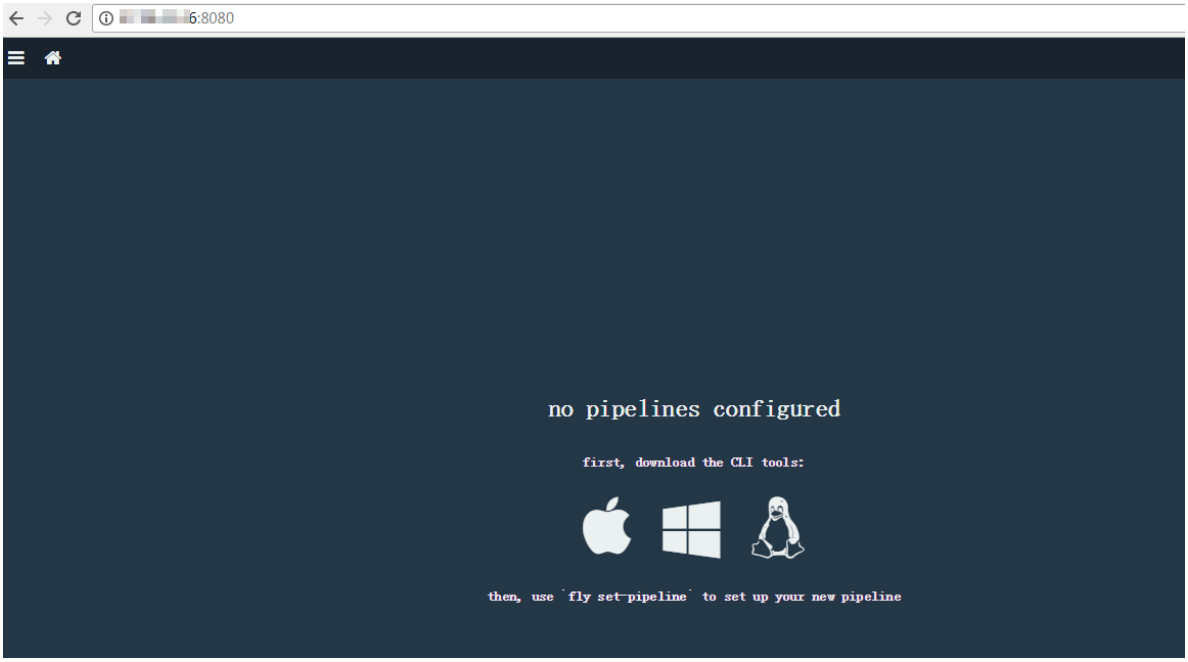
5. Click **Create and Deploy**. The Template Parameter dialog box appears. Select the configuration file to be associated with from the **`Associated Configuration File`** drop-down list. Click **Replace Variable** and then click OK.



After the application is created, the following three services are started.



Then, the Concourse CI deployment is finished. Enter `http://your-ecs-public-ip:8080` in the browser to access the Concourse CI.



Run a CI task (Hello world)

1. In the browser opened in the last section, download the CLI corresponding to your operating system and install the CLI client. Use ECS (Ubuntu 16.04) as an example.
2. For Linux and Mac OS X systems, you must add the execution permissions to the downloaded FLY CLI file first. Then, install the CLI to the system and add it to `$PATH`.

```
chmod +x fly
 install fly /usr/local/bin/fly
```

3. After the installation, you can check the version.

```
$fly -v
 3.4.0
```

4. Connect to the target. The username and password are concourse and changeme by default.

```
$ fly -t lite login -c http://your-ecs-public-ip:8080
 in to team 'main'
 username: concourse
 password:
```

```
saved
```

5. Save the following configuration template as `hello.yml`.

```
jobs:
 - name: hello-world
   plan:
   - task: say-hello
     config:
       platform: linux
       image_resource:
         type: docker-image
         source: {repository: ubuntu}
       run:
         path: echo
         args: ["Hello, world!"]
```

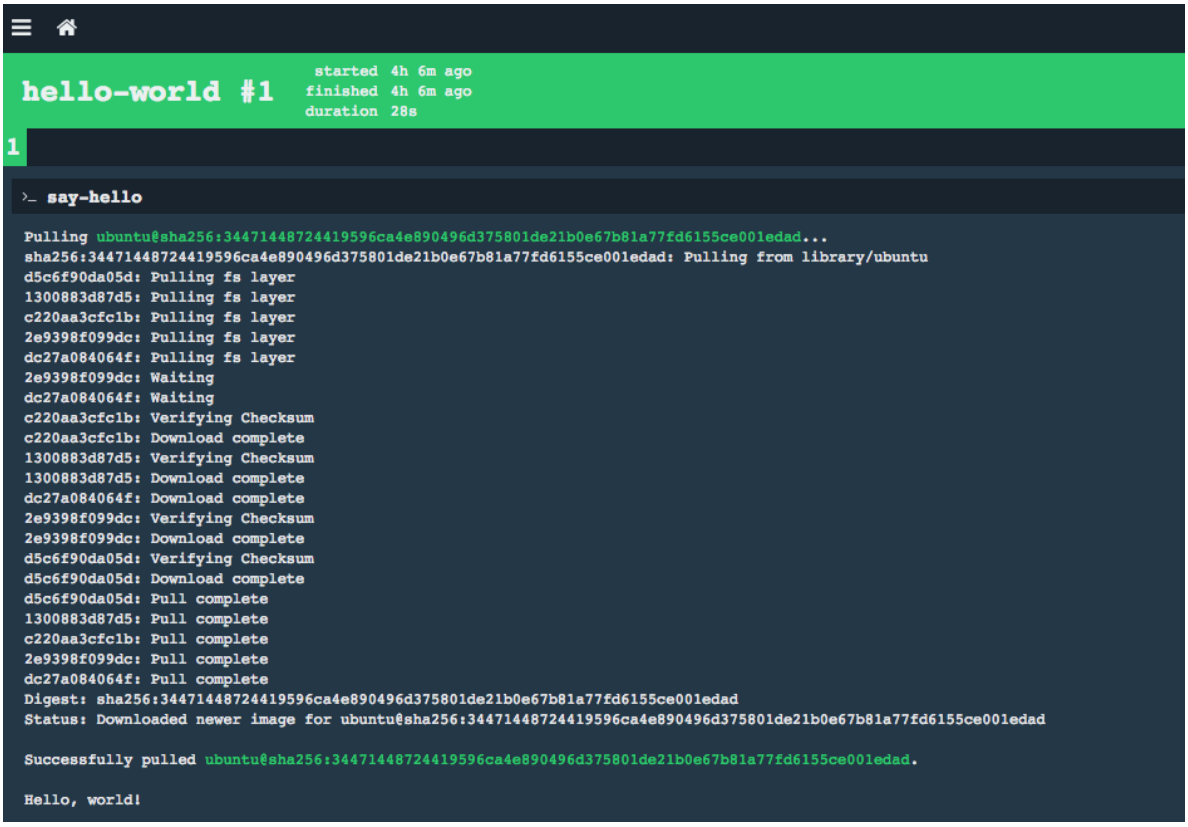
6. Register the task.

```
fly -t lite set-pipeline -p hello-world -c hello.yml
```

7. Start the migration task.

```
fly -t lite unpause-pipeline -p hello-world
```

The page indicating the successful execution is as follows.



For more information about the characteristics of Concourse CI, see *Concourse CI project*.

10 Deploy Container Service clusters by using Terraform

This document introduces how to use Terraform to deploy Alibaba Cloud Container Service cluster in the Virtual Private Cloud (VPC) environment and deploy a sample WordPress application in the cluster. In this document, a solution used to build Alibaba Cloud infrastructures is provided for you to use codes to automatically create, orchestrate, and manage services in Container Service.

Prerequisite

- You must activate Alibaba Cloud Container Service.
- You must activate Alibaba Cloud Container Service and create an AccessKey for your account . Keep your AccessKey ID and AccessKey Secret properly.

Step 1. Install Terraform

Download Terraform

Download Terraform from the *official website*. Select the corresponding version and platform.
In this document, install the Terraform on Linux (the procedure is similar to that of installing the Terraform on Mac OS X).

1. Under Linux, click to download the `terraform_0.11.3_linux_amd64.zip` file.
2. Copy the *.zip* file to an appropriate path (*/usr/local/terraform* in this example).
3. Extract the .zip file and then get a binary file terraform.
4. Create the following entries in the */etc/profile* directory and add the path where the binary file resides (*/usr/local/terraform* in this example) to the PATH environment variable.

```
export TERRAFORM_HOME=/usr/local/terraform
export PATH=$PATH:$TERRAFORM_HOME
```

Install Alibaba Cloud Terraform package

Before using Terraform, an initialization operation is required to load Alibaba Cloud Provider. Run the following command in the template file directory:

```
terraform init
```

After the download is successful, the corresponding plugin is downloaded to the *.terraform* hidden directory in the current folder. If you encounter a network timeout problem during the loading process, follow the instructions to complete the manual installation of the plugin.

- Download the corresponding version and platform Provider from *Alibaba Cloud Terraform Provider official download address*. In this example, the Linux type is selected.
- Copy the downloaded file *terraform-provider-alicloud_1.9.3_linux_amd64.zip* to the Terraform installation directory */usr/local/terraform* and extract it. The current directory gets Alibaba Cloud Provider *terraform-provider-alicloud_v1.9.3_x4*.

Run the following command to test the working of Terraform. If Terraform is successfully installed, the following contents are displayed:

```
$ terraform
Usage: terraform [--version] [--help] [args]

The available commands for execution are listed below.
The most common, useful commands are shown first, followed by
less common or more advanced commands. If you're just getting
started with Terraform, stick with the common commands. For the
other commands, please read the help and docs before usage.

Common commands:
....

All other commands:
debug Debug output management (experimental)
force-unlock Manually unlock the terraform state
state Advanced state management
```

Step 2. Download Container Service Terraform scripts

You can download the Terraform template (*the template download address*) to create the swarm cluster and deploy the WordPress application . This template file defines the resources for creating a swarm cluster and the files that deploy Wordpess on the swarm cluster to help you quickly create and deploy swarm clusters. The template contains the following files after being extracted.

main.tf

The main file of Terraform that defines the resources to be deployed.

- **Region**

  Defines the region where resources are to be created.

  ```
  provider "alicloud" {
  access_key = "${var.alicloud_access_key}"
  secret_key = "${var.alicloud_secret_key}"
  region = "${var.region}"
  }
  ```

- **VPC**

  ```
  resource "alicloud_vpc" "vpc" {
  name = "${var.vpc_name}"
  ```

```
cidr_block = "${var.vpc_cidr}"
}
```

- **VSwitch**

```
resource "alicloud_vswitch" "vswitch" {
availability_zone = "${data.alicloud_zones.default.zones. 0.id}"
name = "${var.vswitch_name}"
cidr_block = "${var.vswitch_cidr}"
vpc_id = "${alicloud_vpc.vpc.id}"
}
```

- **Container Service cluster**

```
resource "alicloud_cs_swarm" "cs_vpc" {
password = "${var.password}"
instance_type = "${data.alicloud_instance_types.main.instance_types
. 0.id}"
name = "${var.cluster_name}"
node_number = "${var.node_number}"
disk_category = "${var.disk_category}"
disk_size = "${var.disk_size}"
cidr_block = "${var.cidr_block}"
image_id = "${data.alicloud_images.main.images. 0.id}"
vswitch_id = "${alicloud_vswitch.main.id}"
}
```

- **WordPress application**

```
resource "alicloud_cs_application" "wordpress" {
cluster_name = "${alicloud_cs_swarm.cs_vpc.name}"
name = "${var.app_name == "" ? var.resource_group_name : var.
app_name}"
version = "${var.app_version}"
template = "${file("wordpress.yml")}"
description = "terraform deploy consource"
latest_image = "${var.latest_image}"
blue_green = "${var.blue_green}"
blue_green_confirm = "${var.confirm_blue_green}"
}
```

outputs.tf

This file defines the output parameters. Resources created as part of the execution generate these output parameters. This is similar to the output parameters specified in a Resource Orchestration Service (ROS) template. For example, the template deploys a swarm cluster and Wordpress application instance. The following output parameters provide the cluster ID and the default domain name for the application.

```
output "cluster_id" {
  value = "${alicloud_cs_swarm.cs_vpc.id}"
}
```

```
output "default_domain" {
  value = "${alicloud_cs_application.wordpress.default_domain}"
```

```
}
```

variables.tf

This file contains the variables that can be passed to main.tf and helps you customize the environment.

```
variable "alicloud_access_key" {
  description = "The Alicloud Access Key ID to launch resources.
Support to environment 'ALICLOUD_ACCESS_KEY'."
}
```

```
variable "alicloud_secret_key" {
  description = "The Alicloud Access Secret Key to launch resources.
Support to environment 'ALICLOUD_SECRET_KEY'."
}
```

```
variable "region" {
  description = "The region to launch resources."
  default = "cn-hongkong"
}
```

```
variable "vpc_cidr" {
  description = "The cidr block used to launch a new vpc."
  default = "172.16.0.0/12"
}
```

```
variable "app_name" {
  description = "The app resource name. Default to variable `
resource_group_name`"
  default = "wordpress"
}
```

wordpress.yml

Deploy the Compose template of the WordPress application from the orchestration templates provided in the console. Log on to the Container Service console, click **Application** in the left-side navigation pane, select **Create Application** > **Create by template** > **Use an existing template**.

Step 3. Run Terraform scripts

To run the script, first locate the directory where you stored the preceding files, such as */root/terraform/wordpress*. You can use the following terraform related commands to run scripts, build container clusters, and deploy applications. For more information, see *Terraform Commands (CLI)*.

Run `terraform init` to initialize the environment.

```
$ terraform init
  Initializing provider plugins...
  ...
   - Checking for available provider plugins on https://releases.
hashicorp.com...
```

```
    - Downloading plugin for provider "alicloud" (1.7.2)...
    * provider.alicloud: version = "~> 1.7"
    Terraform has been successfully initialized!
    ...
```

Run the `terraform providers` command to list the installed providers.

```
terraform providers
.
└── provider.alicloud
```

Before running `terraform plan`, you must first enter the AccessKey ID and AccessKey Secret for authorization.

```
$ export ALICLOUD_ACCESS_KEY="AccessKey ID"
$ export ALICLOUD_SECRET_KEY="AccessKey Secret"
```

Run `terraform plan` to create an execution plan and help you understand the resources that are going to be created or changed.

```
$ terraform plan
Refreshing Terraform state in-memory prior to plan...
The refreshed state will be used to calculate this plan, but will not
be
persisted to local or remote state storage.
data.alicloud_images.main: Refreshing state...
data.alicloud_instance_types.default: Refreshing state...
data.alicloud_zones.default: Refreshing state...
------------------------------------------------------------------------
An execution plan has been generated and is shown below.
Resource actions are indicated with the following symbols:
  + create
Terraform will perform the following actions:
...
Plan: 9 to add, 0 to change, 0 to destroy.
------------------------------------------------------------------------
Note: You didn't specify an "-out" parameter to save this plan, so
Terraform
can't guarantee that exactly these actions will be performed if
"terraform apply" is subsequently run.
```

After the resources are created or updated as expected, run the `terraform apply` command to start the execution of the Terraform module.

```
$ terraform apply
data.alicloud_instance_types.default: Refreshing state...
data.alicloud_images.main: Refreshing state...
data.alicloud_zones.default: Refreshing state...
An execution plan has been generated and is shown below.
Resource actions are indicated with the following symbols:
  + create
Terraform will perform the following actions:
...
Plan: 9 to add, 0 to change, 0 to destroy.
Do you want to perform these actions?
  Terraform will perform the actions described above.
  Only 'yes' will be accepted to approve.
```

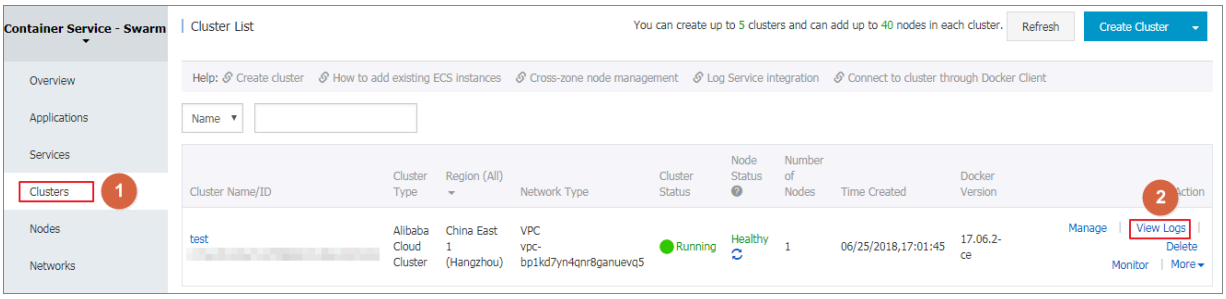
```
  Enter a value: yes
alicloud_vpc.vpc: Creating...
...
Apply complete! Resources: 9 added, 0 changed, 0 destroyed.
Outputs: ##Note
availability_zone = cn-hongkong-a
cluster_id = c95537435b********
default_domain = c95537435b********.cn-hongkong.alicontainer.com
vpc_id = vpc-2zeaudqan6uzt5lzry48a
vswitch_id = vsw-2ze2x92n9b5neor7fcjmr
```

After running the `terraform apply` command, the output parameters requested in the `outputs.tf` are displayed. In the preceding example, the output parameters are the cs_cluster cluster ID, available zone, VPC ID, VSwitch ID name, and the default_domain of the application instance.

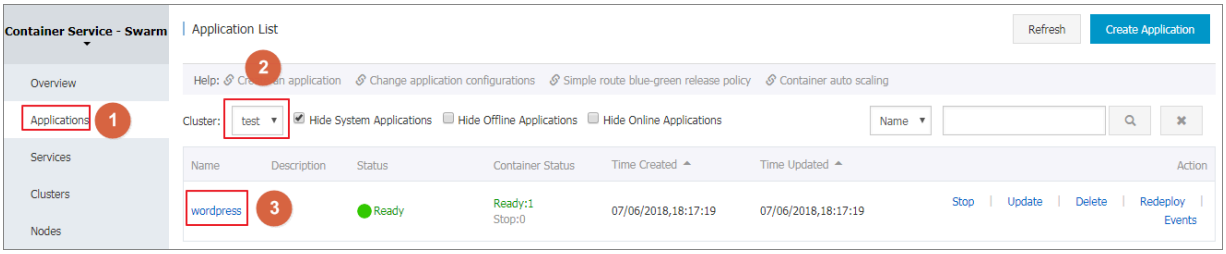
The output values can be listed at any time by running the `terraform output` command to help you configure the WordPress application.

```
terraform output
availability_zone = cn-hongkong-a
cluster_id = c95537435b********
default_domain = c95537435b********.cn-hongkong.alicontainer.com
vpc_id = vpc-2zeaudqan6uzt5lzry48a
vswitch_id = vsw-2ze2x92n9b5neor7fcjmr
```

You can view the cluster created by using Terraform in the Container Service console. View the cluster, node, container, and logs.



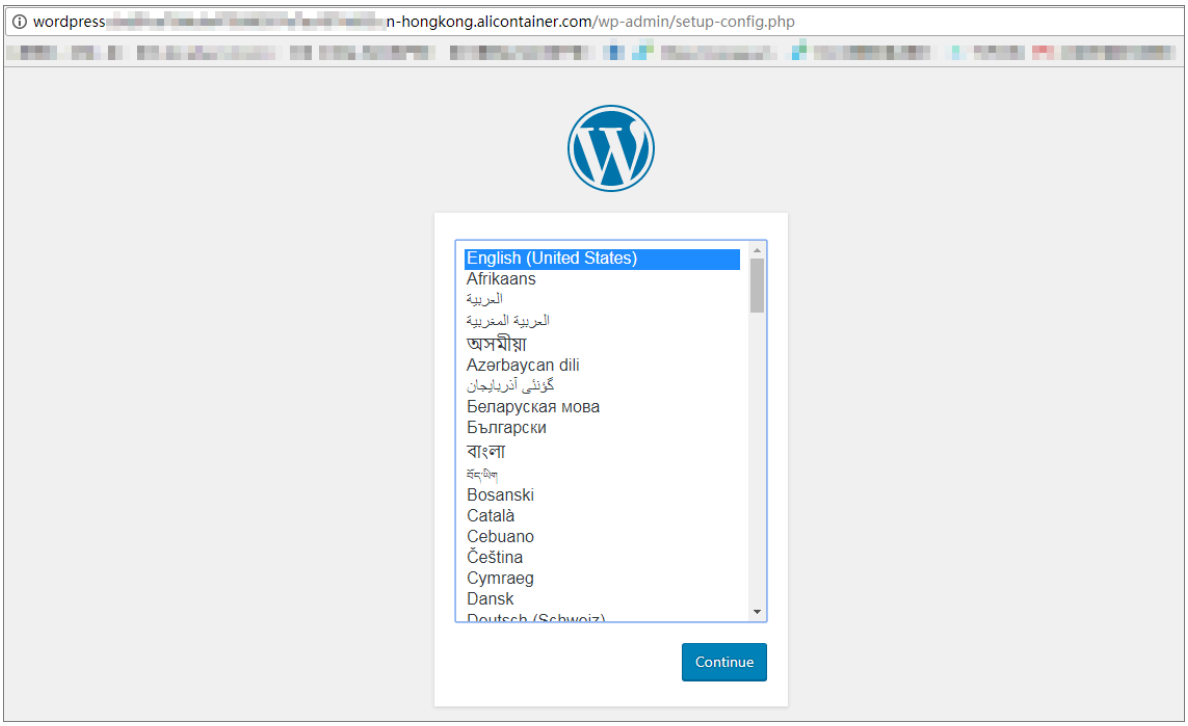
At the same time, you can view the WordPress application information on the Application page.



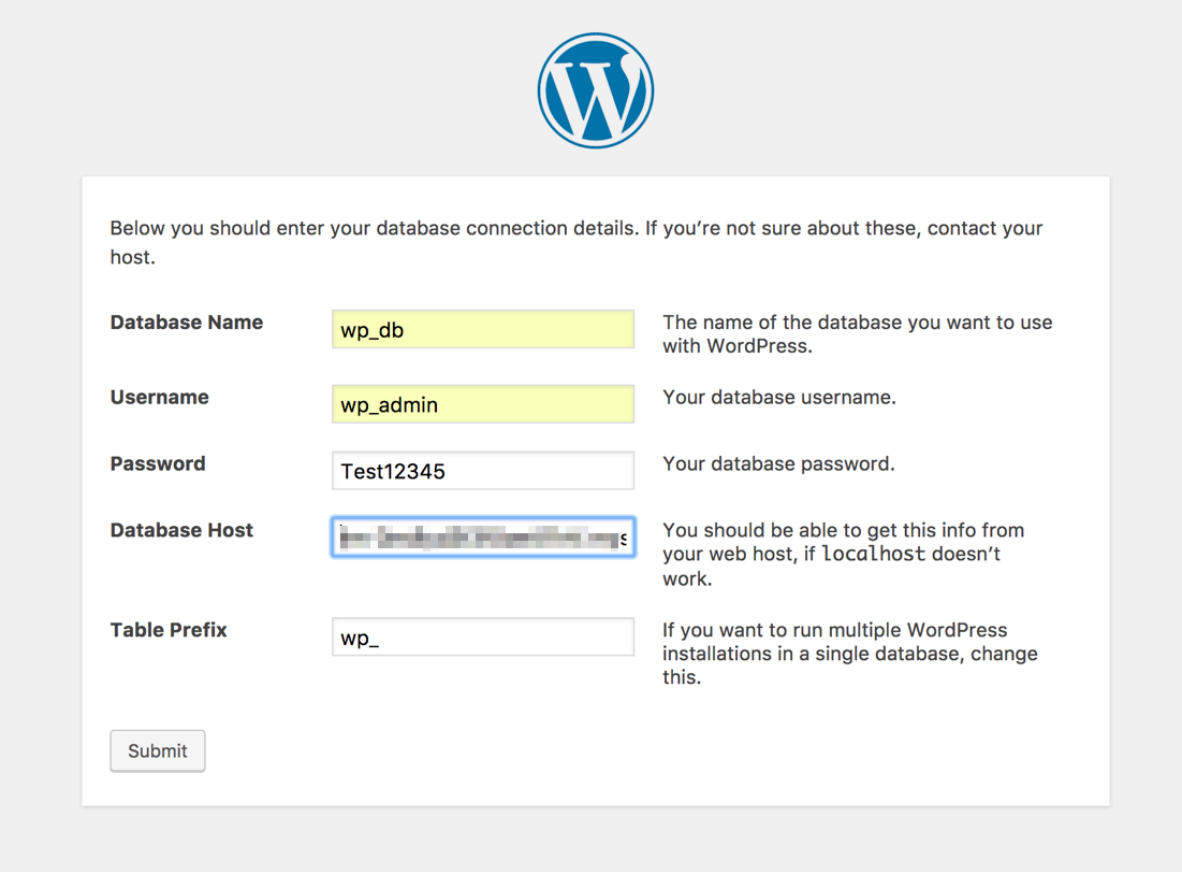
Click the application name, and then click **Routes** to view the route address.

Step 4. Access WordPress

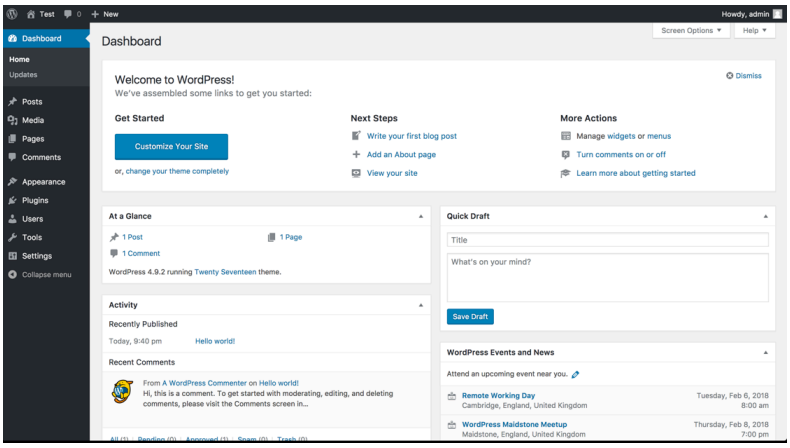
1. Open the Wordpress Compose template `wordpress.yml` and find the application domain prefix `aliyun.routing.port_80: http://wordpress`.
2. The value of the domain name prefix `http://wordpress` and application `default_domain` spliced with the `http: //wordpress.c95537435b********.cn-hongkong.alicontainer.com`. Enter the browser to access the WordPress welcome page, select the language, and set other configurations.



3. Enter the Site Title, username, and password of the administrator. Click Install WordPress.



4. After the installation, click **Log In**. Enter the username and password of the administrator, and then click Log In on the WordPress logon page to log on to the WordPress application.



Further information

Currently, Alibaba Cloud is the official major cloud provider of Terraform. To use Terraform to flexibly build Alibaba Cloud infrastructures, see *Alibaba Cloud Provider* for more information and customize the resource description files to quickly build your cloud infrastructures.

11 Use Chef to automatically deploy Docker and WebServer

Chef is an automated deployment framework. Combined with Alibaba Cloud Container Service, Chef can help you achieve customization and automation in your deployment. Log on to the *Chef* official website first to learn about basic terms for quick start, such as cookbook, recipe, chef workstation, chef server, and chef nodes.

Prerequisites

- You have created a swarm cluster that retains the EIP.
- Prepare a local Linux environment. This example uses Ubuntu 16.04. According to your local environment, download a ChefDK at *https://downloads.chef.io/chefdk/*.
- Log on to the Chef official website to register an account and create an organization. In this example, the created organization is called example.

Install the chef workstation on Linux

You need to go to the Chef official website to download a ChefDK which is compatible with your local Linux environment. This example uses a ChefDK corresponding to Ubuntu 16.04.

First create a *chef-repo* directory in the */home* directory.

```
mkdir /home/chef-repo
```

Enter the *chef-repo* directory and use the **curl** command to download a ChefDK package to install.

```
cd /home/chef-repo
curl -O https://packages.chef.io/files/stable/chefdk/3.0.36/ubuntu/16.
04/chefdk_3.0.36-1_amd64.deb
dpkg -i chefdk_3.0.36-1_amd64.deb
```

Then you need to perform a large number of Chef installation configurations. If you encounter problems during installation, see Chef official documents to troubleshoot the problems.

Verify Chef

```
chef verify #Verify if the ChefDK components are normal
chef --version #View the Chef version.
```

Set Chef environment variables

Set environment variables related to Chef, such as GEM_ROOT, GEM_HOME, and GEM_PATH.

```
export GEM_ROOT="/opt/chefdk/embedded/lib/ruby/gems/2.1.0"
export GEM_HOME="/root/.chefdk/gem/ruby/2.1.0"
export GEM_PATH="/root/.chefdk/gem/ruby/2.1.0:/opt/chefdk/embedded/lib/
ruby/gems/2.1.0"
```

In addition, if Ruby is already installed on your system, update the PATH variable related to Ruby.

```
export PATH="/opt/chefdk/bin:/root/.chefdk/gem/ruby/2.1.0/bin:/opt/
chefdk/embedded/bin:/opt/chefdk/bin:/root/.chefdk/gem/ruby/2.1.0/bin:/
opt/chefdk/embedded/bin:/opt/chefdk/bin:/root/.chefdk/gem/ruby/2.1.0/
bin:/opt/chefdk/embedded/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin
:/usr/bin:/root/bin"
```

Configure firewalld rules for accessing Chef

To access the Chef Manage GUI on the Chef server, add the following firewalld rules and open corresponding ports on the Chef server.

```
firewall-cmd --direct --add-rule ipv4 \
filter INPUT_direct 0 -i eth0 -p tcp \
 --dport 443 -j ACCEPT

firewall-cmd --direct --add-rule ipv4 \
filter INPUT_direct 0 -i eth0 -p tcp \
 --dport 80 -j ACCEPT

firewall-cmd --direct --add-rule ipv4 \
filter INPUT_direct 0 -i eth0 -p tcp \
 --dport 9683 -j ACCEPT

firewall-cmd --reload
```

Download Starter Kit from the Chef Manage Gui

Log on to *Chef Manage GUI*, click **Administration**, and select the organization in the drop-down list. In this example, the organization is example. After the organization is selected, click the **Starter Kit** in the left-side navigation pane to download the chef-starter.zip file to your local host.

Transfer the *chef-starter.zip* file to the Chef workstation in your local Linux , and extract it to the *home/chef-repo* directory.

```
# cd /home/chef-repo
unzip chef-starter.zip
```

Download the SSL Certificate for the Chef server

The certificate is downloaded to the *chef-repo/.chef/trusted_certs* directory.

```
# cd ~/chef-repo
# knife ssl fetch

WARNING: Certificates from api.chef.io will be fetched and placed in
your trusted_cert
directory (/root/chef-repo/.chef/trusted_certs).
```

```
Knife has no means to verify these are the correct certificates. You
should
verify the authenticity of these certificates after downloading.

Adding certificate for wildcard_opscode_com in /root/chef-repo/.chef/
trusted_certs/wildcard_opscode_com.crt
Adding certificate for DigiCert_SHA2_Secure_Server_CA in /root/chef-
repo/.chef/trusted_certs/DigiCert_SHA2_Secure_Server_CA.crt
```

Verify if the Chef workstation is installed successfully

After completing configuration, execute the following commands. If the created organization is displayed, you have successfully connected to the workstation.

```
# cd ~/chef-repo

# knife client list
example-validator
```

Create a cookbook that implements Docker automatic initialization

1. Create a cookbook on the Chef workstation.
   - In the chef-repo/cookbooks directory, execute the following command to create a cookebook named docker_init.

     ```
     chef generate cookbook docker_init
     ```

   - Go to the *chef-repo/cookbooks/docker_init/recipe/* directory to find the default.rb file and configure the file. This example is used to start the latest version of Docker in Ubuntu.

     ```
     apt_update


     package 'apt-transport-https'
     package 'ca-certificates'
     package 'curl'
     package 'software-properties-common'


     execute 'apt-key' do
     command 'apt-key fingerprint 0EBFCD88'
     end


     execute 'apt-repo' do
     command 'add-apt-repository "deb [arch=amd64] https://download.
     docker.com/linux/ubuntu/dists/xenial/stable/"'


     end


     execute 'apt-repo' do
     ```

```
command 'apt-get update'
end


execute 'apt-repo' do
command 'apt-get install docker-ce -y --allow-unauthenticated'
end


service 'docker' do
action [:start, :enable]
end
```

2. Verify if the cookbook named docker_init works locally.

```
# chef-client --local-mode --runlist 'recipe[docker_init]'

[2018-06-27T15:54:30+08:00] INFO: Started chef-zero at chefzero://
localhost:1 with repository at /root/chef-repo
One version per cookbook


Starting Chef Client, version 14.1.12
[2018-06-27T15:54:30+08:00] INFO: *** Chef 14.1.12 ***
[2018-06-27T15:54:30+08:00] INFO: Platform: x86_64-linux
[2018-06-27T15:54:30+08:00] INFO: Chef-client pid: 2010
[2018-06-27T15:54:30+08:00] INFO: The plugin path /etc/chef/ohai/
plugins does not exist. Skipping...
[2018-06-27T15:54:31+08:00] INFO: Setting the run_list to [#] from
CLI options
[2018-06-27T15:54:32+08:00] INFO: Run List is [recipe[docker_init]]
[2018-06-27T15:54:32+08:00] INFO: Run List expands to [docker_init]
[2018-06-27T15:54:32+08:00] INFO: Starting Chef Run for yxm
[2018-06-27T15:54:32+08:00] INFO: Running start handlers
[2018-06-27T15:54:32+08:00] INFO: Start handlers complete.
resolving cookbooks for run list: ["docker_init"]
[2018-06-27T15:54:32+08:00] INFO: Loading cookbooks [docker_init@0.1
.0]
Synchronizing Cookbooks:
- docker_init (0.1.0)
Installing Cookbook Gems:
Compiling Cookbooks...
Converging 10 resources
Recipe: docker_init::default
* apt_update[] action periodic[2018-06-27T15:54:32+08:00] INFO:
Processing apt_update[] action periodic (docker_init::default line 9
)
....
---- End output of add-apt-repository "deb [arch=amd64] https://
download.docker.com/linux/ubuntu/dists/xenial/stable/" ----
Ran add-apt-repository "deb [arch=amd64] https://download.docker.com
/linux/ubuntu/dists/xenial/stable/" returned 1
```

Execute the following command to check if the locally installed docker is upgraded to the latest version.

```
# docker --version
Docker version 17.06.2-ce, build 2e0fd6f
```

3. Upload the cookbook to the Chef server.

   - On the Chef workstation, upload the cookbook named docker_init to the Chef server by executing the following command.

     ```
     knife cookbook upload docker_init
     ```

   - Execute the following command to verify that the cookbook is uploaded successfully.

     ```
     # knife cookbook list
     docker_init 0.1.0
     ```

4. Import the cookbook into the node of the Alibaba Cloud swarm cluster.

   - On the Chef workstation, execute the following command to import docker_init into the node of the swarm cluster that act as a Chef node.

     Note:
     Replace ADDRESS with the EIP of the ECS node of the swarm cluster. USER is the logon user of the ECS node, typically root. PASSWORD is the ECS node logon password. If the swarm cluster has multiple nodes, execute this command for each ECS node.

     ```
     # knife bootstrap ADDRESS --ssh-user USER --ssh-password 'PASSWORD
     ' --sudo --use-sudo-password --node-name node1-ubuntu --run-list '
     recipe[docker_init]'

     Creating new client for node1-ubuntu
     Creating new node for node1-ubuntu
     Connecting to 121.196.219.18
     ...
     https://download.docker.com/linux/ubuntu/dists/xenial/stable/"
      ----
     121.196.219.18 Ran add-apt-repository "deb [arch=amd64] https://
     download.docker.com/linux/ubuntu/dists/xenial/stable/" returned 1
     ```

   - Log on to each ECS node to check if the docker installed on each node has been updated to the latest version. Execute the `docker -- version` command to verify.

Now you have updated the version of Alibaba Cloud container cluster Docker through the Chef automated deployment system.

Create a cookbook that automates the deployment of Web Server

1. Create a new cookbook on the Chef workstation.

- In the chef-repo/cookbooks directory, execute the following command to create a cookbook named web_init.

```
chef generate cookbook web_init
```

- Go to the *chef-repo/cookbooks/web_init/recipe/*directory to find the default.rb file and configure the file.

```
execute 'apt-repo' do
command 'apt-get -y install apache2 --allow-unauthenticated'
end


service 'apache2' do
action [:start, :enable]
end


file '/var/www/html/index.html' do
content '
hello,world
'
end


service 'iptables' do
action :stop
end
```

2. Verify that the cookbook works locally.

- Execute the `curl http://localhost:80` command to check if the web_init works on the local host.
- On the Chef workstation, upload the cookbook named web_init to the Chef server.

```
knife cookbook upload web_init
```

3. Import the cookbook into the node of the Alibaba Cloud swarm cluster.

   On the Chef workstation, execute the following command to import web_init into the node of the swarm cluster that acts as a chef node.

Note:

Replace ADDRESS with the EIP of the ECS node of the swarm cluster. USER is the logon user of the ECS node, typically root. PASSWORD is the ECS node logon password. If the swarm cluster has multiple nodes, execute this command for each ECS node.

```
knife bootstrap ADDRESS --ssh-user USER --ssh-password 'PASSWORD' --sudo --use-sudo-password --node-name node1-ubuntu --run-list 'recipe[web_init]'
```

4. Check if the Web Server starts successfully in the Alibaba Cloud swarm cluster. Log on to the node of the Alibaba Cloud swarm cluster.

   - Execute the `systemctl status apache2.service` command to check if apache2 operates normally.
   - Visit `http://ADDRESS:80` in the browser to see if `hello world` is displayed.

   Note:
   ADDRESS is the EIP of the node.