Services and Networking

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Load Balancing Kubernetes Services using NGINX

Cisco Container Platform uses NGINX to offer advanced layer 7 load balancing solutions. NGINX can handle a large number of requests and at the same time, it can be run on Kubernetes containers.

The NGINX load balancer is automatically provisioned as part of Kubernetes cluster creation. Each Kubernetes cluster is provisioned with a single L7 NGINX load balancer. You can access the load balancer using its virtual IP address, which can be found by running the command `kubectl get svc -n ccp`.

To use the NGINX load balancer, you must create an Ingress resource. Ingress is a Kubernetes object that allows you to define HTTP load balancing rules to allow inbound connections to reach the cluster services. You can configure Ingress to create external URLs for services, load balance traffic, terminate SSL, offer name-based virtual hosting, and so on.

L7 Ingress

Cisco Container Platform supports the following types of L7 Ingresses:

- **Simple fanout**

  It enables you to access the website using http.

  Example

```
cafe.test.com ->   10.1.1.1   ->   /tea      tea-svc:80
                                              /coffee   coffee-svc:80
```

  For this type of Ingress, you need to create a yaml file that defines the Ingress rules.

  Sample yaml file

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
name: cafe-ingress
spec:
```

```
rules:
-host: cafe.test.com
http:
    paths:
    -path:/
    backend:
    serviceName: tea-svc
    servicePort: 80
    -path:/
    backend:
    serviceName: tea-svc
    servicePort: 80
```

- **Simple fanout with SSL termination**

  It enables you to access the website using https.

  Example

```
https://cafe.test.com   ->   10.1.1.1   ->   /tea       tea-svc:80
                                              /coffee    coffee-svc:80
```

  For this type of Ingress, you need to create the following yaml files:

  - A yaml file that defines the Secret

    Sample yaml file

```
apiVersion: v1
kind: Secret
metadata:
  name: cafe-secret
type: Opaque
data:
  tls.crt: base64 encoded cert
  tls.key: base64 encoded key
```

  - A yaml file that defines the Ingress rules

    Sample yaml file

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: cafe-ingress
spec:
  tls:
  -hosts:
  -cafe.test.com
   secretName: cafe-secret
  rules:
  -host: cafe.example.com
  http:
   paths:
   -path:/
   backend:
     serviceName: tea-svc
     sevicePort: 80
   -path:/
   backend:
     serviceName: coffee-svc
     servicePort: 80
```

- **Name based virtual hosting**

It enables you to access the website using multiple host names.

Example

```
tea.test.com    --|          |-> tea.test.com      s1:80
                  |10.1.1.1  |
coffee.test.com --|          |-> coffee.test.com  s2:80
```

For this type of Ingress, you need to create a yaml file that defines the Ingress rules.

Sample yaml file

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata
name: cafe-ingress
spec:
 rules:
 -host: tea.test.com
 http:
    paths:
    -path:/
    backend:
    serviceName: tea-svc
    servicePort: 80
-host: coffee.test.com
http:
paths:
-path:/
backend:
serviceName: coffee-svc
servicePort: 80
```

Note You can download the yaml files that are shown in this topic from the following link:

https://github.com/nginxinc/kubernetes-ingress/tree/master/examples/complete-example

For more information on a sample scenario of implementing Ingress, see Deploying Cafe Application with Ingress.

L4 Ingress

NGINX supports L4 TCP and UDP Ingress load balancing. It uses the NGINX helm chart that contains the TCP or UDP service mappings, instead of the Ingress resources as in the case of L7 support.

Configuring L4 Load Balancing

Note NGINX supports either TCP or UDP L4 load balancing, but not both simultaneously.

Step 1 Access the Kubernetes cluster master node using ssh.

```
ssh -l <username> <IP address of master node>
```

Note Once you create a Kubernetes cluster, it may take a few minutes for the necessary services to start. If ssh to a cluster fails, we recommend that you try again after a few minutes.

Step 2 Get the current helm configuration values.

```
helm get values --all ccp-addons > /tmp/ccp_addons.yaml
```

Step 3 Navigate to the following location:

```
cd /tmp
```

Step 4 Edit the `ccp_addons.yaml` file.

You can search for *tcp* or *udp* in the `ccp_addons.yaml` file, and then add your L4 services.

The following example shows adding the tcp-test-svc TCP service that uses port 3333.

```
tcp:
    "9000": default/tcp-test-svc:3333
```

The following example shows adding the udp-test-svc UDP service that uses port 5005.

```
udp:
    "9001": default/udp-test-svc:5005
```

Step 5 Update the NGINX helm chart with the L4 service mappings.

```
helm upgrade --install ccp-addons /opt/ccp/charts/ccp-agent.tgz -f ccp_addons.yaml
```

Note You need to restart the NGINX Ingress controller pods for the new configuration to take effect.

Step 6 Verify that ingress has successfully mapped the port.

```
kubectl get svc -n ccp | grep ingress-controller
```

Ingress CA

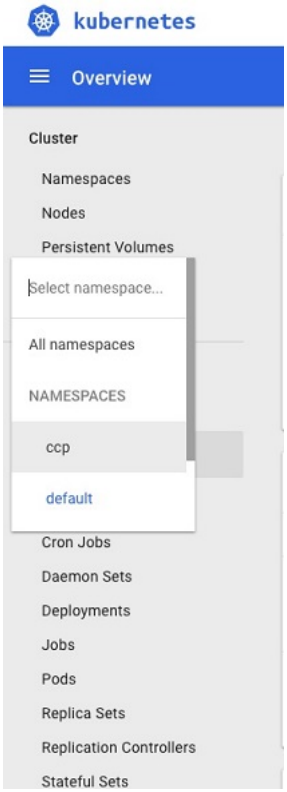
Cisco Container Platform by default creates an L7 Ingress service in order to support Monitoring Health of Cluster Deployments, Monitoring Logs from Cluster Deployments, and Setting up Kubernetes Dashboard. All of these services are exposed with TLS enabled, and the certificate authority (CA) that is used to sign the Ingress controller server certificate is self-signed and per cluster based.

In order to reach the services without triggering SSL warning, you can either add the CA as part of your application that needs to interact with services behind Cisco Container Platform ingress (preferred), or add the CA to your system trusted CA list. The following section describes how to obtain the CA certificate.

Step 1 Log in to the Kubernetes dashboard from browser as described in Setting up Kubernetes Dashboard section, download the kubeconfig file, and then use it to login to the Kubernetes dashboard.

Step 2 From the right pane, click the dropdown box under **Namespace**, click the **ccp** namespace.

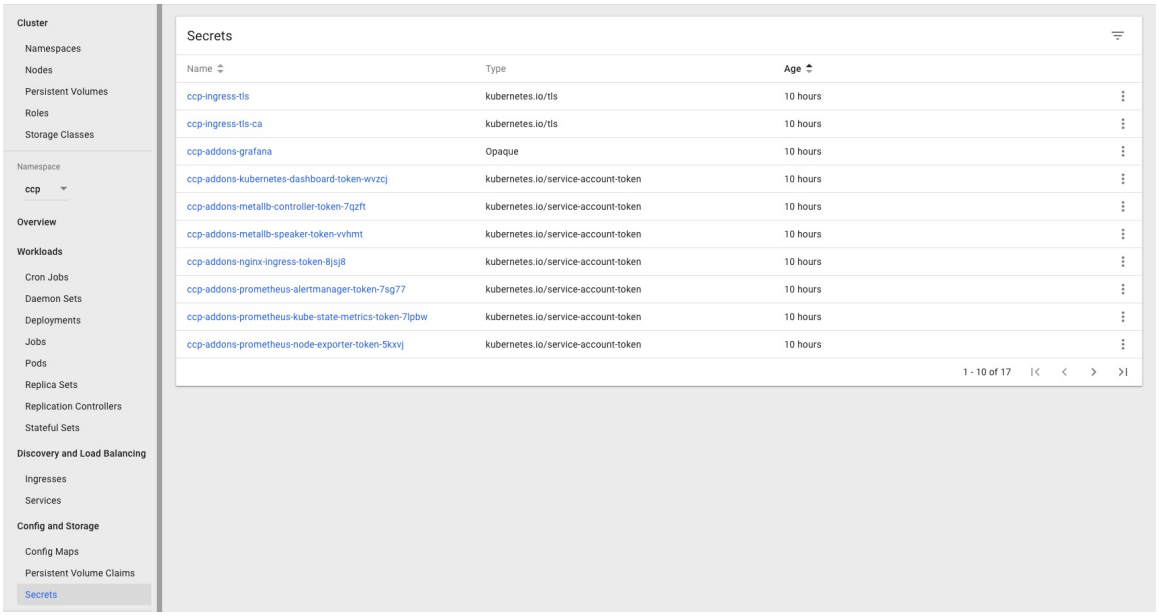
Figure 1: Kubernetes Dashboard



Step 3 Click the **Secrets** tab.

The **Secrets** pane appears.

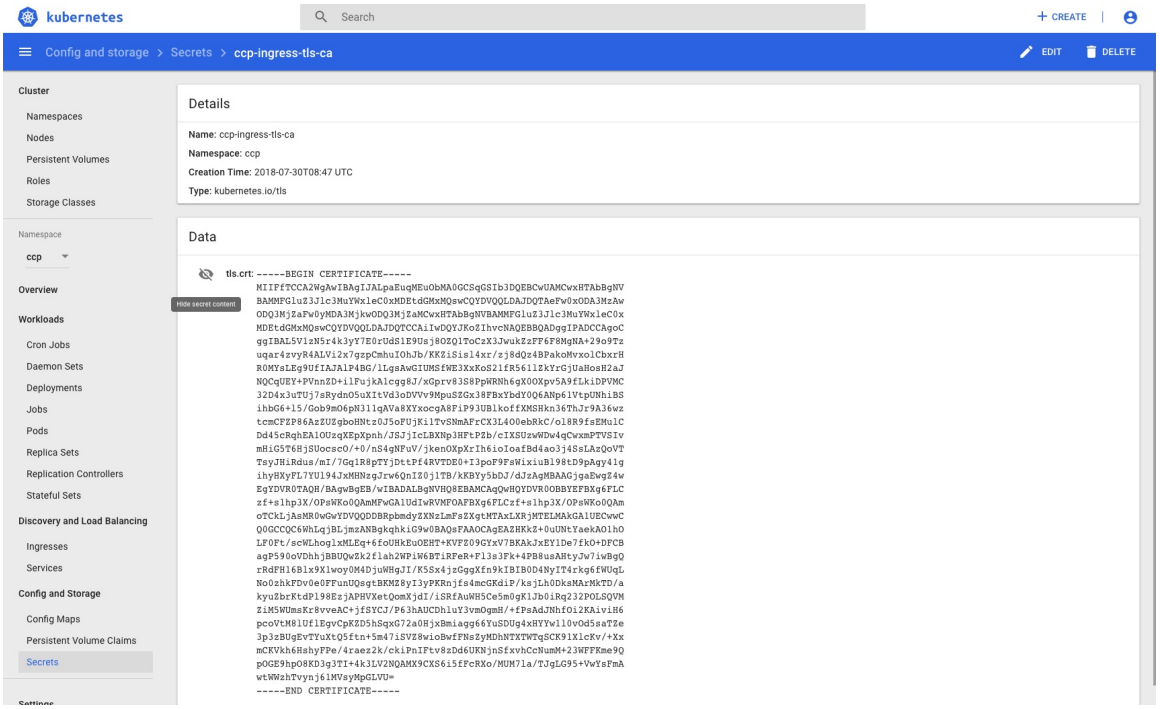
Figure 2: Secrets Pane



Step 4 Open the `ccp-ingress-tls-ca` secret and find the data for `tls.crt`.

Step 5 Click the **Eye** icon to view the details of a `tls.crt`.

Figure 3: Secrets Pane Showing Details of tls.crt



You can save the CA data into a file, and use it when a client is trying to connect to the Ingress service.

The following example uses **curl** to get to the dashboard using the saved CA certificate.

```
$ curl --cacert ./ca.crt -I https://10.10.99.185/dashboard
HTTP/1.1 200 OK
Server: nginx/1.13.12
Date: Mon, 30 Jul 2018 19:08:11 GMT
Content-Type: text/html; charset=utf-8
Connection: keep-alive
Vary: Accept-Encoding
Accept-Ranges: bytes
Cache-Control: no-store
Strict-Transport-Security: max-age=15724800; includeSubDomains
```

Network Policies

Cisco Container Platform supports Kubernetes NetworkPolicies. The NetworkPolicies are independent of the underlying container network plugin.

Load Balancer Services

Cisco Container Platform supports load balancer services on tenant clusters.

While creating a tenant cluster, you need to choose the number of load balancer IP addresses that you want to allocate for a tenant cluster from a VIP pool that you want to use.

Note The cluster creation operation fails if the number of requested load balancer IP addresses is more than the available IP addresses in the pool.

For more information, see Creating Kubernetes Clusters.

Once load balancer IP addresses are allocated for a tenant cluster, externally reachable load balancer IP addresses are automatically provisioned for the load balancer services.

The following code provides an example of creating a service of type **LoadBalancer**.

```
apiVersion: v1
kind: Service
metadata:
     name: frontend
     labels:
             app: guestbook
             tier: frontend
     type: LoadBalancer
```

You can update the number of available load balancer IP addresses from the **Edit Cluster** screen. You need to be aware of the number of used addresses in order to update the number of allocated load balancer IP addresses.

For example:

Suppose the current tenant is allocated with five load balancer IP addresses. If there are three load balanced services running, you cannot reduce the number of load balancer IP addresses to three or less as there are services using those IP addresses already.

Note When you delete a tenant cluster, the allocated load balancer IP addresses are recycled to the VIP pool.