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Table of Contents

Wildcard certificates from Let's Encrypt wi manager and ingress-nginx on Google Kubernetes Engine

Goal

The goal of this guide is to have a simple web service running on a Google Kubernetes Engine cluster with wildcard certificates from Let's Encrypt and using the `ingress-nginx` as the Ingress controller. The certificates will be managed by `cert-manager`.

Prerequisites

- Working GKE cluster
  - running Kubernetes 1.10+
- Domain that you own, using Google Cloud DNS nameservers
  - this guide will use example.xyz in place of a real domain
  - if you have not yet configured your domain registrar for this, refer to the "Configure your domain registrar to use Google Cloud DNS' nameservers" section below.
- Docker and the gcloud tools installed on your machine

This guide assumes you already know how to work with Pods, Deployments, Services, and Secrets on Kubernetes.

Trying out the simple web service locally

The app we'll be using, called `wildcard-demo`, is available on Github and Docker Hub. All it does is return some request and host data in the response, which would normally be useful for apps that work with multiple subdomains.

Pull the image from Docker Hub and run it with the following commands:

```
$ docker pull john2x/wildcard-demo
$ docker run -p 8080:8080 john2x/wildcard-demo
```

With the server running, accessing `http://localhost:8080` or `http://foo.localhost:8080` should return something like the following:

```
$ curl http://localhost:8080 -i
HTTP/1.1 200 OK
Server: gunicorn/19.9.0
Date: Wed, 26 Sep 2018 05:59:11 GMT
Connection: close
Content-Type: text/plain
Content-Length: 193

remote address: 127.0.0.1
x-forwarded-for: None
```

```
hostname: localhost:8080
pod ip: None
pod name: None
node name: None
```

Table of Contents

Most of the information are not available since we are not in a cluster yet.

To stop the server, first find the container id of the image and then stop it with the `docker stop` command.

```
$ docker ps
CONTAINER ID        IMAGE                    COMMAND                  CREATED             ST
6d17c2e30642        john2x/wildcard-demo     "/start.sh"              3 minutes ago       Up
...
$ docker stop 6d17c2e30642
```

The source code of the app is on Github if you want to review the code before deploying it to your cluster, or if you want to build the image yourself.

Deploying the app to the cluster

Now that we've seen what the demo app does, we can deploy it to the cluster and access it from there.

But first let's create a new namespace for the demo app so everything is neat and organized.

```
$ kubectl create namespace wildcard-demo
namespace "wildcard-demo" created
...
$ kubectl get namespace
NAME            STATUS    AGE
default         Active    20m
kube-public     Active    20m
kube-system     Active    20m
wildcard-demo   Active    1m
```

With the namespace ready, let's take a look at our Deployment.

Listing 1: 01-deployment.yaml

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: wildcard-demo
  namespace: wildcard-demo
  labels:
    app: wildcard-demo
spec:
  replicas: 2
  selector:
    matchLabels:
      app: wildcard-demo
  template:
    metadata:
      labels:
        app: wildcard-demo
    spec:
      containers:
```

```
      - name: wildcard-demo
        image: john2x/wildcard-demo:latest
        imagePullPolicy: Always
        ports:
          - containerPort: 8080
            name: gunicorn
        resources:
          requests:
            cpu: 100m
            memory: 32Mi

        env:
          - name: POD_IP
            valueFrom:
              fieldRef:
                fieldPath: status.podIP
          - name: POD_NAME
            valueFrom:
              fieldRef:
                fieldPath: metadata.name
          - name: NODE_NAME
            valueFrom:
              fieldRef:
                fieldPath: spec.nodeName
```


It's a fairly simple Deployment with some pod and node metadata exposed as environment variables.

Save the YAML above to a file and apply it with `kubectl apply -f <file>`.

Next we'll create a Service so we can access the app.

Listing 2: 02-service.yaml

```
apiVersion: v1
kind: Service
metadata:
  name: wildcard-demo
  namespace: wildcard-demo
spec:
  type: ClusterIP
  selector:
    app: wildcard-demo
  ports:
    - port: 80
      targetPort: gunicorn
      name: http
```

With the Deployment and Service ready, we should be able to test the app using port-forwarding. Get a pod name and run the following command:

```
$ kubectl port-forward svc/wildcard-demo 8080:80 --namespace=wildcard-demo
```

Accessing `http://localhost:8080` or `http://foo.localhost:8080` again should show a similar result as when we ran the image locally, only this time we'll get values for the pod and node details.

```
$ curl http://localhost:8080 -i
HTTP/1.1 200 OK
Server: gunicorn/19.9.0
```

```
Date: Wed, 26 Sep 2018 05:59:11 GMT
Connection: close
Content-Type: text/plain
Content-Length: 193

remote address: 127.0.0.1
x-forwarded-for: None
hostname: localhost:8080
pod ip: 10.8.0.8
pod name: wildcard-demo-76dd957877-84jqb
node name: gke-wildcard-demo--default-pool-e14a69d3-br0l
```


Installing ingress-nginx on the cluster

Now that we've tested that the web service is running and accessible, let's set up the Ingress so we can access it externally without having to do port-forwarding.

We'll be using the `ingress-nginx` Ingress controller, and we defer to the official deployment guide at https://kubernetes.github.io/ingress-nginx/deploy. You will need to run the commands under "Mandatory command" and "GCE - GKE". For reference, we mirror the commands here but it is recommended that you visit the official page in case there have been changes to the instructions.

```
$ kubectl apply -f https://raw.githubusercontent.com/kubernetes/ingress-nginx/master/deplo
namespace "ingress-nginx" configured
deployment.extensions "default-http-backend" created
service "default-http-backend" created
configmap "nginx-configuration" created
configmap "tcp-services" created
configmap "udp-services" created
serviceaccount "nginx-ingress-serviceaccount" created
clusterrole.rbac.authorization.k8s.io "nginx-ingress-clusterrole" created
role.rbac.authorization.k8s.io "nginx-ingress-role" created
rolebinding.rbac.authorization.k8s.io "nginx-ingress-role-nisa-binding" created
clusterrolebinding.rbac.authorization.k8s.io "nginx-ingress-clusterrole-nisa-binding" crea
deployment.extensions "nginx-ingress-controller" created

$ kubectl apply -f https://raw.githubusercontent.com/kubernetes/ingress-nginx/master/deplo
service "ingress-nginx" created
```

Missing ClusterRoleBinding for cluster-admin ClusterRole

If you run into forbidden errors when running the commands like the one below, that probably means your Google account does not have the `cluster-admin` ClusterRole bound to it.

```
Error from server (Forbidden): error when creating "https://raw.githubusercontent.com/ku
```

To bind your account to the `cluster-admin` ClusterRole, run the following command:

```
$ kubectl create clusterrolebinding cluster-admin-john --clusterrole=cluster-admin --use
```

Once your account has been bound, re-run the `ingress-nginx` set up commands.

Testing ingress-nginx's default HTTP backend

To verify that the Ingress controller is properly installed, we can visit the default HTTP backend that is included in the set up by visiting its LoadBalancer Service's external IP (I have redacted the last part of the IP address):


```
$ kubectl get service ingress-nginx --namespace=ingress-nginx
NAME            TYPE           CLUSTER-IP     EXTERNAL-IP     PORT(S)
ingress-nginx   LoadBalancer   10.11.244.17   35.188.164.XYZ  80:32336/TCP,443:31053/TC

$ curl http://35.188.164.XYZ -i
HTTP/1.1 404 Not Found
Server: nginx/1.15.3
Date: Wed, 26 Sep 2018 06:06:02 GMT
Content-Type: text/plain; charset=utf-8
Content-Length: 21
Connection: keep-alive

default backend - 404
```

What we have so far

At this point we have the following pieces working:

1. Our wildcard-demo app deployed to its own Namespace, with a Service that's accessible only via port-forwarding.
2. The `ingress-nginx` Ingress controller (v0.19.0 at the time of writing), also deployed to its own Namespace, with a LoadBalancer Service accessible with an external IP address.

Add a subdomain record for ingress-nginx's default HTTP backend

Before we set up a subdomain for the wildcard-demo app, we should configure one for the default HTTP backend first since it's much simpler (being a single subdomain and all).

Configure your domain registrar to use Google Cloud DNS' nameservers

If you haven't updated your domain registrar to use Google Cloud DNS' nameservers yet, this would be a good time to do so.

The exact steps will be different for each registrar, but the overall process should be similar. The following steps will demonstrate the process for a domain registered via Namecheap. If you are using a different registrar, please refer to their respective documentation.

Create a Google Cloud DNS zone

Open Google Cloud Console and navigate to Networing > Network Services > Cloud DNS. Then create a Google Cloud DNS zone for your domain, like so:

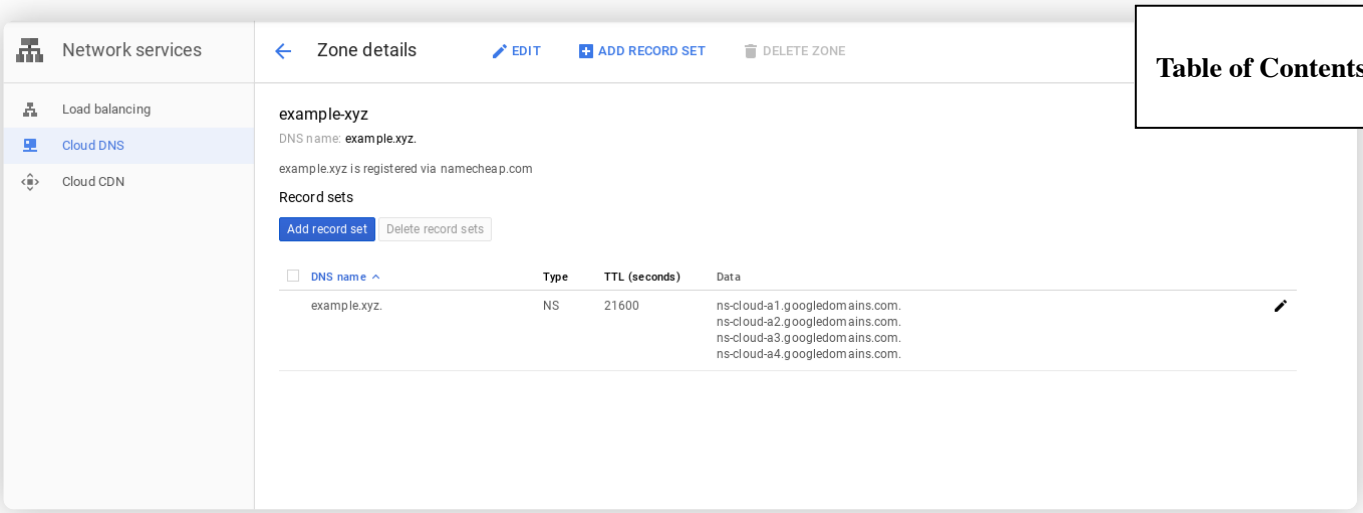


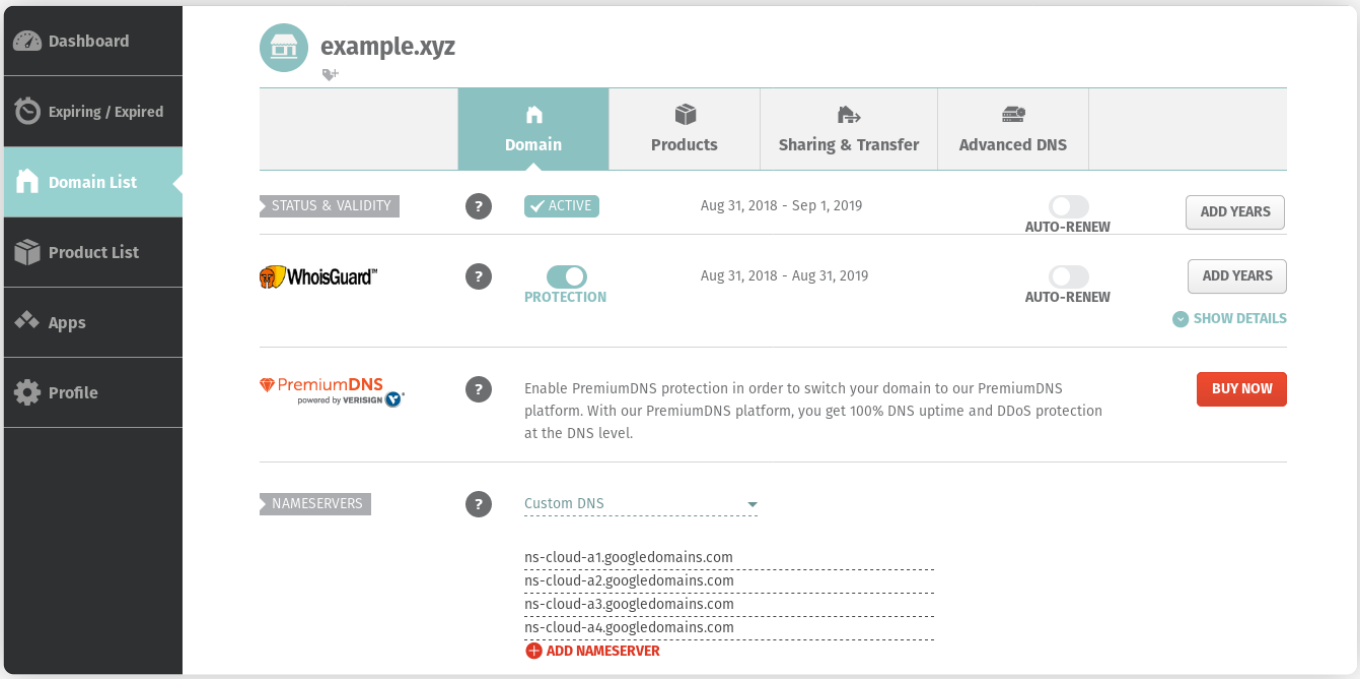
Table of Contents

Note the nameservers listed in the `NS` record.

```
ns-cloud-a1.googledomains.com.
ns-cloud-a2.googledomains.com.
ns-cloud-a3.googledomains.com.
ns-cloud-a4.googledomains.com.
```

Change registrar's nameservers

Go to your domain's management page and change the nameservers to use the ones listed in your Google Cloud DNS zone.



Wait and verify that the nameserver change have propagated

Use `dig` to check if the nameserver change have propagated. Note that propagation could t
in some cases. (I

Table of Contents

```
$ dig NS example.xyz

; <<>> DiG 9.10.8-P1 <<>> NS example.xyz
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 46281
;; flags: qr rd ra; QUERY: 1, ANSWER: 4, AUTHORITY: 0, ADDITIONAL: 9

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;example.xyz.                   IN      NS

;; ANSWER SECTION:
example.xyz.            3600    IN      NS      ns-cloud-a3.googledomains.com.
example.xyz.            3600    IN      NS      ns-cloud-a2.googledomains.com.
example.xyz.            3600    IN      NS      ns-cloud-a4.googledomains.com.
example.xyz.            3600    IN      NS      ns-cloud-a1.googledomains.com.
```

Change the LoadBalancer's External IP address to static

Next is to change the external IP that was generated for the `ingress-nginx` LoadBalancer to a static one so it does not change. Open Google Cloud Console again and go to Networking > VPC Network > External IP addresses. Look for the correct external IP address and change its type from Ephemeral to Static.

Add the A record

Now that we have a static IP address and the domain nameservers are configured and propagated, we can add the A record for the default HTTP backend.

Go to your Google Cloud DNS zone and add an A record for your subdomain of choice using the external IP address of the `ingress-nginx` LoadBalancer Service.

Here we are using `default-http-backend.example.xyz` for the subdomain.

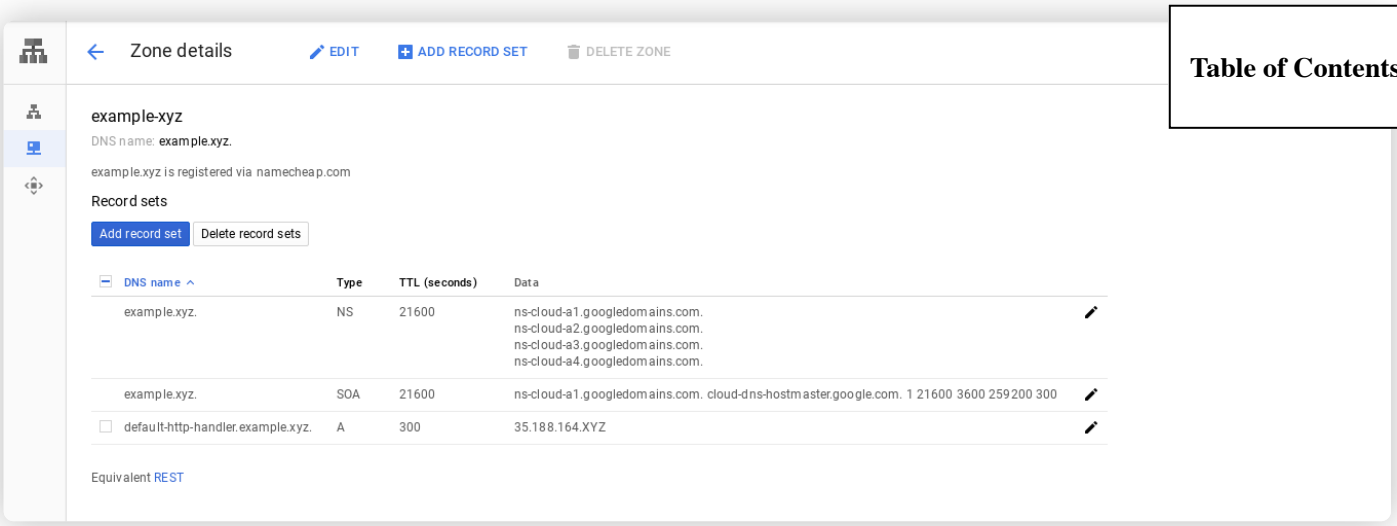


Table of Contents

Wait for about 5 minutes for the changes to propagate, and verify with `dig`.

```
$ dig A default-http-backend.example.xyz

; <<>> DiG 9.10.8-P1 <<>> A default-http-backend.example.xyz
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 29003
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 4, ADDITIONAL: 9

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;default-http-backend.example.xyz. IN        A

;; ANSWER SECTION:
default-http-backend.example.xyz. 300 IN A   35.188.164.XYZ

;; AUTHORITY SECTION:
example.xyz.          1948    IN      NS      ns-cloud-a2.googledomains.com.
example.xyz.          1948    IN      NS      ns-cloud-a4.googledomains.com.
example.xyz.          1948    IN      NS      ns-cloud-a1.googledomains.com.
example.xyz.          1948    IN      NS      ns-cloud-a3.googledomains.com.

;; ADDITIONAL SECTION:
ns-cloud-a1.googledomains.com. 282117 IN A      216.239.32.106
ns-cloud-a1.googledomains.com. 83626 IN AAAA    2001:4860:4802:32::6a
ns-cloud-a2.googledomains.com. 282117 IN A      216.239.34.106
ns-cloud-a2.googledomains.com. 83626 IN AAAA    2001:4860:4802:34::6a
ns-cloud-a3.googledomains.com. 289144 IN A      216.239.36.106
ns-cloud-a3.googledomains.com. 83626 IN AAAA    2001:4860:4802:36::6a
ns-cloud-a4.googledomains.com. 273375 IN A      216.239.38.106
ns-cloud-a4.googledomains.com. 83626 IN AAAA    2001:4860:4802:38::6a

;; Query time: 274 msec
;; SERVER: 208.91.112.53#53(208.91.112.53)
;; WHEN: Wed Sep 26 15:03:39 +08 2018
;; MSG SIZE  rcvd: 377
```

And try accessing the default backend via its new domain.

```
$ curl http://default-http-backend.example.xyz -i
HTTP/1.1 404 Not Found
Server: nginx/1.15.3
Date: Wed, 26 Sep 2018 07:07:25 GMT
Content-Type: text/plain; charset=utf-8
Content-Length: 21
Connection: keep-alive

default backend - 404
```


Add a wildcard subdomain record for the wildcard-demo app

Now that we are able to access the default HTTP backend via a domain address, we want to be able to do the same for our wildcard-demo app. We want `http://wildcard-demo.example.xyz` or `http://foo.wildcard-demo.example.xyz` to point to the wildcard-demo app.

Create an Ingress for the wildcard-demo app

Apply the following resource.

Listing 3: 03-ingress-wildcard-demo.yaml

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: wildcard-demo-ingress
  namespace: wildcard-demo
  annotations:
    kubernetes.io/ingress.class: "nginx"
spec:
  rules:
    - host: wildcard-demo.example.xyz
      http:
        paths:
          - path: /
            backend:
              serviceName: wildcard-demo
              servicePort: http
    - host: "*.wildcard-demo.example.xyz"
      http:
        paths:
          - path: /
            backend:
              serviceName: wildcard-demo
              servicePort: http
```

Then confirm its creation:

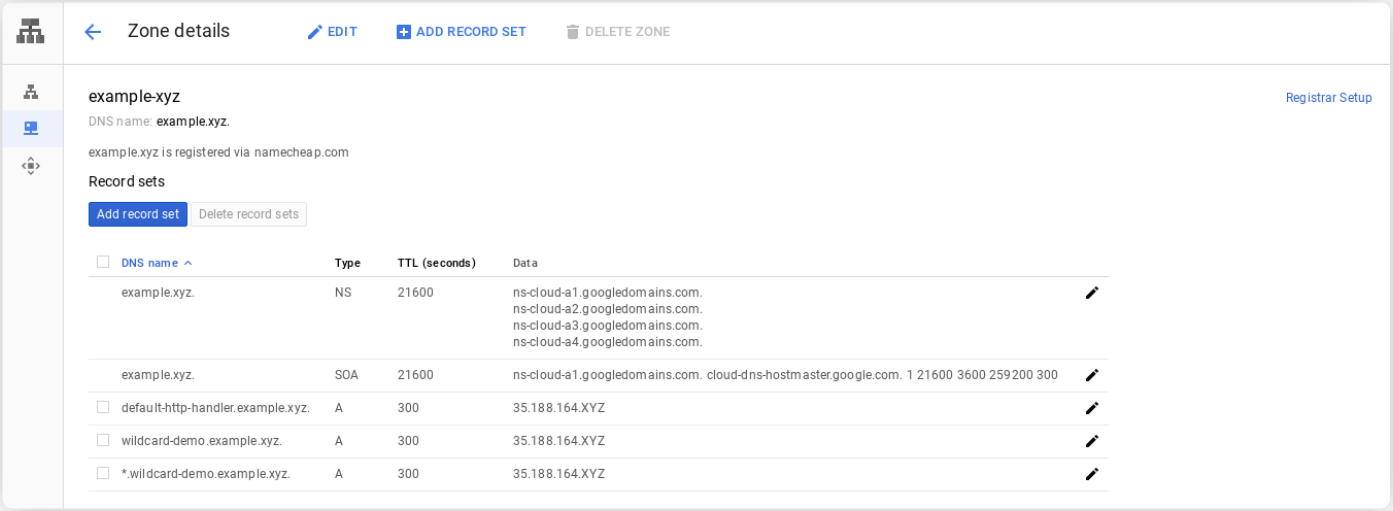
```
$ kubectl get ingress --namespace=wildcard-demo
NAME                    HOSTS                                          AD
wildcard-demo-ingress   wildcard-demo.example.xyz,*.wildcard-demo.example.xyz          35
```

We are not yet able to access the new Ingress at this point, since the hosts do not have a record in our DNS zone yet and the IP address will be routed to the default HTTP backend.

Add the A records for wildcard-demo

We need to add A records in our Google Cloud DNS zone, one for each of the hosts we speci
Ingress. Use the same external IP address for both A records.

Table of Contents



Wait for another 5 minutes, and verify with `dig` again.

```
$ dig A wildcard-demo.example.xyz

; <<>> DiG 9.10.8-P1 <<>> A wildcard-demo.example.xyz
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 782
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 4, ADDITIONAL: 9

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;wildcard-demo.example.xyz.  IN      A

;; ANSWER SECTION:
wildcard-demo.example.xyz. 300 IN    A       35.188.164.XYZ

...truncated...

$ dig A foo.wildcard-demo.example.xyz

; <<>> DiG 9.10.8-P1 <<>> A foo.wildcard-demo.example.xyz
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 18034
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 4, ADDITIONAL: 9

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;foo.wildcard-demo.example.xyz. IN   A

;; ANSWER SECTION:
foo.wildcard-demo.example.xyz. 300 IN A      35.188.164.XYZ
```

```
...truncated...
```

Table of Contents

And finally test the new domain by accessing it.

```
$ curl http://wildcard-demo.example.xyz -i
HTTP/1.1 200 OK
Server: nginx/1.15.3
Date: Wed, 26 Sep 2018 07:26:11 GMT
Content-Type: text/plain
Content-Length: 217
Connection: keep-alive

remote address: 10.8.0.10
x-forwarded-for: 128.106.194.22
hostname: wildcard-demo.example.xyz
pod ip: 10.8.1.8
pod name: wildcard-demo-76dd957877-8cx7w
node name: gke-wildcard-demo--default-pool-e14a69d3-1t2m

$ curl http://foo.wildcard-demo.example.xyz -i
HTTP/1.1 200 OK
Server: nginx/1.15.3
Date: Wed, 26 Sep 2018 07:27:56 GMT
Content-Type: text/plain
Content-Length: 221
Connection: keep-alive

remote address: 10.8.0.10
x-forwarded-for: 128.106.194.22
hostname: foo.wildcard-demo.example.xyz
pod ip: 10.8.0.8
pod name: wildcard-demo-76dd957877-84jqb
node name: gke-wildcard-demo--default-pool-e14a69d3-br0l
```

Note the `X-Forwarded-For` request header being set by `ingress-nginx`.

What we have so far

At this point we have the following additional pieces working:

1. An Ingress for the wildcard demo app.
2. A domain configured to use Google Cloud DNS nameservers.
3. A static external IP address for `ingress-nginx`.

4. The following A records in our Google Cloud DNS Zone:

```
default-http-backend.example.xyz. A    35.188.164.XYZ
wildcard-demo.example.xyz.        A    35.188.164.XYZ
*.wildcard-demo.example.xyz.      A    35.188.164.XYZ
```

Now that we are able to access are Services via their domain addresses, we are ready to request SSL certificates for them.

Installing cert-manager on the cluster

cert-manager is one of the more recent iterations for managing certificates on Kubernetes.

The recommended way to install cert-manager is via Helm, but that is beyond the scope of this g
cert-manager's and/or Helm's official guides to install. Note that cert-manager also has instructi
using static manifests. Whichever method you follow to install, make sure you choose the one w

Table of Contents

Verifying your cert-manager install

By default, cert-manager will be installed in its own Namespace called `cert-manager`.

```
$ kubectl get deployment --namespace=cert-manager
NAME           DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
cert-manager   1         1         1            1           1m
```

Acquiring a "staging" certificate for ingress-nginx's default HTTP backend

Before we attempt acquiring valid certificates, it's a good idea to try acquiring staging certificates first. This way we can debug any issues we run into without worrying about Let's Encrypts rate limits.

Create a Google Cloud service account for managing Cloud DNS resources

In order for `cert-manager` to validate a domain via DNS-01 challenge, it needs to be able to add a TXT record to your Cloud DNS zone. We can authorize `cert-manager` to do this by creating a Google Cloud service account and storing it in a Secret.

Go to your Google Cloud Console and navigate to IAM & Admin > Service accounts. From there, create a new service account, assigning it a recognizable name and grant it access to the "DNS Administrator" role. When prompted to download the key, do so in the JSON format and save it to a file.

Now we need to upload the key stored in the JSON file in a Secret in the Namespace where the Issuer resource will be created (`ingress-nginx` in this case).

```
$ kubectl create secret generic clouddns-service-account --from-file=service-account-ke
secret "clouddns-service-account" created

$ kubectl describe secret clouddns-service-account --namespace=ingress-nginx
Name:         clouddns-service-account
Namespace:    ingress-nginx
Labels:       <none>
Annotations:  <none>

Type:  Opaque

Data
====
service-account-key.json:  2336 bytes
```

Create Issuer in ingress-nginx Namespace

An Issuer is a resource that issues certificates in a single Namespace. There's also a ClusterIssuer that can issue certificates across different Namespaces, but for this guide we will only use Issuer.

The following manifest creates an Issuer in the `ingress-nginx` Namespace and uses Let's Encrypt's `staging` API to request the certificates via a DNS-01 challenge using Google Cloud DNS as the provider.

Listing 4: 04-issuer-ingress-nginx-staging.yaml

```
apiVersion: certmanager.k8s.io/v1alpha1
kind: Issuer
metadata:
  name: letsencrypt-staging
  namespace: ingress-nginx
spec:
  acme:
    server: https://acme-staging-v02.api.letsencrypt.org/directory
    email: john@example.xyz

    # Name of a secret used to store the ACME account private key
    privateKeySecretRef:
      name: letsencrypt-staging

    # ACME DNS-01 provider configurations
    dns01:

      # Here we define a list of DNS-01 providers that can solve DNS challenges
      providers:
        - name: clouddns
          clouddns:
            # A secretKeyRef to a google cloud json service account
            serviceAccountSecretRef:
              name: clouddns-service-account
              key: service-account-key.json
            # The Google Cloud project in which to update the DNS zone
            project: example-project
```


Create Certificate resource

Once we have an Issuer we can create a Certificate.

Listing 5: 05-certificate-ingress-nginx-staging.yaml

```
apiVersion: certmanager.k8s.io/v1alpha1
kind: Certificate
metadata:
  name: default-http-backend-example-xyz-staging
  namespace: ingress-nginx
spec:
  secretName: default-http-backend-example-xyz-staging-tls
  issuerRef:
    name: letsencrypt-staging
    kind: Issuer
  commonName: default-http-backend.example.xyz
  dnsNames:
    - default-http-backend.example.xyz
  acme:
    config:
      - dns01:
          provider: clouddns
        domains:
          - default-http-backend.example.xyz
```

After a couple of minutes, the staging Certificate should be issued and stored in the Secret specified in the `secretName` specified above.

```
$ kubectl describe certificate default-http-backend-example-xyz-staging --namespace=ing
Name:         default-http-backend-example-xyz-staging
Namespace:    ingress-nginx
Labels:       <none>
Annotations:  <truncated>
API Version:  certmanager.k8s.io/v1alpha1
Kind:         Certificate
Metadata:
  <truncated>
Spec:
  Acme:
    Config:
      Dns 01:
        Provider:  clouddns
      Domains:
        default-http-backend.example.xyz
  Common Name:  default-http-backend.example.xyz
  Dns Names:
    default-http-backend.example.xyz
  Issuer Ref:
    Kind:       Issuer
    Name:       letsencrypt-staging
  Secret Name:  default-http-backend-example-xyz-staging-tls
Status:
  Acme:
    Order:
      URL:  https://acme-staging-v02.api.letsencrypt.org/acme/order/7012226/8989674
  Conditions:
    Last Transition Time:  2018-09-26T12:44:31Z
    Message:               Certificate issued successfully
    Reason:                CertIssued
    Status:                True
    Type:                  Ready
    Last Transition Time:  <nil>
    Message:               Order validated
    Reason:                OrderValidated
    Status:                False
    Type:                  ValidateFailed
Events:
  Type    Reason          Age   From          Message
  ----    ------          ----  ----          -------
  Normal  CreateOrder     8m    cert-manager  Created new ACME order, attempting valida
  Normal  DomainVerified  6m    cert-manager  Domain "default-http-backend.example.xyz"
  Normal  IssueCert       6m    cert-manager  Issuing certificate...
  Normal  CertObtained    6m    cert-manager  Obtained certificate from ACME server
  Normal  CertIssued      6m    cert-manager  Certificate issued successfully
```

Table of Contents

Use the Certificate in the default HTTP backend Ingress

We now have a TLS certificate stored in the `default-http-backend-example-xyz-staging-tls` Secret. Create a new Ingress for the default HTTP backend and use the certificate.

Listing 6: 06-ingress-default-http-backend.yaml

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: default-http-backend-ingress
  namespace: ingress-nginx
  annotations:
    kubernetes.io/ingress.class: "nginx"
```

```
spec:
  tls:
    - secretName: default-http-backend-example-xyz-staging-tls
      hosts:
        - default-http-backend.example.xyz
  rules:
    - host: default-http-backend.example.xyz
      http:
        paths:
          - path: /
            backend:
              serviceName: default-http-backend
              servicePort: 80
```


Now when we access the default backend via `http`, we get a `308 Permanent Redirect` to the `https` version thanks to `ingress-nginx`.

```
$ curl http://default-http-backend.example.xyz -i
HTTP/1.1 308 Permanent Redirect
Server: nginx/1.15.3
Date: Fri, 28 Sep 2018 01:51:39 GMT
Content-Type: text/html
Content-Length: 187
Connection: keep-alive
Location: https://default-http-backend.example.xyz/

<html>
<head><title>308 Permanent Redirect</title></head>
<body bgcolor="white">
<center><h1>308 Permanent Redirect</h1></center>
<hr><center>nginx/1.15.3</center>
</body>
</html>
```

Accessing via `https` gives us the familiar `404` response. Note the `-k` flag to disable SSL validation, since the staging certificates are not valid.

```
$ curl https://default-http-backend.example.xyz -i -k
HTTP/1.1 404 Not Found
Server: nginx/1.15.3
Date: Fri, 28 Sep 2018 01:54:10 GMT
Content-Type: text/plain; charset=utf-8
Content-Length: 21
Connection: keep-alive
Strict-Transport-Security: max-age=15724800; includeSubDomains

default backend - 404
```

Acquiring a "staging" wildcard certificate for the wildcard-demo app

The process is similar for wildcard certificates. First we create an Issuer in the `wildcard-demo` Namespace, then create the Certificate, and finally use the certificate in the Ingress.

Create Issuer in wildcard-demo Namespace

First we need to create the Secret to store the Cloud DNS service account key in the `wildcard-demo` Namespace.

```
$ kubectl create secret generic clouddns-service-account --from-file=service-account-ke
secret "clouddns-service-account" created

$ kubectl describe secret clouddns-service-account --namespace=ingress-ng
Name:         clouddns-service-account
Namespace:    wildcard-demo
Labels:       <none>
Annotations:  <none>

Type:  Opaque

Data
====
service-account-key.json:  2336 bytes
```


Then create the Issuer.

Listing 7: 07-issuer-wildcard-demo-staging.yaml

```
apiVersion: certmanager.k8s.io/v1alpha1
kind: Issuer
metadata:
  name: letsencrypt-staging
  namespace: wildcard-demo
spec:
  acme:
    server: https://acme-staging-v02.api.letsencrypt.org/directory
    email: john@example.xyz

    # Name of a secret used to store the ACME account private key
    privateKeySecretRef:
      name: letsencrypt-staging

    # ACME DNS-01 provider configurations
    dns01:

      # Here we define a list of DNS-01 providers that can solve DNS challenges
      providers:
        - name: clouddns
          clouddns:
            # A secretKeyRef to a google cloud json service account
            serviceAccountSecretRef:
              name: clouddns-service-account
              key: service-account-key.json
            # The Google Cloud project in which to update the DNS zone
            project: example-project
```

Create Certificate resource

Listing 8: 08-certificate-wildcard-demo-staging.yaml

```
apiVersion: certmanager.k8s.io/v1alpha1
kind: Certificate
metadata:
  name: wildcard-demo-example-xyz-staging
  namespace: wildcard-demo
spec:
  secretName: wildcard-demo-example-xyz-staging-tls
  issuerRef:
```

```
    name: letsencrypt-staging
    kind: Issuer
  commonName: wildcard-demo.example.xyz
  dnsNames:
    - wildcard-demo.example.xyz
    - "*.wildcard-demo.example.xyz"
  acme:
    config:
      - dns01:
          provider: clouddns
        domains:
          - wildcard-demo.example.xyz
          - "*.wildcard-demo.example.xyz"
```

Table of Contents

Validating wildcard certificates takes longer, so wait a couple of minutes and check its status.

```
$ kubectl describe certificate wildcard-demo-example-xyz-staging --namespace=wildcard-d
Name:         wildcard-demo-example-xyz-staging
Namespace:    wildcard-demo
API Version:  certmanager.k8s.io/v1alpha1
Kind:         Certificate
Metadata:
  <truncated>
Spec:
  Acme:
    Config:
      Dns 01:
        Provider:  clouddns
      Domains:
        wildcard-demo.example.xyz
        *.wildcard-demo.example.xyz
  Common Name:  wildcard-demo.example.xyz
  Dns Names:
    wildcard-demo.example.xyz
    *.wildcard-demo.example.xyz
  Issuer Ref:
    Kind:       Issuer
    Name:       letsencrypt-staging
  Secret Name:  wildcard-demo-example-xyz-staging-tls
Status:
  Acme:
    Order:
      URL:  https://acme-staging-v02.api.letsencrypt.org/acme/order/7022259/9120998
  Conditions:
    Last Transition Time:  2018-09-28T02:13:13Z
    Message:               Certificate issued successfully
    Reason:                CertIssued
    Status:                True
    Type:                  Ready
    Last Transition Time:  <nil>
    Message:               Order validated
    Reason:                OrderValidated
    Status:                False
    Type:                  ValidateFailed
Events:
  Type    Reason          Age              From          Message
  ----    ------          ----             ----          -------
  Normal  CreateOrder     7m               cert-manager  Created new ACME order, attempt
  Normal  DomainVerified  1m (x2 over 4m)  cert-manager  Domain "wildcard-demo.example.
  Normal  IssueCert       1m               cert-manager  Issuing certificate...
  Normal  CertObtained    1m               cert-manager  Obtained certificate from ACME
  Normal  CertIssued      1m               cert-manager  Certificate issued successfull
```

Use the Certificate in the wildcard-demo Ingress

Table of Contents

Finally, update the `wildcard-demo` Ingress to use the new certificate.

Listing 9: 09-ingress-wildcard-demo-staging.yaml

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: wildcard-demo-ingress
  namespace: wildcard-demo
  annotations:
    kubernetes.io/ingress.class: "nginx"
spec:
  tls:
    - secretName: wildcard-demo-example-xyz-staging-tls
      hosts:
        - wildcard-demo.example.xyz
        - "*.wildcard-demo.example.xyz"
  rules:
    - host: wildcard-demo.example.xyz
      http:
        paths:
          - path: /
            backend:
              serviceName: wildcard-demo
              servicePort: http
    - host: "*.wildcard-demo.example.xyz"
      http:
        paths:
          - path: /
            backend:
              serviceName: wildcard-demo
              servicePort: http
```

Now we can access the app via `https`.

```
$ curl https://wildcard-demo.example.xyz -i -k
HTTP/1.1 200 OK
Server: nginx/1.15.3
Date: Fri, 28 Sep 2018 02:20:08 GMT
Content-Type: text/plain
Content-Length: 217
Connection: keep-alive
Strict-Transport-Security: max-age=15724800; includeSubDomains

remote address: 10.8.0.10
x-forwarded-for: 222.164.248.27
hostname: wildcard-demo.example.xyz
pod ip: 10.8.1.8
pod name: wildcard-demo-76dd957877-8cx7w
node name: gke-wildcard-demo--default-pool-e14a69d3-1t2m


$ curl https://foo.wildcard-demo.example.xyz -i -k
HTTP/1.1 200 OK
Server: nginx/1.15.3
Date: Fri, 28 Sep 2018 02:20:08 GMT
Content-Type: text/plain
Content-Length: 217
Connection: keep-alive
```

```
Strict-Transport-Security: max-age=15724800; includeSubDomains

remote address: 10.8.0.10
x-forwarded-for: 222.164.248.27
hostname: foo.wildcard-demo.example.xyz
pod ip: 10.8.1.8
pod name: wildcard-demo-76dd957877-8cx7w
node name: gke-wildcard-demo--default-pool-e14a69d3-1t2m
```

Table of Contents

Switching to valid Let's Encrypt certificates

We're almost done. We now have a working Issuer that we know doesn't run into issues when requesting for certificates from Let's Encrypt, and so it is safe to switch to using Let's Encrypt's production API's.

The process will be similar to how we got the staging certificates. First we need to create an Issuer in the Namespace that needs it, but this time the Issuer will be configured to use Let's Encrypt's production API. Then we create new Certificates using the production Issuer, and finally update the Ingresses to use the production Certificates.

Create production Issuers

For brevity, we will combine the two Issuers into one manifest file.

Listing 10: 10-issuer-wildcard-demo-prod.yaml

```
apiVersion: certmanager.k8s.io/v1alpha1
kind: Issuer
metadata:
  name: letsencrypt
  namespace: ingress-nginx
spec:
  acme:
    server: https://acme-v02.api.letsencrypt.org/directory
    email: john@example.xyz

    # Name of a secret used to store the ACME account private key
    privateKeySecretRef:
      name: letsencrypt

    # ACME DNS-01 provider configurations
    dns01:

      # Here we define a list of DNS-01 providers that can solve DNS challenges
      providers:
        - name: clouddns
          clouddns:
            # A secretKeyRef to a google cloud json service account
            serviceAccountSecretRef:
              name: clouddns-service-account
              key: service-account-key.json
            # The Google Cloud project in which to update the DNS zone
            project: example-project
---
apiVersion: certmanager.k8s.io/v1alpha1
kind: Issuer
metadata:

  name: letsencrypt
  namespace: wildcard-demo
```

```
spec:
  acme:
    server: https://acme-v02.api.letsencrypt.org/directory
    email: john@example.xyz

    # Name of a secret used to store the ACME account private key
    privateKeySecretRef:
      name: letsencrypt

    # ACME DNS-01 provider configurations
    dns01:

      # Here we define a list of DNS-01 providers that can solve DNS challenges
      providers:
        - name: clouddns
          clouddns:
            # A secretKeyRef to a google cloud json service account
            serviceAccountSecretRef:
              name: clouddns-service-account
              key: service-account-key.json
            # The Google Cloud project in which to update the DNS zone
            project: example-project
```


Create production Certificates

Listing 11: 11-certificates-wildcard-demo-prod.yaml

```
apiVersion: certmanager.k8s.io/v1alpha1
kind: Certificate
metadata:
  name: default-http-backend-example-xyz
  namespace: ingress-nginx
spec:
  secretName: default-http-backend-example-xyz-tls
  issuerRef:
    name: letsencrypt
    kind: Issuer
  commonName: default-http-backend.example.xyz
  dnsNames:
    - default-http-backend.example.xyz
  acme:
    config:
      - dns01:
          provider: clouddns
        domains:
          - default-http-backend.example.xyz
---
apiVersion: certmanager.k8s.io/v1alpha1
kind: Certificate
metadata:
  name: wildcard-demo-example-xyz
  namespace: wildcard-demo
spec:
  secretName: wildcard-demo-example-xyz-tls
  issuerRef:
    name: letsencrypt
    kind: Issuer
  commonName: wildcard-demo.example.xyz
  dnsNames:
    - wildcard-demo.example.xyz
    - "*.wildcard-demo.example.xyz"
  acme:
```

```
    config:
      - dns01:
          provider: clouddns
        domains:
          - wildcard-demo.example.xyz
          - "*.wildcard-demo.example.xyz"
```

Table of Contents

Use the new Certificates in our Ingresses

Listing 12: 12-ingress-wildcard-demo-prod.yaml

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: default-http-backend-ingress
  namespace: ingress-nginx
  annotations:
    kubernetes.io/ingress.class: "nginx"
spec:
  tls:
    - secretName: default-http-backend-example-xyz-tls
      hosts:
        - default-http-backend.example.xyz
  rules:
    - host: default-http-backend.example.xyz
      http:
        paths:
          - path: /
            backend:
              serviceName: default-http-backend
              servicePort: 80
---
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: wildcard-demo-ingress
  namespace: wildcard-demo
  annotations:
    kubernetes.io/ingress.class: "nginx"
spec:
  tls:
    - secretName: wildcard-demo-example-xyz-tls
      hosts:
        - wildcard-demo.example.xyz
        - "*.wildcard-demo.example.xyz"
  rules:
    - host: wildcard-demo.example.xyz
      http:
        paths:
          - path: /
            backend:
              serviceName: wildcard-demo
              servicePort: http
    - host: "*.wildcard-demo.example.xyz"
      http:
        paths:
          - path: /
            backend:
              serviceName: wildcard-demo
              servicePort: http
```

After applying the manifests above, we should now be able to access our backends via `https`, and this time their certificates will be valid.

Table of Contents

```
$ curl https://default-http-backend.example.xyz -i
HTTP/1.1 404 Not Found
Server: nginx/1.15.3
Date: Fri, 28 Sep 2018 06:40:10 GMT
Content-Type: text/plain; charset=utf-8
Content-Length: 21
Connection: keep-alive
Strict-Transport-Security: max-age=15724800; includeSubDomains

default backend - 404

$ curl https://foo.wildcard-demo.example.xyz -i
HTTP/1.1 200 OK
Server: nginx/1.15.3
Date: Fri, 28 Sep 2018 06:40:56 GMT
Content-Type: text/plain
Content-Length: 221
Connection: keep-alive
Strict-Transport-Security: max-age=15724800; includeSubDomains

remote address: 10.8.0.10
x-forwarded-for: 128.106.194.70
hostname: foo.wildcard-demo.example.xyz
pod ip: 10.8.1.8
pod name: wildcard-demo-76dd957877-8cx7w
node name: gke-wildcard-demo--default-pool-e14a69d3-1t2m
```

What we have so far

1. `cert-manager` (v0.5.0 at the time of writing) deployed to its own Namespace
2. The following `cert-manager` resources in the `ingress-nginx` Namespace
    - Issuer
    - Certificate (which in turn creates a Secret where the certificate key itself is stored)
3. The following `cert-manager` resources in the `wildcard-demo` Namespace
    - Issuer
    - Certificate (which in turn creates a Secret where the certificate key itself is stored)
4. Ingresses with their `tls` configured

Cleanup

Before we finish, we should delete the staging Certificates we acquired earlier. If you don't plan on using the staging Issuer again in the Namespace, go ahead and delete that as well.

```
$ kubectl delete certificate default-http-backend-example-xyz-staging --namespace=ingres
certificate.certmanager.k8s.io "default-http-backend-example-xyz-staging" deleted

$ kubectl delete certificate wildcard-demo-example-xyz-staging --namespace=wildcard-dem
certificate.certmanager.k8s.io "wildcard-demo-example-xyz-staging" deleted

$ kubectl delete issuer letsencrypt-staging --namespace=ingress-nginx
issuer.certmanager.k8s.io "letsencrypt-staging" deleted

$ kubectl delete issuer letsencrypt-staging --namespace=wildcard-demo
issuer.certmanager.k8s.io "letsencrypt-staging" deleted
```

Next steps

Table of Contents

I hope this guide helps clarify some of the confusion around how to set up wildcard certificates w
Ingress controller.

A good exercise to go on from here would be to automate the process that was covered. It would be great if getting a new `wildcard-demo` instance in a separate Namespace, with its own subdomain and certificates automatically.

If you would like to learn more about the details of the various pieces at work, here are some links:

- ingress-nginx

  official documentation
  https://kubernetes.github.io/ingress-nginx/

- cert-manager

  official documentation
  https://cert-manager.readthedocs.io/en/latest/
  using with ingress-nginx
  https://cert-manager.readthedocs.io/en/latest/tutorials/acme/securing-nginx-ingress-with-letsencrypt.html
  issuing certificates with DNS validation
  https://cert-manager.readthedocs.io/en/latest/tutorials/acme/dns-validation.html
  Issuer reference
  https://cert-manager.readthedocs.io/en/latest/reference/issuers.html
  ClusterIssuer reference
  https://cert-manager.readthedocs.io/en/latest/reference/clusterissuers.html

- Let's Encrypt

  official documentation
  https://letsencrypt.org/docs/
  staging environment
  https://letsencrypt.org/docs/staging-environment/
  DNS-01 validation
  https://docs.certifytheweb.com/docs/dns-validation.html

Issues

Here are some of the issues I ran into while doing my own tests for this guide. These issues are probably just caused by mistakes on my part, but I'm listing them here in case someone finds them helpful.

> ### cert-manager did not work when I tried a DNS zone for a subdomain instead of the domain
>
> In my first attempt at creating the Cloud DNS zone, I didn't want to mix the test domains which will be created from this guide with my other active domains, and so I created a separate DNS zone for my test subdomain.

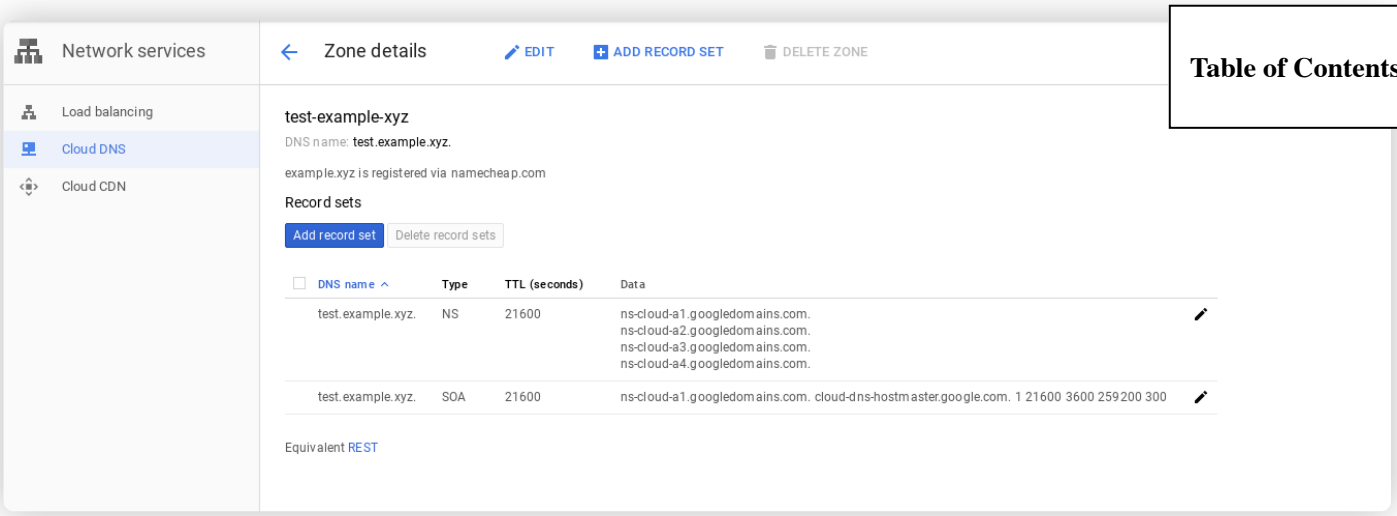


Table of Contents

This didn't play well with Let's Encrypt's verification process and so `cert-manager`'s Issuers couldn't acquire certificates.

I ended up deleting the extra DNS zone and just used the main DNS zone for my domain.

This is a known issue.

Might need to modify cert-manager's Deployment args to use dns01-self-check-nameservers

Another issue I ran into was with the DNS nameserver change not having been fully propagated yet when I started acquiring certificates. What added to the confusion was that when I ran `dig` on my machines, the DNS was good. But when checking `cert-manager`'s logs, I could see that it had trouble resolving my domains. I suspect this was due to not waiting at least 48 hours for the DNS changes to fully propagate. I was getting impatient at the time and so I ended up modifying `cert-manager`'s Deployment manifest and adding the `--dns01-self-check-nameservers` parameter to its container command.

```
...
spec:
  containers:
  - args:
    - --cluster-resource-namespace=$(POD_NAMESPACE)
    - --leader-election-namespace=$(POD_NAMESPACE)
    - --dns01-self-check-nameservers="1.1.1.1;53,8.8.8.8:53"  # add this
...
```

Keywords: kubernetes,google-cloud,lets-encrypt
Modified: 2018-10-29 14:03:55 +08

Emacs 26.1 (Org mode 9.1.9)