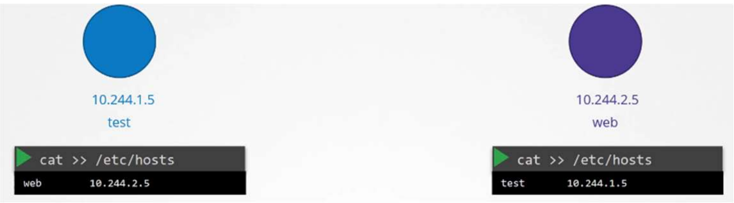
In this lecture, we will discuss how Kubernetes implements DNS in the cluster. In the previous lecture, we saw how you can address a service or pod from another pod. In this lecture, we will see how Kubernetes makes that possible.

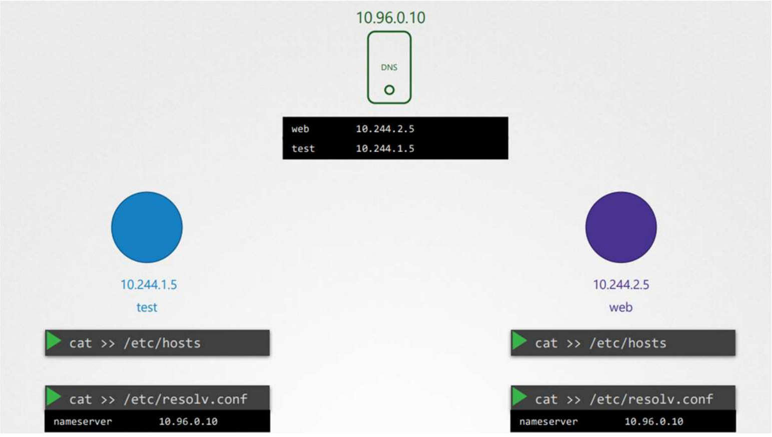
Say you were given two pods with two IP addresses, how would you do it? Based on what we learned in the prerequisite lectures on DNS, an easy way to get them to resolve each other is to add an entry into each of their etc/hosts files. On the first pod, I would say the second pod "web" is at 10.244.2.5, and on the second pod, I would say the first pod "test" is at 10.244.1.5. But of course, when you have thousands of pods in the cluster and hundreds of them being created and deleted every minute, this is not a suitable solution.



```
cat >> /etc/hosts
web        10.244.2.5
```

```
cat >> /etc/hosts
test       10.244.1.5
```

So we move these entries into a central DNS server. We then point these pods to the DNS server by adding an entry into their etc/resolv.conf file specifying that the nameserver is at the IP address of the DNS server, which happens to be 10.96.0.10 in this case



```
web        10.244.2.5
test       10.244.1.5
```

```
cat >> /etc/hosts
```

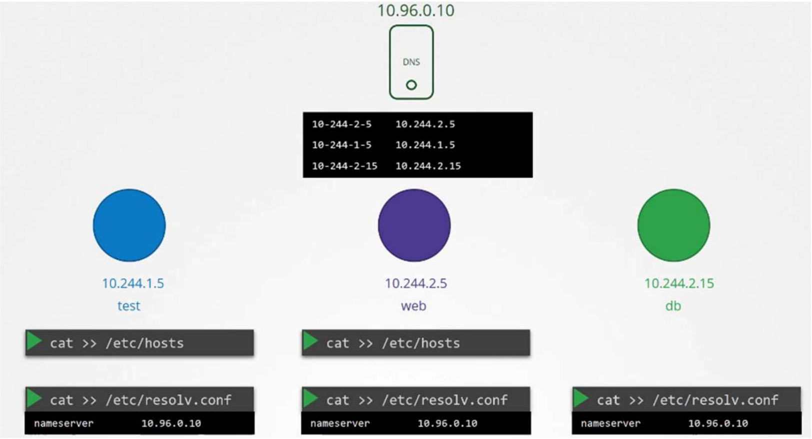
```
cat >> /etc/resolv.conf
nameserver       10.96.0.10
```

```
cat >> /etc/hosts
```

```
cat >> /etc/resolv.conf
nameserver       10.96.0.10
```

Every time a new pod is created, we add a record in the DNS server for that pod so that other pods can access the new pod. We configure the etc/resolv.conf file in the pod to point to the DNS server so that the new pod can resolve other pods in the cluster.

This is kind of how Kubernetes does it, except that it does not create similar entries for pods to map pod name to its IP address as we have seen in the previous lecture. It does that for services. For pods it forms host names by replacing dots with dashes in the IP address of the pod.



```
10-244-2-5     10.244.2.5
10-244-1-5     10.244.1.5
10-244-2-15    10.244.2.15
```

```
cat >> /etc/hosts
```

```
cat >> /etc/hosts
```

```
cat >> /etc/resolv.conf
nameserver        10.96.0.10
```

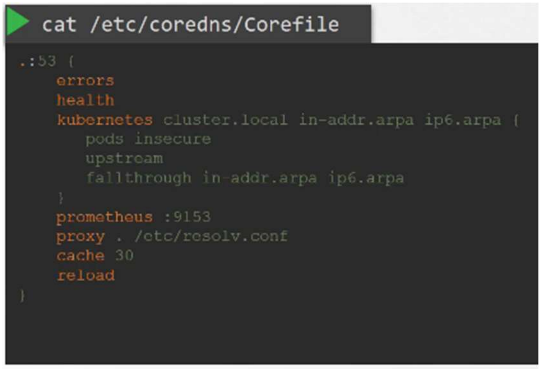
```
cat >> /etc/resolv.conf
nameserver        10.96.0.10
```

```
cat >> /etc/resolv.conf
nameserver        10.96.0.10
```

Kubernetes implements DNS in the same way. It deploys a DNS server within the cluster. Prior to version 1.12, the DNS server implemented by Kubernetes was known as kube-dns. With Kubernetes version 1.12, the recommended DNS server is **CoreDNS**. We took a brief look at CoreDNS in one of the prerequisite lectures.

So how is the CoreDNS set up in the cluster? The CoreDNS server is deployed as a pod in the Kube system namespace in the Kubernetes cluster. Well, they're deployed as two pods for redundancy as part of a replica set. They're actually a replica set within a deployment, but it doesn't really matter, but we'll just see CoreDNS as a pod in this lecture.

This pod runs CoreDNS executable, the same executable that we ran when we deployed CoreDNS ourselves. CoreDNS requires a configuration file. In our case, we used a file named **Corefile**. So does Kubernetes. It uses a file named Corefile located at etc/coredns. Within this file, you have a number of plugins configured, the ones highlighted in orange.

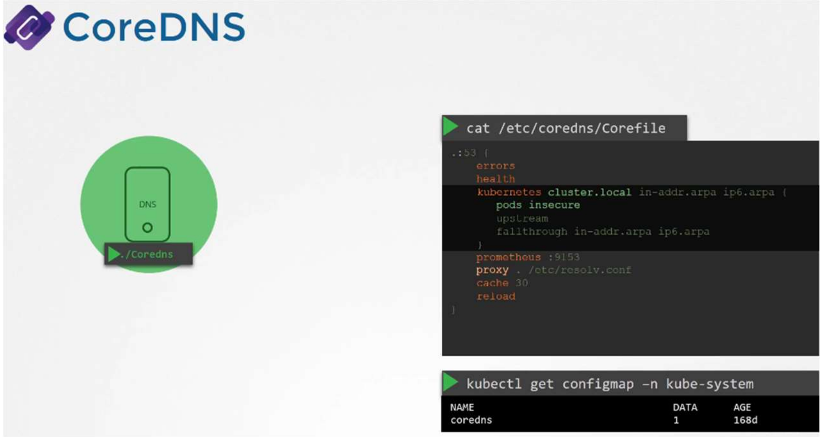


```
cat /etc/coredns/Corefile
.:53 {
    errors
    health
    kubernetes cluster.local in-addr.arpa ip6.arpa {
       pods insecure
       upstream
       fallthrough in-addr.arpa ip6.arpa
    }
    prometheus :9153
    proxy . /etc/resolv.conf
    cache 30
    reload
}
```

Plugins are configured for handling errors, reporting health, monitoring metrics, cache, etc. The plugin that makes CoreDNS work with Kubernetes is the **Kubernetes plugin**, and that is where the top-level domain name of the cluster is set. In this case, **cluster.local**. So every record in the CoreDNS server falls under this domain.

With the Kubernetes plugin, there are multiple options. The "pods" option you can see here is what is responsible for creating a record for pods in the cluster. Remember we talked about a record being created for each pod by converting the IPs into the dashed format. That's disabled by default, but it can be enabled with this entry here

Any record that the DNS server can solve, for example, say a pod tries to reach www.google.com, it is forwarded to the nameserver specified in the CoreDNS pod's etc/resolv.conf. The etc/resolv.conf file is set to use the nameserver from the Kubernetes node. Also, note that this Corefile is passed into the pod as a config map object. That way, if you need to modify this configuration, you can edit the config map object.



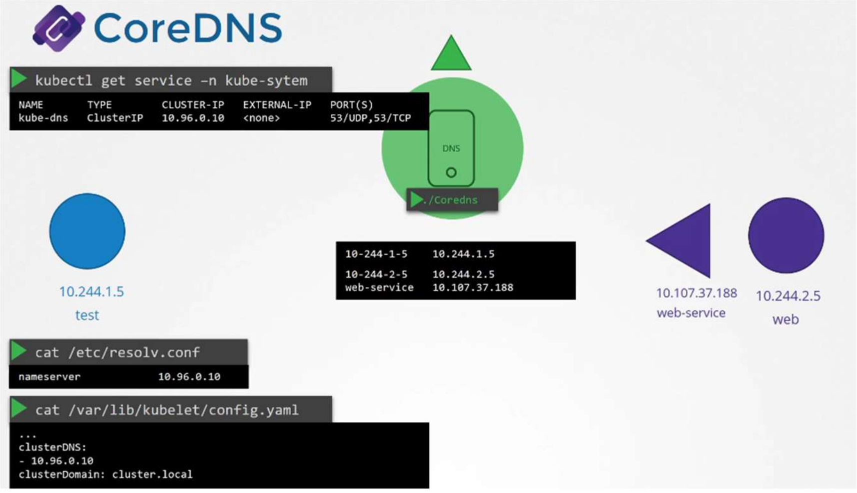
```
cat /etc/coredns/Corefile
.:53 {
    errors
    health
    kubernetes cluster.local in-addr.arpa ip6.arpa {
       pods insecure
       upstream
       fallthrough in-addr.arpa ip6.arpa
    }
    prometheus :9153
    proxy . /etc/resolv.conf
    cache 30
    reload
}
```

```
kubectl get configmap -n kube-system
NAME                                DATA     AGE
coredns                             1        168d
```

We now have the CoreDNS pod up and running using the appropriate Kubernetes plugin. It watches the Kubernetes cluster for new pods or services, and every time a pod or a service is created, it adds a record for it in its database.

Next step is for the pods to point to the CoreDNS server. What address do the pods use to reach the DNS server? When we deploy the CoreDNS solution, it also creates a service to make it available to other components within the cluster. The service is named as "KubeDNS" by default. The IP address of this service is configured as the name server on pods. Now you don't have to configure this yourself. The DNS configurations on pods are done by Kubernetes automatically when the pods are created.

Want to guess which Kubernetes component is responsible for that? The kubelet. If you look at the config file of the kubelet, you will see the IP of the DNS server and domain in it.



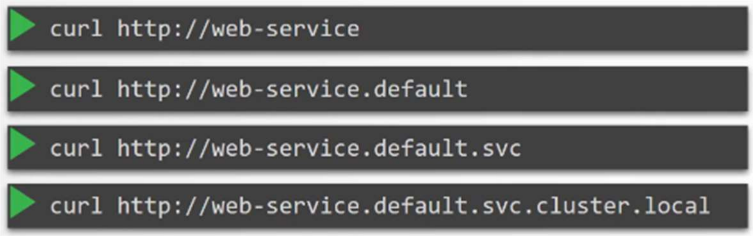
```
kubectl get service -n kube-sytem
NAME      TYPE       CLUSTER-IP   EXTERNAL-IP   PORT(S)
kube-dns  ClusterIP  10.96.0.10   <none>        53/UDP,53/TCP
```

```
10-244-1-5    10.244.1.5
10-244-2-5    10.244.2.5
web-service   10.107.37.188
```

```
cat /etc/resolv.conf
nameserver          10.96.0.10
```

```
cat /var/lib/kubelet/config.yaml
...
clusterDNS:
- 10.96.0.10
clusterDomain: cluster.local
```

Once the pods are configured with the right nameserver, you can now resolve other pods and services. You can access the web service using just "web service" or "web-service.default" or "web-service.default.SVC" or "web-service.default.svc.cluster.local."



```
curl http://web-service
```

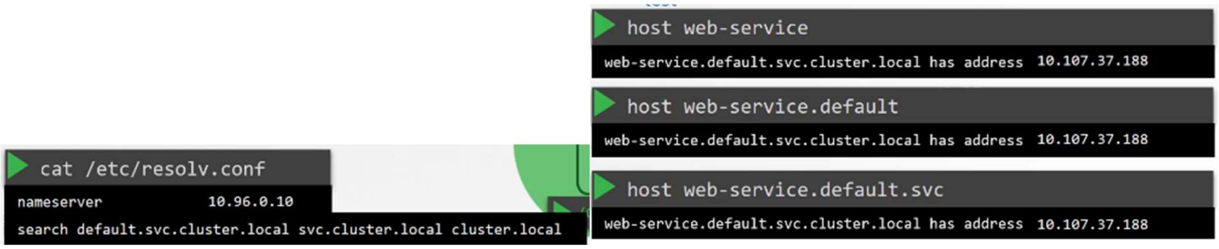
```
curl http://web-service.default
```

```
curl http://web-service.default.svc
```

```
curl http://web-service.default.svc.cluster.local
```

If you try to manually look up the web service using DNS lookup or the "host web service" command, it will return the fully qualified domain name of the web service, which happens to be "web-service.default.SVC.cluster.local." But you didn't ask for that. You just said "web service." So how did it look up the full name?

It so happens the resolv.conf file also has a search entry which is set to "default.service.cluster.local" as well as "svc.cluster.local" and "cluster.local." This allows you to find the service using any name, "web service" or "web-service.default" or "web-service.default.svc."



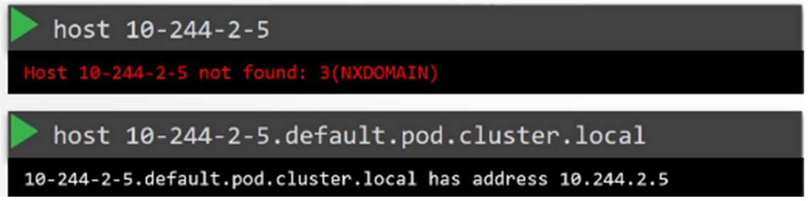
```
cat /etc/resolv.conf
nameserver          10.96.0.10
search default.svc.cluster.local svc.cluster.local cluster.local
```

```
host web-service
web-service.default.svc.cluster.local has address  10.107.37.188
```

```
host web-service.default
web-service.default.svc.cluster.local has address  10.107.37.188
```

```
host web-service.default.svc
web-service.default.svc.cluster.local has address  10.107.37.188
```

However, note that it only has search entries for service, so you won't be able to reach a pod the same way. For that, you need to specify the full FQDN of the pod.



```
host 10-244-2-5
Host 10-244-2-5 not found: 3(NXDOMAIN)
```

```
host 10-244-2-5.default.pod.cluster.local
10-244-2-5.default.pod.cluster.local has address 10.244.2.5
```