Docker Networking

Networking overview

One of the reasons Docker containers and services are so powerful is that you can connect them together, or connect them to non-Docker workloads. Docker containers and services do not even need to be aware that they are deployed on Docker, or whether their peers are also Docker workloads or not. Whether your Docker hosts run Linux, Windows, or a mix of the two, you can use Docker to manage them in a platform-agnostic way.

Docker networks

Network drivers

Docker's networking subsystem is pluggable, using drivers. Several drivers exist by default, and provide core networking functionality:

- **bridge:** The default network driver. If you don't specify a driver, this is the type of network you are creating. Bridge networks are usually used when your applications run in standalone containers that need to communicate.
- **host:** For standalone containers, remove network isolation between the container and the Docker host, and use the host's networking directly.
- **none:** For this container, disable all networking. Usually used in conjunction with a custom network driver.
- **overlay:** Overlay networks connect multiple Docker daemons together and enable swarm services to communicate with each other. You can also use overlay networks to facilitate communication between a swarm service and a standalone container, or between two standalone containers on different Docker daemons. This strategy removes the need to do OS-level routing between these containers.
- **macvlan:** Macvlan networks allow you to assign a MAC address to a container, making it appear as a physical device on your network. The Docker daemon routes traffic to containers by their MAC addresses. Using the macvlan driver is sometimes the best choice when dealing with legacy applications that expect to be directly connected to the physical network, rather than routed through the Docker host's network stack.
- **Network plugins:** You can install and use third-party network plugins with Docker. These plugins are available from Docker Hub or from third-party vendors.

Use the default bridge network

In this example, you start two different alpine containers on the same Docker host and do some tests to understand how they communicate with each other. You need to have Docker installed and running.

1. Open a terminal window. List current networks before you do anything else. Here's what you should see if you've never added a network.

```
[ec2-user@clarusway ~]$ docker network ls
NETWORK ID          NAME                DRIVER              SCOPE
57e7697201a4        bridge              bridge              local
3f4daf00951c        host                host                local
f3add01c4fdb        none                null                local

```

The default bridge network is listed, along with host and none. The latter two are not fully-fledged networks but are used to start a container connected directly to the Docker daemon host's networking stack or to start a container with no network devices.

2. Start two `alpine` containers running `ash`, which is Alpine's default shell rather than `bash`. The `-dit` flags mean to start the container detached (in the background), interactive (with the ability to type into it), and with a TTY (so you can see the input and output). Since you are starting it detached, you won't be connected to the container right away. Instead, the container's ID will be printed. Because you have not specified any --network flags, the containers connect to the default bridge network.

```
[ec2-user@clarusway ~]$ docker run -dit --name alpine1 alpine ash
75846ffef56a6a0404bfebdd80ff0598f768a077b5c6d1e6b0c552990695ff40
[ec2-user@clarusway ~]$ docker run -dit --name alpine2 alpine ash
4bacf9c5b304ef197d8de32631e074805bfe154b8a5dc8458b71b30215ae25ac

```

Check that both containers are actually started:

```
[ec2-user@clarusway ~]$ docker container ls
CONTAINER ID        IMAGE               COMMAND             CREATED
    STATUS              PORTS               NAMES
4bacf9c5b304        alpine              "ash"               About a minute ago   Up
    About a minute                          alpine2
75846ffef56a        alpine              "ash"               2 minutes ago        Up
    2 minutes                               alpine1

```

3. Inspect the bridge network to see what containers are connected to it.

```
[ec2-user@clarusway ~]$ docker network inspect bridge
[
    {
        "Name": "bridge",
        "Id": "57e7697201a40c4d6acb28f6ecaafac18d2ca282fd5eb3d8ced1e0ea5fc7b199",
        "Created": "2020-07-13T10:10:39.886577521Z",
        "Scope": "local",
        "Driver": "bridge",
        "EnableIPv6": false,
        "IPAM": {
            "Driver": "default",
            "Options": null,
            "Config": [
                {
                    "Subnet": "172.17.0.0/16",
                    "Gateway": "172.17.0.1"
                }
            ]
        },
        "Internal": false,
        "Attachable": false,
        "Ingress": false,
        "ConfigFrom": {
            "Network": ""
        },
        "ConfigOnly": false,
        "Containers": {
            "4bacf9c5b304ef197d8de32631e074805bfe154b8a5dc8458b71b30215ae25ac": {
                "Name": "alpine2",
                "EndpointID":
                    "9bc6784ddf823bd7e7c6ac37ceddf87cfea63292f23ca3d5b178a367474a12
                    99",
                "MacAddress": "02:42:ac:11:00:03",
                "IPv4Address": "172.17.0.3/16",
                "IPv6Address": ""
            },
            "75846ffef56a6a0404bfebdd80ff0598f768a077b5c6d1e6b0c552990695ff40": {
                "Name": "alpine1",
                "EndpointID":
                    "8426e9df26bf373f00dd185e23683e9c41ea45aee3aefed68ec1b28a397306
                    fb",
                "MacAddress": "02:42:ac:11:00:02",
                "IPv4Address": "172.17.0.2/16",
                "IPv6Address": ""
            }
        },
        "Options": {
            "com.docker.network.bridge.default_bridge": "true",
            "com.docker.network.bridge.enable_icc": "true",
            "com.docker.network.bridge.enable_ip_masquerade": "true",
            "com.docker.network.bridge.host_binding_ipv4": "0.0.0.0",
            "com.docker.network.bridge.name": "docker0",
            "com.docker.network.driver.mtu": "1500"
        },
        "Labels": {}
    }
]

```

Near the top, information about the bridge network is listed, including the IP address of the gateway between the Docker host and the `bridge` network (`172.17.0.1`). Under the Containers key, each connected container is listed, along with information about its `IP address` (`172.17.0.2` for `alpine1` and `172.17.0.3` for `alpine2`).

4. The containers are running in the background. Use the docker attach command to connect to `alpine1`.

```
[ec2-user@clarusway ~]$ docker attach alpine1
/ #

```

The prompt changes to `#` to indicate that you are the `root` user within the container. Use the `ip addr show` command to show the network interfaces for `alpine1` as they look from within the container:

```
/ # ip addr show
1: lo:  mtu 65536 qdisc noqueue state UNKNOWN qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
6: eth0@if7:  mtu 1500 qdisc noqueue state UP
    link/ether 02:42:ac:11:00:02 brd ff:ff:ff:ff:ff:ff
    inet 172.17.0.2/16 brd 172.17.255.255 scope global eth0
       valid_lft forever preferred_lft forever

```

The first interface is the loopback device. Ignore it for now. Notice that the second interface has the `IP address` `172.17.0.2`, which is the same address shown for `alpine1` in the previous step.

5. From within `alpine1`, make sure you can connect to the internet by pinging `google.com`. The `-c 2 flag` limits the command to `two ping` attempts.

```
/ # ping -c 2 google.com
PING google.com (172.217.22.46): 56 data bytes
64 bytes from 172.217.22.46: seq=0 ttl=109 time=1.375 ms
64 bytes from 172.217.22.46: seq=1 ttl=109 time=1.533 ms

--- google.com ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 1.375/1.454/1.533 ms

```

6. Now try to ping the second container. First, ping it by its IP address, `172.17.0.3`:

```
/ # ping -c 2 172.17.0.3
PING 172.17.0.3 (172.17.0.3): 56 data bytes
64 bytes from 172.17.0.3: seq=0 ttl=255 time=0.112 ms
64 bytes from 172.17.0.3: seq=1 ttl=255 time=0.078 ms

--- 172.17.0.3 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.078/0.095/0.112 ms

```

This succeeds. Next, try pinging the alpine2 container by container name. This will fail.

```
/ # ping -c 2 alpine2
ping: bad address 'alpine2'
```

7. Detach from `alpine1` without stopping it by using the detach sequence, `CTRL + p + q` (hold down CTRL and type p followed by q). If you wish, attach to `alpine2` and repeat steps `4, 5, and 6` there, substituting `alpine1` for `alpine2`.

8. Stop and remove both containers.

```
[ec2-user@clarusway ~]$ docker container stop alpine1 alpine2
alpine1
alpine2
[ec2-user@clarusway ~]$ docker container rm alpine1 alpine2
alpine1
alpine2
```

Use user-defined bridge networks

In this example, we again start two `alpine` containers but attach them to a user-defined network called `alpine-net` which we have already created. These containers are not connected to the `default bridge network` at all. We then start a `third alpine` container which is connected to the bridge network but not connected to `alpine-net` and a `fourth alpine` container which is connected to both networks.

1. Create the `alpine-net` network. You do not need the `--driver bridge` flag since it's the default, but this example shows how to specify it.

```
[ec2-user@clarusway ~]$ docker network create --driver bridge alpine-net

14f01f5d51de657ff67e4c52ea6de245ddd01184d4e90a94c2c4addd703f34f5
```

2. List Docker's networks:

```
[ec2-user@clarusway ~]$ docker network ls

NETWORK ID          NAME                DRIVER              SCOPE
14f01f5d51de        alpine-net          bridge              local
57e7697201a4        bridge              bridge              local
3f4daf00951c        host                host                local
f3add01c4fdb        none                null                local
```

Inspect the `alpine-net network`. This shows you its IP address and the fact that no containers are connected to it:

```
[ec2-user@clarusway ~]$ docker network inspect alpine-net

[
    {
        "Name": "alpine-net",
        "Id": "14f01f5d51de657ff67e4c52ea6de245ddd01184d4e90a94c2c4addd703f34f5",
        "Created": "2020-07-13T10:54:23.575226558Z",
        "Scope": "local",
        "Driver": "bridge",
        "EnableIPv6": false,
        "IPAM": {
            "Driver": "default",
            "Options": {},
            "Config": [
                {
                    "Subnet": "172.18.0.0/16",
                    "Gateway": "172.18.0.1"
                }
            ]
        },
        "Internal": false,
        "Attachable": false,
        "Ingress": false,
        "ConfigFrom": {
            "Network": ""
        },
        "ConfigOnly": false,
        "Containers": {},
        "Options": {},
        "Labels": {}
    }
]
```

Notice that this network's gateway is `172.18.0.1`, as opposed to the default bridge network, whose gateway is `172.17.0.1`. The exact IP address may be different on your system.

3. Create your four containers. Notice the `--network` flags. You can only connect to one network during the `docker run` command, so you need to use `docker network connect` afterward to connect `alpine4` to the `bridge` network as well.

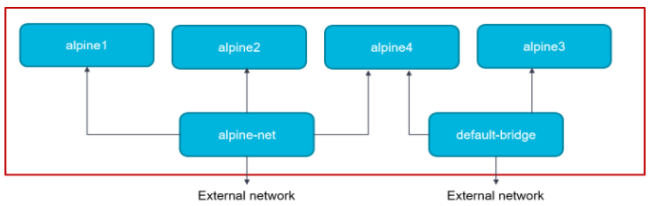
```
[ec2-user@clarusway ~]$ docker run -dit --name alpine1 --network alpine-net alpi

[ec2-user@clarusway ~]$ docker run -dit --name alpine2 --network alpine-net alpi

[ec2-user@clarusway ~]$ docker run -dit --name alpine3 alpine ash

[ec2-user@clarusway ~]$ docker run -dit --name alpine4 --network alpine-net alpi

[ec2-user@clarusway ~]$ docker network connect bridge alpine4
```



Verify that all containers are running:

```
[ec2-user@clarusway ~]$ docker container ls

CONTAINER ID        IMAGE               COMMAND             CREATED
6f48a236c047        alpine              "ash"               3 minutes ago
c95c3b124606        alpine              "ash"               3 minutes ago
09345fe99f16        alpine              "ash"               3 minutes ago
c605cb1885d1        alpine              "ash"               3 minutes ago
```

4. Inspect the `bridge` network and the `alpine-net` network again:

```
[ec2-user@clarusway ~]$ docker network inspect bridge

[
    {
        "Name": "bridge",
        "Id": "6d12e890ec8201e3198cddaa95615987987c477dd7f66f131eeceb98cceefe2e
        "Created": "2020-07-14T08:35:34.936559472Z",
        "Scope": "local",
        "Driver": "bridge",
        "EnableIPv6": false,
        "IPAM": {
            "Driver": "default",
            "Options": null,
            "Config": [
                {
                    "Subnet": "172.17.0.0/16",
                    "Gateway": "172.17.0.1"
                }
            ]
        },
        "Internal": false,
        "Attachable": false,
        "Ingress": false,
        "ConfigFrom": {
            "Network": ""
        },
        "ConfigOnly": false,
        "Containers": {
            "0891d7a4a8e3650ccb1ea169cd3e250226c734184f30757a60bd0513e2953924":
                "Name": "alpine4",
                "EndpointID": "3748c1a25afdf05193c4215de4d85618185f9b37f6707bcf
                "MacAddress": "02:42:ac:11:00:03",
                "IPv4Address": "172.17.0.3/16",
                "IPv6Address": ""
            },
            "87f06cde2e9e05d56ca45e376e5d13bfd61584137385c347cd8d6e08cf15ef67":
                "Name": "alpine3",
                "EndpointID": "bc89281ef104d08ab0407f0bdc5f3365b29a1602b57e7d318
                "MacAddress": "02:42:ac:11:00:02",
                "IPv4Address": "172.17.0.2/16",
                "IPv6Address": ""
            }
        },
        "Options": {
            "com.docker.network.bridge.default_bridge": "true",
            "com.docker.network.bridge.enable_icc": "true",
            "com.docker.network.bridge.enable_ip_masquerade": "true",
            "com.docker.network.bridge.host_binding_ipv4": "0.0.0.0",
            "com.docker.network.bridge.name": "docker0",
            "com.docker.network.driver.mtu": "1500"
        },
        "Labels": {}
    }
]
```

Containers `alpine3` and `alpine4` are connected to the `bridge` network.

```
[ec2-user@clarusway ~]$ docker network inspect alpine-net

[
    {
        "Name": "alpine-net",
        "Id": "14f01f5d51de657ff67e4c52ea6de245ddd01184d4e90a94c2c4addd703f34f5"
        "Created": "2020-07-13T10:54:23.575226558Z",
        "Scope": "local",
        "Driver": "bridge",
        "EnableIPv6": false,
        "IPAM": {
            "Driver": "default",
            "Options": {},
            "Config": [
                {
                    "Subnet": "172.18.0.0/16",
                    "Gateway": "172.18.0.1"
                }
            ]
        },
        "Internal": false,
        "Attachable": false,
        "Ingress": false,
        "ConfigFrom": {
            "Network": ""
```

```
        },
        "ConfigOnly": false,
        "Containers": {
            "0891d7a4a8e3650ccb1ea169cd3e250226c734184f30757a60bd0513e2953924":
                "Name": "alpine4",
                "EndpointID": "c691b71fb8ff6c0e1b6405feab28031acdaff5d764f0f0cd2
                "MacAddress": "02:42:ac:12:00:04",
                "IPv4Address": "172.18.0.4/16",
                "IPv6Address": ""
            },
            "ba2425af655ab6af6f74e90dcf51bc8639c663eb978b991d43940a45116ecffd":
                "Name": "alpine2",
                "EndpointID": "6a6d0d3014a5e8192316bda4fb5bc19f63adb11f4de3acbc5
                "MacAddress": "02:42:ac:12:00:03",
                "IPv4Address": "172.18.0.3/16",
                "IPv6Address": ""
            },
            "f1b109ada2ac11d005f9519846815d2ecb15b57b606d5e1aba418eb4b8f360d8":
                "Name": "alpine1",
                "EndpointID": "7dab942e3fc98084552d9e80716eedd036808cdeda71c1068
                "MacAddress": "02:42:ac:12:00:02",
                "IPv4Address": "172.18.0.2/16",
                "IPv6Address": ""
            }
        },
        "Options": {},
        "Labels": {}
    }
]
```


Containers `alpine1`, `alpine2`, and `alpine4` are connected to the `alpine-net` network.

5. On user-defined networks like `alpine-net`, containers can not only communicate by IP address but can also resolve a container name to an IP address. This capability is called `automatic service discovery`. Let's connect to alpine1 and test this out. alpine1 should be able to resolve alpine2 and alpine4 (and alpine1, itself) to IP addresses.

```
[ec2-user@clarusway ~]$ docker container attach alpine1

/ # ping -c 2 alpine2
PING alpine2 (172.18.0.3): 56 data bytes
64 bytes from 172.18.0.3: seq=0 ttl=255 time=0.082 ms
64 bytes from 172.18.0.3: seq=1 ttl=255 time=0.086 ms

--- alpine2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.082/0.084/0.086 ms

/ # ping -c 2 alpine4
PING alpine4 (172.18.0.4): 56 data bytes
64 bytes from 172.18.0.4: seq=0 ttl=255 time=0.072 ms
64 bytes from 172.18.0.4: seq=1 ttl=255 time=0.079 ms

--- alpine4 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.072/0.075/0.079 ms

/ # ping -c 2 alpine1
PING alpine1 (172.18.0.2): 56 data bytes
64 bytes from 172.18.0.2: seq=0 ttl=255 time=0.029 ms
64 bytes from 172.18.0.2: seq=1 ttl=255 time=0.058 ms

--- alpine1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.029/0.043/0.058 ms

```

6. From `alpine1`, you should not be able to connect to `alpine3` at all, since it is not on the alpine-net network.

```
# ping -c 2 alpine3
ping: bad address 'alpine3'

```

Not only that, but you can't connect to `alpine3` from `alpine1` by its IP address either. Look back at the `docker network inspect` output for the `bridge` network and find alpine3's IP address: `172.17.0.2` Try to ping it.

```
# ping -c 2 172.17.0.2
PING 172.17.0.2 (172.17.0.2): 56 data bytes

--- 172.17.0.2 ping statistics ---
2 packets transmitted, 0 packets received, 100% packet loss

```

Detach from `alpine1` using detach sequence, `CTRL + p + q` (hold down CTRL and type p followed by q).

7. Remember that `alpine4` is connected to both the default `bridge` network and `alpine-net`. It should be able to reach all of the other containers. However, you will need to address `alpine3` by its IP address. Attach to it and run the tests.

```
[ec2-user@clarusway ~]$ docker container attach alpine4
/ # ping -c 2 alpine1
PING alpine1 (172.18.0.2): 56 data bytes
64 bytes from 172.18.0.2: seq=0 ttl=255 time=0.084 ms
64 bytes from 172.18.0.2: seq=1 ttl=255 time=0.076 ms

--- alpine1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.076/0.080/0.084 ms

/ # ping -c 2 alpine2
PING alpine2 (172.18.0.3): 56 data bytes
64 bytes from 172.18.0.3: seq=0 ttl=255 time=0.075 ms
64 bytes from 172.18.0.3: seq=1 ttl=255 time=0.074 ms

--- alpine2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.074/0.074/0.075 ms

/ # ping -c 2 alpine3
ping: bad address 'alpine3'

/ # ping -c 2 172.17.0.2
PING 172.17.0.2 (172.17.0.2): 56 data bytes
64 bytes from 172.17.0.2: seq=0 ttl=255 time=0.091 ms
64 bytes from 172.17.0.2: seq=1 ttl=255 time=0.104 ms

--- 172.17.0.2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.091/0.097/0.104 ms

/ # ping -c 2 alpine4
PING alpine4 (172.18.0.4): 56 data bytes
64 bytes from 172.18.0.4: seq=0 ttl=255 time=0.032 ms
64 bytes from 172.18.0.4: seq=1 ttl=255 time=0.062 ms

--- alpine4 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.032/0.047/0.062 ms

```

8. As a final test, make sure your containers can all connect to the internet by pinging `clarusway.com`. You are already attached to `alpine4` so start by trying from there. Next, detach from `alpine4` and connect to `alpine3` (which is only attached to the bridge network) and try again. Finally, connect to `alpine1` (which is only connected to the alpine-net network) and try again.

```

/ # ping -c 2 clarusway.com
PING clarusway.com (54.164.151.235): 56 data bytes
64 bytes from 54.164.151.235: seq=0 ttl=221 time=85.406 ms
64 bytes from 54.164.151.235: seq=1 ttl=221 time=85.479 ms

--- clarusway.com ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 85.406/85.442/85.479 ms

CTRL + p + q

[ec2-user@clarusway ~]$ docker container attach alpine3

/ # ping -c 2 clarusway.com
PING clarusway.com (54.164.151.235): 56 data bytes
64 bytes from 54.164.151.235: seq=0 ttl=221 time=85.515 ms
64 bytes from 54.164.151.235: seq=1 ttl=221 time=85.424 ms

--- clarusway.com ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 85.424/85.469/85.515 ms

CTRL + p + q

[ec2-user@clarusway ~]$ docker container attach alpine1
/ # ping -c 2 clarusway.com
PING clarusway.com (54.164.151.235): 56 data bytes
64 bytes from 54.164.151.235: seq=0 ttl=221 time=85.383 ms
64 bytes from 54.164.151.235: seq=1 ttl=221 time=85.448 ms

--- clarusway.com ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 85.383/85.415/85.448 ms

CTRL + p + q

```

9. Stop and remove all containers and the alpine-net network.

```
[ec2-user@clarusway ~]$ docker container stop alpine1 alpine2 alpine3 alpine4
alpine1
alpine2
alpine3
alpine4
[ec2-user@clarusway ~]$ docker container rm alpine1 alpine2 alpine3 alpine4
alpine1
alpine2
alpine3
alpine4
[ec2-user@clarusway ~]$ docker network rm alpine-net
alpine-net

```

Using the host network

Let's start a `nginx` container which binds directly to port 80 on the Docker host. From a networking point of view, this is the same level of isolation as if the nginx process were running directly on the Docker host and not in a container. However, in all other ways, such as storage, process namespace, and user namespace, the nginx process is isolated from the host.

1. Create and start the container as a detached process. The `--rm` option means to remove the container once it exits/stops. The `-d` flag means to start the container detached (in the background)

```
[ec2-user@clarusway ~]$ docker run --rm -d --network host --name my_nginx nginx
```

2. Access Nginx by browsing to http://localhost:80/. (< ip number of ec2 instance >:80/)

3. Examine your network stack using the following commands:

- Examine all network interfaces and verify that a new one was not created.

```
[ec2-user@clarusway ~]$ ip addr show

1: lo:  mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0:  mtu 9001 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 06:85:8f:e8:56:ee brd ff:ff:ff:ff:ff:ff
    inet 172.31.39.54/20 brd 172.31.47.255 scope global dynamic eth0
       valid_lft 2759sec preferred_lft 2759sec
    inet6 fe80::485:8fff:fee8:56ee/64 scope link
       valid_lft forever preferred_lft forever
3: docker0:  mtu 1500 qdisc noqueue state DOWN group default
    link/ether 02:42:96:88:c9:9f brd ff:ff:ff:ff:ff:ff
    inet 172.17.0.1/16 brd 172.17.255.255 scope global docker0
       valid_lft forever preferred_lft forever
    inet6 fe80::42:96ff:fe88:c99f/64 scope link
       valid_lft forever preferred_lft forever
```

- Verify which process is bound to port 80, using the `netstat` command. You need to use `sudo` because the process is owned by the Docker daemon user and you otherwise won't be able to see its name or PID.

```
[ec2-user@clarusway ~]$ sudo netstat -tulpn | grep :80

tcp        0      0 0.0.0.0:80              0.0.0.0:*               LISTEN      5500
   /nginx: master
tcp6       0      0 :::80                   :::*                    LISTEN      5500
   /nginx: master
```

4. Stop the container. It will be removed automatically as it was started using the `--rm` option.

```
[ec2-user@clarusway ~]$ docker container stop my_nginx
```

Container networking

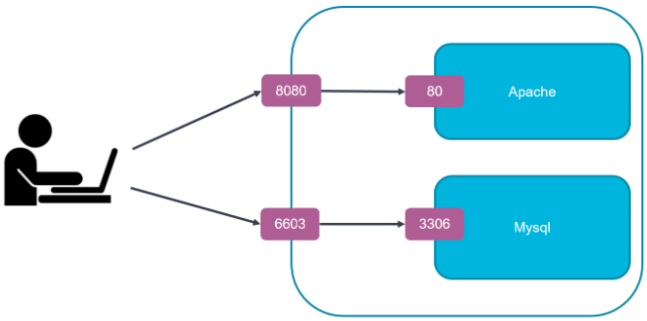
The type of network a container uses, whether it is a bridge, an overlay, a macvlan network, or a custom network plugin, is transparent from within the container. From the container's point of view, it has a network interface with an IP address, a gateway, a routing table, DNS services, and other networking details (assuming the container is not using the none network driver). This lesson is about networking concerns from the point of view of the container.

Published ports

By default, when you create a container, it does not publish any of its ports to the outside world. To make a port available to services outside of Docker, or to Docker containers which are not connected to the container's network, use the `--publish` or `-p` flag. This creates a firewall rule which maps a container port to a port on the Docker host.

```
-p  host_port : container_port
```

```
$ docker run -it -p 8080:80 apache_image
$ docker run -it -p 6603:3066 mysql_image
```



Here are some examples.

Flag value	Description
-p 8080:80	Map TCP port 80 in the container to port 8080 on the Docker host.
-p 192.168.1.100:8080:80	Map TCP port 80 in the container to port 8080 on the Docker host for connections to host IP 192.168.1.100.
-p 8080:80/udp	Map UDP port 80 in the container to port 8080 on the Docker host.
-p 8080:80/tcp -p 8080:80/udp	Map TCP port 80 in the container to TCP port 8080 on the Docker host, and map UDP port 80 in the container to UDP port 8080 on the Docker host.

IP address and hostname

By default, the container is assigned an IP address for every Docker network it connects to. The IP address is assigned from the pool assigned to the network, so the Docker daemon effectively acts as a DHCP server for each container. Each network also has a default subnet mask and gateway.

When the container starts, it can only be connected to a single network, using `--network`. However, you can connect a running container to multiple networks using `docker network connect`. When you start a container using the `--network flag`, you can specify the IP address assigned to the container on that network using the `--ip` or `--ip6` flags.

When you connect an existing container to a different network using docker network connect, you can use the `--ip` or `--ip6` flags on that command to specify the container's IP address on the additional network.

In the same way, a container's hostname defaults to be the container's ID in Docker. You can override the hostname using`--hostname`. When connecting to an existing network using docker network connect, you can use the `--alias` flag to specify an additional network alias for the container on that network.

DNS services

By default, a container inherits the DNS settings of the host, as defined in the `/etc/resolv.conf` configuration file. Containers that use the default `bridge network` get a copy of this file, whereas containers that use a `custom network` use Docker's embedded DNS server, which forwards external DNS lookups to the DNS servers configured on the host.

Custom hosts defined in `/etc/hosts` are not inherited. To pass additional hosts into your container, refer to `add entries to container hosts file` in the `docker run` reference documentation. You can override these settings on a per-container basis. settings on a per-container basis.

Flag value	Description
--dns	The IP address of a DNS server. To specify multiple DNS servers, use multiple --dns flags. If the container cannot reach any of the IP addresses you specify, Google's public DNS server 8.8.8.8 is added, so that your container can resolve internet domains.
--dns-search	A DNS search domain to search non-fully-qualified hostnames. To specify multiple DNS search prefixes, use multiple --dns-search flags.
--dns-opt	A key-value pair representing a DNS option and its value. See your operating system's documentation for resolv.conf for valid options.
--hostname	The hostname a container uses for itself. Defaults to the container's ID if not specified.

Complementary Lesson about Docker Networking