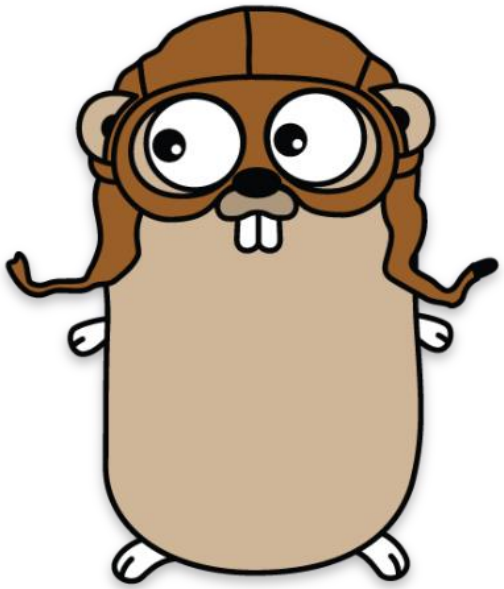
Docker LibNetwork Plugins

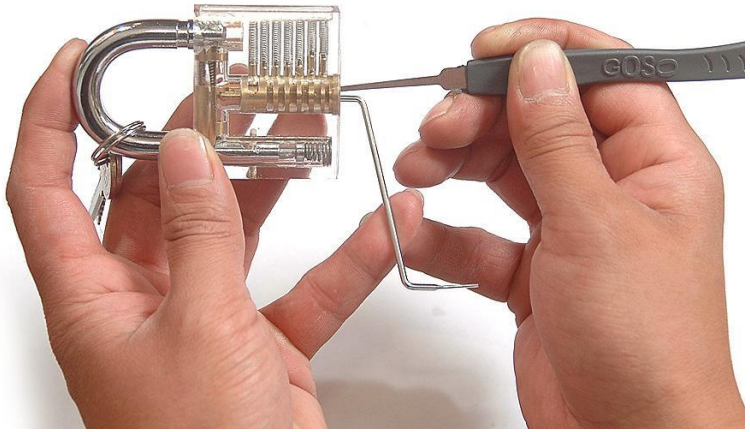
Explorer's Tale

Why am I here?



- I read a code …
- *I re-read the code …*
- *I realized that the code is in GO!*
- *I re-re-read the code …*
- *Finally, I fixed the code …*
- *Now, I can tell a story about it!*

What are we going to do?



- Brainstorm
- Ask ourselves questions
- Reflect on our own experiences

What is a Driver?

"In computing, a device driver is a computer program that operates or controls a particular type of device that is attached to a computer."

Wikipedia …

Docker
Network Driver

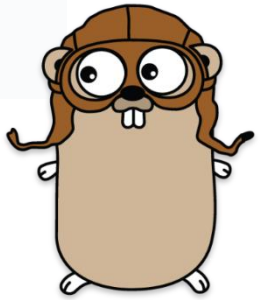
Branch: master

libnetwork / drivers /

- bridge
- host
- ipvlan
- macvlan
- null
- overlay
- remote
- windows

Features Business

docker / libnetwork



What is a Plugin?

"*Plugins* are ways to extend and add to the functionality that already exists in ~~Wordpress~~ Docker."

Wordpress Website…

containernetworking / cni

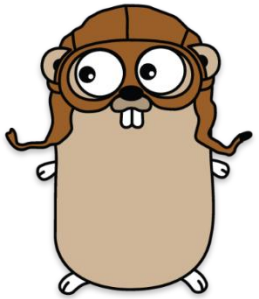
Branch: master

cni / libcni /

CNI ~~Drivers~~ Plugins

- bridge
- host-device
- ipvlan
- loopback
- macvlan
- ptp
- vlan

NET



IPAM

- dhcp
- host-local

containernetworking / plugins

Branch: master

plugins / plugins / ipam /

Branch: master

plugins / plugins / main /

Container Networking Models

CNM  CNI

Container Network Model

- Docker is the only container implementation
- Drinks with Docker Sales Team next Tuesday?
- Are you a "hands-off manager"?
- You don't care about Enterprise vs. Community licensing?

Container Network Interface

- Multiple container runtimes
- You have friends at CoreOS
- You have relatives at Mesosphere
- You worked at Google
- Are you a "micro-manager" or a LOTR fan?

It is a "model" when it is yours, and it is an "interface" when it is someone else's

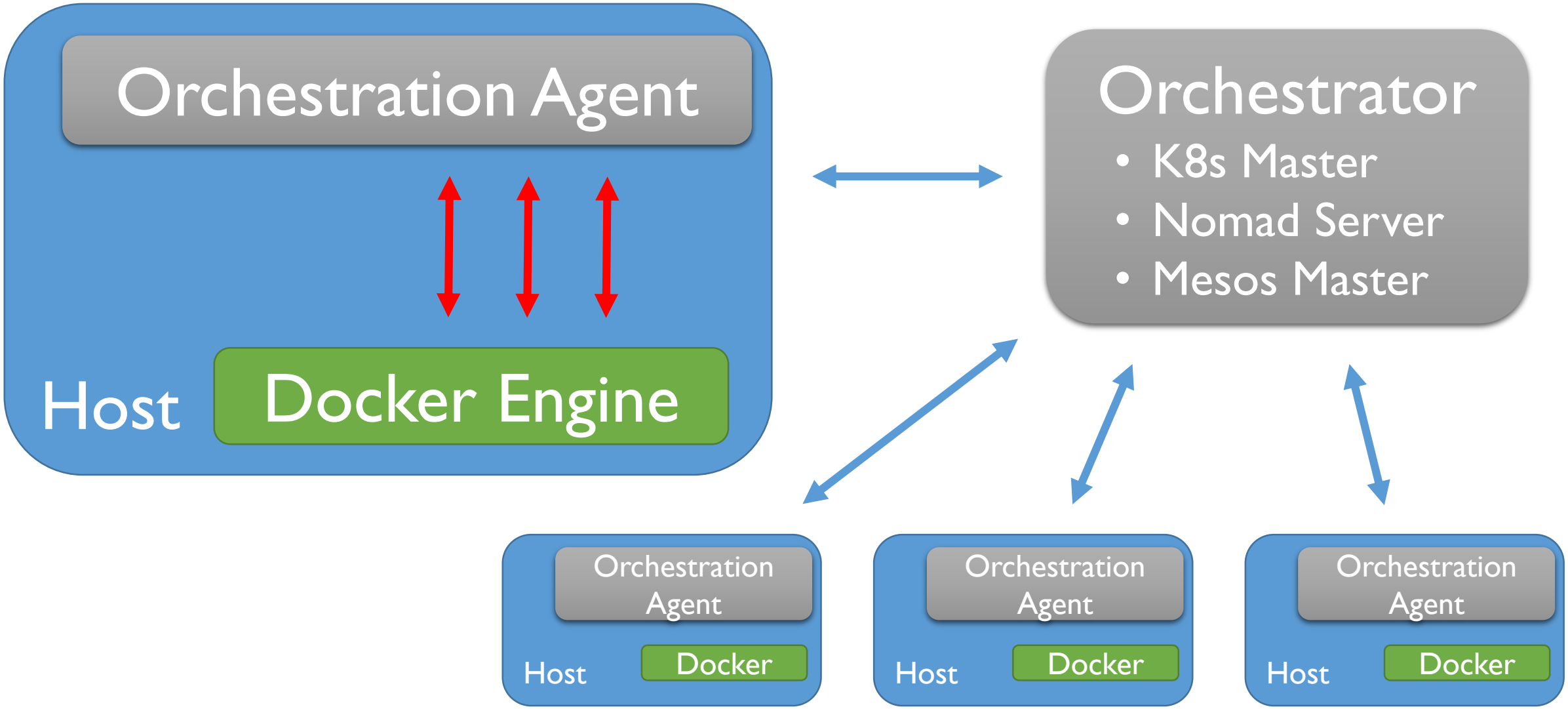
CNI

Container Networking Interface

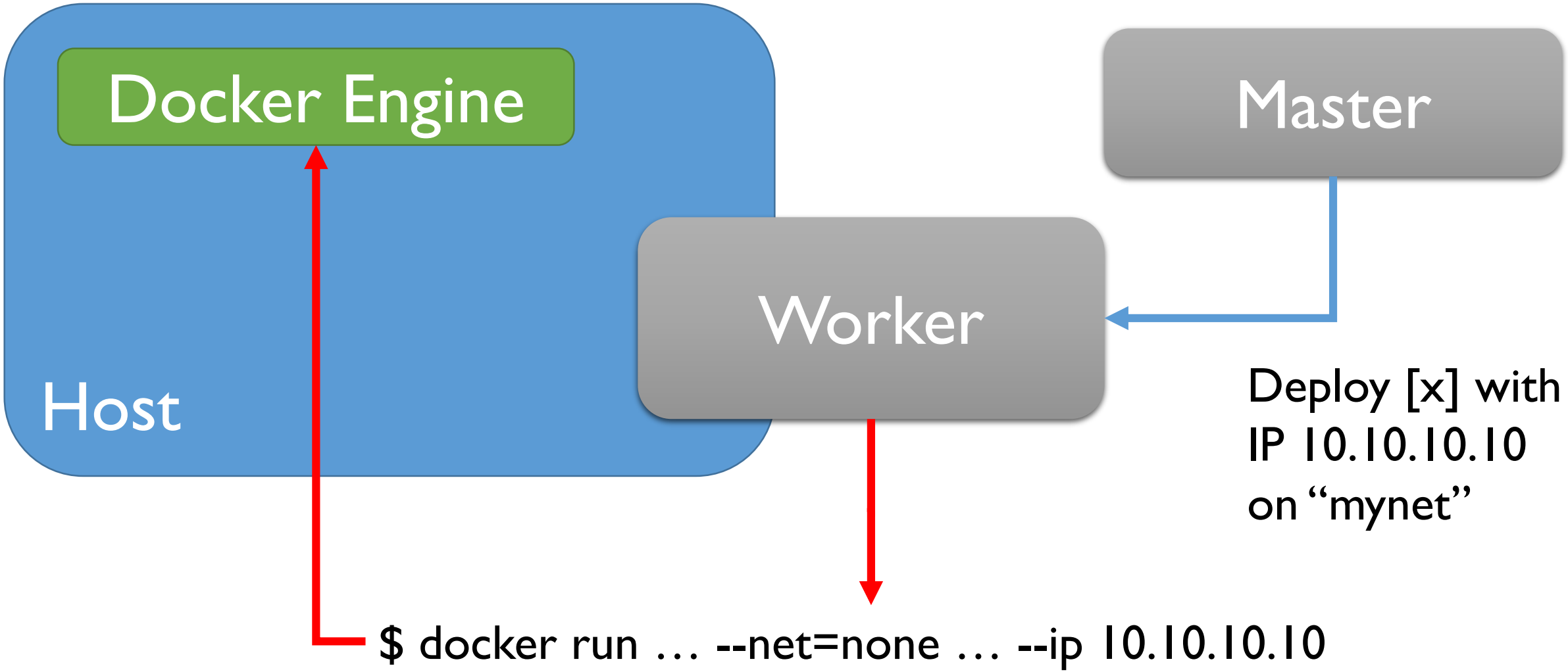
Key Facts about CNI

- It is a specification. However, it comes with tools and plugins (i.e. drivers)
- Each driver is a binary
- Plugin is synonymous to a driver
- Network definitions are stored in JSON files
- Network definitions are passed to the drivers through standard input, `stdin`
- Drivers learn about arguments, e.g. namespace and container id, via environment variables (or configuration file)
- Drivers create container network namespaces and connect them to host networking

Container Network Interface



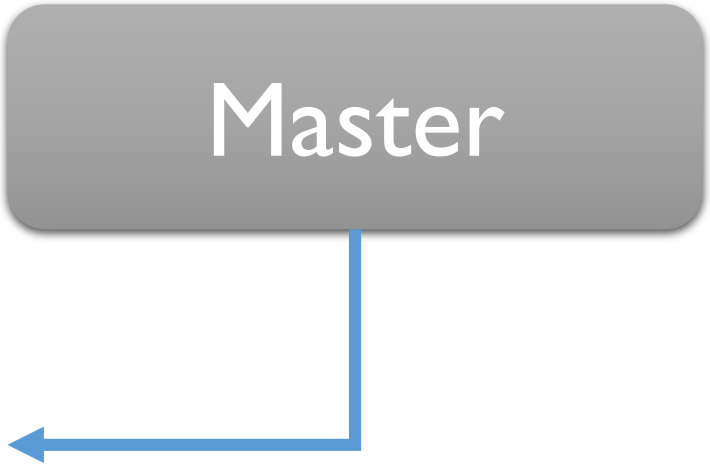
Container Network Interface



Container Network Interface

Questions:

- How does Docker know about “mynet”?
- What is “mynet”?
- Is it “10.10.10.10/24” or “10.10.10.10/16?
- Who creates it?
- Why the Master asks for 10.10.10.10?



```
$ docker run -d -t --net=none
    --name=delta1  centos /bin/bash
```

Container ID

```
$ docker inspect
  -f '{{ .NetworkSettings.SandboxKey }}'
```

Sandbox Key

```
$ cat /etc/cni/net.d/10-mynet.conf |
CNI_COMMAND=ADD \
CNI_CONTAINERID=<Container ID> \
CNI_NETNS=<Sandbox Key> CNI_IFNAME=eth0 \
CNI_PATH=/usr/local/sbin/cni/ /usr/local/sbin/cni/bridge
```

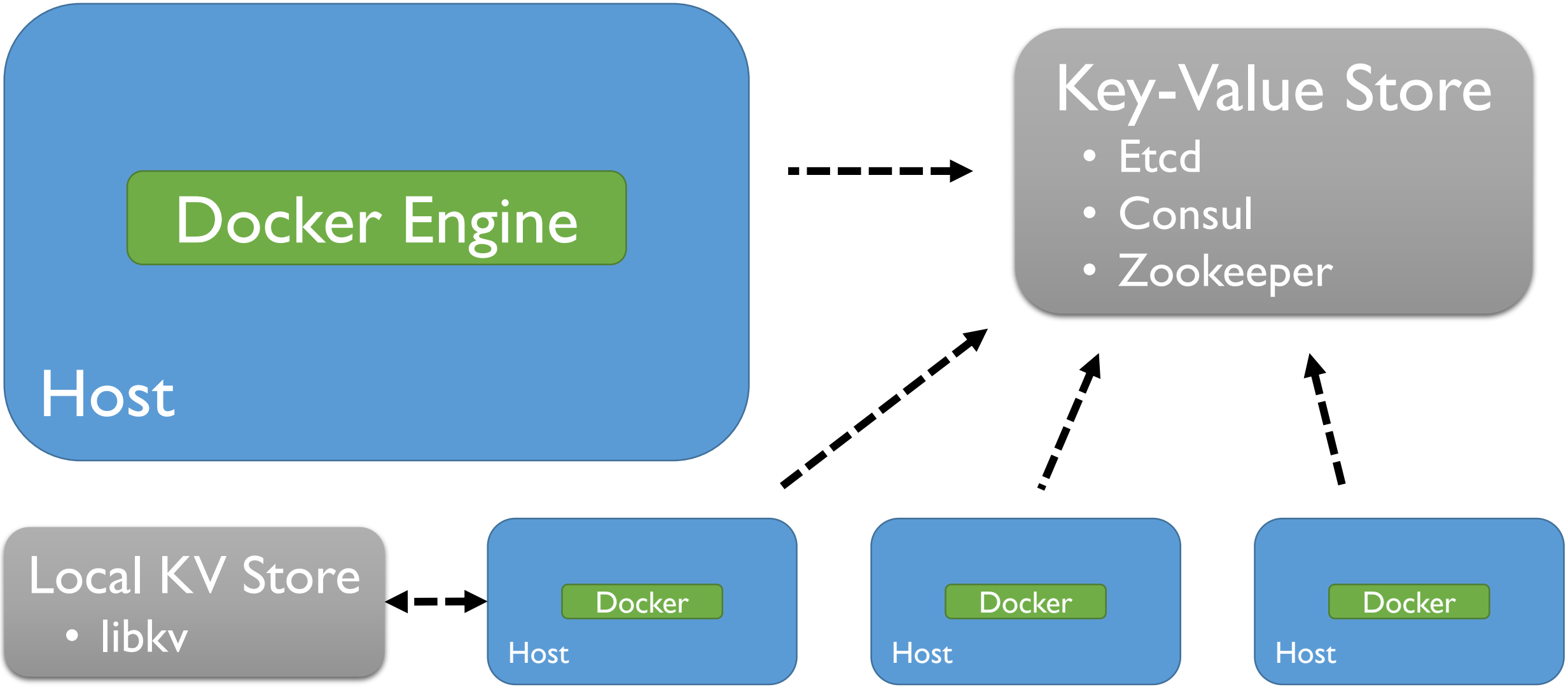
Container Network Interface

- No need to synchronize network information across Docker-enabled hosts
- “Orchestrator” is in charge
- Orchestrator performs IPAM/DHCP-like functions, i.e. cleanup/release
- Workers use CNI network configuration files and binaries

CNM

Container Networking Model

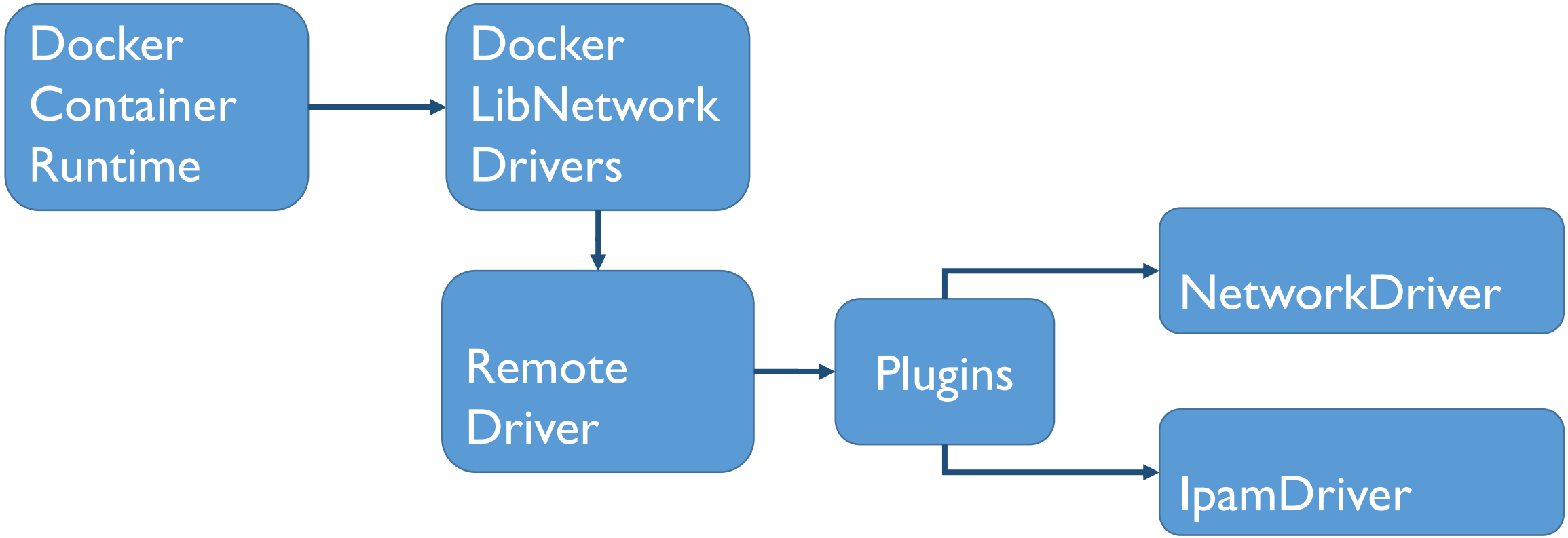
Container Network Model



Key-Value Store & Docker Engine

- Must sync network information across Docker-enabled hosts via Key-Value Store
- No “Orchestrator”
- No “Orchestration Agent”
- Must perform IPAM/DHCP-like functions

Container Network Model



Unix Domain Sockets

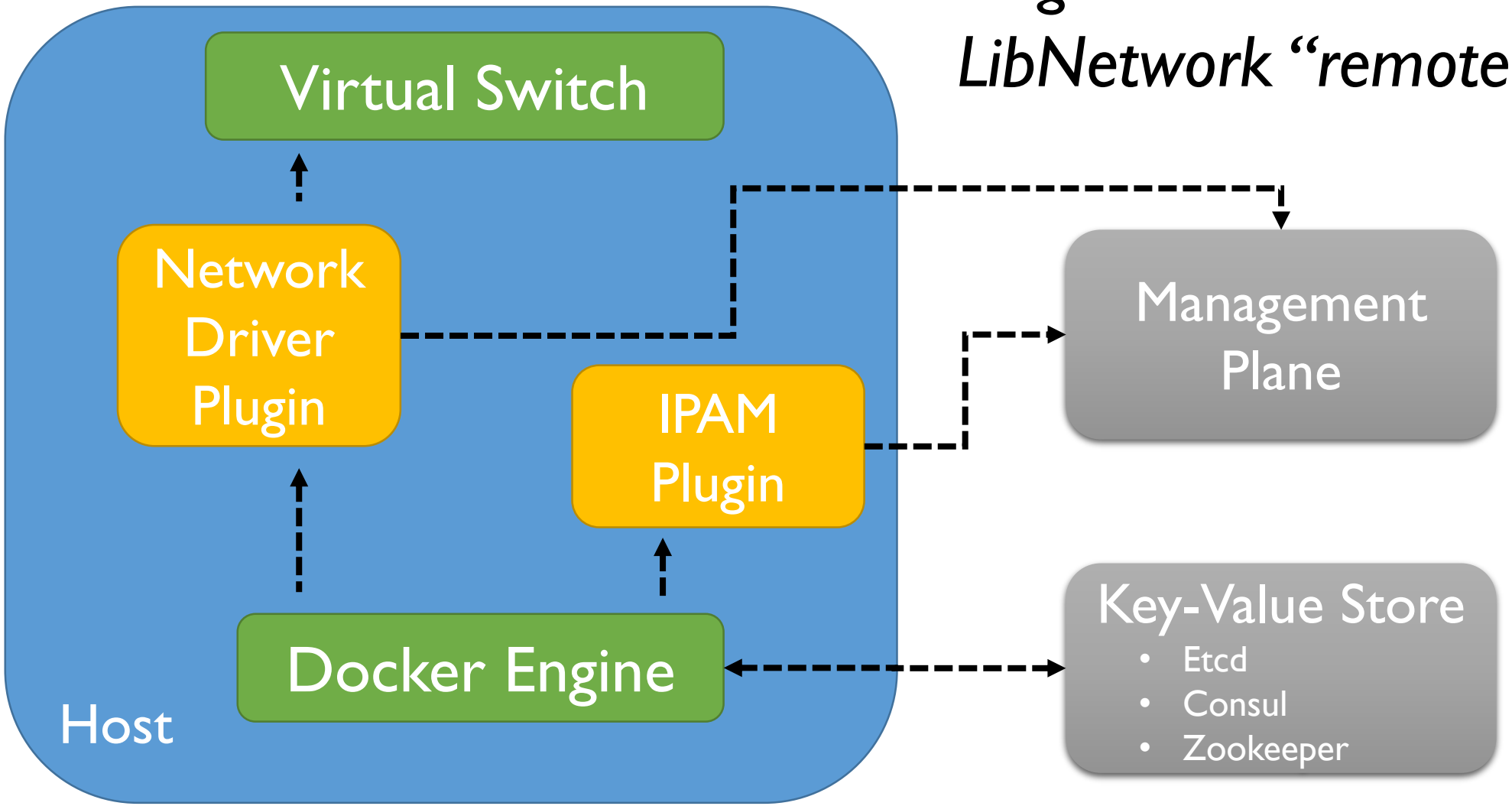
```
$ curl --unix-socket /var/run/docker.sock -H "Content-Type: application/json" \
  -d '{"Image": "alpine", "Cmd": ["echo", "hello world"]}' \
  -X POST http:/v1.24/containers/create
{"Id":"1c6594faf5","Warnings":null}

$ curl --unix-socket /var/run/docker.sock -X POST http:/v1.24/containers/1c6594faf5/start

$ curl --unix-socket /var/run/docker.sock -X POST http:/v1.24/containers/1c6594faf5/wait
{"StatusCode":0}

$ curl --unix-socket /var/run/docker.sock "http:/v1.24/containers/1c6594faf5/logs?stdout=1"
```

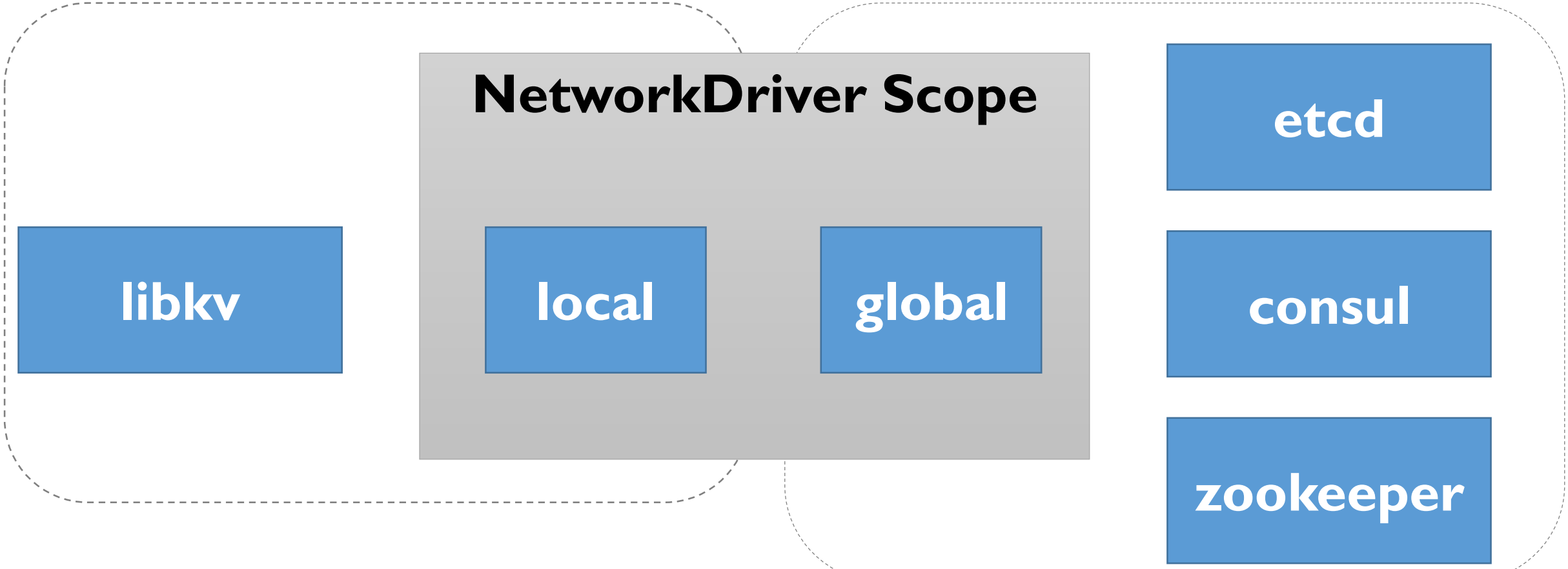
Unix Domain Sockets & Docker Engine

```
echo -e "GET /images/json HTTP/1.0\r\n" | nc -U /var/run/docker.sock
echo -e "GET /version HTTP/1.0\r\n" | nc -U /var/run/docker.sock
echo -e "GET /plugins HTTP/1.0\r\n" | nc -U /var/run/docker.sock
```

Driver vs. Plugin

Plugin is the extension of LibNetwork "remote" Driver






```
NETWORK ID          NAME                DRIVER              SCOPE
52c55293741f        bridge              bridge              local
9f9c1211dc9e        host                host                local
d620dd8aa2be        none                null                local
```

$ docker network create -d **overlay** --ipam-driver **ipamx** --subnet 10.4.4.0/24 mynet

```
Error response from daemon: datastore for
scope "global" is not initialized
```

Docker LibNetwork Remote IPAM Plugin

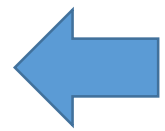
- It is a **web server** listening on Unix Domain Socket
- The socket location: /run/docker/plugins/**ipamx**.sock
- Plugin type: **IpamDriver**

How IPAM Driver works?

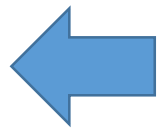
$ docker network create -d bridge **--ipam-driver ipamx** --subnet 10.4.4.0/24 mynet

```
received request to activate the plugin
method: POST
path: /Plugin.Activate
header: user-agent => Go-http-client/1.1
header: content-length => 0
header: accept => application/vnd.docker.plugins.v1.2+json
```

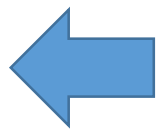
```
received request to provide capabilities
the advertised capabilities are:
 RequiresMACAddress=false,
 RequiresRequestReplay=false
method: POST
path: /IpamDriver.GetCapabilities
header: user-agent => Go-http-client/1.1
header: content-length => 0
header: accept => application/vnd.docker.plugins.v1.2+json
```



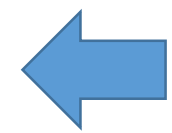
```
received request to provide default IP address spaces
the default IP address spaces are:
  global=ipamx-global,
  local=ipamx-local
method: POST
path: /IpamDriver.GetDefaultAddressSpaces
header: user-agent => Go-http-client/1.1
header: content-length => 0
header: accept => application/vnd.docker.plugins.v1.2+json
```



```
received request to reserve an IP address range
the '10.4.4.0/24' pool is in local address space
the IPv4 address range is 10.4.4.0/24 in the 'ipamx-local'
address space the pool identifier is 'ipamx-local/10.4.4.0/24'
method: POST
path: /IpamDriver.RequestPool
header: content-length => 89
header: accept => application/vnd.docker.plugins.v1.2+json
header: user-agent => Go-http-client/1.1
body: {
   "AddressSpace":"ipamx-local",
   "Pool":"10.4.4.0/24",
   "SubPool":"",
   "Options":{},
   "V6":false
}
```



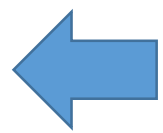
```
received request for an IP address
this is default gateway discovery request
(com.docker.network.gateway) for PoolID
'ipamx-local/10.4.4.0/24'
method: POST
path: /IpamDriver.RequestAddress
header: user-agent => Go-http-client/1.1
header: content-length => 112
header: accept => application/vnd.docker.plugins.v1.2+json
body: {
  "PoolID":"ipamx-local/10.4.4.0/24",
  "Address":"",
  "Options":{
    "RequestAddressType":"com.docker.network.gateway"
  }
}
```



How IPAM Driver works?

$ docker run -d -t --net=**mynet** --name=**delta1** --ip 10.4.4.21 centos /bin/bash

```
received request to release an IP address
method: POST
path: /IpamDriver.ReleaseAddress
header: user-agent => Go-http-client/1.1
header: content-length => 59
header: accept => application/vnd.docker.plugins.v1.2+json
body: {
  "PoolID":"ipamx-local/10.4.4.0/24",
  "Address":"10.4.4.21"
}
```



How IPAM Driver works?

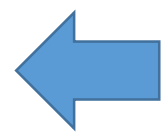
$ docker stop **delta1**

```
received request to release an IP address
method: POST
path: /IpamDriver.ReleaseAddress
header: user-agent => Go-http-client/1.1
header: content-length => 59
header: accept => application/vnd.docker.plugins.v1.2+json
body: {
  "PoolID":"ipamx-local/10.4.4.0/24",
  "Address":"10.4.4.21"
}
```

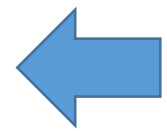
How IPAM Driver works?

$ docker network rm **mynet**

```
received request to release an IP address
method: POST
path: /IpamDriver.ReleaseAddress
header: user-agent => Go-http-client/1.1
header: content-length => 58
header: accept => application/vnd.docker.plugins.v1.2+json
body: {
  "PoolID":"ipamx-local/10.4.4.0/24",
  "Address":"10.4.4.1"
}
```



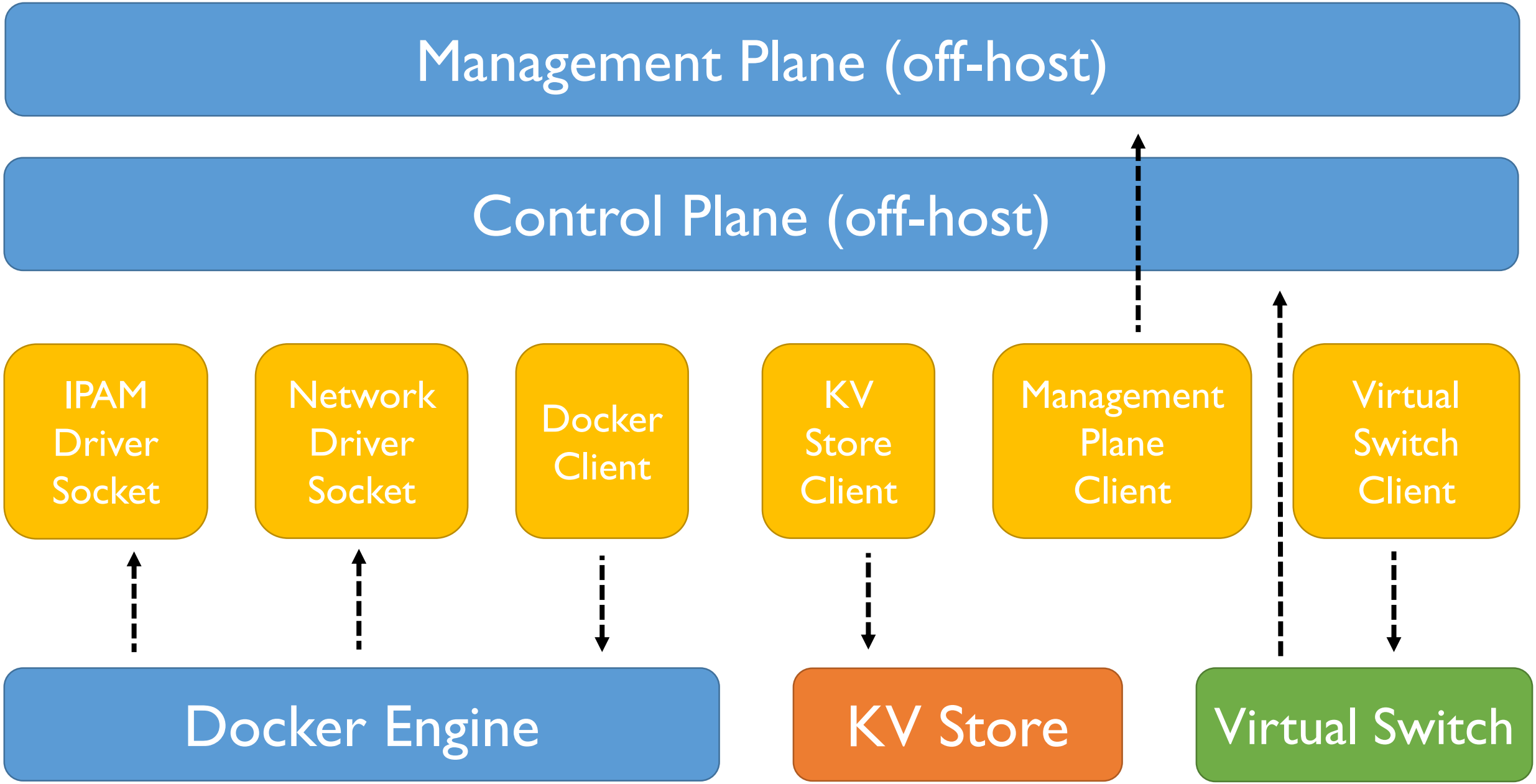
```
received request to release an IP address pool
the IP address pool identifier is 'ipamx-local/10.4.4.0/24'
method: POST
path: /IpamDriver.ReleasePool
header: user-agent => Go-http-client/1.1
header: content-length => 37
header: accept => application/vnd.docker.plugins.v1.2+json
body: {
  "PoolID":"ipamx-local/10.4.4.0/24"
}
```



Common Issues with IPAM in CN(MI)

- Static IP addressing
- Scaling
- Lack of Endpoints
  - /IpamDriver.Metrics
  - /IpamDriver.Version
  - /IpamDriver.Shutdown
  - /IpamDriver.Networks
  - /IpamDriver.Leases
  - /IpamDriver.Configuration

Writing Drivers/Plugins


Management Plane (off-host)
Control Plane (off-host)
IPAM Driver Socket
Network Driver Socket
Docker Client
KV Store Client
Management Plane Client
Virtual Switch Client
Docker Engine
KV Store
Virtual Switch

Thank you! Engage with Community

- Github & Slack
  - docker/libnetwork
  - containernetworking/cni
- Meetups:
  - NANOG
  - NYNOG
- Ping me github.com/greenpau