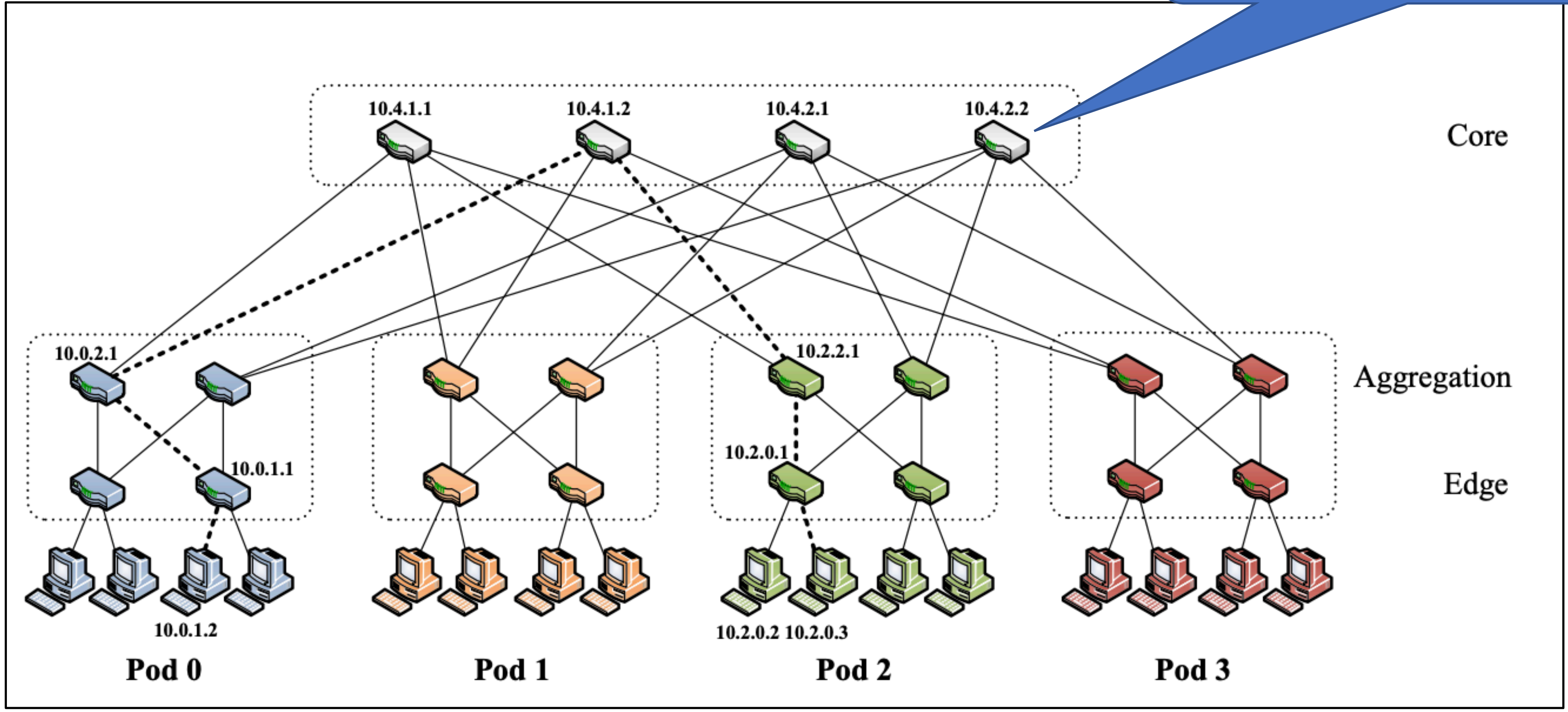
Networking on the ground, in the cloud, and in containers



What is in the box?

Router

A computer optimized for routing and forwarding

- Operating system to manage resources
- Routing protocol implementations (e.g., BGP, OSPF)
- Lots of ports (not TCP ports)
- Chip to forward traffic between ports at “line rate”

Router (2)

Traditionally, a hardware-software combo sold by a router vendor

- Cisco
- Juniper
- Arista
- ….

But moving toward open systems

- SONiC – open source router OS from Microsoft
- Running on commodity hardware

Configuring the router

Routers are not plug-n-play

- Configure IP addresses
- Configure which protocols to run
- Configure those protocols
- Configure management aspects, e.g., DNS servers, NTP servers

Configuration uses custom syntax:

- Example Cisco file: https://github.com/batfish/pybatfish/blob/master/jupyter_notebooks/networks/example/configs/as1border2.cfg

Configuring the router (2)

Traditionally, configuration has been done manually

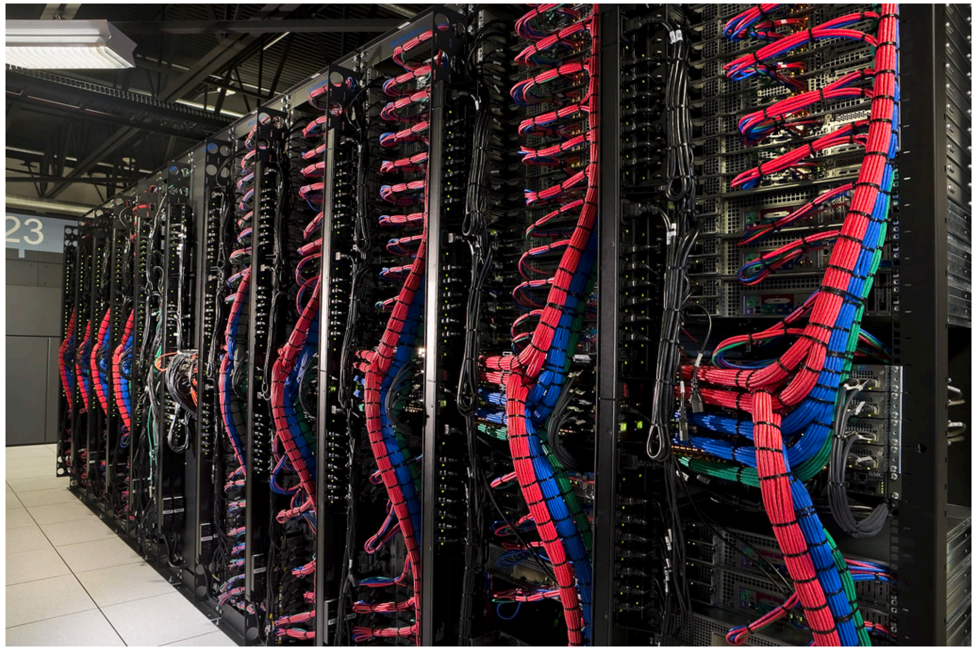
- Figure out the change, reason about it manually
- Log in to the router and apply the change
- High risk of logical errors and “fat fingers”

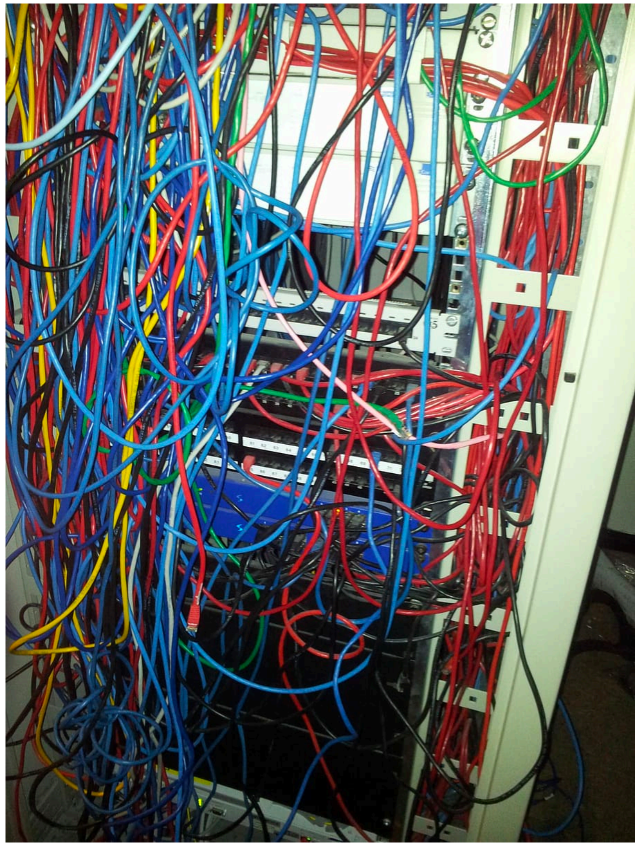
Increasingly, more automation

- Ansible, SaltStack, Nornir
- Batfish

Making a network out of routers

1. Get them connected





Making a network out of routers

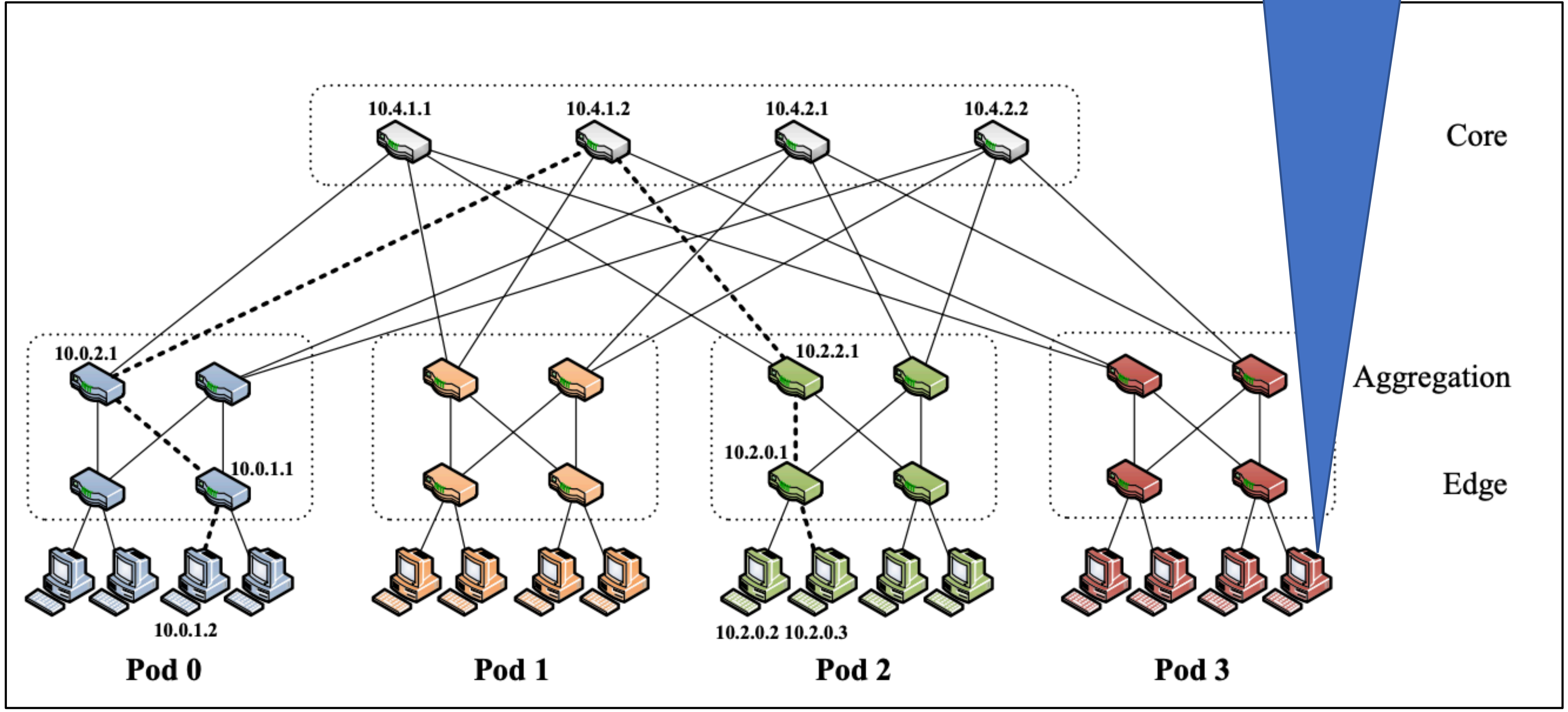
1. Get them connected

2. Configure routers
    - Basic initial configuration provides connectivity to the router

3. Monitor, monitor, monitor

4. Configuration changes and maintenance

What is in this box?



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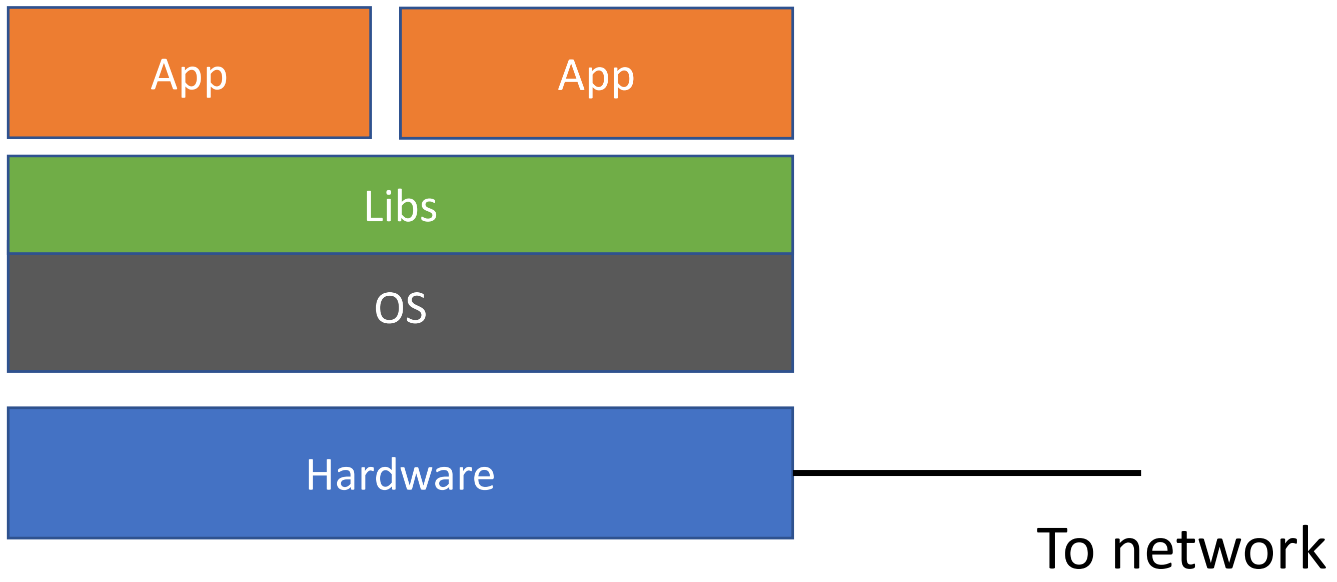


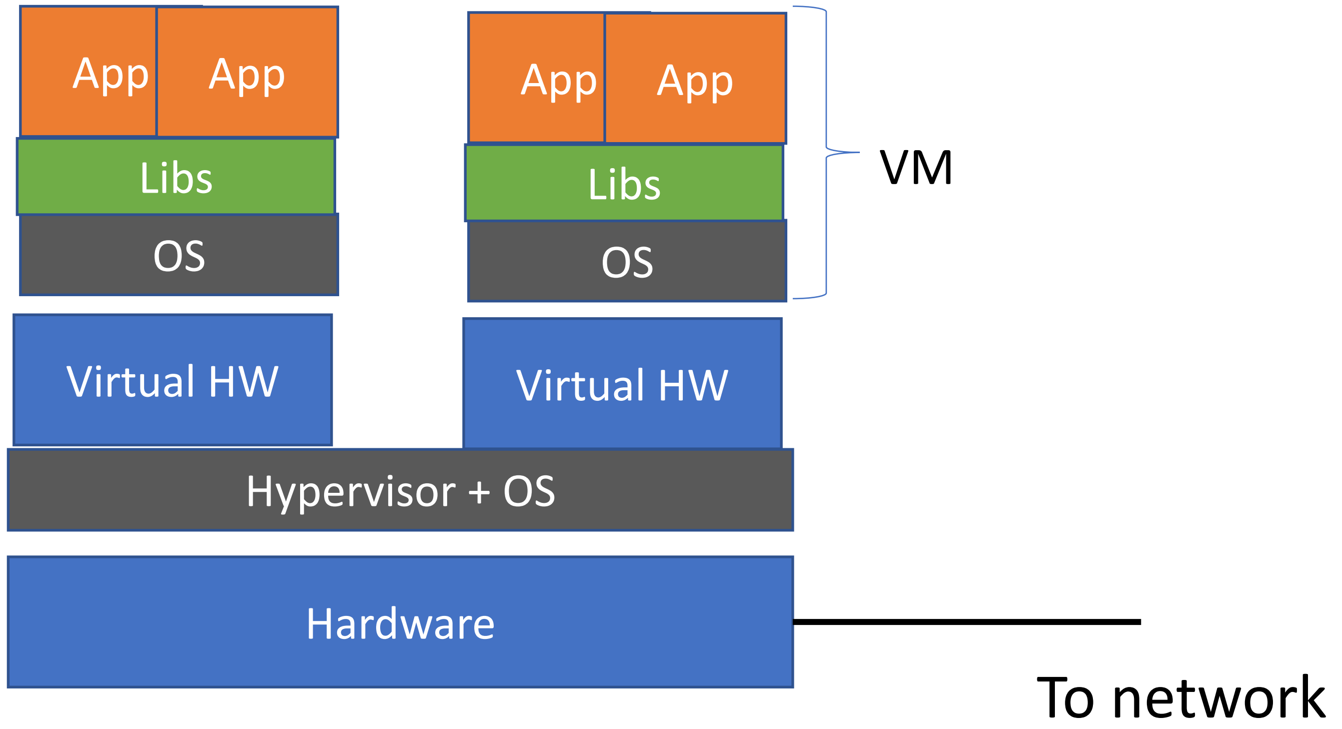
Then came virtual machines (VMs)

HW became too powerful

- Run multiple OSes on the same machine
- Cheaper that way

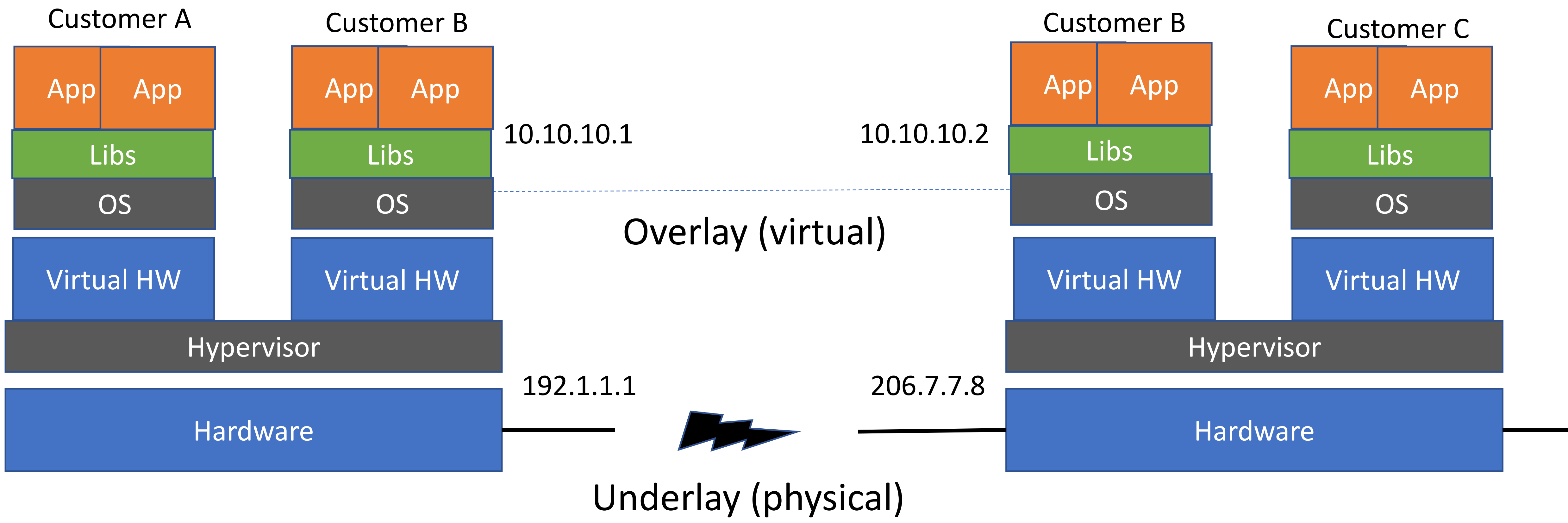
The hypervisor virtualizes the HW and fools the OS

- Provides isolation



The network thinks multiple hosts are connected
The hypervisor acts as a hub for inter-VM traffic

VMs in the cloud



Forwarding between VMs involves a DNS-style lookup from overlay address to underlay location

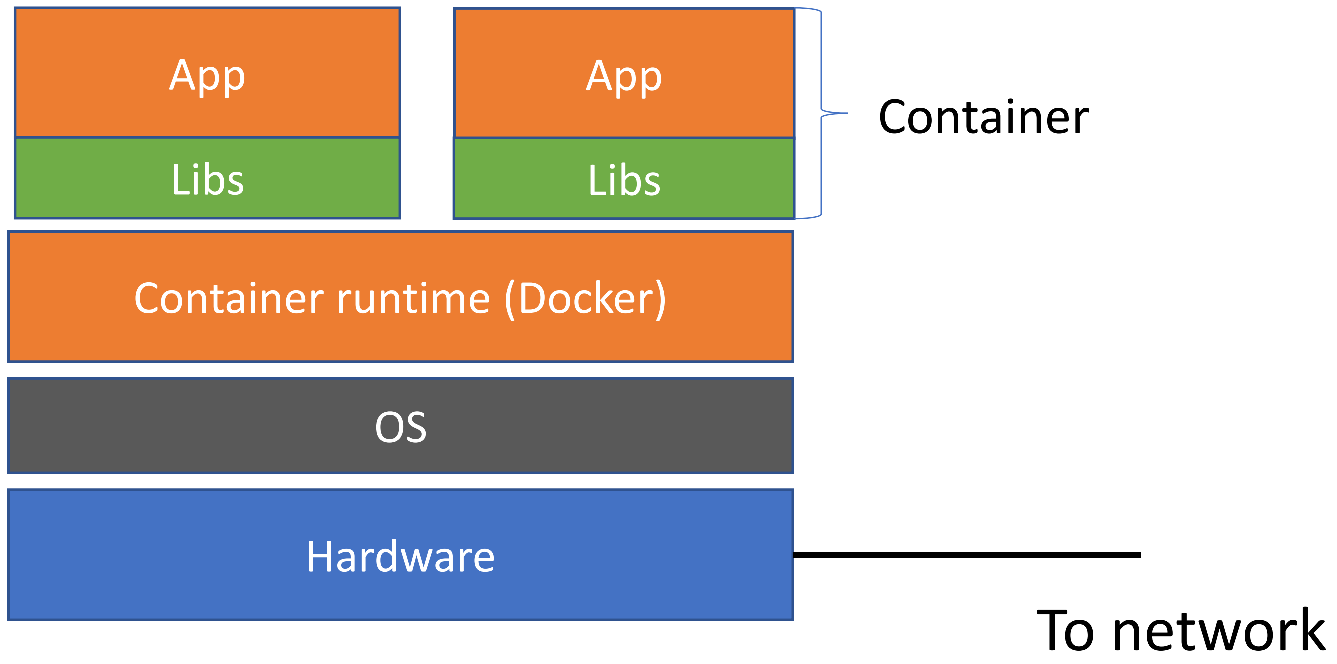
Enter containers

Lighter-weight virtualization than VMs

- Libraries, not the full OS

Better isolation and packaging than apps

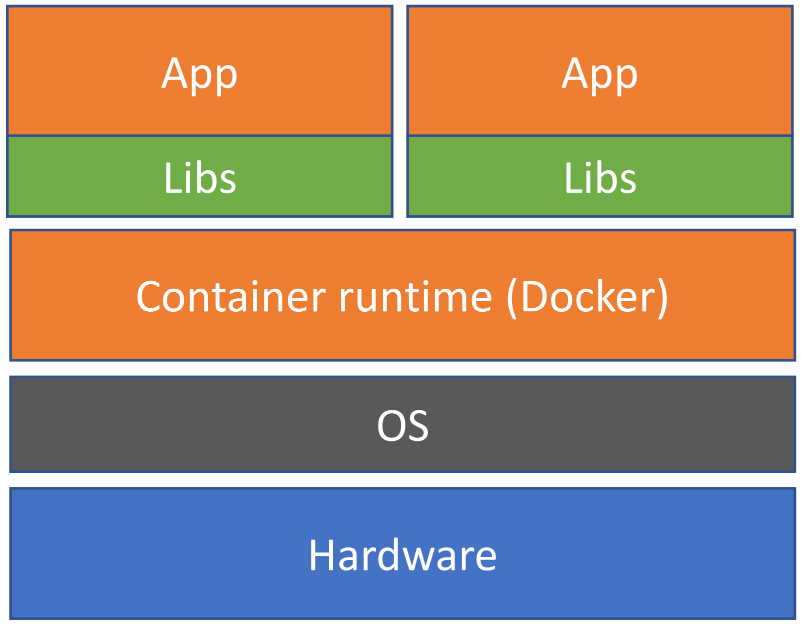
- Bundle the library versions you need



Container networking

Connect containers to the outside world and to each other

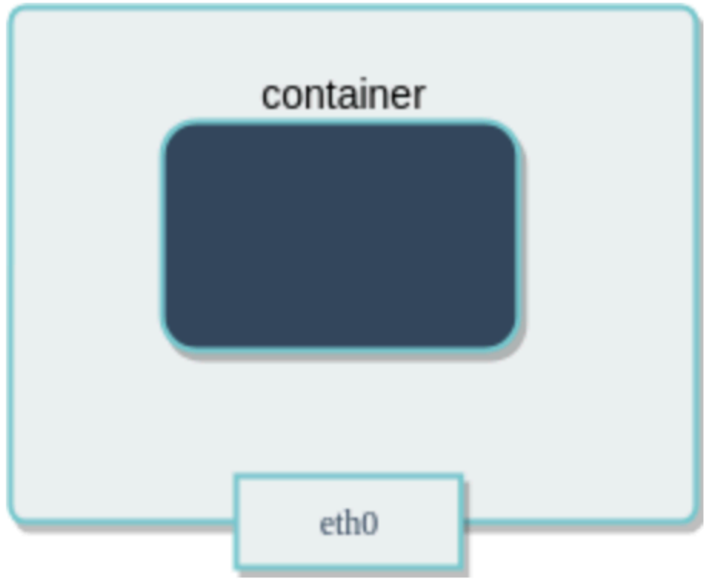
- Port conflicts among containers and other apps running on the same host
- High performance between containers on the same host
- (Virtual) private network between related containers (service mesh)



Container networking: Host

Containers share the IP address (and networking stack) of the host.

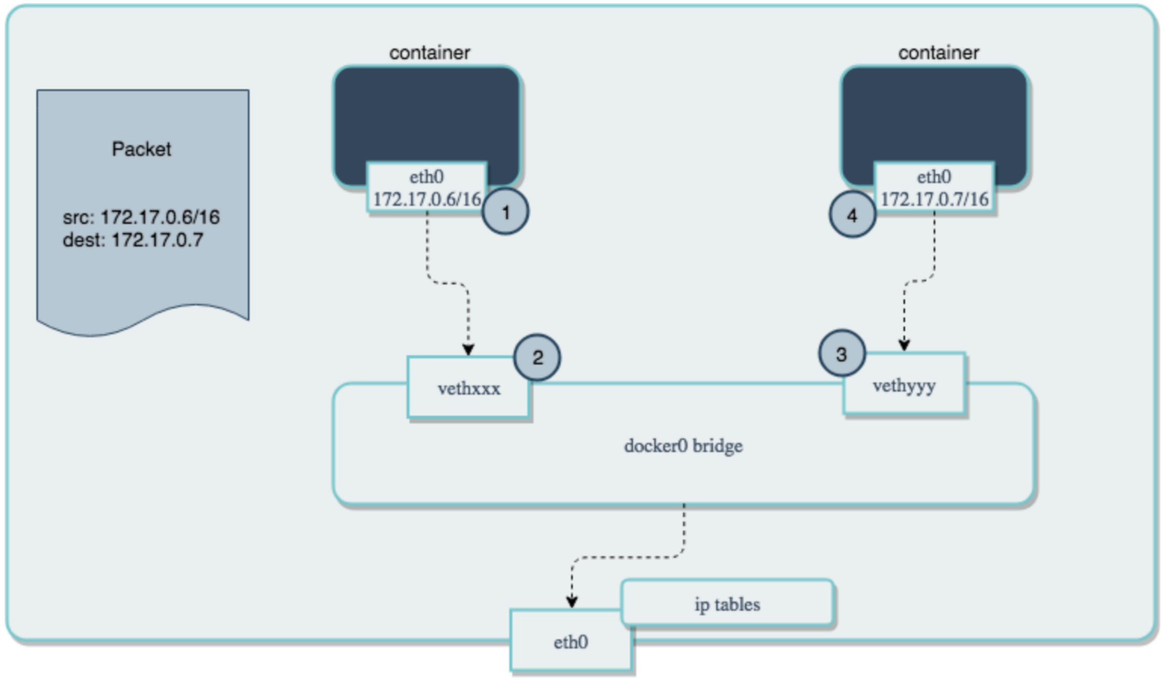
- Cannot handle port conflicts
- Minimal overhead



Container networking: Bridge

An internal network for containers on the same host.

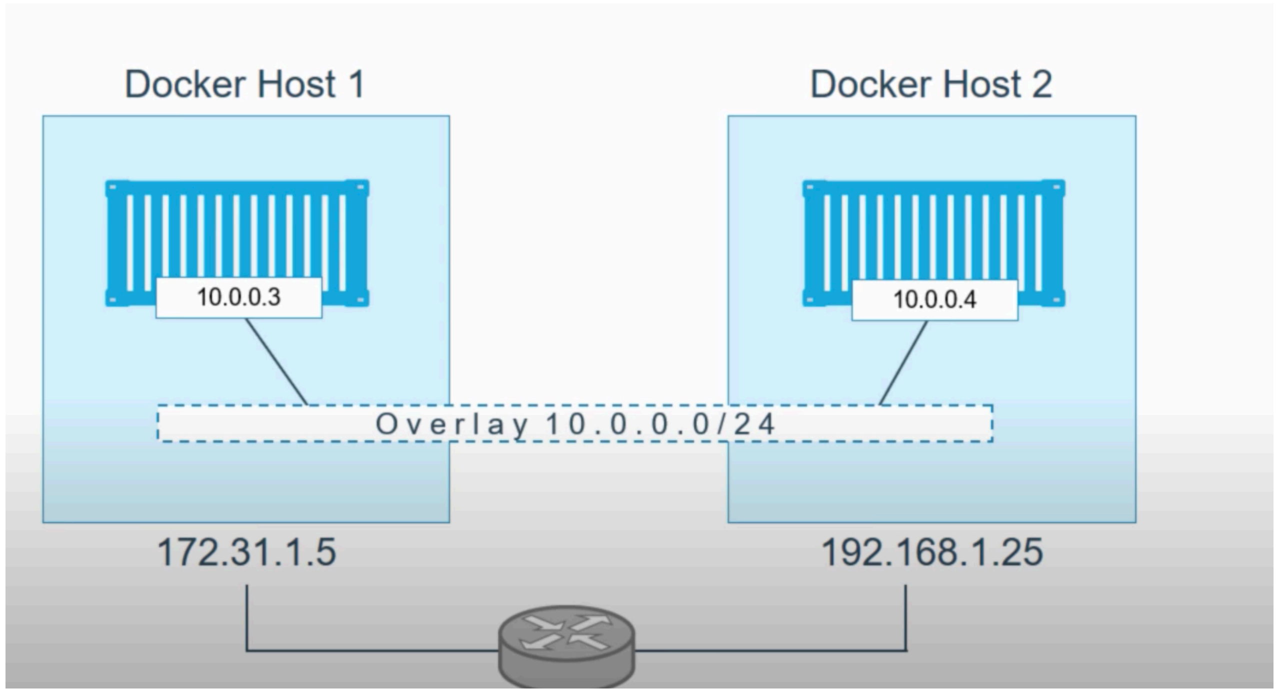
- Use NATs for outside world



Container networking: Overlay

Create a private network across containers on different hosts

- VXLAN is a common way to do that



CNI: Container networking interface

Specification for writing plugins to configure network interfaces

- Decouple runtime from network configuration
- Plugins provide an interface that orchestration engines can use
- GitHub repo: https://github.com/containernetworking/cni