CSE 550: Systems for all

Au 2022

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Building Massive Cloud Networks
Microsoft and Facebook just laid a 160-terabits-per-second cable 4,100 miles across the Atlantic

*Enough bandwidth to stream 71 million HD videos at the same time*

By Thuy Ong | @ThuyOng  | Sep 25, 2017, 7:56am EDT

HUGE data center networks (DCN)

- Thousands of routers
- Hundreds of thousands of servers
Google’s Oregon DC
DCN topologies

- Big iron $\rightarrow$ Commodity switches
Under the hood
DCN topologies

• Big iron → Commodity switches
• 1 Gbps → 10 Gbps → 40 Gbps → 100 Gbps (soon)
• Copper → Fiber

• Often run BGP because of scale and policy controls
Connecting to the cloud

• Public Internet
• VPN from your physical resources to the cloud
• BGP peering
  • E.g., Amazon Direct Connect
Using the cloud

• SaaS - use a software service (e.g., email)
• PaaS - use application building blocks (e.g., database)
• IaaS - launch VMs
• FaaS – run computations

• Build virtual networks
  • Provides the same abstraction as physical networks but with virtual devices
How about the servers?
Originally

```
Hardware
  OS
  Libs
  App
  App
```
Then came virtual machines (VMs)

Hardware 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 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
Current trends

New hardware at the “bottom”
  • FPGA, programmable NICs, TPUs, ASICs

New software systems in the “middle”
  • Service meshes, ML frameworks

New applications and interfaces
  • Serverless computing, edge computing
Over to Dixon and Wenxuan