Abstractions in Networking: Software Defined Networks and OpenFlow
What is an Abstraction?

Block Device
Why is this useful?

mv /home/fred/my_picture.jpg /home/sue

blk = allocate(4096KB, @0xFFFFF12EA16DF2A)
write(*blk, data)

move_head to sector 5
rotate spindle to 7200RPM
magnetize the platter}

....
What are the important abstractions in for networks?
Dest. B | right
Dest. C | right
Dest. A | left
1. Abstraction for the Forwarding Table (OpenFlow)

2. Abstraction for “Routing” State Distribution (SDN)

<table>
<thead>
<tr>
<th>Dest.</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dest. B</td>
<td>right</td>
</tr>
<tr>
<td>Dest. C</td>
<td>right</td>
</tr>
<tr>
<td>Dest. A</td>
<td>left</td>
</tr>
</tbody>
</table>
What is in a switch/router?

- Routing
- Policy
- Operating System
- Specialized Packet Forwarding Hardware
Specialized Packet Forwarding Hardware

Operating System

PCI BUS

Routing Feature

Policy

OpenFlow
OpenFlow Basics
Plumbing Primitives

\(<\text{Match, Action}>\)

**Match** arbitrary bits in headers:

- Match on any header (not only destination)
- Header Patterns define “Flows”

<table>
<thead>
<tr>
<th>Header</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Match: 1000x01xx0101001x</td>
<td></td>
</tr>
</tbody>
</table>

**Action**

- Forward to port(s), drop, send to controller
- Overwrite header, push or pop a new header
Step 1:
Separate Control from Datapath
Step 2:
Cache flow decisions in datapath

“If header = x, send to port 4”
“If header = y, overwrite header with z, send to ports 5,6”
“If header = ?, send to me”
Abstraction 1 in review:

Hardware is decoupled from the software and Most functionality is pushed to Software
1. Abstraction for the Forwarding Table (OpenFlow)

<table>
<thead>
<tr>
<th>Dest. A</th>
<th>left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dest. B</td>
<td>right</td>
</tr>
<tr>
<td>Dest. C</td>
<td>right</td>
</tr>
</tbody>
</table>

2. Abstraction for “Routing” State Distribution (SDN)
Software Defined Networking

SDN Interface

Controller Platform

Control Programs

OSPF

RIP

ISIS

EIGRP
Why SDN Matters

- Decoupling Software from Hardware allows for better network control abstractions.

- Good Network control abstractions can help realize faster, more efficient, more reliable networks.

- New opportunities for Network Management Automation, Troubleshooting, Verification