Flowspacerevisited

**OpenFlow Basics**

**Flow Table Entries**

- **Rule**: 
  - Packet + byte counters
  - 1. Forward packet to zero or more ports
  - 2. Encapsulate and forward to controller
  - 3. Send to normal processing pipeline
  - 4. Modify Fields
  - 5. Any extensions you add!

- **Switch**: 
  - Port
  - MAC
  - src MAC
  - dst MAC
  - Eth type
  - VLAN ID
  - IP src
  - IP dst
  - IP Prot
  - L4 sport
  - L4 dport

- **Action**: 
  - Stats
  - Packet + byte counters

- **Switching**
  - port3
  - 00:20.. 00:1f.. 0800 vlan1 1.2.3.4 5.6.7.8 4 17264 80 port6

- **Flow Switching**
  - port6, port7, port9

- **Firewall**
  - * * * * * * * 22 drop

- **Routing**
  - * * * * * 5.6.7.8 *

- **VLAN Switching**
  - * * 00:1f.. vlan1 *

**Examples**

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**What is a flow?**
- Application flow
- All http
- Jim's traffic
- All packets to Canada
- ...

**Types of action**
- Allow/deny flow
- Route & re-route flow
- Isolate flow
- Remove flow

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Properties of a Flow-based Substrate

- We need flexible definitions of a flow
  - Unicast, multicast, waypoints
  - Different aggregations
- We need direct control over flows
  - Flow as an entity we program: To route, to move, ...
- Exploit the benefits of packet switching
  - It works and is universally deployed
  - It is efficient (when kept simple)

Substrate: “Flowspace”

- Collection of bits to plumb flows (of different granularities) between end points

Flowspace: Simple Example

- Single flow
- All flows from A
- All flows between two subnets

Flowspace: Generalization

- Single flow
- Set of flows
- Field 1
- Field n
- Field 2

FlowSpace: Maps Packets to Slices

- TCP port
- Slice 2
- Slice 3
- IP address
- MAC address

Properties of Flowspace

- Backwards compatible
  - Current layers are a special case
  - No end points need to change
- Easily implemented in hardware
  - e.g. TCAM flow-table in each switch
- Strong isolation of flows
  - Simple geometric construction
  - Can prove which flows can/cannot communicate
Suggested Projects

Route around outages
- Route around failures
  - Implement algorithm to compute shortest paths and install appropriate rules in a network
  - Upon receiving a notification for a broken link recompute shortest paths and update rules

Rule management tools
- Implement and evaluate rule management tools.
  - Periodically check switches in a network (garbage collection).
  - Defragmentation: Merge rules when possible
  - Clean up: Remove unused rules
  - Compress: Create aggregate more compact rules
  - Other sanity checks

Monitoring Radar
- Implement a monitoring radar
  - Use OpenFlow for measurements
  - Scan the flow space over time: Dynamically change the rules you have over time to do finer granularity measurements to specific areas.
  - Take live traffic into account to avoiding spending too much time in inactive regions.

Inter-controller Access Control Signaling
- Denial of Service attack mitigation mechanisms
  - Assume two domains with separate controllers
  - Establish a connection between the controllers and write a simple protocol to notify the remote controller about blocking traffic from specific sources.

Elastic SDN controller
- Elastically scale SDN controller:
  - Monitor load to controller and when it exceeds a threshold span an additional controller and reconfigure switches to balance load.
  - Monitor demand and when it goes below a threshold switch back to a single controller.
Next Steps: Draft Proposal

- Draft proposal (1 page) Due: Thu. 4th of Apr
  - Objectives, Work packages, Deliverables
- Meet with the instructor and discuss proposal: Fri. 5th of Apr
- Incorporate feedback and submit final proposal (2 pages max) Due: Wed. 10th of Apr

This talk wouldn’t be possible without:

- Past slides from:
  - Brandon Heller
  - Yashar Ganjali (CSC2203 Course)
  - Rob Sherwood
  - others

Further Project Ideas