Fast, Accurate Simulation for SDN Prototyping

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Overview

- Motivation
- Related Work
- Goals
- fs-sdn overview and background
- Design and Implementation
- System Evaluation
- Results: Speedup and Accuracy
- Summary
Motivation

- Prototyping, evaluating and debugging SDN applications is hard
  - Increasing scale, diversity, and complexity of apps
  - Will my SDN app behave as expected when deployed in the wild?
  - Does it operate correctly and efficiently at scale?
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SDN prototyping and debugging landscape

Simulation

Emulation

Live Deployment

Custom fluid-flow simulators (e.g., Al-Fares et al., 2008)
Extensions to packet-level simulators (e.g., Klein and Jarschel, 2013)
Mininet (Handigol et al., 2012)

Testbed experiments (e.g., Greenberg et al., 2009)
Virtual slice of a live network (e.g., with FlowVisor, Sherwood et al., 2010)

fs-sdn

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Goals

- A controller API environment to facilitate transition to live environments
- Ability to generate realistic application traffic flows
- Capability to scale up to large networks
- Facilities for detailed debugging and tracing
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fs-sdn Background

• Designed as extensions to the $fs$ network flow record generator (INFOCOM 2011)
  o Written in Python
  o Uses discrete event simulation to drive flow record generation
  o Flowlets instead of packets
  o Accurate to 1 second time scales, way faster than ns2
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fs-SDN design and implementation

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System evaluation

- Set up congruent experiments in fs-sdn and Mininet

Traffic
- CBR
  (10 and 100 Mbps)
- Harpoon Traffic
  (5 and 25 Mbps)

Topology
- 1
- 10
- 50
- 100

Controller
- L3 Shortest Path
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Results: accuracy

Difference??
fs-sdn ignores packet headers

CBR low load (10 Mb/s),
small topology (10 switches)
Results: accuracy

Performance impact of underlying host

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Results: accuracy

CBR high load (100 Mb/s), medium topology (50 switches)
Results: speedup

- Tables show fs-sdn execution times for scenarios with 900 simulated seconds

<table>
<thead>
<tr>
<th>Load</th>
<th>Tiny</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
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<tr>
<td>Low</td>
<td>6</td>
<td>8</td>
<td>33</td>
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<tr>
<td>High</td>
<td>4</td>
<td>8</td>
<td>31</td>
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<thead>
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<tbody>
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<tr>
<td>High</td>
<td>30</td>
<td>62</td>
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Summary and future work

• Fast and Accurate Simulation
• Seamless transition of controllers to “real” deployments
• Code available: https://github.com/jsommers/fs

• Continued work
  o Debugging and tracing capability
  o Improve scalability through parallelizing fs
  o Is it possible to bridge other (including non-Python) controller platforms?
Thank You

Questions?

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