FloodGuard: A DoS Attack Prevention Extension in Software-Defined Networks

DSN 2015

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- This paper address on *data-to-control plane saturation attack*, which overloads the infrastructure of SDN networks.
  - amount of *table-miss* packets
  - consume resources

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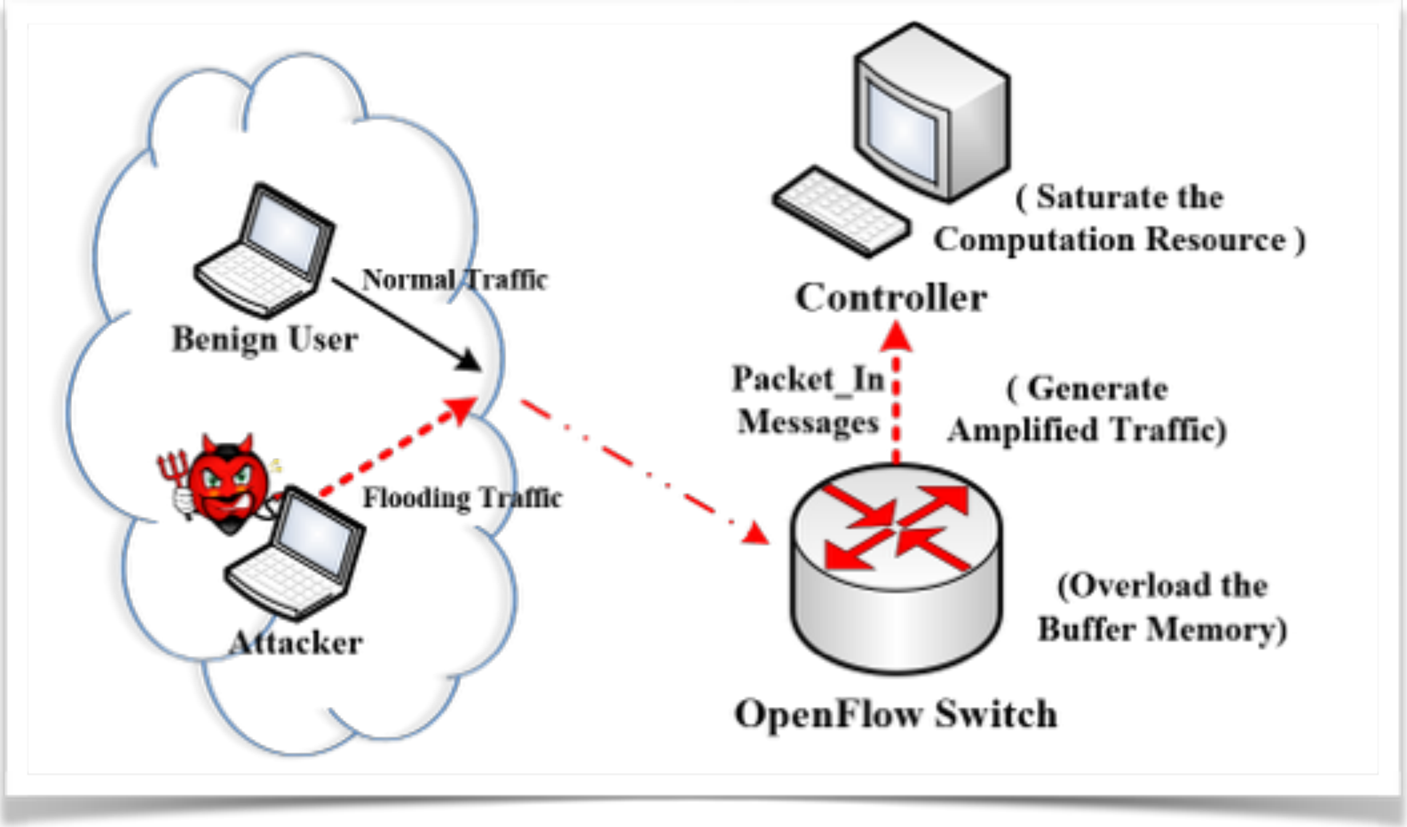
(Saturate the Computation Resource)
Controller
Normal Traffic
Benign User
Packet_In Messages
(Generate Amplified Traffic)
Flooding Traffic
Attacker
(Overload the Buffer Memory)
OpenFlow Switch

FLOODGUARD

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- Proactive Flow Rule Analyzer
- Packet Migration

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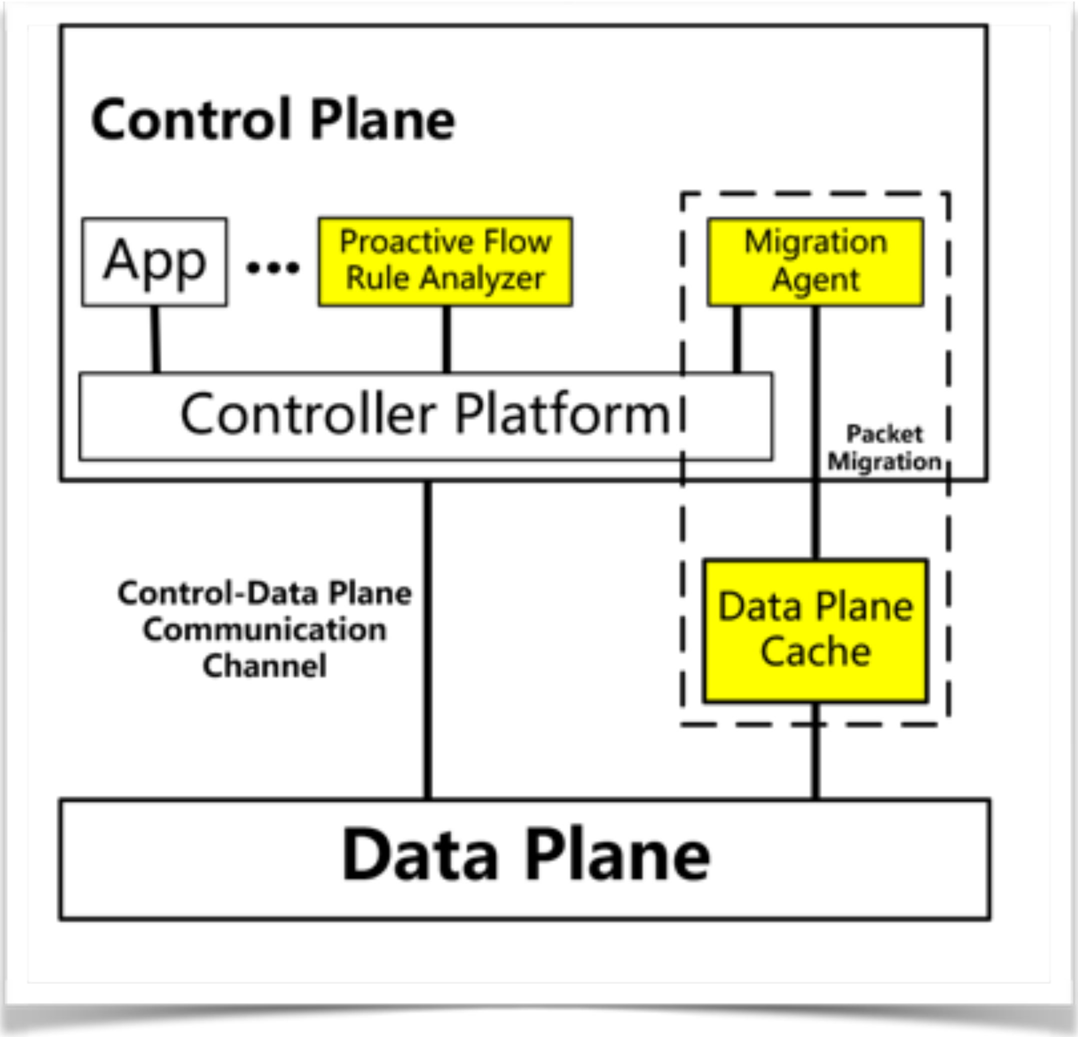

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HOW CAN WE ADDRESS THIS CHALLENGE??

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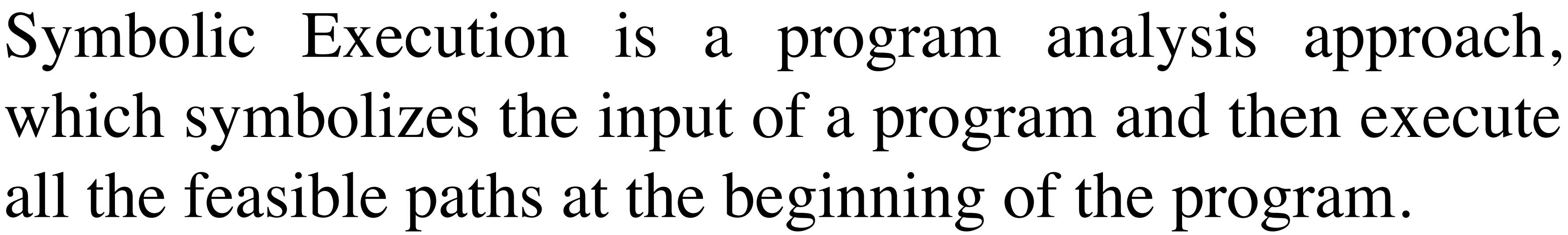
Symbolic Execution



Symbolic Execution is a program analysis approach, which symbolizes the input of a program and then execute all the feasible paths at the beginning of the program.

Proactive Flow Rule Analyzer

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A sample symbolic execution

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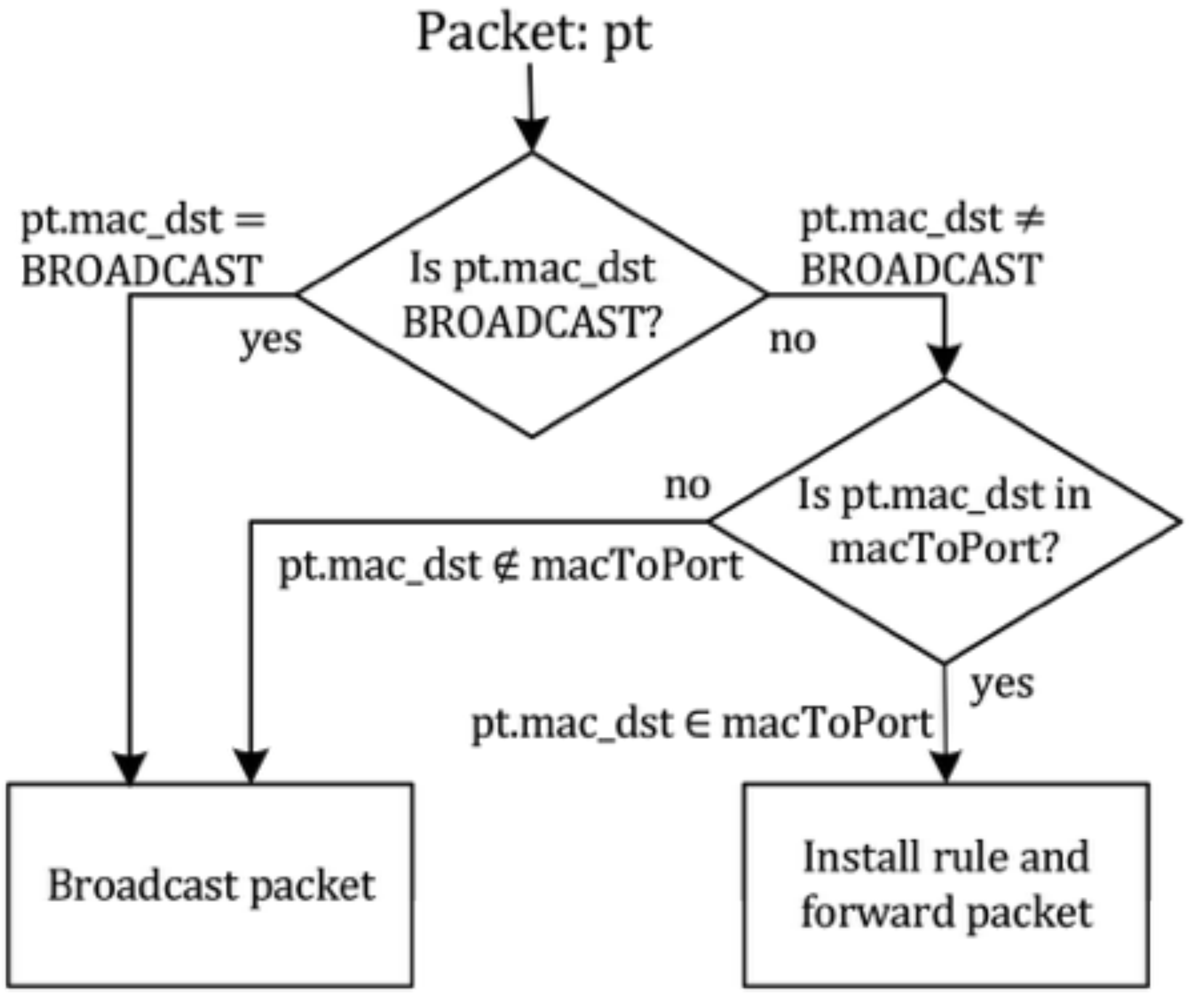

Proactive Flow Rule Analyzer

Symbolic Execution

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Symbolic Execution

OFFLINE

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Symbolic Execution

- OFFLINE
  - For the sake of reducing runtime overhead.

Proactive Flow Rule Analyzer

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RUNTIME

Proactive Flow Rule Analyzer

Symbolic Execution

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For the sake of reducing runtime overhead.

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For the sake of solving the dynamical change.

Packet Migration

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It is unacceptable that drop the table-miss packets.

1. Some events are not processed.
2. The new packets cannot be learned by analyzer.

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Migration Agent

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1. Detect the saturation attack
2. Migrate table-miss packets
3. Rate limit

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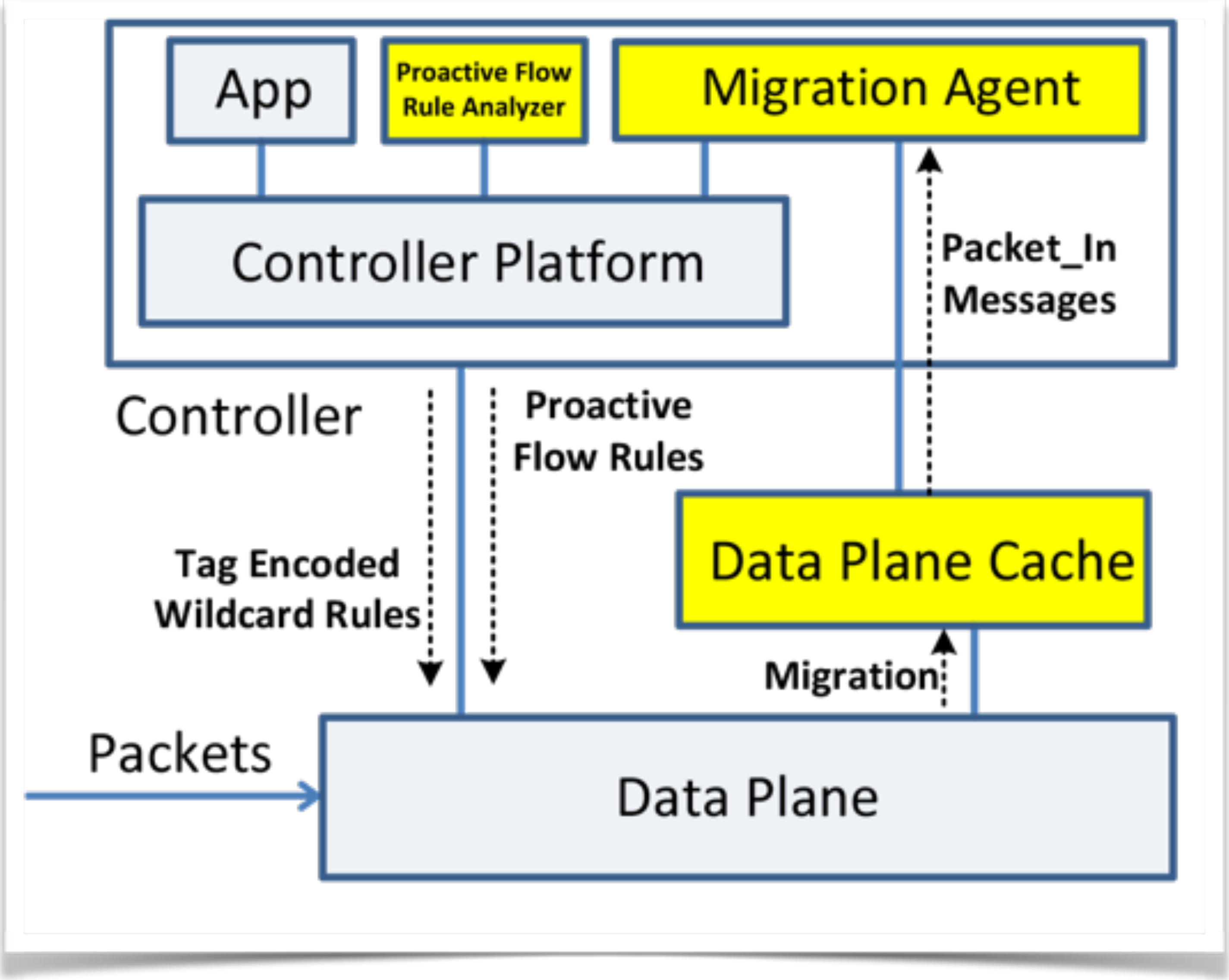

Packet Migration

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Data plane cache

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1. Packet classifier
2. Buffer queue
3. Packet-in generator

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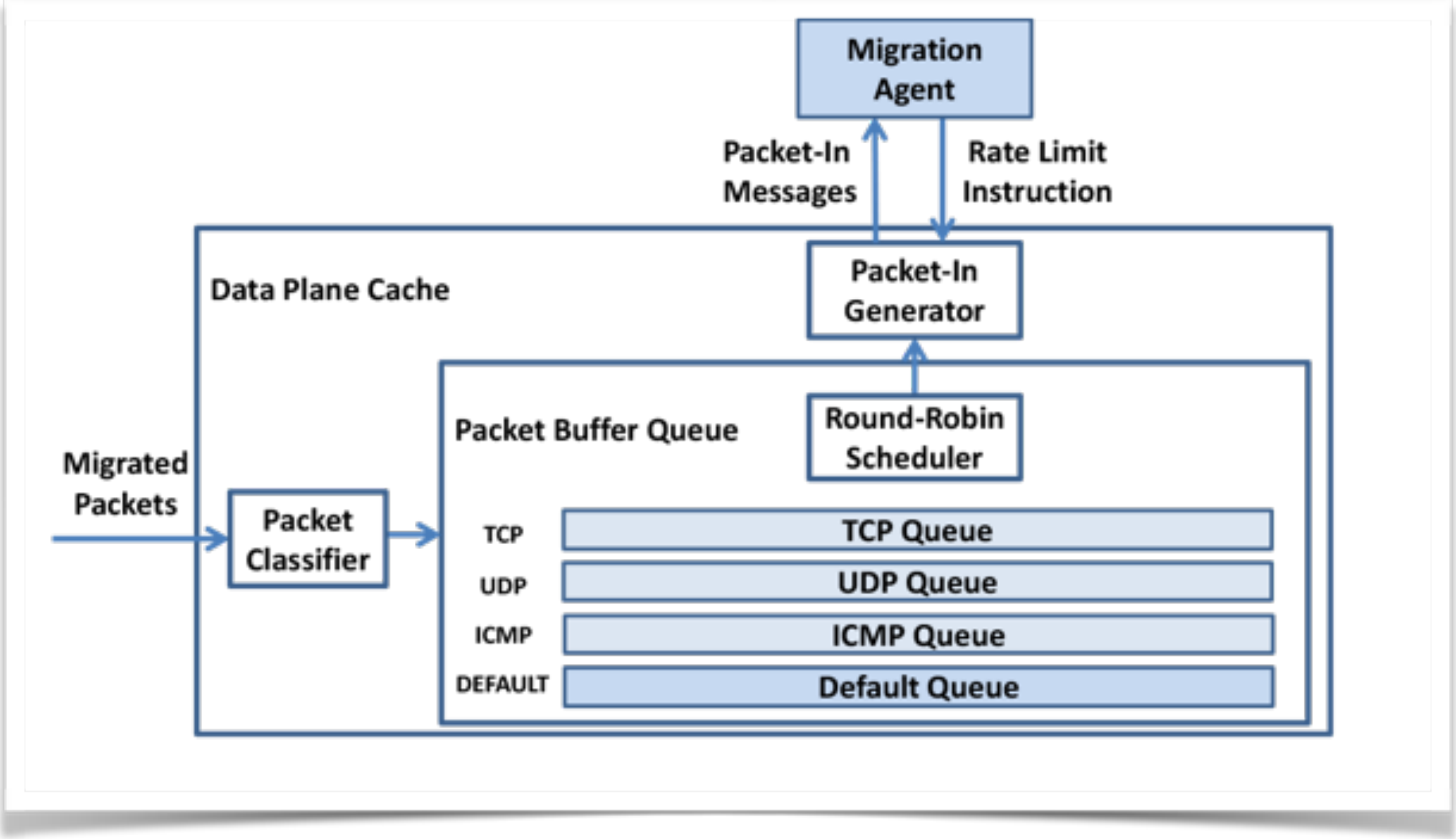

Evaluation

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1. Software

   -MININET

2. Hardware

   -OpenFlow-enabled commercial LinkSys WRT54GL switch

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Controller: POX

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Topology:

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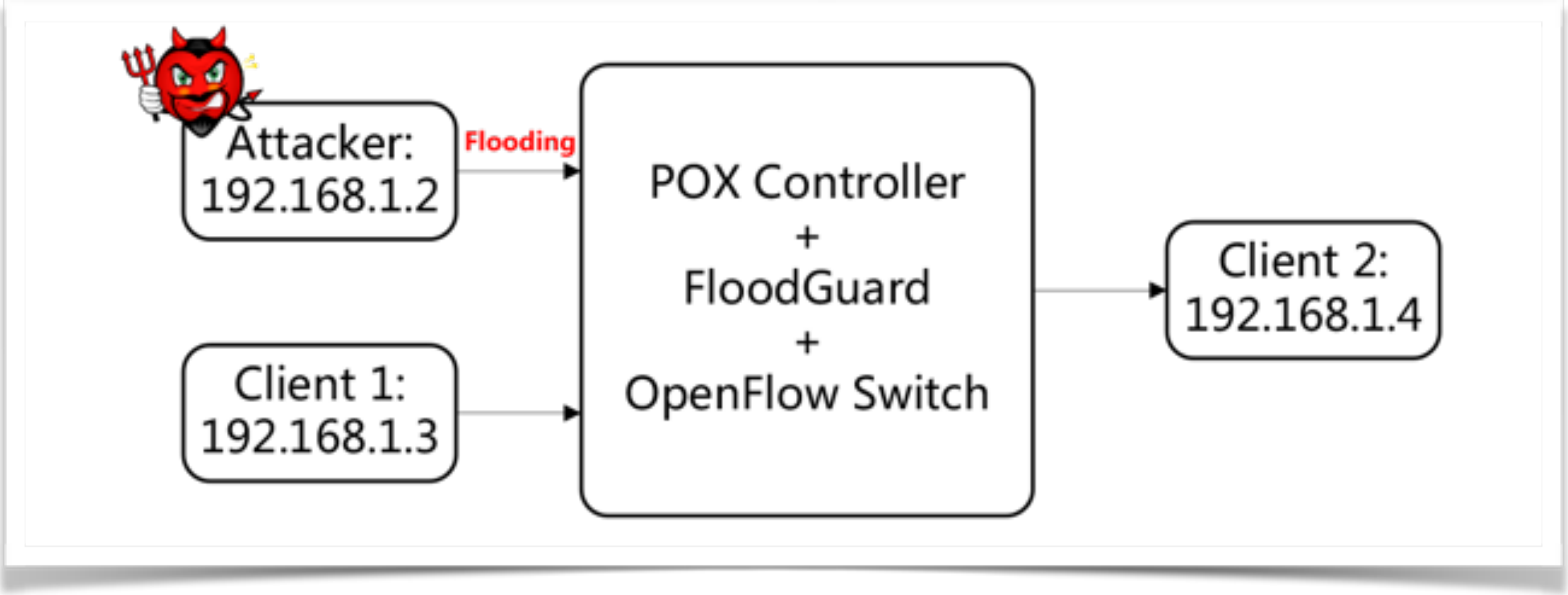

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Defense Effects

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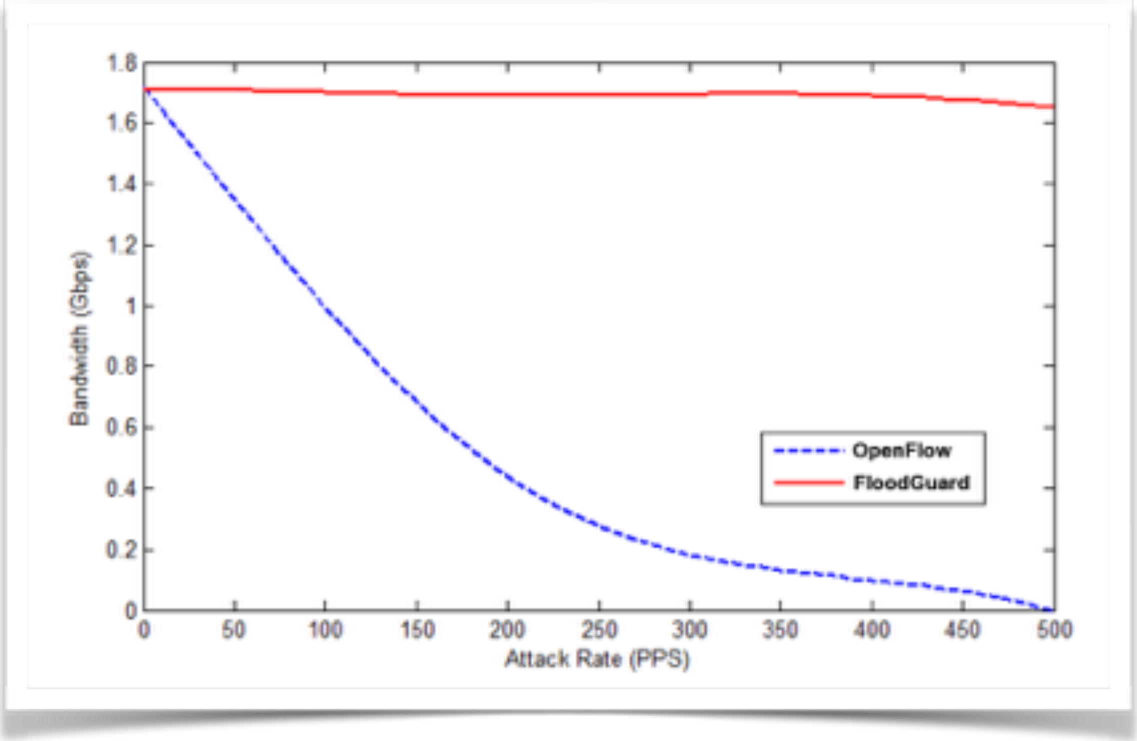

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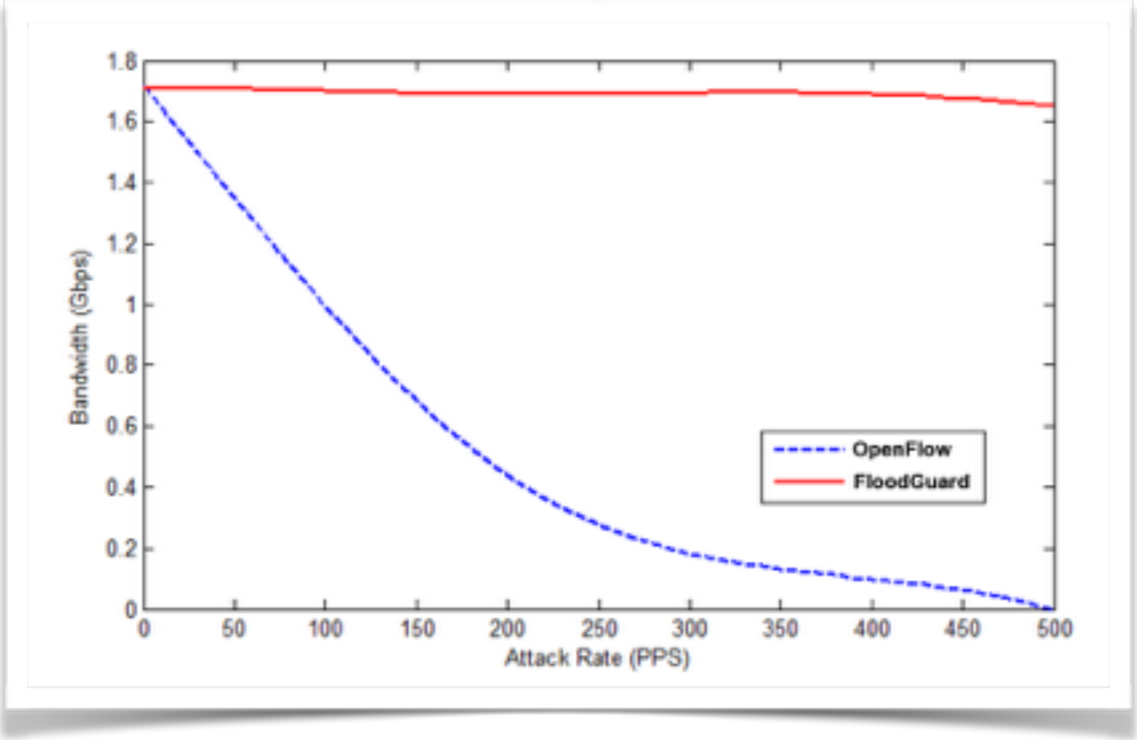

Software

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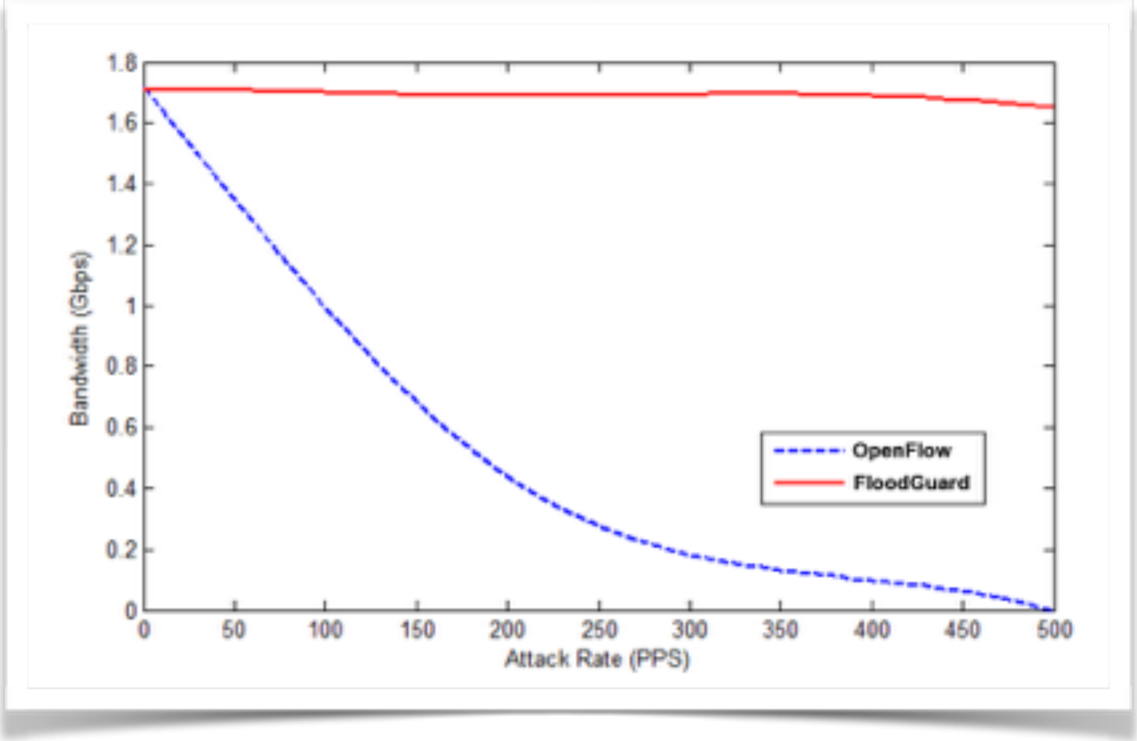
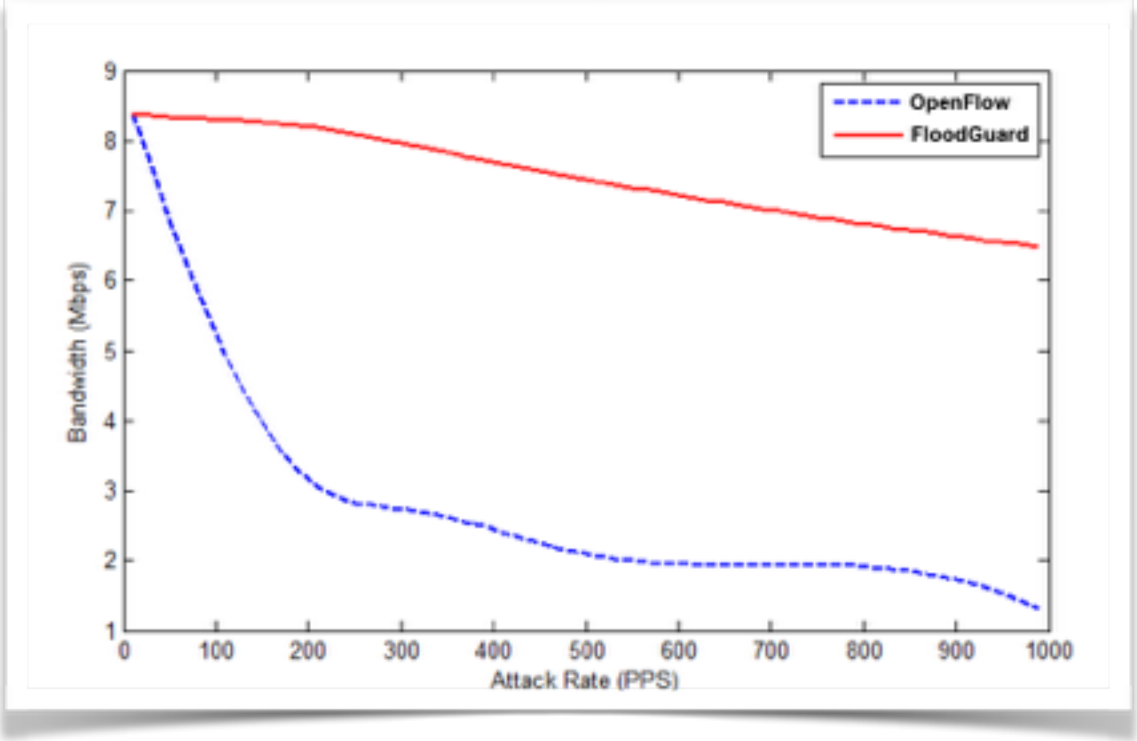
Defense Effects





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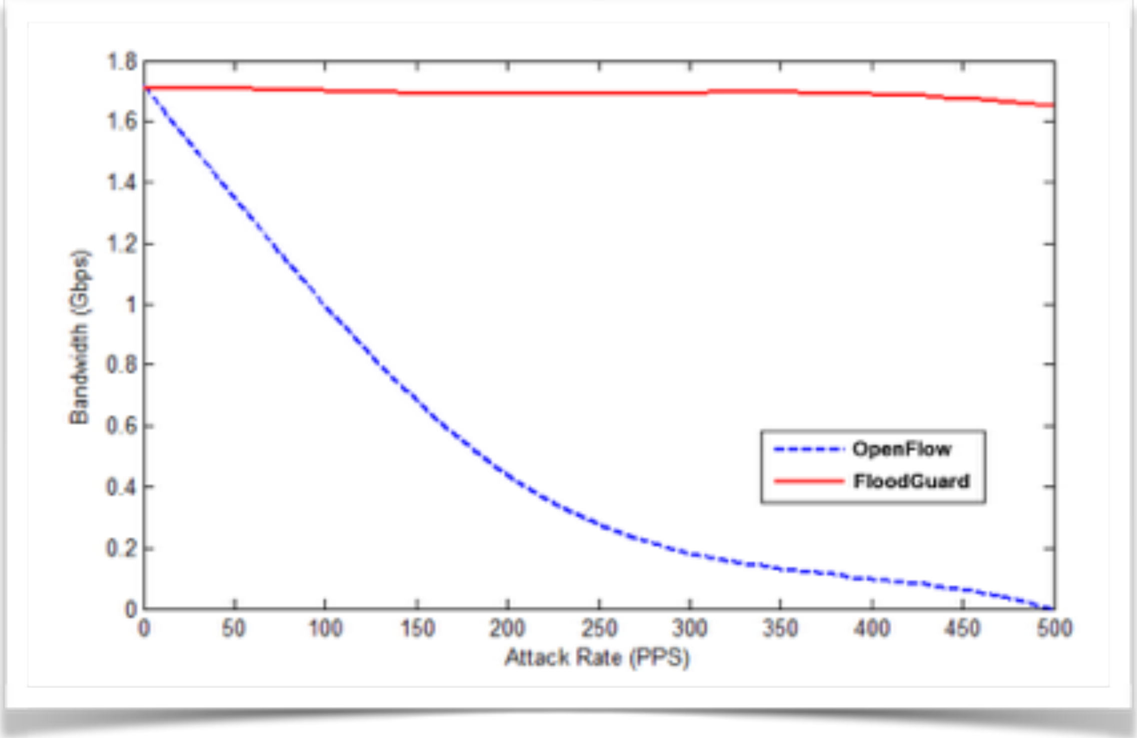

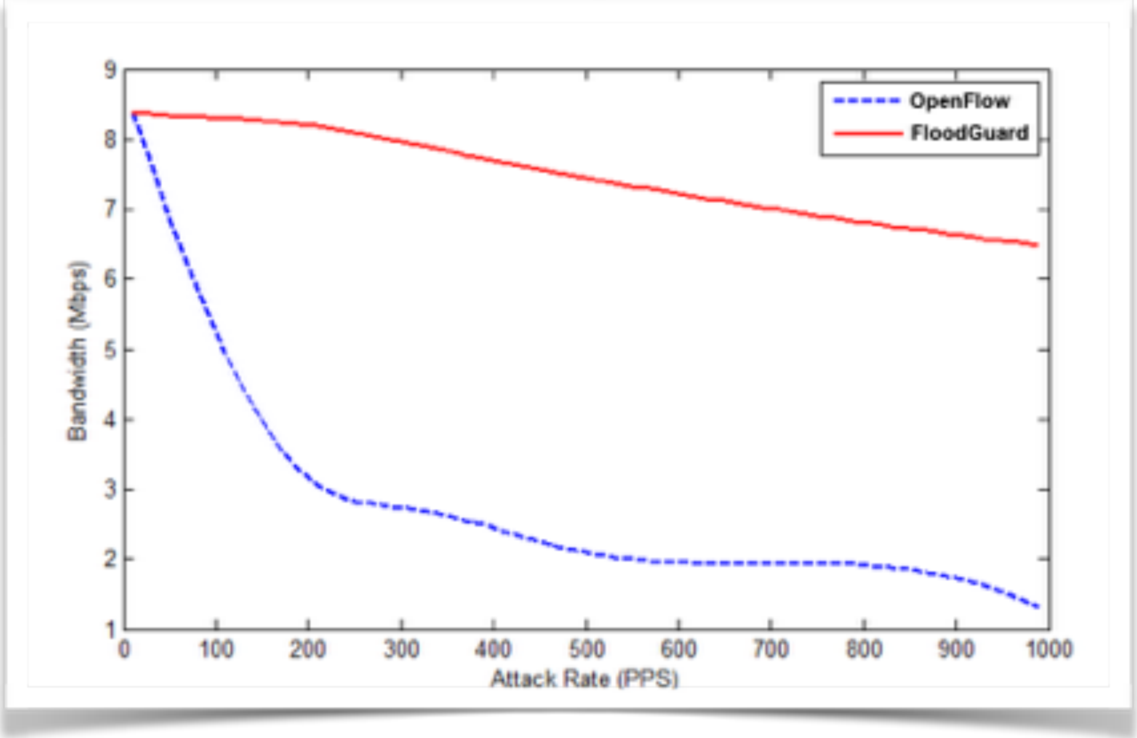

Software

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Saturation attack: 100PPS

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Defense Effects

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1. L2_learning
2. L3_learning
3. LoadBalancing
4. Firewall
5. MAC_blocker

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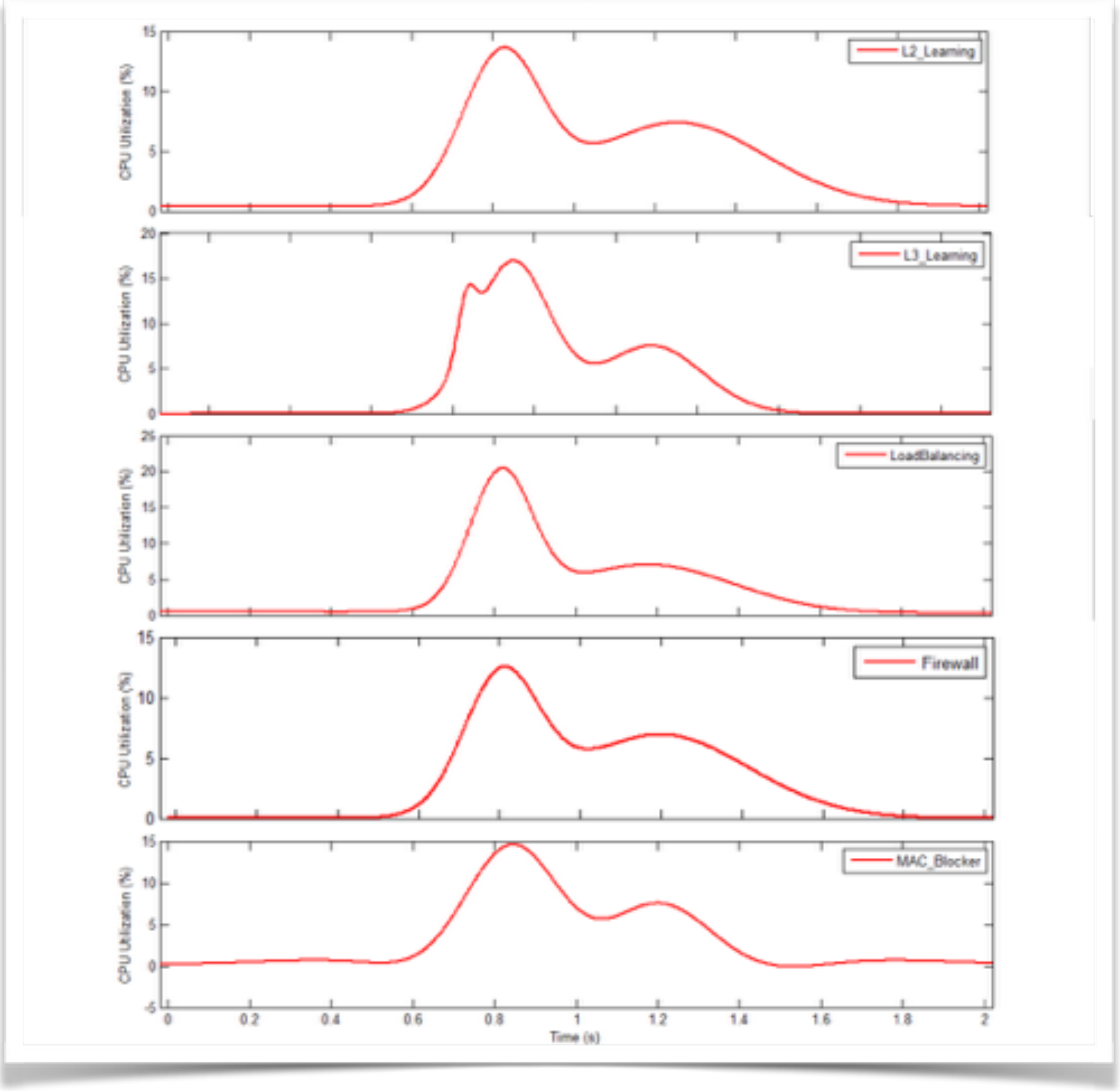

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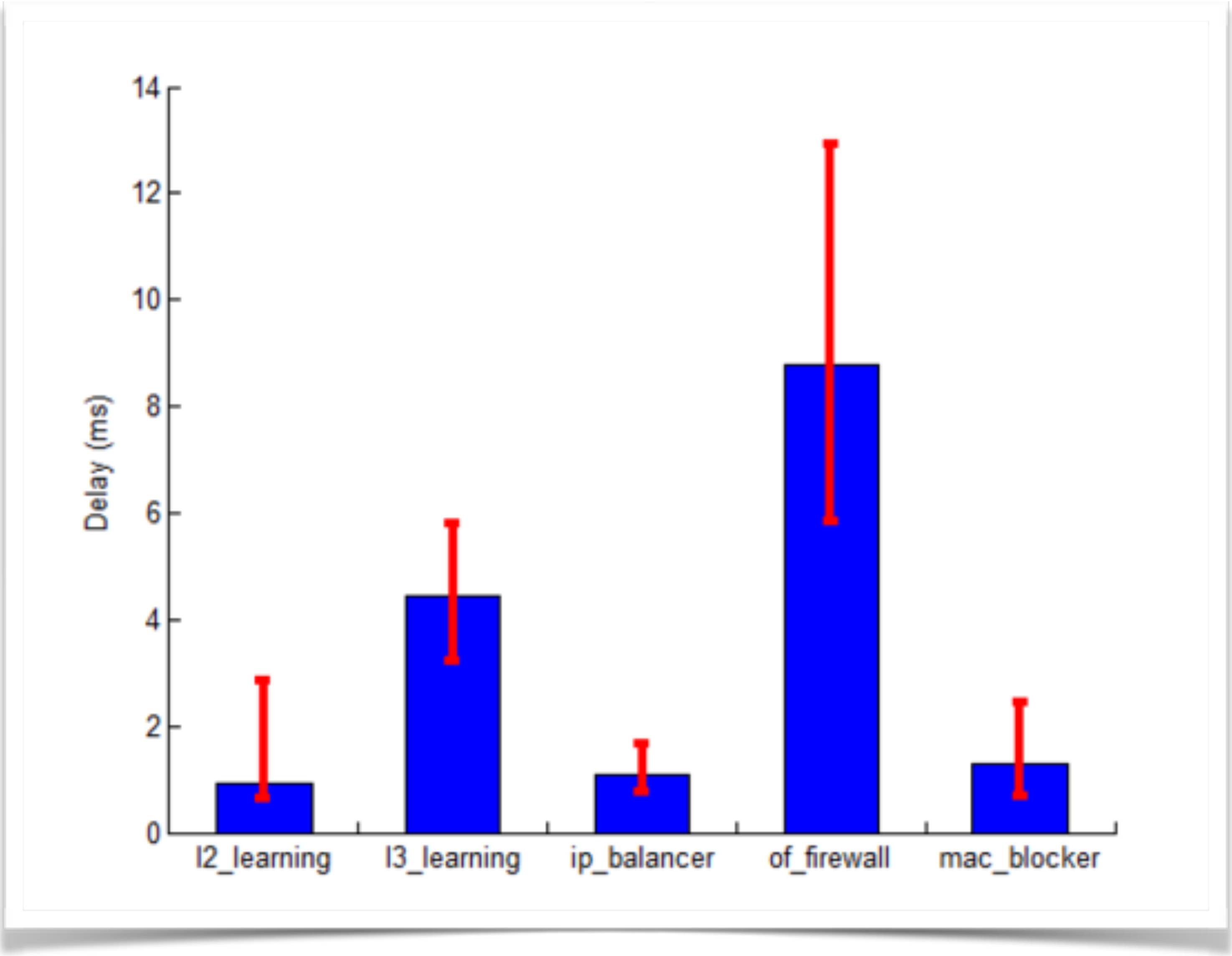

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AVERAGE DELAY OF THE FIRST PACKET IN EACH NEW FLOW

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Overhead

AVERAGE DELAY OF THE FIRST PACKET IN EACH NEW FLOW

OpenFlow	OpenFlow+FLOODGUARD		
Total	Total	Data Plane Cache	Packet Migration
130ms	157ms	30ms	127ms