Bohatei: Flexible and Elastic DDoS Defense

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Project Silver

Motivation

DDoS attacks are increasing in number, volume, and diversity.

DDoS defense today relies on proprietary hardware appliances deployed at fixed locations.

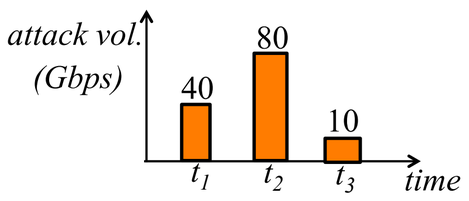
Fundamental limitations of the current approach:
1. High capital cost
2. Fixed capacity
3. Fixed functionality
4. Fixed location

High capital cost

Price of DDoS Defense Appliances

Bit Rate	Price
1Gbps	$11,000-$38,000
4Gbps	$68,000
12Gbps	$128,000

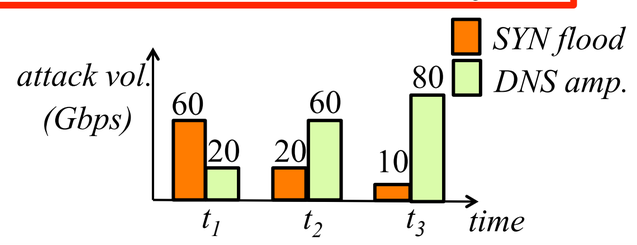
Fixed capacity



Today: Hardware appliance res. footprint=240Gbps

Ideal: Elastic scaling res. footprint=130Gbps

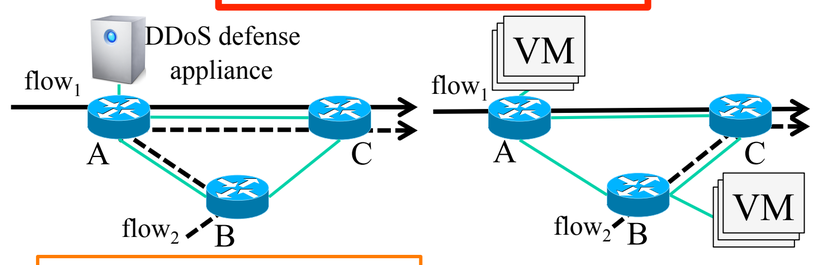
Fixed functionality



Today: hardware appliance res. footprint=420Gbps

Ideal: elastic scaling res. footprint=250Gbps

Fixed location



Today: traffic footprint given hardware appliance=3 hops

Ideal: traffic footprint given elastic scaling=2 hops

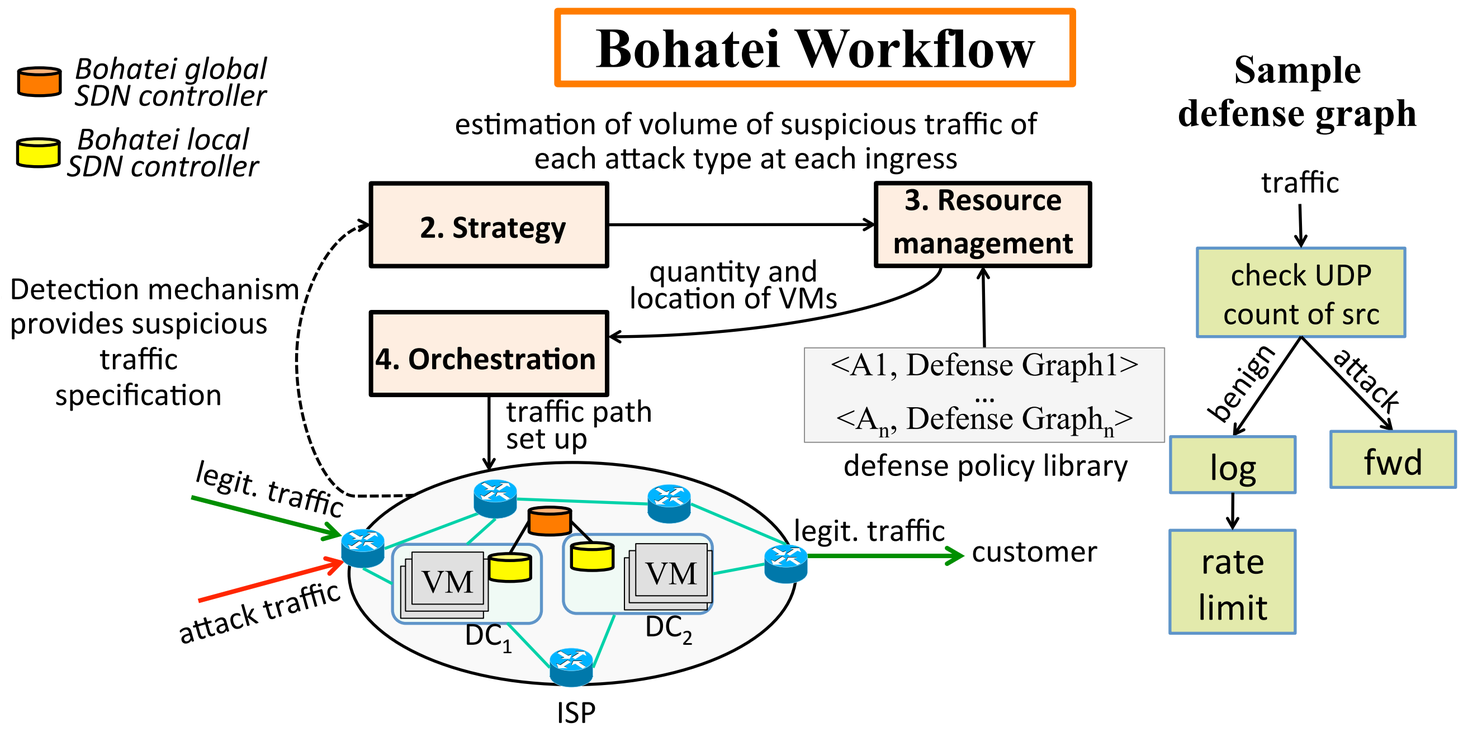
Vision: Enabling Flexible and Elastic Defense using Bohatei

Can we build a *flexible* and *elastic* DDoS defense platform that can handle attacks with varying type, volume, and location?

- Flexibility in traffic steering using SDN
- Elasticity in defense deployment using NFV

Bohatei envisions a four-step workflow:
1. Attack detection (using existing methods)
2. Estimation of volume of attack traffic
3. Resource management
4. Network orchestration

Bohatei Workflow



Sample defense graph

Bohatei Key Ideas

Challenges

1- Responsive resource management: Optimal decision making about the number and type of defense VMs takes hours.

2- Scalable network orchestration: The existing SDN approach to set up switch forwarding rules in a *per-flow* and *reactive* manner swamps the SDN controller.

3- Coping with dynamic adversaries that may quickly change the type, volume, and ingress of attack.

Ideas

1- Hierarchical optimization decomposition:
- The ISP-wide controller determines how many and what types of VMs to run in each datacenter
- Each per-datacenter controller determines the specific server on which each defense VM will run.

2- Proactive tag-based forwarding:
- Forwarding rules based on per-VM tags
- Pro-active switch configuration

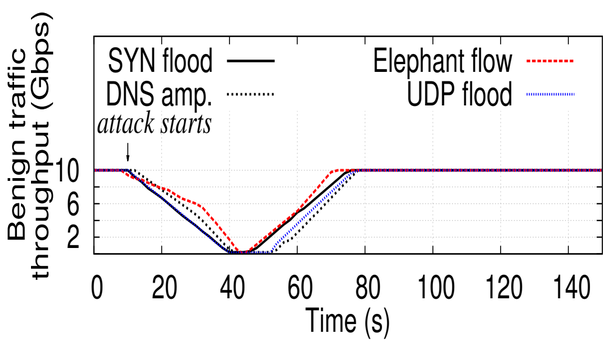
3- Online adaptation: A defense strategy adaptation approach inspired by online algorithms for minimizing *regret* (i.e., how much better we could have done in retrospect)

Key Results

Implementation

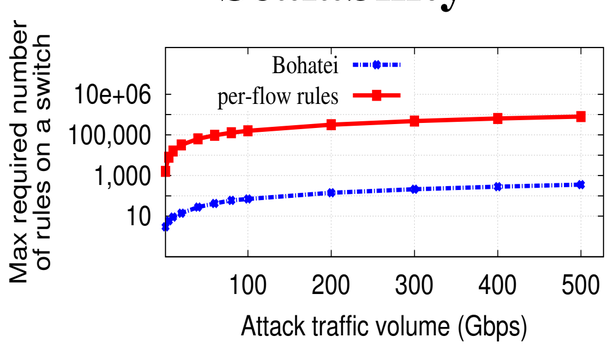
- Implementation of a Bohatei controller using OpenDaylight
- Use of open source tools (e.g., OpenvSwitch, Snort, Bro, iptables) as defense modules
- Evaluation on a real testbed as well as using simulations
- Code is made available

Responsiveness



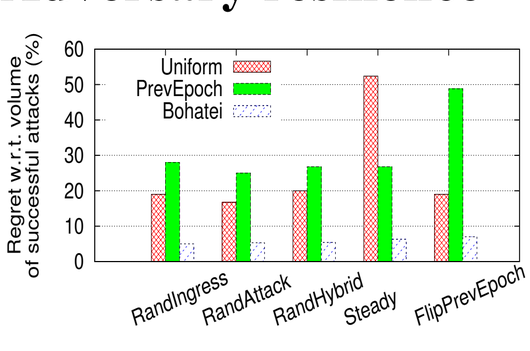
Bohatei responds rapidly (<1 min) to diverse attacks.

Scalability



Handling ~1Tbps attacks requires <1K rules on a switch

Adversary resilience



Bohatei's online adaptation achieves low regret

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project homepage

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