Processing Network Traffic at Line Rate

Jorge Crichigno

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at University of South Carolina

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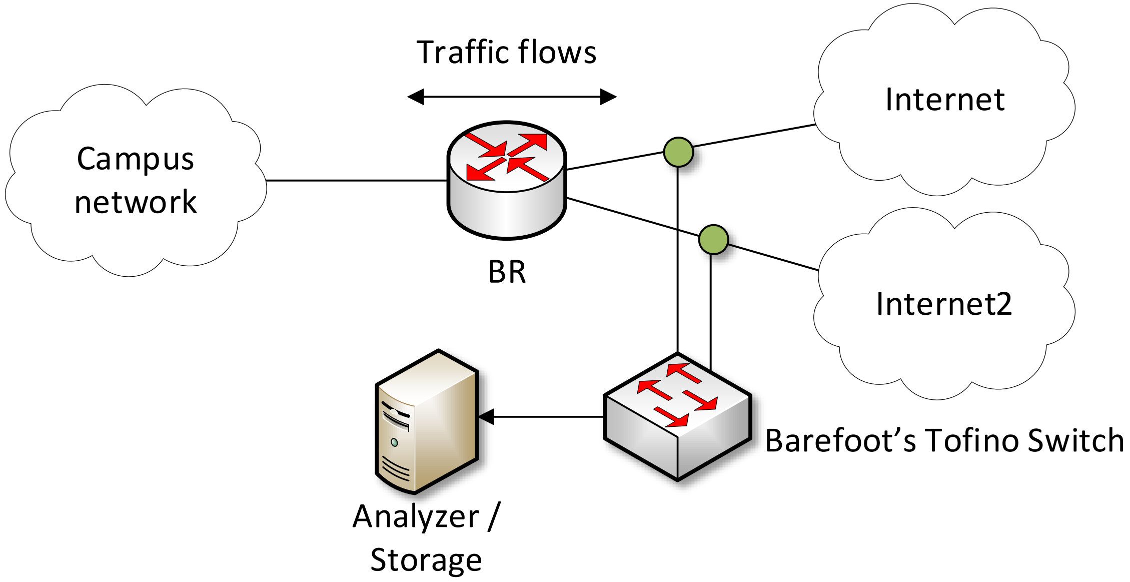
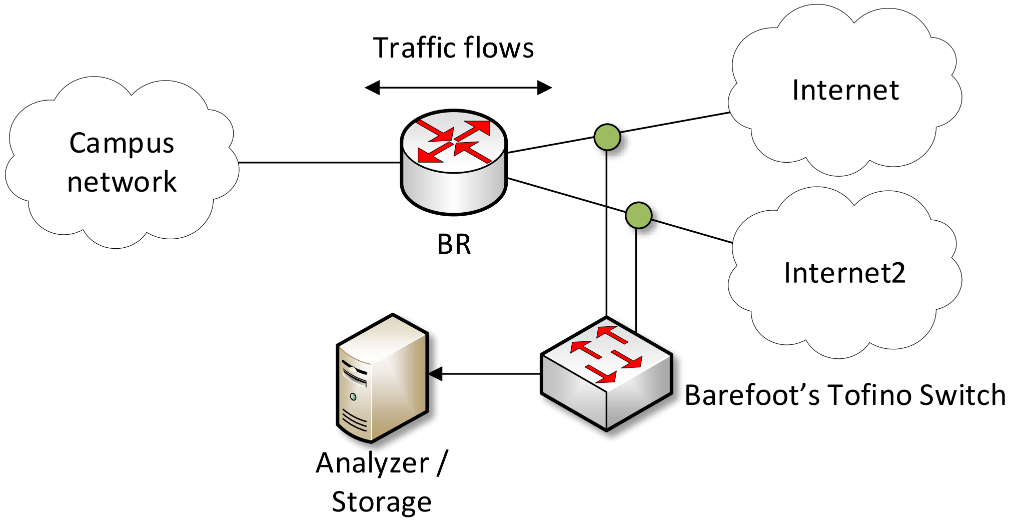
Streaming Analytics

- Streaming analytics of a campus network at line rate (100 Gbps)
- The topology consists of a Barefoot's Tofino switch that receives traffic from two taps reading traffic to/from Internet and Internet2
- An analyzer and storage server are also attached to the Tofino switch to collect the data processed by the switch



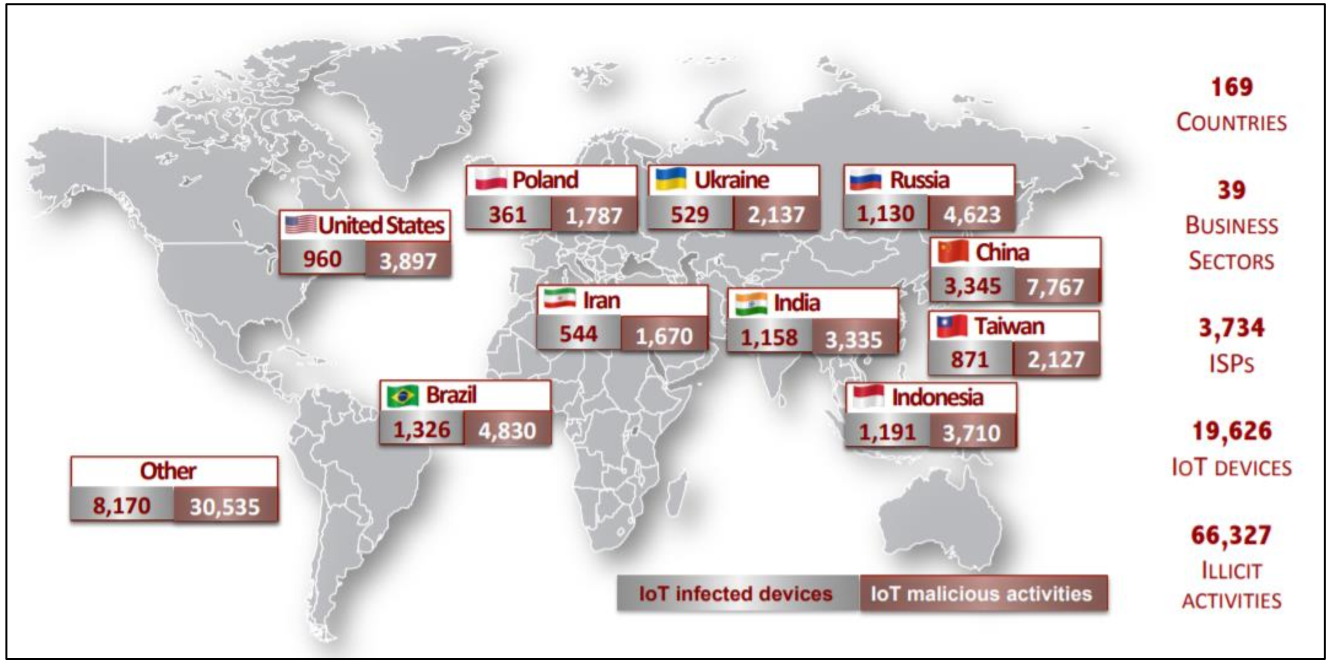
Streaming Analytics

- The Barefoot’s Tofino switch will process packet headers only; payload is discarded
- The switch will track and store flow information only (for example, src-dst IPs, src-dst ports, application layer protocol, TCP flags, number of bytes, inter-packet arrival time, flow duration, latency between src-dst pair)
- The system can anonymize traffic to feed to streaming analytics (analyzer), if needed (for example, anonymizing src / dst IP or portions of them)
- Switch can remove all Personally Identifiable Information (PII) at line rate

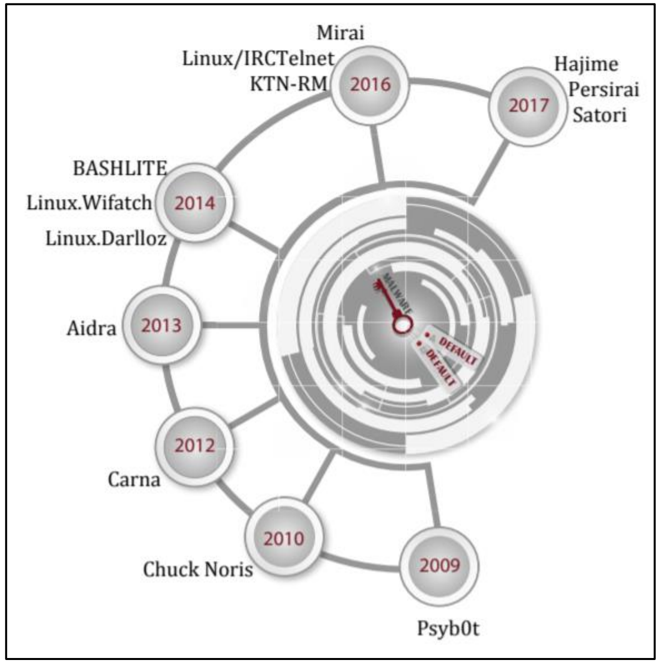


Streaming Analytics

- There is no campus network doing data analytics at line rate
- The following is an example of the type of work that can be executed
  - Detect compromised devices on campus at line rate, using passive data
  - Similar work has been conducted on non-real time, using traffic from the Center and Center for Applied Internet Data Analysis (CAIDA, www.caida.org) (University of California San Diego)



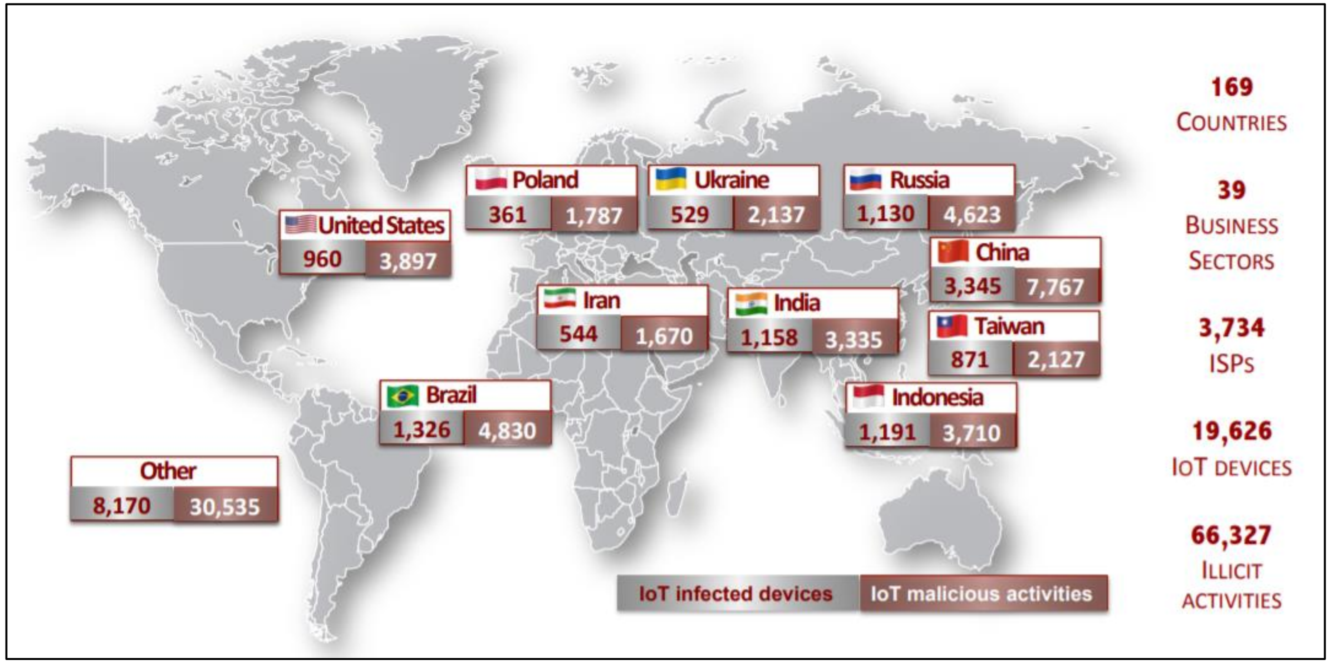
Global distribution of exploited IoT devices; results from UofSC research



Malware exploiting default credentials

Streaming Analytics

- Global distribution of exploited IoT devices by passively analyzing packet headers from CAIDA
  - Exploited IoT devices: these devices are contacting ‘unavailable’ IP addresses (this IP block is referred to as ‘Darknet.’ No healthy device would contact this IP block)



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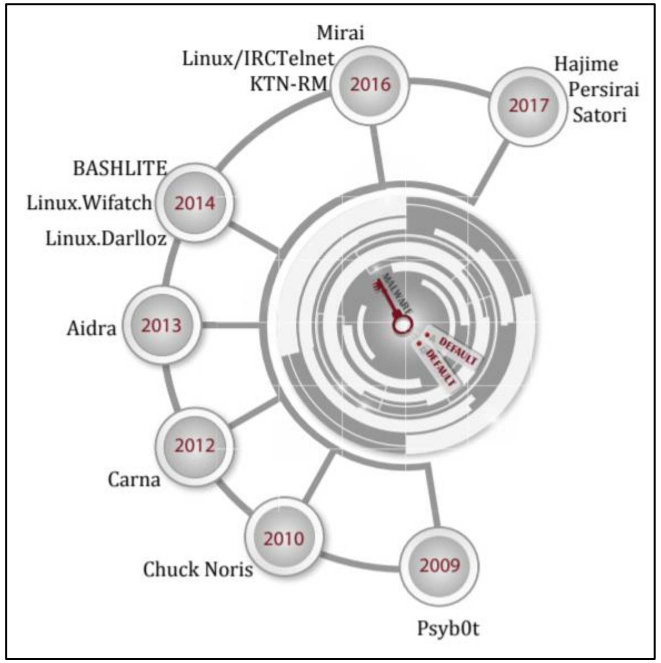

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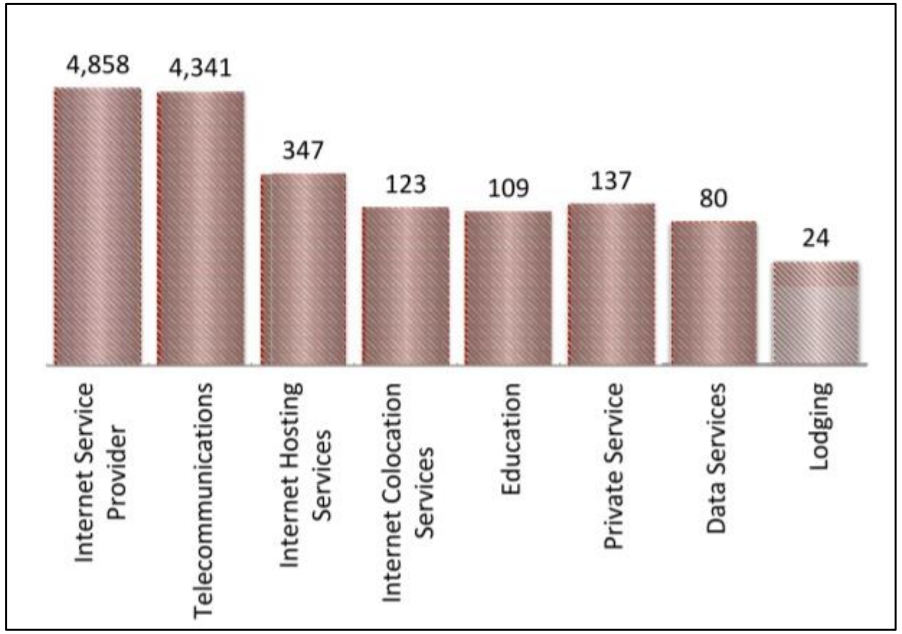
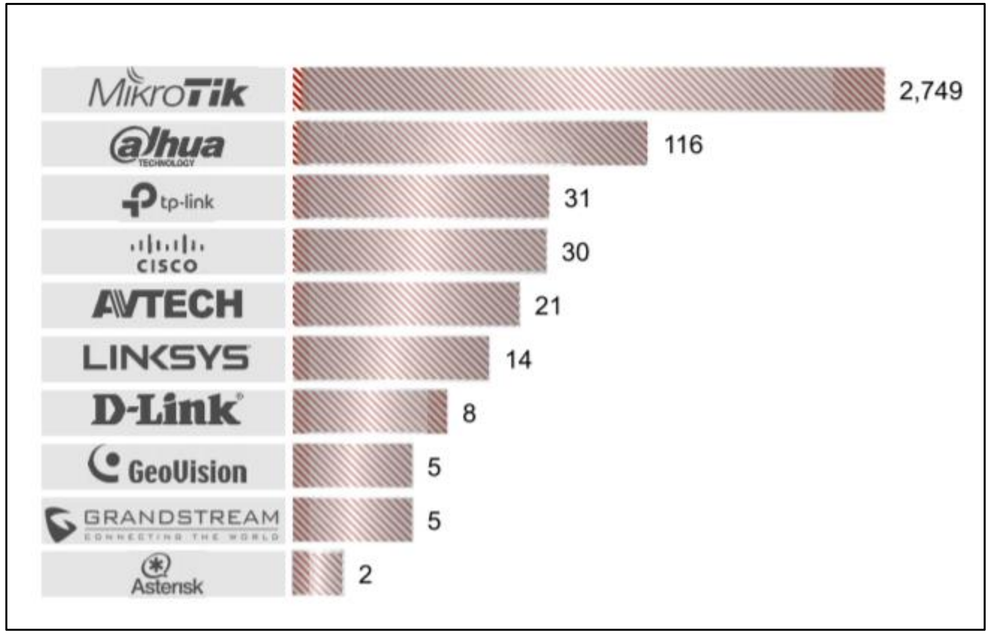


Top sectors hosting exploited IoT devices



Top ten manufacturers of exploited IoT devices

Streaming Analytics

- This data will enable undergraduate and graduate research work
- Novel results regarding the type of threats faced by a large campus network
- Processing and detection at line rate or near line rate
- Strengthen the results of current funded project
- Funding opportunities

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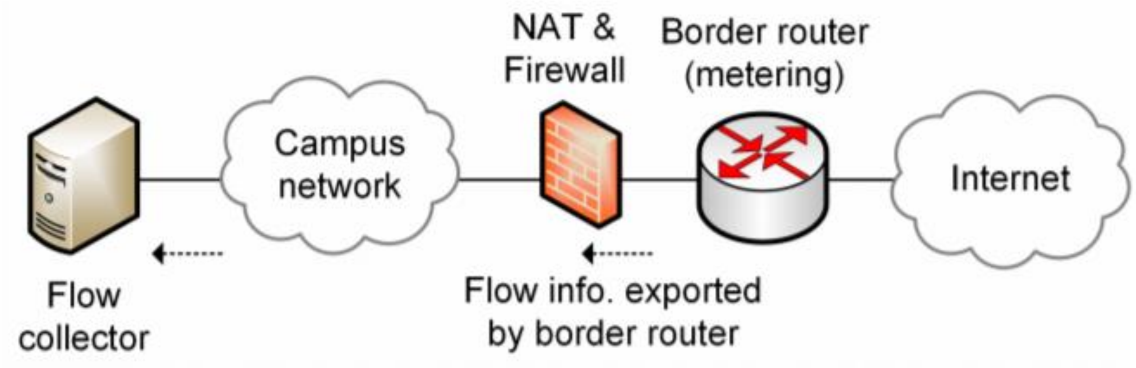
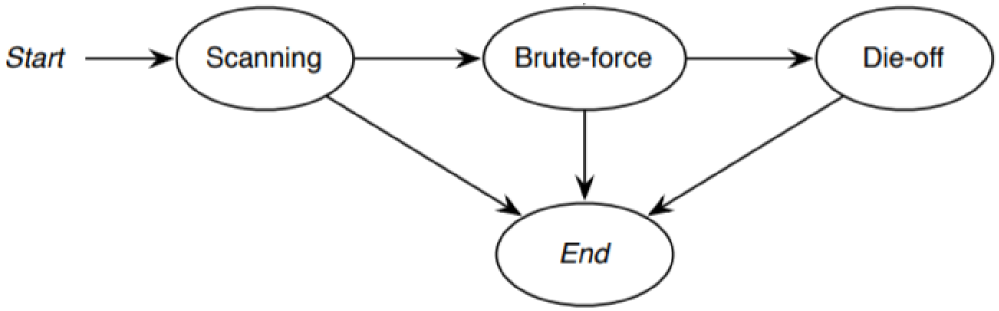
Office of Advanced Cyberinfrastructure

Cybersecurity Innovation for Cyberinfrastructure (CICI)

Honeypot

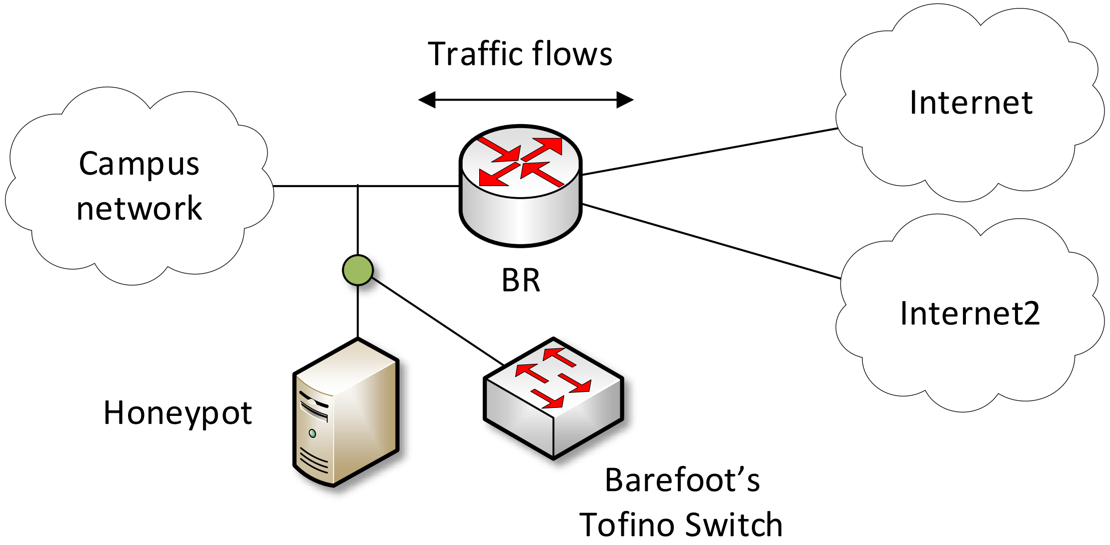
- Flow-based intrusion detection uses flow information to detect malicious activities
- Payload is not used
- Some legacy networks use Netflow to collect flow statistics; for example, SSH compromise detection





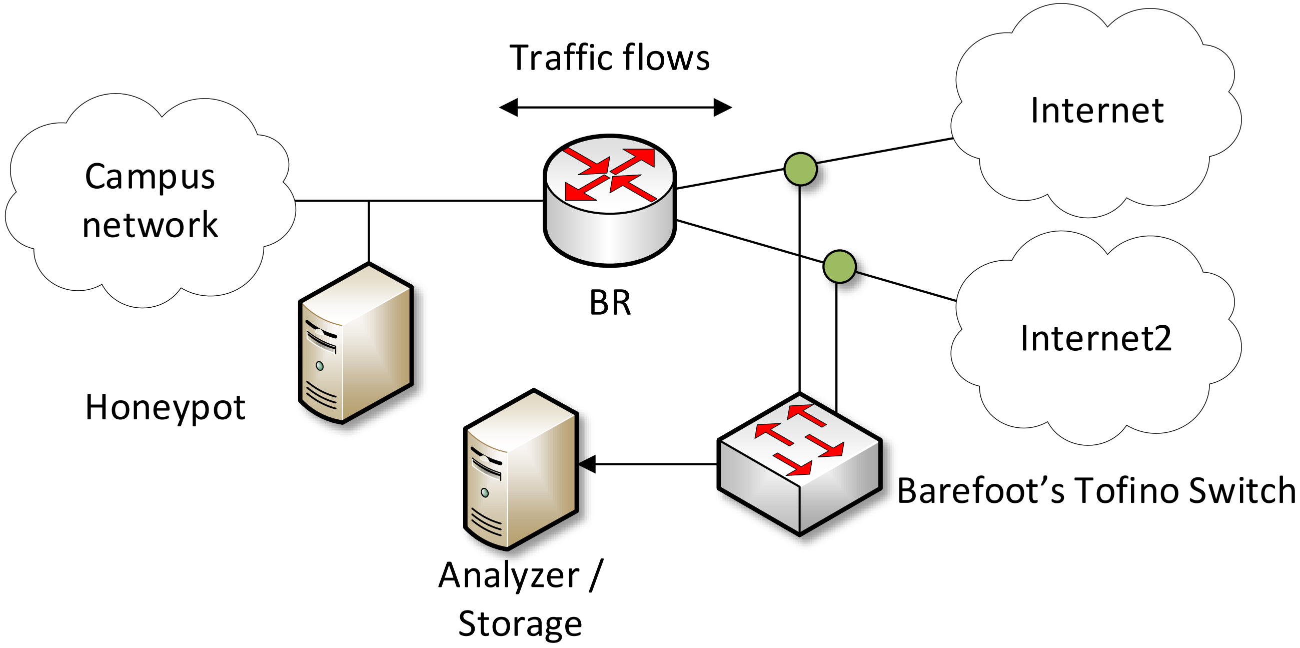
Honeypot

- The main idea is to use the programmable switch as an instrument to detect malicious activities in real time or near real time
- Customized processing (no dependency on Netflow implementations)
- Granular time resolution



Honeypot + Streaming Analytics

- Network topology


Traffic flows
Campus network
Internet
Internet2
BR
Honeypot
Analyzer / Storage
Barefoot's Tofino Switch