GENI Trace Collection for Security Studies

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Questions

1. What assets are you trying to protect?
2. What are the risks to these assets?
3. What are the security solutions?
4. How well does the security solution mitigate those risks?
5. What other risks does the security solution cause?
6. What cost and trade-offs does the security solution impose?

Bruce Schneier, *Beyond Fear*
What assets are you trying to protect?

- Computing nodes
- Programmable routers/switches
- Radar, sensors, ...
- Network bandwidth
- Application data
  - E-commerce data?
  - Healthcare app data?
- Experiments
- Users
What are the risks to the assets?

- Shutdown/disable GENI hardware
- Breach of privacy data
- Misuse of allocated GENI resources
- Unauthorized usage of GENI resources
- Interrupting user experiments
- Users losing interest due unavailability
What are the security solutions?

- Our proposed solution:
  - providing a mechanism of capturing and analyzing packet traces on GENI.
Trace Collection and Analysis in Network Research

- Long history
  - 1994: DAG card developed by University of Waikato networking research group
  - 1995: NLANR established the NLANR/Fix-West real time flow data web site

- Popular trace archives
  - NLANR
  - Internet Measurement Data Catalog [http://imdc.datcat.org/Home](http://imdc.datcat.org/Home)

- Proved to be beneficial
  - Hundreds of papers
Challenges in Network Trace Studies

- High speed trace capture and archive
  - Specialized hardware
  - Enormous storage space

- Trace anonymization
  - Protect privacy
  - Facilitate trace sharing

- New challenges for GENI
  - Packet formats
  - Experimental applications
Mixed Network Traffic in Clean Slate Networks

**IP Networks**

- Ethernet: IP, TCP, payload
- Ethernet: IP, UDP, payload
- Ethernet: IP, ICMP, payload
- Ethernet: IP, TCP, payload

**Clean Slate Networks**

- Ethernet: IP, TCP, payload
- Ethernet: Non-IP, payload
- Ethernet: Non-IP2, payload
- Ethernet: IP, TCP, payload

App Info → new Parser/Sanitizer

IP-based Parser/Sanitizer
Proposed Trace Collection Architecture
Trace Specification and Anonymization

<?xml version="1.0" encoding="UTF-8" ?>
<packet xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <etherheader srcmac="6" dstmac="6">
    00ffff010203<br />
  </etherheader>
  <appheader length="10">
    00ffff010203<br />
  </appheader>
  </header>
  </packet>

Sanitizer with xml plug-ins
Sanitize-app1
Sanitize-app2
Sanitize-appn

<?xml version="1.0" encoding="UTF-8" ?>
<appspec xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <userid>435345396</userid>
  <appid>34235235</appid>
  <avg rate = "10Mbps" />
  <peak rate = "20Mbps" />
  <ul/dl ratio = "1000" />
</appspec>
How well does the security solution mitigate those risks?

- Online capture and anonymization of packet traces for post-analysis
- Facilitate trace sharing and publication
- Audit experiments and their packets
- Detect abnormal behavior
  - Invalid packet formats
  - Misuse of GENI resource
  - unauthorized usage
  - Unexpected experiment behavior (duration, burst, ul/dl, etc)
What other risks does the security solution cause?

- Additional design complexity of GENI infra.
- Users lose interest because of cumbersome application specs
- Weakest link targeted by phony/malicious application/packet specs
- Performance distortion/degradation of experiments
  - Additional packet processing
What cost and trade-offs does the security solution impose?

- Packet and application specs expected from GENI user
  - Detailed specs
  - better understanding of the apps and network activities
  - Cumbersome to user
  - vs.
  - Simplified specs
  - minimal knowledge of apps and activities
  - simple to user