A Software Tool for Multi-Field Multi-Level NetFlows Anonymization

<http://scrub-netflows.sourceforge.net/>

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Motivation: Anonymization?

Anonymization enables entities to share types of data that would otherwise not be shared

(1) Private Data

- User-identifiable information
  - user content (Email messages, URLs)
  - user behavior (access patterns, application usage)
- Machine/Interface addresses
  - IP and MAC addresses

(2) Secret Data

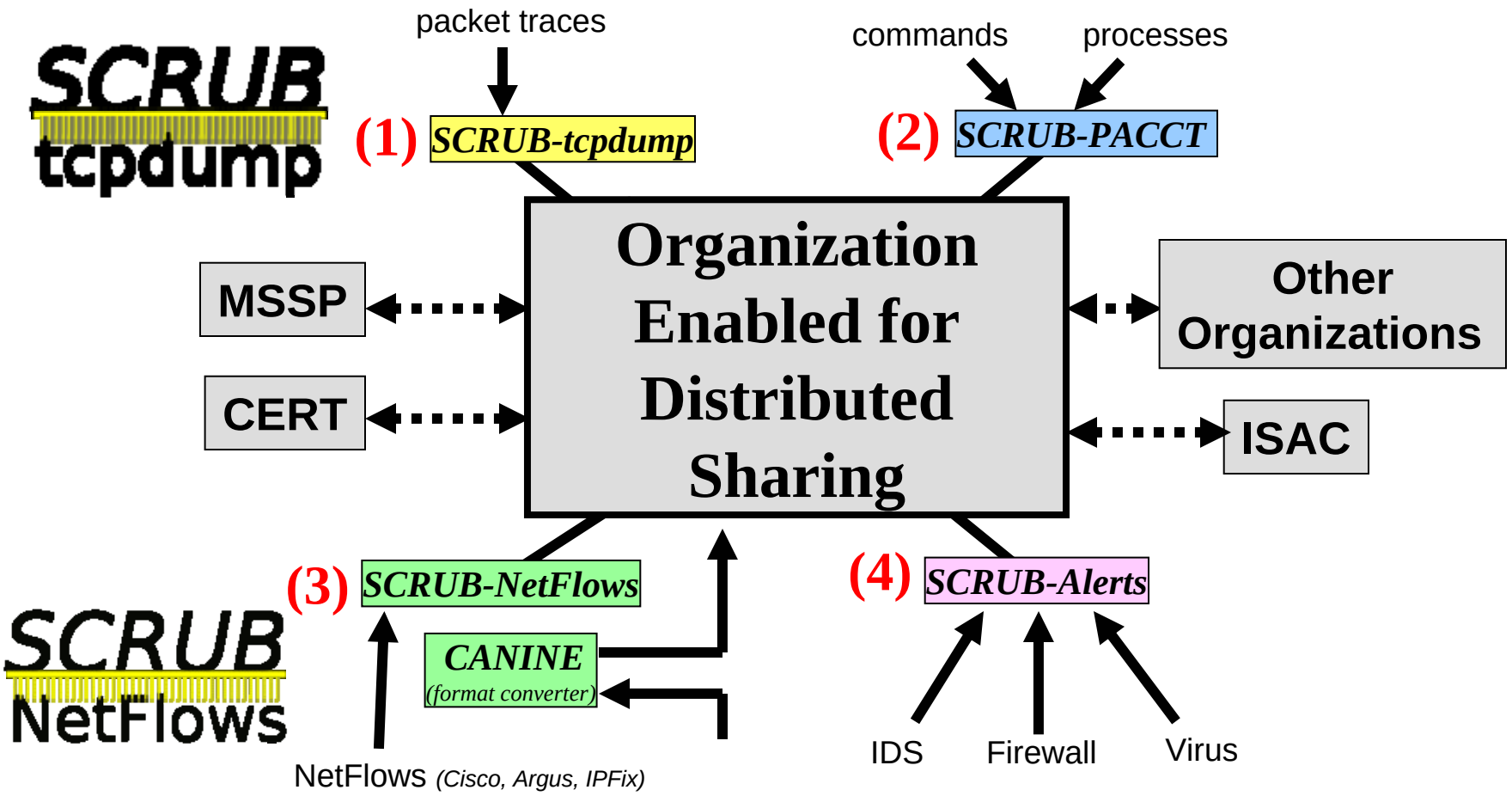
- System configurations (services, topology, routing)
- Traffic patterns (connections, mix, volume)
- Security defenses (firewalls, IDS, routers)
- Attack impacts

Motivation: Sharing?

- **Chasing attackers away (to other organizations) does not improve security**

- **Security data is needed between organizations to correlate events across administrative domains (cumulative learning between organizations)**
  - **Detect attacks**
  - **Blacklist attackers and attacker techniques**
  - **Distinguishing between normal and suspicious network traffic patterns**

*SCRUB** Infrastructure



CANINE (Flocon'05) a NetFlows Converter/Anonymizer

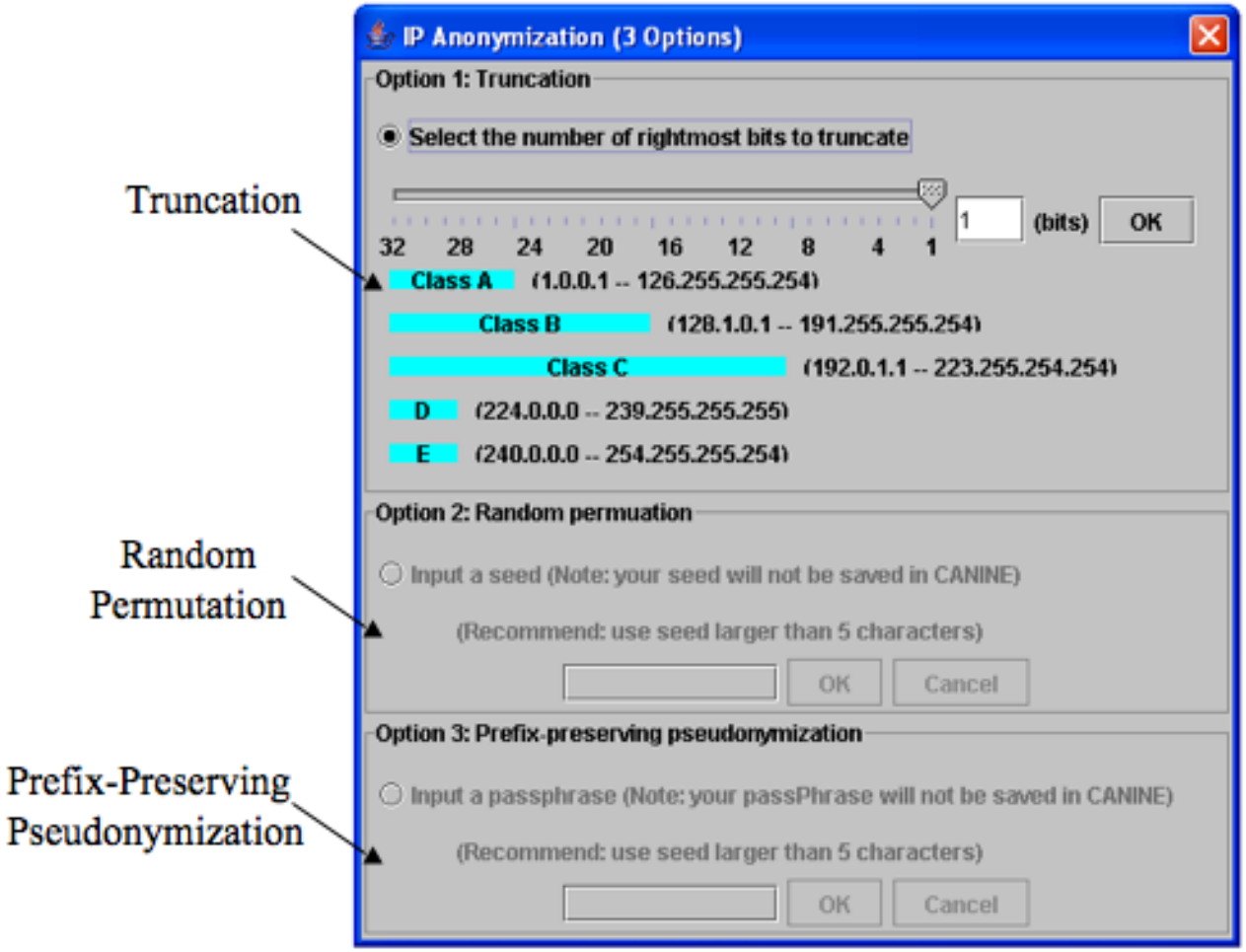
- **CANINE: Converter and ANonymizer for Investigating Netflow Events**

<http://security.ncsa.uiuc.edu/distribution/CanineDownLoad.html>

- **Converter**
  - Cisco V5 & V7, ArgusNCSA, CiscoNCSA, NFDump
- **Anonymizer**
  - 5 NetFlow fields (multi-field)

  (1) IP, (2) Timestamp, (3) Port, (4) Protocol, (5) Byte Count
  - Multiple options for each field (multi-level anonymization)
- **Java GUI – easy to use point-and-click**

IP Address Anonymization in CANINE



SCRUB NetFlows *(Flocon'08)*
New & Improved NetFlows Anonymizer

- **ASCII-based PERL code**
  - works on any NetFlows format converted to ascii
  - optimized code (multi-threaded parallelization)
- **Anonymizes more NetFlow fields (10>5)**
  - adding support for additional fields is minimal
  - (6) TimeStamp (first/last pkt) (7) TOS (8) TTL (9) TCP Flags (10) Packet Count
- **Improved/More anonymization options per field**
  - Fixes Crypto-PAn IP address anonymization flaw
  - Working on tailoring semantics to low/medium/high
- **Command line operation**
  - UNIX friendly, consistency with other SCRUB* tools
  - cascaded streaming operation available via piping

SCRUB-NetFlows
Multi-Level Anonymization Options

- Black Marker (filtering/deletion)
- Pure Randomization (replacement)
- Keyed Randomization (replacement)
- Annihilation/Truncation (accuracy reduction)
- Prefix-Preserving Pseudonymization (IP address)
- Grouping (accuracy reduction)
  - Bilateral Classification
- Enumeration (time, adding noise)
- Time Shift (time, adding noise)

Example: Timestamp Field (First/Last Pkt)

- Black Marker
  - replacement of field with a predefined constant (0)
- Random Time Shift
  - increments given time by a random value within a user defined window
- Enumeration
  - sorts entries by timestamp, applies black-marker
- Distance-preserving pseudonymization
  - preserve distance between two timestamps
- More
  - including pure/keyed randomization, truncation, unit annihilation

Addressing Crypto-PAn Flaw in SCRUB-NetFlows

- Crypto-PAn is widely used for prefix-preserving pseudonymization
  - flaw discovered – attacker can reverse-engineer the original prefix mapping in a given dataset
- Our use of Crypto-PAn
  - Begin with two separate instances of Crypto-PAn with two distinct keys: Crypt1 and Crypt2
  - Determine network and host portion of IP address
  - Run Crypt1 and Crypt2 on the IP address
  - Return the network of Crypt1 concatenated with the host given by Crypt2

Example usage

- Anonymizations done on one line of an Argus NetFlow
  - The program is told to black marker the source IP, randomize the destination IP, and black marker the first timestamp

```
$ ./scrub-netflow.pl -r ArgusData_146_78 -w AnonData -o "srcip bm dstip rand firsttimestamp bm"
Anonymizing ARGUS format
$ tail -n 1 AnonData
01 Jan 71 01:01:01  02 Oct 03 14:00:50   udp 10.10.10.11.1118   ->    39.7.114.87.55525 6        0
   4856         0           INT

$ tail -n 1 ArgusData_146_78
02 Oct 03 14:00:00  02 Oct 03 14:00:50   udp 132.156.189.139.1118   ->    228.154.76.120.55525 6
0         4856         0           INT

$
```

Anonymization for Sharing: The Privacy vs. Analysis Tradeoff

while anonymization protects against information leakage it also destroys data needed for security analysis

- Zero-Sum? (more privacy <> less analysis & vice versa)
- We are now making measurements of the tradeoff
  - another story but we can talk off-line

Summary

- Critical need for security data sharing between organizations
- Anonymization can provide safe security data sharing
  - Multi-Field: prevent information leakage
  - Multi-Level: no one-size-fits-all anonymization solution
- *SCRUB-NetFlows* as part of a data sharing infrastructure *(SCRUB*)* supporting multiple data sources
  - NetFlows is not the only data source of interest
- No “One-Size-Fits-All” anonymization policy
  - multi-level anonymization options can/should be tailored to requirements of sharing parties to optimize tradeoffs
  - privacy/analysis anonymization tradeoffs need to be characterized

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