SSH Compromise Detection using NetFlow/IPFIX

Rick Hofstede, Luuk Hendriks

UNIVERSITY OF TWENTE.

REDSOCKS
malware threat defender

“51 percent of respondents admitted that their organizations have already been impacted by an SSH key-related compromise in the last 24 months.”

–Ponemon 2014 SSH Security Vulnerability Report

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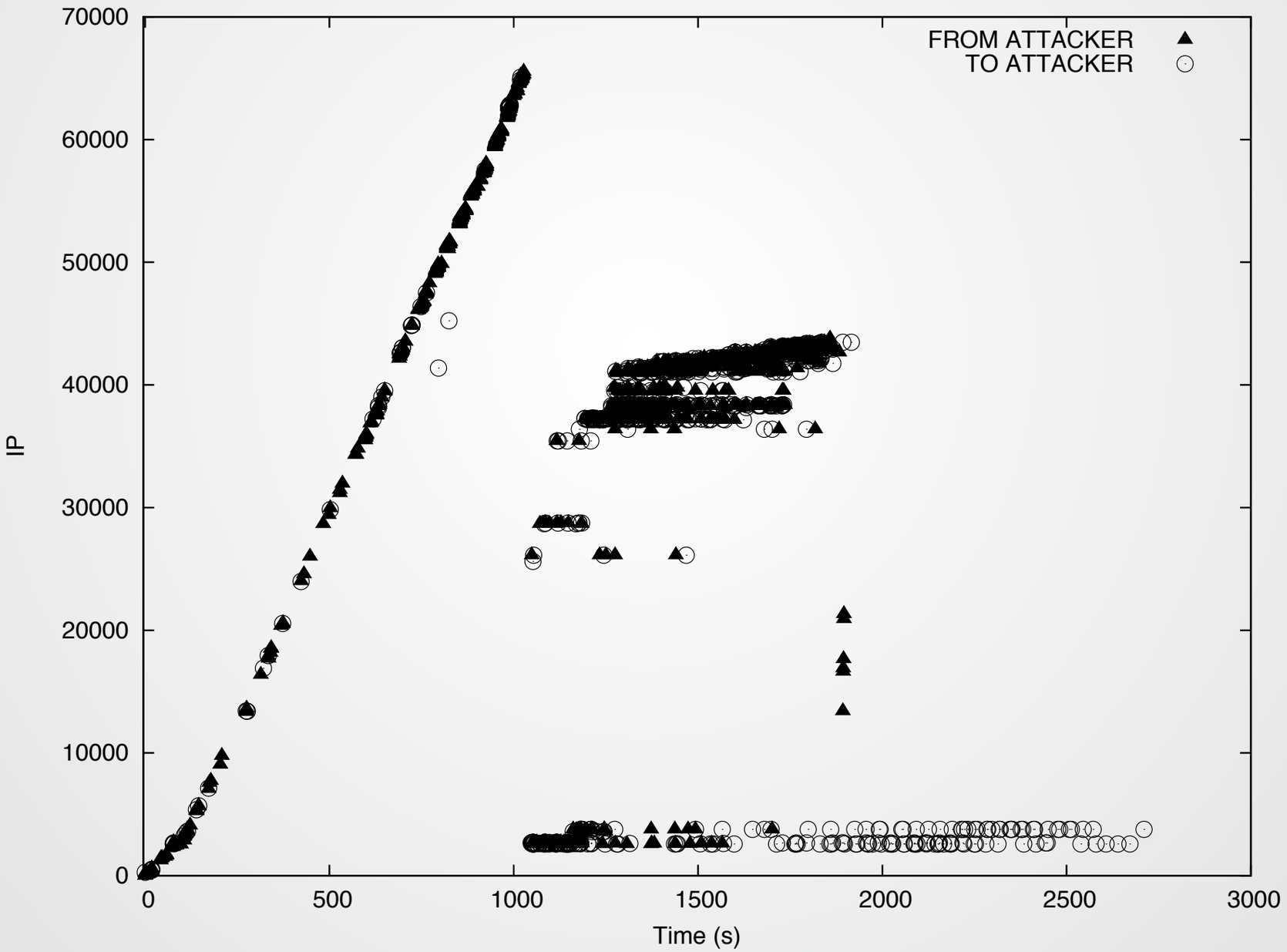
SSH attacks


FROM ATTACKER
TO ATTACKER
IP
Time (s)
0
10000
20000
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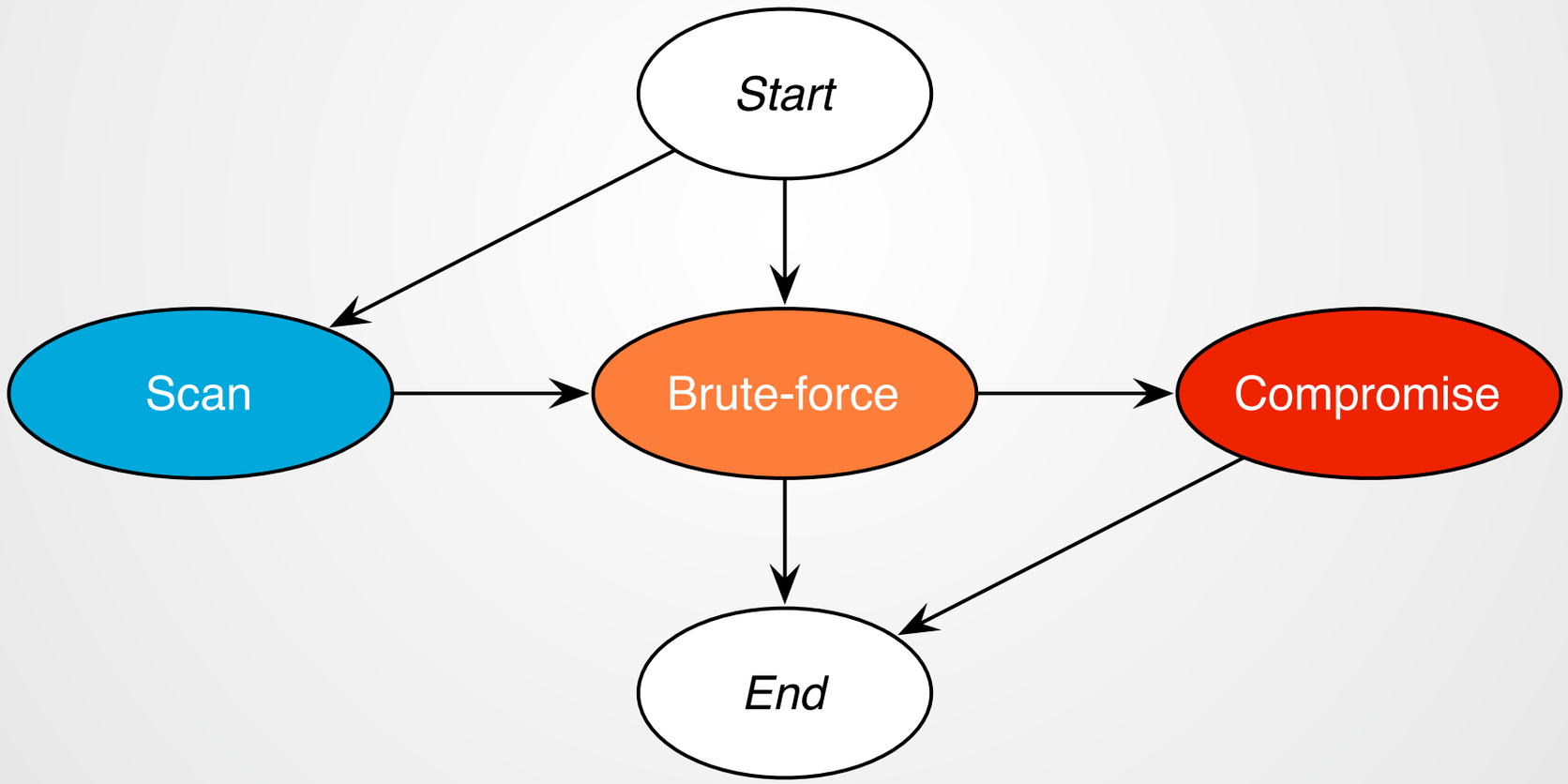
SSH attacks



SSH attacks

- SSH intrusion detection on end hosts is hardly scalable
- Network-based approaches exist, but only inform security operators about the presence of attacks

We perform compromise detection.

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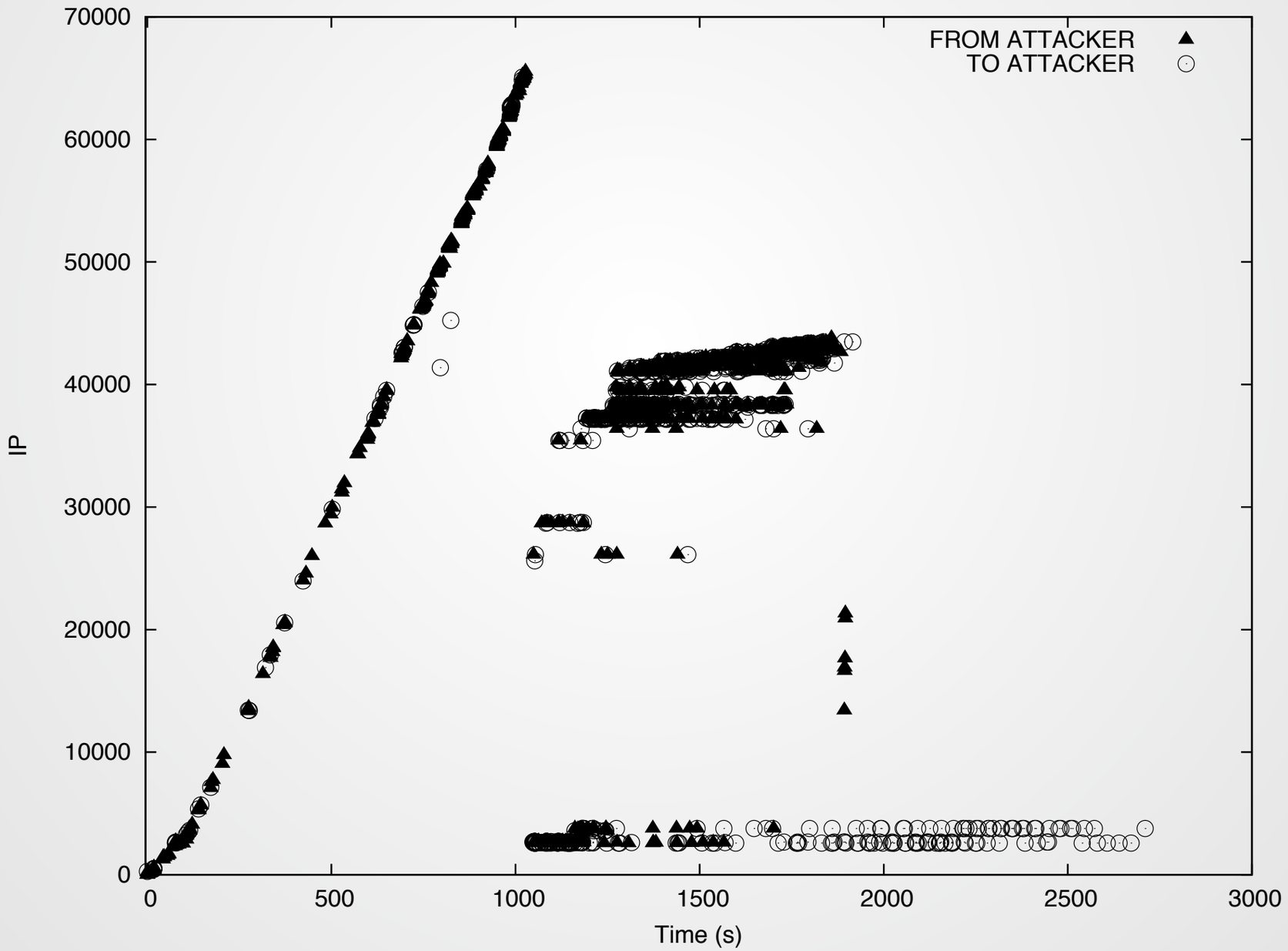
We perform compromise detection.

All flow-based.

SSH attacks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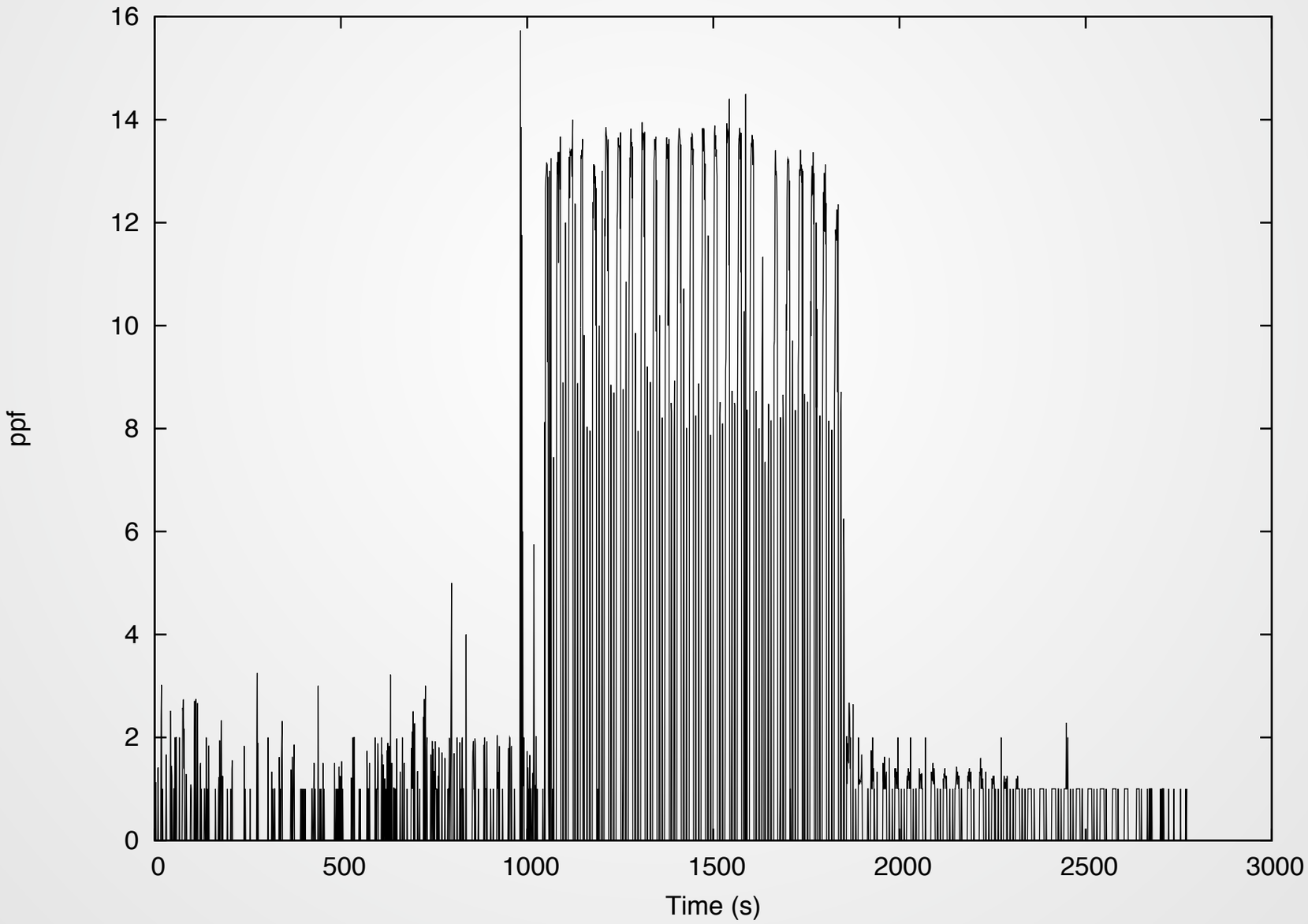

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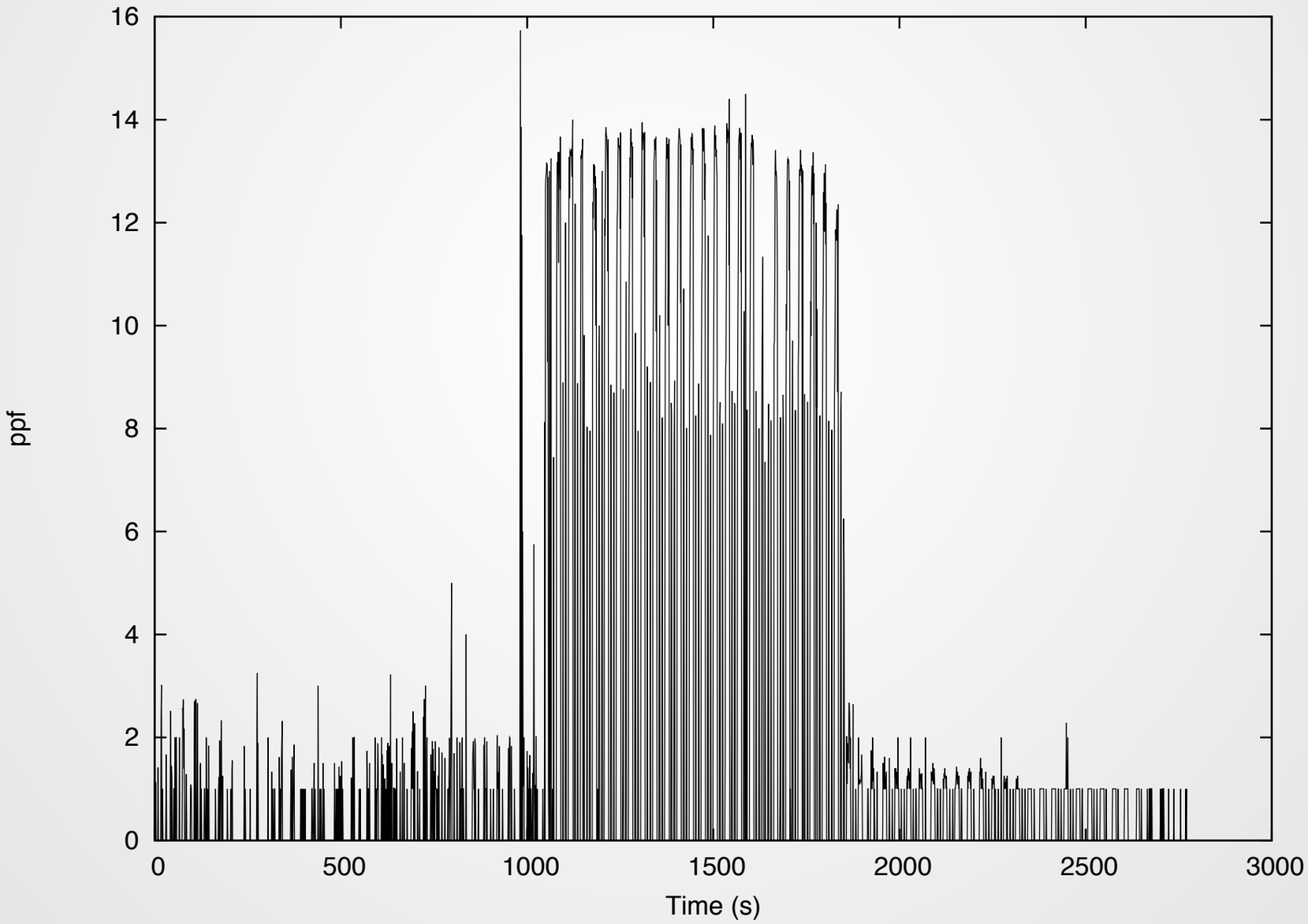

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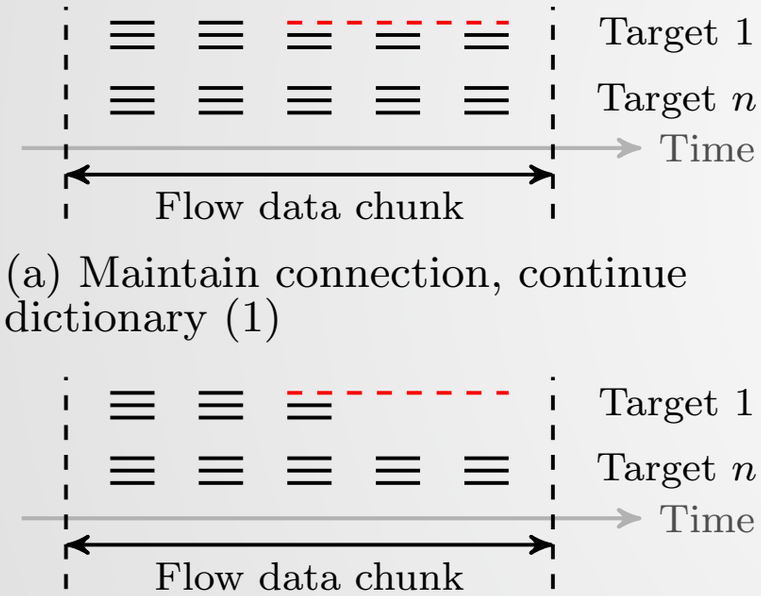

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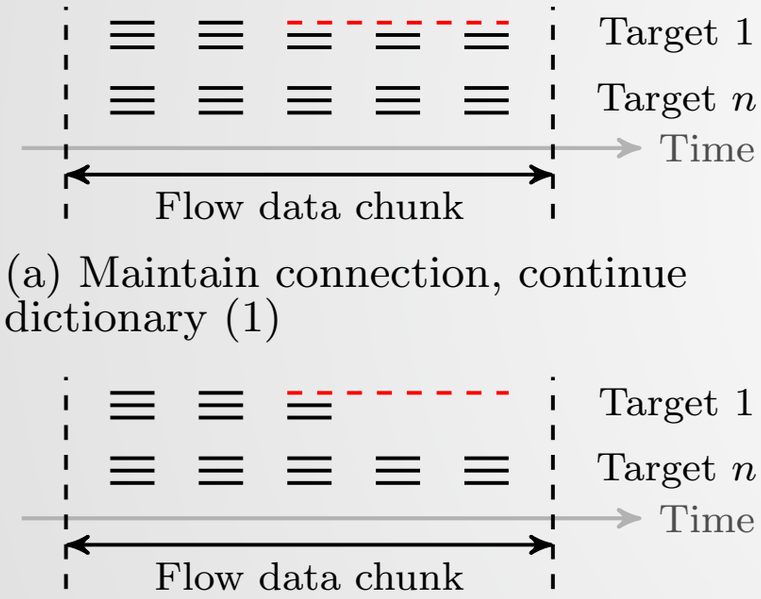

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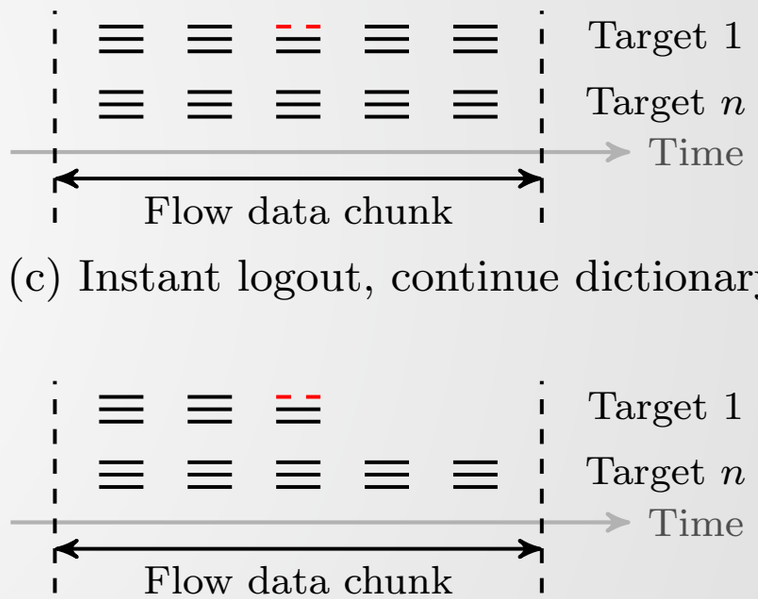

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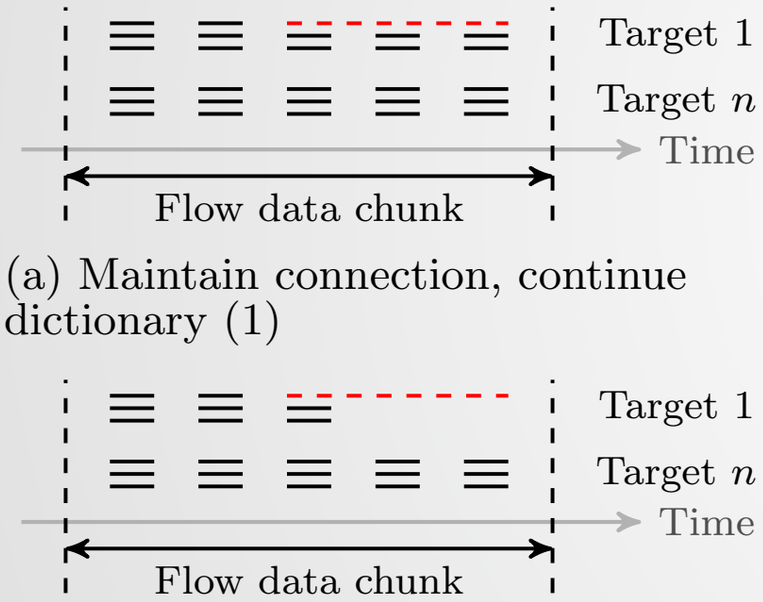

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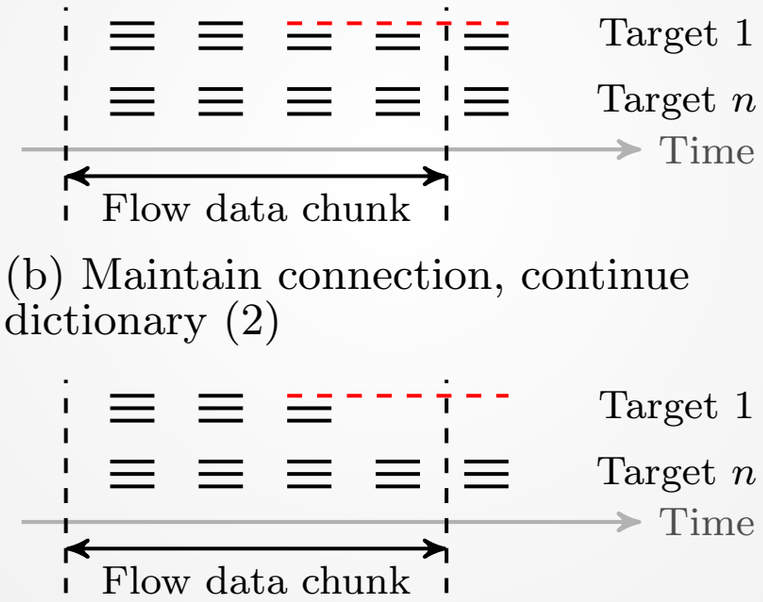
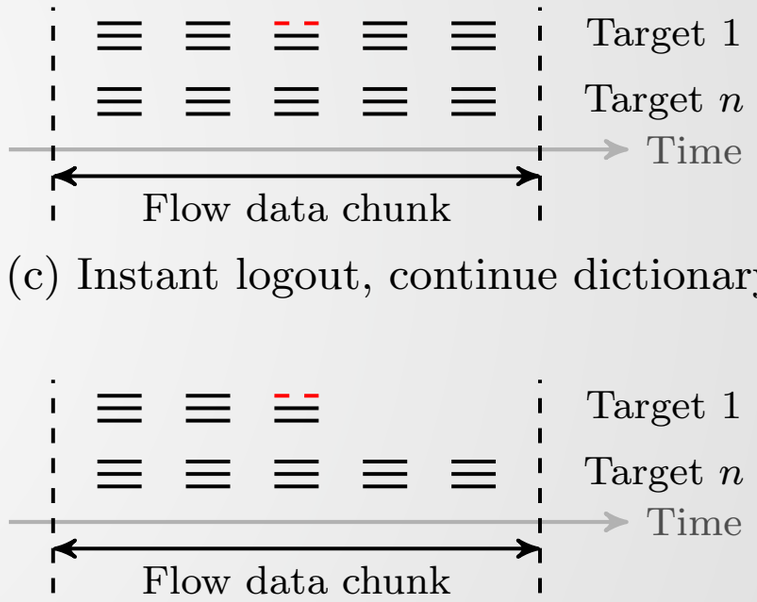


(b) Maintain connection, continue dictionary (2)



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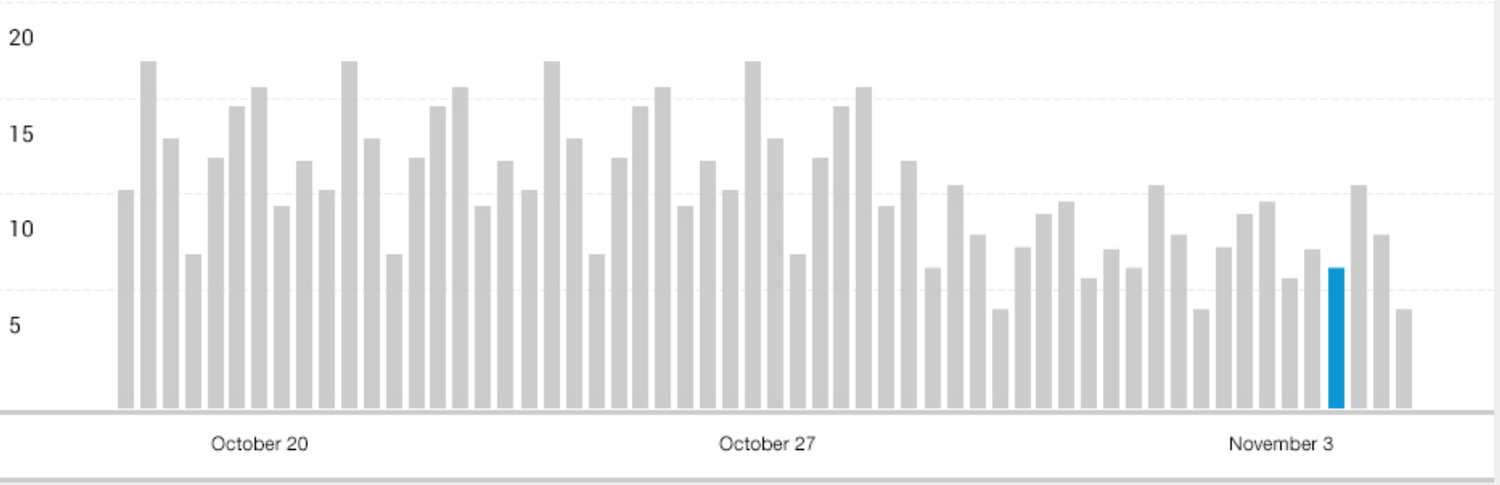
SSHCURE a flow-based intrusion detection system for NfSen. UNIVERSITY OF TWENTE.

- Dashboard
- Incoming
- Outgoing
- Hosts
- Search
- Status
- Help
- Settings

Incoming attacks

Visits — Scan — Brute force — Compromise

Day | Week | Month



Incoming attacks

Phases	Active	Attacker	Date	Targets
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Top targets - Compromise

Target	Attacks	Compromise
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SSHCure

Validation approach

- Ground truth: `sshd` logs from 93 honeypots, servers and workstations, divided over two datasets:
  - Dataset 1 — easy targets
  - Dataset 2 — more difficult targets

	Honeypots	**Servers**	**Workstations**	**Attacks**
Dataset 1	13	0	0	636
Dataset 2	0	76	4	10353

SSHCure

Validation results

- Evaluation metrics:
  - TP / FP — correct / false identification of incident
  - TN / FN — correct / false identification of non-incident
- Detection accuracy close to 100%

	TPR	**TNR**	**FPR**	**FNR**	***Acc***
Dataset 1	0,692	0,921	0,079	0,308	0,839
Dataset 2	—	0,997	0,003	—	0,997

SSHCure

Deployment

- SSHCure is open-source and actively developed
  - Download counter SourceForge (Dec. ’14): 3k
  - Recently moved to GitHub (summer ’14)
- Tested in several nation-wide backbone networks
- Many successful deployments already:
  - Web hosting companies
  - Campus networks
  - National Research and Education Networks (NRENs)
  - Governmental CSIRTs/CERTs

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  - Experience with SURFmap [1]

[1] http://surfmap.sf.net/

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- CSIRTs are becoming more responsible *towards* the Internet: Keep it clean!

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- Integration with existing systems is necessary: IODEF, X-ARF, QuarantaineNet, …

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  - GitHub vs. SourceForge

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- Problem for our algorithms
- Admins are ‘afraid’ of increasing sampling rates

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  - Examples:
    - Availability of TCP flags
    - Assumptions on flow cache entry expiration

Thanks!

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Questions?

https://github.com/sshcure/sshcure