Piloting a DDoS Clearing House for Europe

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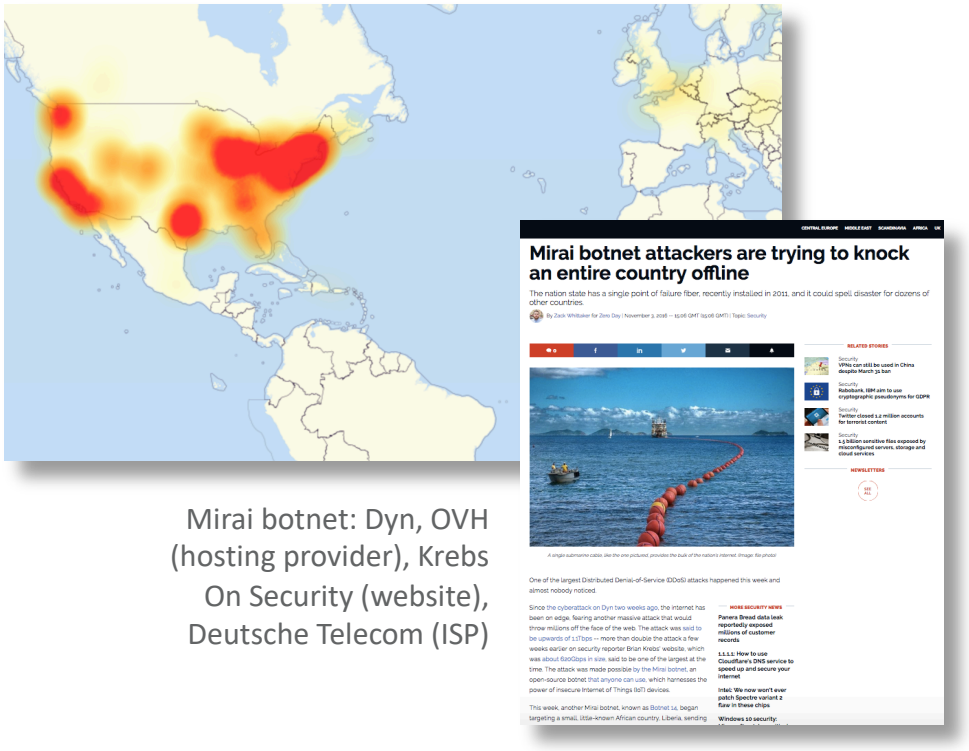
DDoS examples



Mirai botnet: Dyn, OVH (hosting provider), Krebs On Security (website), Deutsche Telecom (ISP)

January 2018

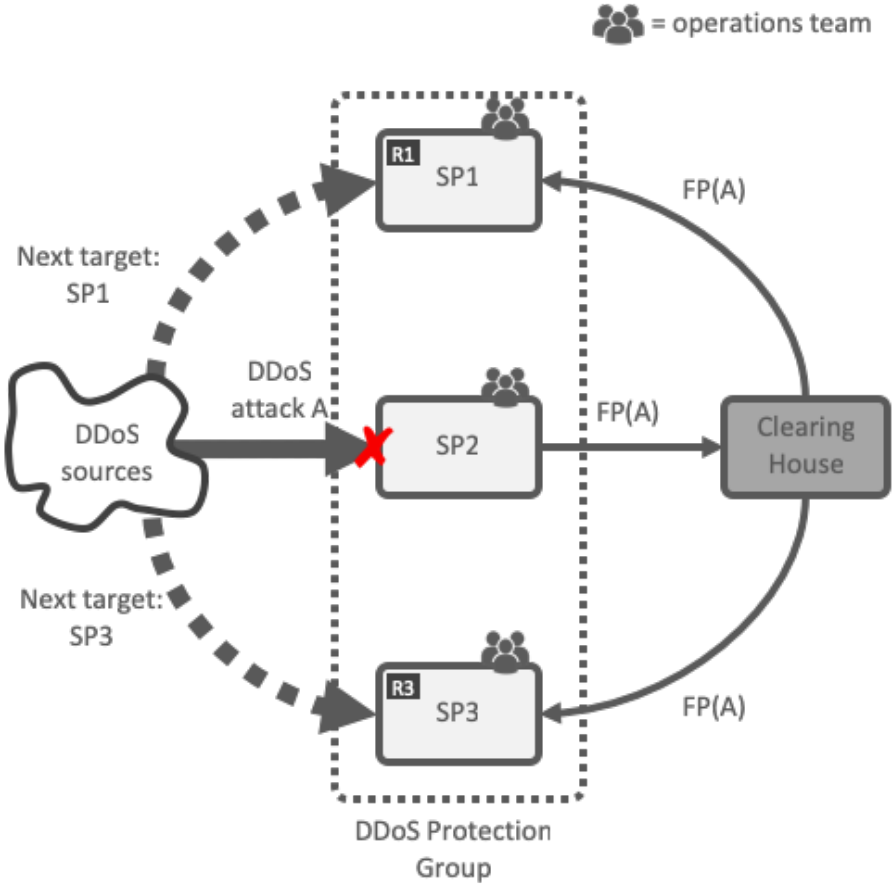
https://en.wikipedia.org/wiki/2016_Dyn_cyberattack
https://www.zdnet.com/article/mirai-botnet-attack-briefly-knocked-an-entire-country-offline/

A few DDoS trends

- Volume at 1+ Tbps, likely going up (e.g., GitHub 1.3 Tbps)
- Many widely distributed sources (Mirai 600K, Hajime 400K)
- High propagate rates (e.g., Mirai from 42K to 71K bots in 1 hour)
- Complex traffic (e.g., bot churn, volumetric/TCP state exhaustion)
- Easier to launch through booters/stressers (Mirai)
- Reflection attacks possible (e.g., Mirai and Reaper botnets)

DDoS clearing house concept

- Continuous and automatic sharing of “DDoS fingerprints” buys providers time (proactive)
- Extends DDoS protection services that critical service providers use and does not replace them
- Improves attribution, allowing for better prosecution and increased deterrent effects



DDoS fingerprints = summary of DDoS traffic

- Examples: source IP addresses, port numbers, protocol type, no victim IP addresses
- Optional: PCAPs, device-specific packet filter rules, suspected type of DDoS attack (e.g., Mirai)
- Created from network measurements (e.g., PCAP, Netflow, IPFIX, sFlow, Logfile)

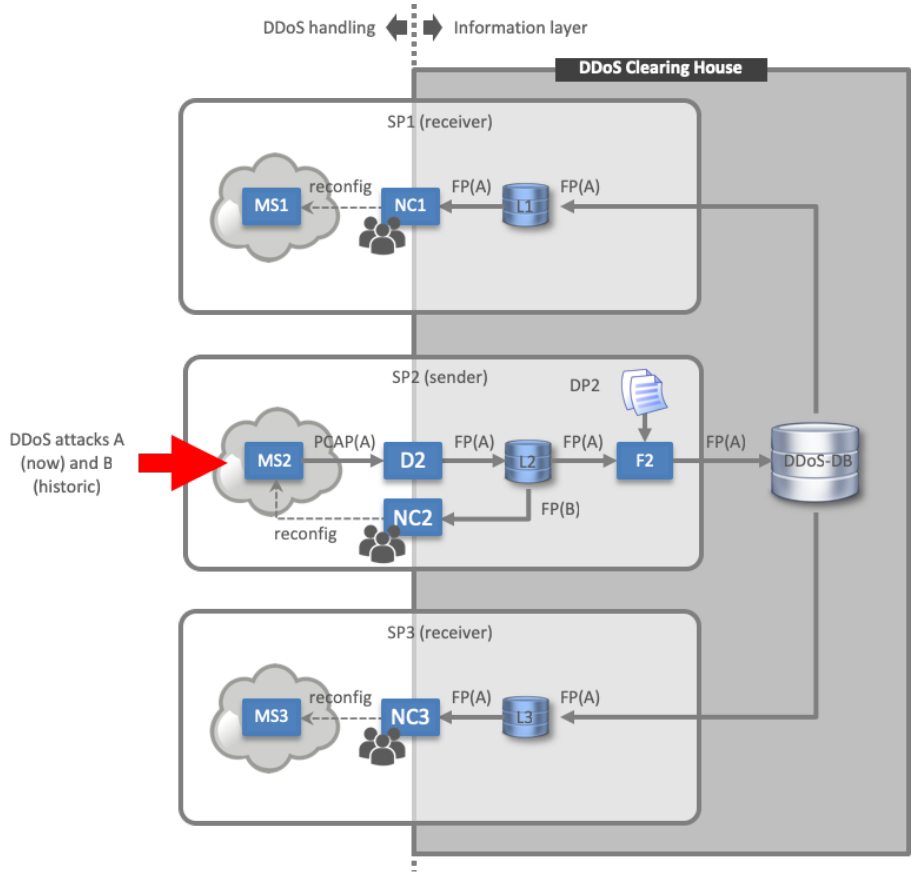

```
{
 "multivector_key": "fa0a8f21a1816a6531acb543743124ec",
 "key": "fa0a8f21a1816a6531acb543743124ec",
 "src_ips": [
  "109.26.226.136",
  ... ],
 "dst_ports": [80],
 "src_ports": [123 ],
 "ip_protocol": "17",
 "service": "NTP",
 "additional": {"ntp_reqcode": 42 },

 "total_src_ips": 1798,
 "total_packets": 2387741,
 "duration_sec": 120.32017302513123,
 "start_time": "2014-12-22 11:12:56",
 "avg_bps": 9545941.59169052,
 "avg_pps": 19844.893337223457,
 "start_timestamp": 1419243176.663222
}
```


Source: [Conrads]

Clearing house architecture (draft)

- Key component: DDoS dissector
- Sharing within and across providers through fingerprint databases
- OPS teams in control
  - Outgoing: filtering of fingerprints
  - Incoming: writing and installing filtering rules based on fingerprints



https://github.com/ddos-clearing-house

Pilot in the Netherlands

- Joint effort 10 different orgs (including 3 CONCORDIA partners)
- Iteration 1: set up full “fingerprint sharing cycle” (tech + legal)
- Iteration N>1: iteratively improve clearing house
  - Improve Dissector (e.g., add API and signing of fingerprints)
  - Optionally add more partners
  - Update data sharing agreement

Status NL pilot

- Inter-domain DDoS-DB running at SIDN Labs

- Key challenge: data sharing agreement clearing house
  - Draft available, developed by KPN and SIDN
  - Legal folks finalizing loose ends

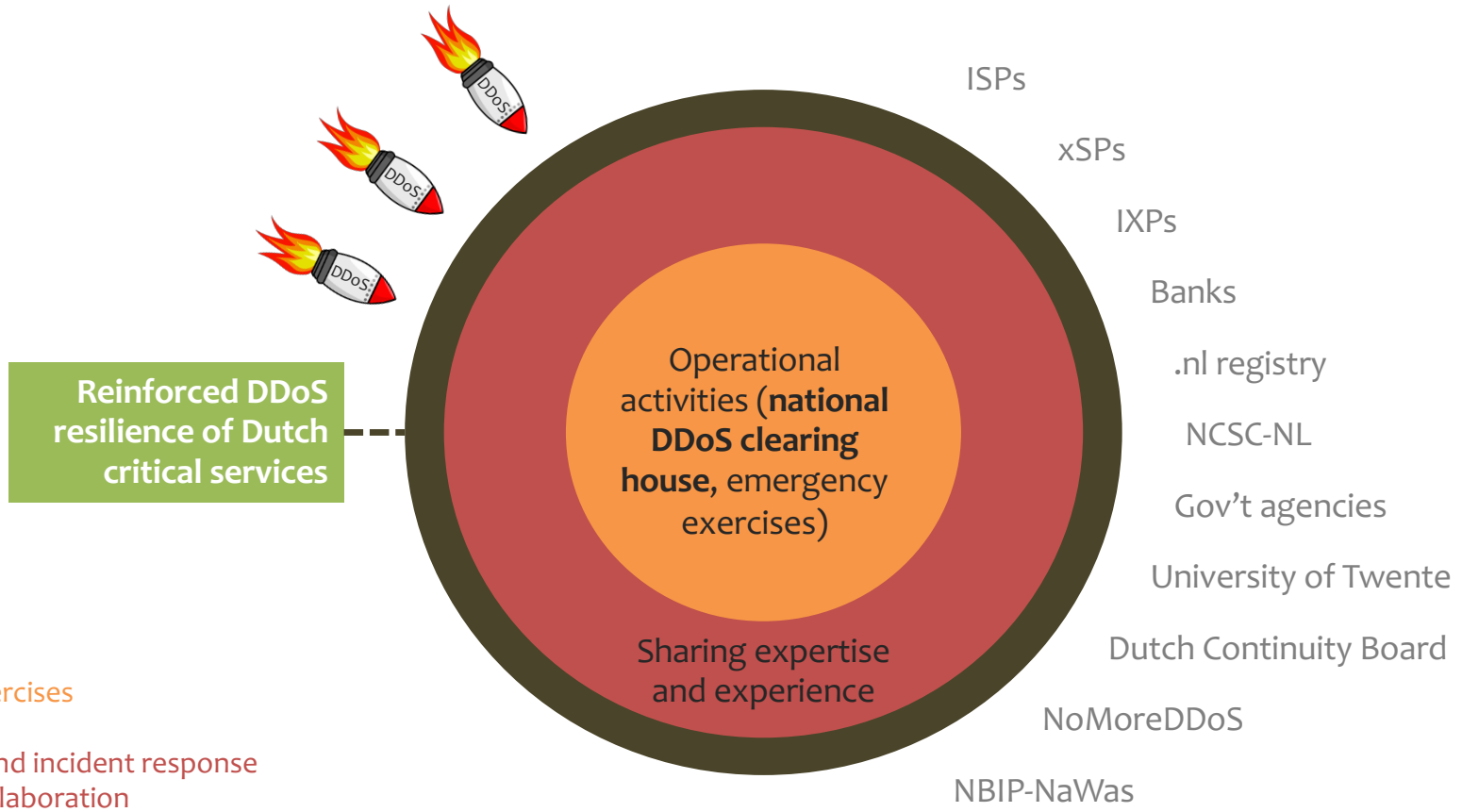
Iteration 1 data sharing agreement

- Requirement #1: simple
  - Minimal # topics (e.g., objective, liability, security, PII, governance)
  - DDoS fingerprints only include metadata for now, no PCAPs
  - Fixed but extensible duration of 6 months

- Requirement #2: scalable
  - Parties: SIDN (DDoS-DB operator) and KPN (test member)
  - KPN as ”more complex” partner (larger company, regulation)
  - Translate to English for use in CONCORDIA

Broader view: Dutch anti-DDoS coalition

Objective: further improve the protection of Dutch critical services by sharing expertise, experiences, and operational data on DDoS attacks



Working groups:

- Clearing house
- Emergency exercises
- Outreach
- Ground rules and incident response
- Sustainable collaboration

Lessons learned in NL so far

- Overall observations
  - Need for a DDoS clearing house widely acknowledged
  - Other gaps: DDoS exercises and sharing experience and expertise
  - Personal trust has been key at this stage

- Data sharing agreement
  - Close collaboration between legal and tech from the start is a must
  - Provide guidance for legal experts on concept of DDoS fingerprints
  - Legal uncertainty may lead to conservatism (cf. [daSilva])
  - Find level of simplicity and scalability that matches pilot iteration

Partners in NL

amsix
kpn
POLITIE
SURF
DNB
SIDN
National Cyber Security Centre
Ministry of Justice and Security
Betaalvereniging Nederland
UNIVERSITY OF TWENTE.
NLIX
The Interconnect Exchange
Belastingdienst
Agentschap Telecom
Ministerie van Economische Zaken en Klimaat
DINL
Stichting Digitale Infrastructuur Nederland
NBIP
nationale beheersorganisatie internet providers
vodafone
Ziggo

Plus NoMoreDDoS and Dutch Continuity Board

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Proposed next steps T3.2

- Pilot NL: finalize data sharing agreement, request NL partners to sign, share via DDoS-DB at SIDN Labs, start improving the software
- Research: set up DDoS-DB for T3.2, request T3.2 partners to sign data sharing agreement, start sharing fingerprints, run experiments (e.g., clustering of fingerprints, rule generation) and write the cookbook
- Feed research results back into the NL pilot as well as into IT pilot
- Partners: SIDN, SURF, TI, UT, CODE, UZH, Ericsson

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Q&A

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Further reading

[Mirai] M. Antonakakis, T. April, M. Bailey, M. Bernhard, E. Bursztein, J. Cochran, Z., Durumeric, J. A. Halderman, L. Invernizzi, M. Kallitsis, D. Kumar, C. Lever, Z. Ma, J. Mason, D. Menscher, C. Seaman, N. Sullivan, K. Thomas, and Y. Zhou, “Understanding the Mirai Botnet”, 26th USENIX Security Symposium, 2017

[Hajime] S. Herwig, K. Harvey, G. Hughey, R. Roberts, and D. Levin, “Measurement and Analysis of Hajime, a Peer-to-peer IoT Botnet”, Network and Distributed Systems Security (NDSS) Symposium 2019, San Diego, CA, USA, February 2019

[daSilva] K. e Silva, “Mitigating botnets: Regulatory solutions for industry intervention in large-scale cybercrime”, Ph.D. thesis (submitted), Tilburg University, Dec 2019

[Conrads] J. Conrads, “DDoS Attack Fingerprint Extraction Tool: Making a Flow-based Approach as Precise as a Packet-based”, M.Sc. Thesis, University of Twente, Aug 2019