Chair of Network Architectures and Services
Department of Informatics
Technical University of Munich

HEAP BGP Observatory

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Acknowledgements: Johann Schlamp, Ralph Holz, Quentin Jacquemart, Ernst Biersack

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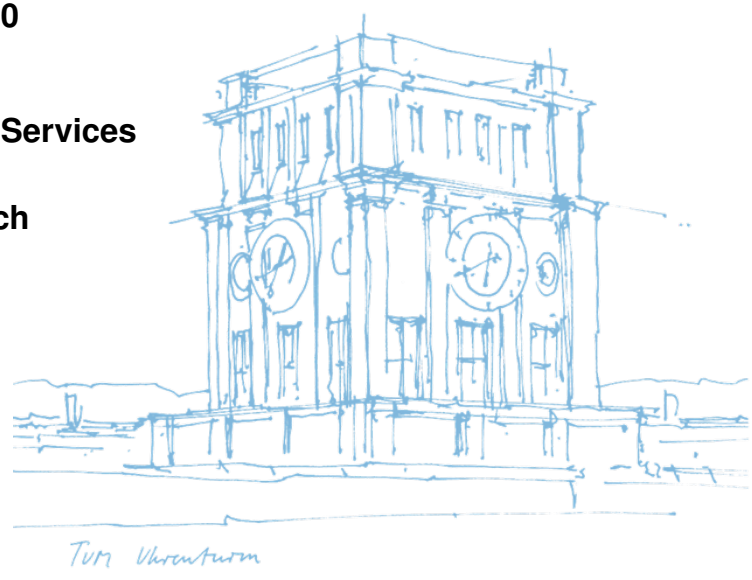
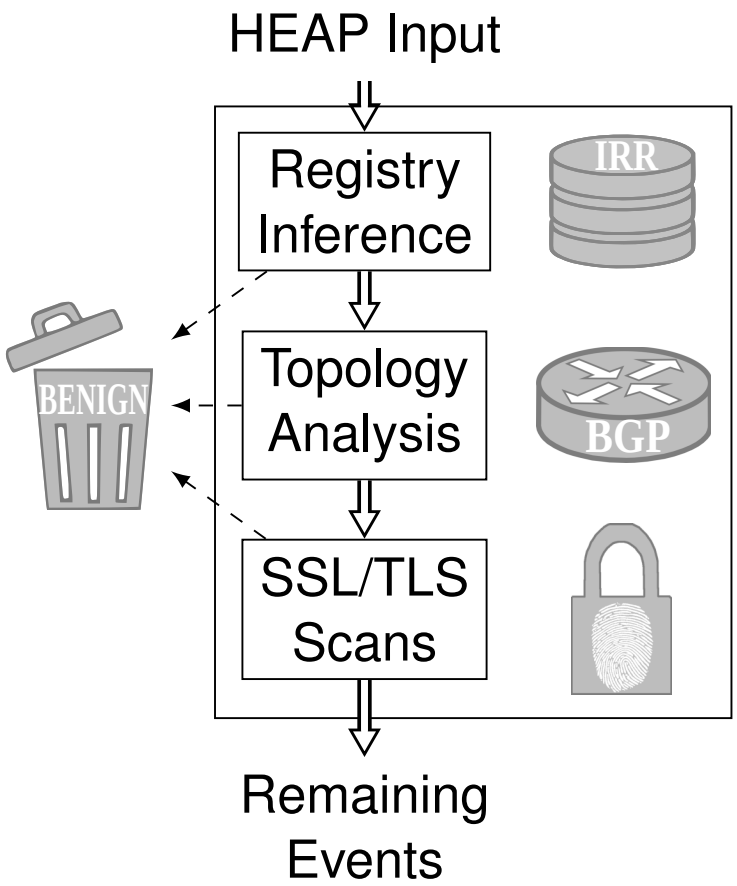


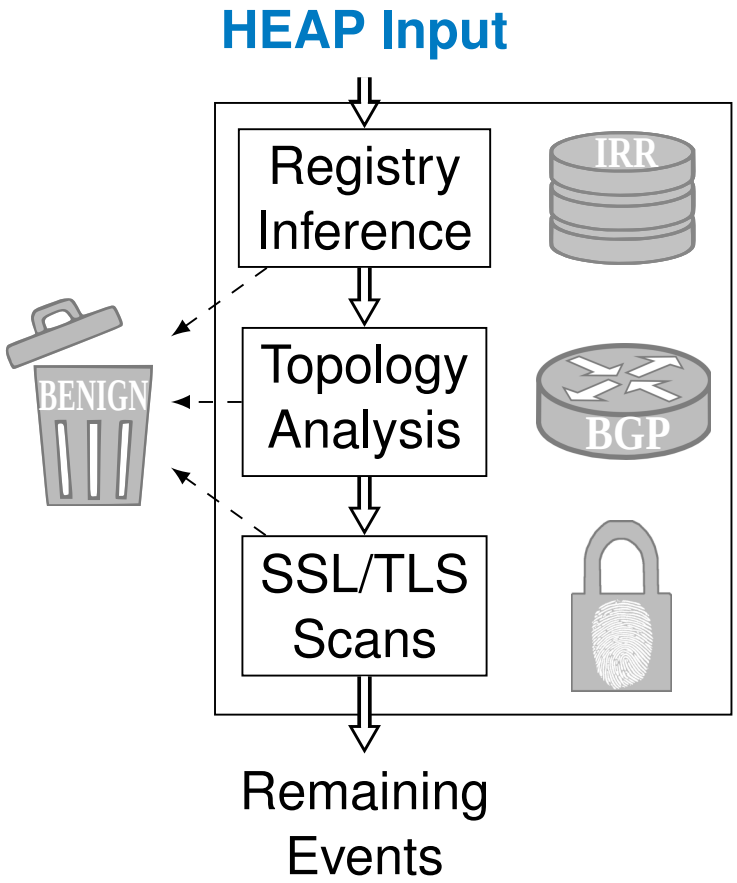
Hijacking Event Analysis Program (HEAP)



Goal: Investigating BGP hijacking events

- Identify false positives based on three independent filters
- Active research since 2015
- Initial work:
  Heap: Reliable Assessment of BGP Hijacking Attacks
  by J. Schlamp, R. Holz, Q. Jacquemart, G. Carle, E. Biersack
  in IEEE JSAC, June 2016 [2]

Hijacking Event Analysis Program (HEAP)



HEAP Input

- Possible hijacks
- subMOAS from local BGP dumps and updates
- Published events from BGPMON[1]

[1] https://bgpstream.com/

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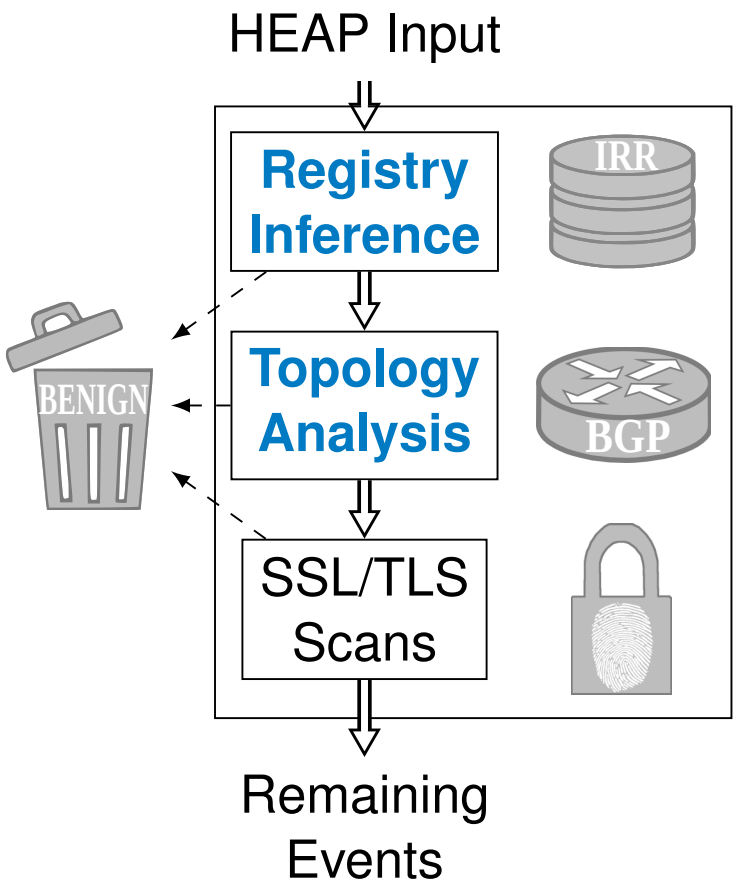


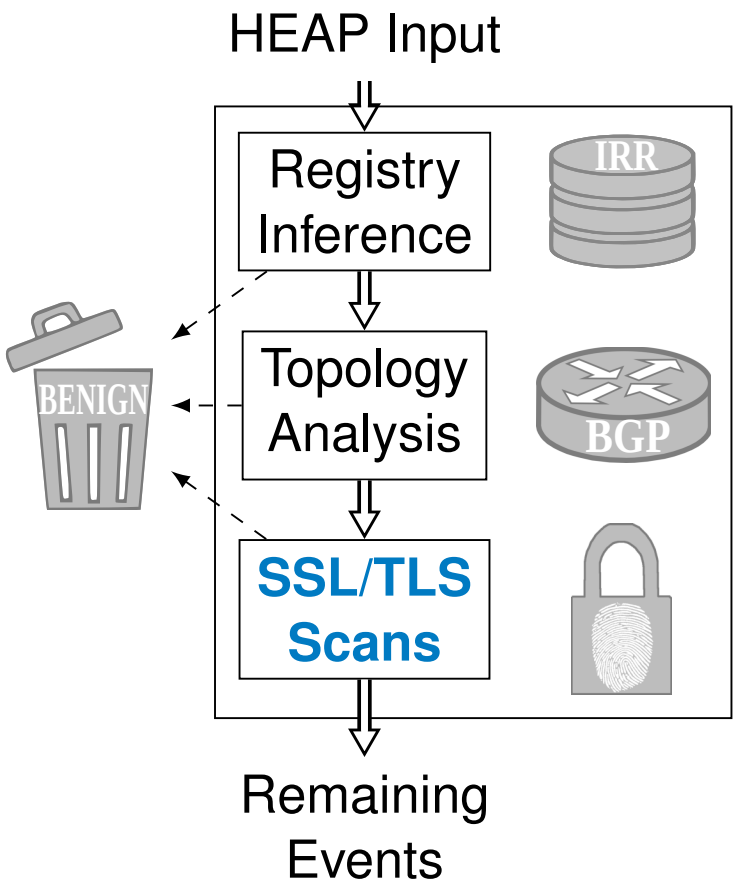
Registry Inference

- Legitimizing relations between actors disprove an attack
- Based on Internet Routing Registries
- Historical data available

Topology Analysis

- An upstream provider should filter attacks
- Based on AS paths
- Extracted from local BGP dumps and collectors

Hijacking Event Analysis Program (HEAP)



Cryptographic Assurance
An attacker does not possess private keys and can not perform successful SSL/TLS handshakes with the according certificate.

- Ground truth:
  - Host behavior before a possible hijack
  - Regular updates
  - Good coverage, Internet-wide
- Event scans
  - Host behavior during a possible hijack
  - Fast reaction to events

Hijacking Event Analysis Program (HEAP)

Ground truth: Internet-wide Scans

- Regularly collects certificates from HTTPS capable IPv4 Hosts
  - Complete IPv4 ZMAP scan towards port 443
  - SSL/TLS connections to each host with an open port
- Results:
  - ~47 M hosts with open port 443
  - ~35 M successful SSL/TLS handshakes
  - Covering 3 M /24 networks

Hijacking Event Analysis Program (HEAP)

Alert Scans

- Establish SSL/TLS connections during an alert
- Scan alerts in seconds
  - Only consider hosts from ground truth
  - Small number of hosts
  - High scan rate
- Average daily events:
  - subMOAS: ~5000
  - BGPMON: ~5-10 $\rightarrow$ ~30% benign

Prefix Top List

Ranking the Importance of Events

How can the importance and impact of a hijack be evaluated?

- Rank events based on the hijacked prefix

→ Prefix Top Lists `https://prefixtoplists.net.in.tum.de/`

- Provides a new top list type
- Ranks prefixes and ASes as important Internet resources
- Assigns weights based on domain based top lists
- Prefix Top Lists: Gaining Insights with Prefixes from Domain-based Top Lists on DNS Deployment
  by J. Naab, P. Sattler, J. Jelten, O. Gasser, and G. Carle at IMC 2019 [1]

Rank	Prefix	Weight	# Domains	# IP addr.
1	172.217.18.0/24, AS15169 – GOOGLE	0,0178	1039	35
2	172.217.16.0/24, AS15169 – GOOGLE	0,0175	1000	33
3	172.217.22.0/24, AS15169 – GOOGLE	0,0173	1041	42
4	216.58.206.0/23, AS15169 – GOOGLE	0,0165	973	35
5	172.217.23.0/24, AS15169 – GOOGLE	0,0164	775	23
6	140.205.64.0/18, AS37963 – CNNIC-ALIBABA	0,0160	6	4
7	216.58.208.0/24, AS15169 – GOOGLE	0,0154	443	14
8	111.160.0.0/13, AS4837 – CHINA169-BACKBONE	0,0134	3	4

BGP Prefix Ranking for August 1, 2019 based on Alexa List.

Joint Platform

Enable Data Sharing and Joint Work

- Ongoing project to build a platform that enables to share **data and analysis tools**
- Provide VMs connected to a scientific data store
  - Allow collaboration on data
  - Easy reproduction of results
  - Work close to the data
- We share data from HEAP and other work through this platform
- If you are interested in access and collaborations contact us via

→ heap@net.in.tum.de

→ joint-platform@net.in.tum.de

- **We will be happy to collaborate!**

Bibliography

[1] J. Naab, P. Sattler, J. Jelten, O. Gasser, and G. Carle.
Prefix top lists: Gaining insights with prefixes from domain-based top lists on dns deployment.
In *Proceedings of the Internet Measurement Conference*, IMC '19, page 351–357, New York, NY, USA, 2019. Association for Computing Machinery.

[2] J. Schlamp, R. Holz, Q. Jacquemart, G. Carle, and E. W. Biersack.
Heap: Reliable assessment of bgp hijacking attacks.
IEEE Journal on Selected Areas in Communications, 34(6):1849–1861, June 2016.