SpamTracer: How Stealthy Are Spammers?

Traffic Monitoring and Analysis (TMA) 2013

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April 19th, 2013 Turin

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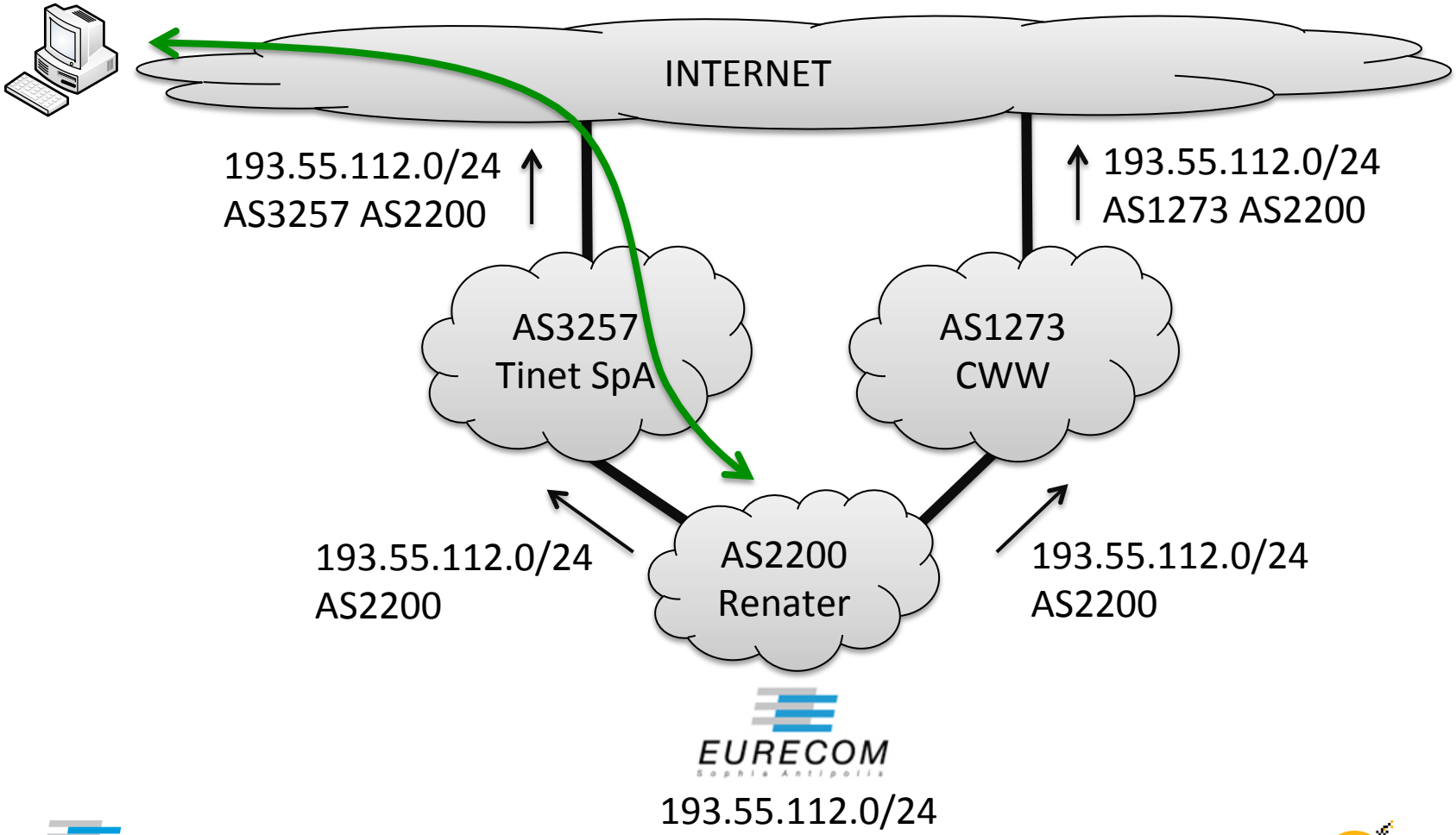
Motivation

- CONJECTURE
  - Spammers would use BGP hijacking to send spam from the stolen IP space and remain untraceable
  - [Ramachandran and Feamster 2006]
  - [Hu and Mao 2007]

- POTENTIAL EFFECTS
  - Hijackers can steal someone else's IP identity
  - Spam filters heavily rely on IP reputation as a first layer of defense

Border Gateway Protocol :: Example

The Eurecom network 193.55.112.0/24 is originated by AS2200 (Renater, Eurecom's ISP).

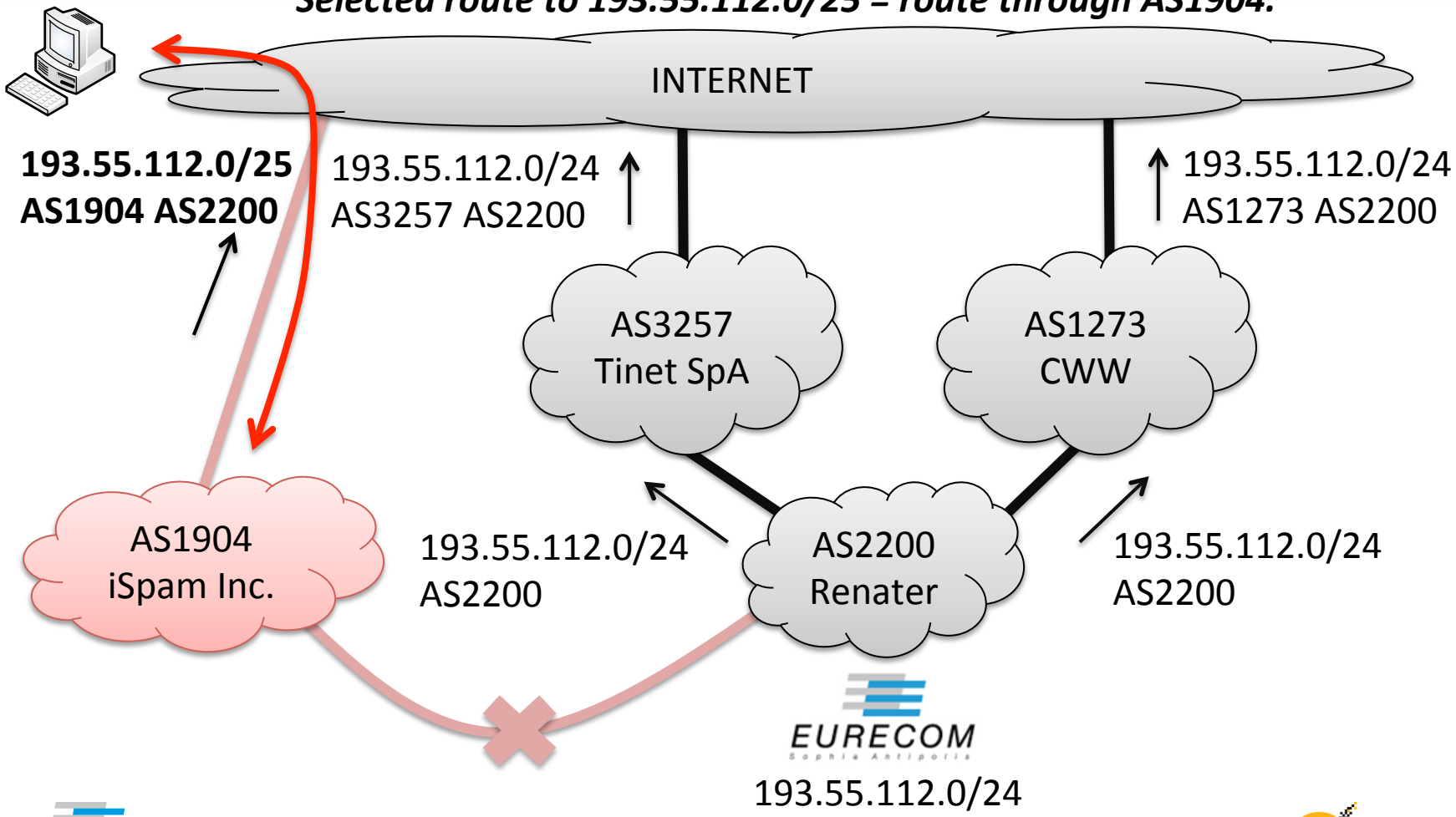


BGP Hijacking :: Or the Art of Breaking the Internet

- CAUSE
  - The injection of erroneous routing information into BGP
  - No widely deployed security mechanisms yet
    - Ex.: RPKI, BGPsec
- EFFECTS
  - Blackhole or MITM [Pilosof 2008] of the victim network
- EXPLANATIONS
  - Router misconfiguration, operational fault
    - Ex.: Hijack of part of Youtube network by Pakistan Telecom
  - Malicious intent?

BGP Hijacking :: Example

AS2200 originates 193.55.112.0/25. Very stealthy!
Selected route to 193.55.112.0/25 = route through AS1904.



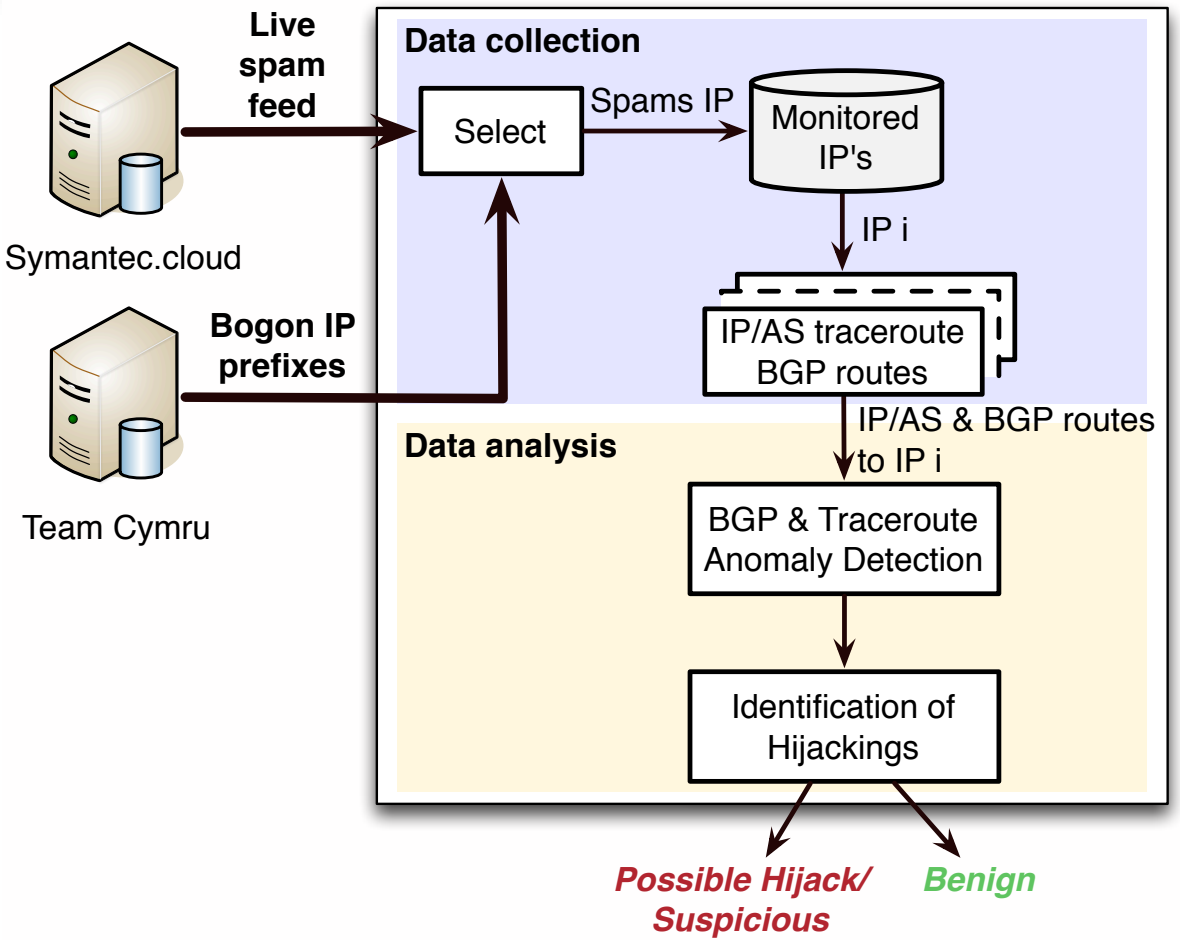
Fly-by Spammers :: Myth or Reality?

- STARTING POINT
  - Anecdotal evidences of spammers sending spam from unused IP space hijacked for a short period of time (< 1 day)
- OBJECTIVE
  - Validate or invalidate on large scale the conjecture about fly-by spammers
- IMPLEMENTATION
  - SPAMTRACER: collect routing information about spamming networks
  - Extract abnormal routing behaviors to detect possible BGP hijacks

SPAMTRACER :: Presentation

- ASSUMPTION
  - When an IP address block is hijacked for stealthy spamming, a routing change will be observed when the block is released by the spammer to remain stealthy
- METHOD
  - Collect BGP routes and IP/AS traceroutes to spamming networks just after spam is received and during several days
  - Look for a routing change from the hijacked state to the normal state of the network

SPAMTRACER :: System Architecture



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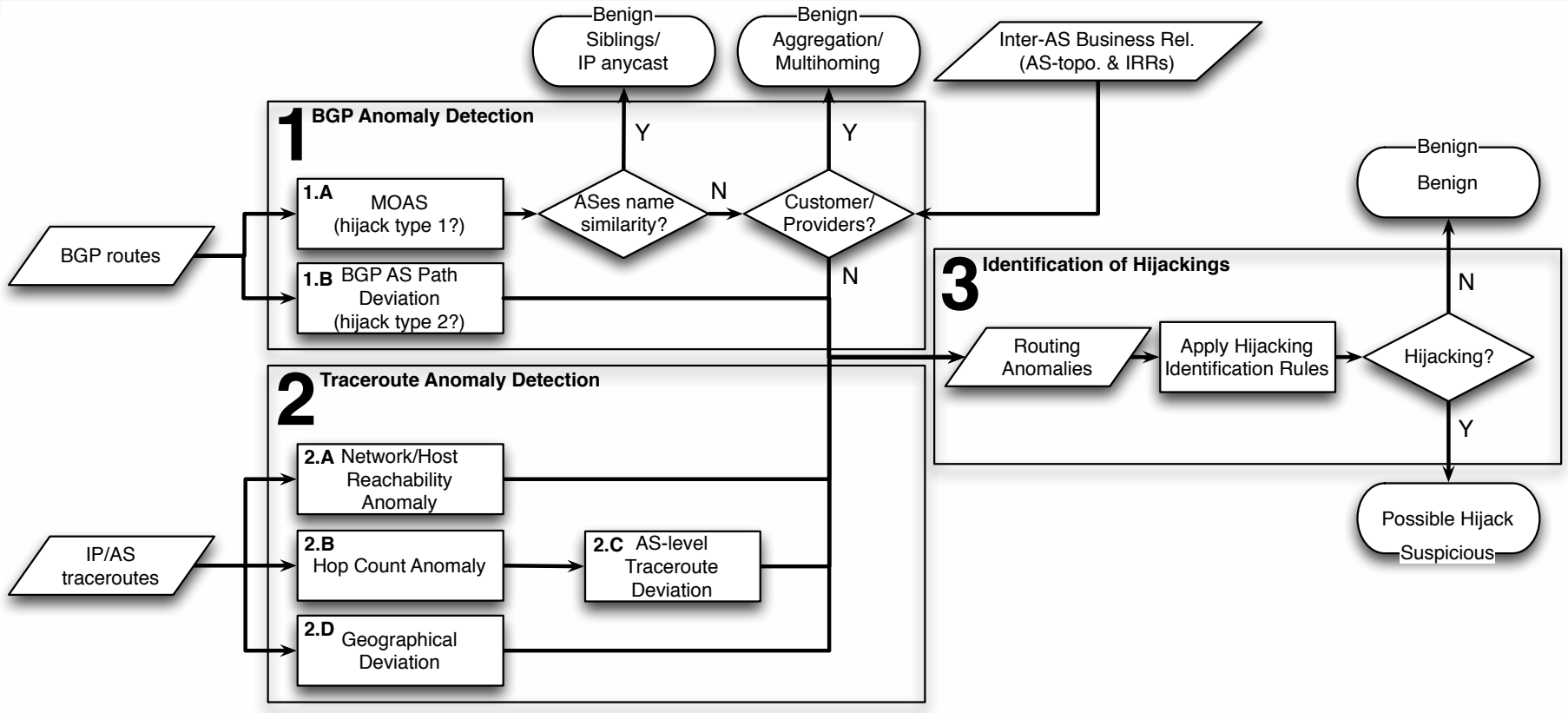
Data Analysis

- DATA SET
  - IP/AS Traceroutes and BGP routes from SPAMTRACER
- OBJECTIVE
  - Uncover abnormal routing behaviors
  - Classify them as benign/malicious
- REMARKS
  - BGP engineering practices are similar to BGP hijacks
  - Inter-AS routing is mainly governed by private routing policies ➔ no ground-truth!

Routing Anomaly Detection & Analysis



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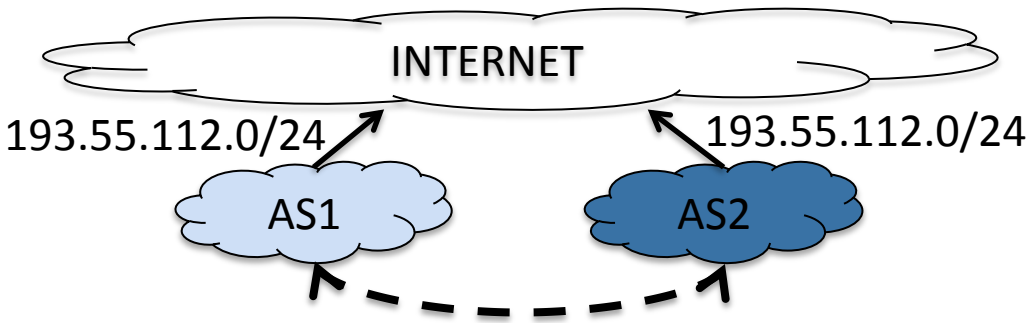
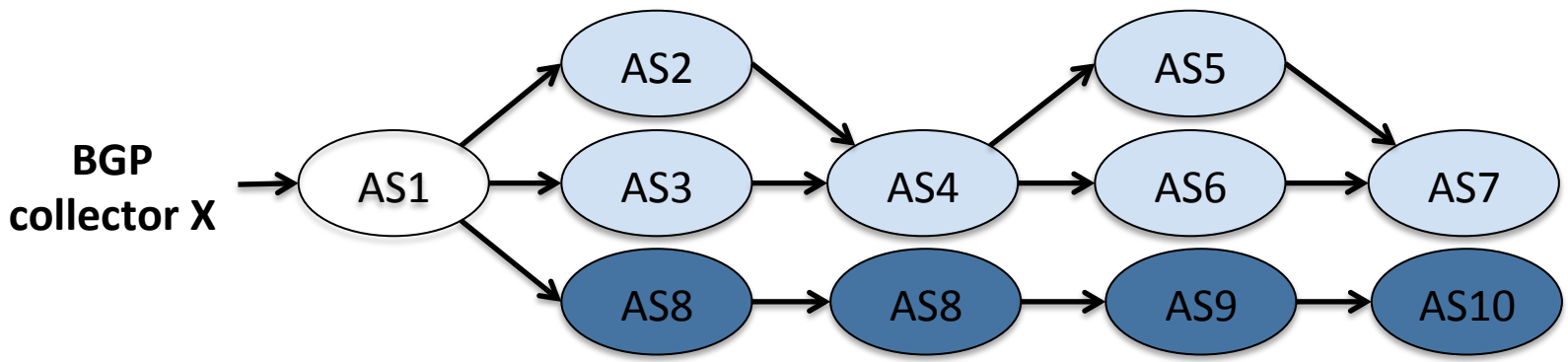
1. BGP Anomaly Detection

A. Multiple Origin ASes (MOASes)



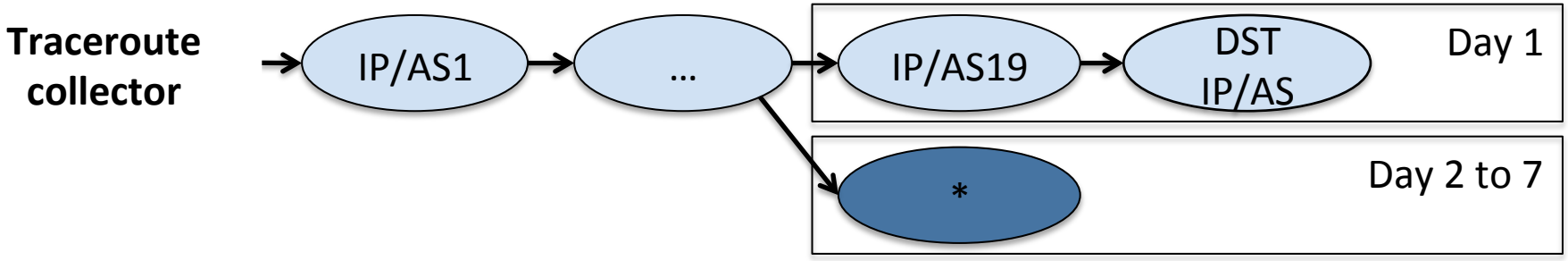
Provider-customer or **sibling** relationship ➔ BGP engineering = **legitimate**

B. BGP AS Path Deviation

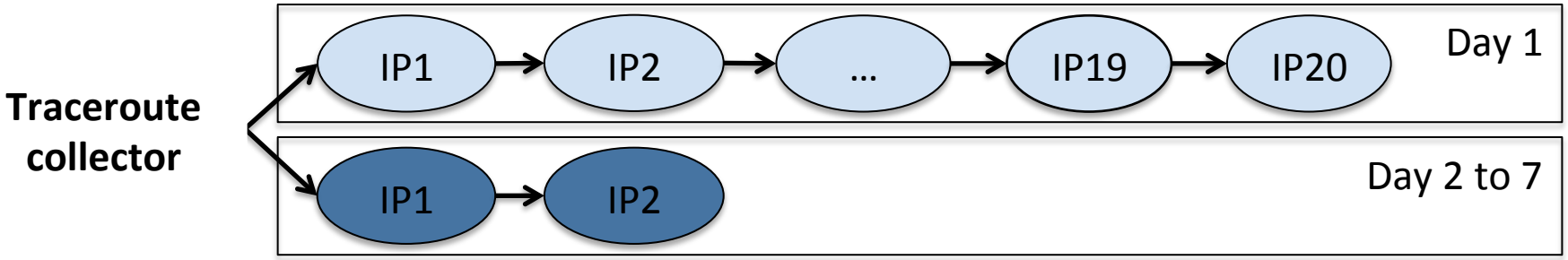


2. Traceroute Anomaly Detection

A. Network/Host Reachability Anomaly

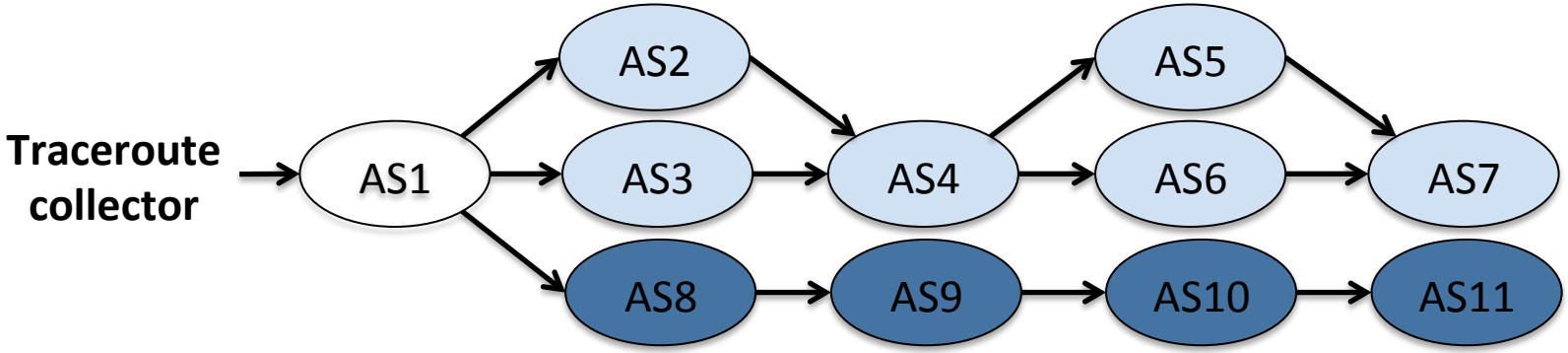


B. Hop Count Anomaly

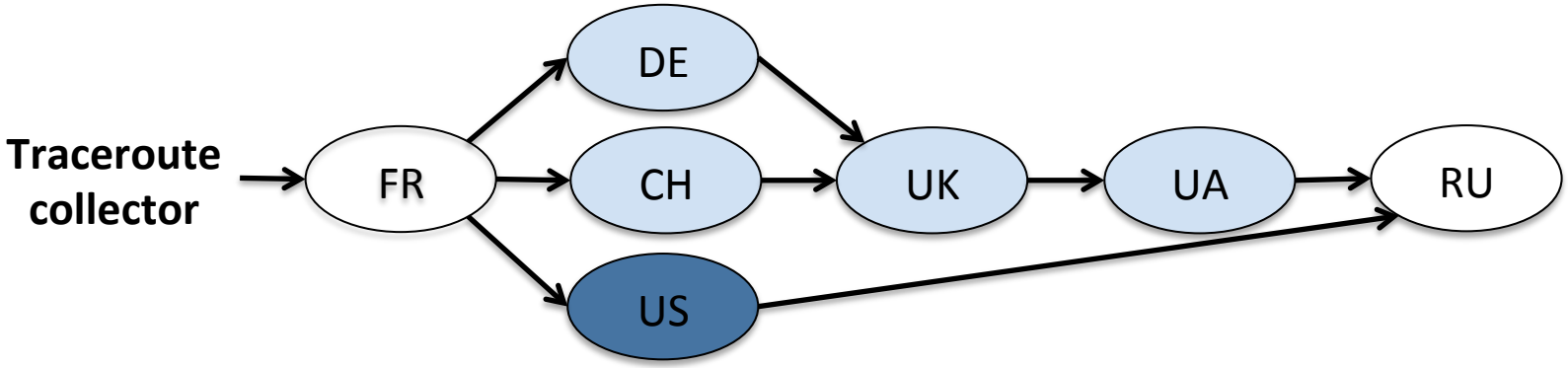


2. Traceroute Anomaly Detection

C. AS-level Traceroute Deviation



D. Geographical Deviation



3. Identification of Hijackings

- Hijacking signatures correspond to specific combinations of routing anomalies
  - A hijacking must exhibit a BGP AS Path deviation
  - A MOAS highly increases the suspiciousness of the routing behavior
  - A Host/Network Reachability anomaly moderately increases the suspiciousness
  - A Hop Count anomaly, Traceroute AS-level path or Country-level path deviation slightly increase the suspiciousness
- Uncovered hijackings are manually investigated
  - Collected data, IRR's, looking glasses, mailing lists

Results

- 81 identified hijackings in the SPAMTRACER data set from April 2011 to September 2011

- 61 benign cases
  - Customer-provider or sibling relationship between ASes in MOAS (e.g., merged companies)
  - Misclassification because of inaccurate traceroutes/IP-to-AS mapping/IP geolocation

Results

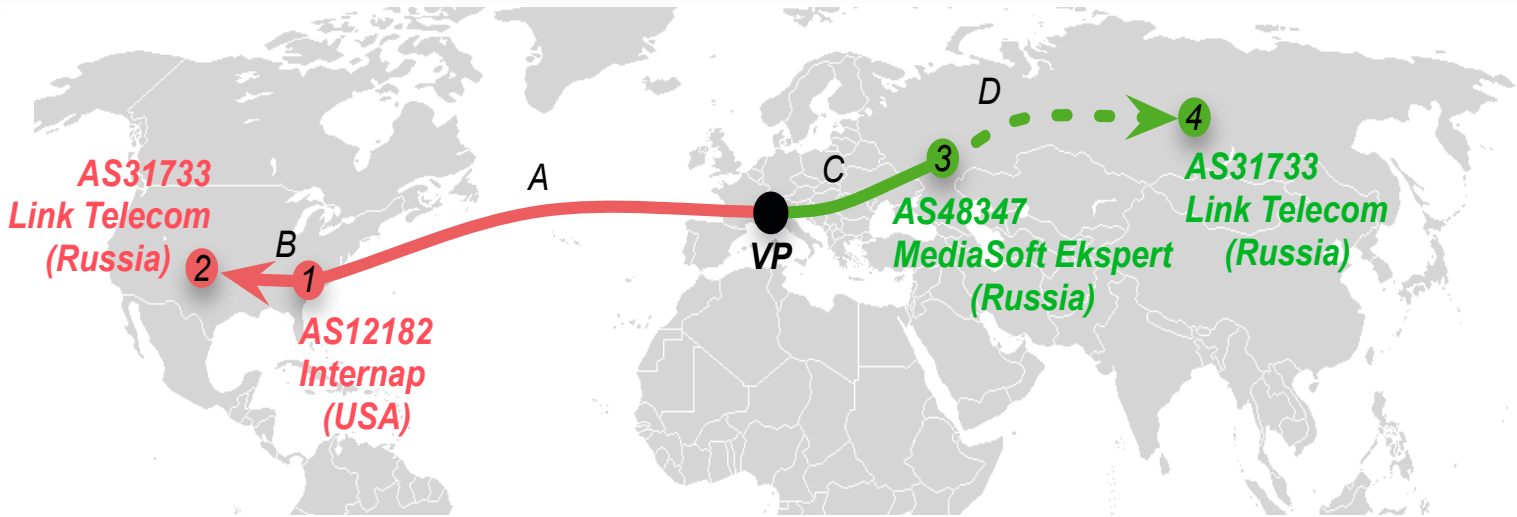
- 20 suspicious/malicious cases
  - No explanation for MOAS
  - No explanation for a major AS path change combined with other routing anomalies
  - One hijack case validated thanks to feedback from the owner

- No hijack of unused IP space for no more than one day as described in [Ramachandran 2006]

Link Telecom Hijack Case Study :: The Story of a Sophisticated Spammer

- The network of the Russian ISP Link Telecom was hijacked for 5 months by a spammer in the U.S.
- By the time their network was hijacked, Link Telecom had suspended their activity
- The hijacker provided the U.S. ISP Internap with a fake proof of ownership of the network blocks by registering the expired `linktelecom.biz` domain

Link Telecom Hijack Case Study :: The Story of a Sophisticated Spammer



- Traceroutes collected by SPAMTRACER towards Link Telecom's IP blocks during (AB) and after (CD) the hijack

Conclusion

- Several hijackings were identified in the SPAMTRACER data set, one of them confirmed by the network owner
- From the results obtained, the fly-by spammers phenomenon does not seem to currently be a significant and prevalent threat
- Short-lived hijacks by spammers: conjecture or reality?

Future Work

- Improve the visibility of hijacks by deploying SpamTracer at large scale
- Refine the anomaly scoring system by leveraging fuzzy logic
- Improve the hijacking validation process by
  - Asking feedback from victim network owners
  - Correlating different data sources

Thank you!

Time for Q&A!

Some references

[Ramachandran 2006] A. Ramachandran and N. Feamster. Understanding the network-level behavior of spammers. In SIGCOMM ’06: Proceedings of the 2006 conference on Applications, technologies, architectures, and protocols for computer communications, pages 291– 302, Pisa, Italy, 2006.

[Hu 2007] X. Hu and Z. M. Mao. Accurate Real-Time Identification of IP Prefix Hijacking. In Proceedings of the 2007 IEEE Symposium on Security and Privacy, SP ’07, pages 3–17, Washington, DC, USA, 2007. IEEE Computer Society.

[Pilosov 2008] A. Pilosov and T. Kapela. Stealing the Internet: An Internet-Scale Man In The Middle Attack. Defcon 16, Las Vegas, NV, August 2008.

[ISTR 2012] Symantec Internet Security Threat Report: Future Spam Trends: BGP Hijacking. Case Study - Beware of "Fly-by Spammers". http://www.symantec.com/threatreport/, April 2012.