

Illegitimate Source IP Addresses At Internet Exchange Points

@ Connect WG, RIPE 73, Madrid

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Introduction

What are illegitimate source IP addresses?

Packets with source addresses that are not valid within the scope of the public Internet.

What are illegitimate source IP addresses?

- Intentionally spoofed traffic
- Internal traffic leaked by mistake
- General misconfiguration, unknown...

Packets with source addresses that are not valid within the scope of the public Internet.

Why looking at illegitimate source IPs?

- Includes attack traffic (DoS, DDoS, ...)
- Studying unwanted traffic can give insights to come up with mitigation strategies
- Potentially exposes information about internal infrastructure
- Utilizes (expensive) bandwidth

Illegitimate Traffic: Our Categories

- BOGON: RFC1918, IANA reserved, Multicast, Future Use, etc...
- UNROUTED: Source IP address is not announced in the "global routing table"
- INVALID: Traffic sent by a network that is not responsible for the corresponding prefix

What we do...

- Previous studies like the Spoofer Project send probes to check for BCP38 compliance
- Our work is a passive approach to check for BCP38 deployment
- Provides insights about specific traffic volume and characteristics

Identifying Traffic

Identifying Bogon and Unrouted

Bogon

- RFC1918, Multicast, Future Use, IANA reserved

Traffic with a source address which is covered by this list is of class BOGON

Unrouted

- Routing information: IXP Route Server, RIPE/RIS, RouteViews
- Compile a list of observed prefixes at all routing sources

Ignored: Announcements larger than /8 and smaller than /24

Traffic with a source address which is **not** covered by this list is of class UNROUTED

Routing Information

We utilize as many data sources as possible to minimize false positives

- RIPE/RIS (14 collectors)
- RouteViews (16 collectors)
- Bogon/Martian prefix list as provided by Team Cymru

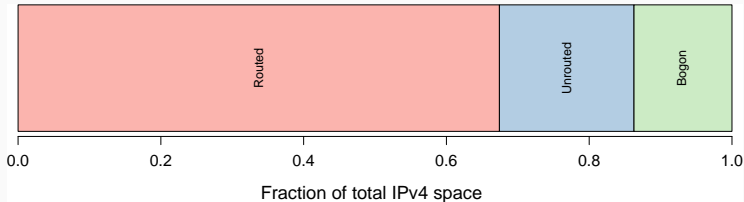
Bogon And Unrouted Overview

Bogon Prefixes

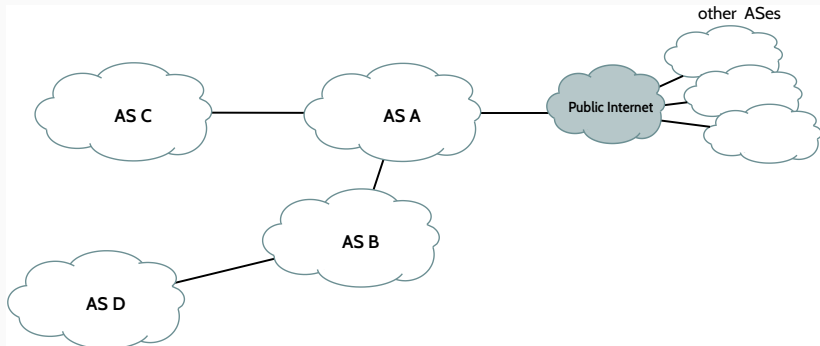
- As defined in RFC1918 and RFC5737
- 2.3M /24
- 14% of the IPv4 address space

Unrouted Prefixes

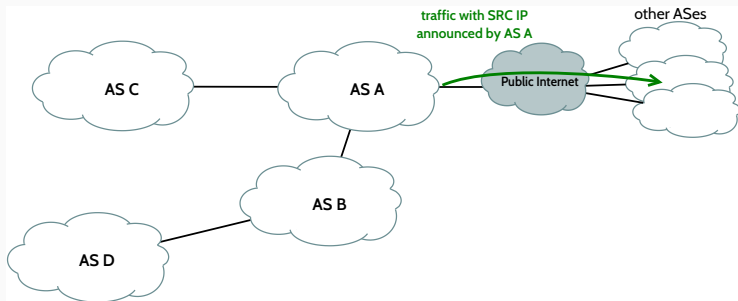
- 11.3M validly announce /24 (78% of the IPv4 address space)
- 3.16M unrouted /24 (excluding Bogon)



AS specific: Identifying Invalid

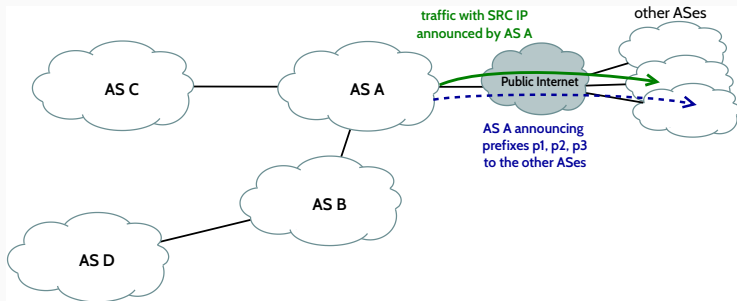


AS specific: Identifying Invalid

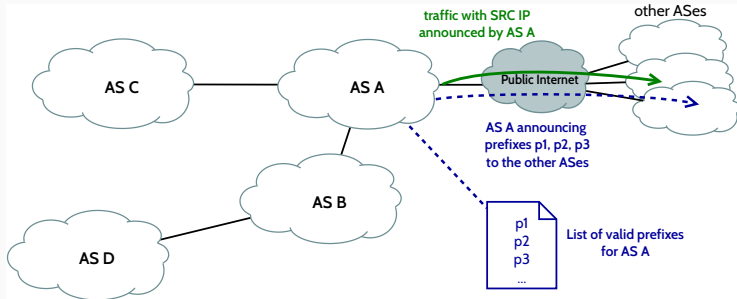


Assumption: An AS announcing a prefix is also a legitimate source for traffic originating from this prefix.

AS specific: Identifying Invalid

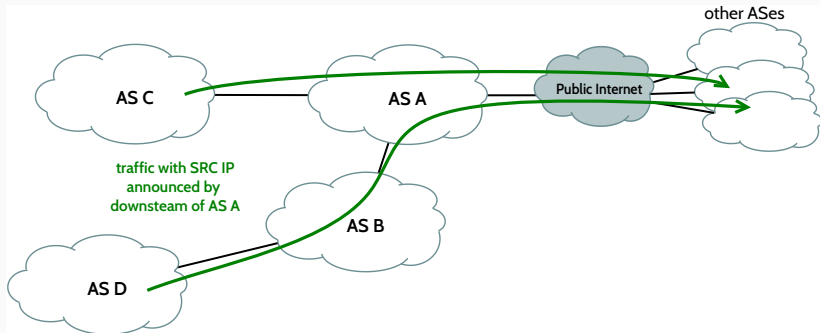


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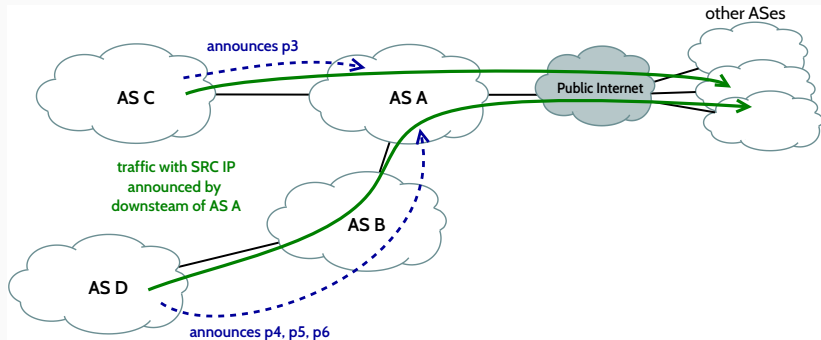


Construct list of valid prefixes for each AS

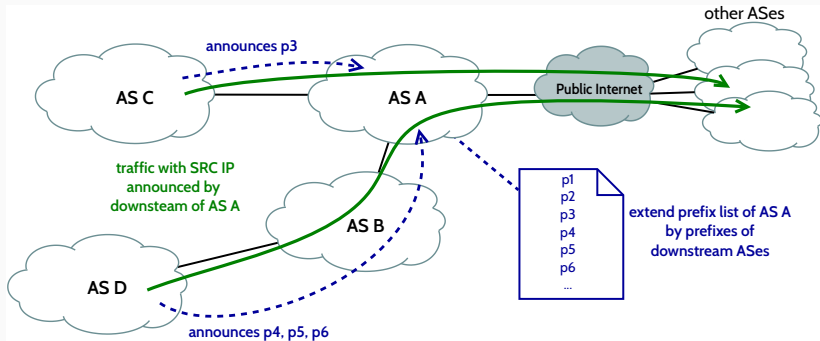
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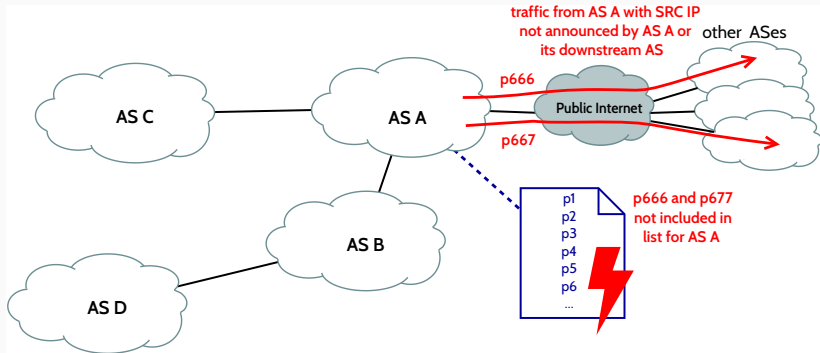


AS specific: Identifying Invalid



Prefix lists are also created for AS B, AS C and AS D (derived from public routing data) and added to the list of AS A

AS specific: Identifying Invalid



INVALID: Traffic with a SRC IP from a Prefix NOT covered by the prefix list of AS A

Identifying Invalid: Limitations

False positives

- No full picture of the complete BGP state
- Can not capture direct private interconnects

False negatives

- AS must just be *somewhere* on the AS Path to be valid source

Lots of number crunching involved

The process works completely offline, using a lot of computation time and memory.

Applying our methodology at a Large European IXP

- Measurements taken at a Large European IXP (LIXP)
- More than 700 members and peak traffic up to 5 Tb/s
- 5 weeks of uninterrupted IPFIX from 2016-01-18 to 2016-02-21
- Sampling rate 1/32K
- We only considered IPv4 (until now...no need to queue for this question ;))

Fractions of BOGON, UNROUTED, INVALID in terms of total traffic

	Absolute traffic	Bytes	Packets
BOGON	28.11 TB	0.004%	0.029%
UNROUTED	72.56 TB	0.010%	0.053%
INVALID	509.68 TB	0.076%	0.087%

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Relative amount is small, but absolutely we have 610TB of traffic for all 3 classes within one week.

Overview: Traffic Classes Over One Week

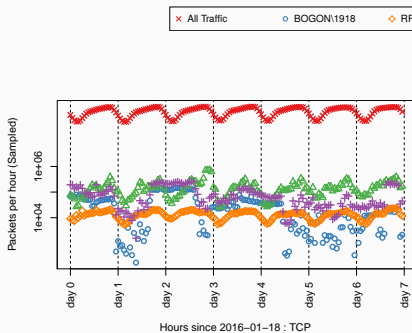


Figure 1: LIXP: TCP – Time series week 2016-01-18

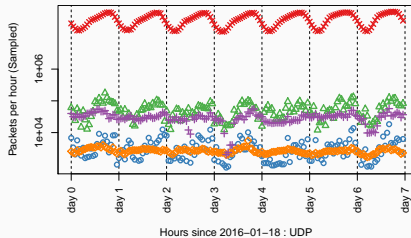
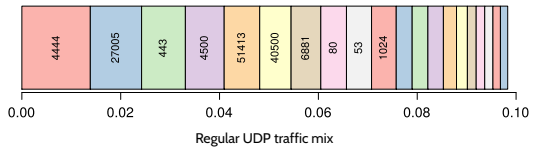
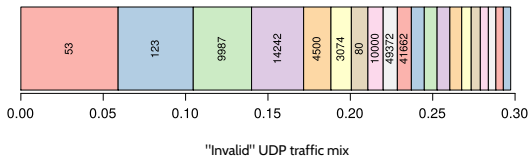
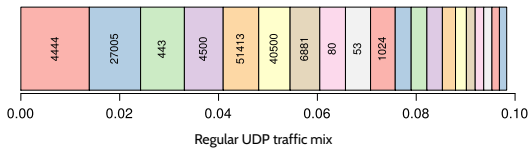


Figure 2: LIXP: UDP – Time series week 2016-01-18

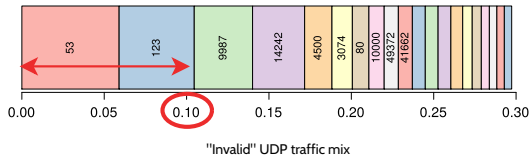
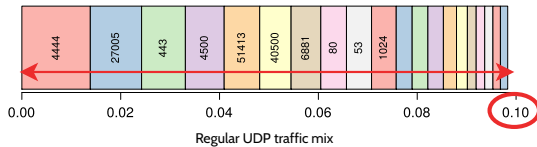
Top 20 UDP Destination Ports



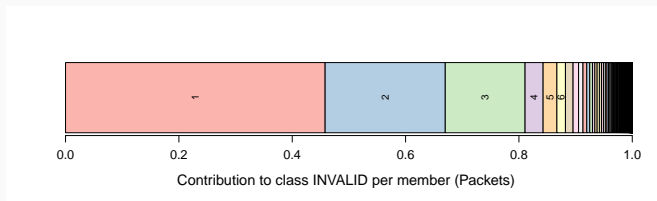
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Contribution to INVALID by IXP member



80% of the INVALID traffic can be attributed to 3 IXP members

Member Categorization (Bogon)

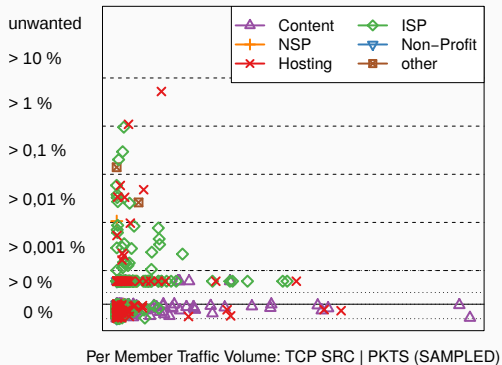


Figure 3: LIXP BOGON

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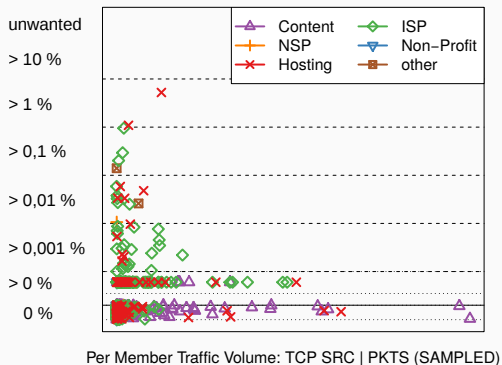


Figure 3: LIXP BOGON

- Majority does not leak anything
- TCP SYNs leaked: Probably misconfigured NAT
- Mostly low traffic ISPs and small hosters

Member Categorization (Unrouted and Invalid)

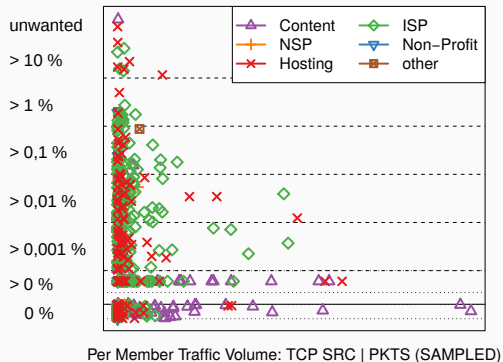


Figure 4: LIXP: UNROUTED and INVALID

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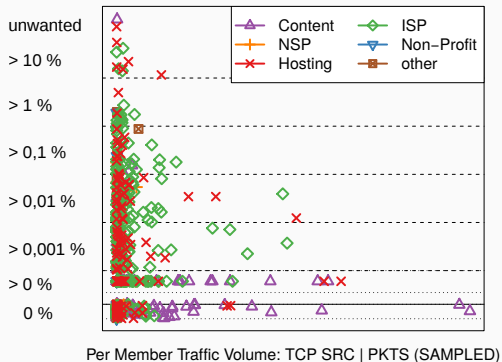


Figure 4: LIXP: UNROUTED and INVALID

- More members involved than in BOGON
- Still lots of members with 0%
- High traffic members have low unwanted level
- Lots of low traffic ISPs and hosters

Conclusion

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- Large networks tend to deploy their filtering correctly – (Yes, it can be done!)
- Many small networks lack proper filtering
- Only a small amount of members contribute most of the unwanted traffic

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Continue the ongoing efforts by the community to educate people and get rid of excuses!