Weaponizing BGP Using Communities

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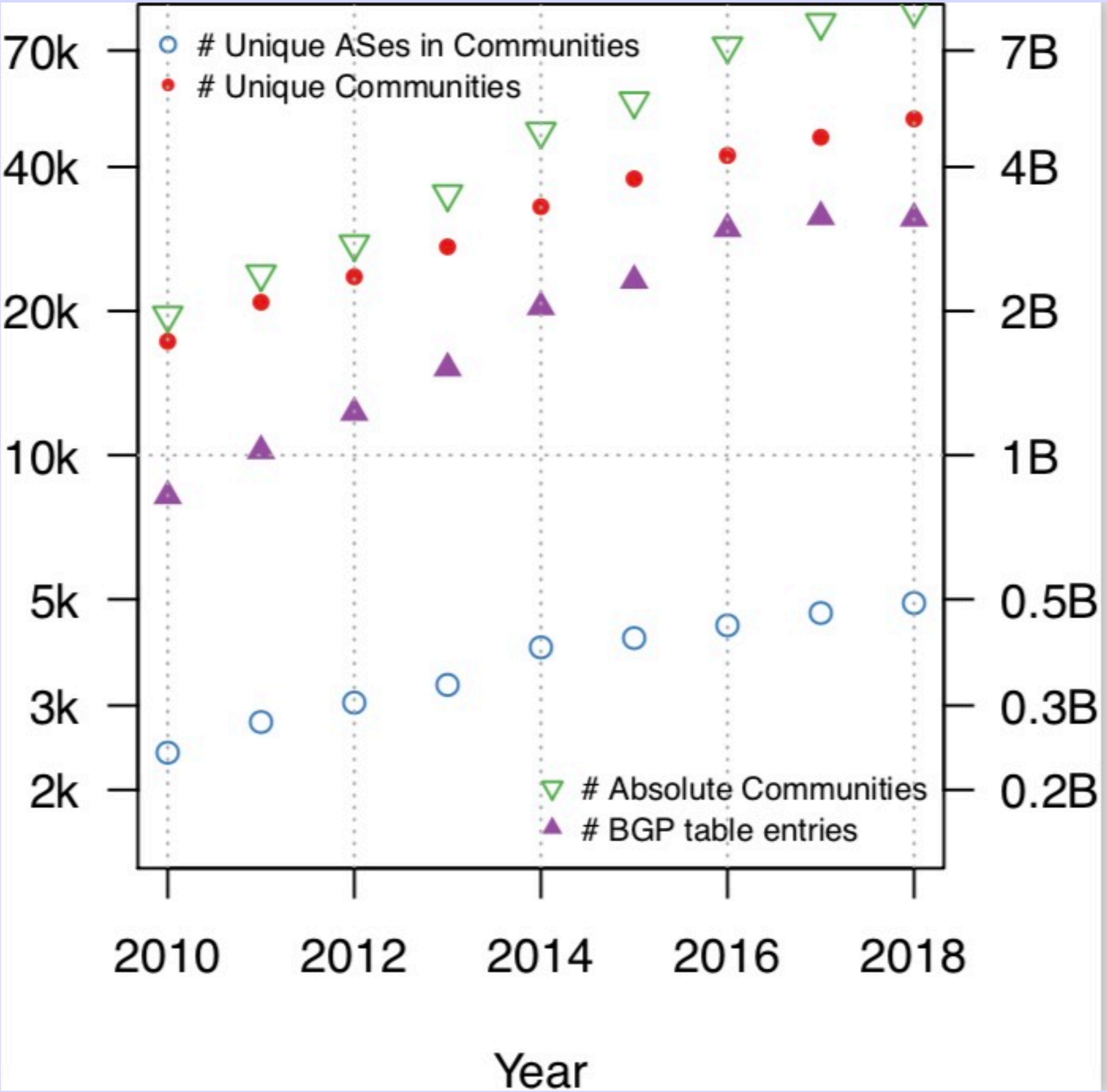

○ # Unique ASes in Communities
● # Unique Communities
▽ # Absolute Communities
▲ # BGP table entries
70k
40k
20k
10k
5k
3k
2k
7B
4B
2B
1B
0.5B
0.3B
0.2B
2010
2012
2014
2016
2018
Year

Ill-Defined Semantics

We have a syntax, `AS:<blarg>`

But there are no formal semantics, just convention and BCPs

We're putting semantics in comments

```
i = 0;  /* i = 42 */
```

Flavors, We Think

- Active
  - Path prepending
  - Modify local preference
  - Remote triggered blackholing
  - Selective announcements
- Passive
  - Location Tagging
  - RTT Tagging

And then anything a thousand kiddies have invented

Propagation

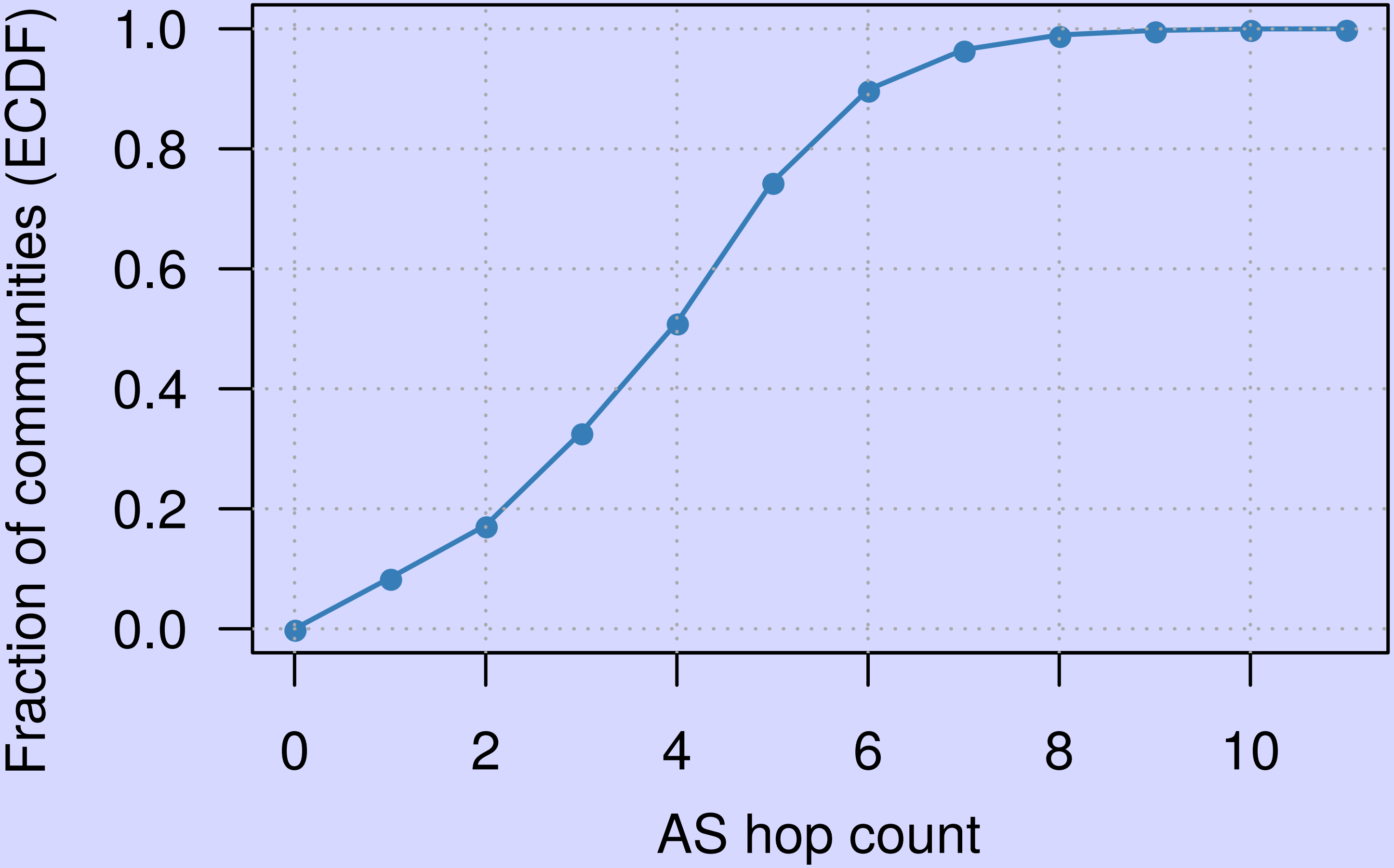
- RFC 1997: Communities are a transitive optional attribute
- RFC 7454: Scrub own, forward foreign communities
- So many people do not expect them to propagate that widely
- I, for one, did not

Only 14% of Transit ASs propagate communities

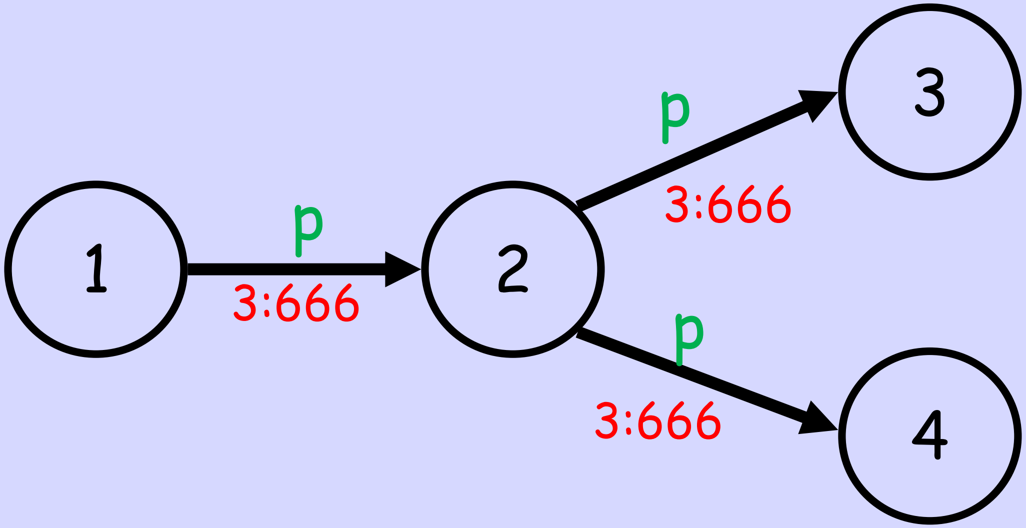
(2.2k of 15.5k)

Surprise!

- 14% seems small, but AS graph is highly connected
- More than 50% of communities traverse more than four ASes
- 10% of communities have a hop count of more than six ASes
- Longest community propagation observed: through 11 ASes


Fraction of communities (ECDF)
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
AS hop count

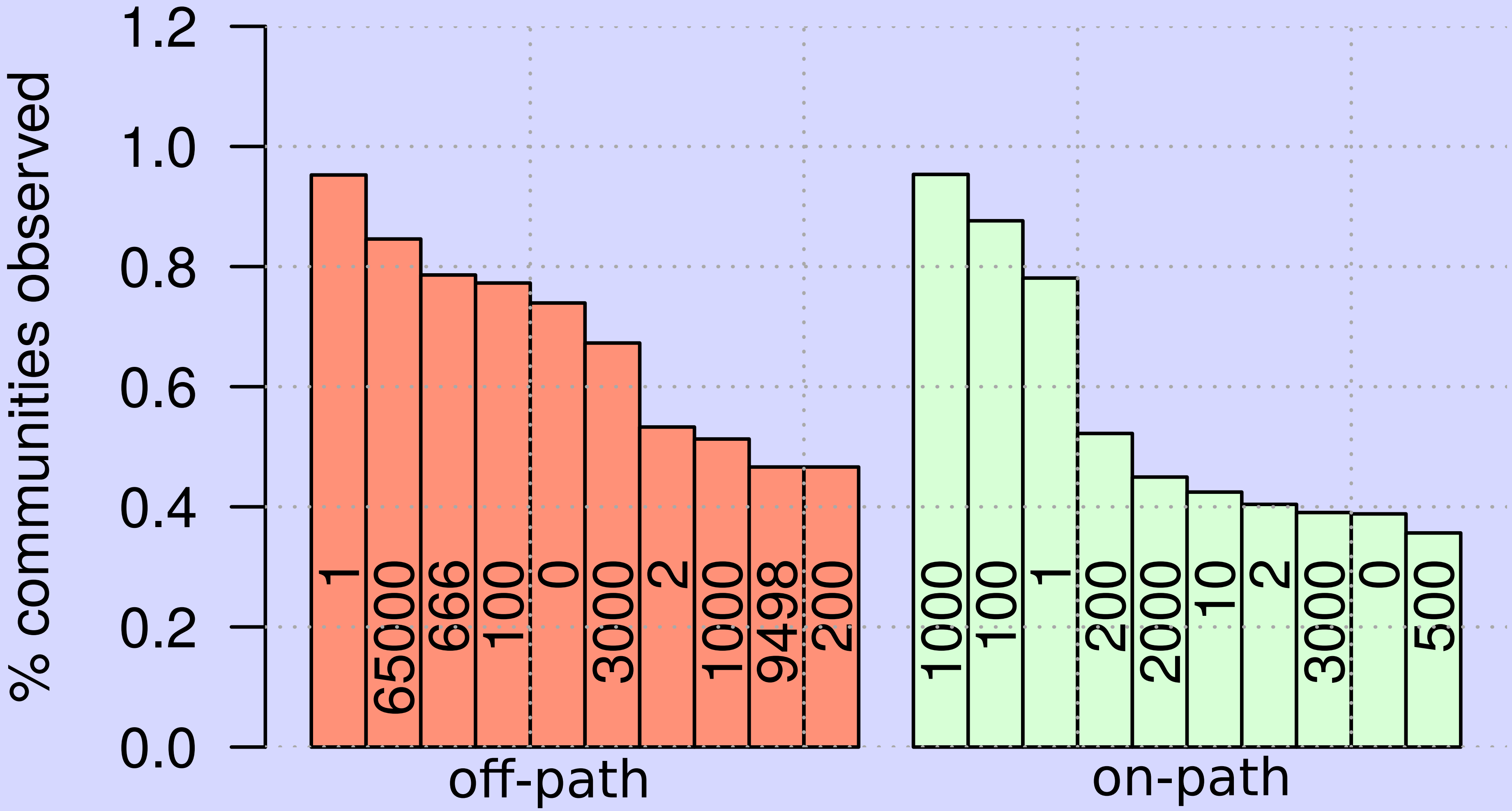
On/Off Path



2 and 3 are On Path

4 is Off Path

Observed Communities

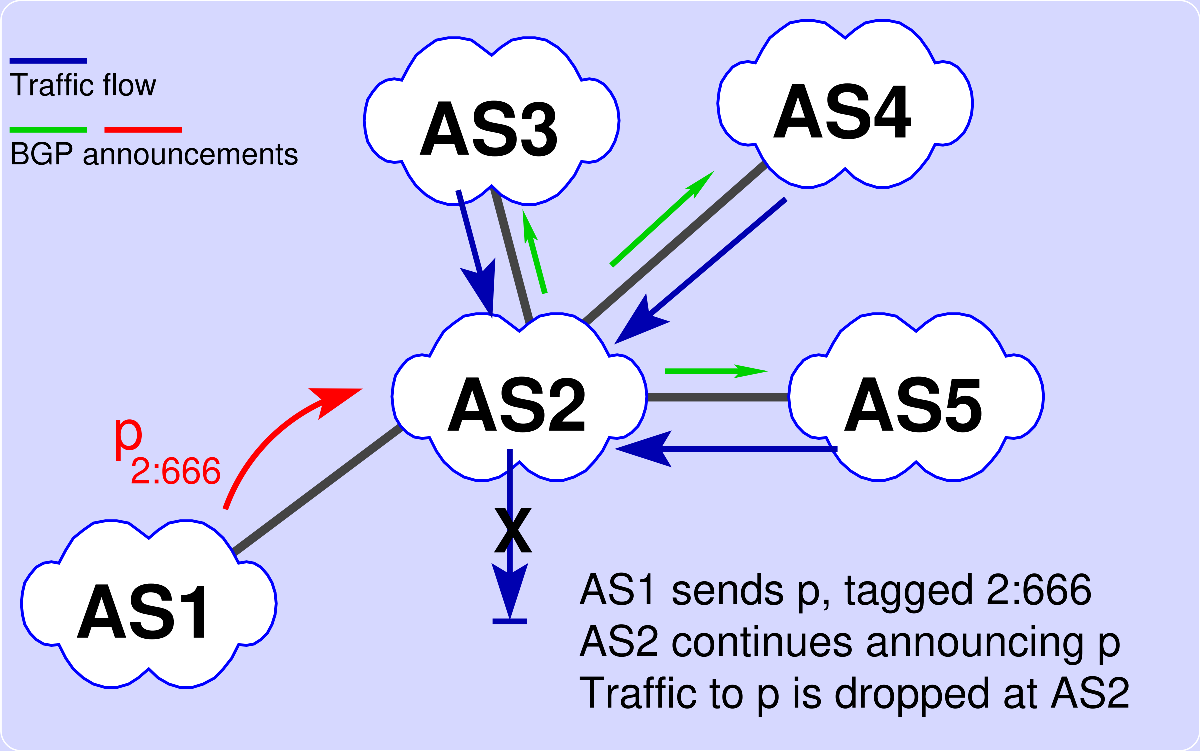


So Let's Break Things!

Method to our Madness

- All experiments first tested in Lab
- Impacts were estimated
- Validated on the Internet, with operators' consent, e.g. for hijacks

Remote Triggered Black Hole

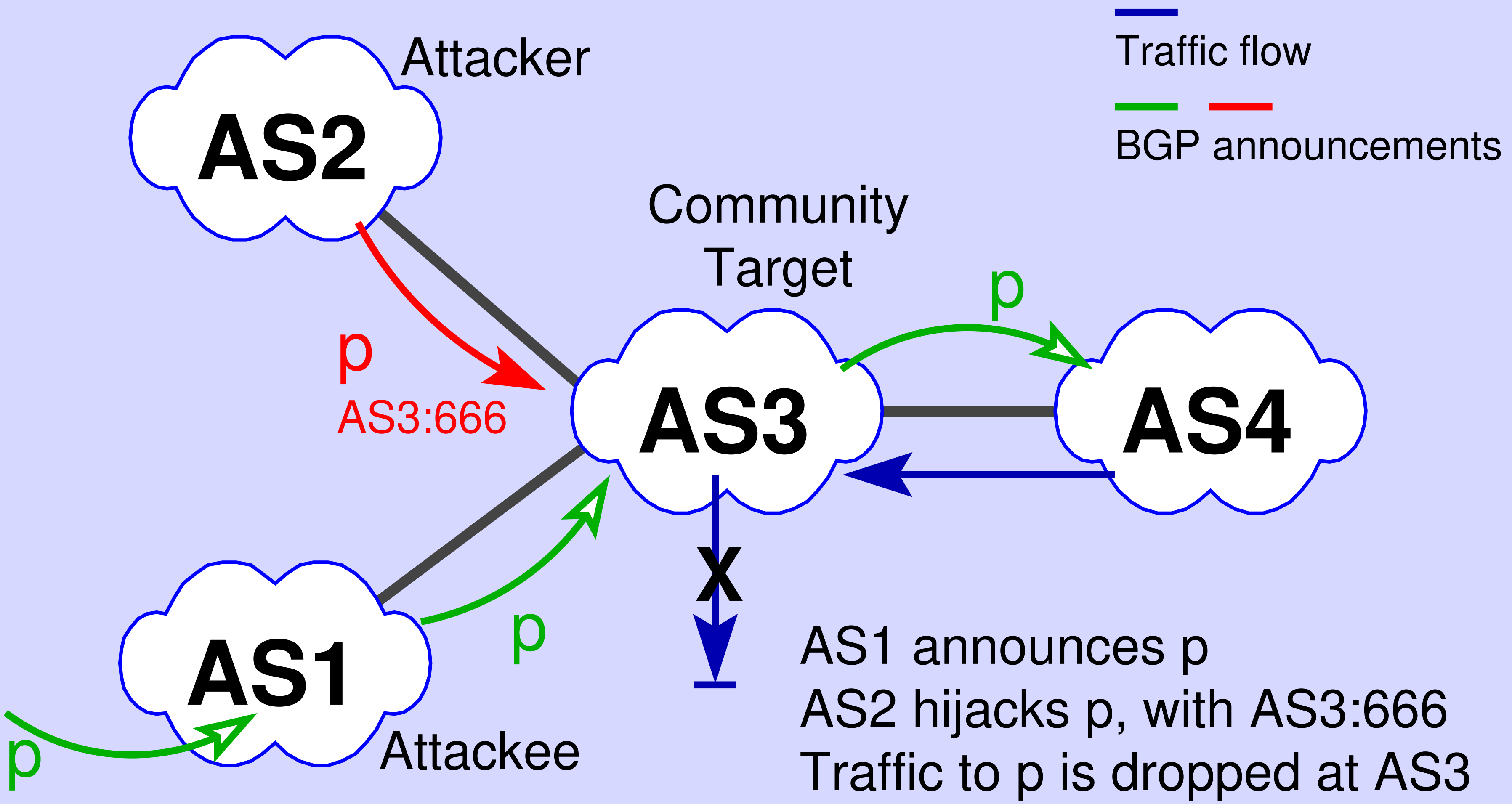


AS1 sends p, tagged 2:666
AS2 continues announcing p
Traffic to p is dropped at AS2

Safeguards:

- Provider should check customer prefix before accepting RTBH
- Customer may only blackhole own prefixes
- Different policies for Customers/Peers
- On receiving RTBH, add `no-export`

What Can Happen

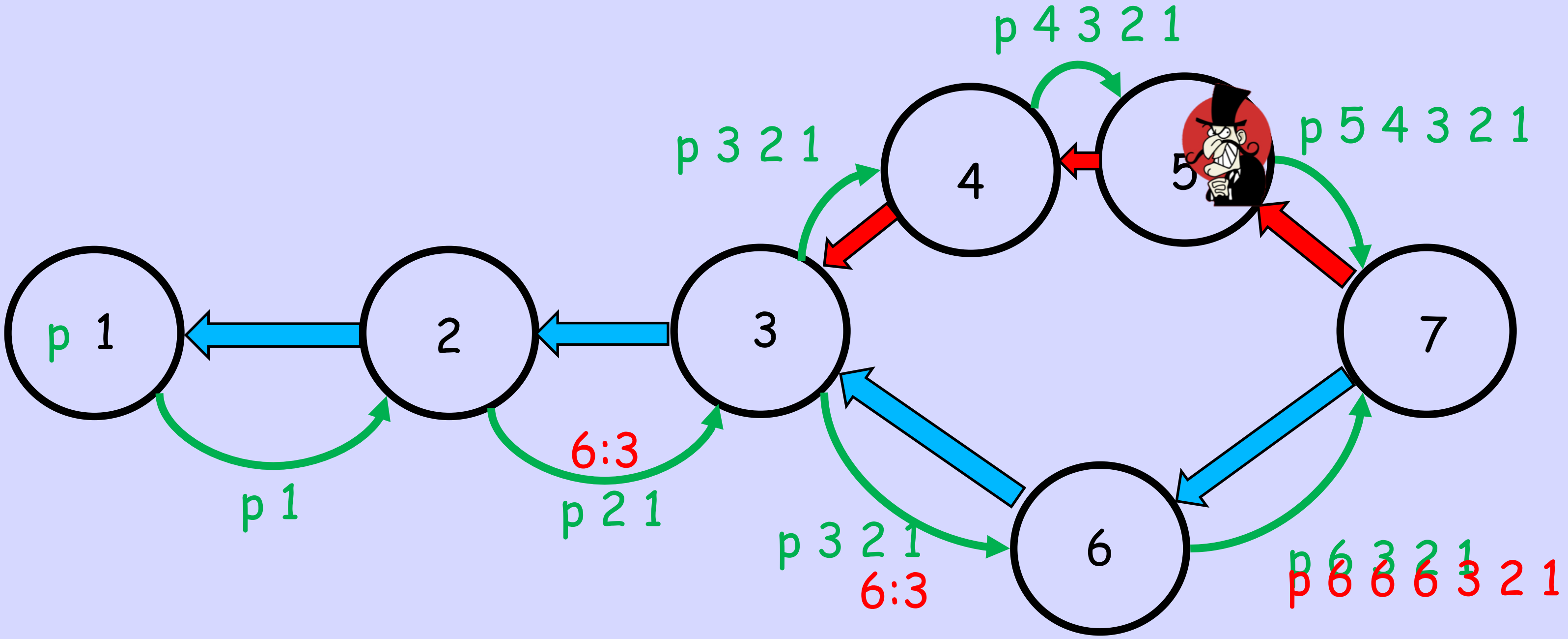


AS1 announces p
AS2 hijacks p, with AS3:666
Traffic to p is dropped at AS3

It Works Well

- Works multi-hop and is hard to spot
- Triggering RTBH is possible for attackers because, e.g.,:
    - BH prefix is more specific, thus accepted via exception
    - Providers check BH community before prefix filters (bug in NANOG recipe)
    - No validation for origin of community is possible

Traffic Steering



That's Not Realistic

Oh Yeah?

https://dyn.com/blog/bgp-dns-hijacks-target-payment-systems/

“BGP hijacks made use of BGP communities to shape route propagation. Although they also changed origins, which was the giveaway.”

It's the Cloud, Man

- ASN value ambiguous: who is "sender", "recipient"
- No defined semantics, values can mean anything
- Used both for signaling and triggering of actions
- No cryptographic protection
- Attribution is impossible
- It is hard to apply filters or understand what is going on

I Read it on the Internet

- Communities can be modified, added, removed by every AS
- No attribution is possible
- No cryptographic protection
- Yet operators bet on their 'correctness'
- Large communities partially improve the situation

Don't Propagate Without Thinking Very Deeply

- On Input – Drop anything not addressed to you, unless special agreement
- On Output – Drop everything except signals from you to the direct peer
- And Beware Cisco 'mis-feature' re well known communities

```
draft-ietf-grow-wkc-behavior-00
```

ONLY
YOU
CAN PREVENT
WILDFIRES
SMOKEY
Ad Council
SMOKEYBEAR.COM
SMOKEY