Mitigating Route Hijacking using RPKI and Automation

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ABOUT US

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- Architect @ Juniper Networks APAC
- 20 years in the Service Provider domain
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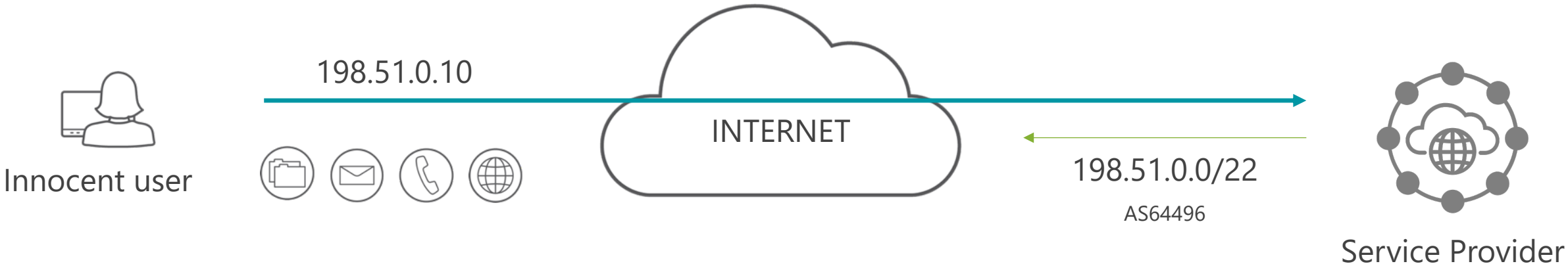
The Perfect world



Prefix filters, IRR filtering, Peer lock, etc. are all In place?

- Prefix filters
- Peer lock aka “bignetworks filter”
- Bogon ASN filtering
- Bogon Prefix filtering
- Filter long ASN path
- Filter small prefixes
- IRR filtering

The Perfect world…or not (yet)?

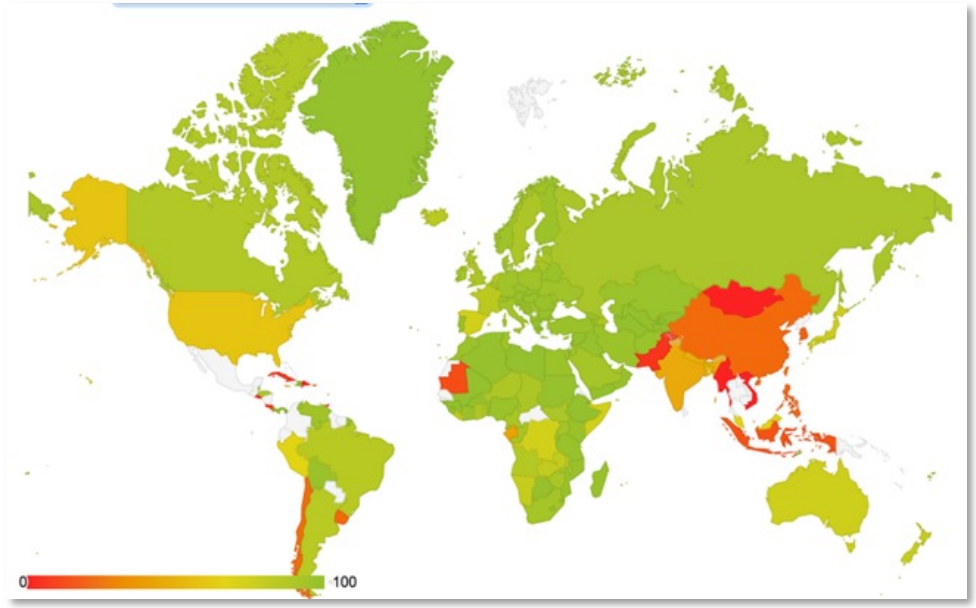
I know all my customers and peers (all friends) and have filters and strict IRR applied.

However,…

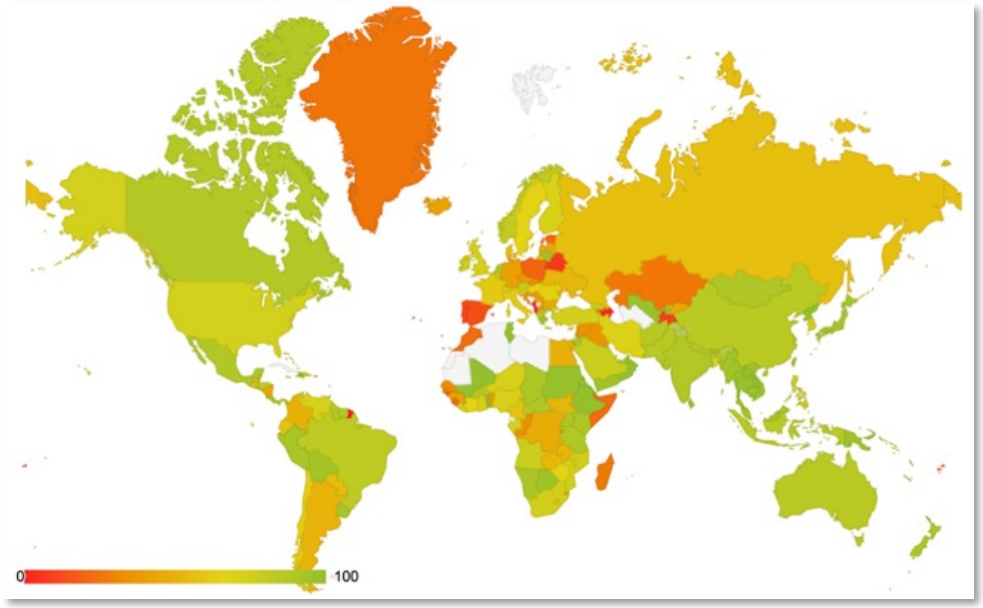
- Prefix filters don’t care about the originating ASN or AS-PATH
- Peer Lock doesn’t cover every network and is arbitrary
- Downstream customers might use private ASN
- Downstream customers who are multihomed might unknowingly leak routes which they don’t originate
- IRR databases are far from correct, are incomplete or contain outdated data

IRR database accuracy

RIPE IRR



RADB IRR



BGP Hijacking is happening

April 2021 - Vodafone Idea (AS55410)

- AS55410 mistakenly announced over 30,000 BGP prefixes causing a 13x spike in inbound traffic to their network.
- VIL-AS-AP (Vodafone Idea) - hijacked 37739 prefixes - countries affected 164 - ASNs affected 4012 - duration 1:30:00
- Incident lasted around two hours. Users suffered slow connections and denial of service to some servers.

Source : https://www.manrs.org/2021/04/a-major-bgp-hijack-by-as55410-vodafone-idea-ltd/
Source : https://anuragbhatia.com/2021/04/networking/isp-column/large-prefix-hijack-from-vodafone-as55410/

April 2020 - Akamai, Amazon and Alibaba

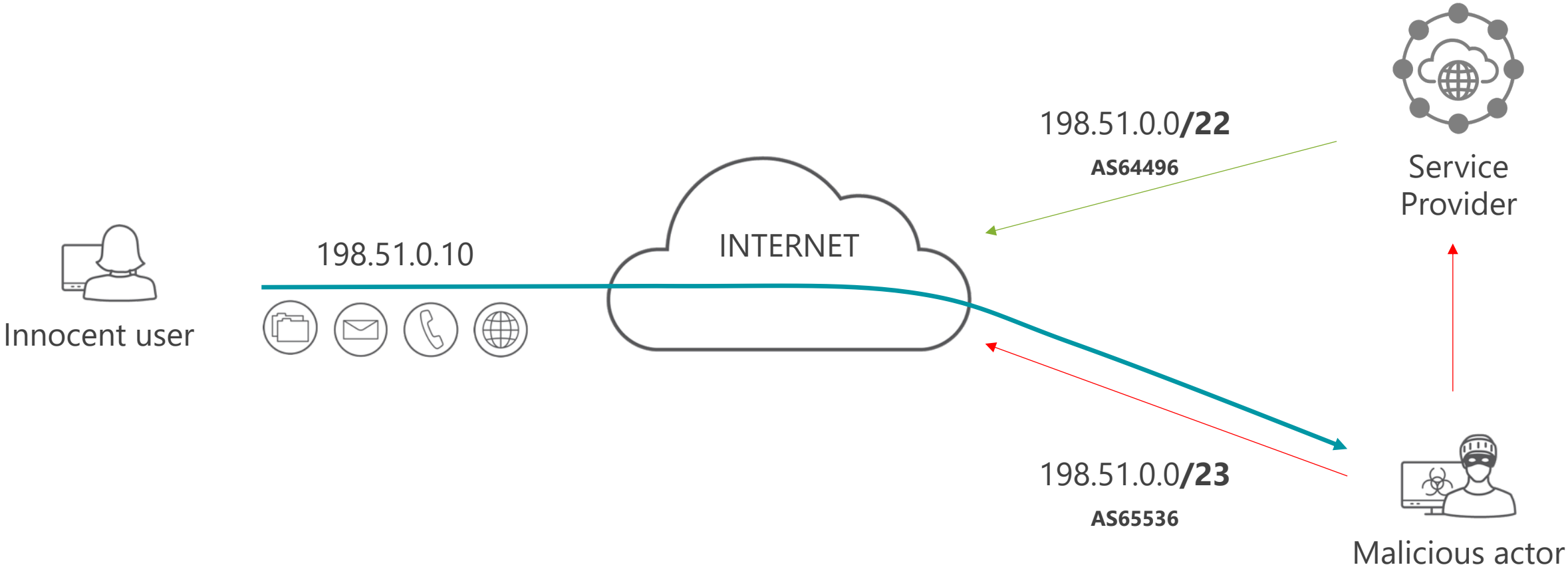
- A massive BGP hijack involving over 8,800 prefixes affected companies such as Akamai, Amazon and Alibaba on April 1, 2020.
- Initiated by a Rostelecom user, the attack caused service disruptions throughout the world.
- Stricter network filtering by Rostelecom could have prevented the attack.

September 2020 - Telstra

- 500 prefixes wrongfully advertised as belonging to Telstra caused lengthy data detours.
- Incident was caused by post verification testing to address an unrelated software bug.

Source: https://www.anapaya.net/blog/border-gateway-protocol-hijacking-examples-and-solutions

What happened to our innocent user?



So now what?

Photo by Markus Spiske on Unsplash

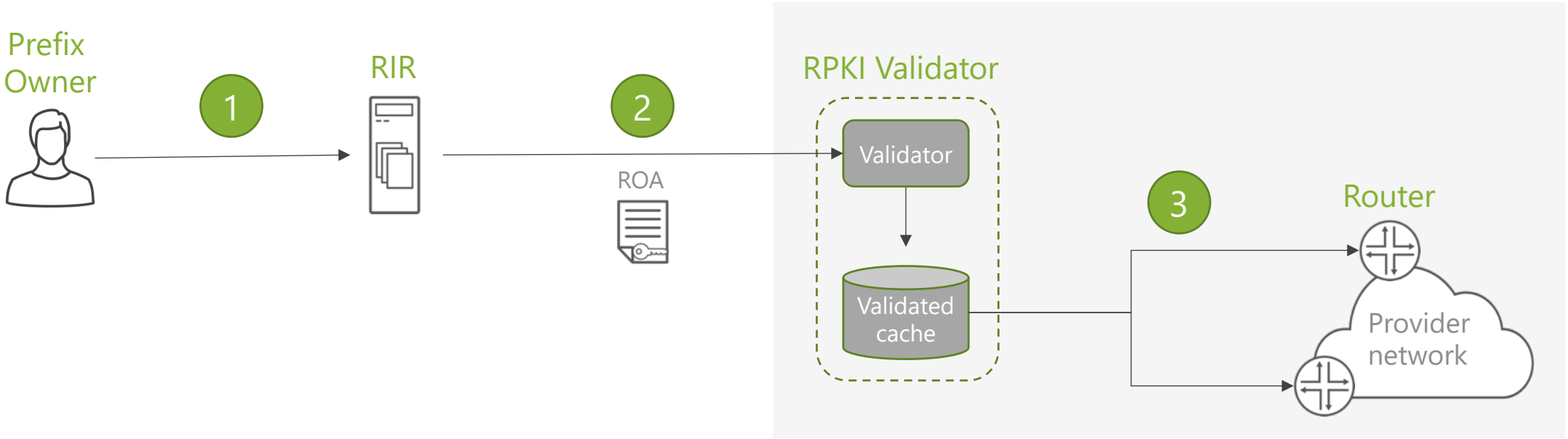
Origin Validation using RPKI

Resource Public Key Infrastructure (RPKI) is a method of cryptographic signing records that associate a prefix with an originating AS number.

All the five RIRs (AFRINIC, APNIC, ARIN, LACNIC & RIPE) provide a method for members to take a prefix/ASN pair and sign those with a ROA (Route Origin Authorization) record.

The ROA can then be used by operators to validate route advertisements. They are sure a route advertisement is intended by the legitimate owner.

Origin validation explained



1. The owner of a prefix registers with an RIR and creates a signed Validated ROA Payload (VRP)
2. RPKI validator downloads signed VRPs and verifies it
3. RPKI validator sends VRP to border routers that validate the BGP routes

RPKI Validator implementations

Open-source projects supporting RPKI: https://rpki.readthedocs.io/en/latest/ops/tools.html

Some notable mentions:

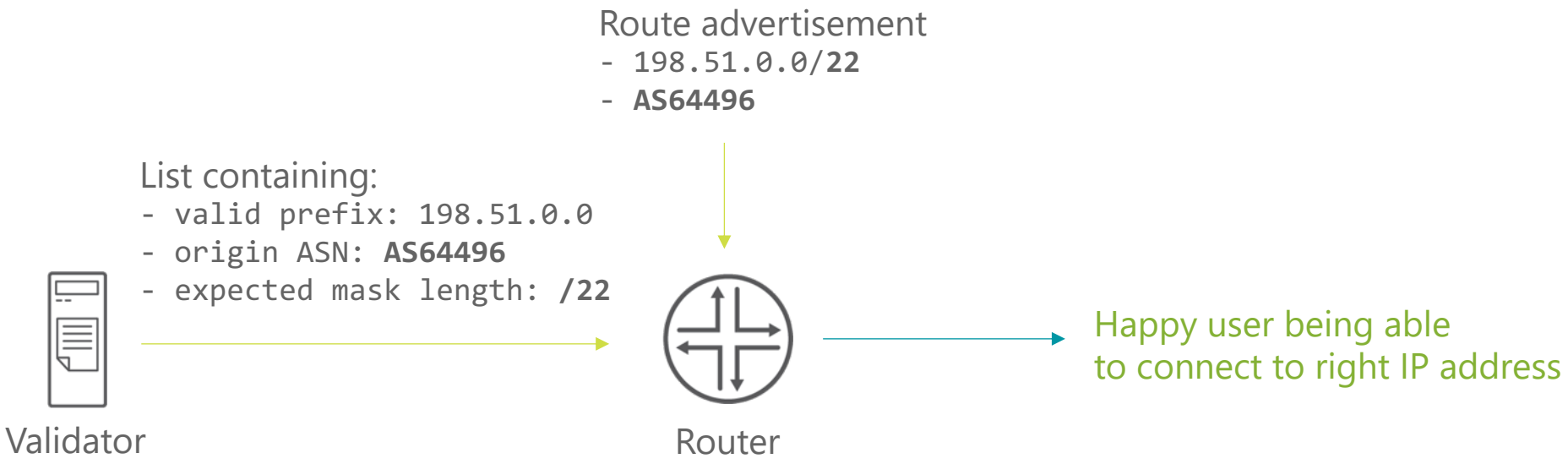
Routinator: Project from NLnet Labs
https://github.com/NLnetLabs/routinator

Fort Validator: Part of the FORT routing security initiative by LACNIC and NIC.MX
https://github.com/NICMx/FORT-validator

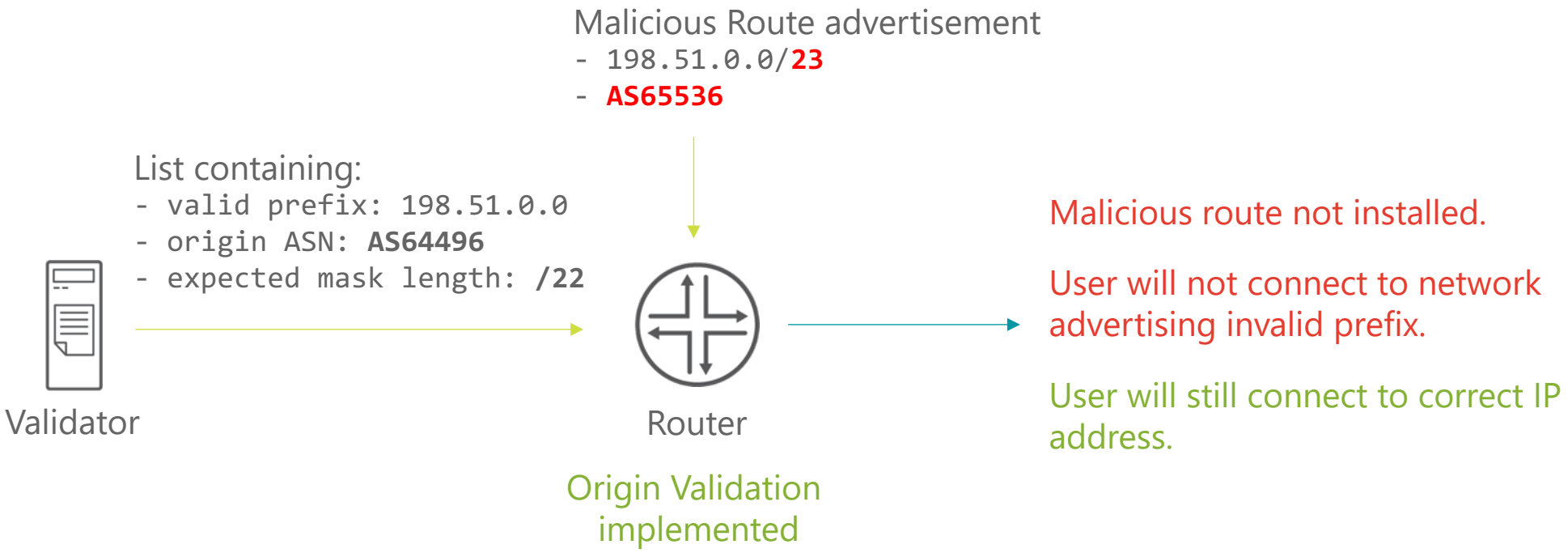
OctoRPKI: Project from Cloud Flare
https://github.com/cloudflare/cfrpki#octorpki

Prover: https://github.com/lolepezy/rpki-prover

Perfect world routing



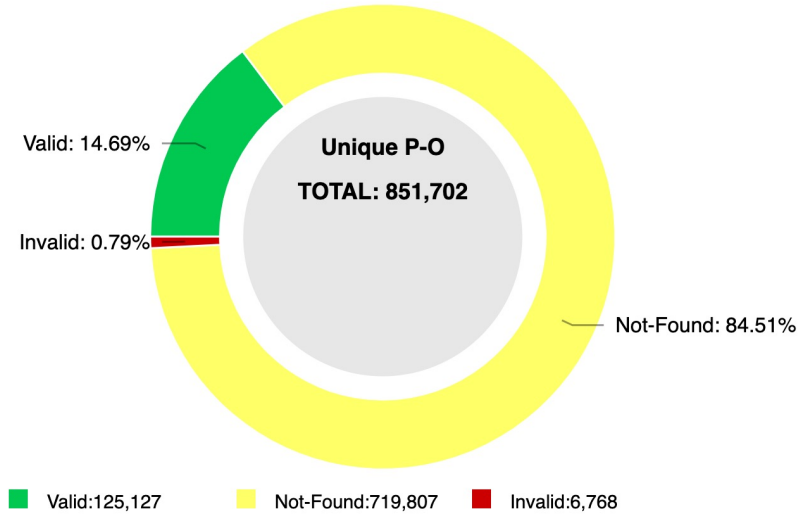
Even better world, Origin validation implemented



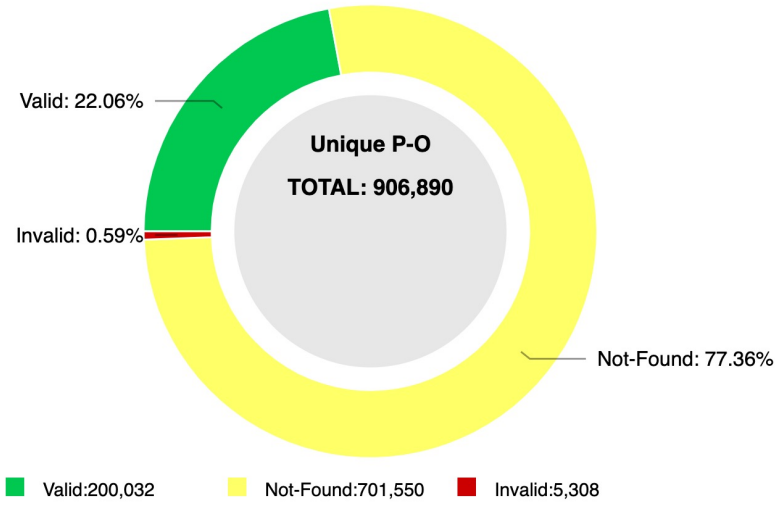
But…only if the world was perfect

RPKI-ROV analysis of Unique Prefix-Origin Pairs (IPv4)

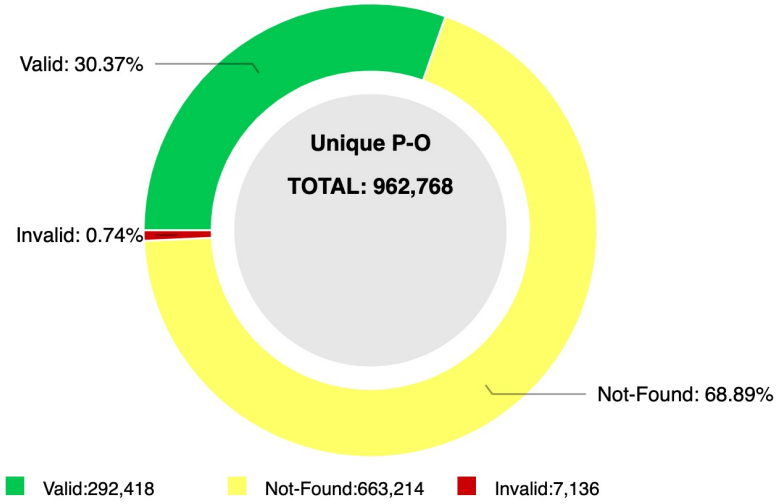
July 2019
(Valid: ~15%)



July 2020
(Valid: ~22%)

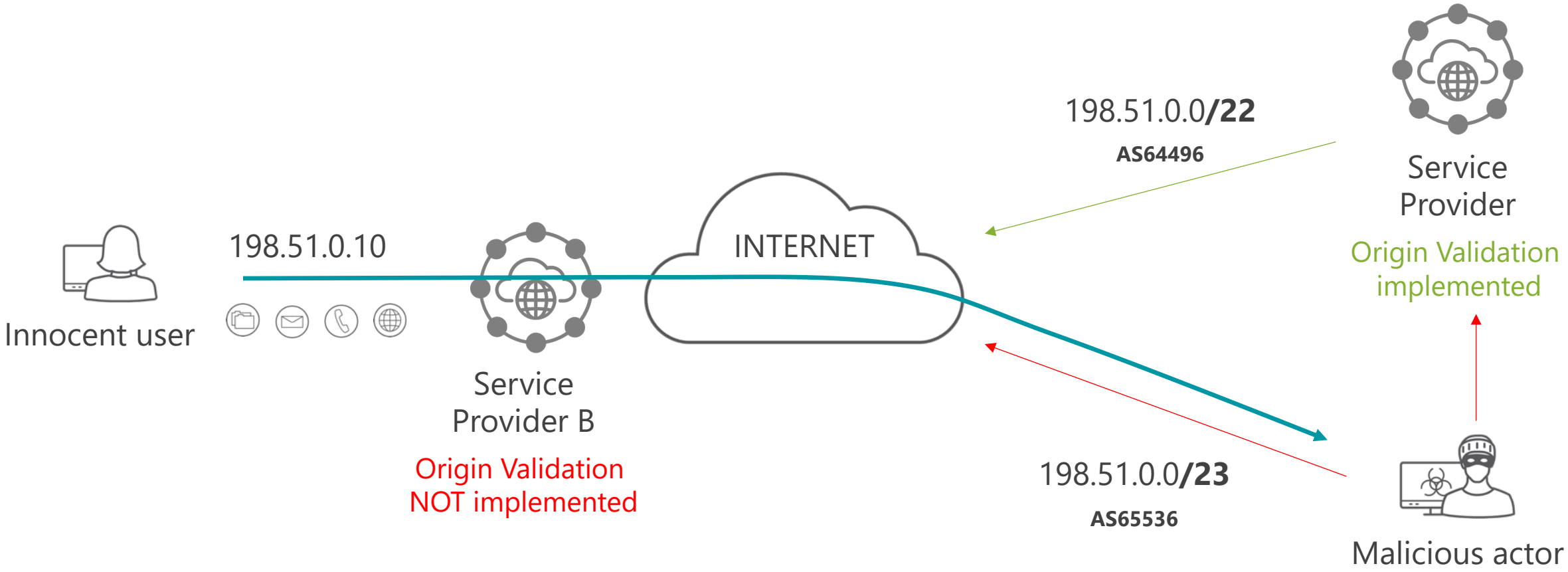


July 2021
(Valid: ~30%)

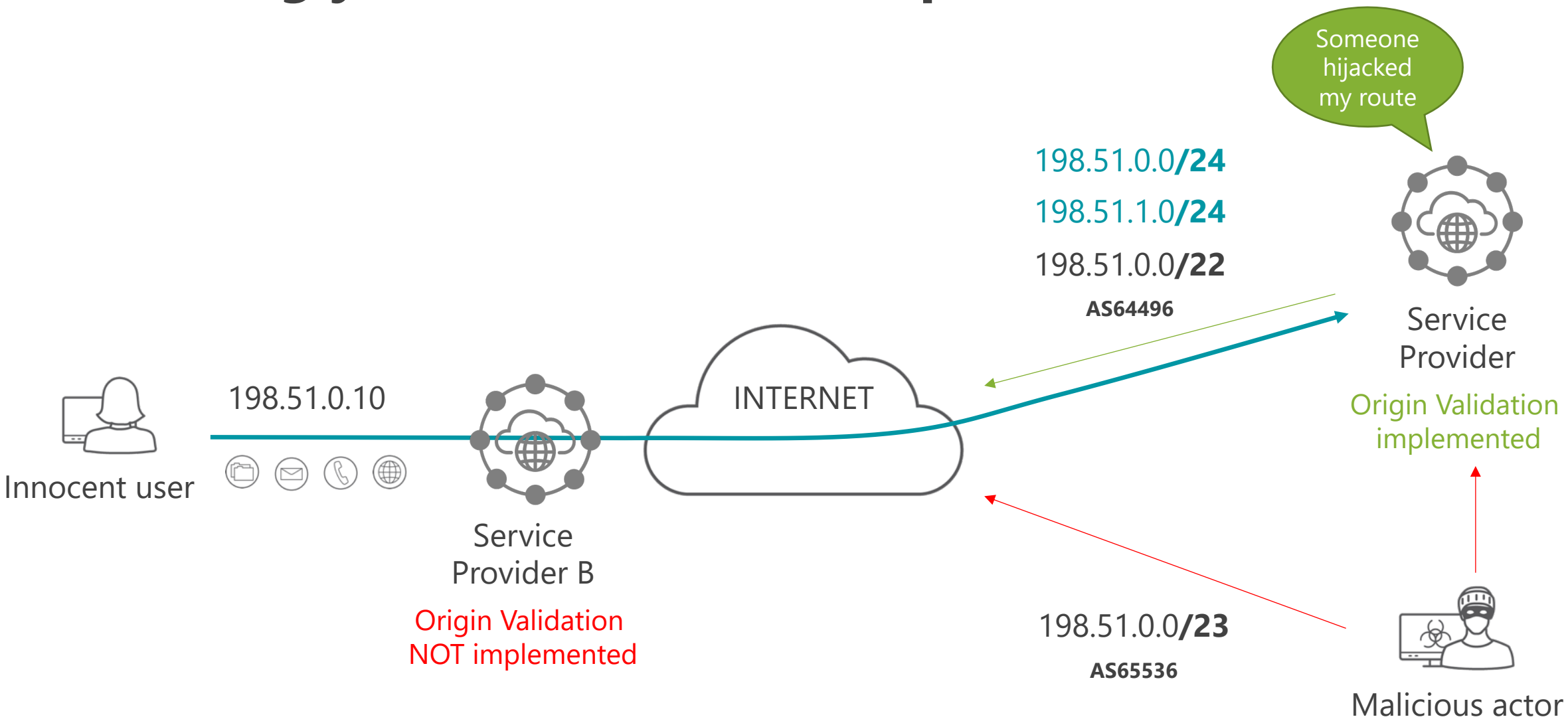


Source: https://rpki-monitor.antd.nist.gov

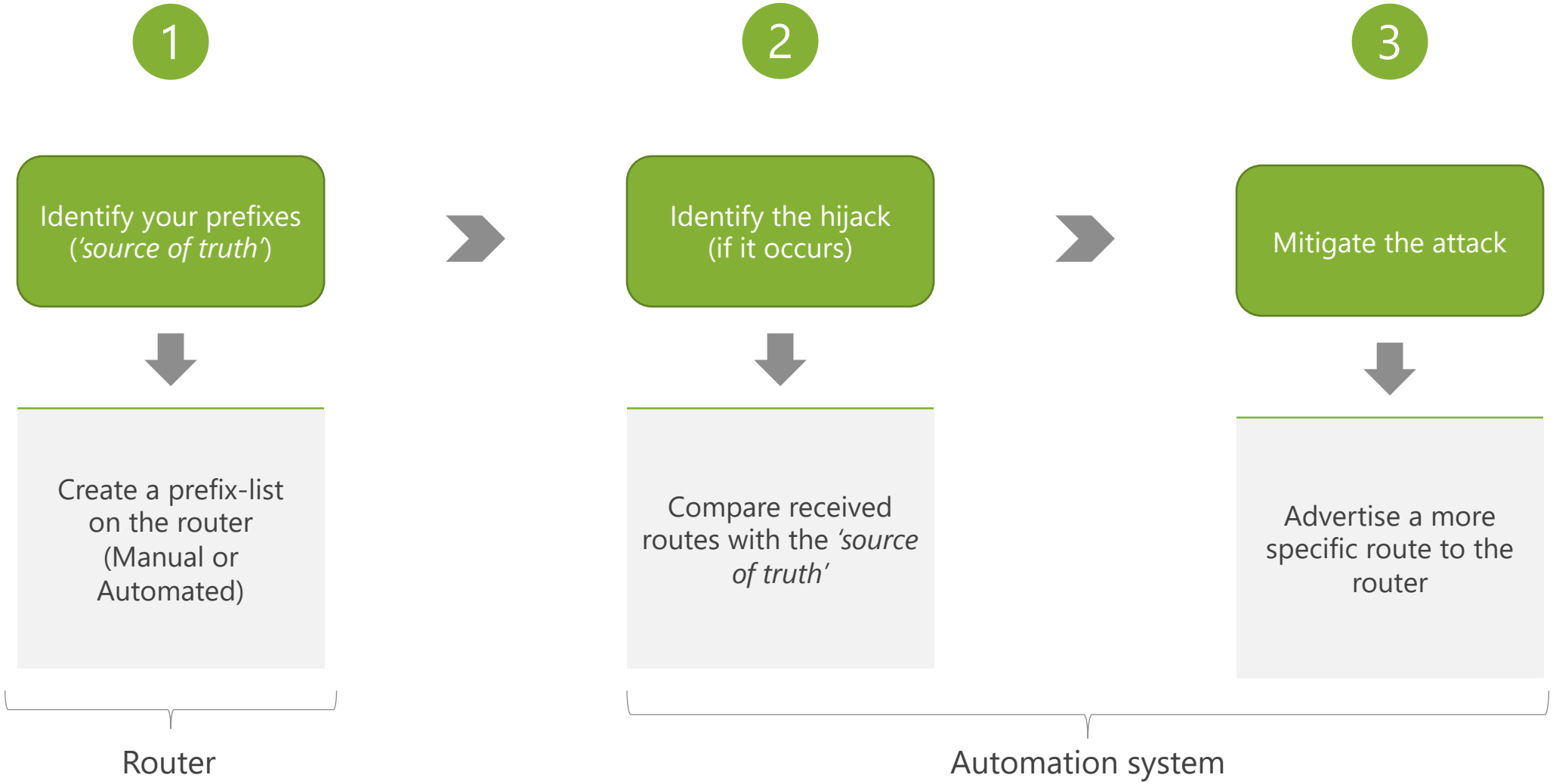
Protecting your network in an imperfect world (1/2)



Protecting your network in an imperfect world (2/2)



3 steps to detect & mitigate route hijacks with Automation



3 steps to detect & mitigate route hijacks with Automation


```
policy-options {
    prefix-list AS64496-prefixes {
        10.0.16.0/21;
        10.0.24.0/21;
        10.0.25.0/24;
        10.0.32.0/19;
        :
        :
        198.51.0.0/22;
    }
}
```

Note: Sample outputs from Juniper JUNOS

3 steps to detect & mitigate route hijacks with Automation


```
policy-options {
    policy-statement hijack-check {
        term invalid-myprefixes {
            from {
                protocol bgp;
                prefix-list-filter AS64496-prefixes
orlonger;
            }
            then {
                community add HIJACKED;
                reject;
            }
        }
    }
    community HIJACKED members 64496:1111;
    community MITIGATED members 100:2222;
    community MYCUSTOMERS members 100:9999;
    community MYROUTES members 100:1000;
}
```

```
protocols {
    bgp {
        group ebgp {
            type external;
            import hijack-check;
            family inet {
                unicast;
            }
            export [ EXPORT-PEER deny-all ];
            neighbor 17.8.2.2 {
                peer-as 200;
            }
            neighbor 17.8.3.2 {
                peer-as 300;
            }
        }
    }
}
```

Note:

- Sample outputs from Juniper JUNOS
- Ensure proper policy hierarchy to ensure routes are not dropped
- Additional consideration required for ASN hijacking case

3 steps to detect & mitigate route hijacks with Automation

2

Identify the hijack (if it occurs)

Compare received routes with the prefix-list

Automation system

```
root@isp-r1> show route community 64496:1111 all

inet.0: 781928 destinations, 2345613 routes (781922 active, 0 holddown, 781864 hidden)
+ = Active Route, - = Last Active, * = Both

198.51.0.0/23          [BGP ] 00:01:17, localpref 100
                       AS path: 200 65535 I, validation-state: unverified
                     > to 17.8.2.2 via ge-0/0/2.0
```

Note: Sample outputs from Juniper JUNOS

3 steps to detect & mitigate route hijacks with Automation

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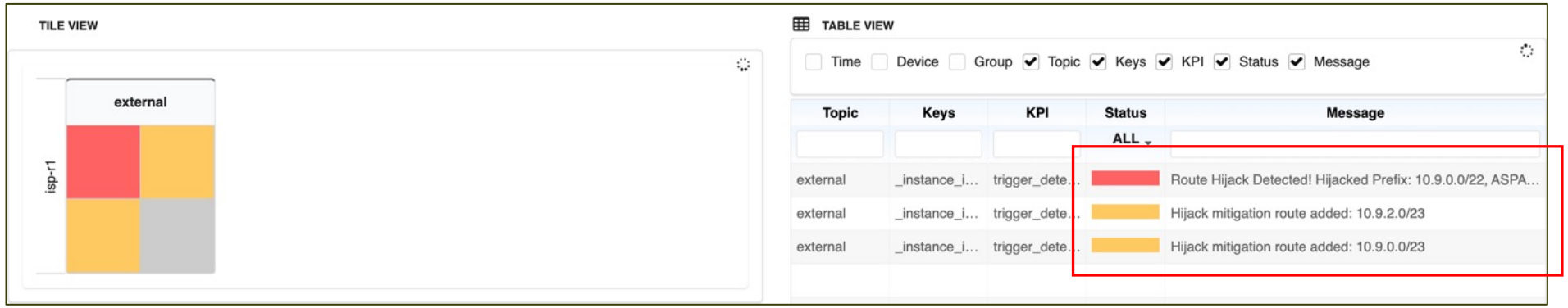
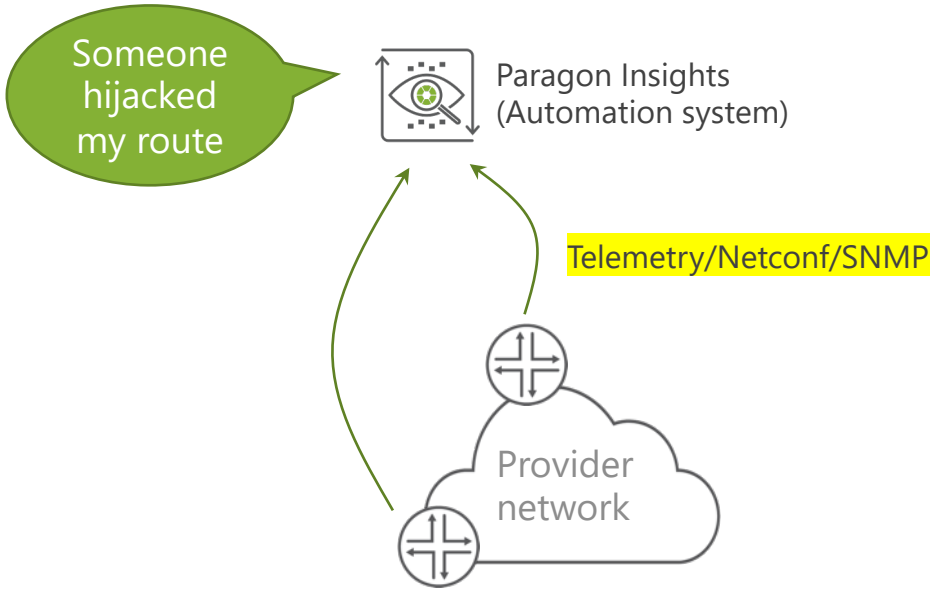
Automation system





3 steps to detect & mitigate route hijacks with Automation

3

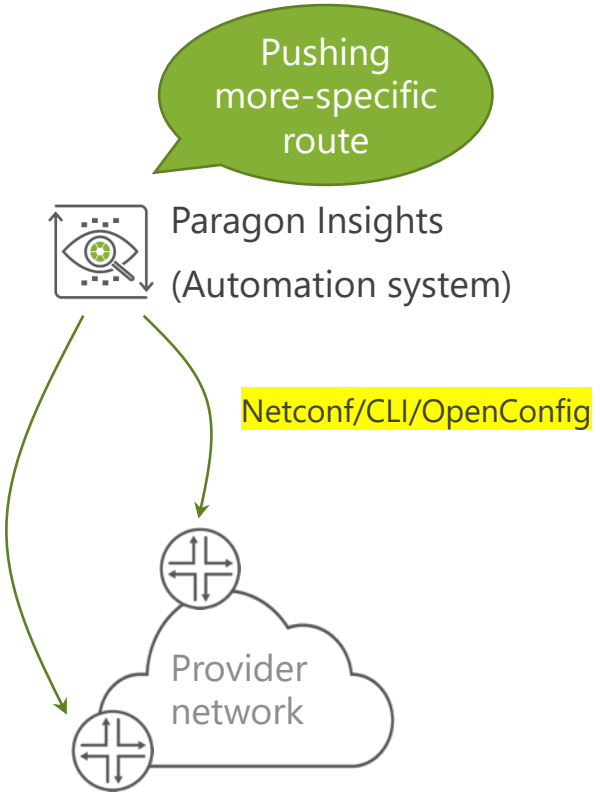
Mitigate the attack

Advertise a more specific route to the router

Automation system

```
root@isp-r1# show groups __automation_routeHijack__
routing-options {
    static {
        route 198.51.0.0/24 {
            discard;
            no-install;
            community 64496:2222;
        }
        route 198.51.1.0/24 {
            discard;
            no-install;
            community 64496:2222;
        }
    }
}
```

Note: Sample outputs from Juniper JUNOS



Ready? Call to action!

To Do:

- Sign your Prefixes (create ROAs)
- Setup a Validator
- Configure your routers
- Use automation where relevant
- Support work in IETF and APNIC

Start now: make the internet more reliable and secure!


Thank You
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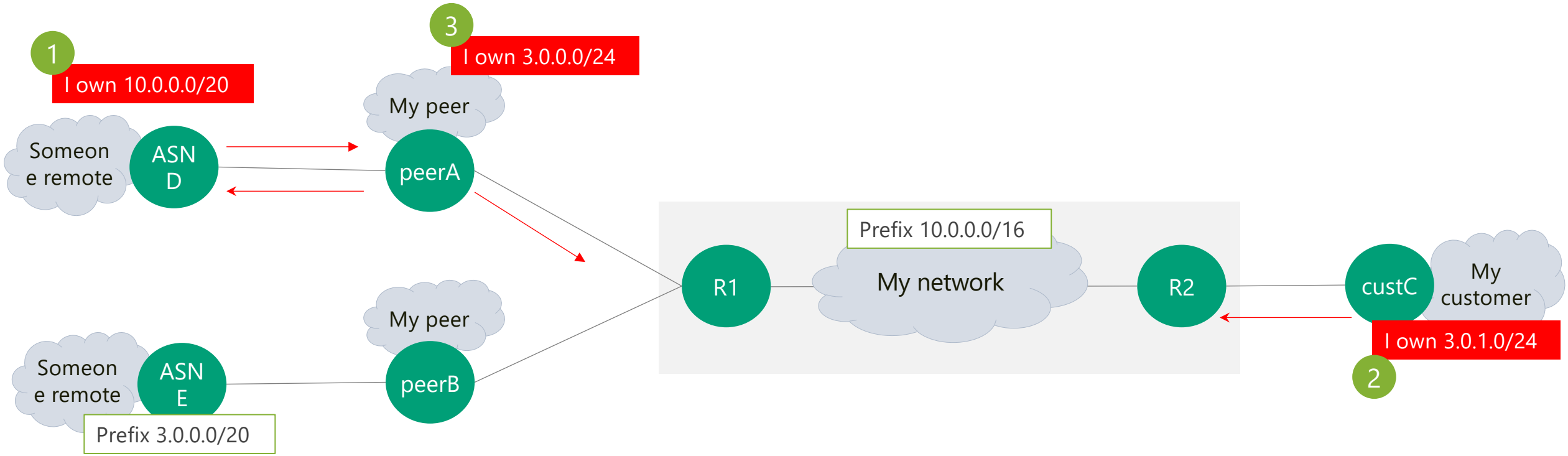
COMMON TYPES OF ROUTE HIJACKS



	Hijack type	Impact to the ISP
1	Someone hijacks my route	Traffic destined to me is blackholed
2	Me or my customer inadvertently hijack someone's route	My network becomes a sink for the hijacked route
3	Someone hijacks someone else's route	I might potentially send traffic to the wrong destination