

Securing Internet Routing: The Puzzle Pieces (revisited)

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BGP Incidents/Headlines

Cloudflare 1.1.1.1 incident on 27, 2024

2024-07-04

Radars by Qrator
@Qrator_Radar

Route Leak at 2025-04-01 07:36 UTC

AS3223 (VOXILITY) leaked 4828 prefixes from AS3491 (CONSOLE-CONNECT-ASN) and some others, toward AS3356 (LEVEL3) creating conflicts with 104 ASNs in 40 countries, mostly in 🇺🇸, 🇺🇸 and 🇺🇸

Max propagation: 85%
Duration: ~5 minutes

6:40 pm · 1 Apr 2025 · 3,435 Views

Route leak incident on January 22, 2026

Doug Madory (also on Bluesky) reposted

Doug Madory (also on Bluesky) @DougMadory · 12h
Replying to @NeoAnde44411160 @spamhaus and @ripe_ncc

UPDATE:
AS3215 (@orange) began announcing 90.99.0.0/16 and 90.98.0.0/16 at 15:01 UTC on Apr-20, which gave Orange control of the IP space from hijacker.

Bogus route (90.98.0.0/15) was withdrawn at 17:27 UTC on Apr-21.

#bgphijack

BGP Leaks	2025	BGP Hijacks
3	Q1	0
10	Q2	4
4	Q3	1
5	Q4	0

Spamhaus @spamhaus

We've recently observed some unusual large-scale routes appearing on the internet (see image), involving the following networks:

- AS393232: Comcast Cable Communications 🇺🇸
- AS36429: @chartercomms 🇺🇸
- AS41128: @orange 🇺🇸
- AS13335: @Cloudflare 🇺🇸
- AS17072: @totalplaymx 🇲🇽
- AS270118: SOLUCIONES, ANALITICOS Y SERVICIOS TEAM (Stratosphere Technology Latam) 🇲🇽
- AS199524: @gcore_official 🇲🇽

The label "path (fixed)" indicates that identical paths were observed by several probes across the internet. This strongly suggests that AS199524 is the central pivot point behind these announcements.

While the first four paths have since disappeared, the most recent three remain active. ↓

Date	Prefix	Origin	Path (fixed)
2026-03-30	96.160.0.0/14	AS393232	AS17072 AS270118 AS199524
2026-03-30	96.164.0.0/14	AS393232	AS17072 AS270118 AS199524
2026-03-30	96.168.0.0/16	AS393232	AS17072 AS270118 AS199524
2026-03-30	96.188.0.0/14	AS393232	AS17072 AS270118 AS199524
2026-04-01	47.1.0.0/16	AS36429	AS13335 AS17072 AS270118 AS199524
2026-04-01	47.2.0.0/16	AS36429	AS13335 AS17072 AS270118 AS199524
2026-04-13	90.98.0.0/15	AS41128	AS17072 AS270118 AS199524

5:10 PM · Apr 13, 2026 · 75K Views

Why BGP incidents?

NO one is in CHARGE

- No single *authority* point for the Internet
- No *reference* point for what is *right* in routing

Why BGP incidents?

Routing (still) works by RUMOUR

- TELL your neighbors what you know
- LEARN/accept what your neighbors know
- Assume everyone is *honest* (correct)

Why BGP incidents?

Routing works in REVERSE

- What I tell others, affects my inbound traffic
- What I trust and accept, affects my outbound traffic

Why BGP incidents?

We still don't have the E(evil) bit

– RFC3514

Puzzle Pieces: RFC8212

BGP is permissive by default (RFC4271):

- What you learn/accept from one peer, (best path) is advertised to all other peers
- **AS-to-AS leaks** happen

RFC8212 changes this (*through code*):

- From Default Allow/Permit to Default Deny/Reject
- For all eBGP sessions: **Without an explicit Import or Export policy, DO NOT use routes from or send routes to eBGP peers.**

<https://github.com/bgp/RFC8212> tracks implementations:

- Default on vendors: **IOS-XR**, **SR-OS** (>19.5.R1), **SR Linux** (>19.11.R1)
- Default on routing daemons: **BIRD** (>2.0.1), **OpenBGPD** (>6.4), **FRR** (>7.4)
- Configurable knobs: **EOS** (4.18.0f), **IOS-XE** (17.2.1), **Junos** (20.3R1)



Puzzle Pieces: WHOIS

Verify the resource holder:

```
whois -h whois.apnic.net 202.144.128.0/19
whois -h whois.apnic.net 2405:d000::/32

whois -h whois.apnic.net AS17660
whois -h whois.apnic.net AS18024
```

```
aut-num: AS17660
as-name: DRUKNET-AS
descr: DrukNet ISP
descr: Bhutan Telecom
descr: Thimphu
country: BT
import: from AS6461 action pref=100; accept ANY
export: to AS6461 announce AS-DRUKNET-TRANSIT
import: from AS2914 action pref=150; accept ANY
export: to AS2914 announce AS-DRUKNET-TRANSIT
```

```
inetnum: 202.144.128.0 - 202.144.159.255
netname: BTTELECOM
descr: DrukNet, Bhutan Telecom
descr: Thimphu
country: BT
org: ORG-BTL2-AP
admin-c: JT106-AP
tech-c: JT106-AP
abuse-c: AB1276-AP
status: ALLOCATED PORTABLE
mnt-by: APNIC-HM
mnt-lower: MAINT-BT-DRUKNET
mnt-routes: MAINT-BT-DRUKNET
mnt-irt: IRT-BTTELECOM-BT
last-modified: 2020-10-20T01:02:25Z
source: APNIC
```

```
inet6num: 2405:d000::/32
netname: DRUKNET-BT-20080204
descr: Bhutan Telecom Ltd
descr: Internet Service Provider
country: BT
org: ORG-BTL2-AP
admin-c: JT106-AP
tech-c: JT106-AP
abuse-c: AB1276-AP
status: ALLOCATED PORTABLE
mnt-by: APNIC-HM
mnt-lower: MAINT-BT-DRUKNET
mnt-routes: MAINT-BT-DRUKNET
mnt-irt: IRT-BTTELECOM-BT
last-modified: 2021-01-14T06:16:00Z
source: APNIC
```

```
aut-num: AS18024
as-name: BTTELECOM-AS-AP
descr: Bhutan Telecom Ltd
country: BT
org: ORG-BTL2-AP
admin-c: DN01-AP
tech-c: DN01-AP
abuse-c: AB1276-AP
mnt-lower: MAINT-BT-DRUKNET
mnt-routes: MAINT-BT-DRUKNET
mnt-by: APNIC-HM
mnt-irt: IRT-BTTELECOM-BT
last-modified: 2021-01-14T06:16:00Z
source: APNIC
```

Puzzle Pieces: IRR

Internet Routing Registry - IRR

- Where networks publish their routing intents
- ~ **route/route6** objects

```
route:      202.144.128.0/19
descr:     DRUKNET-BLOCK
origin:    AS17660
mnt-by:    MAINT-BT-DRUKNET
last-modified: 2021-03-03T09:40:47Z
source:    APNIC
```

```
route6:    2405:d000::/32
descr:     DRUKNET-IPV6-BLOCK
origin:    AS17660
notify:    netops@bt.bt
mnt-by:    MAINT-BT-DRUKNET
last-modified: 2010-07-21T03:46:02Z
source:    APNIC
```

Puzzle Pieces: IRR

Can be used to build route filters:

- With RPSL tools ([bgpq4](#))
- **Accept** (permit) if an entry exists in the IRR database

```
→ bgpq4 -6bl PEERv4-IN AS17660
PEERv4-IN = [
    2405:d000::/32,
    2405:d000:7000::/36
];

~

→ bgpq4 -S APNIC -6bl PEERv4-IN AS17660
PEERv4-IN = [
    2405:d000::/32,
    2405:d000:7000::/36
];
```

```
→ bgpq4 -AbL PEERv4-IN AS17660
PEERv4-IN = [
    45.64.248.0/22,
    103.245.240.0/22,
    103.245.242.0/23,
    119.2.96.0/19,
    163.227.12.0/23{23,24},
    163.227.18.0/23{23,24},
    163.227.20.0/22{23,24},
    163.227.24.0/21{23,24},
    202.144.128.0/19{19,20},
    202.144.128.0/23,
    202.144.148.0/22
];

~

→ bgpq4 -S APNIC -AbL PEERv4-IN AS17660
PEERv4-IN = [
    45.64.248.0/22,
    103.245.240.0/22,
    103.245.242.0/23,
    119.2.96.0/19,
    163.227.12.0/23{23,24},
    163.227.18.0/23{23,24},
    163.227.20.0/22{23,24},
    163.227.24.0/21{23,24},
    202.144.128.0/19
];
```



Puzzle Pieces: IRR

Sometimes, transit provider relationships (**as-set**) published too:

- To aggregate downstream networks, it maybe providing transit for

```
route:      X.1.2.0/24
origin:     AS18024

route6:     2001:db8:a::/48
origin:     AS18024
```

```
route:      X.1.3.0/24
origin:     AS18025

route6:     2001:db8:b::/48
origin:     AS18025
```

```
→ whois -h whois.apnic.net "AS-DRUKNET-TRANSIT"
% [whois.apnic.net]
% Whois data copyright terms   http://www.apnic
% Information related to 'AS-DRUKNET-TRANSIT'

as-set:      AS-DRUKNET-TRANSIT
descr:       DrukNet transit networks
members:     AS17660
members:     AS132232
members:     AS134715
members:     AS135666
members:     AS137925
members:     AS59219
members:     AS18024
members:     AS18025
members:     AS137994
members:     AS140695
members:     AS151498
members:     AS151955
members:     AS152317
members:     AS138558
members:     AS13335
members:     AS132894
members:     AS138529
members:     AS153779
members:     AS153740
admin-c:     DN01-AP
tech-c:      DN01-AP
notify:      netops@bt.bt
mnt-by:      MAINT-BT-DRUKNET
last-modified: 2025-06-09T11:07:14Z
source:      APNIC
```



Puzzle Pieces: IRR

AS-SET can be used to build:

- AS-PATH filters or route filters

```
bgpq4 -S APNIC -Al BTv4-IN AS-DRUKNET-TRANSIT
```

```
→ bgpq4 -S APNIC -Al BTv4-IN AS-DRUKNET-TRANSIT
no ip prefix-list BTv4-IN
ip prefix-list BTv4-IN permit 1.0.0.0/24
ip prefix-list BTv4-IN permit 1.1.1.0/24
ip prefix-list BTv4-IN permit 1.32.192.0/18
ip prefix-list BTv4-IN permit 27.124.0.0/18
ip prefix-list BTv4-IN permit 36.50.37.0/24
ip prefix-list BTv4-IN permit 43.226.16.0/21 ge 22 le 24
ip prefix-list BTv4-IN permit 43.226.124.0/22 le 24
ip prefix-list BTv4-IN permit 43.230.208.0/24
ip prefix-list BTv4-IN permit 43.240.36.0/22 le 24
ip prefix-list BTv4-IN permit 43.243.28.0/22 le 24
ip prefix-list BTv4-IN permit 43.243.68.0/22 le 24
ip prefix-list BTv4-IN permit 43.243.72.0/22 le 24
ip prefix-list BTv4-IN permit 43.243.108.0/22 le 24
ip prefix-list BTv4-IN permit 43.249.204.0/22 le 24
ip prefix-list BTv4-IN permit 45.64.52.0/22 le 24
ip prefix-list BTv4-IN permit 45.64.248.0/22
ip prefix-list BTv4-IN permit 45.64.248.0/23
ip prefix-list BTv4-IN permit 45.64.250.0/23 ge 24 le 24
```

```
bgpq4 -f 17660 -l BT-AS-IN AS-DRUKNET-TRANSIT
```

```
→ bgpq4 -f 17660 -l BT-AS-IN AS-DRUKNET-TRANSIT
no ip as-path access-list BT-AS-IN
ip as-path access-list BT-AS-IN permit ^17660(_17660)*$
ip as-path access-list BT-AS-IN permit ^17660(_[0-9]+)*_(13335|18024|18025|59219)$
ip as-path access-list BT-AS-IN permit ^17660(_[0-9]+)*_(132232|132894|134715|135666)$
ip as-path access-list BT-AS-IN permit ^17660(_[0-9]+)*_(137925|137994|138529|138558)$
ip as-path access-list BT-AS-IN permit ^17660(_[0-9]+)*_(140695|151498|151955|152317)$
ip as-path access-list BT-AS-IN permit ^17660(_[0-9]+)*_(153740|153779)$
```

```
bgpq4 -S APNIC -6Al BTv6-IN AS-DRUKNET-TRANSIT
```

```
→ bgpq4 -S APNIC -6Al BTv6-IN AS-DRUKNET-TRANSIT
no ipv6 prefix-list BTv6-IN
ipv6 prefix-list BTv6-IN permit 2001:df0:eb80::/48
ipv6 prefix-list BTv6-IN permit 2001:df2:a8c0::/48
ipv6 prefix-list BTv6-IN permit 2001:df3:e180::/48
ipv6 prefix-list BTv6-IN permit 2001:df4:3440::/48
ipv6 prefix-list BTv6-IN permit 2001:df5:a300::/48
ipv6 prefix-list BTv6-IN permit 2001:df5:acc0::/48
ipv6 prefix-list BTv6-IN permit 2400:1440::/32
ipv6 prefix-list BTv6-IN permit 2400:1c80::/32 le 40
ipv6 prefix-list BTv6-IN permit 2400:4e60::/32 le 33
```



AS-SET Problems

- Cannot verify the integrity and authenticity of member ASNs
- No limit to the number of member ASNs ~ [bloated AS-SETs](#)

Example: the AS-SET called `AS9498:AS-BHARTI-IN` expands

<https://bgp.tools/as-set/as9498:as-bharti-in>

- 69592 ASNs
- IPv4 prefixes: 1,983,008
- IPv6 prefixes: 862,660

[CIDR report](#) as of 13/04/2026:

- 78464 ASNs
- IPv4 prefixes: 1,048,206
- IPv6 prefixes: 246,103

AS-SET Problems

Prevalence of non-hierarchical AS-SETs:

- Name collision

```
as-set: AS-GEMNET
descr: GEMNET s.r.o. ASes
members: AS59479
members: AS202733
tech-c: DUMY-RIPE
admin-c: DUMY-RIPE
mnt-by: GEMNETCZ-MNT
created: 2013-08-19T09:49:13Z
last-modified: 2024-08-27T14:09:27Z
source: RIPE
```

```
as-set: AS-GEMNET
descr: GEMNET LLC
country: MN
members: AS9934, AS9484, AS10219, AS9789,
AS38038, AS24496, AS24559, AS4850,
AS38042, AS38051, AS10076,
AS17882, AS38218, AS38454, AS38805,
AS38818, AS38273, AS10109, AS38869,
AS45237, AS45509, AS17463, AS24302,
AS45203, AS45204, AS45923, AS24320,
AS24496, AS45237, AS55342, AS55805,
AS55801, AS55408, AS55882, AS56194,
AS58598, AS58625, AS133177, AS135136,
AS138907, AS134074, AS45204:AS-GEMNET
tech-c: GA263-AP
admin-c: GA263-AP
mnt-by: MAINT-GEMNET-MN
mnt-lower: MAINT-GEMNET-MN
last-modified: 2024-10-08T02:49:37Z
source: APNIC
```

Hierarchical AS-SET should be adopted:

- RFC2622 defines `<AS#>:AS-<as-set-name>`

```
as-set: AS4826:AS-VOCUS
descr: Vocus Communications AS4826 AS-SET
members: AS4826, AS4826:AS-CUSTOMERS
admin-c: VPL1-AP
tech-c: VPL1-AP
remarks: For queries please email the below contacts
remarks: NOC - noc@vocus.net
remarks: IRR Data - irr@vocus.com.au
remarks: Peering enquiries - peering@vocus.com.au
notify: irr@vocus.com.au
mnt-by: MAINT-AU-VOCUS
last-modified: 2022-05-29T00:28:23Z
source: APNIC
```

```
as-set: AS4826:AS-CUSTOMERS
descr: Vocus Communications AS4826 Customer AS-SET
members: AS10083, AS10146, AS10150, AS10204, AS10207, AS10213
members: AS10234, AS11795, AS11857, AS12007, AS12041, AS12200
members: AS12684, AS12740, AS131074, AS131162, AS131182, AS131214
members: AS131282, AS131291, AS131298, AS131480, AS13150, AS131581
members: AS131599, AS131715, AS131998, AS132030, AS132046, AS132094
members: AS132145, AS132205, AS132221, AS132245, AS132257, AS132269
members: AS132321, AS132368, AS132433, AS132448, AS132458, AS132476
members: AS132481, AS132491, AS132492, AS132534, AS132576, AS132581
```



AS-SET Transition

Adopted from Maz-san's talk:

1. Create a new hierarchical AS-SET
 - AS45204:AS-GEMNET (ensure same members as old one)
2. Add the new AS-SET as member of the old one
 - Add the new AS-SET as member of the old one
 - AS-GEMNET [members: AS45204:AS-GEMNET]
 - From here on, only update your new AS-SET
3. Inform your peers & update PeeringDB
 - Ask your peers / providers to use your new AS-SET
4. Then delete the old AS-SET

Puzzle Pieces: Identifying Good

Given a routing update does not identify itself as BAD

- We try to identify (approximate) what is GOOD

Puzzle Pieces: BGP Roles (RFC9234)

Defines a **ROLE** for your local AS with respect to your BGP neighbors:

- Role capability negotiated through BGP open message
 - Loose vs Strict

– Roles:

- **Provider:** I provide transit to my neighbor
- **Customer:** I am customer of my neighbor
- **Peer:** We are peers
- **RS:** I am a route server
- **RS-client:** I am a client to a RS

– Allowed relationships (for session to establish)

- Provider <-> Customer / Customer <-> Provider
- Peer <-> Peer
- RS <-> RS-client / RS-client <-> RS

```
set protocols bgp group TRANSIT description "My Transit Providers"  
set protocols bgp group TRANSIT otc-local-role customer  
set protocols bgp group TRANSIT neighbor 172.16.200.101 peer-as 64501
```

Configuring roles: Junos (>25.2R1)

```
Router bgp 64522  
neighbor 172.16.200.101 remote-as 64501  
neighbor 172.16.200.101 description "Transit from ISP-A"  
neighbor 172.16.200.101 local-role customer
```

Configuring roles: FRR



Puzzle Pieces: BGP Roles (RFC9234)

If role capability negotiated successfully:

- OTC (Only-to-Customer) attribute is exchanged
- We set the role; OTC works in code (no config 😊)
- Protects without need for explicit policy

OTC Check:

- Outbound check (before marking)
 - A route with OTC attribute **MUST NOT** be sent to **Provider, Peer, RS**
- Inbound check (before marking)
 - If route with OTC is received from **Customer** or **RS-client**, it is a route leak. Discard!
 - If a route with OTC received from a **Peer**, and its value is **!=** to the peer ASN, it is a leak!

```
Border Gateway Protocol - UPDATE Message
  Marker: ffffffffffffffffffffffffffffffffff
  Length: 64
  Type: UPDATE Message (2)
  Withdrawn Routes Length: 0
  Total Path Attribute Length: 38
  Path attributes
    Path Attribute - ORIGIN: IGP
    Path Attribute - AS_PATH: 100 250
    Path Attribute - NEXT_HOP: 100.100.3.1
    Path Attribute - COMMUNITIES: 65000:0
    Path Attribute - OTC: 100
      Flags: 0xc0, Optional, Transitive, Complete
      Type Code: OTC (35)
      Length: 4
      Only to Customer: 100
```

OTC setting:

- Outbound marking:
 - If a route is sent to **Customer, Peer, RS-client** set OTC attribute (*ASN of sender*)
- Inbound marking:
 - If route is received from **Provider, Peer, RS** and OTC is not set, mark with OTC attribute (value is ASN of sender)

Puzzle Pieces: RPKI [Origin Validation]

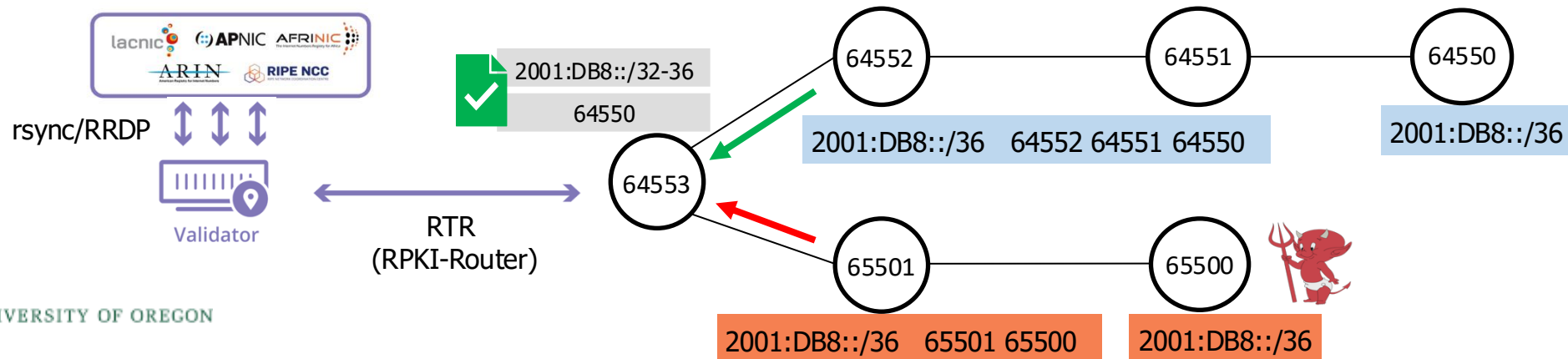
ROA – Route Origin Authorization

- Digitally signed ~ binds prefixes and nominated ASN
- Can be verified crypto-magically

Prefix	2001:DB8::/32
Max-length	/36
Origin ASN	AS64550

ROV – Route Origin Validation

- Helps validate if an ASN is permitted to originate a route
- Mis-origination / origin hijack



Puzzle Pieces: RPKI [Path Validation]

Forged origin ASN will pass the ROV test

- Need to secure/validate the PATH

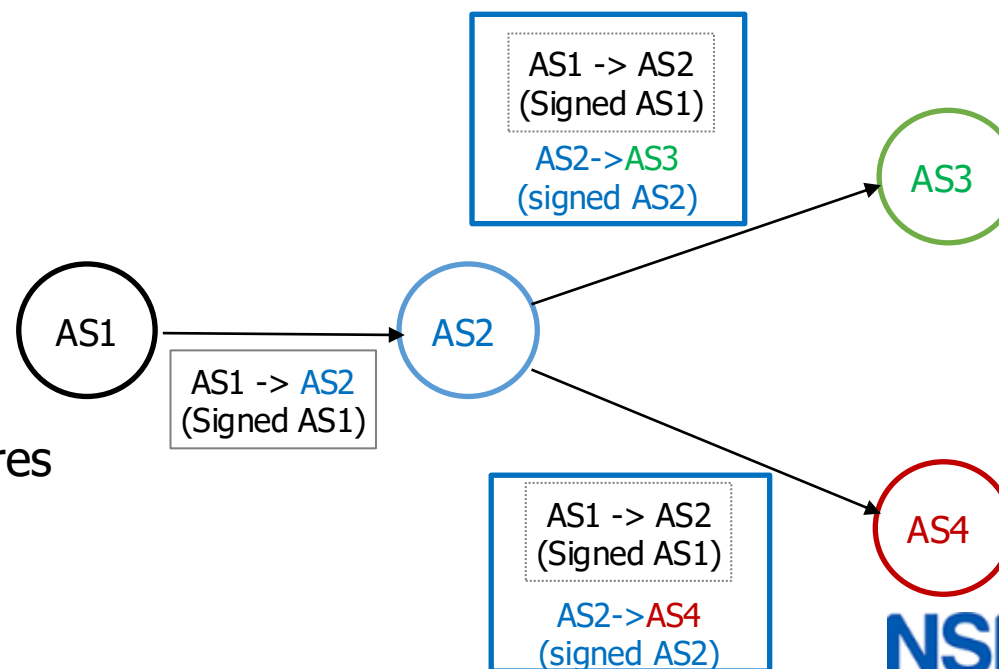
One idea was RFC8205 (BGPsec) → AS path validation

Forward Path Signing

1. AS1 signs message to AS2
2. AS2 signs message to AS3/AS4, encapsulating AS1's message

Validation

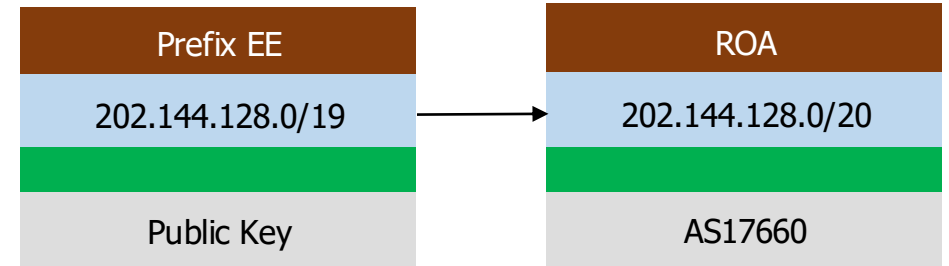
1. ROA check for the received prefix
2. Validate AS_PATH against the chain of signatures (for each AS in the path)



BGPsec Challenges

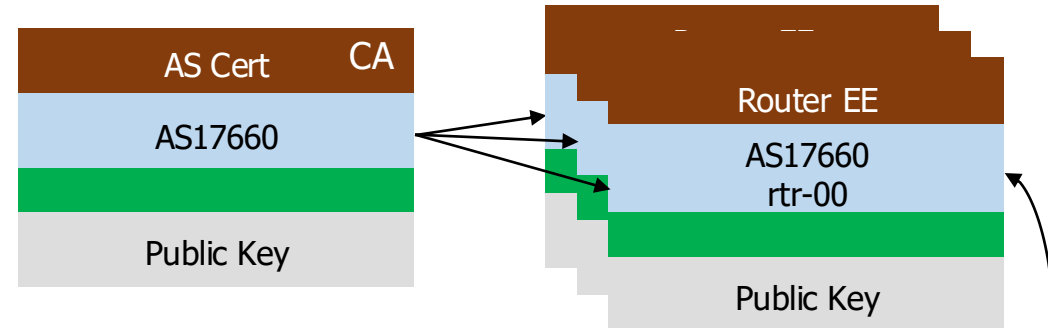
Cannot jump across non-BGPsec routers (networks)

- Traditional BGP: no BGPsec update messages



Complex crypto on the router

- CPU heavy ~ validate chain of signatures
- Memory heavy
 - Per-prefix BGP update
 - New attributes to carry signatures, certs, key IDs for every AS in the AS_PATH



Encodes ASN and Router ID

Puzzle Pieces: RPKI [Path Validation]

ASPA – Autonomous System Provider Authorization

- Binds a set of Provider ASNs to a Customer ASN
 - signed by the holder of the Customer ASN
- (Re)uses existing tool chains
- No crypto on routers!

```
→ monocle rpki aspas --customer 203898 --format markdown
Data source: Cloudflare (cached at 2026-04-10 04:10:33 UTC, 1604 ASPAs)
Found 1 ASPAs
| Customer ASN | Customer Name | Country | Providers |
|-----|-----|-----|-----|
| AS203898 | Cloudflare Inc | US | 1273, 2860, 8220 |

→ monocle rpki aspas --customer 1299 --format markdown
Data source: Cloudflare (cached at 2026-04-10 04:10:33 UTC, 1604 ASPAs)
Found 1 ASPAs
| Customer ASN | Customer Name | Country | Providers |
|-----|-----|-----|-----|
| AS1299 | f/k/a Telia Carrier | SE | 0 |
```

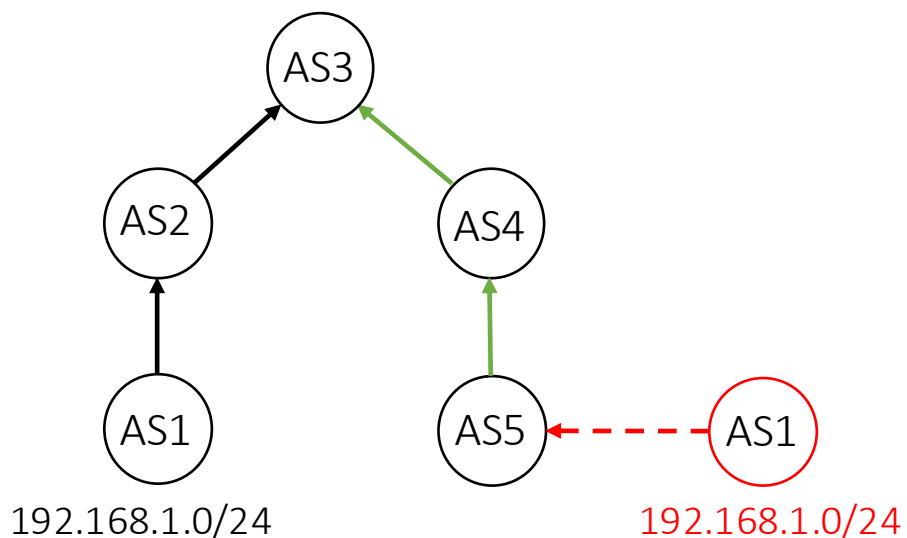
AS-to-AS hop verification (Upstream: Customer to Provider)

At each hop, look at the customer AS, check if the next AS is listed as one of its providers in the ASPA data

- If every hop in the path lines up, path is VALID (Provider)
- If any hop contradicts ASPA data (a customer AS says “this AS is not my provider”) path is INVALID
- If for one or more hops in the path, there is no ASPA data – it is Unknown (No Attestation)

Puzzle Pieces: RPKI [Path Validation]

ASPA - Spoofed origin AS



– AS1, announce 192.168.1.0/24

– ASPA:

AS1 > [AS2]

AS2 > [AS3]

AS3 > [AS0]

AS4 > [AS3]

– AS4 sees:

5 1 192.168.1.0/24

3 2 1 192.168.1.0/24

– AS4 knows

- AS5 is 'Not Provider' for AS1

– Hence, INVALID



Puzzle Pieces: RPKI [Path Validation]

[Credit: Tim Bruijnzeels @RIPE]

Valley Free Routing

- Routes go UP from customers to providers (single peak of a shared provider or two adjacent peers), and then DOWN from providers to customers.
- Routes that go UP, then DOWN and then UP (and DOWN...) have a **valley** ~ considered as leaks!

ASPA can find valleys (detect leaks):

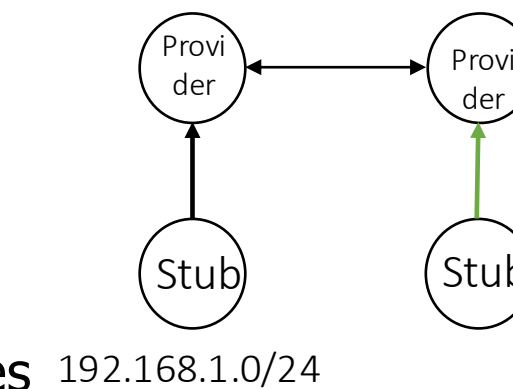
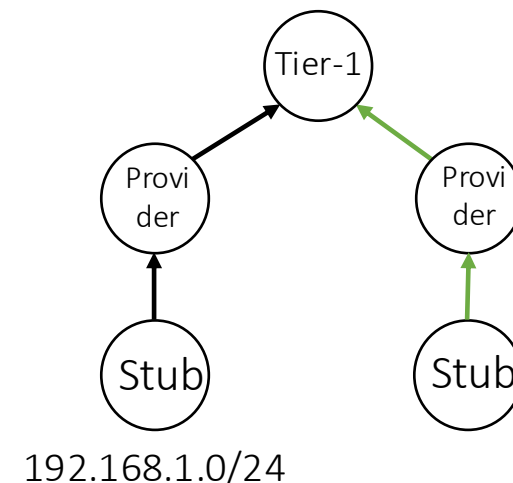
Take the longest possible:

- Customer to Provider path from the origin as UP ramp
- Provider to Customer on the reverse end as DOWN ramp

UP and DOWN must either:

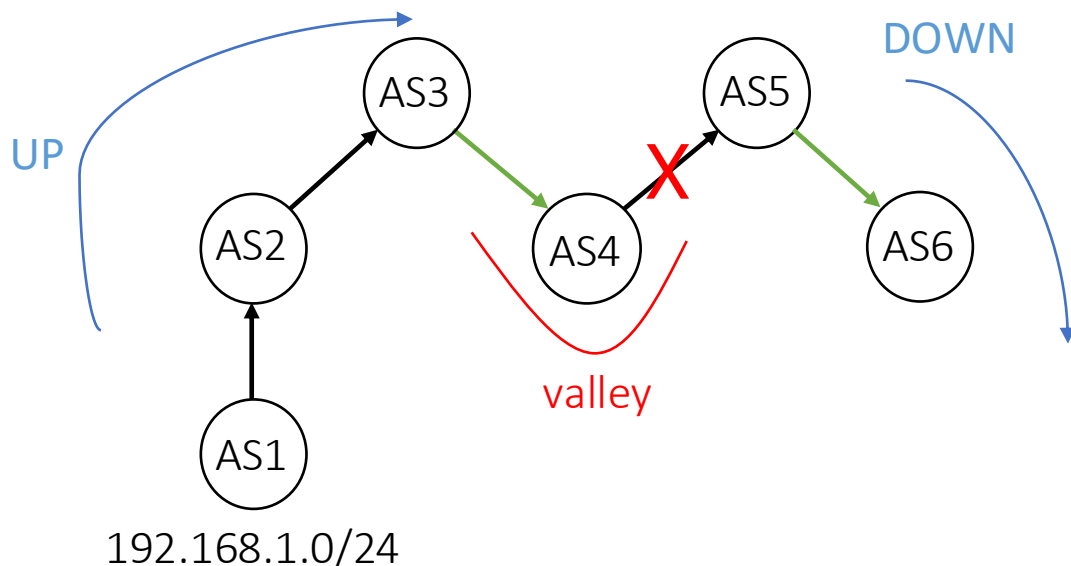
- Meet at adjacent peers
- Meet at a shared provider
- Overlap with multiple hops

A gap in the UP and DOWN indicates there is a valley - **Invalid**



Puzzle Pieces: RPKI [Path Validation]

ASPA: Provide to Provider leak



- AS1, announce 192.168.1.0/24
- ASPA:
 - AS1 > [AS2]
 - AS2 > [AS3]
 - AS4 > [AS3, AS5]
 - AS6 > [AS5]
 - AS3 > [AS0] and AS5 > [AS0]
- AS6 sees: 5 4 3 2 1 192.168.1.0/24
 - ASPA says: AS4 is 'Not Provider' for AS3
 - UP: 3 2 1 (from origin)
 - ASPA says: AS4 is 'Not Provider' for AS5
 - DOWN: 6 5 (AS6 verifying)
 - There is a gap (UP/DOWN don't cover the full AS_PATH)
- AS4 is a valley → INVALID

ASPA Timeline

Standards	Still in draft/discussion – end of 2026 😊 <ul style="list-style-type: none">- RTRv2- ASPA	
Signers	Support: <ul style="list-style-type: none">- ARIN- RIPE	WIP/TBC: <ul style="list-style-type: none">- APNIC (Q2-Q3 2026) ~ [https://github.com/APNIC-net/rpki-rtr-demo]- AFRINIC- LACNIC Ask your RIR 😊
Relying Party	Support: <ul style="list-style-type: none">- Routinator (RP + RTR)- rpkiclient (RP)- RTRTR (RTR proxy/server)- StayRTR (RTR server)- FORT (RP + RTR)- Krill (delegated CA)	
COTS BGP Speakers	Push your vendors!	



Analysis Tool: RouteViews

When incidents happen, folks need access to BGP data to understand **when and how it happened?**

- Public collectors like [RouteViews](#) become crucial
- RouteViews collects and archives BGP routing tables (RIBs) and BGP updates:
 - archives every 2 hours
 - **27-year-old** data archive

What is RouteViews

RouteViews operates collectors at IXPs around the world

- Also hosts a few multi-hop collectors at UO for those who are not at IXPs

Many free and commercial tools used by network engineers every day include data from RouteViews

- CAIDA ASRANK
- CAIDA BGP Reader
- HE BGP Tools
- Kentik Market Intelligence
- Kentik BGP monitoring
- Catchpoint
- BGPMon
- Cloudflare Radar
- And many more

RouteViews Collector Map

<https://www.routeviews.org/routeviews/map/>



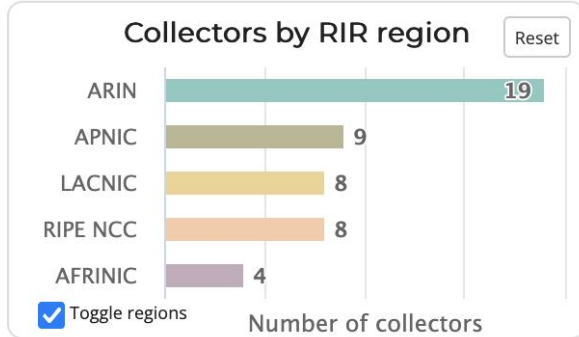
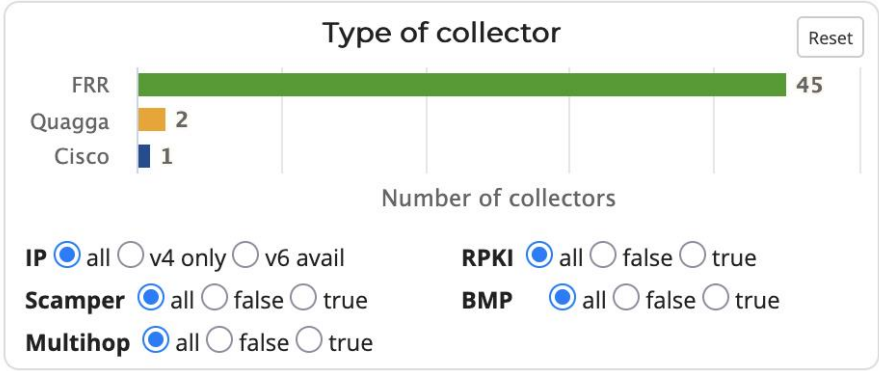
Africa

Exchange	Location	Proto	Collector
GIXA	Accra, Ghana	IPv4	route-views.gixa.routeviews.org
JINX	Johannesburg, South Africa	IPv4/6	route-views.jinx.routeviews.org (RETIRED)
IXPN Lagos	Lagos, Nigeria	IPv4/6	ixpn.los.routeviews.org
KIXP	Nairobi, Kenya	IPv4/6	route-views.kixp.routeviews.org
NAPAfrica	Johannesburg, South Africa	IPv4/6	route-views.napafrika.routeviews.org

Search collectors by name or IP Maintain filters during search

48
of 48 collectors visible

Installed date
From:
To:



RouteViews: Help us help you

We are interested in new locations

- regions or economies with no collectors
- IXPs with large numbers of peers (>100)

We are looking for collector hosts

- Hosts: IXPs or members of IXPs

Peering with RouteViews:

- Selective peering: <https://www.peeringdb.com/asn/6447>
- Want to receive full BGP table (if possible)
- Multihop peering for those who aren't at IXPs

Questions?



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