



NICK BOUWHUIS @ ESN0G36

NLNOG TOOLS DEEP-DIVE

QUICK INTRO

- ▶ Nick Bouwhuis
- ▶ Board member since 2024
- ▶ Network Engineer @ Speakup
- ▶ Behind various side-hustles

ABOUT NLNOG

- ▶ Started in 2002 with a mailing list
- ▶ Formal foundation since 2015
- ▶ 3 events per year
 - ▶ New Years Drink
 - ▶ Summer event (2 weeks ago)
 - ▶ NLNOG day

ABOUT NLNOG

- ▶ IRC: IRCnet - irc.nlnog.net - #nlnog
- ▶ Discord: <https://nlnog.net/discord/>
- ▶ Mailing List / other channels: nlnog.net

TOOLS

- ▶ RING
- ▶ RING Looking Glass
- ▶ IRRexplorer
- ▶ BGP Filter Guide
- ▶ Ride Share (new!)



THE PROBLEM

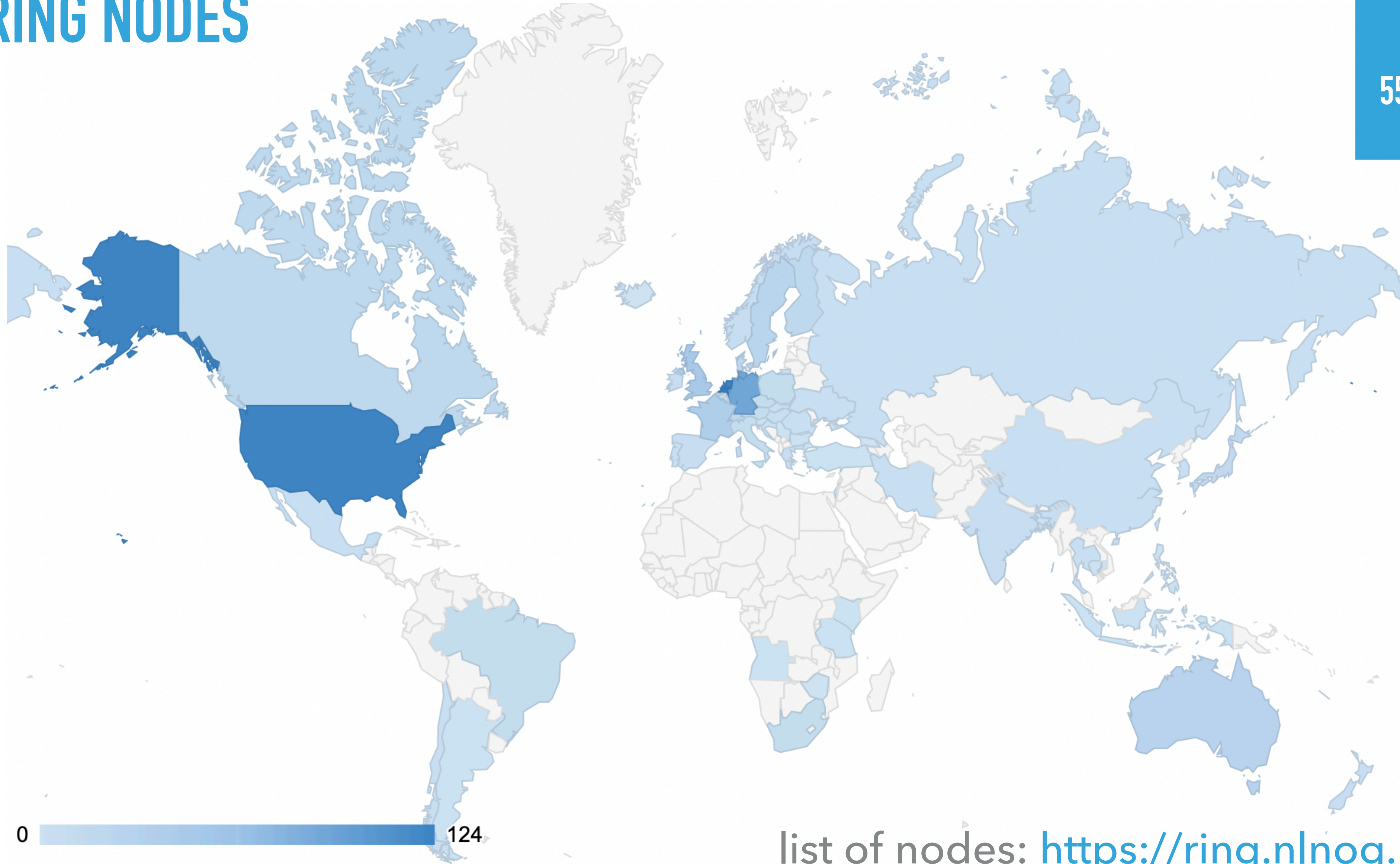
- ▶ Debugging network-related issues between networks can be hard
- ▶ Having vantage points in many different networks can help
- ▶ Having proper debugging tools helps even more!

THE SOLUTION: THE NLNOG RING

- ▶ You provide a (virtual) machine in your network
- ▶ You get shell (SSH) access to machines of all participants in return
- ▶ ... and access to some cool tools to do debugging and testing

NLNOG RING NODES

700+ NODES
500+ ASNS
55+ COUNTRIES



NLNOG RING TOOLS

- ▶ **ring-ping**: ping a specified target from a number of RING nodes
- ▶ **ring-trace**: visualise traceroutes to a target from a selection of RING nodes in a diagram
- ▶ **ring-http**: compare answers to HTTP requests to a specified URL
- ▶ **ring-sqa**: alert on sudden changes in the number of other RING nodes that can be reached
- ▶ **ring-all**: perform any available Linux CLI command on a set of nodes and gather all results
- ▶ And of course: there's an extensive set of CLI tools available, for example: **mtr**, **traceroute**, **tcptraceroute**, **ping**, **curl**, **dig**, **python**, etc

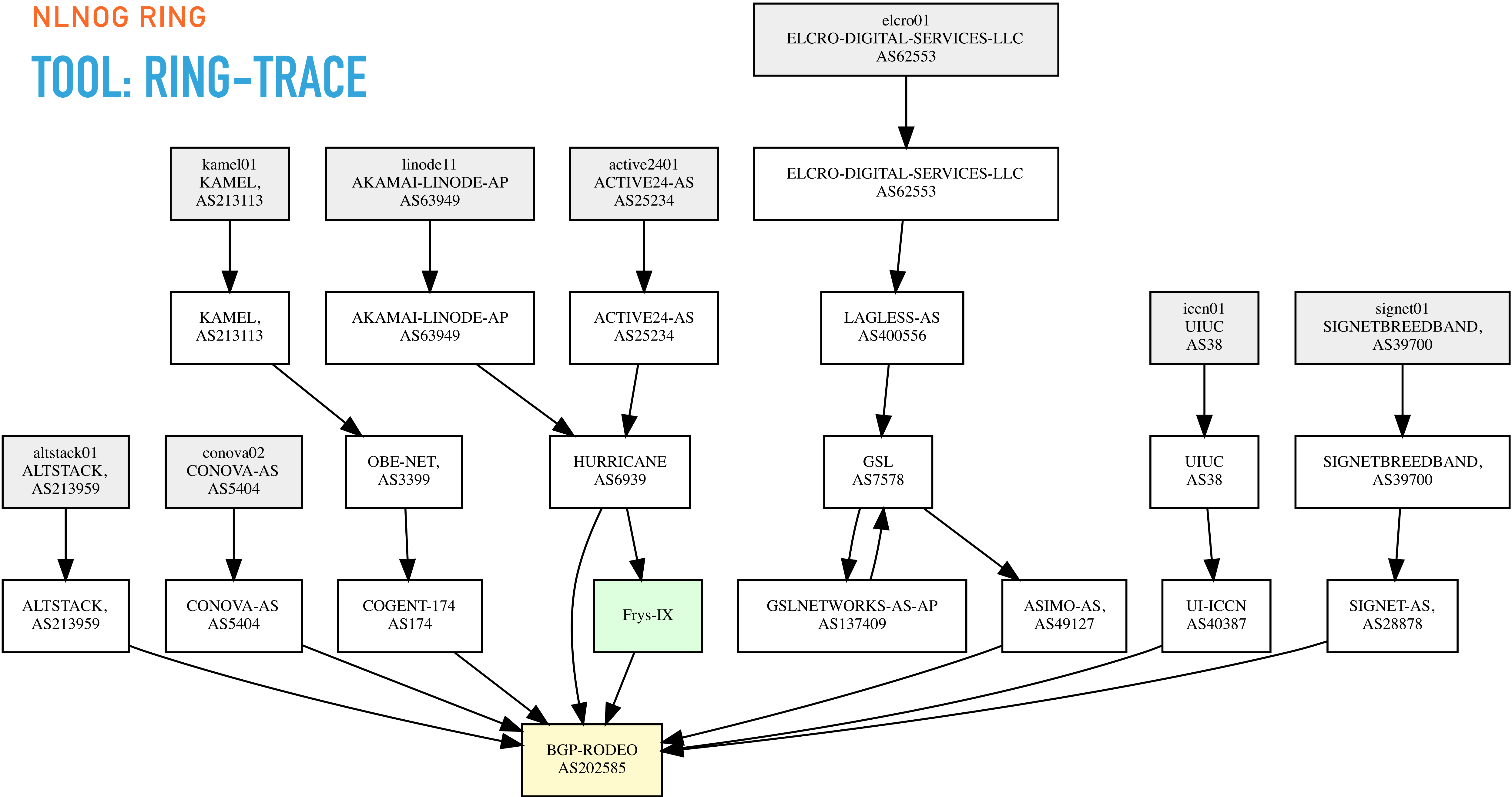
TOOL: RING-PING

Ping a target from a random selection of nodes:

```
bouwhuis@bouwhuis01: ~  
bouwhuis@bouwhuis01:~$ ring-ping -vi -n 10 www.nlnog.net  
amazon13:          105.006      [ Canada - AS16509 (arin, AMAZON-02 - Amazon.com, Inc.)  
nynex01:           6.983       [ Germany - AS62023 (ripenc, NYNEX NYNEX satellite 0H  
franceix01:        10.306      [ France - AS57734 (ripenc, FRANCEIX, FR) ]  
elastx01:          19.561      [ Sweden - AS48579 (ripenc, ELASTX, SE) ]  
vultr26:           14.810      [ United Kingdom - AS20473 (arin, AS-VULTR - The Const  
plurimedia01:      11.157      [ France - AS8839 (ripenc, SDV-AS SdV Plurimedia, FR)  
vultr29:           21.876      [ Sweden - AS20473 (arin, AS-VULTR - The Constant Comp  
neptune01:         75.062      [ New York, United States - AS21700 (arin, NEPTUNE-NET  
redpilllinpro01:   19.318      [ Norway - AS39029 (ripenc, REDPILL-LINPRO Redpill Li  
fasttrackcomm01:   121.854     [ Colorado, United States - AS30688 (arin, FASTTRACK-M  
10 servers: 40.59ms average 19.44ms median  
bouwhuis@bouwhuis01:~$
```

NLNOG RING

TOOL: RING-TRACE



TOOLS: RING-HTTP AND AN EXTENSIVE LINUX SSH TOOLSET

teun@bit01: ~ (ssh)

```
teun@bit01:~$ ring-http -v https://nlnog.net
riepert01:      OK
greenmini01:    OK
perke01:        curl: (7) Couldn't connect to server
celya01:        OK
krasa01:        curl: (7) Couldn't connect to server
lamdahellix01:  OK
anexia01:       OK
kampde01:       OK
edgoo05:        OK
angolacables06: OK
tdc01:          OK
vultr13:        OK
sabay01:        OK
chaosdarmstadt01: OK
exanetworks01:  OK
teamix01:       OK
elastx01:       OK
amazon14:       OK
eolas01:        OK
gandi01:        OK
bittenbytes01:  OK
vultr14:        OK
v4less02:       OK
pdxnet01:       OK
iway01:         OK
lay...         OK
aus...         OK
sbt...
```

teun@perke01: ~ (ssh)

```
teun@perke01:~$ telnet nlnog.net 443
Trying 2a00:f10:400:2:435:64ff:fe00:70a...
Connected to nlnog.net.
Escape character is '^]'.
^]
telnet> q
Connection closed.
teun@perke01:~$ dig +short nlnog.net A
185.107.224.30
teun@perke01:~$ dig +short nlnog.net AAAA
2a00:f10:400:2:435:64ff:fe00:70a
teun@perke01:~$ ping -4 nlnog.net -c 1
ping: connect: Network is unreachable
teun@perke01:~$ ping -6 nlnog.net -c 1
PING nlnog.net(2a00:f10:400:2:435:64ff:fe00:70a (2a00:f10:400:2:435:64ff:fe00:70a)) 56 data byt
es
64 bytes from 2a00:f10:400:2:435:64ff:fe00:70a (2a00:f10:400:2:435:64ff:fe00:70a): icmp_seq=1 t
tl=53 time=25.8 ms

--- nlnog.net ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 25.796/25.796/25.796/0.000 ms
teun@perke01:~$
```

THE RING-HTTP TOOL SHOWS FAILED HTTP REQUESTS FROM SOME NODES

LOGGING INTO ONE OF THE NODES WITH PROBLEMS
WE CAN USE STANDARD CLI TOOLS TO DEBUG THE ISSUE
(IN THIS CASE: THIS NODE IS IPV6-ONLY AND RING-HTTP DEFAULTS TO IPV4)

RING NODE REQUIREMENTS

- ▶ A physical or virtual machine running Ubuntu 22.04
- ▶ You represent the ASN hosting the RING node and provide working contact information for this ASN
- ▶ A publicly accessible IPv6 address (and optionally IPv4)
- ▶ At least 20GB disk space and 2GB RAM
- ▶ No firewalling to and from the internet
- ▶ NLNOG RING Admins get full control (sudo access)

MORE INFORMATION, APPLICATION & CONTACT

- ▶ Information and application form: <https://ring.nlnog.net>
- ▶ Email: ring-admins@nlnog.net
- ▶ IRC Channel: **#ring** on the IRCNet network
- ▶ Discord Channel: **#ring** on NLNOG's Discord server (<https://nlnog.net/discord>)
- ▶ Configurations, code and playbooks: <https://github.com/nlnog/ring-ansible>



NLNOG Looking Glass

Please enter an IP address, prefix or hostname to look up in our routing tables.

Search

2001:db8::/32

Exact match

on

All peers (311)

Show routes

IPv4: 157 peers up, 51 down, 147,821,326 prefixes received

IPv6: 162 peers up, 57 down, 34,740,014 prefixes received

20 BITTERBAL1-v4

AS-Path 200995 202585 via next-hop 212.72.236.1

Origin validation state valid

ASPA validation state unknown

Only To Customer (OTC) yes, ASN: 200995

Origin IGP

MED 0

Last update 2026-03-31 09:55:27 UTC (03w6d23h ago)

69 KAPSI1-v4	
AS-Path	57692 199508 1299 57866 202585 via next-hop 91.232.154.62
Origin validation state	valid
ASPA validation state	unknown
Only To Customer (OTC)	yes, ASN: 57692
Origin	IGP
MED	0
Last update	2026-04-22 13:21:28 UTC (5d20h24m ago)
Communities	1299:30000 (EU Customers)



IRR EXPLORER SHOWS THE ROUTING, IRR AND RPKI STATUS FOR RESOURCES, AND HIGHLIGHTS POTENTIAL ISSUES.



[Data source status](#)

☐ Reduced colour mode

☐ Show

Report for prefix 193.169.138.0/23

What does the prefix table show?

Explanation of different messages

Directly overlapping prefixes of 193.169.138.0/23

Prefix ▼	RIR ◆	BGP ◆	RPKI ◆	RIPE ◆	Advice ◆
193.169.138.0/23	RIPE NCC	49627	49627 ▶/24	49627 ✓	✓ Everything looks good
193.169.138.0/24	RIPE NCC			49627 ✓	⚠ Route objects exist, but prefix not seen in DFZ
193.169.139.0/24	RIPE NCC			49627 ✓	⚠ Route objects exist, but prefix not seen in DFZ

Report for ASN AS49627

What does the prefix table show?

Explanation of different messages

Prefixes originated by AS49627

Prefix ▼	RIR ⬆	BGP ⬆	RPKI ⬆	RIPE ⬆	Advice ⬆
91.232.130.0/24	RIPE NCC	49627	49627 ▶/24	49627 ✓	✓ Everything looks good
185.68.160.0/22	RIPE NCC	49627	49627 ▶/24	49627 ✓	✓ Everything looks good
185.68.160.0/24	RIPE NCC			49627 ✓	⚠ Route objects exist, but prefix not se
185.68.161.0/24	RIPE NCC			49627 ✓	⚠ Route objects exist, but prefix not se
185.68.162.0/24	RIPE NCC			49627 ✓	⚠ Route objects exist, but prefix not se
185.68.163.0/24	RIPE NCC			49627 ✓	⚠ Route objects exist, but prefix not se
193.169.138.0/23	RIPE NCC	49627	49627 ▶/24	49627 ✓	✓ Everything looks good
193.169.138.0/24	RIPE NCC			49627 ✓	⚠ Route objects exist, but prefix not se



Search

[Data source status](#)

Report for prefix 2a07:cd40::/32

- What does the prefix table show?
- Explanation of different messages

Directly overlapping prefixes of 2a07:cd40::/32

Prefix ▼	RIR ⬆	BGP ⬆	RPKI ⬆	RIPE ⬆	Advice ⬆
2a07:cd40::/29	RIPE NCC			213822	Route objects exist, but prefix not seen in DFZ No (covering) RPKI ROA found for route objects
2a07:cd40::/32	RIPE NCC	213822	213822 ▶/32		No route objects match DFZ origin

All overlaps of least specific match 2a07:cd40::/29

Prefix ▼	RIR ⬆	BGP ⬆	RPKI ⬆	RIPE ⬆	Advice ⬆
2a07:cd40::/32	RIPE NCC	213822	213822 ▶/32		No route objects match DFZ origin
2a07:cd40::/29	RIPE NCC			213822	Route objects exist, but prefix not seen in DFZ No (covering) RPKI ROA found for route objects

Search[Data source status](#)

Report for prefix 2a07:cd40::/32

What does the prefix table show?

Explanation of different messages

Directly overlapping prefixes of 2a07:cd40::/32

Prefix ▼	RIR ⬆	BGP ⬆	RPKI ⬆	RIPE ⬆	Advice ⬆
2a07:cd40::/29	RIPE NCC			213822	Route objects exist, but prefix not seen in DFZ No (covering) RPKI ROA found for route objects
2a07:cd40::/32	RIPE NCC	213822	213822 ▶/32	213822 ✓	Everything looks good

All overlaps of least specific match 2a07:cd40::/29

Prefix ▼	RIR ⬆	BGP ⬆	RPKI ⬆	RIPE ⬆	Advice ⬆
2a07:cd40::/32	RIPE NCC	213822	213822 ▶/32	213822 ✓	Everything looks good

Included in the following AS sets

Name	ARIN	RIPE
AS-31576-PEERS		✓
AS-ATOM86CUST4		✓
AS-ATOM86CUST6		✓
AS-ECHELON-PEERS		✓
AS-EUROACCESS		✓
AS-EUROACCESS-V6		✓
AS-FRYS-IX-CONNECTED		✓
AS-IX		✓

Source	Last update
BGP and RIRstats	40 minutes ago (2026-04-28 08:46 UTC)
AFRINIC	an hour ago (2026-04-28 08:25 UTC)
ALTDB	8 hours ago (2026-04-28 01:38 UTC)
APNIC	an hour ago (2026-04-28 08:23 UTC)
ARIN	an hour ago (2026-04-28 08:23 UTC)
BBOI	4 days ago (2026-04-24 19:04 UTC)
BEI I	6 days ago (2026-04-22 11:08 UTC)

IRR EXPLORER

nick@mbp:~

```
→ ~ curl -s https://irrexplorer.nlnog.net/api/prefixes/asn/49627 | jq
```

```
{
  "directOrigin": [
    {
      "prefix": "91.232.130.0/24",
      "rir": "RIPE NCC",
      "rpkiRoutes": [
        {
          "asn": 49627,
          "rpslText": "route:          91.232.130.0/24\ndescr:          RPKI ROA for 91.232.130.0/24 / AS49627\nremarks:       This AS49627 route object represents routing data retrieved\n                from the RPKI. This route object is the result of an automated\n                RPKI-to-IRR conversion process performed by IRRd\n                .\nmax-length:    24\norigin:        AS49627\nsource:        RPKI # Trust Anchor: ripe\n",
          "rpslPk": "91.232.130.0/24AS49627/ML24",
          "rpkiStatus": "VALID",
          "rpkiMaxLength": 24
        }
      ],
      "bgpOrigins": [
        49627
      ],
      "irrRoutes": {
        "RIPE": [
          {
            "asn": 49627
```



BGP Filter Guide

Guidance on BGP Filtering

[Guides](#)

[News](#)

[About](#)

BGP Filter Guides

RPKI

Rejecting RPKI invalid BGP Routes: [reject_invalids](#).

[RPKI FAQ](#) at the RPKI Documentation project

Locally attest well-known Trust Anchor publication point prefixes [slurm_ta](#).

Bogon ASN filtering

Rejecting routes which have a Bogon ASN anywhere in the AS_PATH: [bogon_asn](#).

Rejecting RPKI Invalid BGP Routes

- Reject RPKI Invalid BGP Routes
 - Purpose
- Configuration Examples
 - OpenBGPD on OpenBSD
 - Junos
 - Cisco classic IOS and IOS XE
 - Cisco IOS-XR
 - BIRD
 - Nokia SR OS
 - Configure RTR to the RPKI validator(s)
 - Drop invalid prefixes
 - FRR (vtysh)
 - VyOS
 - Mikrotik
 - RouterOS v7
 - Huawei VRP
 - Arista EOS

BIRD

BIRD 2.0 supports RTR. However, the current implementation does not perform an automatic revalidation of routes upon receipt of new ROAs.

The RPKI-RTR protocol receives and maintains a set of ROAs from a cache server (also called validator). You can validate routes (RFC 6483) using function `roa_check ( )` in filter and set it as import filter at the BGP protocol. BIRD should re-validate all of affected routes after RPKI update by RFC 6811, but we don't support it yet! You can use a BIRD's client command `reload in bgp_protocol_name` for manual call of revalidation of all routes. (https://bird.network.cz/?get_doc&v=20&f=bird-6.html#ss6.13)

BIRD 3.0 *does* support automatic revalidation. It is [enabled by default \(rpki reload on\)](#), but, for BGP channels, you must configure [import table yes](#) and/or [export table yes](#), for respective direction.

The [rtrsub](#) utility can be used to generate static ROA tables for BIRD 1.6.

Set up RTR as following:

```
roa4 table r4;
roa6 table r6;

protocol rpki {
    roa4 {
        table r4;
    };
    roa6 {
        table r6;
    };
    remote "10.1.1.6" port 323;
}
```

**EASY WAY FOR NLNOG EVENT VISITORS
TO FIND OR OFFER RIDES TO/FROM NLNOG EVENTS**



Dashboard

Event: **nl-nog-day-2026**

Edit my ride

Request a ride

You have 1 pending seat request. [Review](#)

Rides offered

Driver	Direction	Location	Departure	Return	Seats	
Pieter Janssen	round trip	Groningen, P+R Hoogkerk	Thu 10 Sep 06:30	Thu 10 Sep 19:00	2/3 free	Details
Sanne de Vries	to event	Eindhoven Centraal (Kiss & Ride)	Thu 10 Sep 07:15	-	2/2 free	Details
Jeroen van der Berg	round trip	Amsterdam Sloterdijk P+R	Thu 10 Sep 07:45	Thu 10 Sep 18:30	2/3 free (yours) 1 pending	Details

Ride requests

Who	Direction	Location	When	Notes
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UPCOMING NLNOG EVENTS

- ▶ NLNOG New Years Drink: January 2027 (probably) Utrecht, NL
- ▶ NLNOG Summer Event (with BBQ!): ~June 2027
- ▶ NLNOG Day: TBA
- ▶ Check nlnog.net for details

One more thing...



Who's leaking onto the **peering LAN?**

We watch the peering LAN on 32 IXPs and list every network sending something it shouldn't. Live, public, open data.

■ WHAT BELONGS ON IT

- **IP unicast between routers**
- **ARP**
- **Neighbour discovery**

Nothing else.

■ WHAT WE SEE INSTEAD

IPv6 RA

CDP

LLDP

STP

MNDP

MAC-Telnet

RoMON

DHCP

Ubiquiti discovery

ARP off-LAN

Wrong netmask

IPv6 to ff:ff:ff:ff:ff:ff

RARP

Syncthing

■ HOW IT WORKS

Listen on a member port. Name the sender.

01 · SENSOR

On the LAN

One Python file on a member's peering interface. Raw socket, flags every frame that isn't unicast IP, ARP or ND.

02 · REPORT

Over MQTT

Per source MAC: counts per type, first and last seen, the last few frames, raw.

03 · ATTRIBUTE

MAC → ASN

Neighbour table and PeeringDB tie the MAC to a peering LAN IP and the network that holds it.

04 · PUBLISH

Site, API, alerts

A page per network and per IXP, with decoded frames, a pcap and the fix.

Every leaking port, as it happens.

ix.watch

Network, AS or MAC...

NetworksIXPsAdd your IXDataAlertsSupport

Who's leaking onto the peering LAN?

An IXP peering LAN should carry IP unicast, ARP and neighbour discovery between member routers, and nothing else. We watch the LAN on [32 IXPs](#) and list every network sending something else, live. New to this? [Here's what it all means.](#)

225 sources sending in the last hour · 433 in the last 7 days · 32 IXPs · 135 more we couldn't attribute · 2,613 frames inspected per second

All IXPs 433

Pause

Network	IXP	Source	Sending	Frames	First seen	Last seen
Misaka.io AS917	LOCIX FRANKFURT via ParadoxNetworks (AS52025)	ea:13:1f:41:b0:74 185.1.166.7 2001:7f8:f2:e1::917:1	RoMON	99,998	13 Oct	1s ago

■ WHY IT MATTERS

Noise.

Flooded to every member port. Every router's CPU handles it, just to drop it.

Leaks.

CDP, LLDP and Ubiquiti discovery hand out model and firmware. MAC-Telnet and RoMON offer a management login.

Breaks.

A router advertisement offering itself as everyone's default route. A /24 on a /23 broadcasting at half the LAN.

■ THE FIX

Usually **one line.**

Every network page shows the decoded frames, a pcap for Wireshark, and the config for the vendor we saw.

IPv6 RA

Arista EOS

```
interface Ethernet1  
  ipv6 nd ra disabled all
```

MNDP, CDP, LLDP

MikroTik RouterOS

```
/ip neighbor discovery-settings  
set discover-interface-list=LAN
```

■ RIGHT NOW • LAST 7 DAYS

32

IXPs watched

308

networks leaking

434

router ports

2.6k

frames inspected
per second

ARP off-LAN



219

IPv6 RA



125

MNDP



33

CDP



18

DHCP



11

Router ports per leak type

api.ix.watch, 19 Oct 2026

■ ALL OF IT IS YOURS

Open data. **No key.**

API

JSON snapshot, per IXP and per network. CORS open.

```
/snapshot.json  
/as/<asn>.json
```

Live feed

Server-sent events, one per sampled frame.

```
/events?ix=frys-ix
```

pcaps

The raw frames behind every network page, for Wireshark.

```
/as/<asn>.pcap
```

Alerts

Mail when your network starts leaking. Log in with PeeringDB. Free for IX operators.

```
alerts.ix.watch
```

<https://api.ix.watch>

■ ADD YOUR IX

Don't see your exchange yet?

Help us **add it.**

Run a sensor

One Python file on your peering interface. Your IXP gets a section, credited to you.

```
$ sudo python3 ixsensor.py
```

Give us a VM

A small VM with a leg on the peering LAN. We run the sensor.

Give us a port

Run an IXP? The smallest port you offer is plenty.

THANK YOU!

<https://nlnog.net/get-involved>