Internet Interconnection and Observability Walkthrough

Aaron Atac

NANOG™

Introduction

- This presentation is a high-gloss attempt to educate newcomers about internet interconnection and observability.
- Who am I? A network engineer.
- I've spent most of my career focused on content distribution networks and internet backbone architecture.
- Currently, I'm focused on GPU/AI datacenter networks.

Bits

- If you didn't know already, computers digitally convert messages into 0s and 1s. Off/On in terms of electricity is simple to signal.
- Those 0s and 1s are called bits.
- Bit is short for binary digit. Follows the metric system.
  - 1000 bits = 1 kilobit, 1000 kilobits = 1 megabit, and so on...
- Network bandwidth is usually measured in bits.

Routers

- Routers forward bits by sharing and following routes of other routers, predefined standards, and configuration.
- Networks interconnect their routers over physical cable or wirelessly over antenna to exchange bits and routes.
- To transmit and receive bits over cable or antenna, bits are modulated into electrical signal or light waves.

Modulating Bits Into Light Waves

- Most industrial routers' have empty sockets to plug in small modules called transceivers aka optics.
- Optics are rated to go different distances (km) and speeds (bps).
- The latest Ethernet standard optics can reach 800 Gbps over 120km (75 mi)! These are called 800G-ZR optics.
- SR, DR, FR, LR, ER, ZR, ZR+ references max [R]each.

Modulating Bits Into Light Waves

- Light waves have parameters that we can modify to encode bits:
  - Amplitude: Modifying power (off, weak, moderate, strong).
  - Wavelength/Frequency: Modifying color (wavelength).
    - Which thereby modifies frequency.
  - Phase: Modifying alignment/offset.

Modulating Bits Into Light Waves

- Old Way: Non-Return-to-Zero (NRZ)
  - 1 bit at a time.
  - Off = 0, On = 1.

Modulating Bits Into Light Waves

- Newer Way: Pulse Amplitude Modulation (PAM)
  - 2 bits at once. Faster!
  - Uses 4 distinct amplitude (strength) levels.
    - Off (00), Weak (01), Moderate (10), Strong (11)

Modulating Bits Into Light Waves

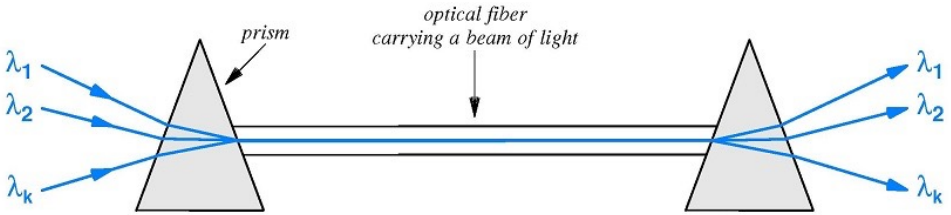
- Newest Way: Quadrature Amplitude Modulation (QAM)
  - Combines amplitude (intensity) + phase (alignment/offset).
  - 16-QAM sends 4 bits at once with 16 different combinations.
    - 0000, 0001, 0010, 0011, etc…
  - 4k-QAM, can send 12 bits at once with 4,096 combinations.
    - 000000000000, 000000000001, 000000000010, etc…

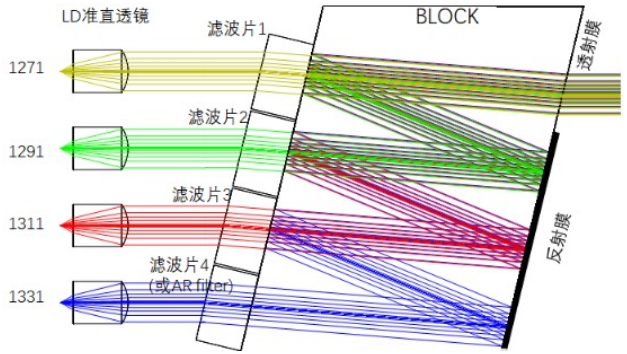
Multiplexing

- To further increase efficiency, multiplexers merge (mux) and split (demux) different channels of colors/freq over the same strand.
  - This is known as wavelength division multiplexing (WDM) or dense wavelength division multiplexing (DWDM).
- Polarization division multiplexing (PDM) is used to send different waves in vertical and horizontal orientation.

Wave Division Multiplexing

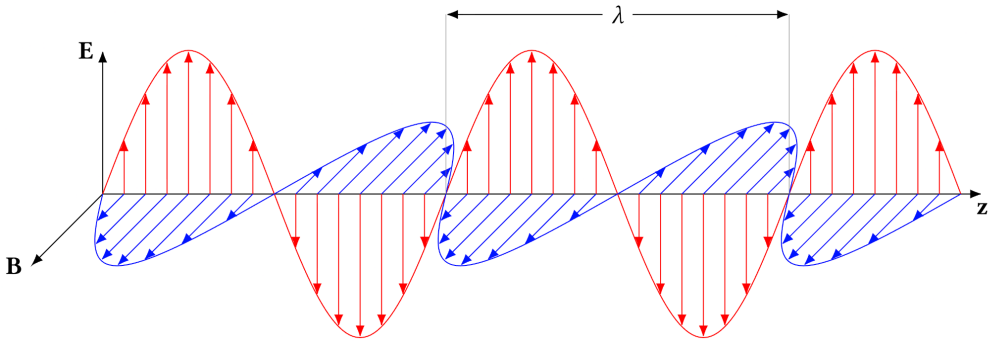
- Each laser sends a unique color/frequency and thereby each wavelength is a distinct channel or lane of communication.
- Prisms and chemically tuned mirrors are used to mux/demux.

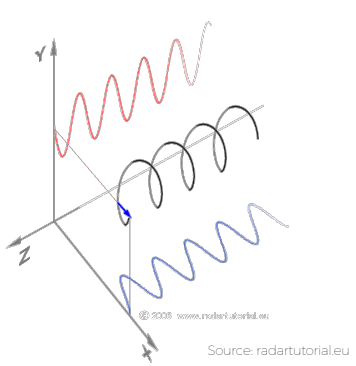




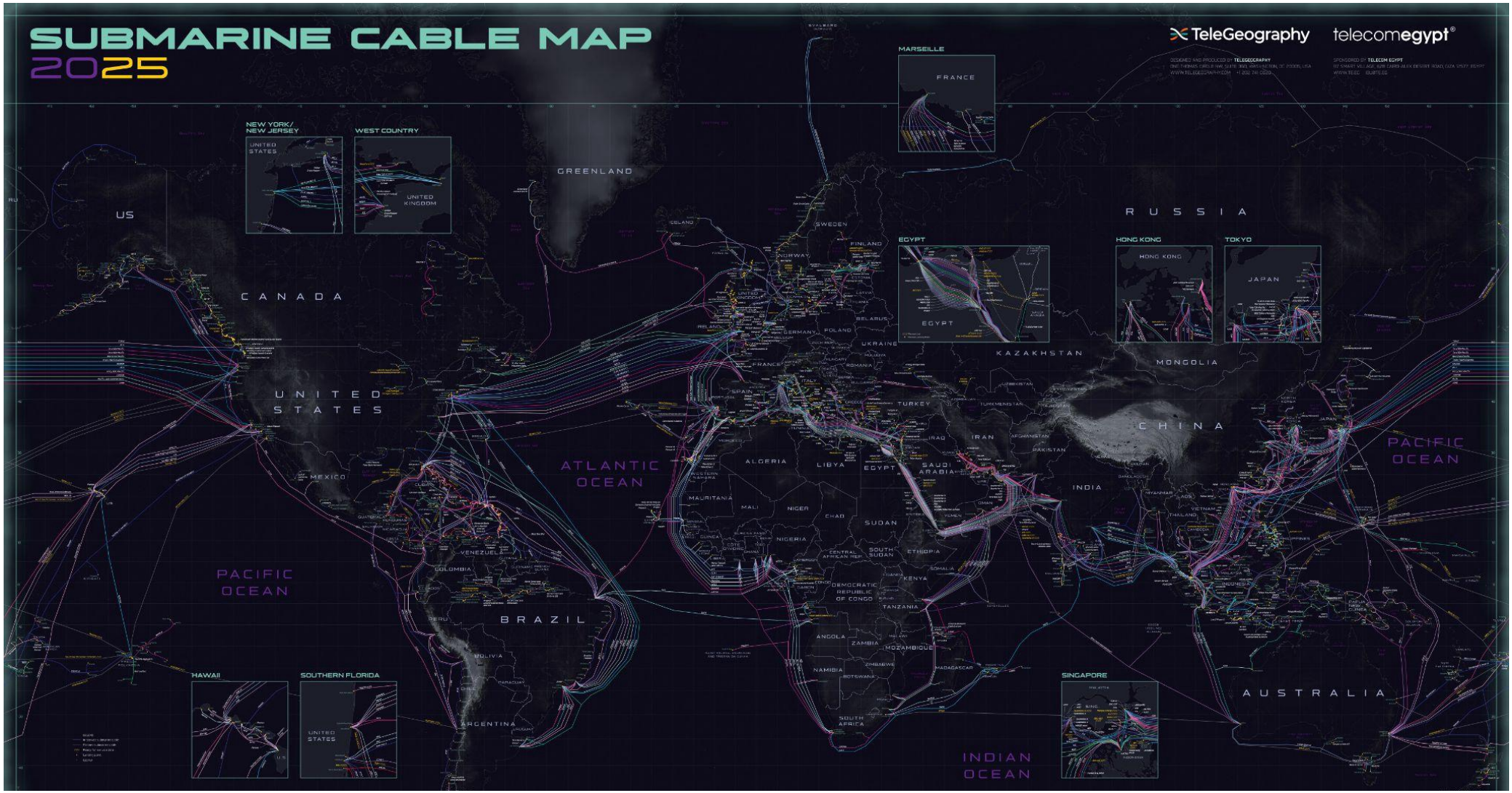
Polarization Division Multiplexing

- Polarization division multiplexing is used to send different waves in vertical and horizontal orientation. Coherent optics use DSP (Digital Signal Processors) chips inside to untwist these waves.





North America Core Long Haul Wavelength Network


SUBMARINE CABLE MAP
2025
TeleGeography
telecomegypt
MARSELLE
FRANCE
NEW YORK/
NEW JERSEY
UNITED
STATES
WEST COUNTRY
UNITED
KINGDOM
GREENLAND
US
CANADA
UNITED
STATES
MEXICO
ATLANTIC
OCEAN
PACIFIC
OCEAN
BRAZIL
ARGENTINA
PERU
BOLIVIA
PARAGUAY
CHILE
COLOMBIA
VENEZUELA
ICELAND
SWEDEN
FINLAND
NORWAY
IRELAND
GERMANY
POLAND
BELARUS
UKRAINE
FRANCE
ROMANIA
SPAIN
ITALY
PORTUGAL
GREECE
TURKEY
EGYPT
HONG KONG
HONG KONG
TOKYO
JAPAN
RUSSIA
KAZAKHSTAN
MONGOLIA
CHINA
IRAN
IRAQ
AFGHANISTAN
PAKISTAN
SAUDI
ARABIA
INDIA
ALGERIA
LIBYA
MAURITANIA
MALI
NIGER
CHAD
SUDAN
NIGERIA
ETHIOPIA
SOUTH
SUDAN
KENYA
SOMALIA
DEMOCRATIC
REPUBLIC
OF CONGO
TANZANIA
ANGOLA
ZAMBIA
MOZAMBIQUE
ZIMBABWE
NAMIBIA
BOTSWANA
MADAGASCAR
SOUTH
AFRICA
INDIAN
OCEAN
AUSTRALIA
PACIFIC
OCEAN
HAWAII
SOUTHERN FLORIDA
UNITED
STATES
SINGAPORE

Examples Of Physical Faults

- Trenched lines get accidentally cut by construction.
- Poles fall due to car collisions and weather. Sometimes catch fire.
- Ships anchors drop and cut subsea cables, usually close to port.
- Signal is prone to decay by dust (physical) or weather (wireless).
- Transceivers, inline amplifiers, and routers go faulty.
- Electricity or cooling fails, humans make mistakes, etc...

Where The Light Meets Business

- Facilities:
  - Data Centers
  - Carrier Hotels
  - Universities
  - Utility & Water Closets

Where The Light Meets Business

- Facilities rent you:
  - Space: Racks, cages
  - Cooling: Hot/Cold Aisles
  - Power: kw/rack, distinct feeds for redundancy
  - Interconnection/cross-connects/xconns
    - rack-to-rack, cage-to-cage, rack/cage-MMR.

Facilities & Business Relationships

- Facilities are not meant to remain empty.
- Sourcers find facilities with resources for the best price.
- Some networks end up having to build their own facilities.
- As demand increases, resource supply in dense metros becomes constrained, therefore it's implied some will have to build further out into unprecedented communities.

Facilities & Business Relationships

- You'll often hear about the buying and selling of "waves" or "dark fiber" by service providers connected to different facilities.
- A wave implies the fiber is already lit and tuned to a certain wavelength/frequency.
- Dark fiber implies the link is not lit and you are expected to light the strand and mux/demux as needed.

Facilities & Business Relationships

- Besides leased waves or dark fiber routes for site to site connectivity, networks connect to each other with different business relationships locally in these facilities.
- Waves, fiber, and interconnection in these facilities is what makes up the internet.
- How do you participate?

Registration

- Besides getting space, power, and cooling, you need to register for numbers…and pay.
- Five Regional Internet Registries (RIRs) assign numbers to distinguish networks, machines, and their purposes.
  - ARIN, LACNIC, RIPE, AFRINIC, APNIC
- There are independent brokers that resale and auction numbers.

ASNs and IPs

- Autonomous System Numbers (ASNs) provide network identification and distinction.
- Internet Protocol (IPs) addresses distinguish machines and are aggregated into prefixes.
- Out of RIR region use is sometimes permitted with conditions.
- IPv6? IPv6 was mostly driven by resource exhaustion. $2^{32} \rightarrow 2^{128}$.

BGP

- Border Gateway Protocol (BGP) is a standard implemented in software used to exchange routes to IPs within ASNs.
  - BGP is the routing protocol of the internet.
  - BGP has evolved and extended its capabilities over time.
  - The most specific prefix with the shortest path of ASNs wins.
  - BGP has many traffic engineering possibilities.

BGP Peering Business Relationships

- Transits: Comparable to you paying a courier like FedEx to deliver your package anywhere in the world.
  - In theory, transits are supposed to get you to any destination, but in practice every network has different reachability (view).
  - Transit networks capacity to other networks is shared amongst all customers. Lossless delivery not guaranteed!

BGP Peering Business Relationships

- Transits:
  - Burstable billing (95/5): Transits sample how much you use over a month, and they will sort those samples high to low. They ignore the top 5% of samples or bursts. You are billed the next highest number for the month. Brief spikes are "free."

BGP Peering Business Relationships

- Transits:
  - Transit services can be resold and this makes up a large amount of the internet service provider economy.
  - Transit providers are thereby tiered.
  - Tier 1s are at the top and in theory should have no upstreams.
  - Tiers change by geographic market.

BGP Peering Business Relationships

- Private Network Interconnect (PNI/SFI): Direct connection to another network that usually is settlement free, but not always.
  - Ideally, there is a mutual benefit seen + reduction of cost.
  - One of the two networks still has to initiate and pay the facility for the cross-connect (xconn).
  - Optics, IPs, and router ports have cost too.

BGP Peering Business Relationships

- IXPs: Comparable to a potluck. You pay a renewing membership fee and then can exchange traffic with everyone in the room.
  - IXPs use "route servers" for everyone to exchange routes over bgp without having to directly peer with every member.
  - You can chose not to use the route server and selectively peer.
  - You can directly peer and use route server simultaneously.

BGP Peering Relationship Summary

- Transits: Middle man network, distant routes, and you pay the highest renewable cost. Often referred to as "upstreams."
- Private Network Interconnects (PNI/SFI): Most control over your capacity. Xconn provider is only third party and cost.
- IXPs: Middle man network and generally pay some renewable costs. Middle man network implies additional risk of loss.

Sampling Traffic

- Every Nth packet ingressed on a link will have its attributes like source and destination address copied to a collector for analysis.
- Sampling and analyzing network flows (netflow/flow) for sources and destinations help networks with peering decisions.
- Flow also helps in diagnosing issues with routing and attacks.
- You can even use flow to filter and mitigate impact of attacks.

Sampling Traffic

- Requesting to peer with top src/dest ASNs by flows sampled:
  - How much are you paying for those bits via transit?
  - Is the considered network in the same facility or the same IXP as you? If not, how much would it cost to reach?
  - How much are cross connects, optics, IPs, IXP recurring costs?
  - What is the network's peering policy? How much capacity?

BGP Paths and Views

- Paths are unidirectional. Asymmetry of traffic flow is common.
- Redundancy does not imply true diversity!
  - Fiber from different providers on the same pole are vulnerable to a car accident taking out the pole and both cables.
  - Transit from different providers could be reselling same upstreams or have shared-risk fiber routes, or both.

BGP Paths and Views

- Today, internet traffic/demand is strongly centralized to a common set of destination networks. What about the rest?
- Connectivity to a global uniform internet does not exist!
- Every network has different views of paths. Research has shown significant deviation. See Huston's Desperately Seeking Default.
- Per cidr-report, ~60% of networks are only seen via one path!

BGP Traffic Engineering

- Network engineers need to strategically announce and filter BGP path views to best serve their customers.
  - Views may contain geographically distant but short AS paths.
  - Views may contain lossy paths due to congestion or fault.
  - Views may contain tromboning or looped paths.
  - Views may contain adversarial paths!

Advertising BGP Paths

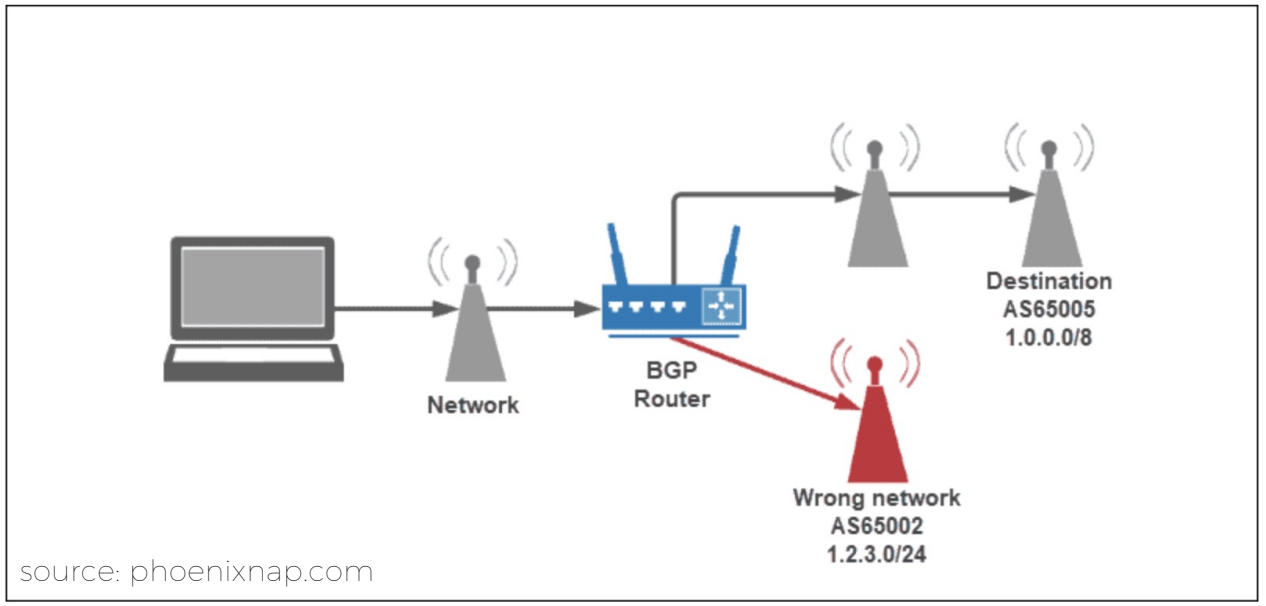
- Selective Announcement: Strategically manipulate reachability.
- Prefix Length (Specificity): Advertise more specifics to attract.
- AS Path Prepending: Artificially lengthen the path to disway.
- Communities (Tags): Attach signal to trigger actions by peers.
  - BLACKHOLE, GRACEFUL_SHUTDOWN, NO_EXPORT
  - Advertise/Don't advertise my prefix to specific networks

Receiving BGP Paths

- Filter against explicit lists and/or attributes:
  - Prefix, Path, and Communities
- Validate route origin ASN and path:
  - RPKI ROA & ASPA
- Verify source address is in table/matches ingress interface:
  - uRPF

Filtering and Validity of BGP Paths

- BGP Paths can be hijacked for either MTM or DoS attacks!



RPKI

- RPKI is a cryptographic framework for signing BGP prefixes with the originating AS number, maxLength, and recently upstreams.
  - The five RIRs act as the root Trust Anchors (aka CAs).
  - ROA records sign a prefix's origin ASN and maxLength.
  - ASPA records sign a ASN's upstream providers.
  - Routers validate if paths are RPKI valid, invalid, or unknown.

MANRS

- Mutually Agreed Norms for Routing Security (MANRS)
  - Filtering: Prevent propagation of incorrect routing info.
  - Anti-spoofing: Prevent traffic with spoofed source IPs.
  - Coordination: Maintain globally accessible contact info.
  - Global Validation: Facilite validation of routing info.


Observability

Databases

- RIRs' IRRs: Who is who and what are they attesting to route?
- PeeringDB: What facilities networks are in, metadata, contacts.
- RIPEStat: Multitool for historical analysis and resource lookups.
- CAIDA's ASRank and Qrator.Radar: BGP relationships, events, and network size.

RPKI Observability

- NIST RPKI Monitor & CloudFlare's RPKI Portal: Global adoption statistics dashboard and interactive explorer to browse global ROAs and BGP announcements.
- Cloudflare's isbgpsafeyet.com: Test to check if your ISP is dropping RPKI Invalid routes.

Route Archives & Observability

- RouteViews & RIPE RIS: Collects and archives routing data.
- RIPE BGPlay: Visualize BGP route propagation and timing.
- Cloudflare's Radar: Internet trends and anomalies dashboard.
- Georgia Tech's GRIP: BGP Hijacks
- Georgia Tech's IODA: Internet Outages

Route Archives & Observability

- bgproutes.io: Aggregated route collecting databases together.
- bgp.potaroo.net / cidr-report.org: Research, stats, graphs!
- bgp.tools: Network metadata aggregator and route collection.
- kentik.com/blog: Doug Madory's analysis of large scale BGP events such as hijacks, leaks, and blackouts.

Measurement

- RIPE Atlas: Global network of distributed probes for active measurement
  - Globaltraceroute.com is a friendly frontend for RIPE Atlas.
- NLNOG Ring: Community of networks providing shell access to internal servers for debugging. Also communities
- Waveform's Bufferbloat Test: Measure latency under load.

Reputation & Location Sources

- Akamai
- Proofpoint
- Spamhaus
- Team Cymru
- SPUR
- Geofeeds
  - geolocatemuch.com
  - geofeed-finder
- MaxMind


Let's Explore!

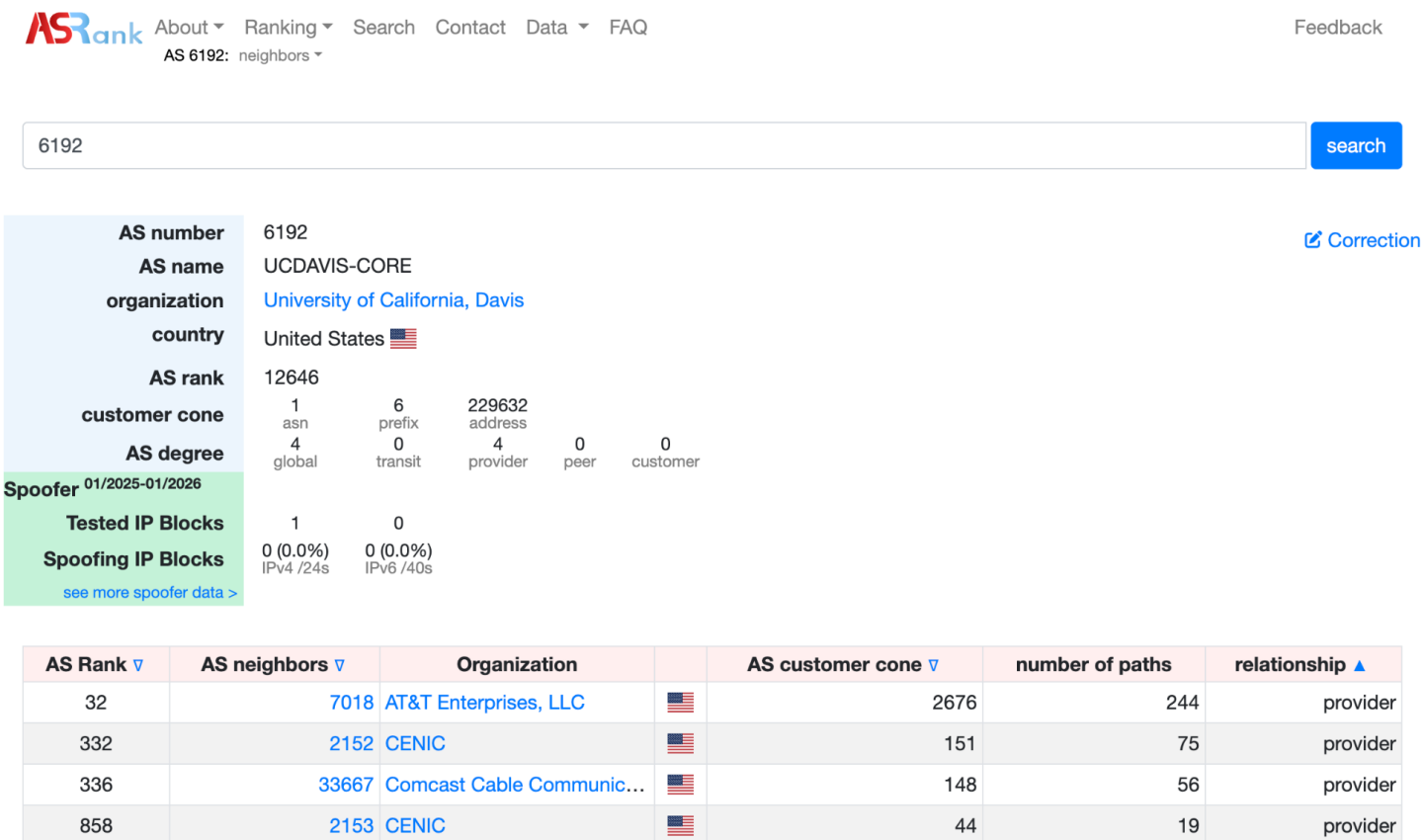
Who is networks.cs.ucdavis.edu?

```
medill:~ aatac$ dig +short networks.cs.ucdavis.edu
coe-cs-zea.cs.ucdavis.edu.
169.237.5.191
medill:~ aatac$ whois -h whois.cymru.com " -v 169.237.5.191"
AS      | IP               | BGP Prefix          | CC | Registry | Allocated  | AS Name
6192    | 169.237.5.191    | 169.237.5.0/24      | US | arin     | 1995-08-04 | UCDAVIS-CORE - University of California, Davis, US
```

PeeringDB


PeeringDB
Search here for a network, IX, or facility.
Advanced Search
Legacy Search
Registeror
Login
English (English)
University of California at Davis
EXPORT
Organization
University of California at Davis
Also Known As
Long Name
Company Website
ASN
6192
IRR as-set/route-set
Route Server URL
Looking Glass URL
Network Types
IPv4 Prefixes
IPv6 Prefixes
Traffic Levels
Not Disclosed
Traffic Ratios
Not Disclosed
Geographic Scope
Not Disclosed
Protocols Supported
Unicast IPv4 Multicast IPv6 Never via route servers
Last Updated
2022-07-27T05:33:24Z
Public Peering Info Updated
Peering Facility Info Updated
Contact Info Updated
Notes
RIR Status
ok
RIR Status Updated
2024-06-26T04:47:55Z
Logo
Public Peering Exchange Points
Filter
Exchange
IPv4
ASN
IPv6
Speed
Port Location
RS Peer
BFD Support
No filter matches.
You may filter by Exchange, ASN or Speed.
Interconnection Facilities
Filter
Facility
ASN
Country
City
No filter matches.
You may filter by Facility, ASN, Country or City.

ASRank


ASRank
About
Ranking
Search
Contact
Data
FAQ
Feedback
AS 6192: neighbors
6192
search
AS number 6192
AS name UCDAVIS-CORE
organization University of California, Davis
country United States
AS rank 12646
customer cone 1 asn 6 prefix 229632 address
AS degree 4 global 0 transit 4 provider 0 peer 0 customer
Correction
Spoofer 01/2025-01/2026
Tested IP Blocks 1 0
Spoofing IP Blocks 0 (0.0%) IPv4 /24s 0 (0.0%) IPv6 /40s
see more spoofer data >
AS Rank
AS neighbors
Organization
AS customer cone
number of paths
relationship
32 7018 AT&T Enterprises, LLC 2676 244 provider
332 2152 CENIC 151 75 provider
336 33667 Comcast Cable Communic... 148 56 provider
858 2153 CENIC 44 19 provider

ASRank

```
medill:~ aatac$ asnrel 6192
provider: 7018
provider: 2152
provider: 33667
provider: 2153
```

IRR

```
medill:~ aatac$ bgpq4 -4 AS6192 | egrep -v "no" | sed 's/.*permit //'
128.120.0.0/16
128.120.80.0/24
152.79.0.0/16
168.150.0.0/17
169.237.0.0/16
192.82.111.0/24
medill:~ aatac$ bgpq4 -6 AS6192 | egrep -v "no" | sed 's/.*permit //'
2001:468:e24::/48
2607:f810::/32
2607:f810:330::/44
2607:f810:f30::/44
```

Looking Glasses & Probes

```
medill:~ aatac$ lgripeinfo 169.237.5.191
Prefix            Peers    Upstream                 Origin                   AS-Len   Prepends
------            -----    --------                 ------                   ------   --------
169.237.5.0/24    225      7018 (Unknown)           6192 (UCDavis)           4        0
169.237.5.0/24    82       7018 (Unknown)           6192 (UCDavis)           5        0
169.237.5.0/24    25       7018 (Unknown)           6192 (UCDavis)           3        0
169.237.5.0/24    6        7018 (Unknown)           6192 (UCDavis)           6        0
169.237.5.0/24    1        7018 (Unknown)           6192 (UCDavis)           2        0
```

Looking Glasses & Probes

```
medill:~ aatac$ lgripe 169.237.5.191
Prefix          |  AS Path                          |  Communities
----------------+-----------------------------------+-------------
169.237.5.0/24  |  34854 1299 7018 6192             |  1299:25000 34854:3001
169.237.5.0/24  |  59919 9002 3356 7018 6192        |  9002:9002 9002:64615
169.237.5.0/24  |  202365 50673 174 7018 6192       |  174:21000 174:22013 50673:1000
169.237.5.0/24  |  7018 6192                        |  7018:2000 7018:32112
169.237.5.0/24  |  50304 1299 7018 6192             |
169.237.5.0/24  |  132825 174 7018 6192             |
169.237.5.0/24  |  206499 34549 174 7018 6192       |  174:21000 174:22013 34549:100 34549:174
169.237.5.0/24  |  22652 1299 7018 6192             |  1299:431 1299:4000 1299:25000 1299:25300
169.237.5.0/24  |  55720 3491 7018 6192             |
169.237.5.0/24  |  34927 56655 1299 7018 6192       |  1299:25000 56655:2100
169.237.5.0/24  |  44393 58057 6939 7018 6192       |  58057:65010
169.237.5.0/24  |  20205 1299 7018 6192             |  1299:25000
169.237.5.0/24  |  34549 174 7018 6192              |  174:21000 174:22013 34549:100 34549:174
169.237.5.0/24  |  216285 8280 6762 7018 6192       |  17152:1 6762:31 6762:10100 8280:3002
169.237.5.0/24  |  213241 9002 3356 7018 6192       |
```

Looking Glasses & Probes

RIPE NCC
RIPE Atlas

Global Traceroute *v2.6*

Select Probe

Probe 1011307: CENIC (AS2152): Redding, California, US

Target type:
- (•) Trace to user-entered target
- ( ) Trace to other probe
- ( ) My IP address

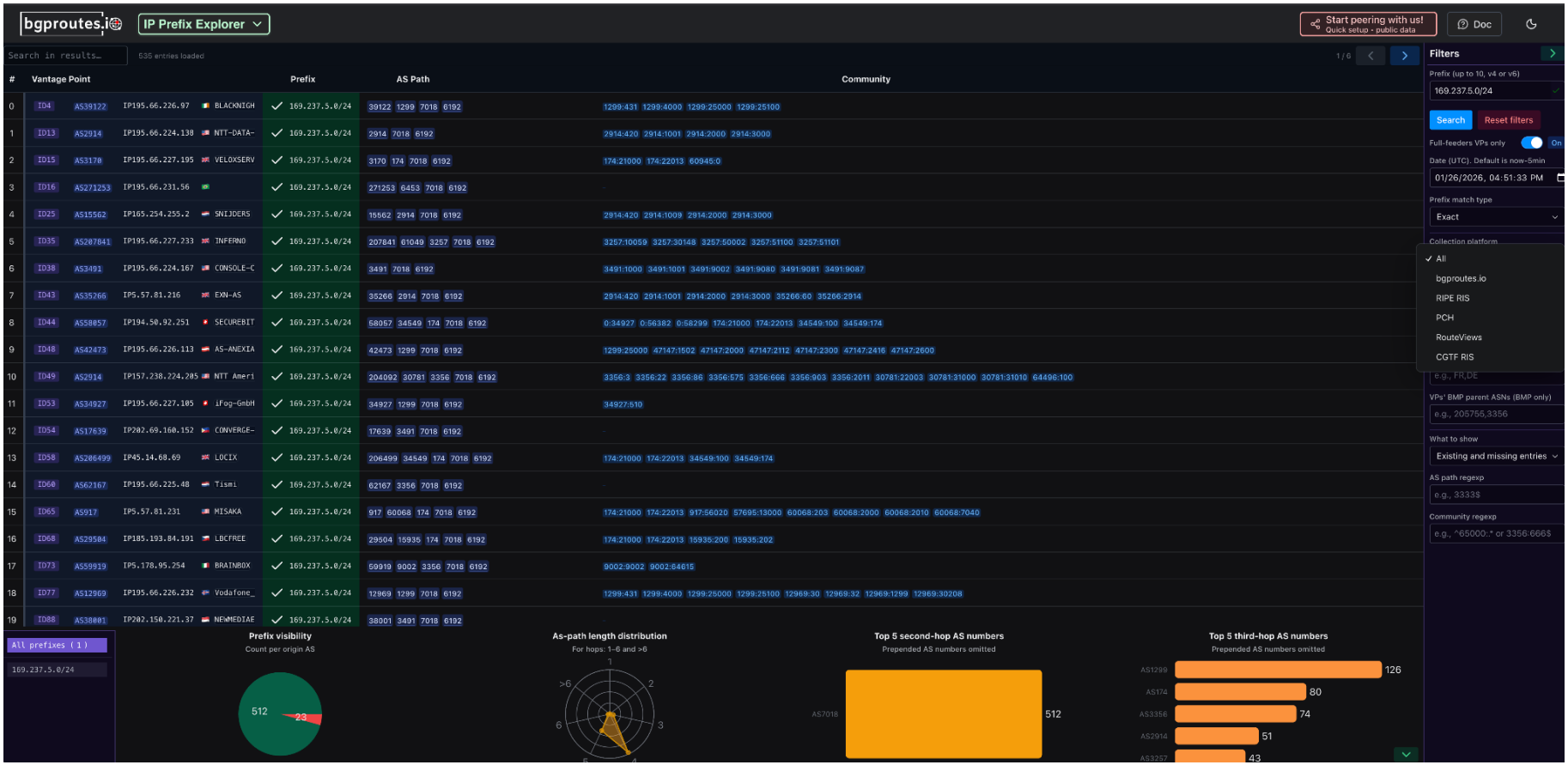
Target Address: 169.237.5.191

Submit | Reset Filters

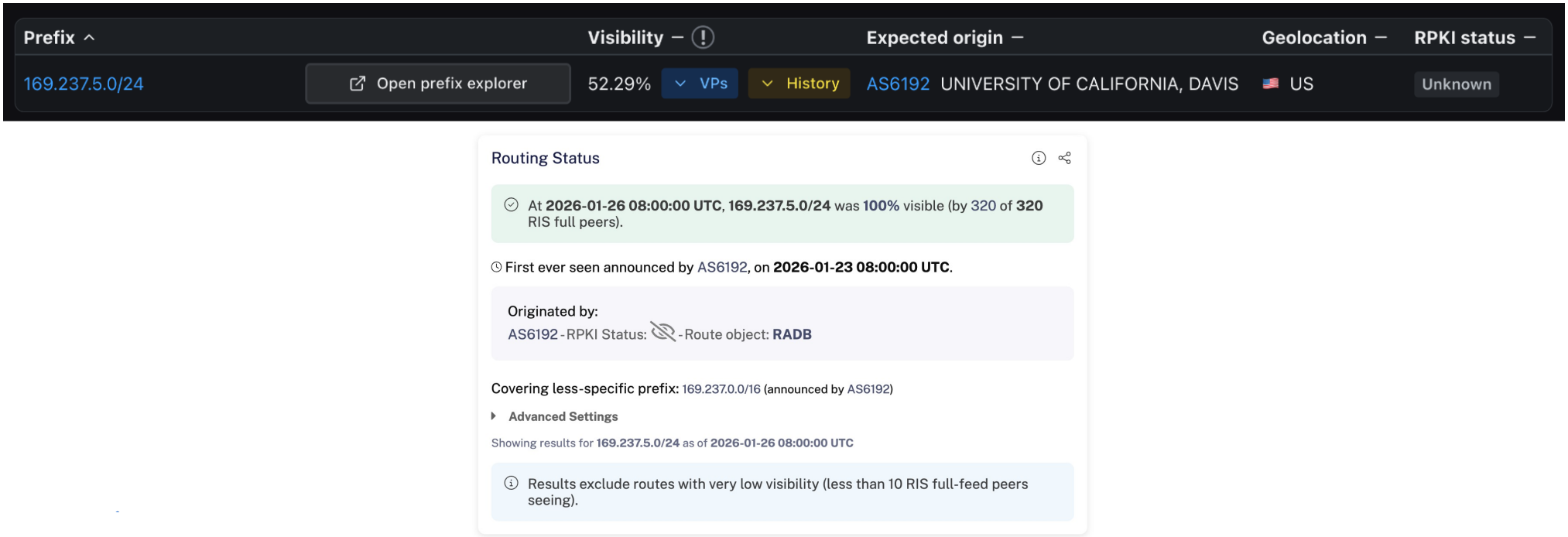
```
traceroute to 169.237.5.191 (169.237.5.191) 64 hops max, 76 byte packets
  1  10.233.64.1 (10.233.64.1) [AS???]  0.093 ms  0.028 ms  0.028 ms
  2  198.189.66.252 (198.189.66.252) [AS2152]  0.348 ms  0.319 ms  33.007 ms
  3  rive1-agg-01--fres1-agg-01--200g--01.cenic.net (137.164.11.105) [AS2152]  7.502 ms  7.221 ms  7.207 ms
  4  dc-lax-agg10--rive1-agg-01-800g--01.cenic.net (137.164.11.86) [AS2152]  7.537 ms  7.234 ms  7.244 ms
  5  * * *
  6  * * *
  7  192.205.37.41 (192.205.37.41) [AS7018]  17.302 ms  17.232 ms  17.375 ms
  8  32.130.91.80 (32.130.91.80) [AS7018]  17.983 ms
     *
     *
  9  * * *
 10  * * *
 11  * * *
 12  border-dav--transit1.ucdavis.edu (192.82.111.28) [AS6192]  13.948 ms  13.907 ms  13.862 ms
 13  transit1--net4-cdf1.ucdavis.edu (128.120.0.32) [AS6192]  14.281 ms  14.256 ms  14.153 ms
 14  * * *
 15  * * *
 16  * * *
 17  * * *
 18  * * *
255  * * *

Source address is: 198.189.66.253
```

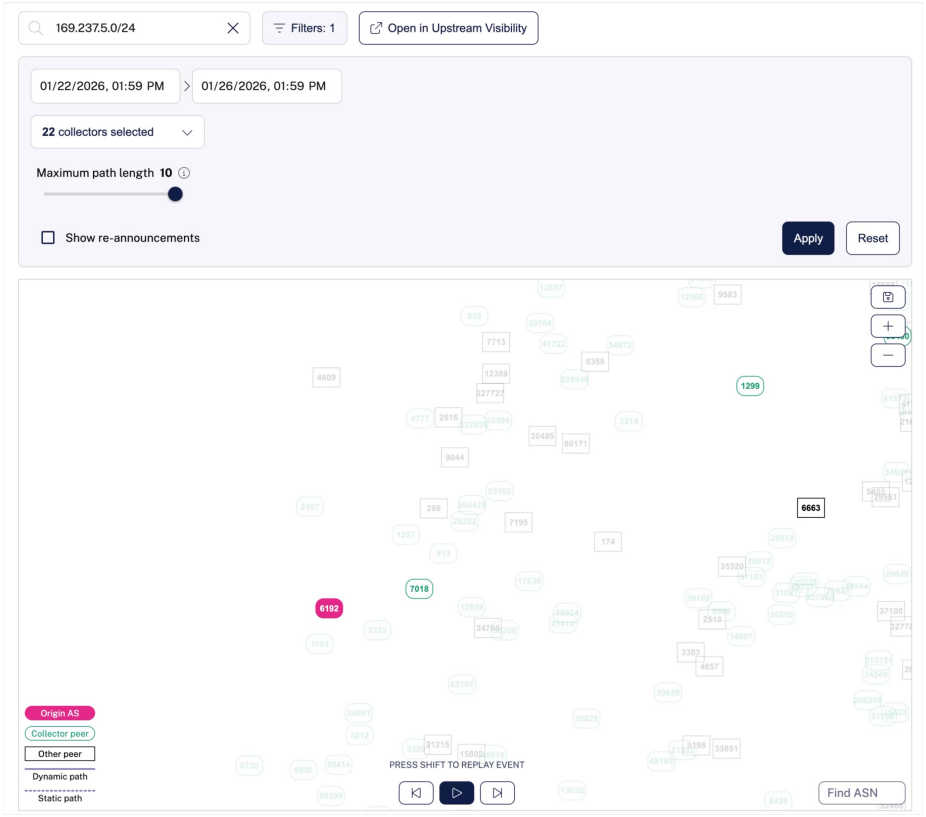
Looking Glasses & Probes



Looking Glasses & Probes



Looking Glasses & Probes



Looking Glasses & Probes

UCDAVIS
INFORMATION AND
EDUCATIONAL TECHNOLOGY

NETWORK STATUS SUPPORT SUBSCRIBE TO UPDATES

Network Degradation

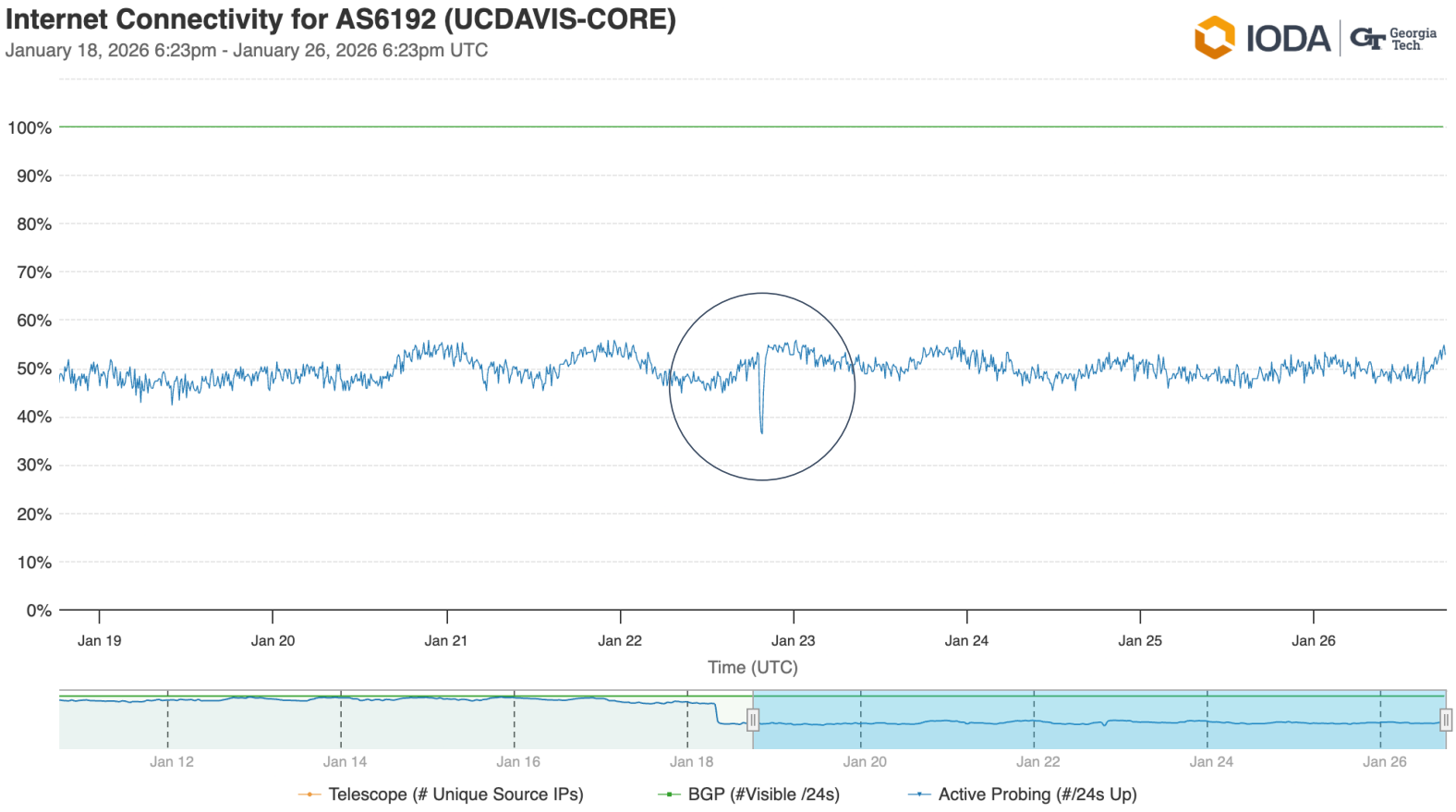
Subscribe

Investigating - UC Davis network is currently experiencing a degradation due to bandwidth constraints.

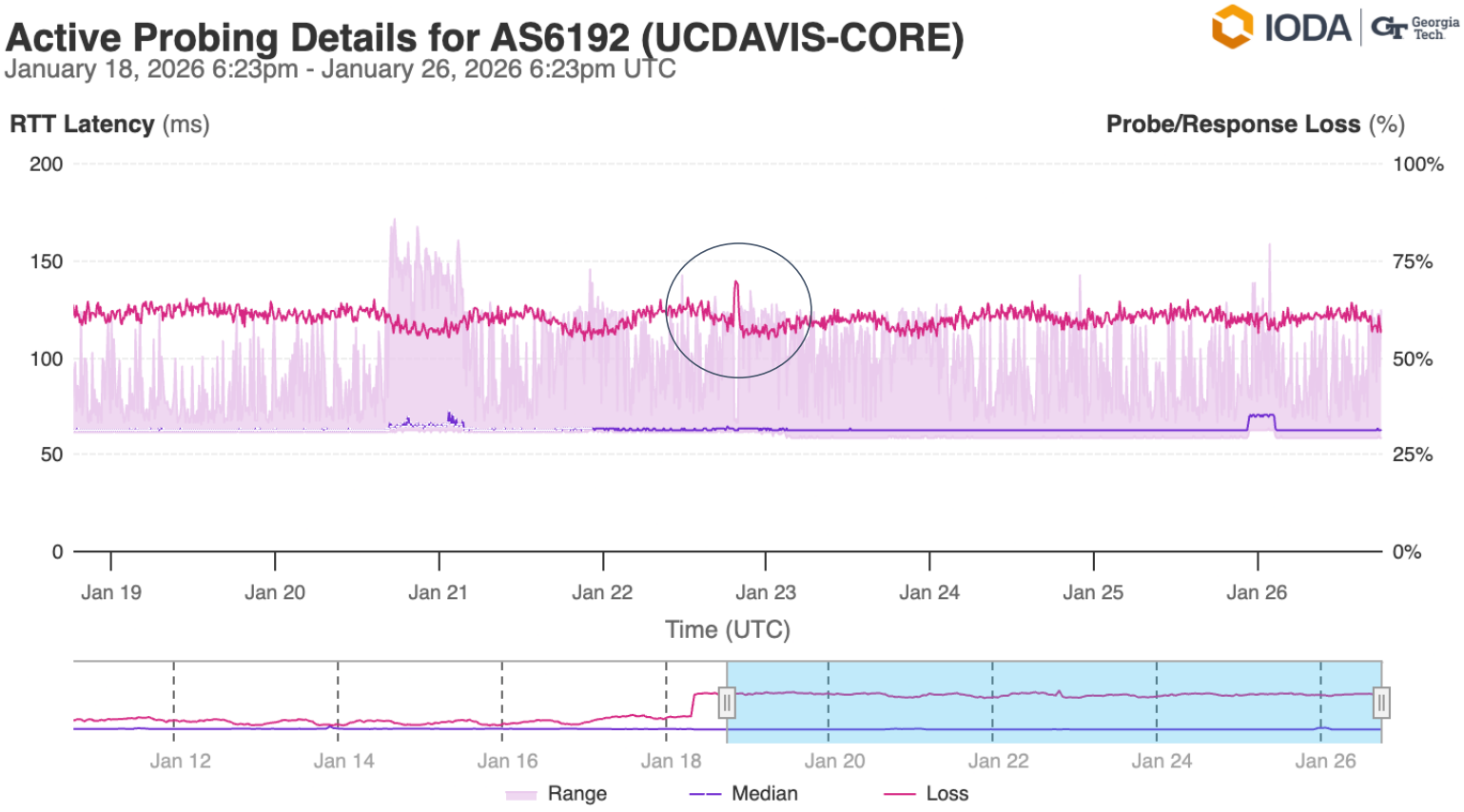
The NOC is attempting to engineer traffic flows to balance the load across multiple ISPs to stabilize.

IT Express Service Desk
ithelp@ucdavis.edu
530.754.HELP (4357)
Jan 22, 2026 - 11:11 PST

Looking Glasses & Probes



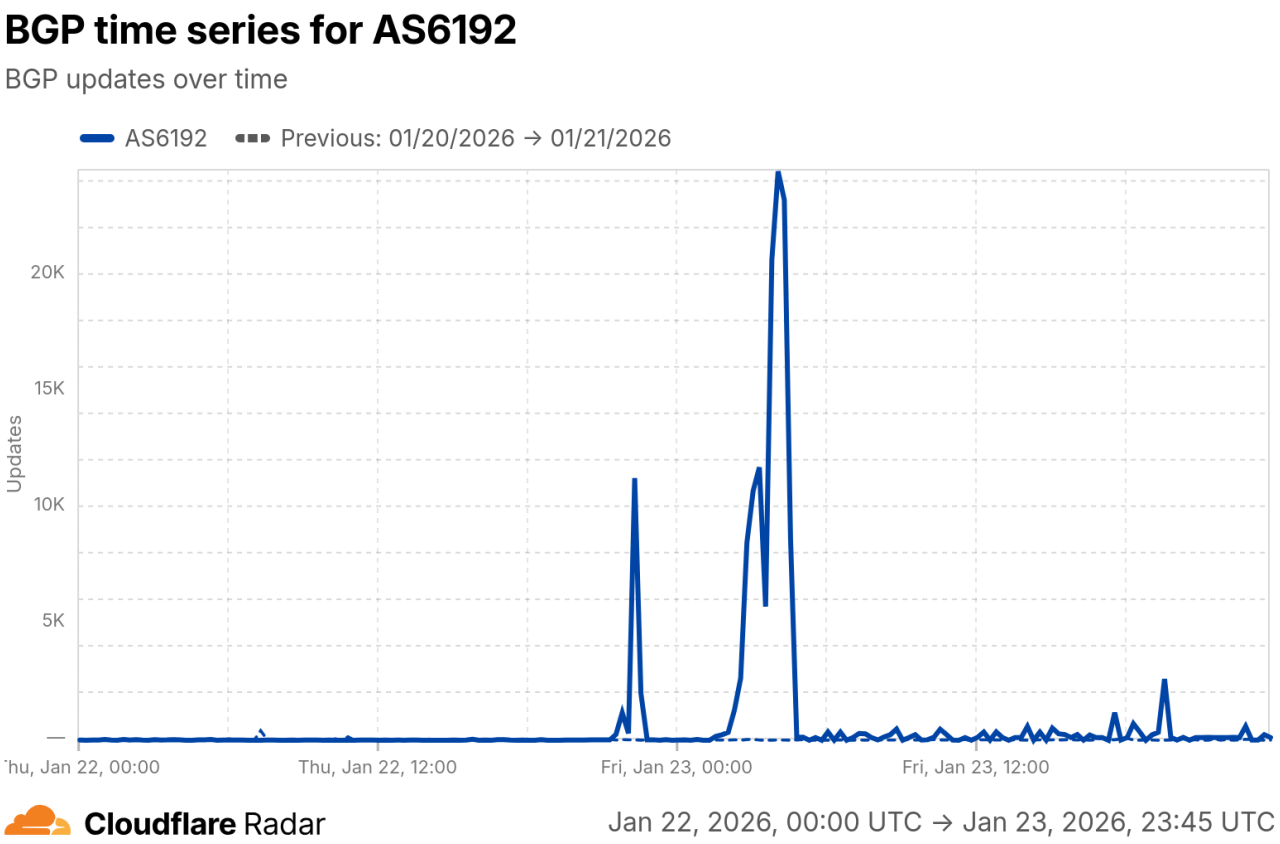
Looking Glasses & Probes



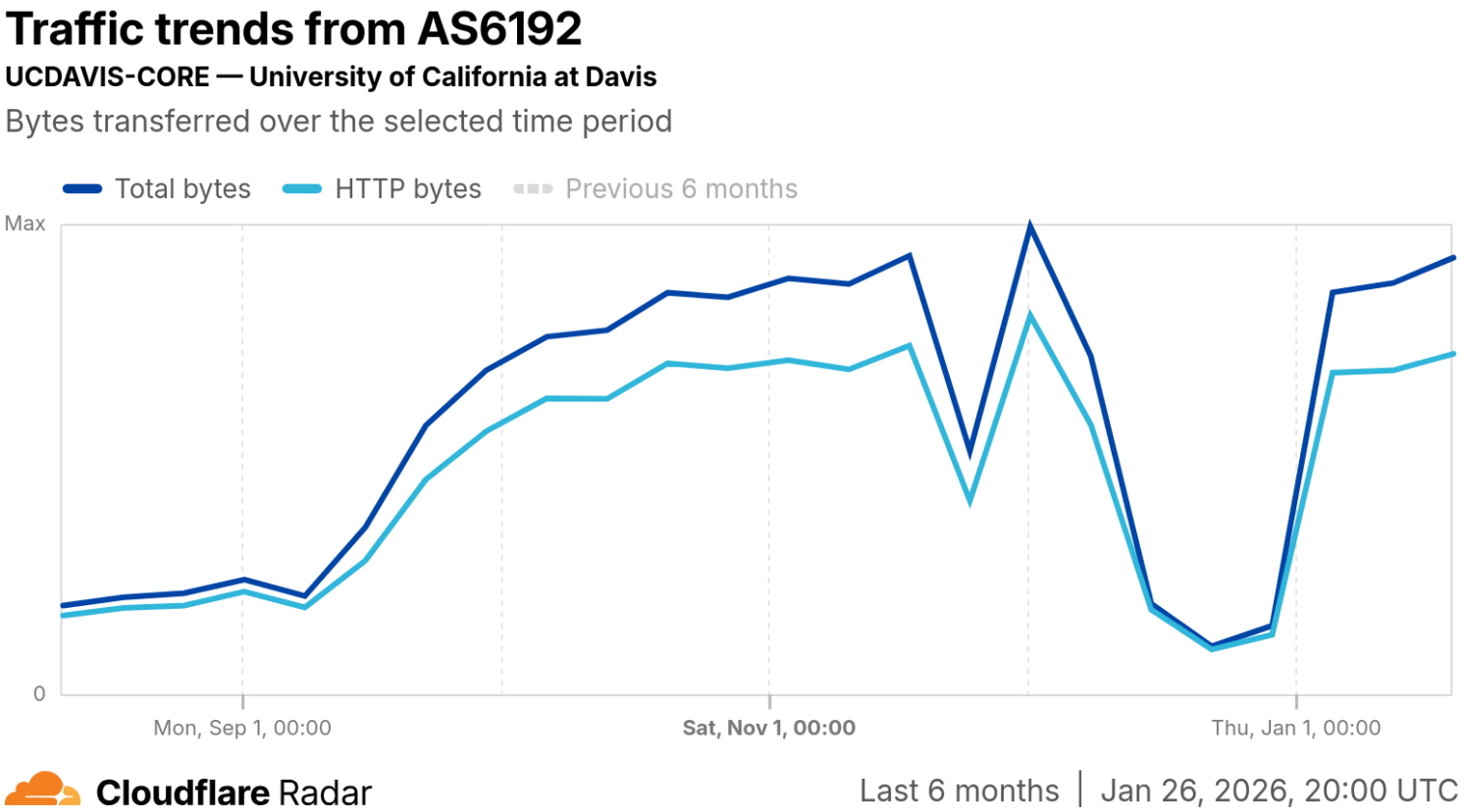
Looking Glasses & Probes

```
medill:~ aatac$ bgpdump -M /Users/aatac/Downloads/bview.20260123.0800.gz | grep 169.237.5.0/24
2026-01-26 11:23:00 [info] logging to syslog
TABLE_DUMP2|01/23/26 08:00:00|B|80.77.16.114|34549|169.237.5.0/24|34549 174 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|165.16.221.66|37721|169.237.5.0/24|37721 5511 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|193.33.94.251|58057|169.237.5.0/24|58057 174 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|195.128.231.254|49432|169.237.5.0/24|49432 48362 1299 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|202.150.221.37|38001|169.237.5.0/24|38001 3491 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|5.255.90.109|202365|169.237.5.0/24|202365 50673 174 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|45.61.0.85|22652|169.237.5.0/24|22652 1299 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|49.12.70.222|44393|169.237.5.0/24|44393 394256 174 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|89.234.186.6|204092|169.237.5.0/24|204092 30781 3356 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|165.254.255.2|15562|169.237.5.0/24|15562 2914 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|193.163.86.231|34800|169.237.5.0/24|34800 58057 50673 174 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|103.212.68.10|55720|169.237.5.0/24|55720 2914 7018 6192|IGP
TABLE_DUMP2|01/23/26 08:00:00|B|178.208.11.4|50628|169.237.5.0/24|50628 1299 7018 6192|IGP
```

Looking Glasses & Probes



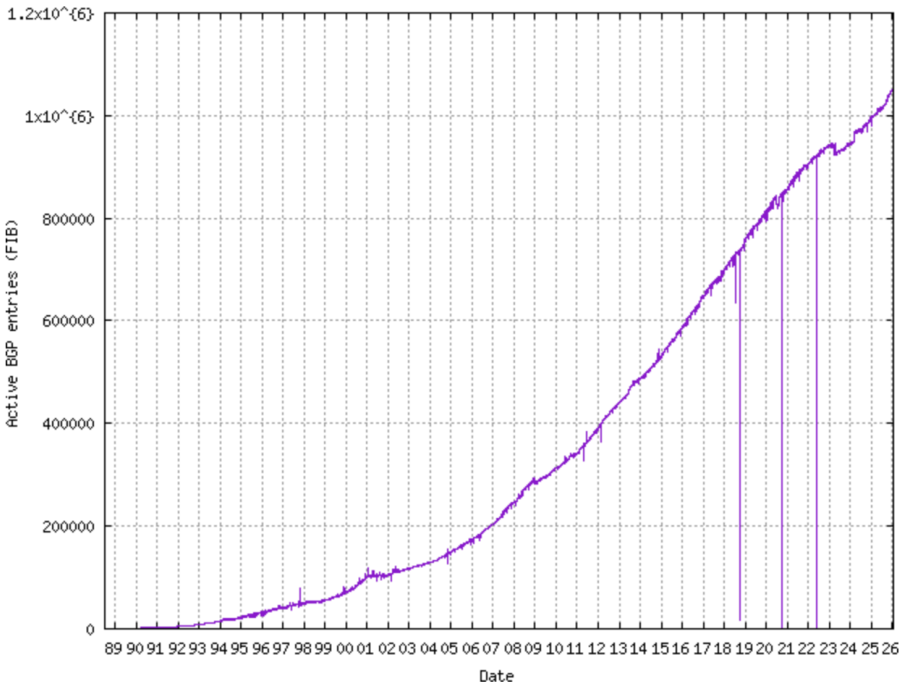
Looking Glasses & Probes



Looking Glasses & Probes

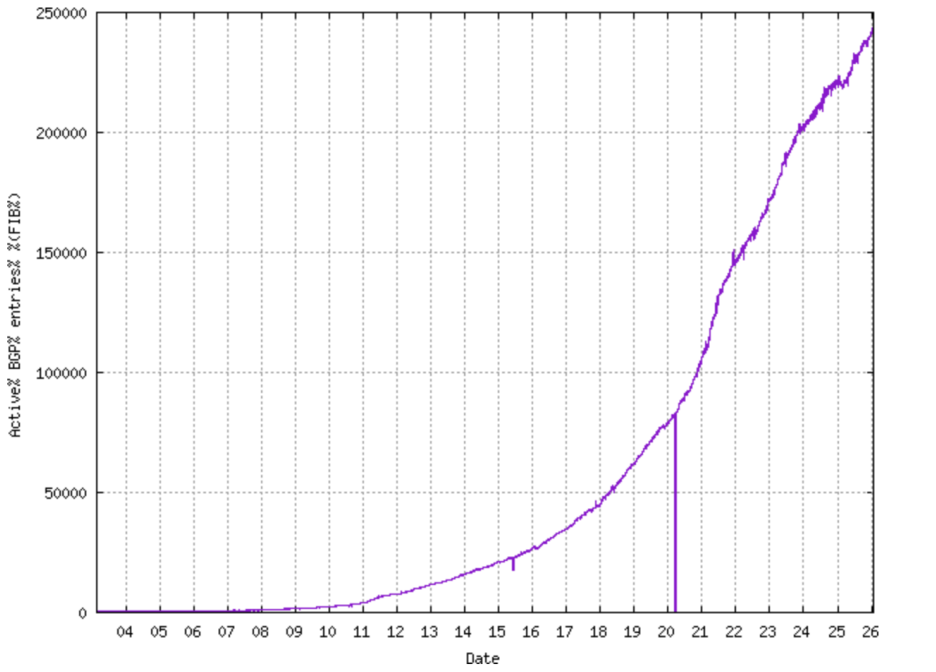
https://www.cidr-report.org/cgi-bin/plota?fi

Active BGP entries (FIB)

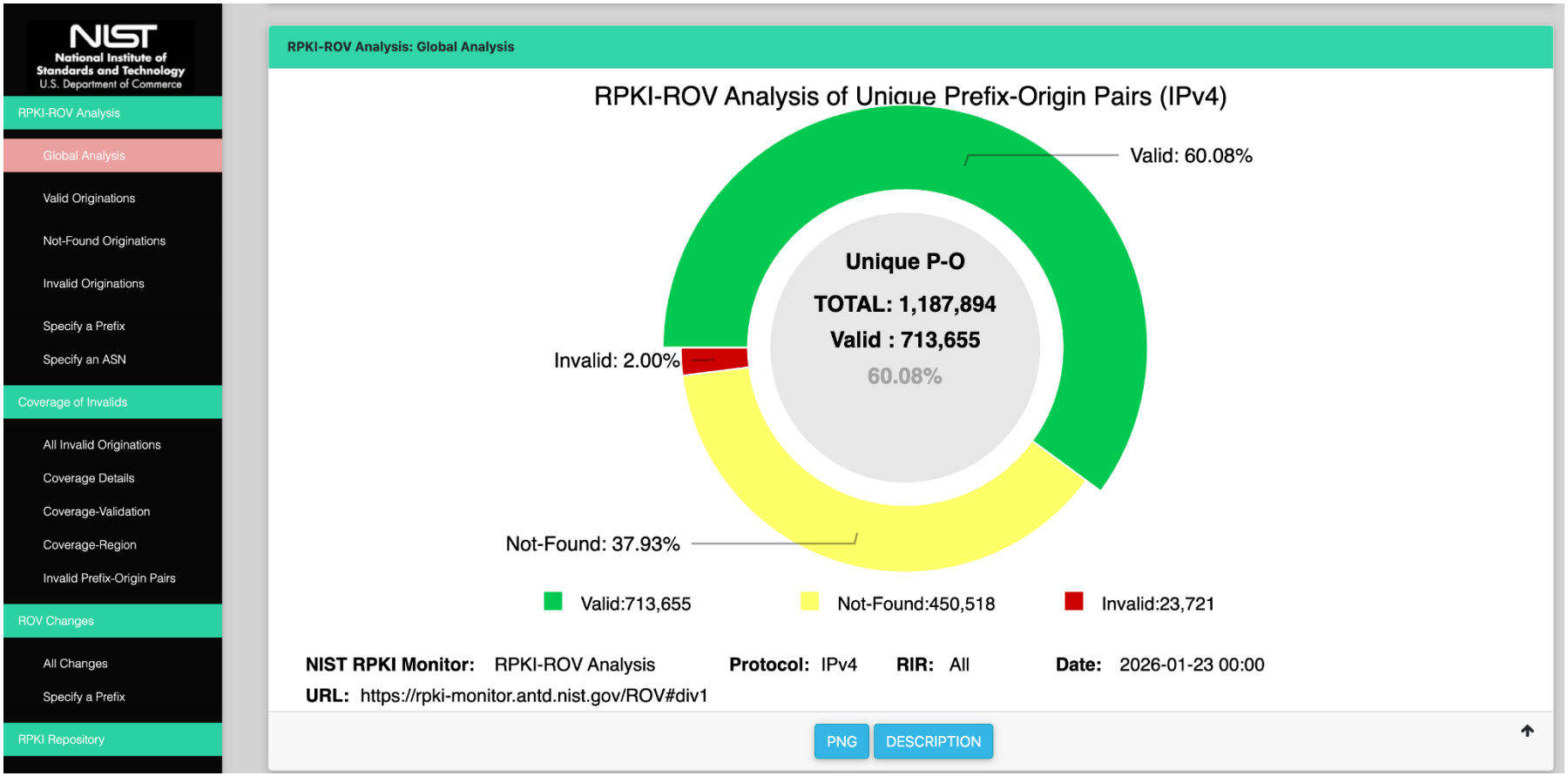


https://www.cidr-report.org/cgi-bin/plota?file=

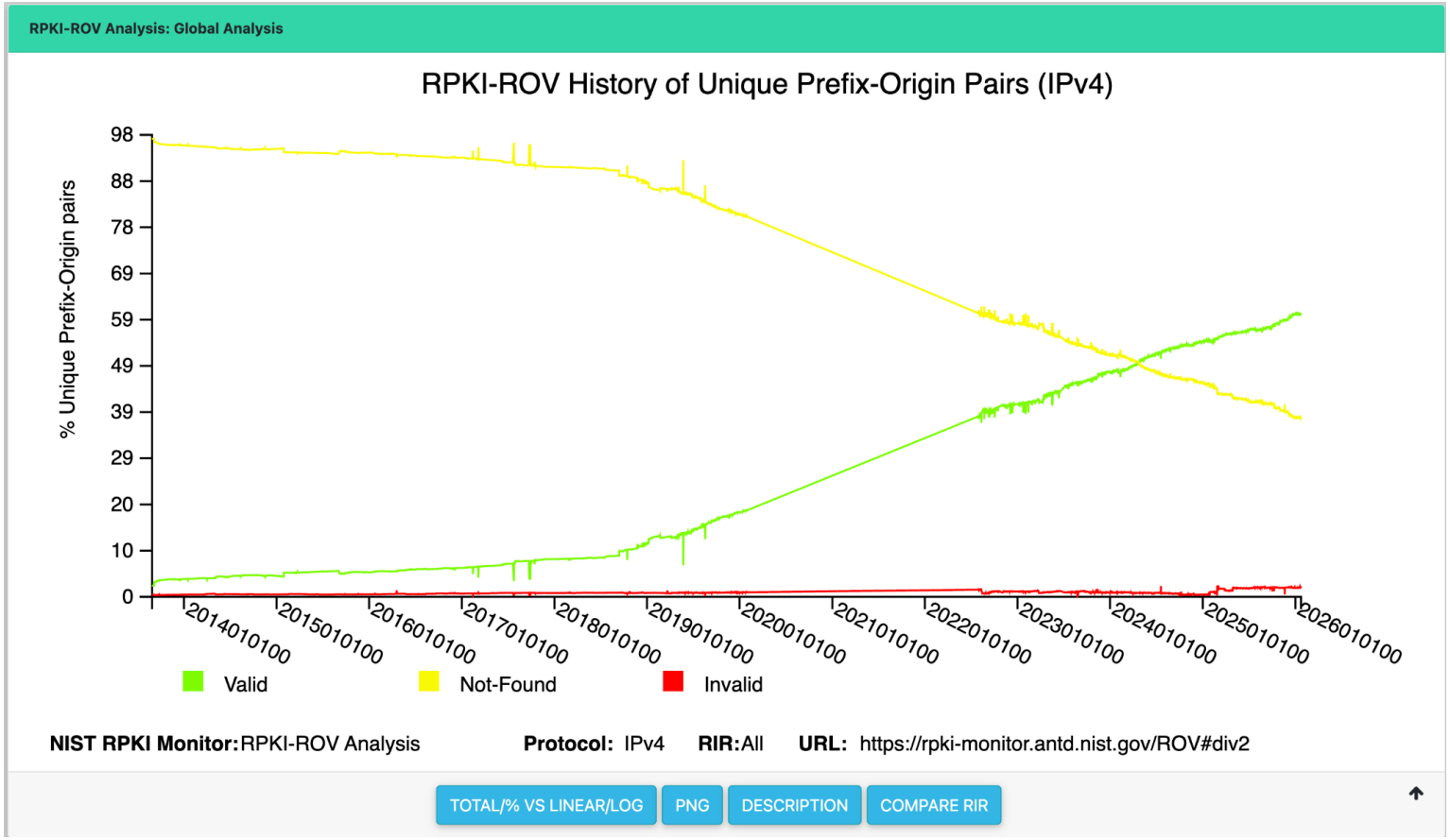
Active% BGP% entries% %(FIB%)



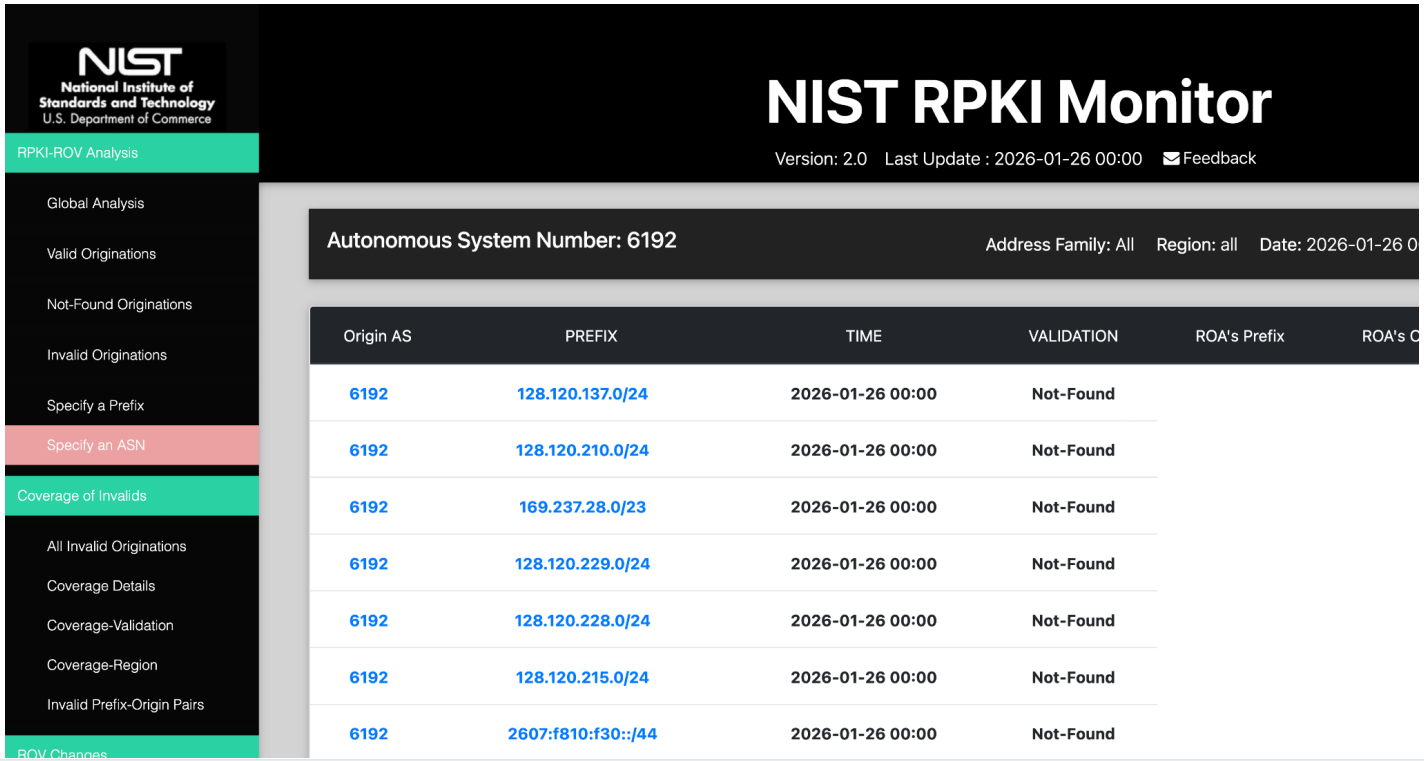
RPKI Observability



RPKI Observability

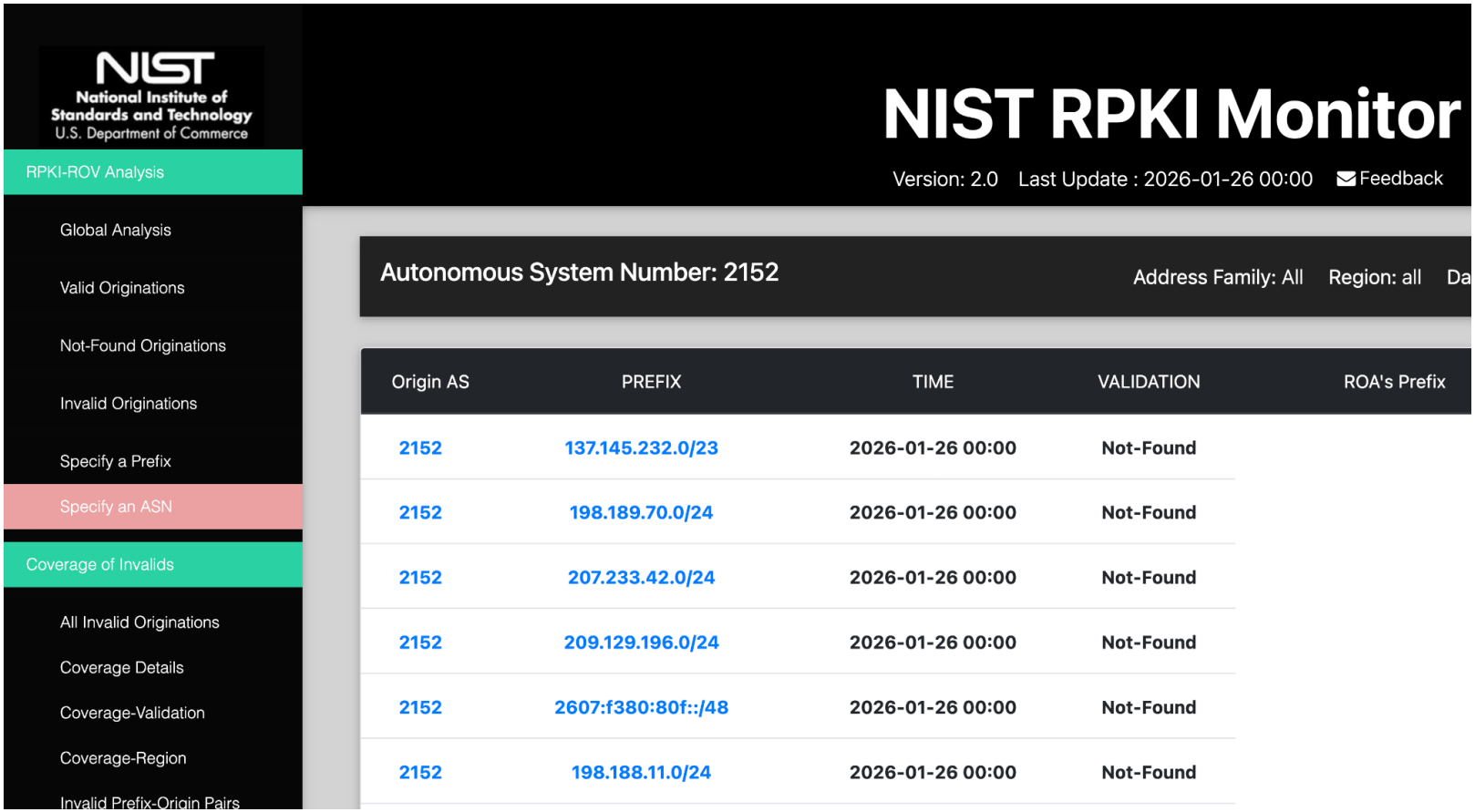


RPKI Observability

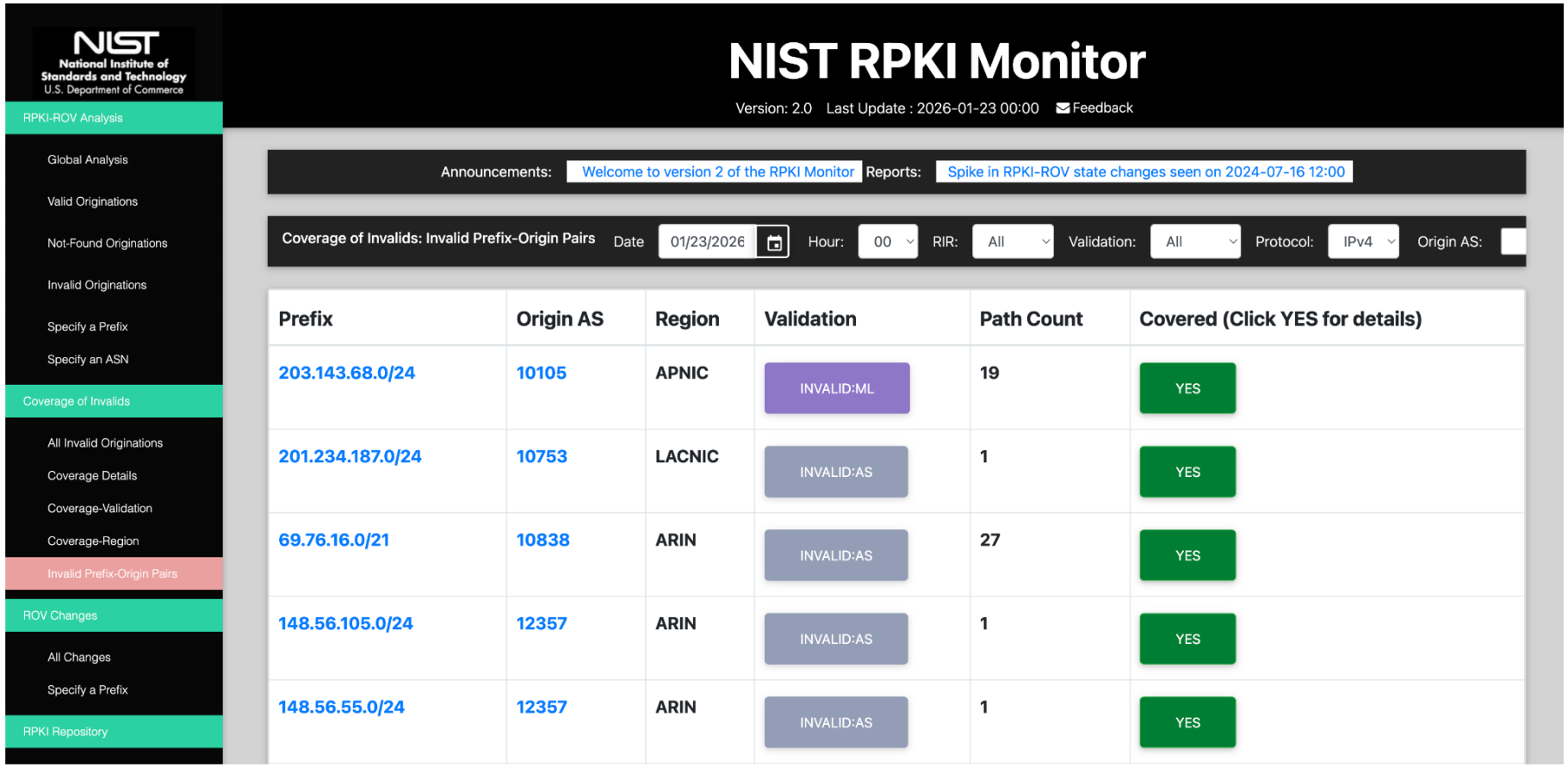


6192	169.237.5.0/24	2026-01-26 00:00	Not-Found

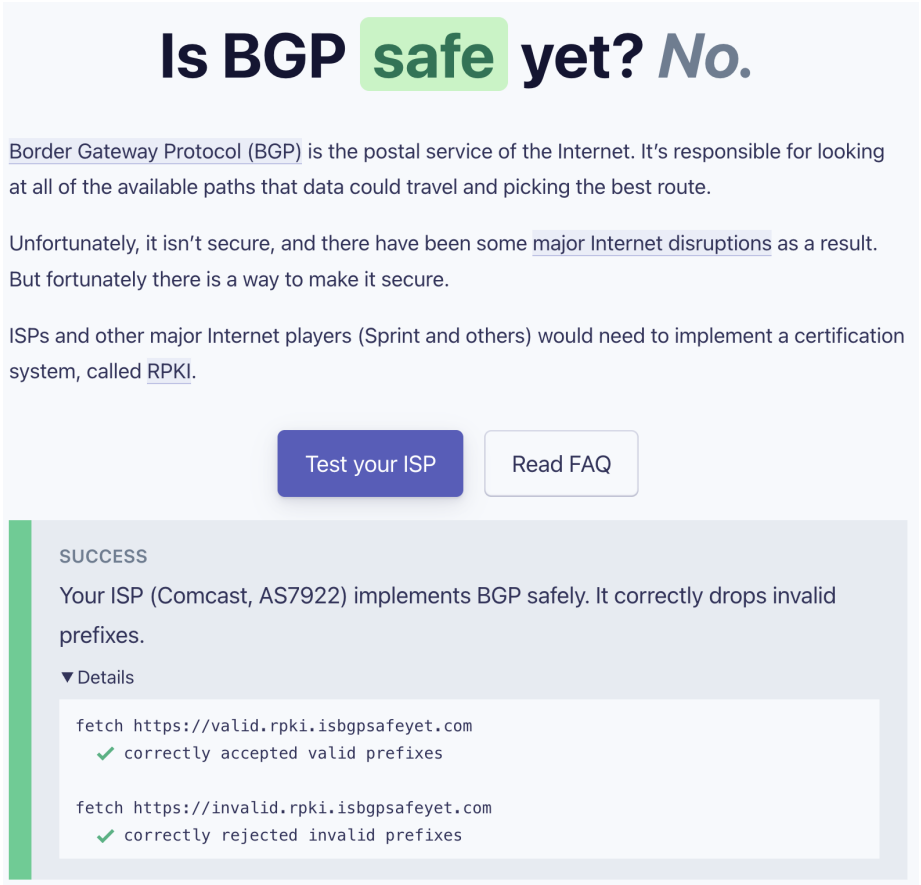
RPKI Observability



RPKI Observability



RPKI Observability



RPKI Observability

```
medill:~ aatac$ dig +short valid.rpki.isbgpsafeyet.com
valid.rpki.cloudflare.com.
104.17.231.6
104.17.230.6
medill:~ aatac$ dig +short invalid.rpki.isbgpsafeyet.com
invalid.rpki.cloudflare.com.
103.21.244.8
103.21.244.9
```

RPKI Observability

Comcast

EXPORT

Organization	Comcast Cable Communications, LLC
Also Known As	Comcast Backbone - 7922
Long Name	
Company Website	https://corporate.comcast.com/
ASN	7922
IRR as-set/route-set	RADB::AS-COMCAST-IBONE
Route Server URL	ssh://rviewsxr@route-server.newyork.ny.ibone.comcast.net

RPKI Observability

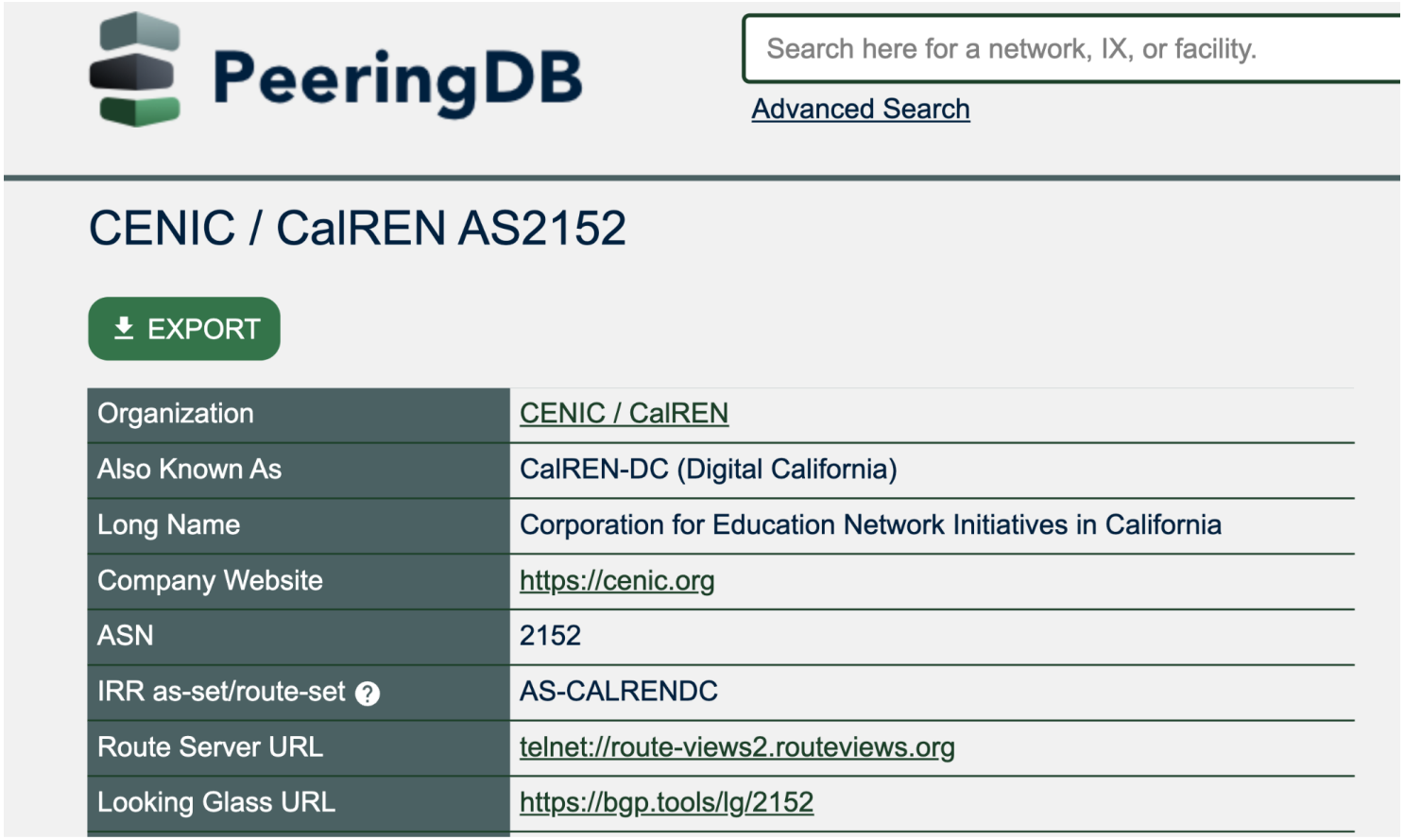
```
Login with username: rviewsxr

Location:   New York City
Network:  Comcast Route Server
**************************************************************************

rviewsxr@route-server.newyork.ny.ibone.comcast.net's password:


RP/0/RSP0/CPU0:route-server.newyork.ny.ibone#sh ip bgp 104.17.231.6
Fri Jan 23 15:34:18.245 utc
BGP routing table entry for 104.17.224.0/20
Versions:
  Process           bRIB/RIB  SendTblVer
  Speaker          321970030   321970030
Last Modified: May 10 16:23:57.588 for 36w5d
Paths: (1 available, best #1)
  Not advertised to any peer
  Path #1: Received by speaker 0
  Not advertised to any peer
  13335, (aggregated by 13335 10.34.2.204), (received & used)
    66.208.229.9 from 66.208.229.9 (96.109.22.243)
      Origin IGP, metric 0, localpref 300, valid, internal, best, group-best
      Received Path ID 0, Local Path ID 0, version 321970030
      Community: 7922:403 7922:888 7922:2900
      Originator: 96.109.22.243, Cluster list: 96.109.22.250, 96.109.22.50
RP/0/RSP0/CPU0:route-server.newyork.ny.ibone#sh ip bgp 103.21.244.8
Fri Jan 23 15:34:25.589 utc
% Network not in table
```

RPKI Observability



RPKI Observability

CENIC - CalREN

AS Number **2152**

BGP

Select BGP Session to query:

All Sessions

Input Prefix:

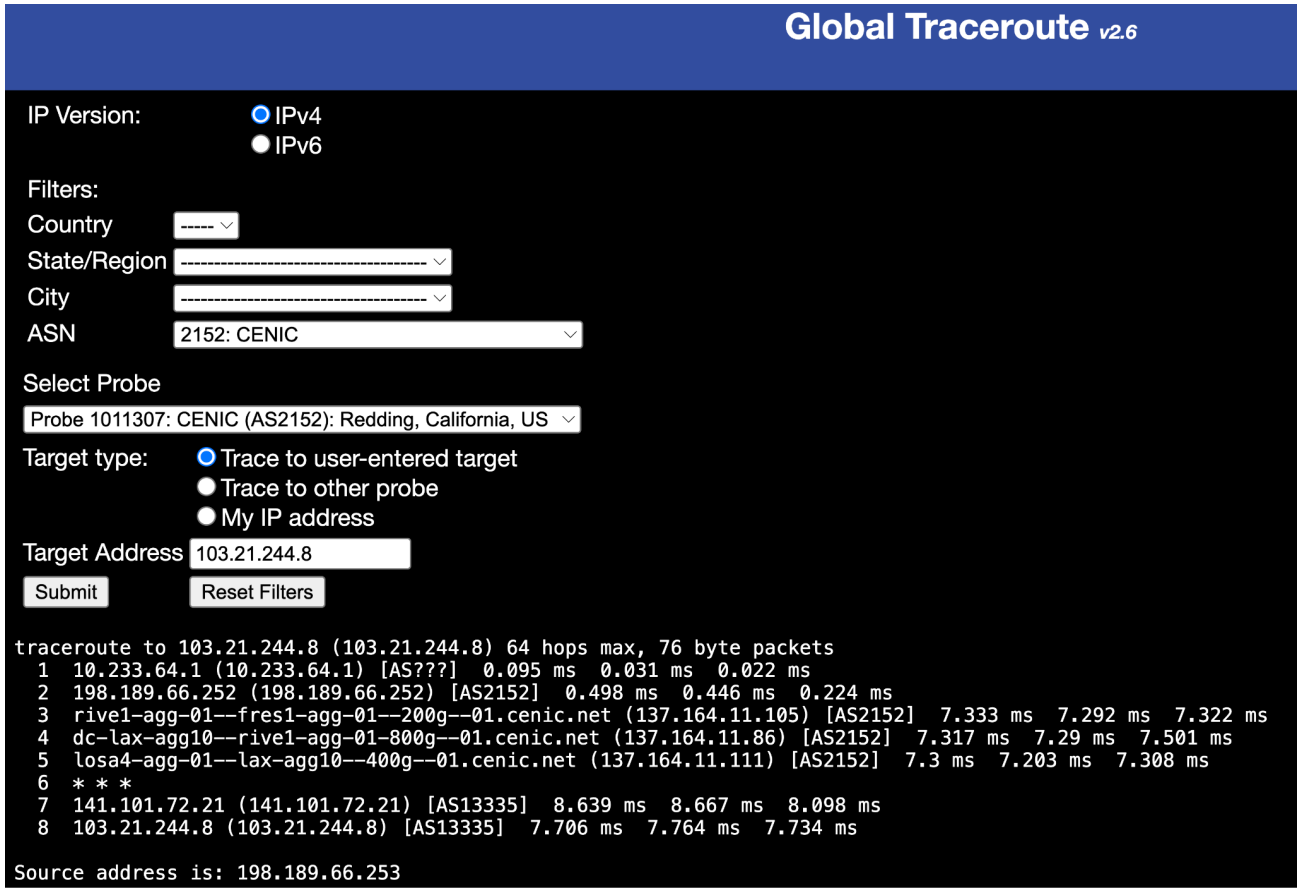
103.21.244.8

-

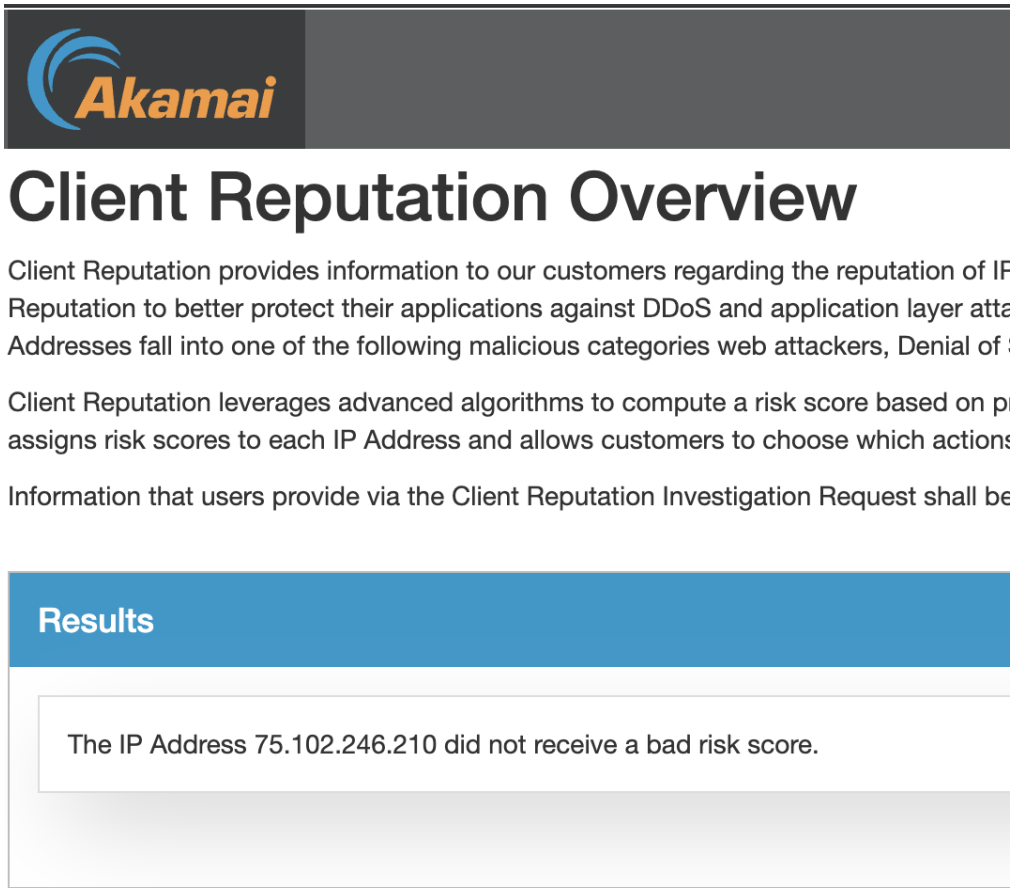
Query

```
103.21.244.0/24      unicast [Los Angeles 0000-00-00] * (?/-) [AS13335]
 Type: BGP
 BGP.as_path: 2152 13335
 BGP.community: [AS2152: Originally learned via a commodity peer] [AS2152: Originally
learned in LAX]
 BGP.large_community: (13335, 10000012, 0)
                      unicast [Sunnyvale 0000-00-00] * (?/-) [AS13335]
 Type: BGP
 BGP.as_path: 2152 13335
 BGP.community: [AS2152: Originally learned via a commodity peer] [AS2152: Originally
learned in SVL]
 BGP.large_community: (13335, 10000004, 0)
```

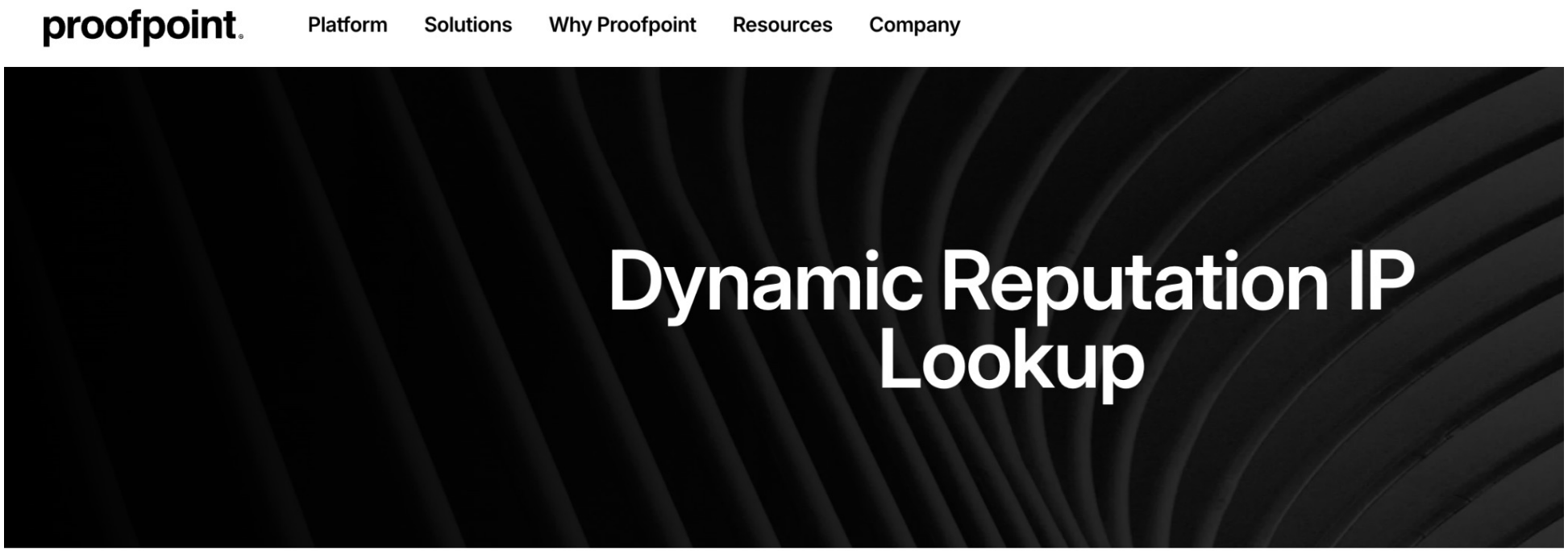
RPKI Observability



Reputation & Location



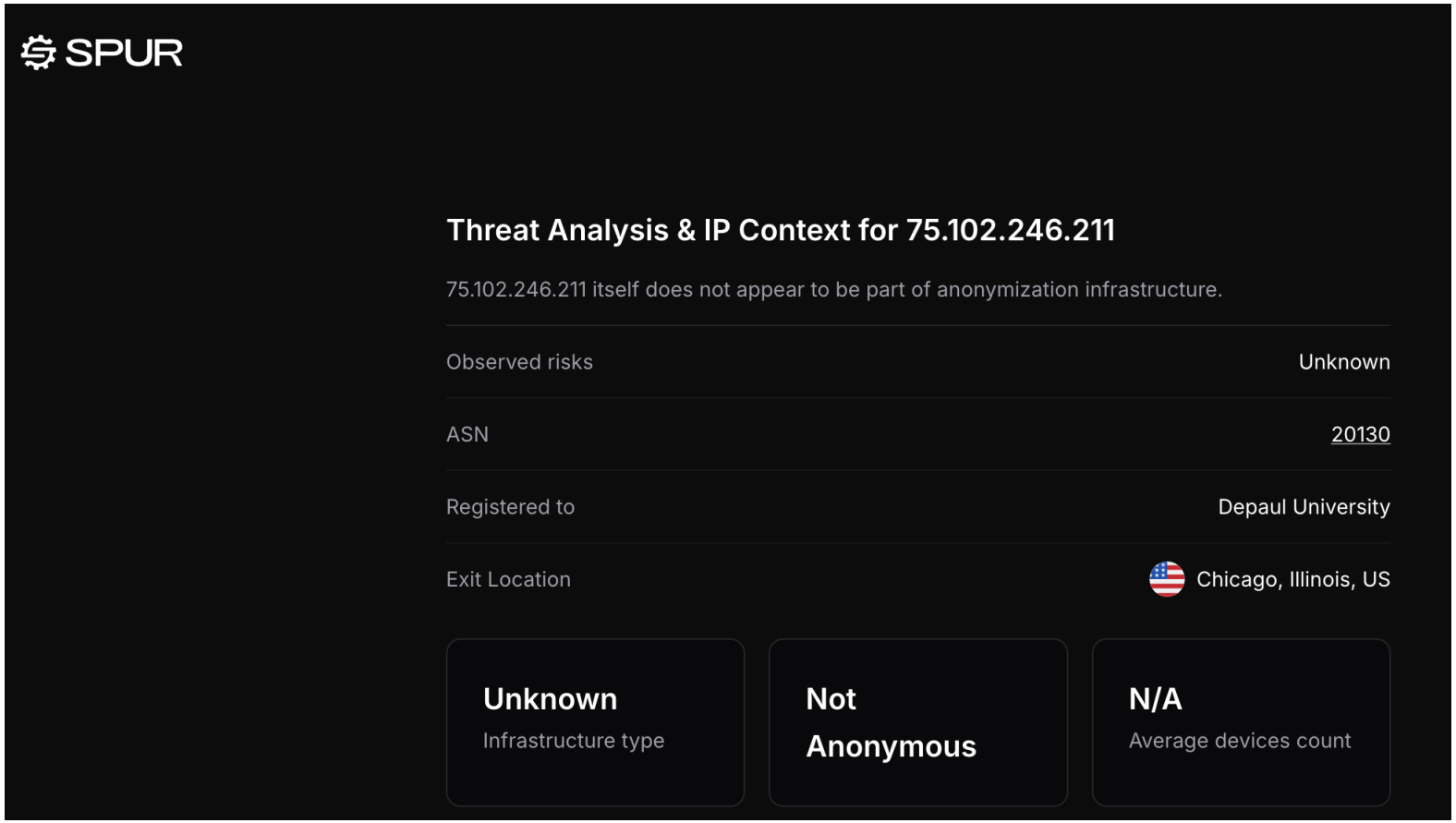
Reputation & Location



Not Blocked

This IP address is not blocked.

Reputation & Location



Reputation & Location

Geolocate much?

RFC9092/RFC9632 gives to the network operator the power to control the geolocation of its IP resources.

It works by linking geofeed files in whois. This allows geolocation databases and content providers to automatically discover the geofeed files and to import them from a format they are already familiar with. It can be used to set the geolocation of entire prefixes or specific IPs.

It works by simply editing a text file. No need to open tickets or send emails.

At the moment there are 575131 prefixes with geofeeds.

READ MORE | TEST YOUR GEOFEED

Adoption

Name	File format	Auto-discovery v4	Auto-discovery v6	Reactivity	Share
Fastah	✓	✓	✓	1 day	
IPInfo.io	✓	✓	✓	1 day	
IPData.co	✓	✓	✓	2 days	
IPGeolocation.io	✓	✓	✓	2 days	
ipapi.co	✓	✓	✓	2 days	
IPRegistry.co	✓	✓	✓	3 days	
BigDataCloud	✓	✓	✓	4 days	
apiip	✓	✓	✓	4 days	
db-ip	✓	✓	✓	9 days	
IPWhois	✓	✓	✓	10 days	
MaxMind	✓	✓	✓	15 days	
WhoisXMLAPI	✓	?	?	N/A	
IP2Location	✓	✗	✗	N/A	
IPStack.com	?	✗	✗	N/A	

Rows per page: 100 1–14 of 14

Report wrong data I Add my provider to the list

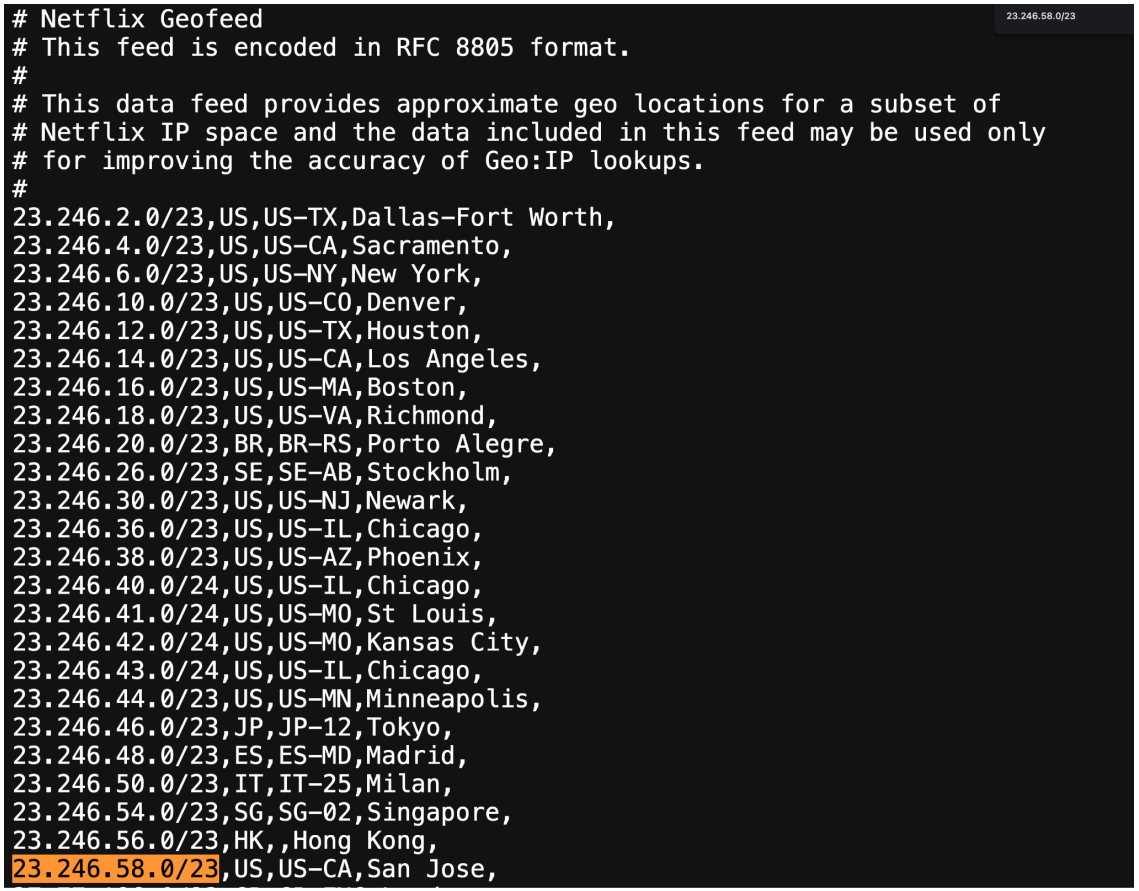
Last update: 2026-01-26

Reputation & Location

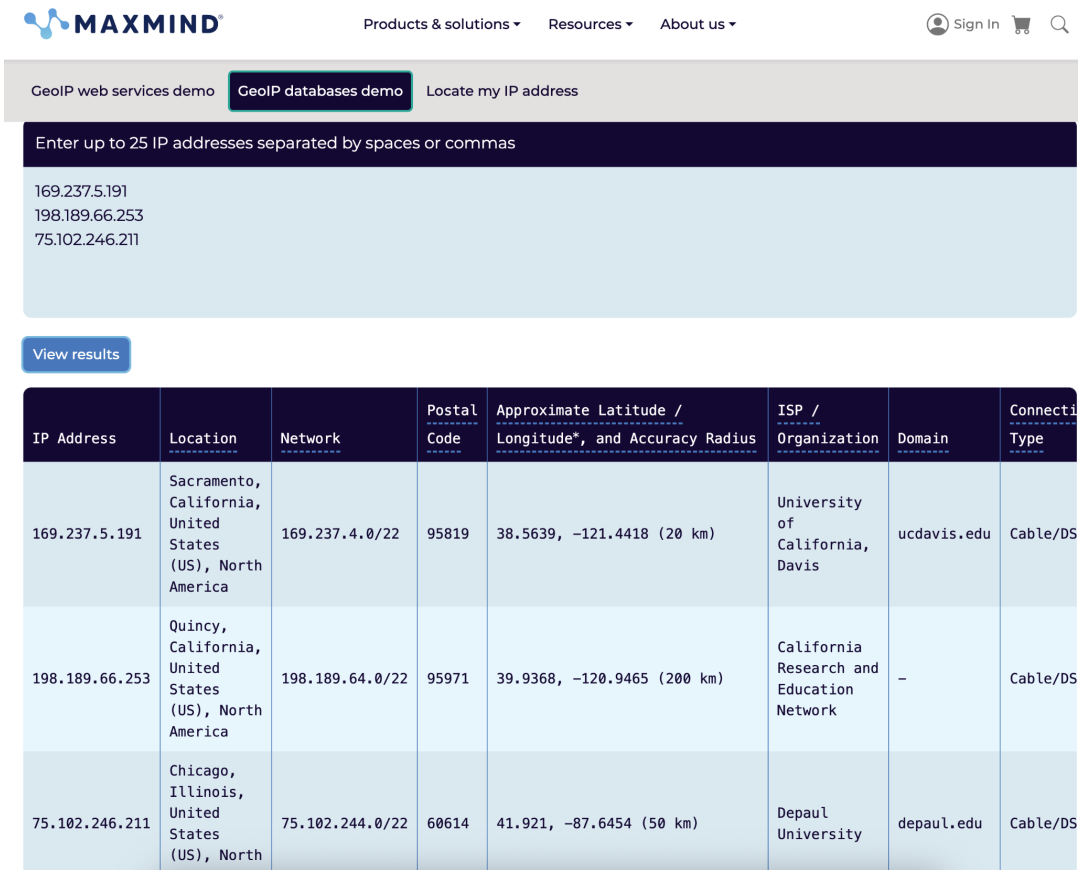
```
# whois.arin.net

NetRange:       23.246.0.0 - 23.246.63.255
CIDR:           23.246.0.0/18
NetName:        NETFLIX-SS-3
NetHandle:      NET-23-246-0-0-1
Parent:         NET23 (NET-23-0-0-0-0)
NetType:        Direct Allocation
OriginAS:
Organization:   Netflix Streaming Services Inc. (SS-144)
RegDate:        2013-10-30
Updated:        2023-08-21
Comment:        Geofeed https://raw.githubusercontent.com/Netflix/nflx-geofeed/main/geofeed.csv
Ref:            https://rdap.arin.net/registry/ip/23.246.0.0
```

Reputation & Location

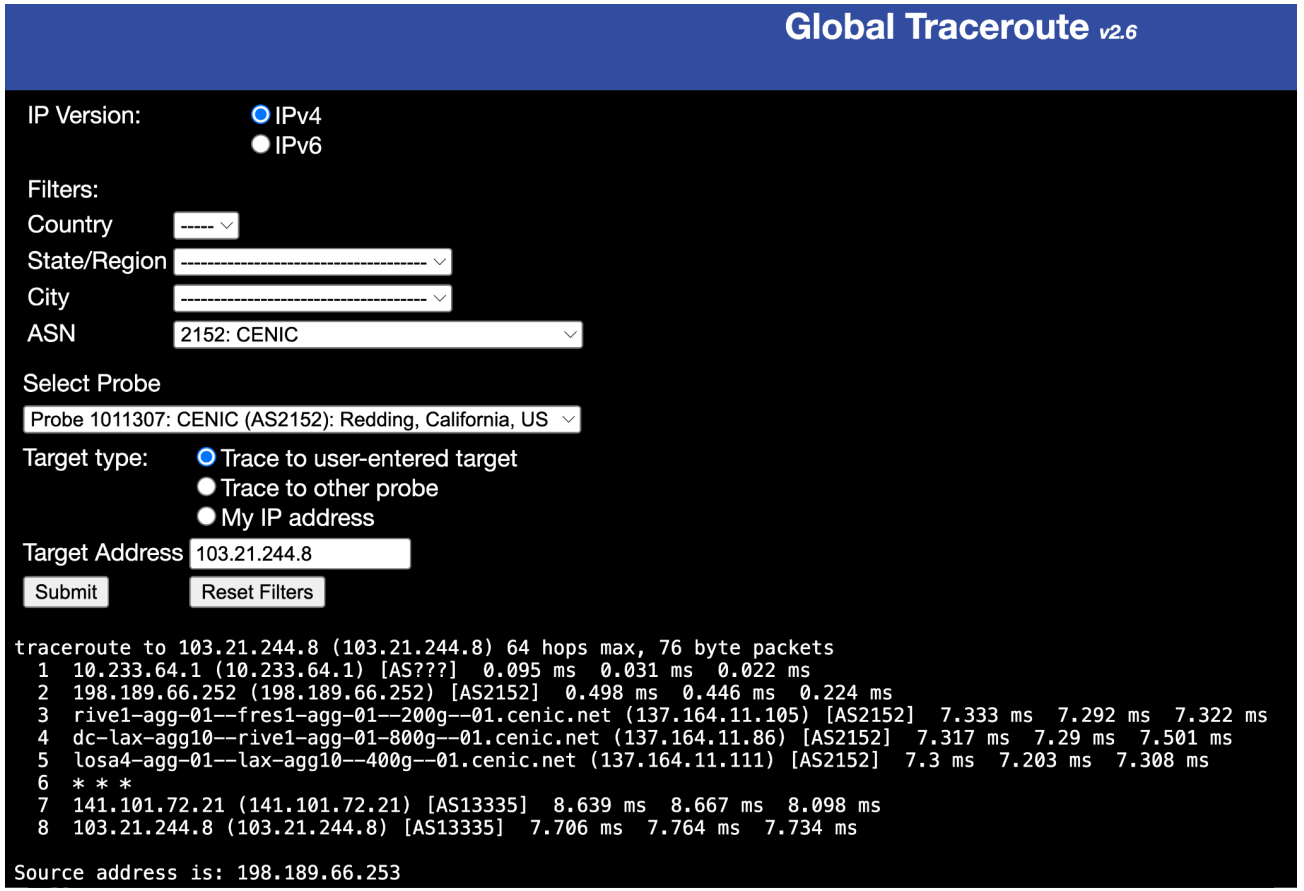


Reputation & Location



IP Address	Location	Network	Postal Code	Approximate Latitude / Longitude*, and Accuracy Radius	ISP / Organization	Domain	Connecti Type
169.237.5.191	Sacramento, California, United States (US), North America	169.237.4.0/22	95819	38.5639, -121.4418 (20 km)	University of California, Davis	ucdavis.edu	Cable/DS
198.189.66.253	Quincy, California, United States (US), North America	198.189.64.0/22	95971	39.9368, -120.9465 (200 km)	California Research and Education Network	-	Cable/DS
75.102.246.211	Chicago, Illinois, United States (US), North	75.102.244.0/22	60614	41.921, -87.6454 (50 km)	Depaul University	depaul.edu	Cable/DS

Reputation & Location



Thank You!

Questions?

NANOG™