

# The Internet Routing Table using RouteViews

Philip Smith <pfs@routeviews.org>  
mnNOG6, Ulaanbaatar  
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# Background

- **RouteViews was first started in 1995**
- Now a growing network of 40+ collectors positioned strategically at Internet Exchange Points around the world
- RouteViews collaborates with the Center for Applied Internet Data Analysis (CAIDA) working with NSF grants that support Designing a Global Measurement Infrastructure to Improve Internet Security, GMI3S ([OAC-2131987](#)), and an Integrated Library for Advancing Network Data Science, ILANDS ([CNS-2120399](#)).
- RouteViews is supported with financial and in-kind donations by multiple organizations
- **RouteViews is based at the University of Oregon and operated by NSRC**
- NSRC supports the growth of global Internet infrastructure by providing engineering assistance, collaborative technical workshops, training, and other resources to university, research & education networks worldwide.
- NSRC is partially funded by the IRNC program of the NSF ([OAC-2029309](#)) and Google with other contributions from public and private organizations.
- The University of Oregon is a public research institution in Eugene, Oregon, USA founded in 1876.



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# RouteViews Team Members

Hans Kuhn



Nina Bargisen



Owen Conway



Philip Smith



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# What is RouteViews

- A tool that allows Internet network operators to look at the BGP table from different backbones and locations around the world to troubleshoot and to assess:
  - Reachability, hijacks, bugs, peer visibility, mass withdrawals, RPKI status,...
- Operators who find it a valuable tool also peer to contribute to the value
- RouteViews operates collectors strategically positioned at IXPs around the world.
  - It also hosts a few multi-hop collectors at UO for those operators who are not present at IXPs.



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# RouteViews Collector Map

<http://www.routeviews.org/routeviews/index.php/map/>

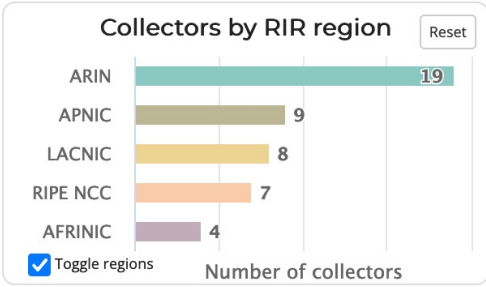
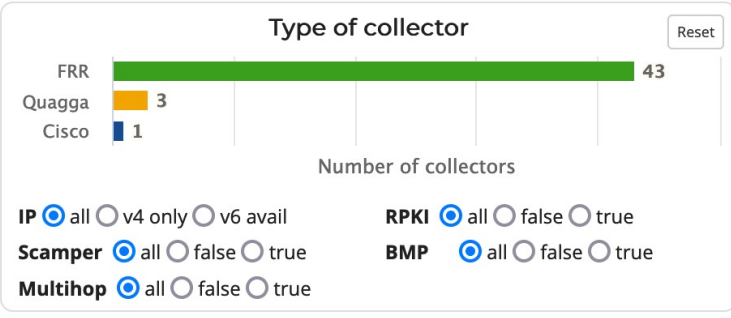


Map filter **Peers by region** Peer count RIB count

Search collectors by name or IP   Maintain filters during search

**47**  
of 47 collectors  
visible

**Installed date**  
From:   
To:



Interactive map created by UO InfoGraphics Lab  
Powered by CARTO | HighCharts | Leaflet



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# RouteViews News

- Collectors:
  - The majority use FRR<sup>1</sup> (either version 9.1 or 10)
  - One Cisco ASR1004 and one (still) using Quagga
  - Moving collectors from metal to VMs (easier deployment & management)
- Location update:
  - Recent additions include KINX, CIX-ATL, PacWave LAX, Iraq IX, PIT Mexico & Santiago, DE-CIX Johor Bahru
  - Several new locations offered; resources required to fulfil those offers

<sup>1</sup>FRRouting Project: <https://frrouting.org/>



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# RouteViews Development Projects

- API
  - Allow programmatic access to live RouteViews data
  - (our collectors currently allow **telnet** access, which 1000s of automated scripts hammer on a daily basis)
- LookingGlass
  - **telnet** access is unsustainable
  - Aim to making LookingGlass default access for each collector
    - **telnet** will remain available on one collector for legacy
- BMP
  - Live feed from collectors for BGP data consumers



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# RouteViews Behind the Scenes Projects

- Months of ongoing effort:
  - Upgrading archive infrastructure and storage
    - RouteViews stores BGP data from 1997 – around 50 Tbytes (compressed)
  - Tooling
    - Automation tools for managing the whole infrastructure and deploying new peers
  - Collector OS (from CentOS to Ubuntu)
    - CentOS end-of-life – half the collectors still running CentOS
  - FRR performance
    - Standardising on two latest releases, upgrading from old releases
    - “Badly behaving peers” (aka slow peers)



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# RouteViews Future Planning

- Collectors & hosts in new locations outside North America
  - Large IXPs with dense interconnection
  - Unique or specialist environments (eg R&E exchanges)
- Scalable and diverse archiving
- Improved community support
  - Running this infrastructure costs money!
  - We hugely appreciate our generous supporters
    - <https://www.routeviews.org/routeviews/index.php/supporters/>
- Your suggestions are very welcome! 🙏



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# Using RouteViews

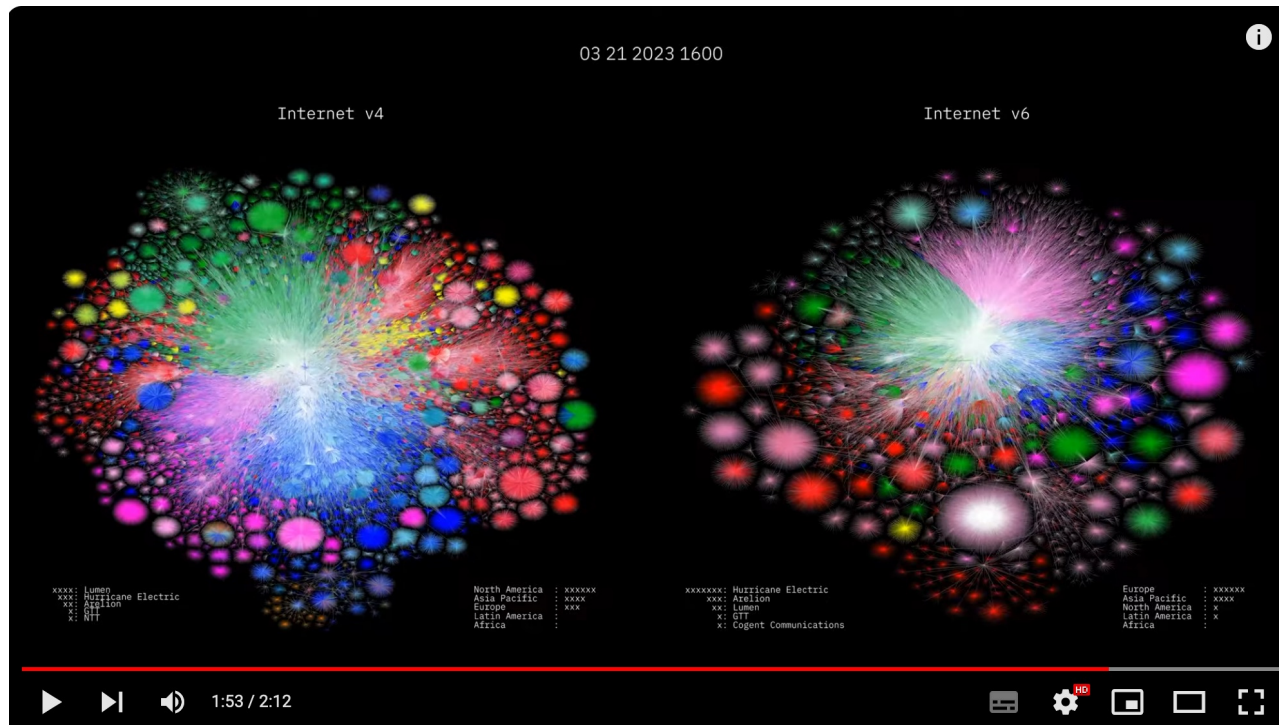
- Network Operators use the live data to analyse how their routes appear on the Global Routing System
- Researchers use the 27-year-old data archive to study trends, route hijacks, and changes such as:
  - Origin change
  - Next-hop change
  - New prefix / more specifics
  - New neighbours
  - Operator ASN appearing in a new transit path
  - Bogons



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# RouteViews Impact



Barrett Lyon:

<https://www.youtube.com/watch?v=vo5gIK9czIE>



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# Use Cases – Multihop Collector

```
route-views2.routeviews.org> sh bgp sum
```

32 peers, multi-hop

```
IPv4 Unicast Summary (VRF default):  
BGP router identifier 128.223.51.102, local AS number 6447 vrf-id 0  
BGP table version 2376140  
RIB entries 1842070, using 169 MiB of memory  
Peers 32, using 644 KiB of memory
```

Lots of full tables

| Neighbor        | V | AS    | MsgRcvd | MsgSent | TblVer  | InQ | OutQ | Up/Down  | State/PfxRcd | PfxSnt | Desc               |
|-----------------|---|-------|---------|---------|---------|-----|------|----------|--------------|--------|--------------------|
| 12.0.1.63       | 4 | 7018  | 278377  | 377     | 2376140 | 0   | 0    | 06:14:18 | 938553       | 0      | ATT                |
| 37.139.139.17   | 4 | 57866 | 281167  | 751     | 2376140 | 0   | 0    | 06:14:18 | 941733       | 0      | Fusix              |
| 45.61.0.85      | 4 | 22652 | 430462  | 754     | 2376140 | 0   | 0    | 05:30:45 | 943602       | 0      | FIBRENOIRE         |
| 62.115.128.137  | 4 | 1299  | 1145666 | 377     | 2376140 | 0   | 0    | 06:14:18 | 919817       | 0      | Telia              |
| 64.71.137.241   | 4 | 6939  | 222621  | 376     | 2376140 | 0   | 0    | 06:14:18 | 961672       | 0      | Hurricane Electric |
| 77.39.192.30    | 4 | 20912 | 199676  | 2247    | 2376140 | 0   | 0    | 06:14:18 | 942334       | 0      | PANSERVICE         |
| 87.121.64.4     | 4 | 57463 | 124693  | 375     | 2376140 | 0   | 0    | 06:13:35 | 483102       | 0      | NETIXLTD           |
| 89.149.178.10   | 4 | 3257  | 301777  | 377     | 2376140 | 0   | 0    | 06:14:18 | 939075       | 0      | Tiscali            |
| 91.218.184.60   | 4 | 49788 | 280255  | 376     | 2376140 | 0   | 0    | 06:14:18 | 943183       | 0      | NEXTHOPNO          |
| 94.156.252.18   | 4 | 34224 | 365615  | 376     | 2376140 | 0   | 0    | 06:14:17 | 965856       | 0      | NETERRA            |
| 105.16.0.247    | 4 | 37100 | 304500  | 746     | 2376140 | 0   | 0    | 06:11:16 | 942394       | 0      | SEACOM             |
| 129.250.1.71    | 4 | 2914  | 267752  | 751     | 2376140 | 0   | 0    | 06:14:18 | 939523       | 0      | NTT-A              |
| 137.164.16.84   | 4 | 2152  | 219827  | 376     | 2376140 | 0   | 0    | 06:14:18 | 941035       | 0      | CENIC              |
| 140.192.8.16    | 4 | 20130 | 247609  | 751     | 2376140 | 0   | 0    | 06:14:18 | 964417       | 0      | DEPAULEDU          |
| 144.228.241.130 | 4 | 1239  | 4442    | 377     | 2376140 | 0   | 0    | 06:14:17 | 45863        | 0      | Sprint             |
| 147.28.7.1      | 4 | 3130  | 421     | 376     | 2376140 | 0   | 0    | 06:14:18 | 14           | 0      | RGnet, LLC         |



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# Use Cases – Weird Announcements

```
route-views7.routeviews.org> sh ip bgp 45.181.4.0/24
BGP routing table entry for 45.181.4.0/24, version 54948963
Paths: (8 available, best #2, table default)
  Not advertised to any peer
```

```
...
924 835 16735 53062 262698 269289
 185.121.168.42 from 185.121.168.42 (10.20.30.40)
  Origin IGP, valid, external, best (Older Path), rpki validation-state: not found
  Community: 835:11103 924:90 924:601 924:690 16735:111 16735:7000 16735:7203 16735:53062 24115:16735 24115:24115 24115:65023
 53062:10020 53062:10021 53062:30004 53062:30007 53062:30009 53062:30011 53062:30013 53062:30045 53062:30049 53062:30058
 53062:30091 53062:30092 53062:30105 53062:30114 53062:30115 53062:30117 53062:30122 53062:30130 53062:30136 53062:30152
 53062:30156 53062:30161 53062:30168 53062:30182 53062:30183 53062:30184 53062:30185 53062:30186 53062:30187 53062:30188
 53062:30191 53062:30198 53062:30200 53062:30203 53062:30208 53062:30217 53062:30222 53062:30228 53062:30232 53062:30235
 53062:30239 53062:30244 53062:30250 53062:30255 53062:30263 53062:30274 53062:30278 53062:30287 53062:30291 53062:30296
 53062:30301 53062:30305 53062:30317 53062:30328 53062:30344 53062:30355 53062:30357 53062:30369
  Large Community: 924:1:90 924:600:90 924:601:101 24115:1000:2 24115:1001:1 24115:1002:1 24115:1003:26 24115:1004:16735
 53062:11:3692 53062:12:81 53062:13:48
  Last update: Thu Jun 20 04:03:53 2024
37989 18106 263444 262316 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289
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 203.123.48.6 from 203.123.48.6 (203.123.48.6)
  Origin IGP, valid, external, rpki validation-state: not found
  Community: 13538:2000
  Last update: Sun Jun 16 10:17:30 2024
```

What is AS53062 trying to achieve with all these communities??

What is AS269289 trying to achieve by prepending 101 times??



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# Use Cases – Invalid ROAs

```
route-views.phoix.routeviews.org> sh ip bgp rpki invalid
BGP table version is 14686437, local router ID is 198.32.172.137, vrf id 0
Default local pref 100, local AS 6447
Status codes:  s suppressed, d damped, h history, * valid, > best, = multipath,
                i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found
```

|     | Network       | Next Hop       | Metric | LocPrf | Weight | Path                                |
|-----|---------------|----------------|--------|--------|--------|-------------------------------------|
| I*> | 1.6.168.0/24  | 198.32.172.156 | 0      |        | 0      | 142271 9304 6453 4755 9583 ?        |
| I*> | 1.6.169.0/24  | 198.32.172.156 | 0      |        | 0      | 142271 9304 6453 4755 9583 i        |
| I*> | 1.6.183.0/24  | 198.32.172.156 | 0      |        | 0      | 142271 9304 6453 4755 9583 i        |
| I*> | 1.6.219.0/24  | 198.32.172.156 | 0      |        | 0      | 142271 9304 6453 4755 9583 137130 i |
| I*> | 1.6.247.0/24  | 198.32.172.156 | 0      |        | 0      | 142271 9304 6453 4755 9583 i        |
| I*> | 1.7.178.0/24  | 198.32.172.156 | 0      |        | 0      | 142271 9304 6453 4755 9583 137130 i |
| I*> | 1.7.191.0/24  | 198.32.172.156 | 0      |        | 0      | 142271 9304 6453 4755 9583 137130 i |
| I*> | 1.7.205.0/24  | 198.32.172.156 | 0      |        | 0      | 142271 9304 6453 4755 9583 140202 i |
| I*> | 1.7.228.0/24  | 198.32.172.156 | 0      |        | 0      | 142271 9304 6453 4755 9583 137130 i |
| I*> | 1.44.160.0/23 | 198.32.172.156 | 0      |        | 0      | 142271 9304 7473 7474 ?             |
|     | ...           |                |        |        |        |                                     |



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# Use Cases – Valid ROAs

```
route-views.phoix.routeviews.org> sh ip bgp rpki valid
BGP table version is 14686899, local router ID is 198.32.172.137, vrf id 0
Default local pref 100, local AS 6447
Status codes:  s suppressed, d damped, h history, * valid, > best, = multipath,
                i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

    Network          Next Hop          Metric LocPrf Weight Path
V*> 1.0.0.0/24       198.32.172.170   0 150000 150000 150000 150000 150000 18233 135607 13335 i
V* 1.0.4.0/22       198.32.172.170   0 150000 150000 150000 150000 150000 18233 135607 7545 2764 38803 i
V*>                 198.32.172.156   0                0 142271 135607 7545 2764 38803 i
V* 1.0.5.0/24       198.32.172.170   0 150000 150000 150000 150000 150000 18233 135607 7545 2764 38803 i
V*>                 198.32.172.156   0                0 142271 135607 7545 2764 38803 i
V* 1.0.64.0/18      198.32.172.170   0 150000 150000 150000 150000 150000 18233 135607 174 2497 7670 18144 i
V*>                 198.32.172.156   0                0 142271 174 2519 7670 18144 i
V*> 1.1.1.0/24       198.32.172.170   0 150000 150000 150000 150000 150000 18233 135607 13335 i
V* 1.6.0.0/22       198.32.172.170   0 150000 150000 150000 150000 150000 18233 135607 9583 i
V*>                 198.32.172.156   0                0 142271 135607 9583 i
V* 1.6.1.0/24       198.32.172.170   0 150000 150000 150000 150000 150000 18233 135607 9583 i
V*>                 198.32.172.156   0                0 142271 135607 9583 i
V* 1.6.2.0/24       198.32.172.170   0 150000 150000 150000 150000 150000 18233 135607 9583 i
V*>                 198.32.172.156   0                0 142271 135607 9583 i
...
```



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# Routing Table Analysis – Motivation

- 1998: No one was publishing any Internet routing table analysis
  - Only CIDR-Report reporting on top 20 contributors to routing table, and top 20 bad aggregators
- With support of APNIC, my weekly report started in February 1999
  - <https://thyme.apnic.net>
  - Started recording global IPv6 table in September 2010
- With NSRC support, started recording the global R&E table in May 2021
  - <https://bgp.nsrc.org/REN>
- Weekly reports from these record:
  - Routing table size
  - CIDR-Report style reporting on a per-RIR basis
  - ...and many other interesting features



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## IPv4 Routing Report 29<sup>th</sup> September 2024

|   |            |
|---|------------|
| BGP routing table entries examined:                           | 961066     |
| Prefixes after maximum aggregation (per Origin AS):           | 366248     |
| Deaggregation factor:   | 2.62       |
| Unique aggregates announced (without unneeded subnets):       | 467048     |
| Number of IPv4 prefixes with a valid ROA:                     | 404399     |
| Number of IPv4 prefixes with an invalid ROA:                  | 1096       |
| Number of IPv4 prefixes with no ROA:                          | 555571     |
| Total ASes present in the Internet Routing Table:             | 76228      |
| Prefixes per ASN:   | 12.61      |
| Origin-only ASes present in the Internet Routing Table:       | 65287      |
| Origin ASes announcing only one prefix:                       | 26834      |
| Transit ASes present in the Internet Routing Table:           | 10941      |
| Transit-only ASes present in the Internet Routing Table:      | 534        |
| Average AS path length visible in the Internet Routing Table: | 5.3        |
| Max AS path length visible:                                   | 84         |
| Max AS path prepend of ASN (152107)                           | 80         |
| Prefixes from unregistered ASNs in the Routing Table:         | 975        |
| Number of instances of unregistered ASNs:                     | 991        |
| Special use prefixes present in the Routing Table:            | 1          |
| Prefixes being announced from unallocated address space:      | 527        |
| Number of addresses announced to Internet:                    | 3032175872 |
| Equivalent to 180 /8s, 187 /16s and 85 /24s                   |            |
| Total number of prefixes smaller than registry allocations:   | 314371     |

## Global per AS IPv4 prefix count summary

| ASN   | No of nets | /20 equiv | Max Agg | Description                                      |
|-------|------------|-----------|---------|--|
| 8151  | 11549      | 3244      | 501     | UNINET, MX                                       |
| 16509 | 10814      | 11831     | 3814    | AMAZON-02, US                                    |
| 9808  | 10059      | 8751      | 74      | CHINAMOBILE-CN China Mobile Communications Group |
| 12479 | 7628       | 1708      | 145     | UNI2-AS, ES                                      |
| 7545  | 5832       | 840       | 658     | TPG-INTERNET-AP TPG Telecom Limited, AU          |
| 4538  | 4933       | 4192      | 74      | ERX-CERNET-BKB China Education and Research Netw |
| 11492 | 4631       | 308       | 556     | CABLEONE, US                                     |
| 39891 | 4602       | 278       | 58      | ALJAWWALSTC-AS, SA                               |
| 18403 | 4399       | 347       | 23      | FPT-AS-AP FPT Telecom Company, VN                |
| 7155  | 4169       | 287       | 89      | VIASAT-SP-BACKBONE, US                           |
| 7552  | 3990       | 1331      | 25      | VIETEL-AS-AP Viettel Group, VN                   |
| 174   | 3863       | 8771      | 901     | COGENT-174, US                                   |
| 20940 | 3824       | 3395      | 129     | AKAMAI-ASN1, NL                                  |
| 9498  | 3808       | 509       | 263     | BBIL-AP BHARTI Airtel Ltd., IN                   |
| 9009  | 3684       | 315       | 1870    | M247, RO   |
| 7713  | 3651       | 1044      | 66      | TELKOMNET-AS-AP PT Telekomunikasi Indonesia, ID  |
| 6327  | 3601       | 1320      | 79      | SHAW, CA   |
| 749   | 3485       | 55081     | 2708    | DNIC-AS-00749, US                                |
| 10620 | 3451       | 479       | 1048    | Telmex Colombia S.A., CO                         |
| 22773 | 3426       | 3035      | 188     | ASN-CXA-ALL-CCI-22773-RDC, US                    |

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# What about IPv6 ?

## IPv6 Routing Report 29<sup>th</sup> September 2024 (Singapore)

|  |        |
|--|--------|
| BGP routing table entries examined:                      | 204473 |
| Number of IPv6 prefixes with a valid ROA:                | 124057 |
| Number of IPv6 prefixes with an invalid ROA:             | 1282   |
| Number of IPv6 prefixes with no ROA:                     | 79134  |
| Total ASNs present in the IPv6 Routing Table:            | 33422  |
| Average AS path length:                                  | 4.8    |
| Longest AS path:   | 36     |
| Total Origin ASNs present in the IPv6 Routing Table:     | 33104  |
| Paths with bogon ASNs present in the IPv6 Routing Table: | 0      |



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## Global IPv6 per AS prefix count summary (Singapore)

| ASN   | No of Nets | Description  |
|-------|------------|--|
| 11172 | 7139       | Alestra, S. de R.L. de C.V., MX                                  |
| 16509 | 5195       | AMAZON-02, US  |
| 9808  | 5065       | CHINAMOBILE-CN China Mobile Communications Group Co., Ltd., CN   |
| 18403 | 3590       | FPT-AS-AP FPT Telecom Company, VN                                |
| 7552  | 3155       | VIETEL-AS-AP Viettel Group, VN                                   |
| 45609 | 2922       | BHARTI-MOBILITY-AS-AP Bharti Airtel Ltd. AS for GPRS Service, IN |
| 24547 | 2069       | CMNET-V4HEBEI-AS-AP Hebei Mobile Communication Company Limited,  |
| 45271 | 1746       | ICLNET-AS-AP Idea Cellular Limited, IN                           |
| 13335 | 1604       | CLOUDFLARENET, US  |
| 39891 | 1530       | ALJAWWALSTC-AS, SA   |
| 17622 | 1529       | CNCGROUP-GZ China Unicom Guangzhou network, CN                   |
| 38266 | 1529       | VIL-AS-AP Vodafone Idea Ltd, IN                                  |
| 28573 | 1526       | Claro NXT Telecomunicacoes Ltda, BR                              |
| 12479 | 1412       | UNI2-AS, ES  |
| 36183 | 1313       | AKAMAI-AS, US  |
| 17072 | 1285       | TOTAL PLAY TELECOMUNICACIONES SA DE CV, MX                       |
| 32098 | 1253       | TRANSTELCO-INC, US   |
| 22773 | 1217       | ASN-CXA-ALL-CCI-22773-RDC, US                                    |
| 56046 | 1205       | CMNET-JIANGSU-AP China Mobile communications corporation, CN     |
| 6167  | 1199       | CELLCO-PART, US  |

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## Number of IPv4 prefixes announced by prefix length

|          |           |           |           |           |            |            |            |
|----------|-----------|-----------|-----------|-----------|------------|------------|------------|
| /1:0     | /2:0      | /3:0      | /4:0      | /5:0      | /6:0       | /7:0       | /8:16      |
| /9:16    | /10:36    | /11:92    | /12:295   | /13:577   | /14:1171   | /15:2062   | /16:13223  |
| /17:8266 | /18:13755 | /19:24625 | /20:44714 | /21:52138 | /22:111690 | /23:100406 | /24:587259 |
| /25:725  | /26:0     | /27:0     | /28:0     | /29:0     | /30:0      | /31:0      | /32:0      |

29<sup>th</sup> September 2024 ↑

29<sup>th</sup> September 2023 ↓

|          |           |           |           |           |            |           |            |
|----------|-----------|-----------|-----------|-----------|------------|-----------|------------|
| /1:0     | /2:0      | /3:0      | /4:0      | /5:0      | /6:0       | /7:0      | /8:16      |
| /9:14    | /10:39    | /11:101   | /12:297   | /13:578   | /14:1197   | /15:2066  | /16:13503  |
| /17:8307 | /18:13878 | /19:25164 | /20:44345 | /21:51234 | /22:110296 | /23:99117 | /24:559640 |
| /25:739  | /26:0     | /27:0     | /28:0     | /29:0     | /30:0      | /31:0     | /32:0      |



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## Number of IPv6 prefixes announced by prefix length

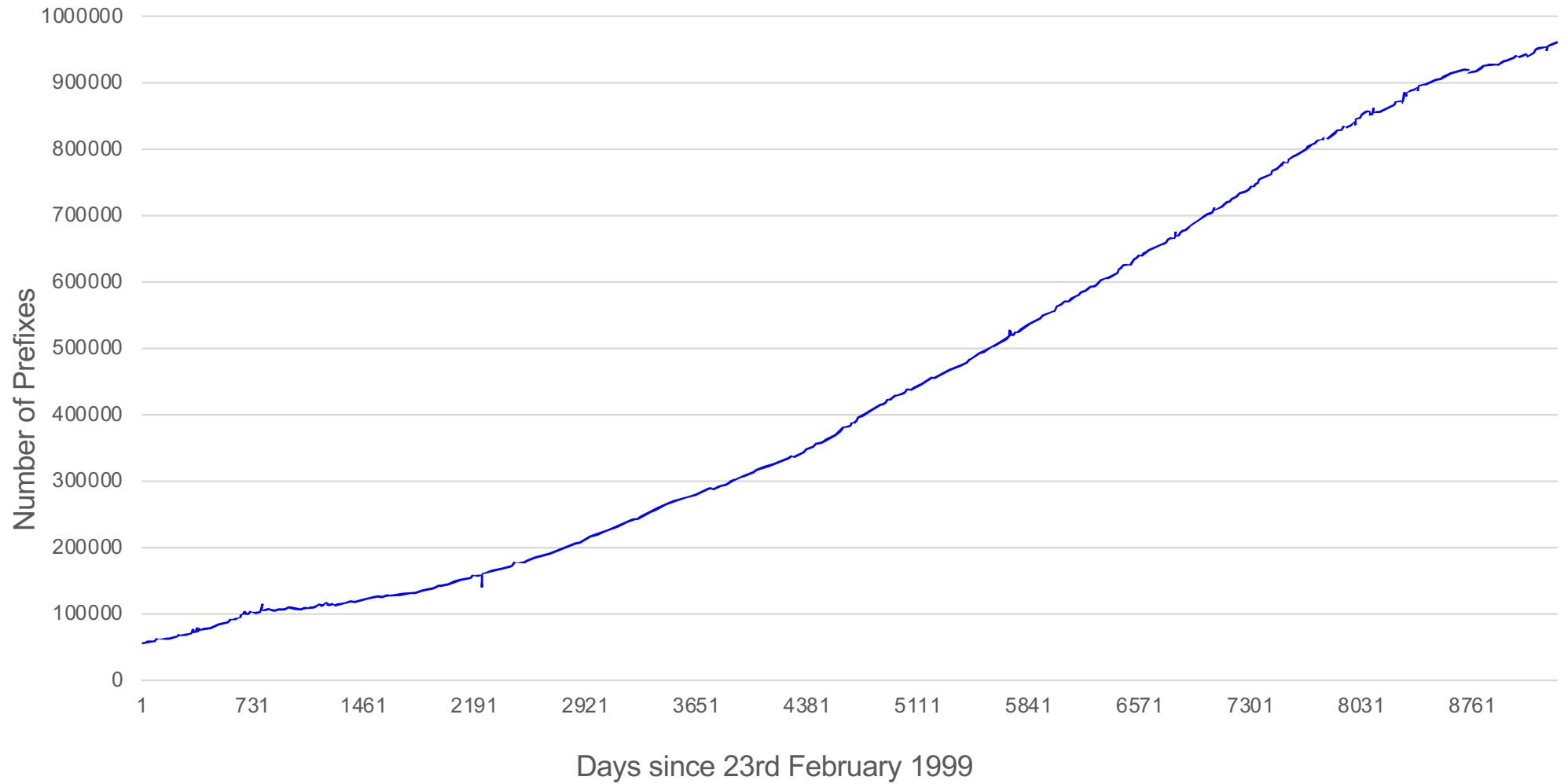
|           |          |          |          |           |          |          |          |
|-----------|----------|----------|----------|-----------|----------|----------|----------|
| /16:1     | /17:0    | /18:0    | /19:1    | /20:14    | /21:3    | /22:6    | /23:8    |
| /24:33    | /25:11   | /26:20   | /27:21   | /28:210   | /29:5270 | /30:597  | /31:336  |
| /32:24841 | /33:3798 | /34:3414 | /35:1183 | /36:7149  | /37:1057 | /38:2077 | /39:1631 |
| /40:17830 | /41:1192 | /42:2349 | /43:1064 | /44:19305 | /45:2627 | /46:4133 | /47:5726 |
| /48:96533 | /49:4    | /50:0    | /51:0    | /52:1     | /53:0    | /54:0    | /55:0    |
| /56:1     | /57:0    | /58:0    | /59:0    | /60:0     | /61:0    | /62:0    | /63:0    |
| /64:12    |          |          |          |           |          |          |          |

29<sup>th</sup> September 2024 ↑

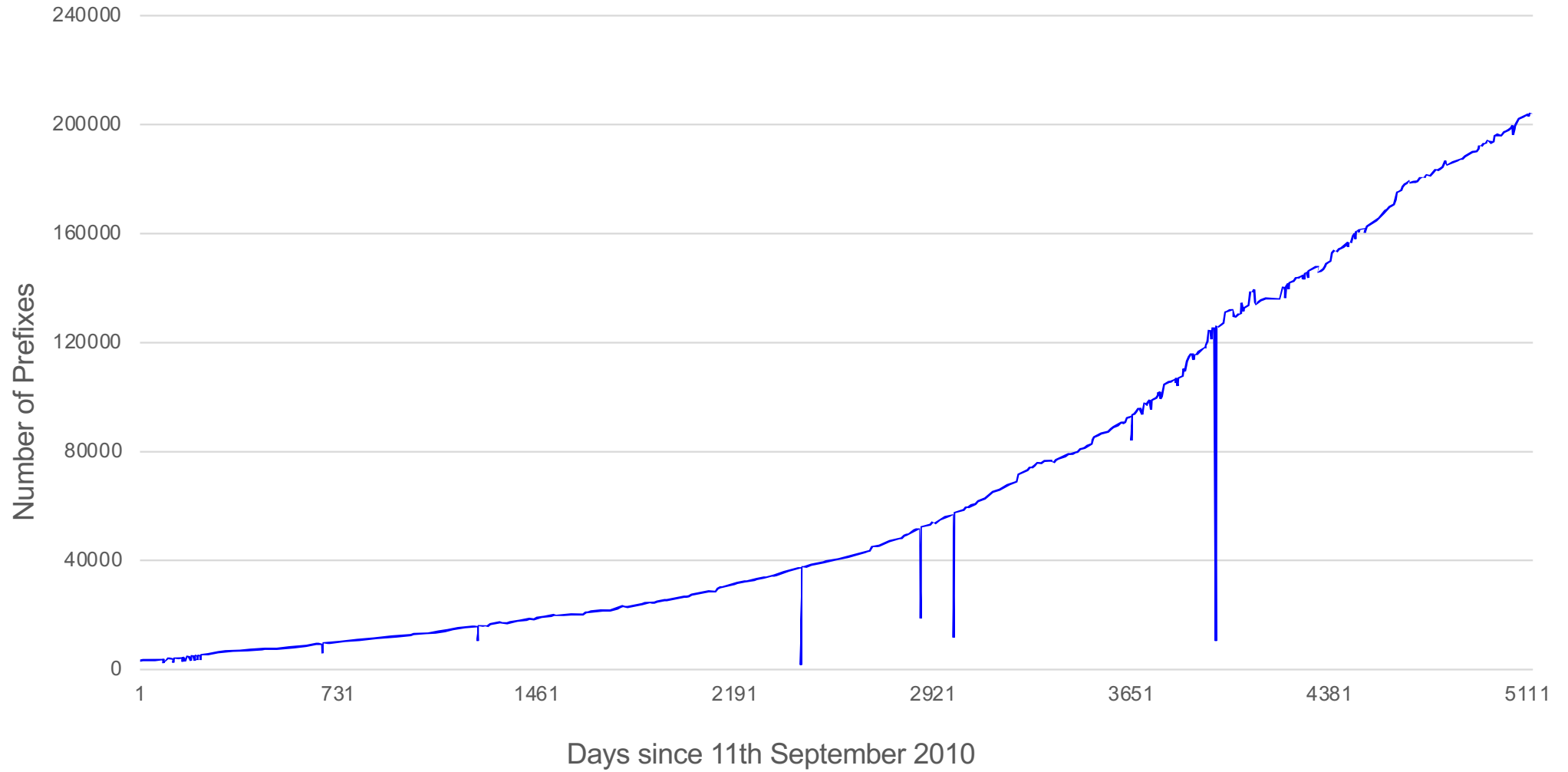
29<sup>th</sup> September 2023 ↓

|           |          |          |          |           |          |          |          |
|-----------|----------|----------|----------|-----------|----------|----------|----------|
| /16:1     | /17:0    | /18:0    | /19:1    | /20:14    | /21:3    | /22:7    | /23:7    |
| /24:32    | /25:8    | /26:16   | /27:20   | /28:208   | /29:4383 | /30:617  | /31:312  |
| /32:23280 | /33:3278 | /34:2811 | /35:1024 | /36:6180  | /37:996  | /38:1789 | /39:1387 |
| /40:14854 | /41:946  | /42:3516 | /43:1099 | /44:16290 | /45:2154 | /46:3291 | /47:4565 |
| /48:87554 | /49:4    | /50:0    | /51:0    | /52:1     | /53:0    | /54:0    | /55:0    |
| /56:1     | /57:0    | /58:0    | /59:0    | /60:0     | /61:0    | /62:0    | /63:0    |
| /64:2     |          |          |          |           |          |          |          |

# Global IPv4 Routing Table

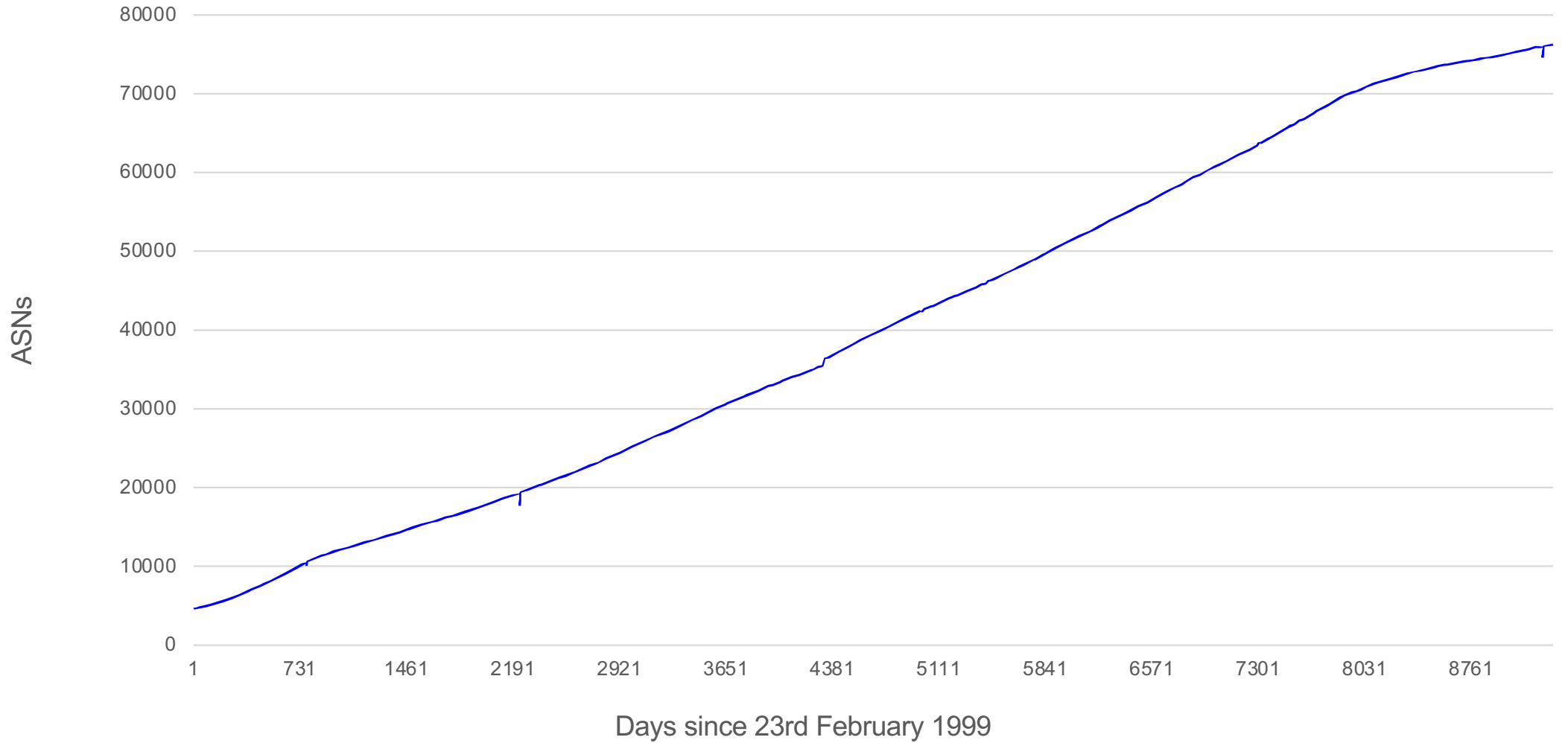


# Global IPv6 Routing Table

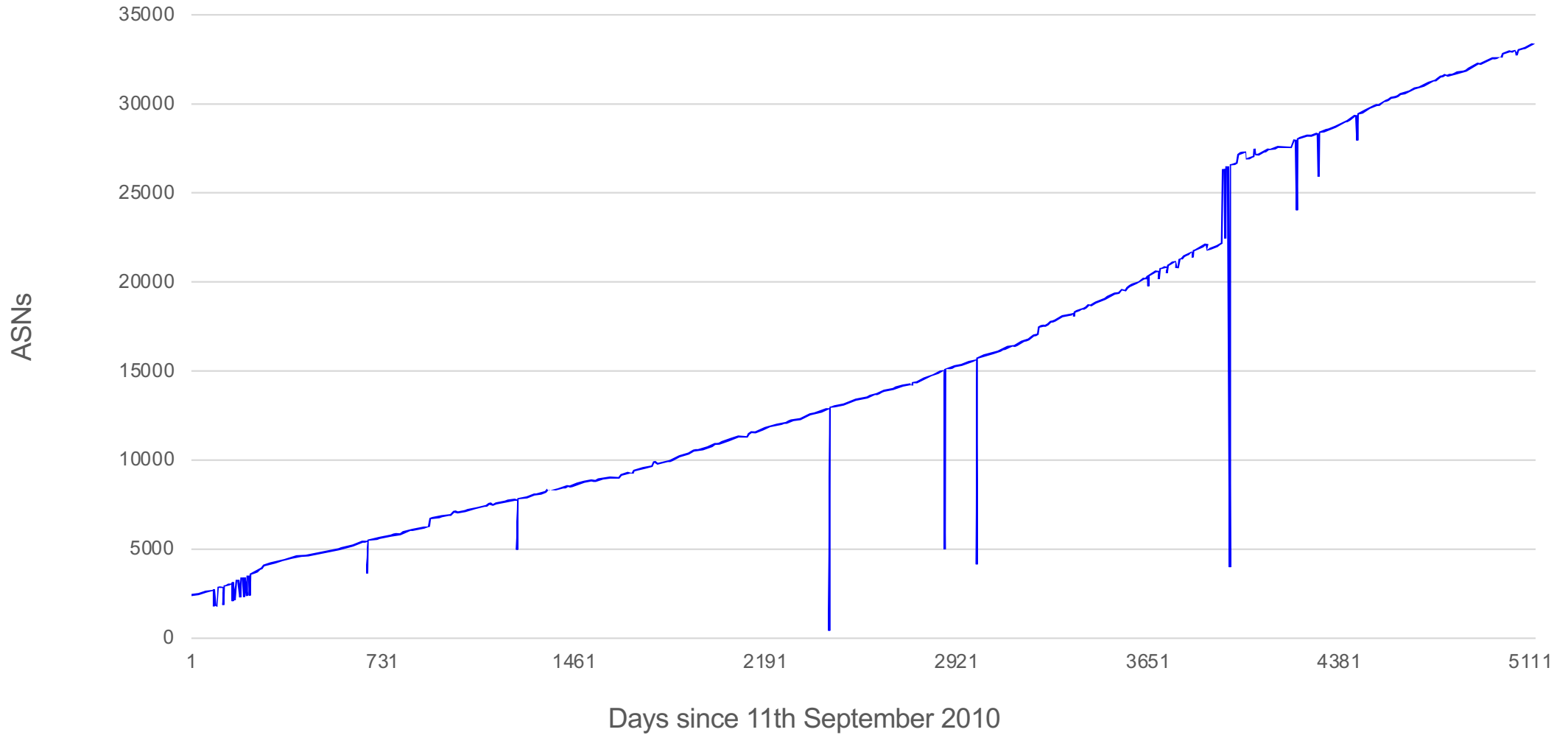




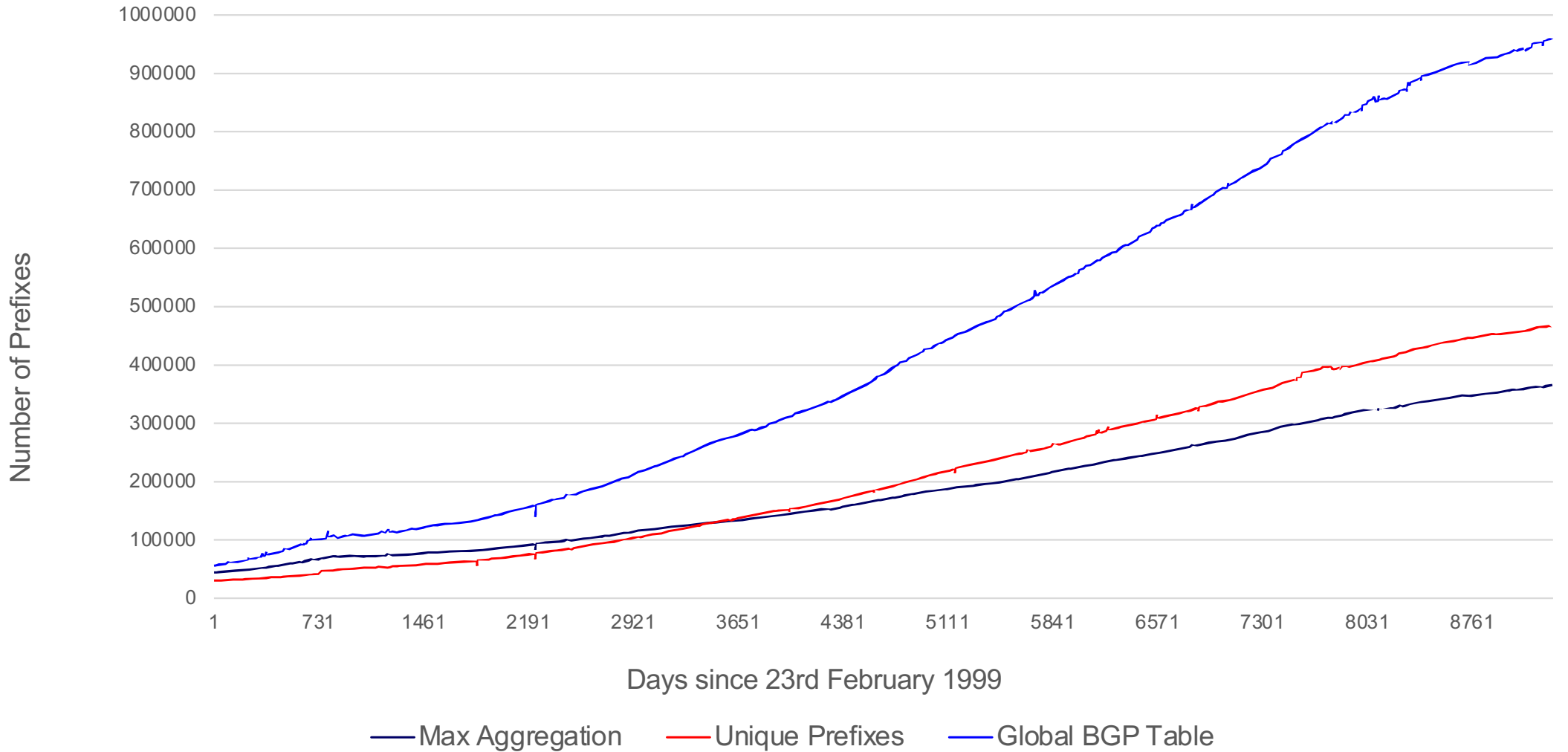
# IPv4 AS Growth



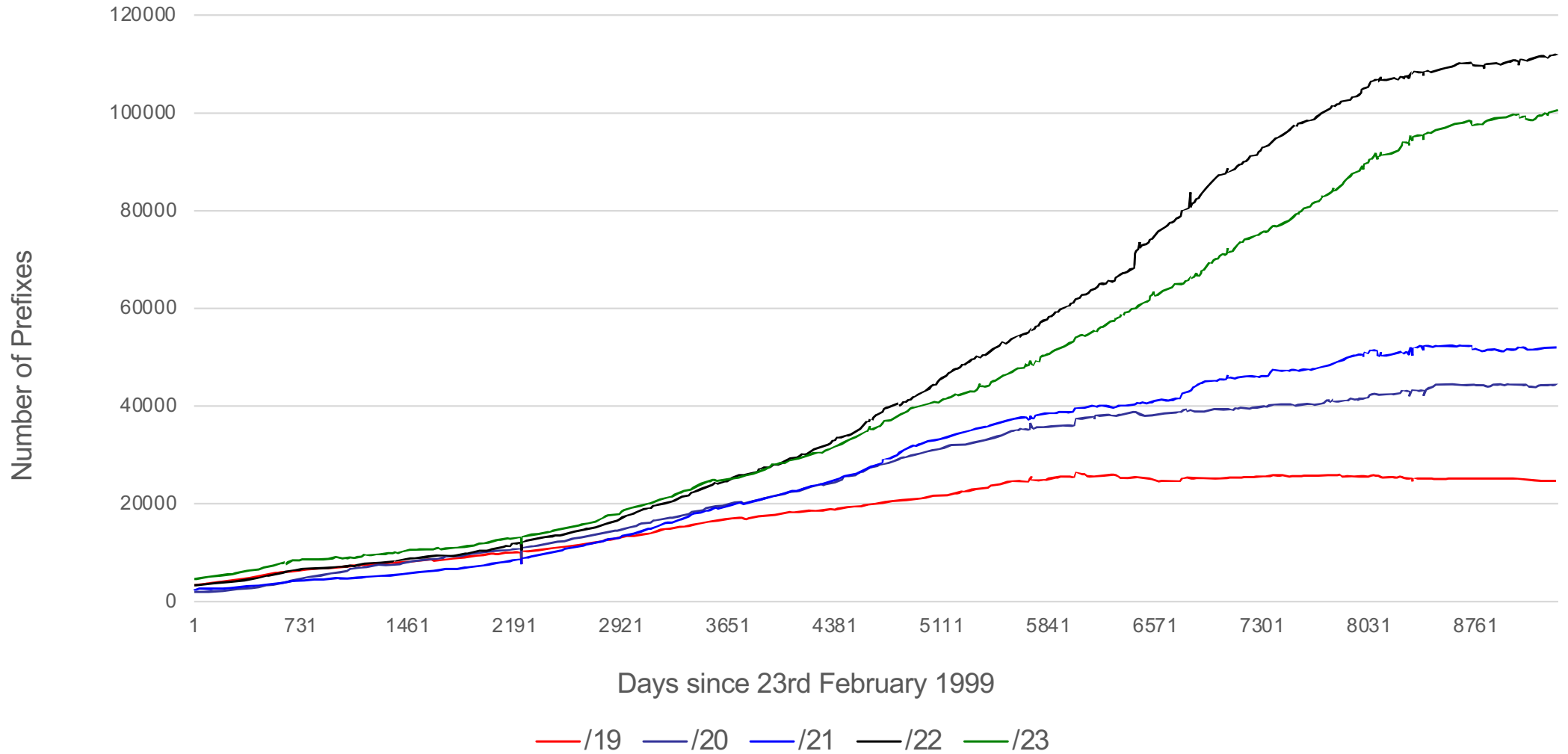
# IPv6 AS Growth



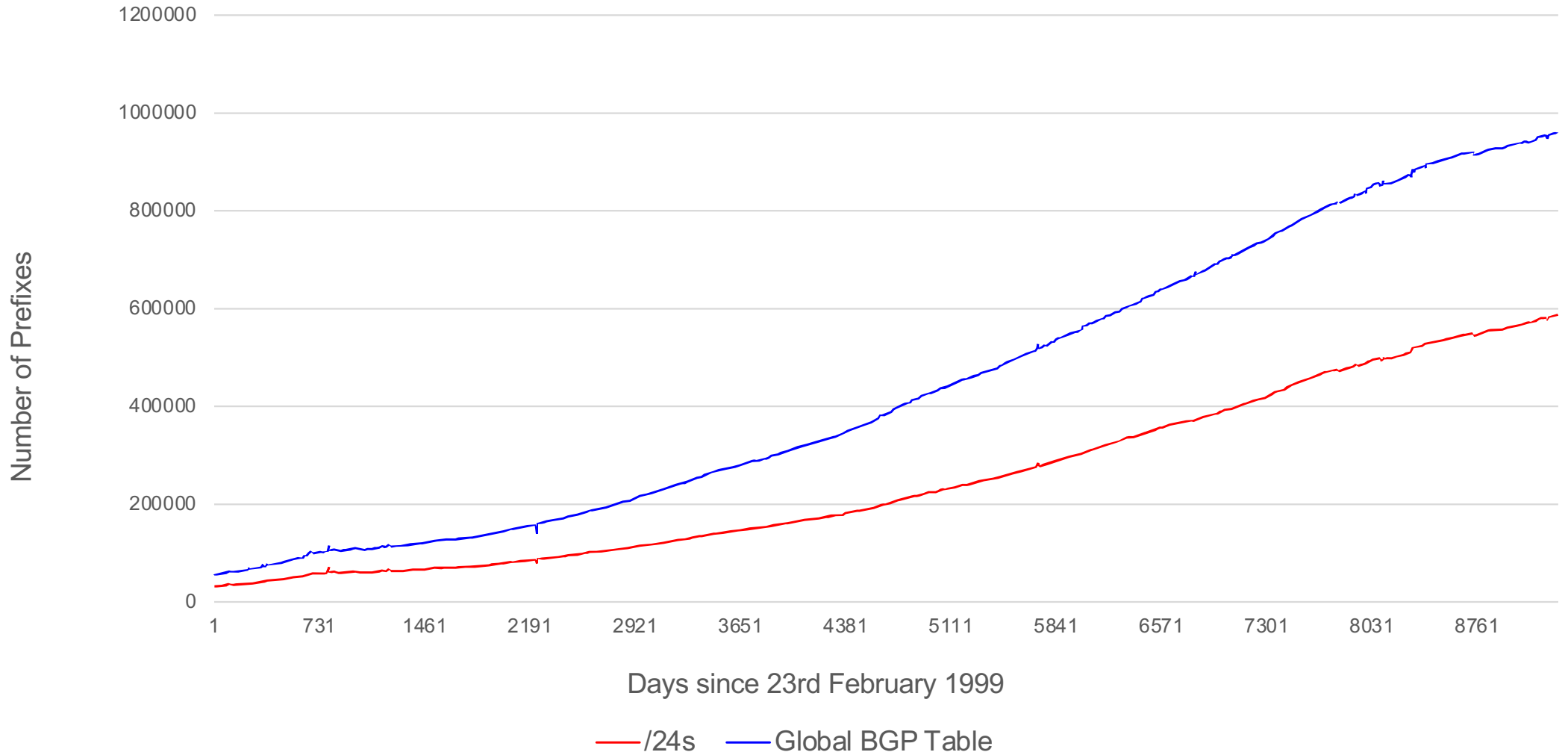
# IPv4 Max Aggregation vs Unique Prefixes



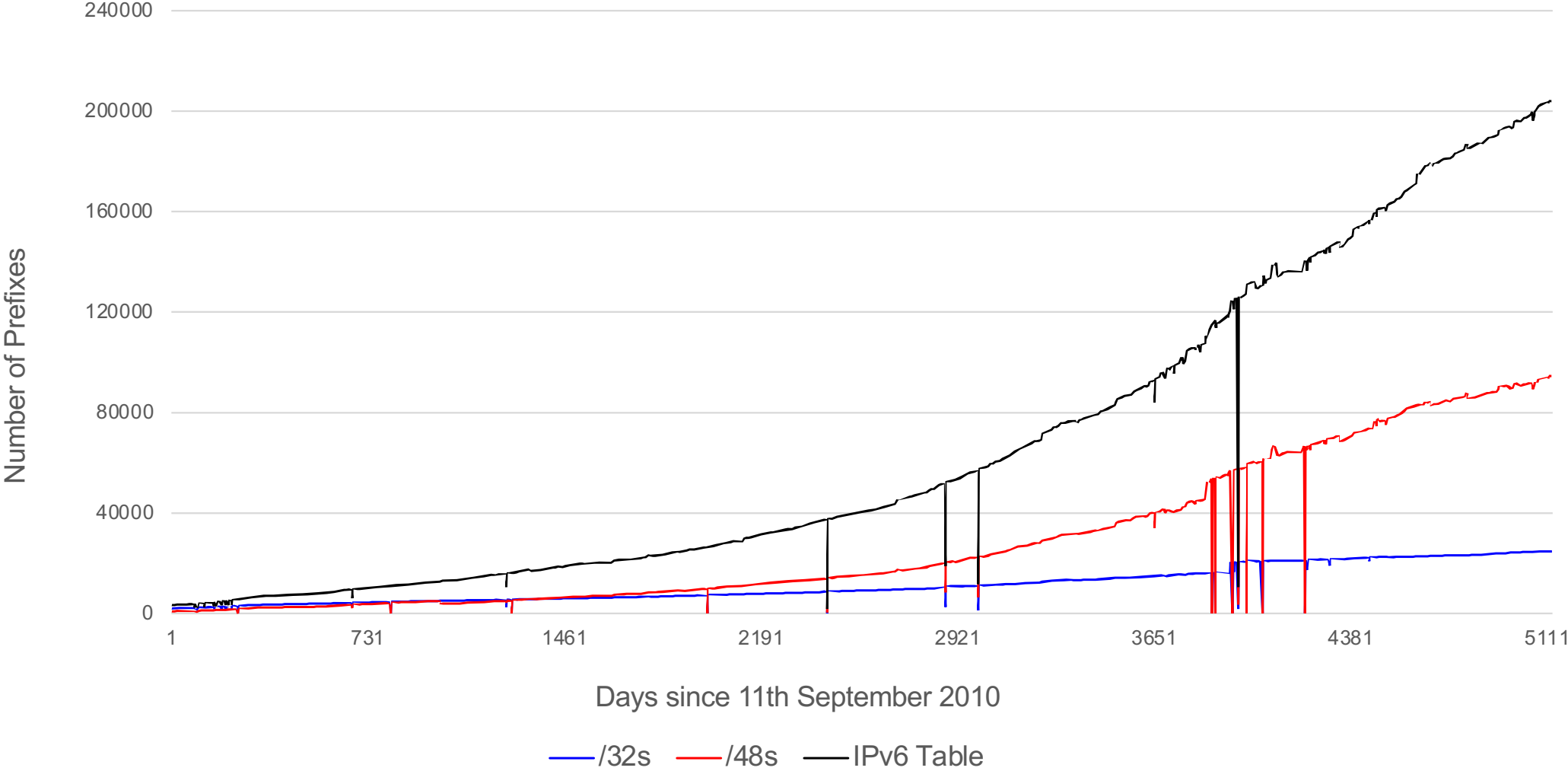
# IPv4 Prefix sizes announced



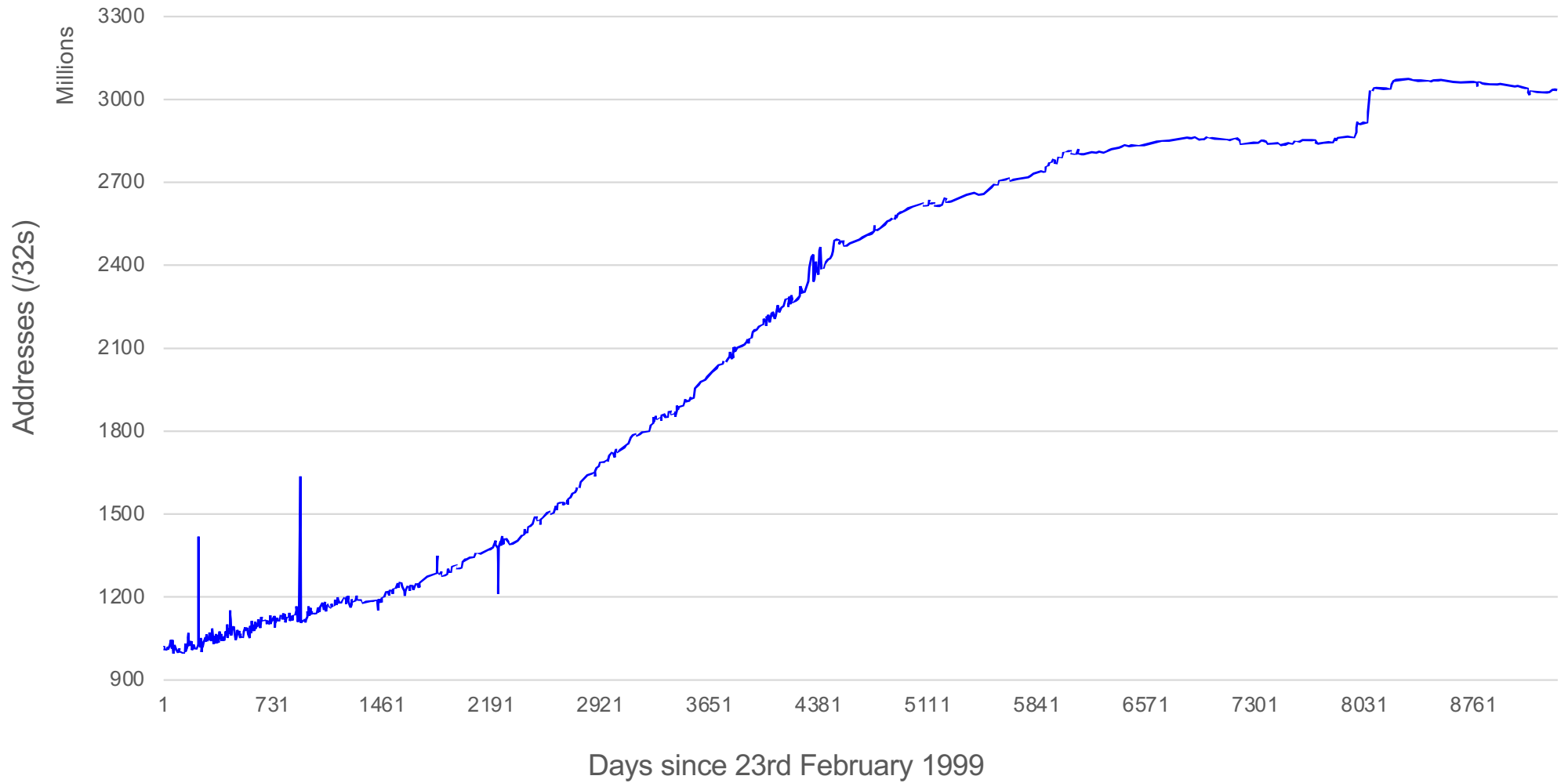
# IPv4 /24s announced



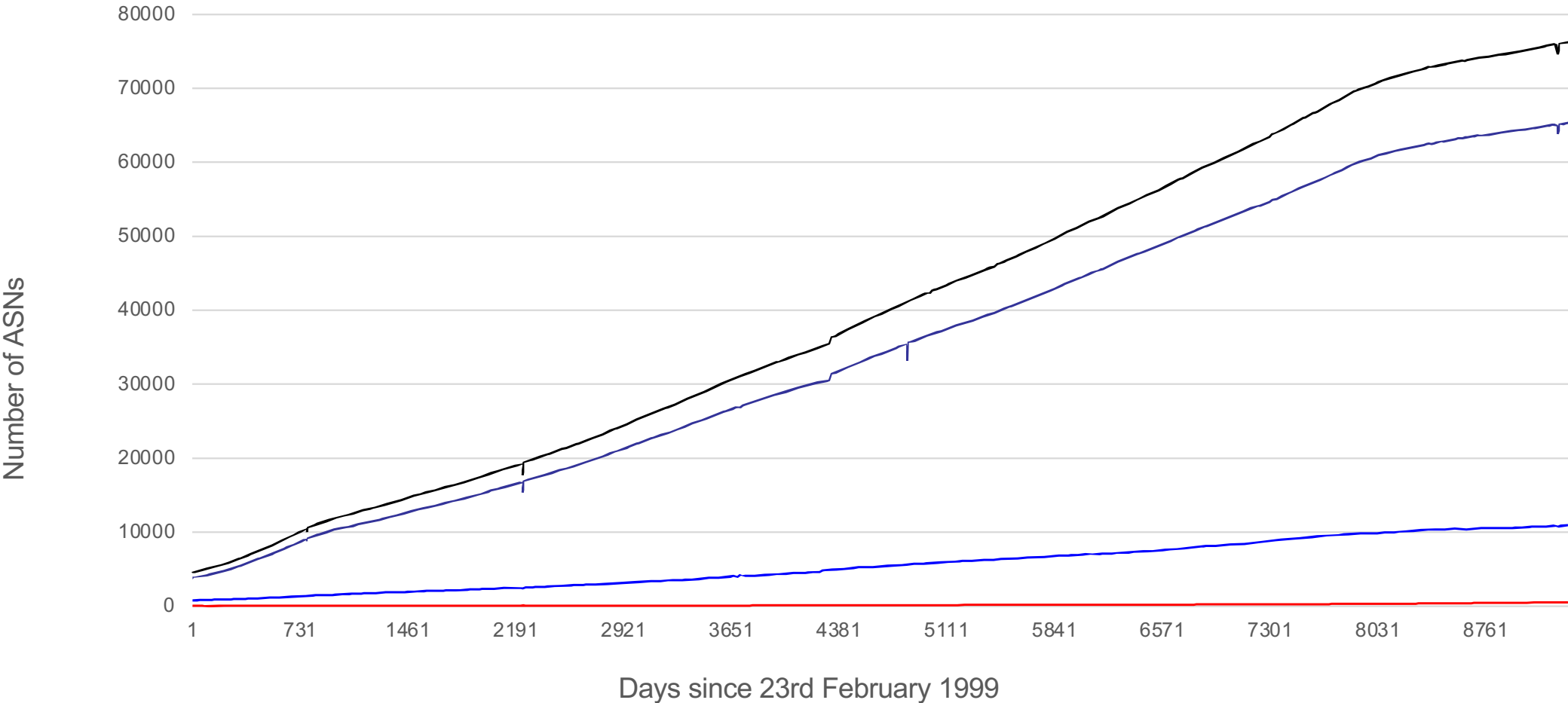
# IPv6 /32s vs /48s



# IPv4 Address Space announced



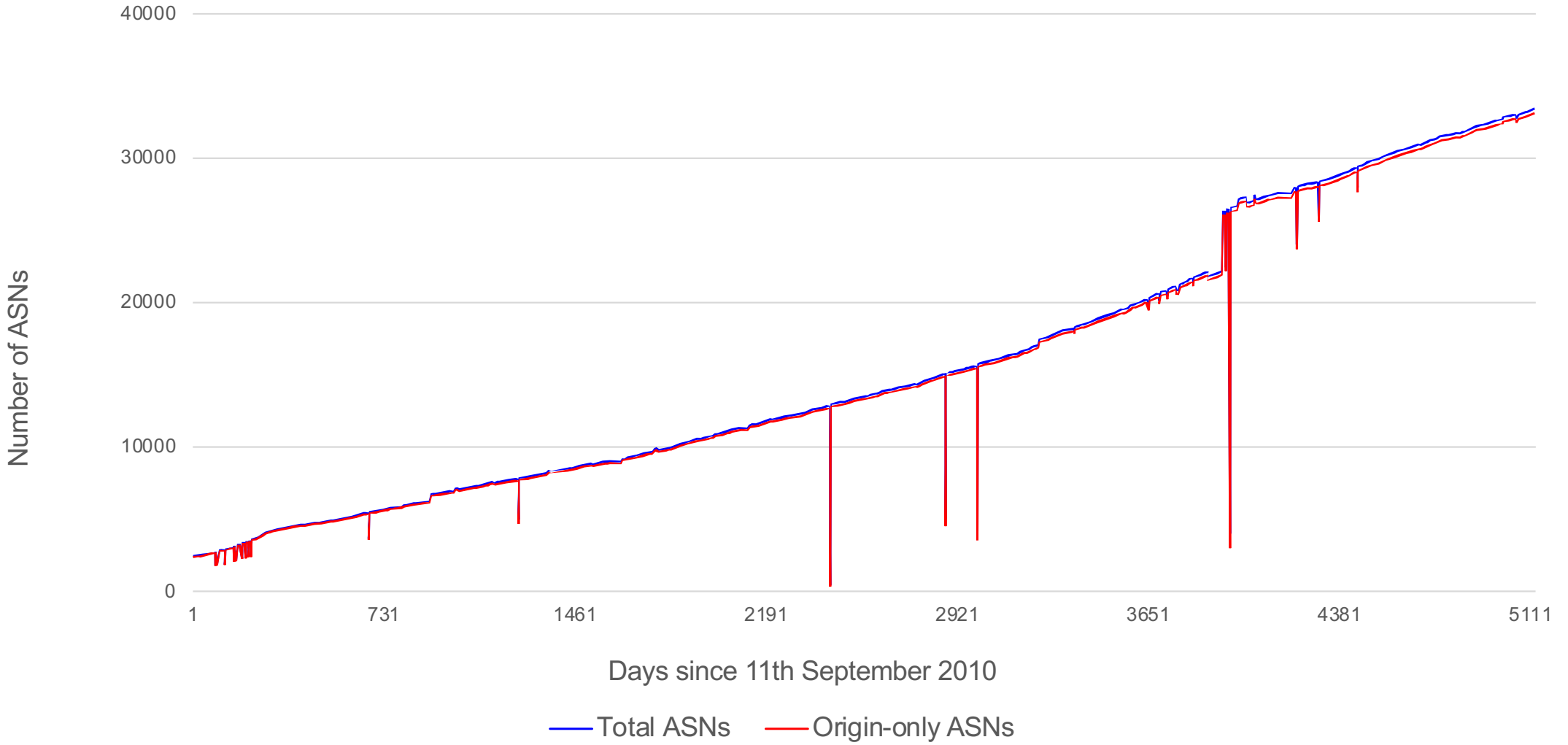
# IPv4 AS Announcements



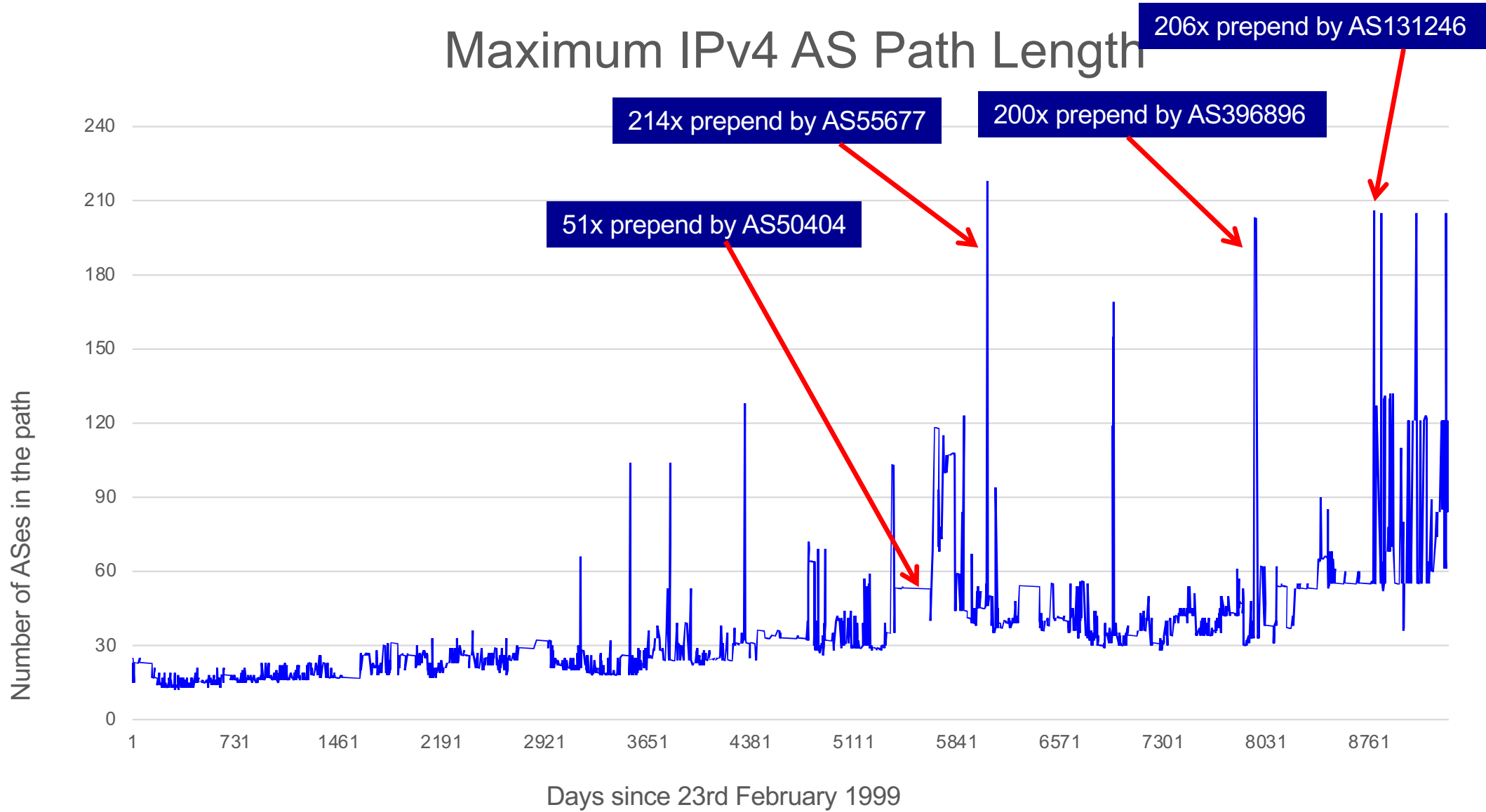
— Total ASNs    — Origin-only ASNs    — ASN providing Transit & Origin    — Transit-only ASNs



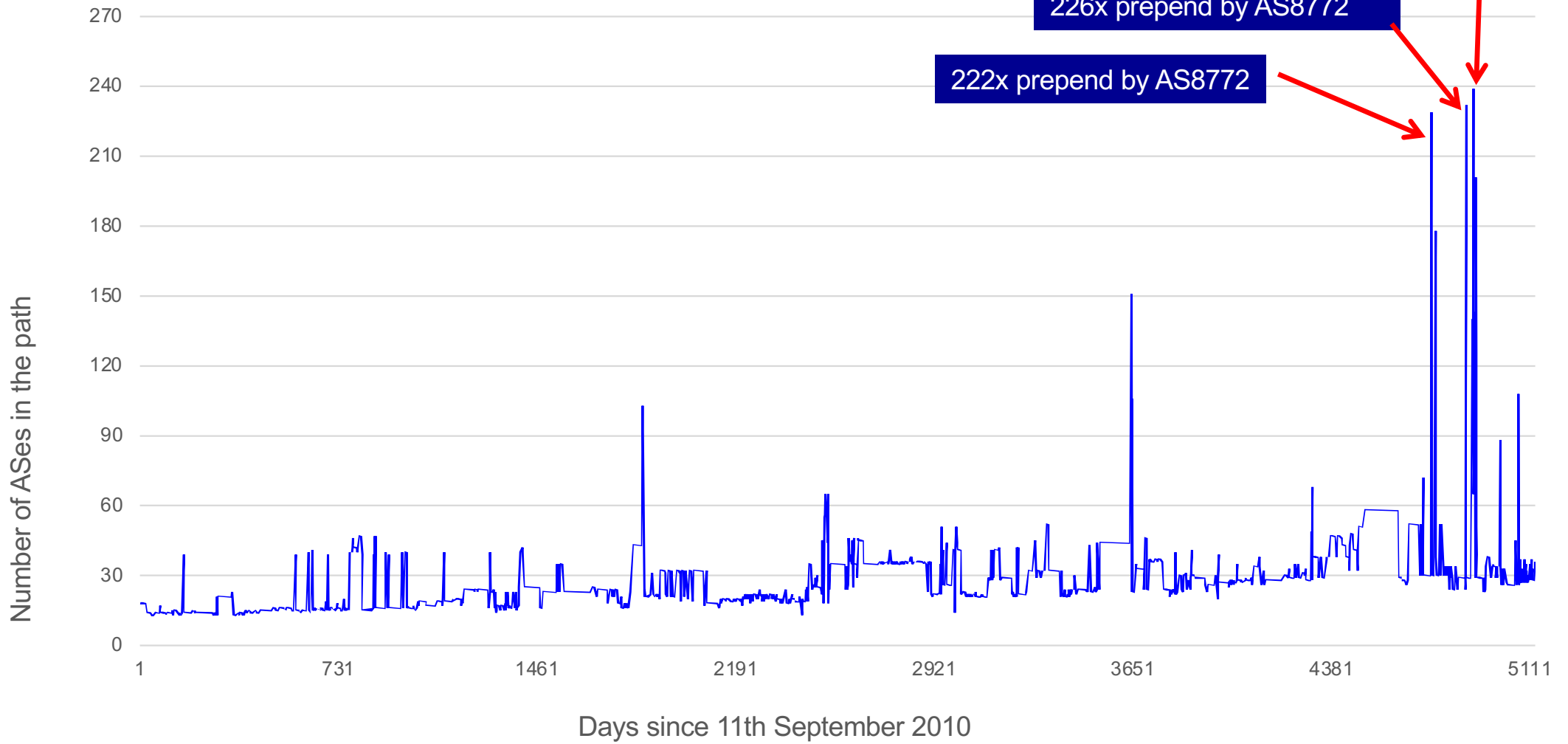
# IPv6 AS Announcements



# Maximum IPv4 AS Path Length



# Maximum IPv6 AS Path Length



# Looking at Deaggregation in IPv4

- Deaggregation Report
  - One summary takes BGP table and aggregates prefixes by origin AS
    - Called “Max Aggregation” in report
  - Global and per RIR basis
    - <https://thyme.apnic.net/>
  - For R&E networks worldwide
    - <https://bgp.nsrc.org/REN/>
  - For ISO-3166 economies
    - <https://bgp.nsrc.org/REN/OIX/iso-3166>
- Calculates Deaggregation Factor:
  - Measure of Routing Table size/Aggregated Size
  - Global value has been increasing slowly and steadily since “records began”

# September 2024

- **Total Prefixes**

- Global BGP Table

- 961k prefixes

- North America

- 280k prefixes

- Europe & Middle East

- 267k prefixes

- Asia & Pacific

- 258k prefixes

- Latin America & Caribbean

- 123k prefixes

- Africa

- 32k prefixes

- **Deaggregation Factor**

- Global Average

- 2.62

- North America

- 2.22

- Europe & Middle East

- 2.07

- Asia & Pacific

- 3.42

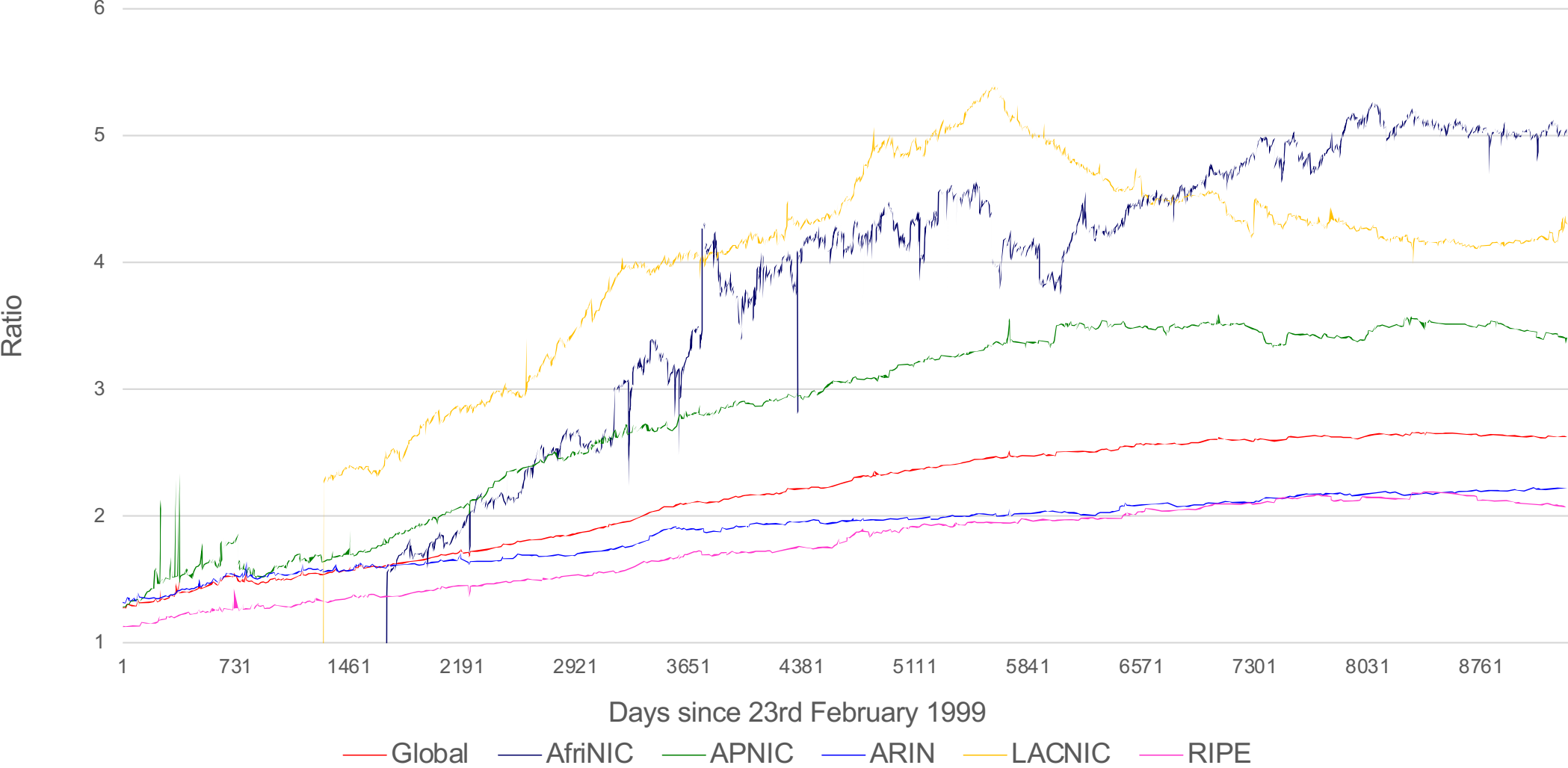
- Latin America & Caribbean

- 4.29

- Africa

- 5.01

# Deaggregation: RIR Regions vs Global



## Asia Pacific Aggregation Savings Summary

| ASN   | No of Nets | Savings | Description                                     |
|-------|------------|---------|---|
| 9808  | 10059      | 9985    | CHINAMOBILE-CN China Mobile Communications Grou |
| 7545  | 5832       | 5174    | TPG-INTERNET-AP TPG Telecom Limited, AU         |
| 4538  | 4933       | 4859    | ERX-CERNET-BKB China Education and Research Net |
| 18403 | 4399       | 4376    | FPT-AS-AP FPT Telecom Company, VN               |
| 7552  | 3990       | 3965    | VIETEL-AS-AP Viettel Group, VN                  |
| 7713  | 3651       | 3585    | TELKOMNET-AS-AP PT Telekomunikasi Indonesia, ID |
| 9498  | 3808       | 3545    | BBIL-AP BHARTI Airtel Ltd., IN                  |
| 45899 | 3262       | 3157    | VNPT-AS-VN VNPT Corp, VN                        |
| 24560 | 2831       | 2366    | AIRTELBROADBAND-AS-AP Bharti Airtel Ltd., Telem |
| 45090 | 2208       | 2122    | TENCENT-NET-AP Shenzhen Tencent Computer System |
| 4755  | 2212       | 2016    | TATACOMM-AS TATA Communications formerly VSNL i |
| 9829  | 1995       | 1961    | BSNL-NIB National Internet Backbone, IN         |
| 23969 | 1863       | 1847    | TOT-NET TOT Public Company Limited, TH          |
| 4766  | 2273       | 1695    | KIXS-AS-KR Korea Telecom, KR                    |
| 45609 | 1799       | 1479    | BHARTI-MOBILITY-AS-AP Bharti Airtel Ltd. AS for |
| 56047 | 1517       | 1468    | CMNET-HUNAN-AP China Mobile communications corp |
| 56041 | 1532       | 1459    | CMNET-ZHEJIANG-AP China Mobile communications c |
| 56046 | 1614       | 1444    | CMNET-JIANGSU-AP China Mobile communications co |
| 9583  | 1864       | 1325    | SIFY-AS-IN Sify Limited, IN                     |
| 17557 | 1243       | 1210    | PKTELECOM-AS-PK Pakistan Telecommunication Comp |

<https://thyme.apnic.net/current/data-CIDRnet-APNIC>

## Mongolia Aggregation Savings Summary

| ASN    | No of nets | /20 equiv | MaxAgg | Description                               |
|--------|------------|-----------|--------|---|
| 17882  | 143        | 9         | 36     | UNIVISION-AS-AP UNIVISION LLC, MN         |
| 10219  | 37         | 2         | 9      | SKYMEDIA-AS-MAIN Skymedia Corporation, MN |
| 9934   | 29         | 2         | 11     | MICOM-MN-AS Mongolia Telecom, MN          |
| 45204  | 16         | 4         | 6      | GEMNET-MN GEMNET LLC, MN                  |
| 45237  | 12         | 1         | 4      | GLOBAL-MG-AS-AP Magicnet LLC, MN          |
| 38805  | 12         | 2         | 7      | CITINET-AS-MN-AP STXCitinet, Leading Inte |
| 141681 | 9          | 1         | 6      | IMNL-AS-AP ONDO LLC, MN                   |
| 56301  | 8          | 1         | 6      | MN-NDC-MN National Data Center building,  |
| 24496  | 8          | 1         | 5      | GNET-AS-MN GNET Co.,Ltd Internet Service  |
| 24320  | 8          | 1         | 1      | RAILCOM Railcom - Commercial Center, MN   |
| 10109  | 7          | 0         | 3      | TOPNET-AS-MN-AP Topica LLC, Internet Serv |
| 58439  | 6          | 1         | 2      | ICNC-AS ICNC LLC, MN                      |
| 9484   | 6          | 5         | 6      | MOBINET-AS-MN Mobinet LLC. AS Mobinet Int |
| 63962  | 5          | 1         | 5      | ITTOOLS-AS iTools JSC, MN                 |
| 38818  | 5          | 3         | 5      | YOKOUNANET-MN-AS-AP YOKOZUNANET LLC, MN   |
| 135033 | 4          | 0         | 1      | BODISYSTEMSLLC-AS-AP BodiSystems Co. Ltd, |
| 142539 | 3          | 0         | 2      | SHUNKHLAIGROUP-AS-AP Shunkhlai Group, MN  |
| 133453 | 3          | 0         | 1      | MOGULSS-AS-AP Mogul Service LLC, MN       |
| 55805  | 3          | 1         | 3      | MOBICOM-AS-MN MobiCom Corporation, MN     |
| 151355 | 2          | 0         | 1      | GENERALTECH1-AS-AP Software operation, Fo |

<https://bgp.nsrc.org/REN/OIX/iso-3166/MN-ASnet>



## Mongolia Address Span Summary

| ASN    | No of nets | /20 equiv | Description                                       |
|--------|------------|-----------|---|
| 17882  | 143        | 9         | UNIVISION-AS-AP UNIVISION LLC, MN                 |
| 9484   | 6          | 5         | MOBINET-AS-MN Mobinet LLC. AS Mobinet Internet Se |
| 45204  | 16         | 4         | GEMNET-MN GEMNET LLC, MN                          |
| 38818  | 5          | 3         | YOKOUNANET-MN-AS-AP YOKOZUNANET LLC, MN           |
| 38805  | 12         | 2         | CITINET-AS-MN-AP STXCitinet, Leading Internet & V |
| 10219  | 37         | 2         | SKYMEDIA-AS-MAIN Skymedia Corporation, MN         |
| 9934   | 29         | 2         | MICOM-MN-AS Mongolia Telecom, MN                  |
| 141681 | 9          | 1         | IMNL-AS-AP ONDO LLC, MN                           |
| 63962  | 5          | 1         | ITTOOLS-AS iTools JSC, MN                         |
| 58439  | 6          | 1         | ICNC-AS ICNC LLC, MN                              |
| 56301  | 8          | 1         | MN-NDC-MN National Data Center building, MN       |
| 56293  | 2          | 1         | KEWIKONET-AS-AP Kewiko LLC, MN                    |
| 55805  | 3          | 1         | MOBICOM-AS-MN MobiCom Corporation, MN             |
| 45237  | 12         | 1         | GLOBAL-MG-AS-AP Magicnet LLC, MN                  |
| 38869  | 1          | 1         | SKYNET-AS-AP Skynetworks LLC, MN                  |
| 24559  | 2          | 1         | GMOBILE-MN G-Mobile Corporation, MN               |
| 24496  | 8          | 1         | GNET-AS-MN GNET Co.,Ltd Internet Service Provider |
| 24320  | 8          | 1         | RAILCOM Railcom - Commercial Center, MN           |
| 10076  | 1          | 1         | ASN-ERDEMNET # AS-ERDEMNET CONVERTED TO ASN-ERDEM |

<https://bgp.nsrc.org/REN/OIX/iso-3166/MN-AS20net>

# Conclusion

- RouteViews is an incredibly valuable community tool to help network operators and researchers ensure the ongoing stability of the global Internet infrastructure
  - Network Operator network visibility
  - Researchers analysing events, incidents, changes,...
- Global routing table (IPv4 and IPv6) growth shows no sign of abating
  - Deaggregation is the main cause/culprit
  - Every network operator needs to do their part – it's not someone else's problem, it is our collective problem to address



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THANK YOU

Questions?



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