The Internet Routing Table

Using RouteViews

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RouteViews

A collaborative router looking glass to share BGP views among network operators and researchers.

RouteViews was founded at the University of Oregon's Advanced Network Technology Center (ANTC) in 1995. Data archives began in 1997 and amount to 50TBs (compressed) today.

The group is currently led by the Network Startup Resource Center (NSRC) group engineering team at the University of Oregon.

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 additional organizations:

https://www.routeviews.org/routeviews/index.php/supporters/

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.

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The University of Oregon is a public research institution in Eugene, Oregon, USA founded in 1876. UO is renowned for its research prowess and commitment to teaching. Both NSRC and RouteViews are based at the UO.

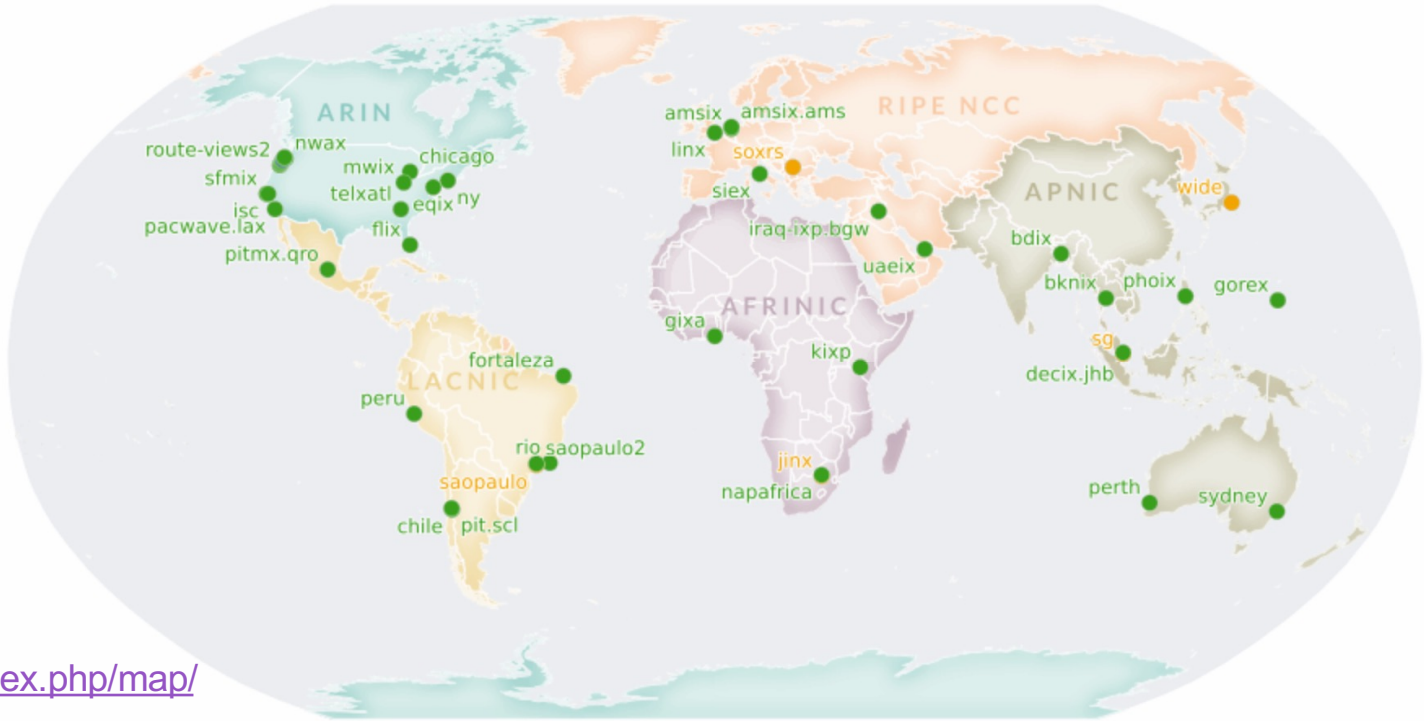
Why RouteViews?

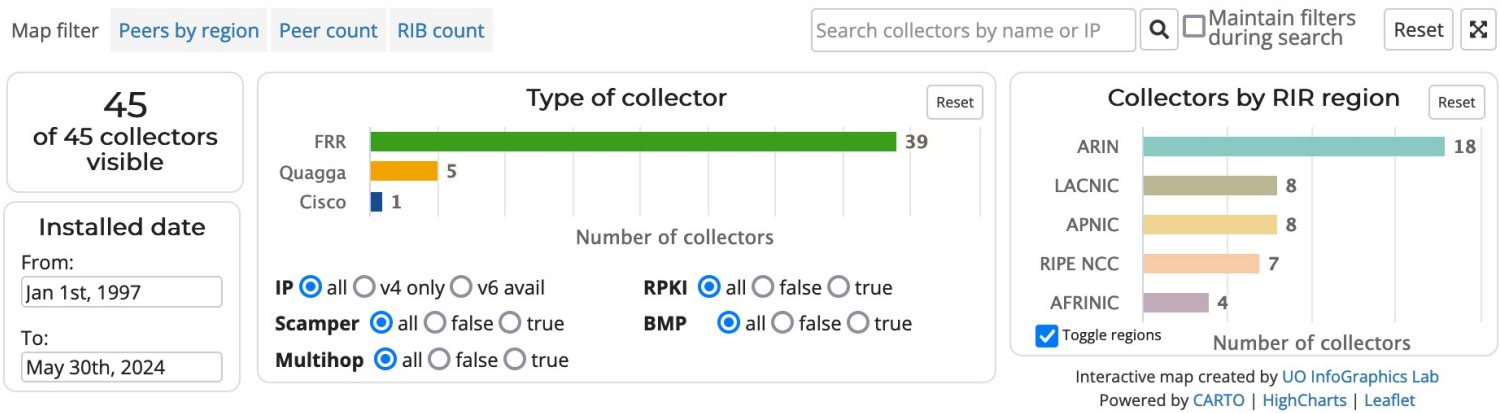
It's YOUR Internet

- Originally conceived in 1995 as a tool for Internet 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, and RPKI status
- Operators who find it a valuable tool also peer to contribute to the value
- The data-set of BGP information archived by RouteViews since 1997 has become an invaluable research resource
  - RouteViews data has been used in over 1000 research papers.
  - http://www.routeviews.org/routeviews/index.php/papers/

RouteViews Collector Map

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





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

IPv4 Routing Report 7th July 2024

BGP routing table entries examined:	954718
Prefixes after maximum aggregation (per Origin AS):	363479
Deaggregation factor:	2.63
Unique aggregates announced (without unneeded subnets):	465343
Total ASes present in the Internet Routing Table:	75931
Prefixes per ASN:	12.57
Origin-only ASes present in the Internet Routing Table:	65033
Origin ASes announcing only one prefix:	26696
Transit ASes present in the Internet Routing Table:	10898
Transit-only ASes present in the Internet Routing Table:	532
Average AS path length visible in the Internet Routing Table:	4.4
Max AS path length visible:	84
Max AS path prepend of ASN (152107)	80
Prefixes from unregistered ASNs in the Routing Table:	996
Number of instances of unregistered ASNs:	998
Special use prefixes present in the Routing Table:	1
Prefixes being announced from unallocated address space:	548
Number of addresses announced to Internet:	3025297920
Equivalent to 180 /8s, 82 /16s and 98 /24s	
Total number of prefixes smaller than registry allocations:	312447

APNIC Region

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 Prefixes being announced by APNIC Region ASes:                    255695
     Total APNIC prefixes after maximum aggregation:                74318
     APNIC Deaggregation factor:                                     3.44
 Prefixes being announced from the APNIC address blocks:           247558
     Unique aggregates announced from the APNIC address blocks:    101248
 APNIC Region origin ASes present in the Internet Routing Table:    14228
     APNIC Prefixes per ASN:                                        17.40
 APNIC Region origin ASes announcing only one prefix:                4320
 APNIC Region transit ASes present in the Internet Routing Table:    1918
 Average APNIC Region AS path length visible:                         4.6
     Max APNIC Region AS path length visible:                          84
 Number of APNIC region 32-bit ASNs visible in the Routing Table:    9630
 Number of APNIC addresses announced to Internet:               761719808
                 Equivalent to 45 /8s, 102 /16s and 236 /24s
 APNIC AS Blocks        4608-4864, 7467-7722, 9216-10239, 17408-18431
(pre-ERX allocations)  23552-24575, 37888-38911, 45056-46079, 55296-56319,
                      58368-59391, 63488-64098, 64297-64395, 131072-153913

 APNIC Address Blocks     1/8,  14/8,  27/8,  36/8,  39/8,  42/8,  43/8,
                         49/8,  58/8 to 61/8, 101/8, 103/8, 106/8,
                        110/8 to 126/8, 133/8, 175/8, 180/8, 182/8, 183/8,
                        202/8, 203/8, 210/8, 211/8, 218/8 to 223/8
```

Global per AS IPv4 prefix count summary

ASN	No of nets	/20 equiv	Max Agg	Description
8151	11857	3312	502	UNINET, MX
16509	10107	11533	3627	AMAZON-02, US
9808	9841	8746	77	CHINAMOBILE-CN China Mobile Communications Group
12479	7717	1708	145	UNI2-AS, ES
7545	5653	777	672	TPG-INTERNET-AP TPG Telecom Limited, AU
4538	4933	4192	74	ERX-CERNET-BKB China Education and Research Netw
39891	4758	286	60	ALJAWWALSTC-AS, SA
11492	4641	308	547	CABLEONE, US
18403	4217	347	23	FPT-AS-AP FPT Telecom Company, VN
7155	4166	287	88	VIASAT-SP-BACKBONE, US
7552	3960	1331	21	VIETEL-AS-AP Viettel Group, VN
20940	3821	3396	134	AKAMAI-ASN1, NL
9498	3786	511	264	BBIL-AP BHARTI Airtel Ltd., IN
174	3709	8790	883	COGENT-174, US
7713	3624	1044	66	TELKOMNET-AS-AP PT Telekomunikasi Indonesia, ID
9009	3596	306	1820	M247, RO
6327	3594	1320	78	SHAW, CA
10620	3519	492	935	Telmex Colombia S.A., CO
22773	3426	3035	189	ASN-CXA-ALL-CCI-22773-RDC, US
45899	3263	1841	105	VNPT-AS-VN VNPT Corp, VN

What about IPv6 ?

IPv6 Routing Report 7th July 2024 (Singapore)

BGP routing table entries examined:	198270
Number of IPv6 prefixes with a valid ROA:	117833
Number of IPv6 prefixes with an invalid ROA:	828
Number of IPv6 prefixes with no ROA:	79609
Total ASNs present in the IPv6 Routing Table:	33016
Average AS path length:	4.8
Longest AS path:	26
Total Origin ASNs present in the IPv6 Routing Table:	32716
Paths with bogon ASNs present in the IPv6 Routing Table:	2

Global IPv6 per AS prefix count summary (Singapore)

ASN	No of Nets	Description
11172	7052	Alestra, S. de R.L. de C.V., MX
9808	5017	CHINAMOBILE-CN China Mobile Communications Group Co., Ltd., CN
16509	4900	AMAZON-02, US
18403	3875	FPT-AS-AP FPT Telecom Company, VN
7552	2982	VIETEL-AS-AP Viettel Group, VN
45609	2767	BHARTI-MOBILITY-AS-AP Bharti Airtel Ltd. AS for GPRS Service, IN
24547	2035	CMNET-V4HEBEI-AS-AP Hebei Mobile Communication Company Limited,
45271	1842	ICLNET-AS-AP Idea Cellular Limited, IN
13335	1601	CLOUDFLARENET, US
38266	1530	VIL-AS-AP Vodafone Idea Ltd, IN
17622	1526	CNCGROUP-GZ China Unicom Guangzhou network, CN
28573	1483	Claro NXT Telecomunicacoes Ltda, BR
39891	1460	ALJAWWALSTC-AS, SA
12479	1320	UNI2-AS, ES
17072	1294	TOTAL PLAY TELECOMUNICACIONES SA DE CV, MX
36183	1283	AKAMAI-AS, US
6167	1222	CELLCO-PART, US
22773	1187	ASN-CXA-ALL-CCI-22773-RDC, US
32098	1174	TRANSTELCO-INC, US
56046	1164	CMNET-JIANGSU-AP China Mobile communications corporation, CN

Number of IPv4 prefixes announced by prefix length

/1:0	/2:0	/3:0	/4:0	/5:0	/6:0	/7:0	/8:16
/9:14	/10:37	/11:92	/12:294	/13:573	/14:1168	/15:2060	/16:13256
/17:8269	/18:13769	/19:24712	/20:44289	/21:51904	/22:111590	/23:99945	/24:582034
/25:696	/26:0	/27:0	/28:0	/29:0	/30:0	/31:0	/32:0

7th July 2024 ↑

7th July 2023 ↓

/1:0	/2:0	/3:0	/4:0	/5:0	/6:0	/7:0	/8:16
/9:14	/10:39	/11:103	/12:297	/13:578	/14:1198	/15:2072	/16:13465
/17:8268	/18:13851	/19:25223	/20:44392	/21:51536	/22:110114	/23:98711	/24:556237
/25:748	/26:0	/27:0	/28:0	/29:0	/30:0	/31:0	/32:0

Number of IPv6 prefixes announced by prefix length

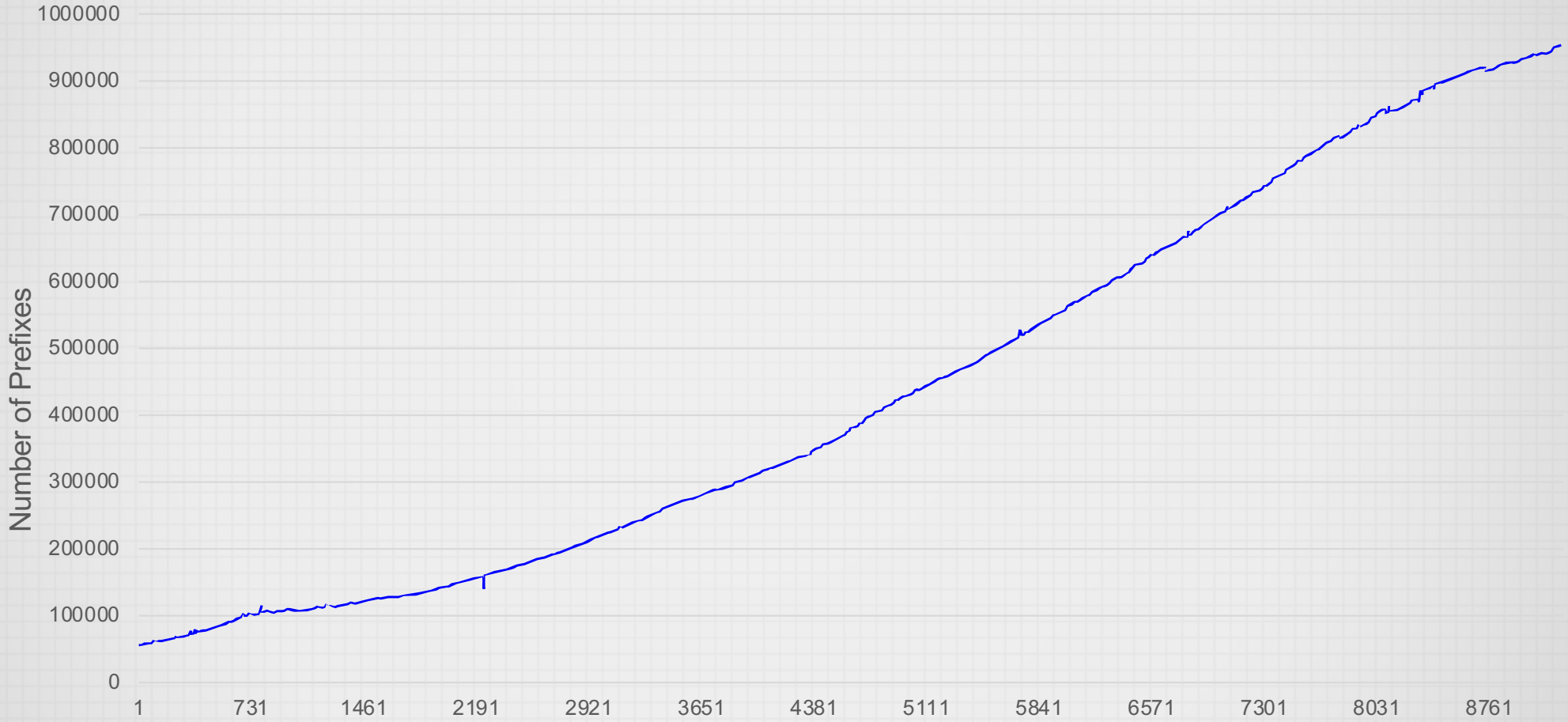
/16:1	/17:0	/18:0	/19:1	/20:14	/21:3	/22:6	/23:8
/24:31	/25:11	/26:16	/27:22	/28:209	/29:4872	/30:624	/31:339
/32:24575	/33:3570	/34:3206	/35:1114	/36:7017	/37:1084	/38:2045	/39:1587
/40:16608	/41:1127	/42:2268	/43:1084	/44:18711	/45:2576	/46:3979	/47:5661
/48:94077	/49:4	/50:0	/51:0	/52:1	/53:0	/54:0	/55:0
/56:1	/57:0	/58:0	/59:0	/60:0	/61:0	/62:0	/63:0
/64:0							

7th July 2024 ↑

7th July 2023 ↓

/16:1	/17:0	/18:0	/19:1	/20:14	/21:3	/22:7	/23:7
/24:30	/25:8	/26:16	/27:20	/28:203	/29:4355	/30:609	/31:312
/32:23225	/33:3152	/34:2641	/35:1021	/36:6293	/37:974	/38:1705	/39:1545
/40:14229	/41:937	/42:3454	/43:1074	/44:15655	/45:1957	/46:3409	/47:3964
/48:84802	/49:0	/50:0	/51:0	/52:0	/53:0	/54:0	/55:0
/56:0	/57:0	/58:0	/59:0	/60:0	/61:0	/62:0	/63:0
/64:0							

Global IPv4 Routing Table



Days since 23rd February 1999

RouteViews

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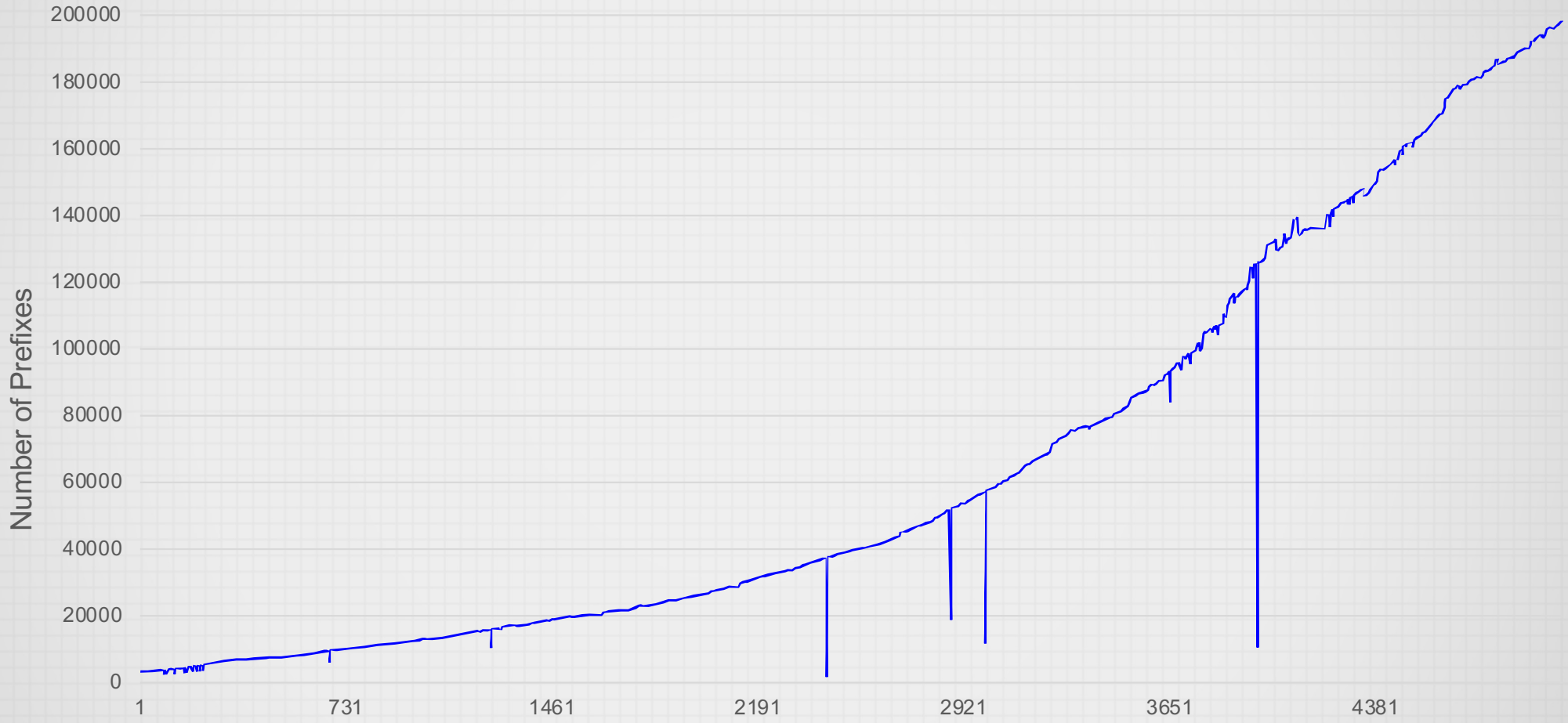
Global IPv6 Routing Table



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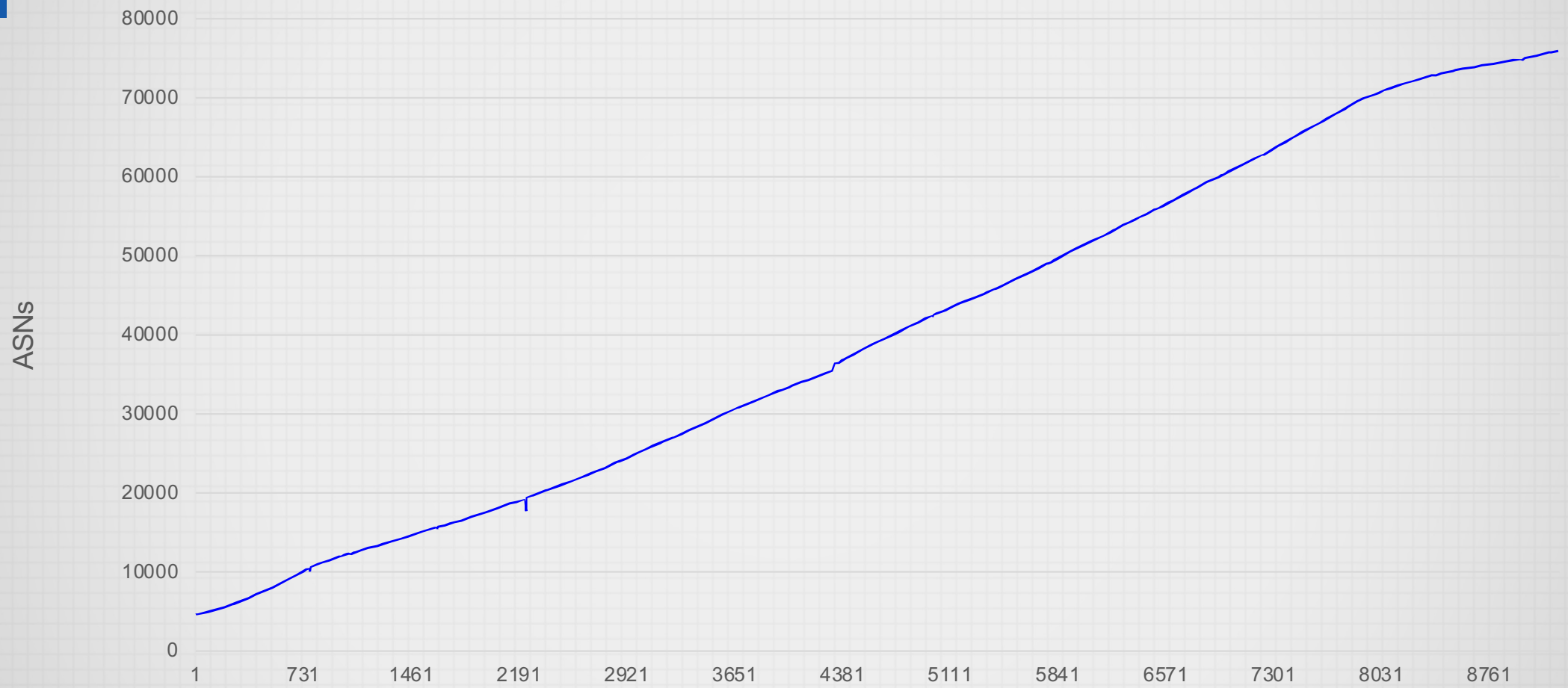
IPv4 AS Growth



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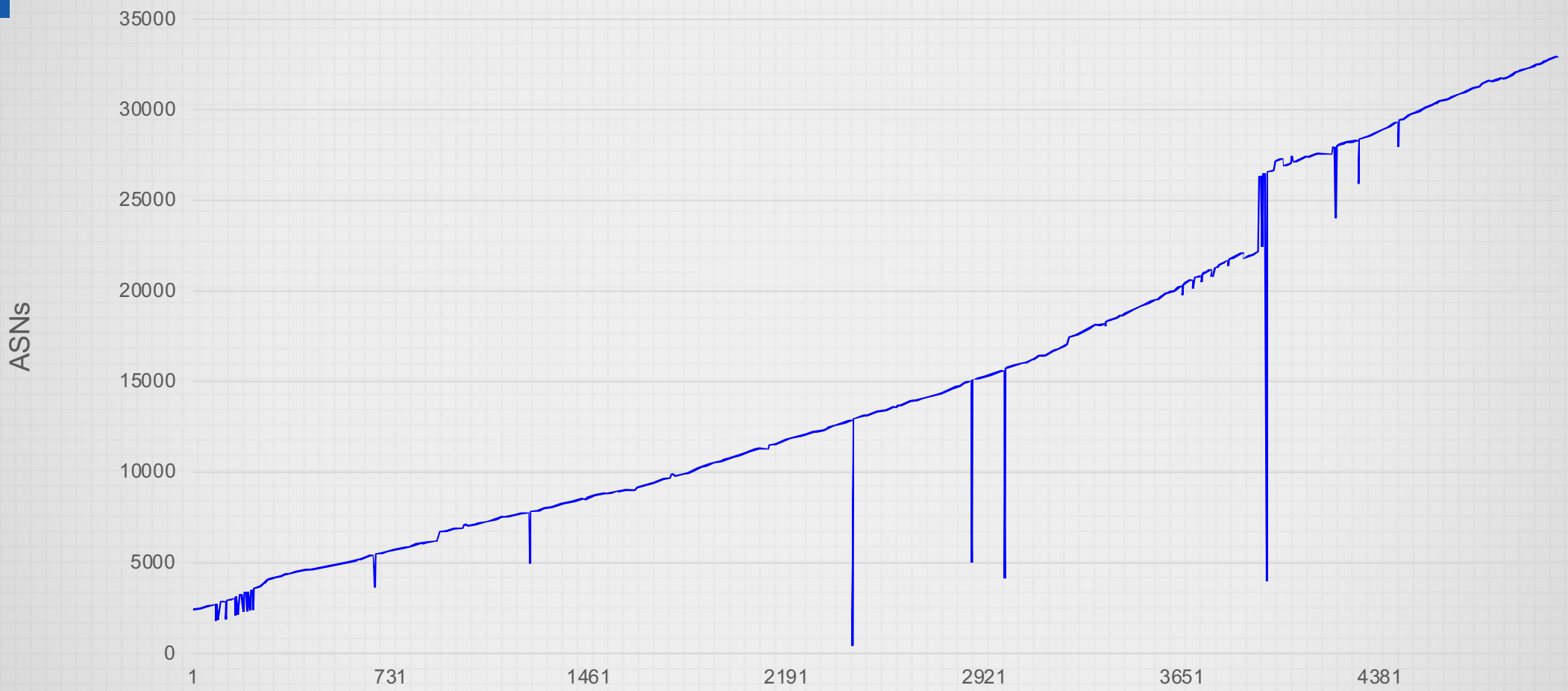
IPv6 AS Growth



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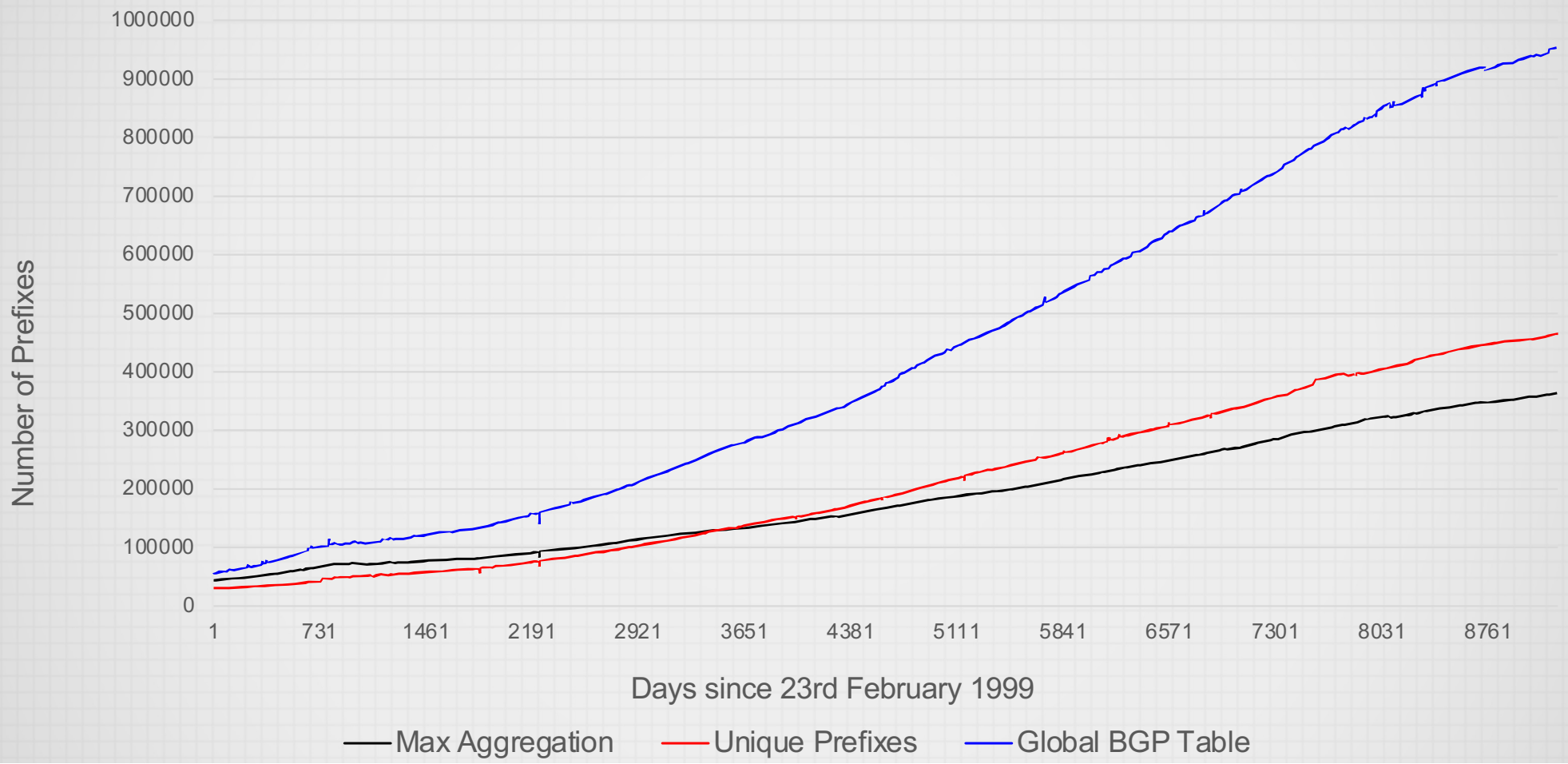
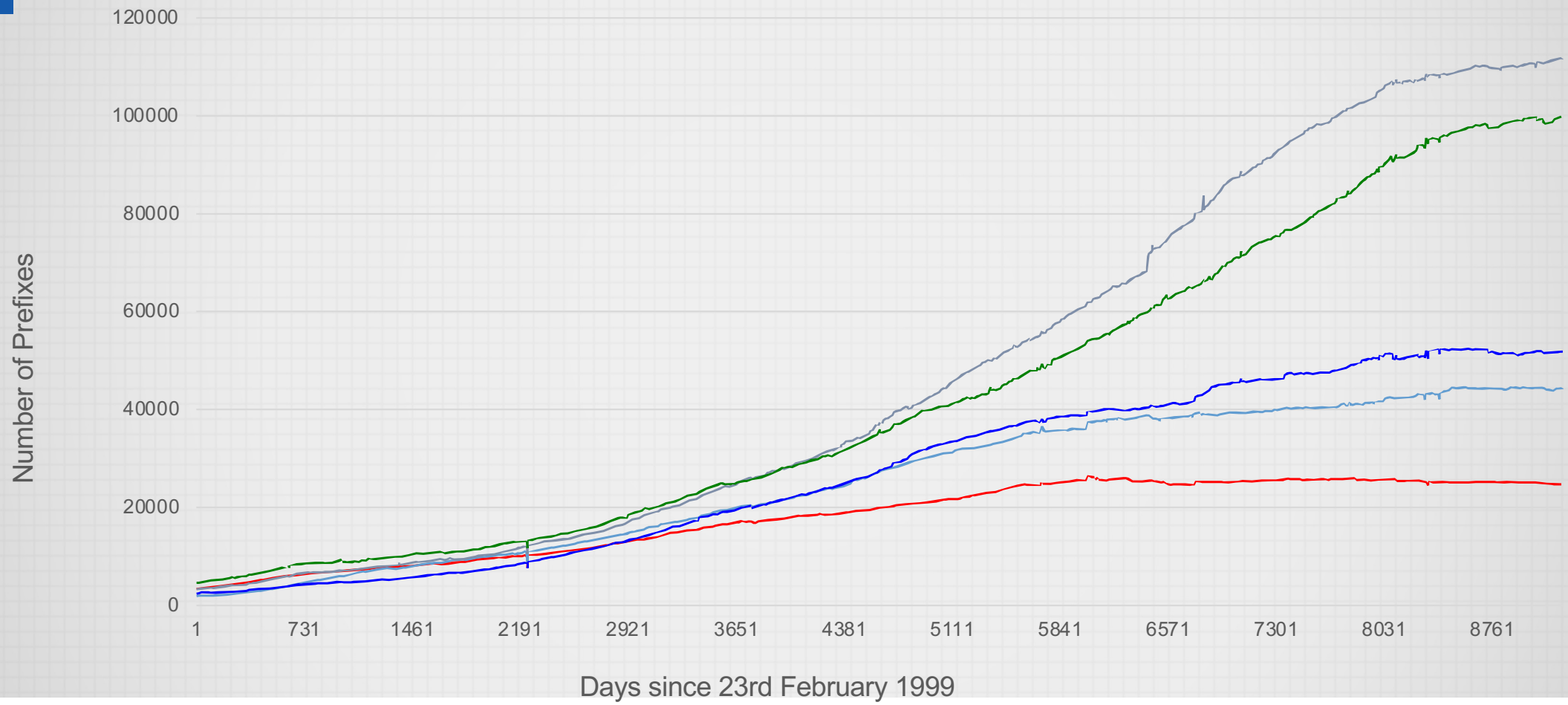
IPv4 Max Aggregation vs Unique Prefixes



IPv4 Prefix sizes announced



RouteViews

/19 /20 /21 /22 /23

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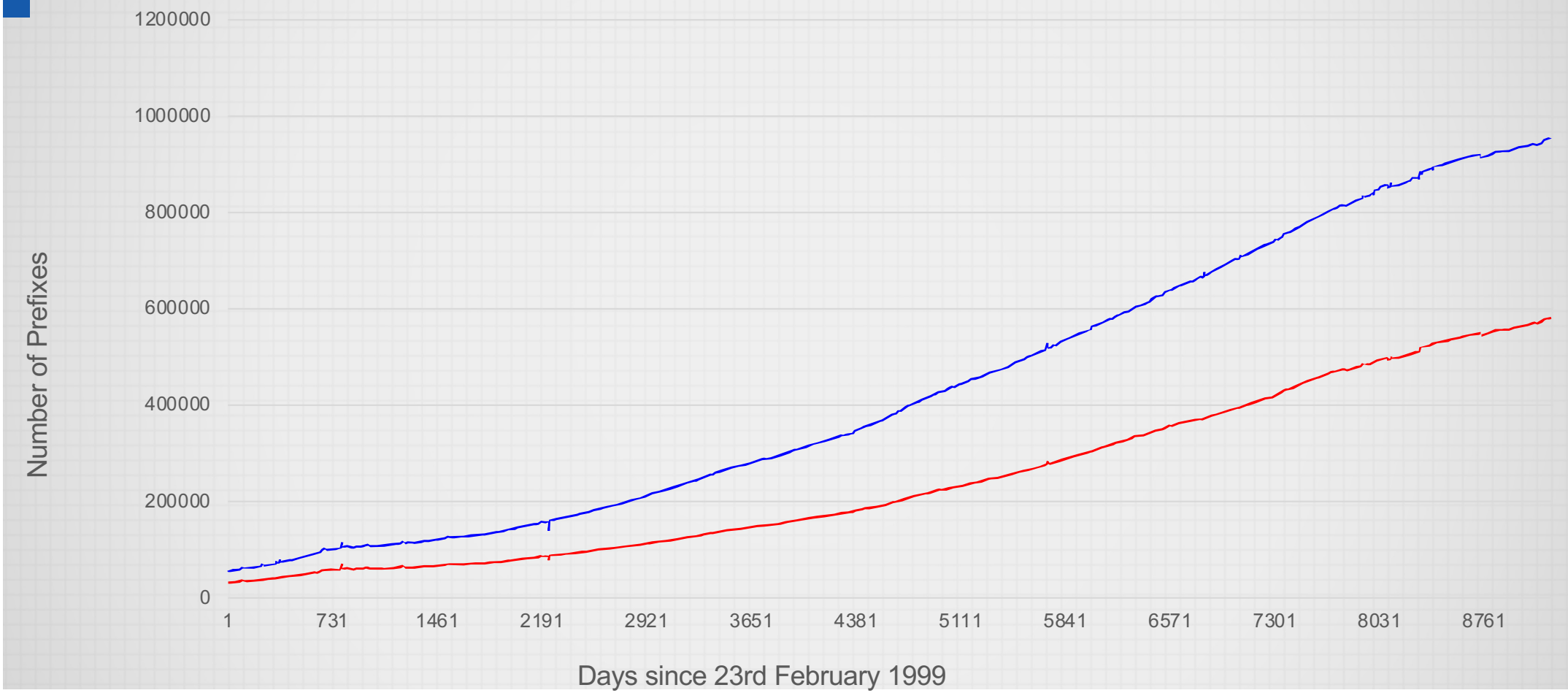
IPv4 /24s announced



RouteViews

/24s Global BGP Table

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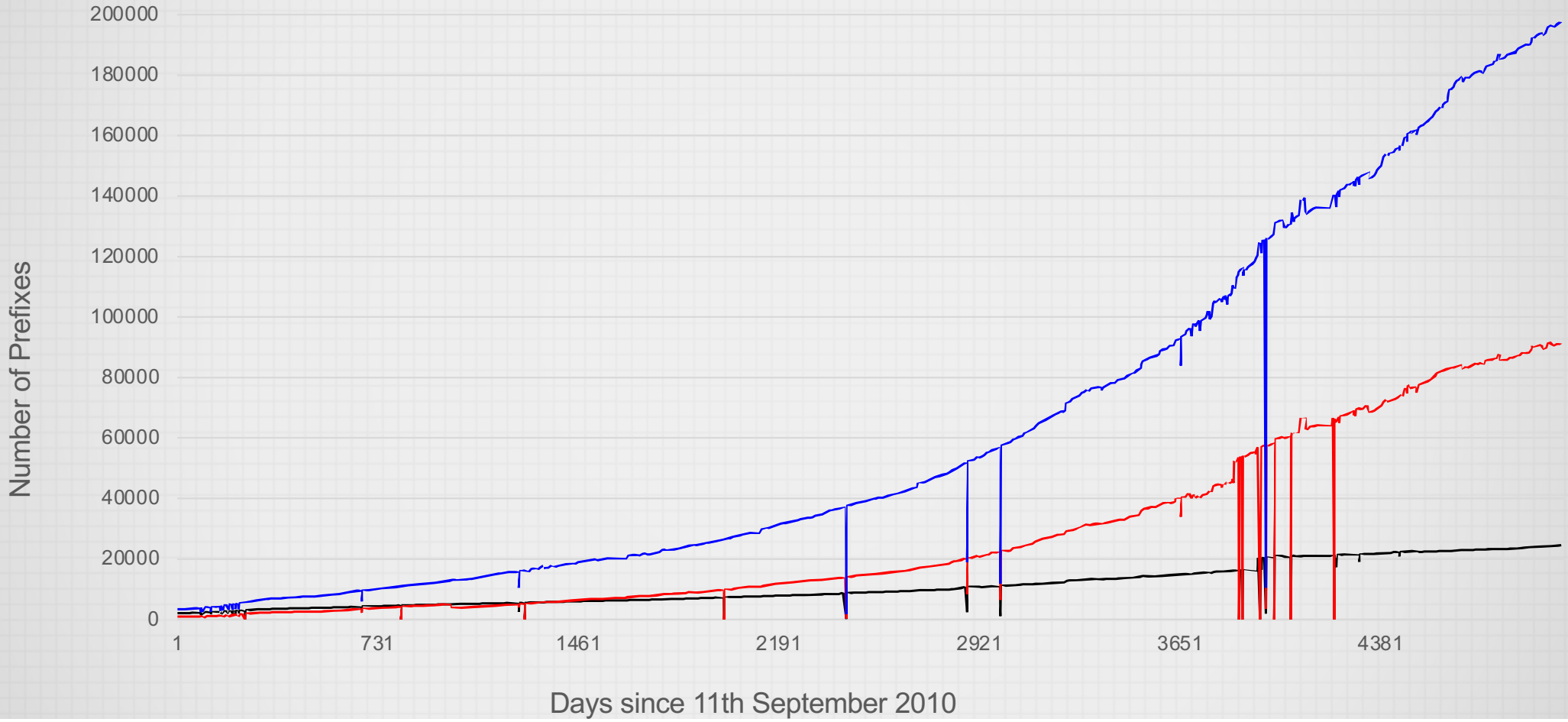
IPv6 /32s vs /48s



RouteViews

/32s /48s IPv6 Table

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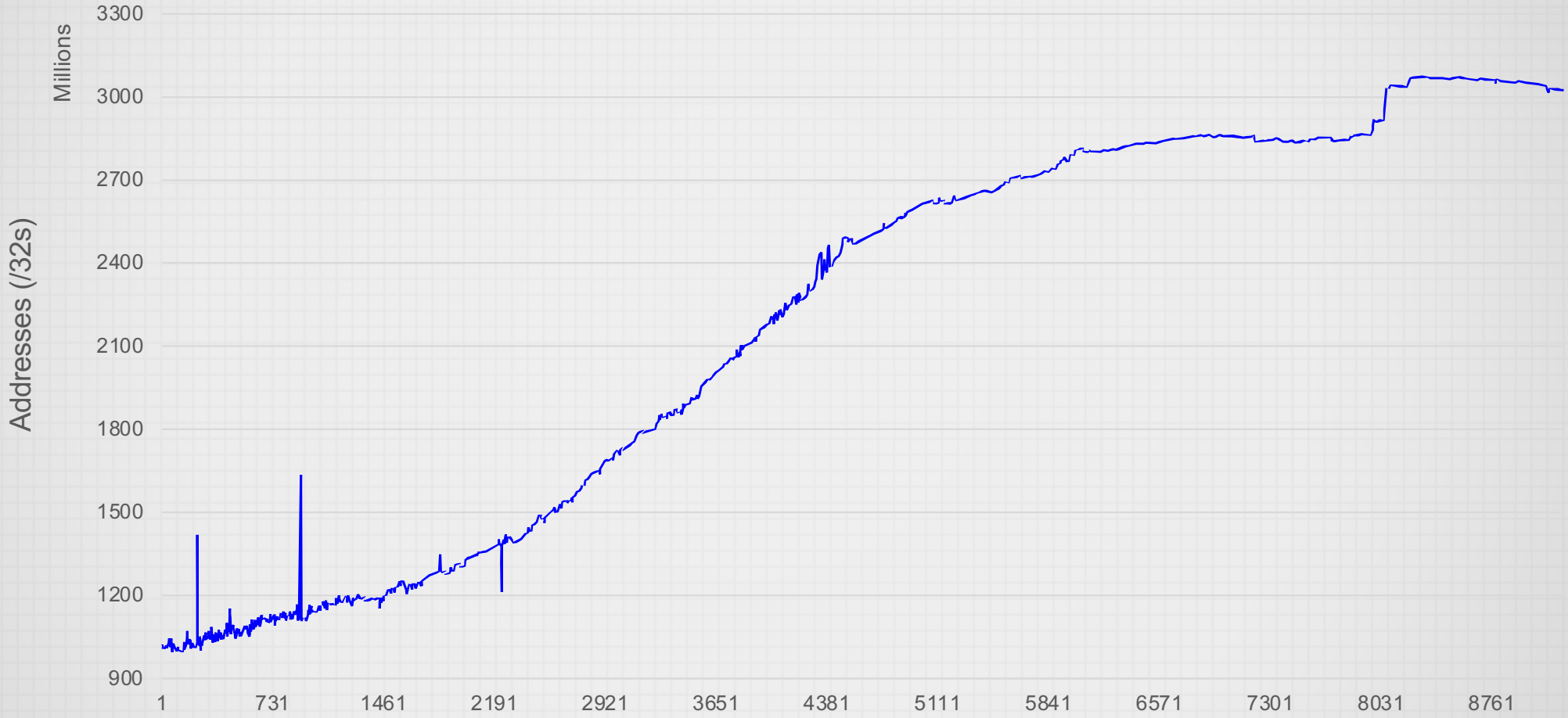
IPv4 Address Space announced



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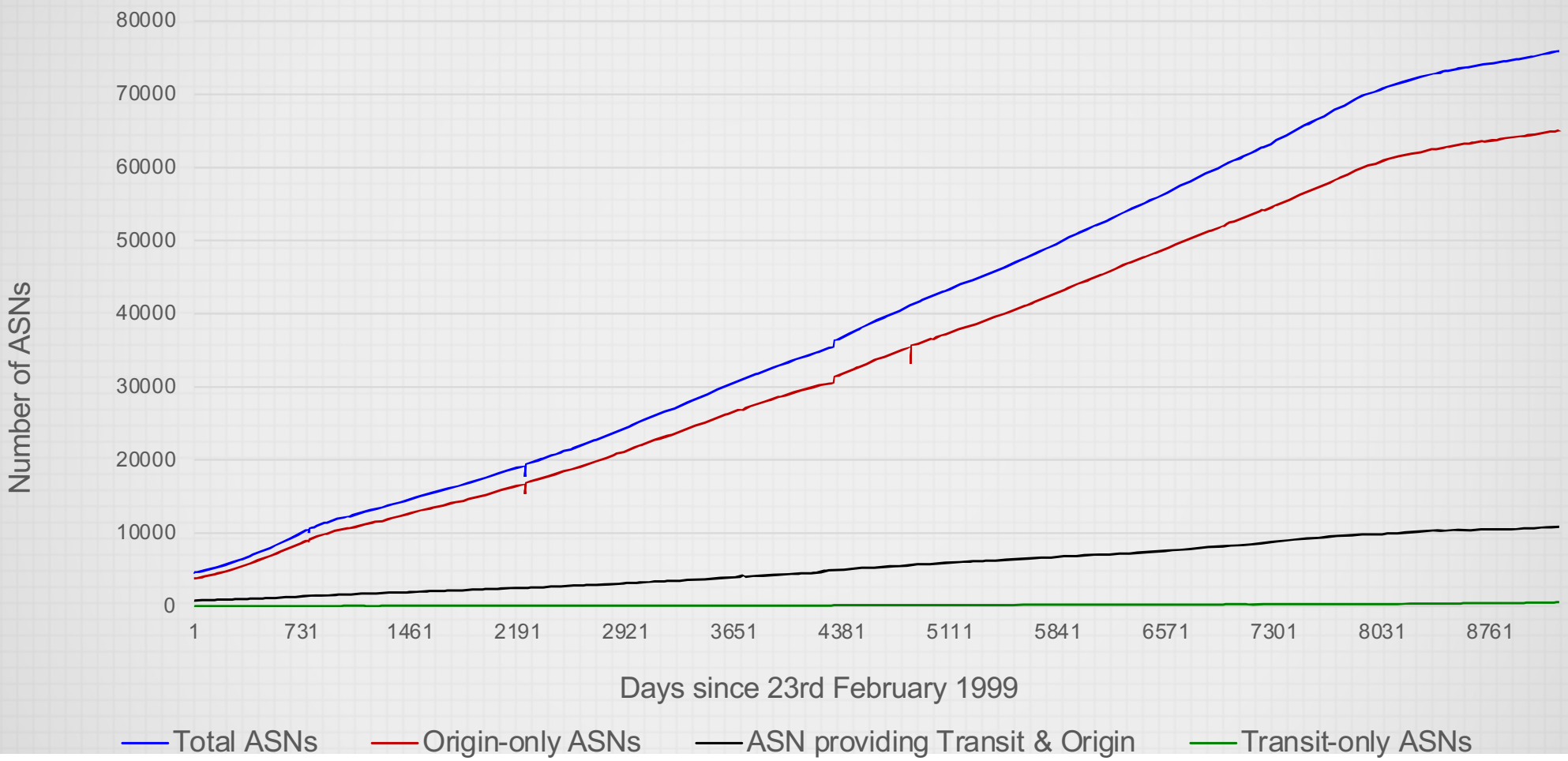
IPv4 AS Announcements



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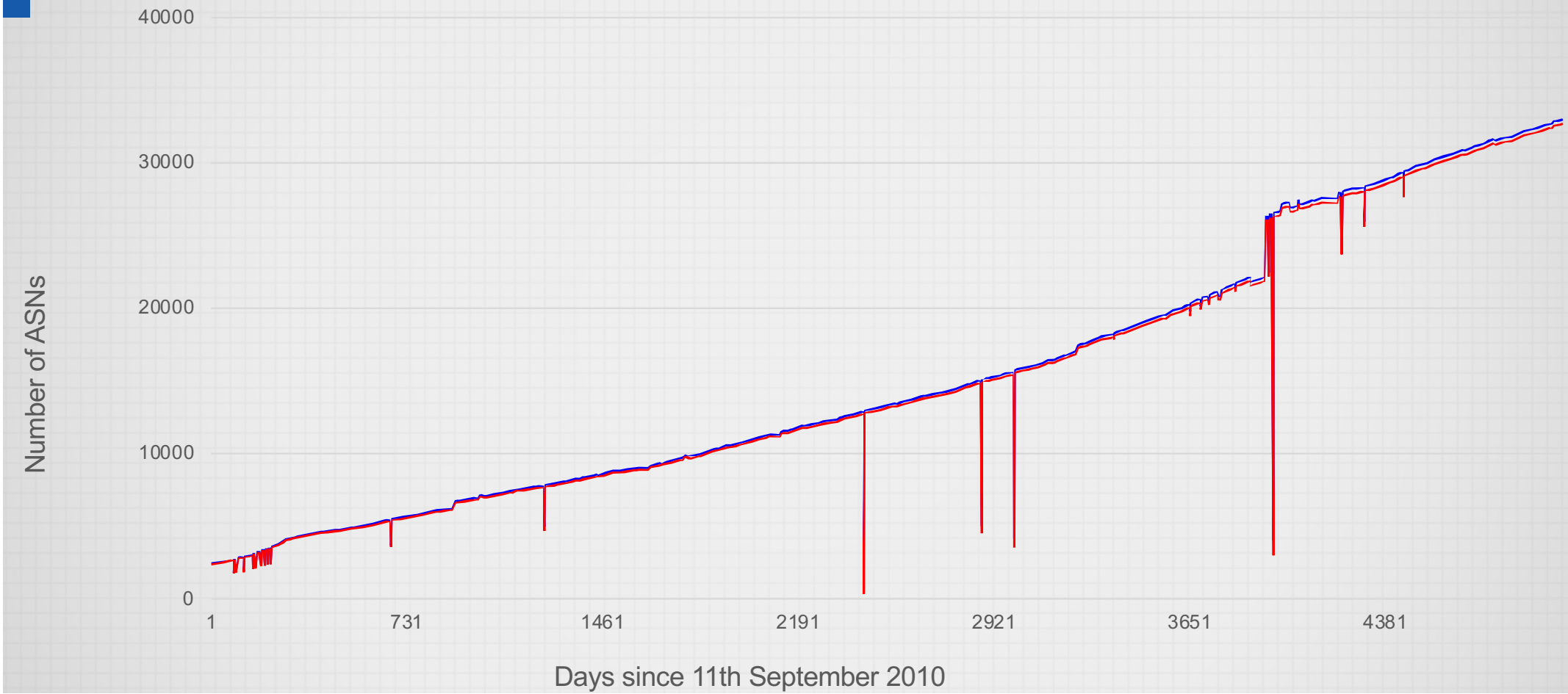
IPv6 AS Announcements



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Total ASNs

Origin-only ASNs

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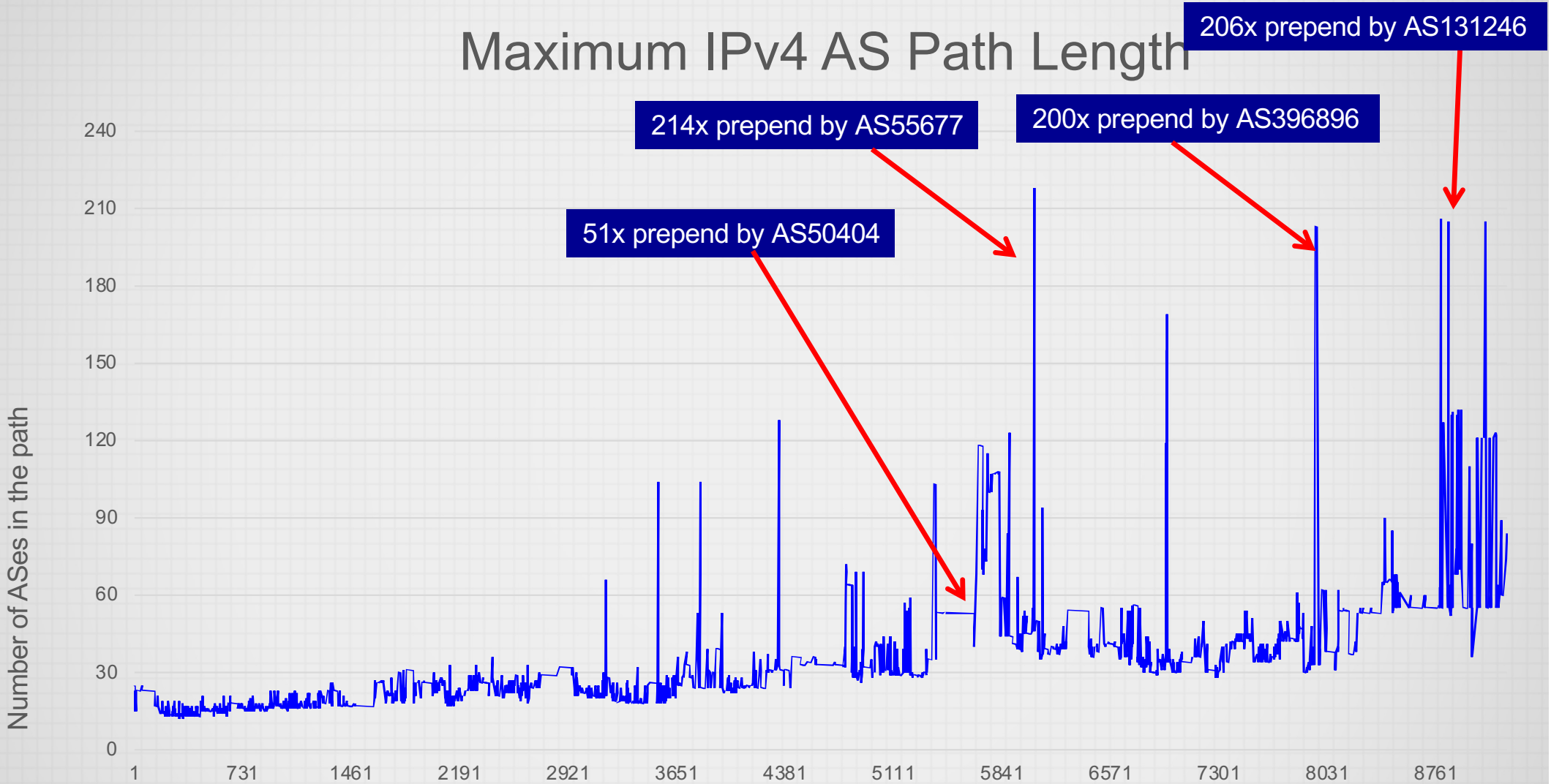
Maximum IPv4 AS Path Length



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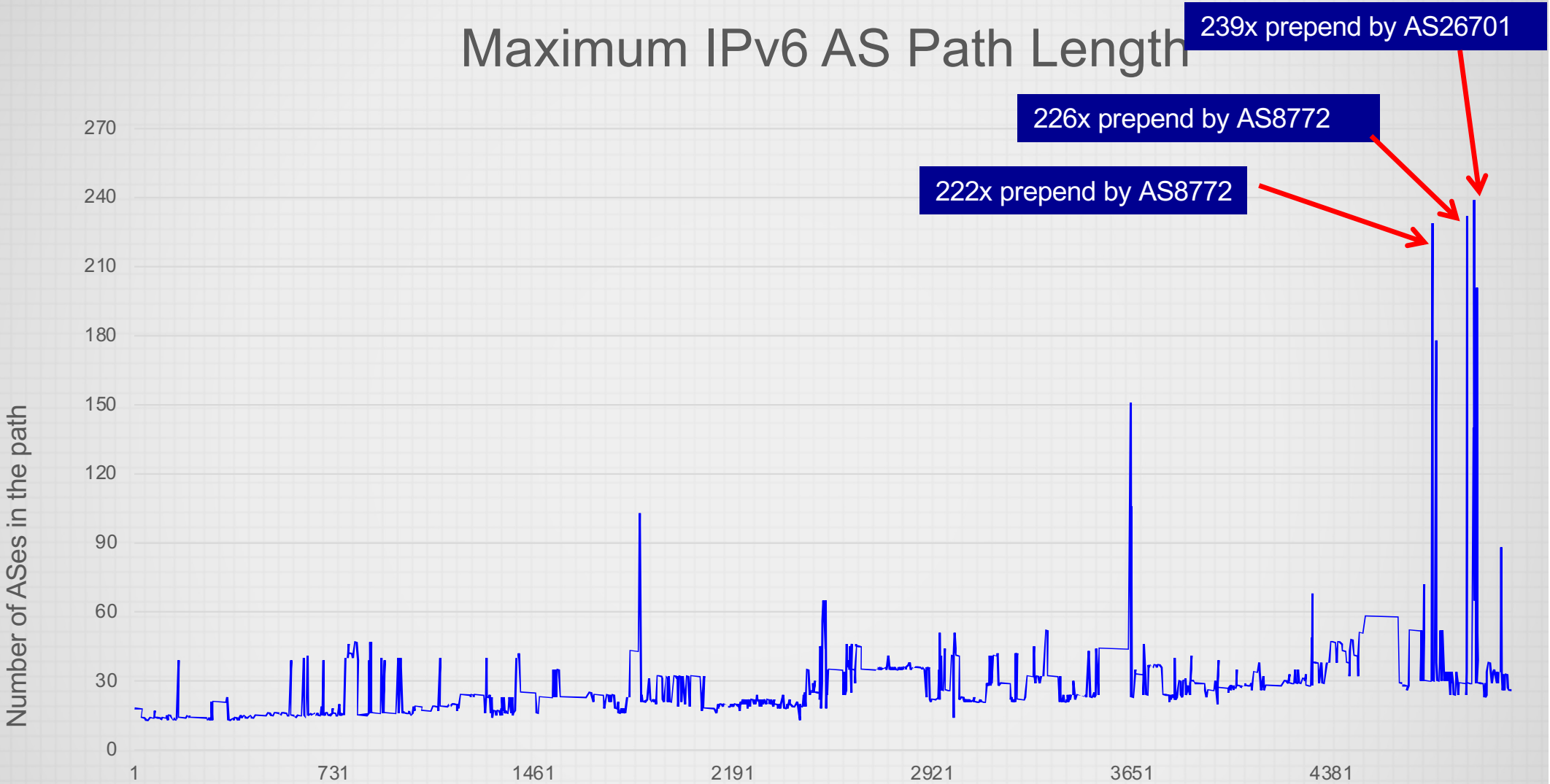
Maximum IPv6 AS Path Length



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Days since 11th September 2010

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Looking at Deaggregation in IPv4

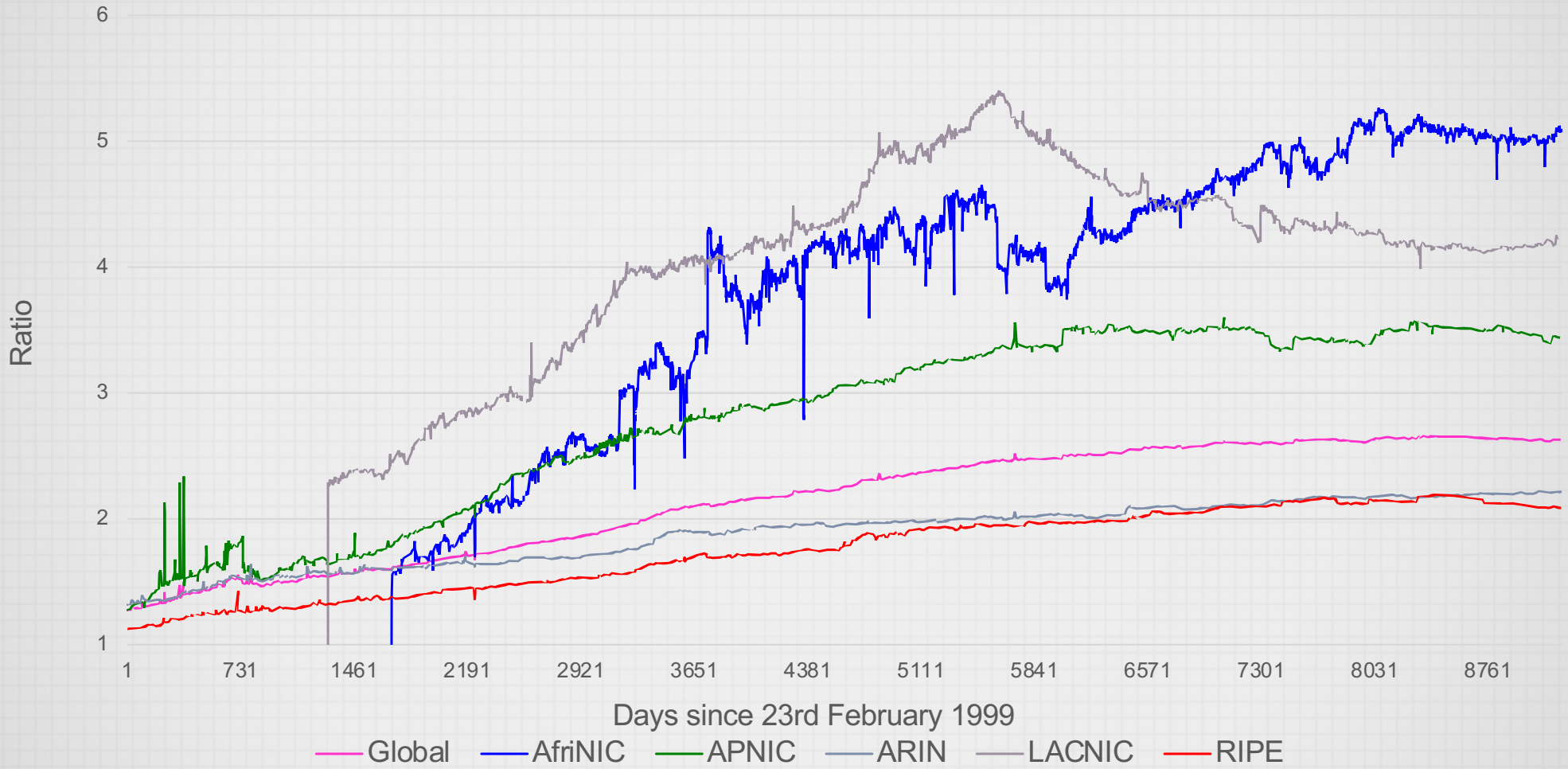
- Deaggregation Report
  - One summary takes BGP table and aggregates prefixes by origin AS
    - Called “Max Aggregation” in report
  - Global and per RIR basis
    - https://thyme.apnic.net/
  - For R&E networks worldwide
    - https://bgp.nsrc.org/REN/
  - For ISO-3166 economies
    - https://bgp.nsrc.org/REN/OIX/iso-3166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

July 2024

- Total Prefixes
- Global BGP Table
  - 955k prefixes
- North America
  - 278k prefixes
- Europe & Middle East
  - 266k prefixes
- Asia & Pacific
  - 256k prefixes
- Latin America & Caribbean
  - 122k prefixes
- Africa
  - 32k prefixes

- Deaggregation Factor
- Global Average
  - 2.63
- North America
  - 2.22
- Europe & Middle East
  - 2.09
- Asia & Pacific
  - 3.44
- Latin America & Caribbean
  - 4.17
- Africa
  - 5.10

Deaggregation: RIR Regions vs Global



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Asia Pacific Aggregation Savings Summary

ASN	No of Nets	Savings	Description
9808	9841	9764	CHINAMOBILE-CN China Mobile Communications Grou
7545	5653	4981	TPG-INTERNET-AP TPG Telecom Limited, AU
4538	4933	4859	ERX-CERNET-BKB China Education and Research Net
18403	4217	4194	FPT-AS-AP FPT Telecom Company, VN
7552	3960	3939	VIETEL-AS-AP Viettel Group, VN
7713	3624	3558	TELKOMNET-AS-AP PT Telekomunikasi Indonesia, ID
9498	3786	3522	BBIL-AP BHARTI Airtel Ltd., IN
45899	3263	3158	VNPT-AS-VN VNPT Corp, VN
24560	2823	2424	AIRTELBROADBAND-AS-AP Bharti Airtel Ltd., Telem
45090	2192	2113	TENCENT-NET-AP Shenzhen Tencent Computer System
4755	2197	1989	TATACOMM-AS TATA Communications formerly VSNL i
9829	1976	1940	BSNL-NIB National Internet Backbone, IN
23969	1944	1928	TOT-NET TOT Public Company Limited, TH
4766	2285	1706	KIXS-AS-KR Korea Telecom, KR
45609	1884	1567	BHARTI-MOBILITY-AS-AP Bharti Airtel Ltd. AS for
56047	1515	1467	CMNET-HUNAN-AP China Mobile communications corp
56046	1578	1463	CMNET-JIANGSU-AP China Mobile communications co
56041	1516	1445	CMNET-ZHEJIANG-AP China Mobile communications c
9583	1847	1310	SIFY-AS-IN Sify Limited, IN
17557	1250	1219	PKTELECOM-AS-PK Pakistan Telecommunication Comp

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

Philippines Aggregation Savings Summary

ASN	No of nets	/20 equiv	MaxAgg	Description
9658	545	66	22	ETPI-IDS-AS-AP Eastern Telecoms Phils.,
17639	541	117	41	CONVERGE-AS Converge ICT Solutions Inc.
132199	525	77	205	GLOBE-MOBILE-5TH-GEN-AS Globe Telecom I
9299	502	726	65	IPG-AS-AP Philippine Long Distance Tele
4775	414	161	47	GLOBE-TELECOM-AS Globe Telecoms, PH
6648	253	74	12	BAYAN-TELECOMMUNICATIONS Bayan Telecomm
55303	237	14	89	EAGLENET-AP 60 Market Square,P.O. Box 3
10139	193	43	9	SMARTBRO-PH-AP Smart Broadband, Inc., P
23944	148	32	21	SKYBB-AS-AP SKYBroadband SKYCable Corpo
135607	131	8	23	INFINIVAN-AS-AP Infinivan Incorporated,
23930	107	6	51	IPVG-AS-AP IP-Converge Data Center, Inc
18190	102	6	57	WWW-PH-AP SunValley New Oriental, PH
7629	101	43	16	EPLDT-AS-AP 5F L.V. Locsin Bldg, PH
9927	67	4	14	PHILCOMNET-PH Philippine Global Communi
4759	65	4	1	ITEXTRON-AS-AP TEXTRON CORPORATION, PH
17895	60	4	2	GLOBALREACH-AP Globalreach eBusiness Ne
55821	52	12	10	RADIUSTELECOMS-AS-AP RADIUS TELECOMS, I
18233	39	3	8	PTTNET Philippine Telegraph and Telepho
138965	37	2	5	SSTI-AS-AP Streamtech Systems Technolog
38553	37	2	4	DCNETWORK-AS-AP Dataconnect Network Ser

https://bgp.nsrc.org/REN/OIX/iso-3166/PH-ASnet

Philippines Address Span Summary

ASN	No of nets	/20 equiv	Description
9299	502	726	IPG-AS-AP Philippine Long Distance Telephone Co
4775	414	161	GLOBE-TELECOM-AS Globe Telecoms, PH
17639	541	117	CONVERGE-AS Converge ICT Solutions Inc., PH
132199	525	77	GLOBE-MOBILE-5TH-GEN-AS Globe Telecom Inc., PH
6648	253	74	BAYAN-TELECOMMUNICATIONS Bayan Telecommunicatio
9658	545	66	ETPI-IDS-AS-AP Eastern Telecoms Phils., Inc., P
10139	193	43	SMARTBRO-PH-AP Smart Broadband, Inc., PH
7629	101	43	EPLDT-AS-AP 5F L.V. Locsin Bldg, PH
23944	148	32	SKYBB-AS-AP SKYBroadband SKYCable Corporation,
55303	237	14	EAGLENET-AP 60 Market Square,P.O. Box 364, PH
55821	52	12	RADIUSTELECOMS-AS-AP RADIUS TELECOMS, INC., PH
17970	29	12	SKYBB-AS-AP SKYBroadband SKYCable Corporation,
139831	23	8	DTC-AS-AP DITO TELECOMMUNITY CORP., PH
135607	131	8	INFINIVAN-AS-AP Infinivan Incorporated, PH
3550	5	8	DEPTSCITECHREPH-AS-AP Philippine Network Founda
23930	107	6	IPVG-AS-AP IP-Converge Data Center, Inc., PH
18190	102	6	WWW-PH-AP SunValley New Oriental, PH
56207	18	4	COMCLARK-PH ComClark Network & Technology Corp,
56099	17	4	AVCHI-CLICK-AS-AP Asian Vision Cable, PH
45754	31	4	CLEARPATH-AS-AP Clear Path Networks Inc, PH

https://bgp.nsrc.org/REN/OIX/iso-3166/PH-CIDRnet

Collector Deployment

Locations

- At Internet Exchange Points
  - Or DataCentres hosting major interconnections
- Goal is to maximise opportunities for Autonomous Networks to peer with the RouteViews collector
- There are also multi-hop collectors hosted at the University of Oregon

Collector

- One interface on the IXP peering LAN
  - Peering with operators who wish to supply a BGP feed to the RouteViews collector
- One interface for management and backhaul
  - Managing the collector
  - Sending the collected BGP table & BGP updates for archival at the University of Oregon

Collector Data

Multi-Threaded Routing Toolkit (MRT)

- https://tools.ietf.org/html/rfc6396
- MRT provides a standard for parsing or dumping routing information to a binary file.
- RouteViews Dumps consist of BGP RIBs and UPDATES
  - RIBs are archived every 2 hours
  - UPDATEs are archived every 15 minutes

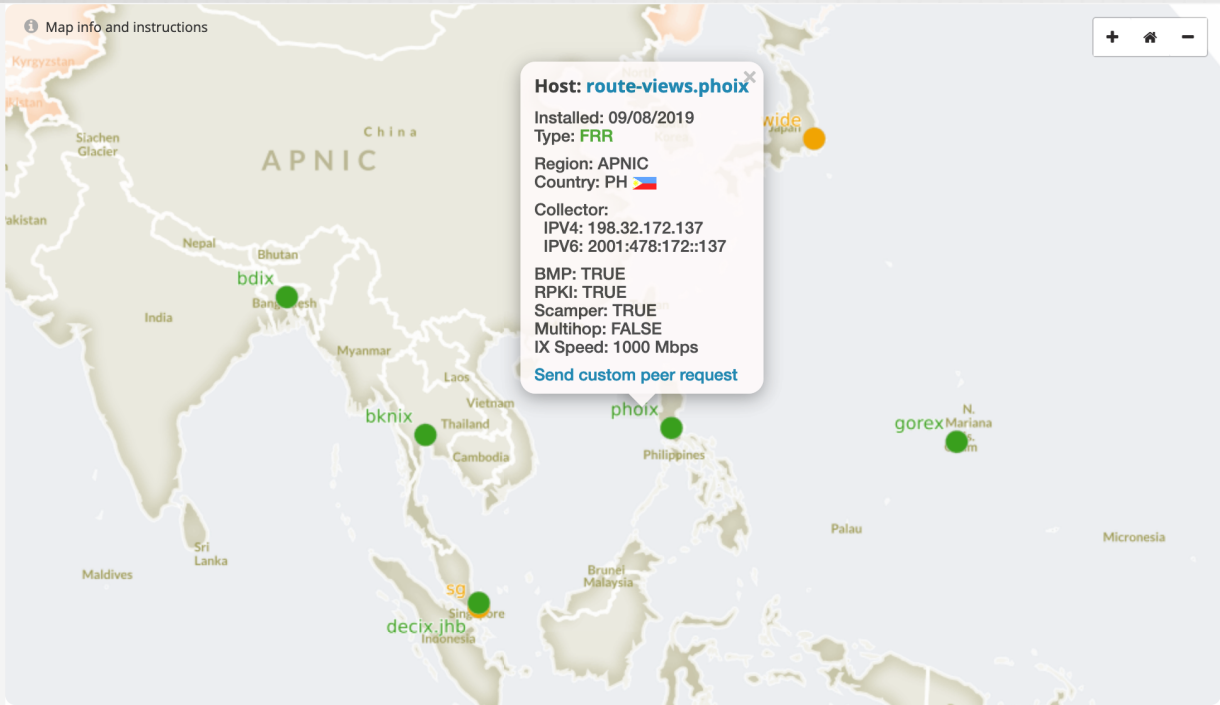
Data Access

- MRT files are bzipped and rsynced back to http://archive.routeviews.org/ on above schedule
- They can be accessed via http, ftp and rsync
- Map view tool is interactive

Direct BGP Monitoring Protocol Feed (BMP)

- New Model, development under way to make this scale
- BMP upstream from collectors, not FROM peers

Collector Data



Index of /route-views.phoix/bgpdata

Name	Last modified	Size	Description
Parent Directory		-	
2019.08/	2019-08-08 22:58	-	
2019.09/	2019-08-28 23:01	-	
2019.10/	2019-09-28 23:01	-	
2019.11/	2019-10-28 23:01	-	
2019.12/	2019-11-28 23:01	-	
2020.01/	2019-12-28 23:01	-	
2020.02/	2020-01-28 23:01	-	
2020.03/	2020-02-28 23:01	-	
2020.04/	2020-03-28 23:01	-	
2020.05/	2020-04-28 23:01	-	
2020.06/	2020-05-28 23:01	-	
2020.07/	2020-06-28 23:01	-	
2020.08/	2020-07-28 23:01	-	
2020.09/	2020-08-28 23:01	-	

http://archive.routeviews.org/route-views.phoix/bgpdata/

Operations

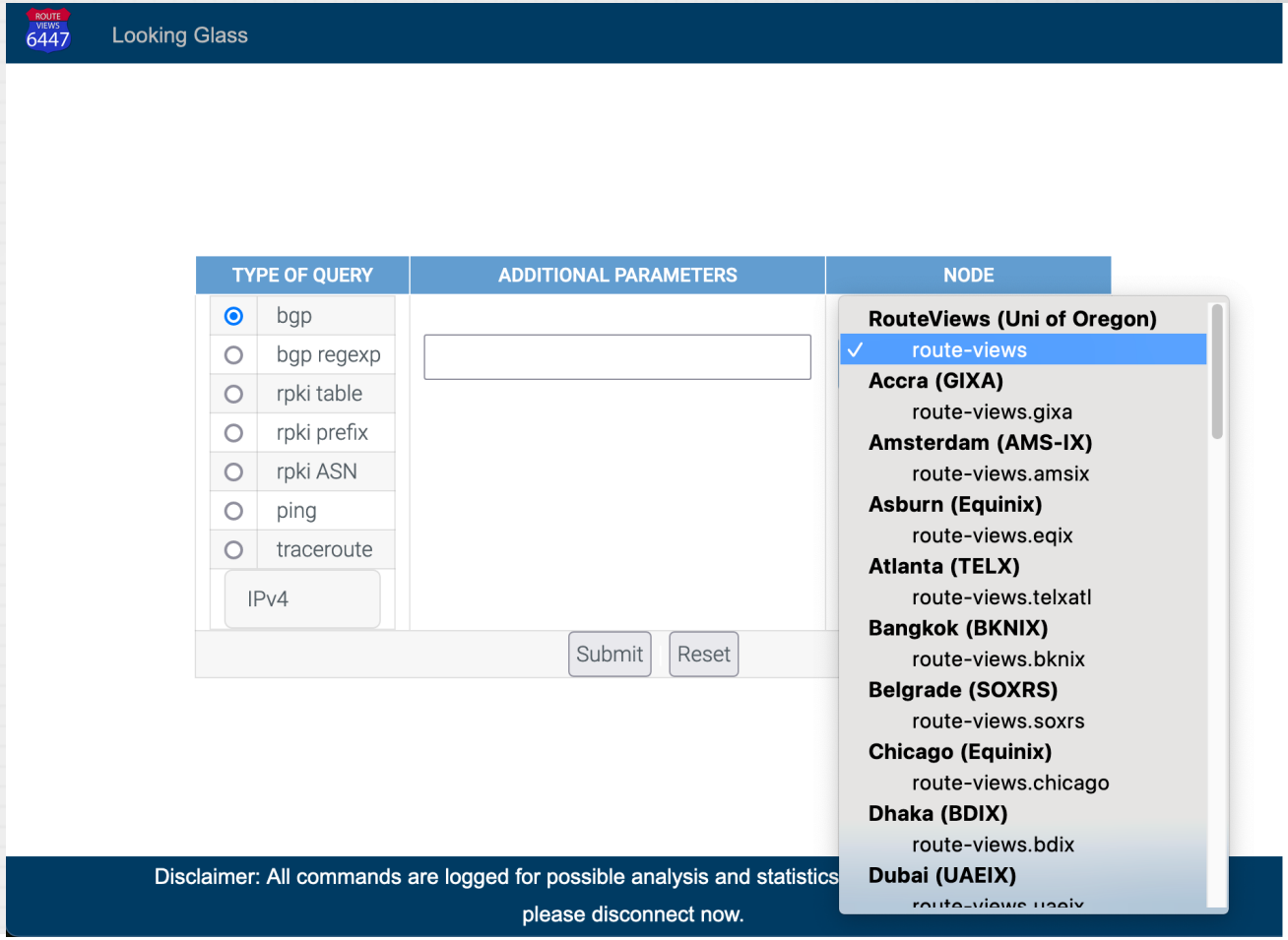
Access

- BGP is the backbone of the Global Routing Infrastructure.
- To ensure its stability, it needs to be constantly monitored.
- RouteViews provides:
  - Command-Line/Looking Glass
  - Prefix Visibility, Verify Convergence, Path Stability
  - Comparing Local/Regional/Global Views
  - Troubleshooting Reachability
  - Access to historical BGP data, i.e. “When did this happen??”

Operations

Looking Glass

- Looking Glass front-end as an alternative access is being tested
- This will likely replace the telnet access in the near future



Operations

API

- A new enhanced API coming soon
- Allows programmatic access to many of the RouteViews collectors live data
- Please do NOT set up automated scripts logging into collectors and doing “show bgp *things*”
  - Many folks hammer the RouteViews collectors with automated scripting 😭😡
  - Please use the API !!

Use Cases – Multihop Collector

Operations

32 peers, multi-hop

Lots of full tables

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

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

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
147.28.7.2      4       3130    262297       377  2376140    0    0 06:14:18       918899        0 RGnet, LLC
162.251.163.2   4      53767     40301       751  2376140    0    0 06:14:18       166509        0 ICASTCENTER
```

Use Cases – PhOpenIX Collector

Operations

Only 3 working dual stack peers and 2 IPv4-only peers 😭

```
route-views.phoix.routeviews.org> sh bgp sum

IPv4 Unicast Summary:
BGP router identifier 198.32.172.137, local AS number 6447 VRF default vrf-id 0
BGP table version 14685684
RIB entries 1793017, using 164 MiB of memory
Peers 5, using 101 KiB of memory

Neighbor        V         AS   MsgRcvd   MsgSent   TblVer  InQ OutQ  Up/Down State/PfxRcd   PfxSnt Desc
198.32.172.4    4       4775     25293     16532 14685684    0    0 5d17h43m         1199        0 Globe Telecom
198.32.172.125  4     135423     17339     16532 14685684    0    0 5d17h43m           26        0 Totl Information
198.32.172.129  4     137818     10221      8272 14685684    0    0 2d19h01m          165        0 Panay Telephone
198.32.172.156  4     142271   4120009     16532 14685684    0    0 5d17h43m       747880        0 ESW / DS Networks
198.32.172.170  4     150000   3917204      8112 14685684    0    0 14:12:01       970089        0 Data-Beam Business

Total number of neighbors 5

IPv6 Unicast Summary:
BGP router identifier 198.32.172.137, local AS number 6447 VRF default vrf-id 0
BGP table version 10018955
RIB entries 399096, using 37 MiB of memory
Peers 4, using 80 KiB of memory

Neighbor          V         AS   MsgRcvd   MsgSent   TblVer  InQ OutQ  Up/Down State/PfxRcd   PfxSnt Desc
2001:478:172::4   4       4775     16537     16531 10018955    0    0 5d17h43m            3        0 Globe Telecom
2001:478:172::129 4     137818         0         0        0    0    0    never       Active        0 Panay Telephone
2001:478:172::156 4     142271   3808285     16531 10018955    0    0 5d17h43m       103426        0 ESW / DS Networks
2001:478:172::170 4     150000    589403      8112 10018955    0    0 14:12:26       199048        0 Data-Beam Business

Total number of neighbors 4
```

PhOpenIX Collector

How to make useful??

- Currently only one peer giving us full IPv4 and IPv6 routes
- Two others giving their domestic PH tables
- According to PeeringDB (https://www.peeringdb.com/ix/1561) there are 44 participants!
- Request:
  - Please peer with RouteViews
  - Costs you nothing
  - Peering helps the Philippine Internet community with routing operations and troubleshooting
- Peering Request – email to help@routeviews.org with:
  - PeeringDB entry URL (https://www.peeringdb.com/asn/<ASN>)
  - Contact details (in addition to PeeringDB)
  - On receipt we will set up the BGP sessions (IPv4 and IPv6)
  - Inactive entries are removed after 2 weeks

Use Cases

Operations

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

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

```
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 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
```

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 ?
...
```

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
V*  1.6.4.0/22       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
...
```

RouteViews Impact

Geoff Huston wrote in his report, "BGP in 2022 – the routing table":

"I should take a moment to mention the RouteViews Project. It was originally intended to offer a multi-perspective real-time view of the inter-domain routing system, allowing network operators to examine the current visibility of route objects from various points in the inter-domain topology.

What makes RouteViews so unique is that it archives these routing tables every two hours and has done so for more than two decades. It also archives every BGP update message. ***This vast collection of data is a valuable research data source in its own right****, and here we are just taking a tiny slice of this data set to look at longer-term routing growth trends.*

The folk at the RouteViews Project, with support from the University of Oregon and the US National Science Foundation, should be commended for their efforts here. This is a very unique data set if you are interested in the evolution of the Internet over the years."

RouteViews Impact

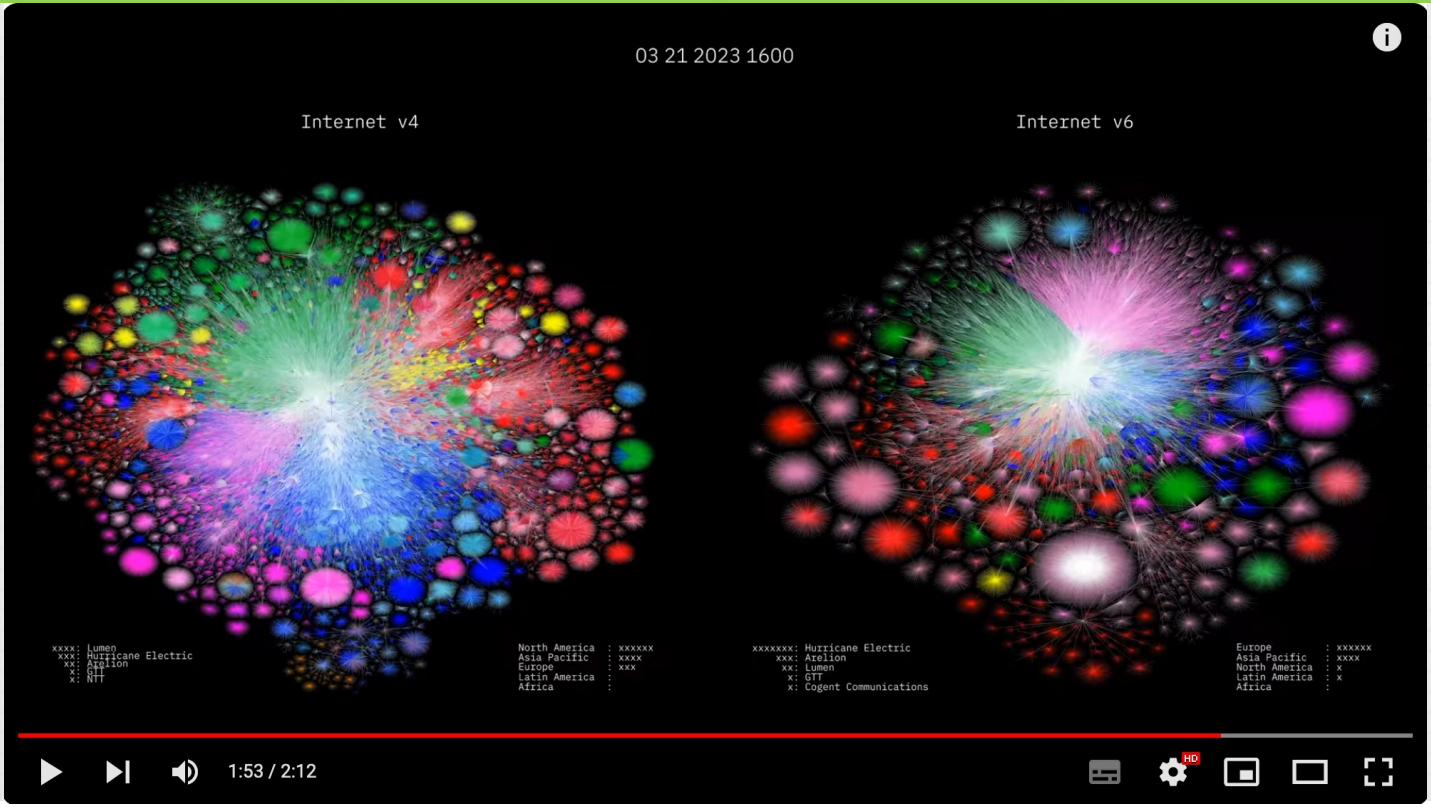
Aftab Siddiqui

"The MANRS Observatory relies heavily on BGPStream and GRIP for the detection of BGP related incidents such as BGP Leaks and BGP mis-origination. It is also very critical to verify that any incident highlighted by these services can be verified independently and to do that ***we require raw BGP data which is made available by 2 sources: RIPE RIS and RouteViews.*** *Diversity of data sources is once again very important to verify any such incidents. NSRC, which manages the RouteViews project, ensures that the routing data they provide is accurate and they have promptly addressed any issues or concerns raised by the MANRS team, whether it is related to changes in the MRT format causing problems in data parsing or helping with BMP data.* ***Actively maintaining RouteViews provides community service by NSRC.***

MANRS has gained a lot of good reputation in the community due to the support and expertise provided by its partners such as NSRC. NSRC included MANRS Action explanation and implementation guidelines in their training courses for network operators and R&E networks, in their technical video content, and has been promoting various MANRS programs to respective communities specifically in Asia Pacific and Africa where the MANRS participation is low as compared to other regions."

RouteViews Impact

Barrett Lyon: https://www.youtube.com/watch?v=vo5glK9czIE



UNIVERSITY OF OREGON

NSRC Network Startup Resource Center

THANK YOU

Questions?