



Internet Routing Table Analysis Update

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SANOG 38

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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 from 23rd February 1999:
 - Routing table size
 - CIDR-Report style reporting on a per-RIR basis
 - ...and many other interesting features
- Started recording global IPv6 table in September 2010

IPv4 Routing Report 11th July 2022

BGP routing table entries examined:	902815
Prefixes after maximum aggregation (per Origin AS):	340343
Deaggregation factor:	2.65
Unique aggregates announced (without unneeded subnets):	436338
Total ASes present in the Internet Routing Table:	73378
Prefixes per ASN:	12.30
Origin-only ASes present in the Internet Routing Table:	62965
Origin ASes announcing only one prefix:	25896
Transit ASes present in the Internet Routing Table:	10413
Transit-only ASes present in the Internet Routing Table:	395
Average AS path length visible in the Internet Routing Table:	4.3
Max AS path length visible:	61
Max AS path prepend of ASN (37447)	57
Prefixes from unregistered ASNs in the Routing Table:	995
Number of instances of unregistered ASNs:	1001
Special use prefixes present in the Routing Table:	1
Prefixes being announced from unallocated address space:	514
Number of addresses announced to Internet:	3067942784
Equivalent to 182 /8s, 221 /16s and 23 /24s	
Total number of prefixes smaller than registry allocations:	306700

APNIC Region

Prefixes being announced by APNIC Region ASes:	235536
Total APNIC prefixes after maximum aggregation:	66972
APNIC Deaggregation factor:	3.52
Prefixes being announced from the APNIC address blocks:	230653
Unique aggregates announced from the APNIC address blocks:	95583
APNIC Region origin ASes present in the Internet Routing Table:	12763
APNIC Prefixes per ASN:	18.07
APNIC Region origin ASes announcing only one prefix:	3686
APNIC Region transit ASes present in the Internet Routing Table:	1741
Average APNIC Region AS path length visible:	4.7
Max APNIC Region AS path length visible:	25
Number of APNIC region 32-bit ASNs visible in the Routing Table:	7977
Number of APNIC addresses announced to Internet:	773037568
Equivalent to 46 /8s, 19 /16s and 158 /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, 131072-147769
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	8535	3443	592	Uninet S.A. de C.V., MX
9808	7570	9000	58	CMNET-GD Guangdong Mobile Communication
12479	6723	1721	140	UNI2-AS, ES
7545	5788	783	678	TPG-INTERNET-AP TPG Telecom Limited, AU
16509	5205	9529	2322	AMAZON-02, US
11492	4791	316	669	CABLEONE, US
4538	4765	4192	74	ERX-CERNET-BKB China Education and Rese
7155	4027	264	32	VIASAT-SP-BACKBONE, US
22773	3961	3013	262	ASN-CXA-ALL-CCI-22773-RDC, US
20940	3662	3347	206	AKAMAI-ASN1, NL
7552	3545	1330	20	VIETEL-AS-AP Viettel Group, VN
7713	3528	1023	56	TELKOMNET-AS-AP PT Telekomunikasi Indon
16625	3505	1811	2442	AKAMAI-AS, US
10620	3406	525	650	Telmex Colombia S.A., CO
6327	3360	1317	69	SHAW, CA
39891	3267	187	22	ALJAWWALSTC-AS, SA
8551	2997	378	40	BEZEQ-INTERNATIONAL-AS Bezeqint Interne
12389	2907	2281	894	ROSTELECOM-AS, RU
45899	2800	1897	55	VNPT-AS-VN VNPT Corp, VN
30036	2579	372	134	MEDIACOM-ENTERPRISE-BUSINESS, US

AfriNIC APNIC ARIN LACNIC RIPE NCC



What about IPv6 ?

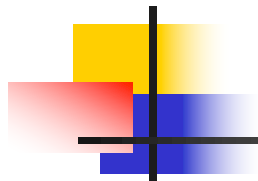
IPv6 Routing Report 10th July 2022 (London)

BGP routing table entries examined:	147084
Number of IPv6 prefixes with a valid ROA:	62542
Number of IPv6 prefixes with an invalid ROA:	601
Number of IPv6 prefixes with no ROA:	83941
Total ASNs present in the IPv6 Routing Table:	28447
Average AS path length:	4.2
Longest AS path:	38
Total Origin ASNs present in the IPv6 Routing Table:	28145
Paths with bogon ASNs present in the IPv6 Routing Table:	4

Global IPv6 per AS prefix count summary (London)

ASN	No of Nets	Description
11172	3869	Alestra, S. de R.L. de C.V., MX
17622	2380	CNCGROUP-GZ China Unicom Guangzhou network, CN
16509	2278	AMAZON-02, US
45609	2265	BHARTI-MOBILITY-AS-AP Bharti Airtel Ltd. AS for GPRS Service
7552	2167	VIETEL-AS-AP Viettel Group, VN
45271	1810	ICLNET-AS-AP Idea Cellular Limited, IN
9808	1721	CHINAMOBILE-CN China Mobile Communications Group Co., Ltd.,
24547	1620	CMNET-V4HEBEI-AS-AP Hebei Mobile Communication Company Limit
12479	1607	UNI2-AS, ES
28573	1486	Claro NXT Telecomunicacoes Ltda, BR
17623	1438	CNCGROUP-SZ China Unicom Shenzen network, CN
36183	1341	AKAMAI-AS, US
39891	1272	ALJAWWALSTC-AS, SA
22773	1245	ASN-CXA-ALL-CCI-22773-RDC, US
32098	1129	TRANSTELCO-INC, US
62240	1116	CLOUVIDER Clouvider - Global ASN, GB
56046	1093	CMNET-JIANGSU-AP China Mobile communications corporation, CN
38266	1072	VODAFONE-IN Vodafone India Ltd., IN
13335	1052	CLOUDFLARENET, US
17072	972	TOTAL PLAY TELECOMUNICACIONES SA DE CV, MX

AfriNIC APNIC ARIN LACNIC RIPE NCC



Non-routable ASNs for IPv6

List of Unregistered Origin ASNs

Bad AS	Designation	Net Originated	Transit AS	Transit AS Name
65206	PRIVATE	2001:f40:11::/48	9930	TTNET-MY, MY
65540	DOCUMENT	2a0c:a641::/32	42298	GCC-MPLS-peering, QR

Network	Path
N*> 2001:948::/29	17660 2603 {1653,39590,64530,64540,64541,65002,65003,65004,65005,65006,65007,65008,65009,65010,65430}
I*> 2001:f40:11::/48	17660 9930 65206
N*> 2a0a:bcc0::/29	17660 2603 1653 41001 {64600,65001,65002,65501,65502}
N*> 2a0c:a641::/32	17660 6453 3257 8781 42298 65540



Deprecated AS Set

- Use of BGP AS Set is not recommended
 - RFC6472/BCP172 (December 2011)
 - Still some in both IPv4 and IPv6 BGP tables
 - IPv4 has 323 entries
 - IPv6 has 36 entries

IPv4 Prefixes using Deprecated AS_SET

Net Originated	AS Path
15.36.64.0/18	17660 2687 25888 {21326}
20.133.40.0/21	17660 6453 3356 22562 {17916}
20.137.0.0/21	17660 6453 3356 21877 {4237}
20.137.160.0/20	17660 6453 3356 206 {4237}
20.137.176.0/20	17660 6453 3356 21877 {4237}
20.137.240.0/20	17660 6453 3356 21877 {4237}
20.148.32.0/19	17660 6453 3356 21877 {4237}
23.56.208.0/24	17660 2914 20940 {12222}
23.200.20.0/24	17660 6453 3257 20940 20940 {12222}
37.52.0.0/14	17660 1299 6849 {6877}
37.142.0.0/17	17660 1299 8657 12849 {21450}
37.142.128.0/17	17660 1299 8657 12849 {21450}
37.221.128.0/19	17660 1299 25291 3255 {62384}
41.196.34.0/23	17660 6453 5511 24863 {37069}
41.215.160.0/20	17660 6453 174 37613 37030 {37140}
41.215.160.0/21	17660 2914 6453 37282 37030 {37140}
41.215.162.0/24	17660 6453 174 37613 37030 {37140}
41.215.168.0/21	17660 6453 37282 37030 {37140}
45.40.128.0/20	17660 1299 26496 {398101}
45.40.132.0/22	17660 1299 26496 {398101}
45.40.140.0/22	17660 1299 26496 {398101}
45.40.160.0/22	17660 1299 26496 {398101}
45.89.32.0/22	17660 6453 3356 35913 35913 35913 35913 35913 35913 35913 35913 {10912,12189,19437,29791}
46.200.0.0/14	17660 1299 6849 {6877}
49.231.25.0/24	17660 45430 45458 {132681}
50.62.0.0/20	17660 1299 26496 {398101}
50.62.4.0/22	17660 1299 26496 {398101}
...	
216.221.212.0/22	17660 6453 3356 26585 26585 {26585}
216.221.220.0/22	17660 6453 3356 26585 26585 {26585}
217.24.112.0/20	17660 1299 12389 {28860}
217.25.32.0/20	17660 2119 25146 41943 {41943}
217.27.240.0/20	17660 2914 29006 {36483}
217.112.32.0/20	17660 1299 20485 40966 40966 40966 40966 {30943}
217.114.48.0/20	17660 1299 25460 25460 {30847}
217.168.16.0/20	17660 2914 29006 {36483}

IPv6 Prefixes using Deprecated AS_SET

Net Originated	AS Path
2001:410::/32	17660 1299 2603 2603 2603 6509 {271,7860,8111,10972,53904}
2001:510::/32	17660 2914 6453 376 {36786}
2001:6d0:8000::/48	17660 1299 20485 8985 {42385}
2001:948::/29	17660 2603 {1653,39590,64530,64540,64541,65002,65003,65004,65005,65006,65007,65008,65009,65010,65430}
2001:1208::/32	17660 1299 8151 {3905}
2001:4220::/32	17660 6453 1299 1273 24835 {36935}
2001:4220::/33	17660 6453 1299 1273 24835 {36935}
2400:5200:402::/48	17660 6939 4637 55410 {16625}
2402:7500::/32	17660 2914 3491 9924 {24158}
2404:c000::/32	17660 2914 6453 7473 45147 {7713,9002,16625,17727,23693,55818}
2404:c000::/33	17660 2914 6453 7473 45147 {16625,55818}
2600:140f:d400::/48	17660 6939 4637 55410 {16625}
2604:7ac0:e00::/40	17660 2914 3356 12213 {29802}
2606:b400:8814::/48	17660 2914 3356 7160 {7160}
2607:f390::/32	17660 6453 174 32440 {2055,17244}
2607:f7a8:600::/39	17660 2914 3356 46887 {397488}
2607:f7a8:800::/39	17660 2914 3356 46887 {395749}
2607:f7a8:c00::/39	17660 2914 3356 46887 {21687}
2607:f7b8::/32	17660 1299 10490 {2637}
2800:480::/32	17660 1299 14080 14080 14080 14080 14080 14080 14080 14080 14080 14080 14080 14080 14080 {264718}
2800:482::/32	17660 2914 6453 14080 14080 14080 14080 14080 14080 {10620}
2800:484::/32	17660 2914 6453 14080 {10620}
2800:485::/32	17660 2914 6453 14080 {10620}
2800:800:930::/48	17660 2914 3491 14080 {26611}
2800:800:940::/48	17660 2914 3491 14080 {26611}
2800:800:950::/48	17660 1299 14080 14080 14080 14080 14080 14080 14080 14080 14080 14080 {26611}
2800:800:960::/48	17660 2914 3491 14080 {26611}
2803:3b80:4000::/36	17660 6453 6762 263702 263702 263702 {263702}
2806:1030::/32	17660 6453 8151 {20940}
2806:1070::/32	17660 6453 8151 {3905,20940}
2a00:6480::/32	17660 8365 35548 {29018}
2a01:1b0::/32	17660 1299 31477 31477 {51923}
2a01:6480:10::/48	17660 1299 29049 {199524}
2a02:ac00::/29	17660 2914 3356 6717 {6717}
2a03:f600::/32	17660 1299 3301 25146 {41943}
2a0a:bcc0::/29	17660 2603 1653 41001 {64600,65001,65002,65501,65502}



Unassigned resources

- Use of unassigned address space is rampant
 - Currently 512 unassigned prefixes in IPv4 routing table
- Use of unassigned ASNs is also a big problem
 - Currently 377 unassigned ASNs in use
- Many are transited by well known / reputable operators
 - Why??

List of Unregistered Origin ASNs

The complete list in use:

940, 1636, 3577, 4879, 6485, 6565, 7363, 10425, 10926, 10931, 10981, 11011, 11044, 11091, 11223, 11316, 11490, 11610, 11636, 11825, 11945, 11967, 11969, 11974, 12176, 12240, 13224, 13317, 13339, 13342, 13492, 13520, 13717, 13980, 14046, 14076, 14350, 14428, 14439, 14461, 14545, 14552, 14594, 14605, 14651, 14889, 15037, 15115, 15132, 15178, 15182, 15200, 15220, 15329, 15804, 16615, 16769, 16804, 16809, 17341, 18604, 18691, 18781, 18796, 18798, 18805, 18821, 18976, 19023, 19081, 19140, 19142, 19176, 19330, 19359, 19507, 19521, 19533, 19658, 19700, 19708, 20089, 20118, 20190, 20200, 20227, 20421, 20443, 20447, 21584, 21666, 21695, 21714, 21861, 21986, 22063, 22160, 22226, 22272, 22484, 22538, 22539, 22694, 22733, 22736, 22743, 22774, 22830, 23021, 23176, 23190, 23194, 23288, 23357, 23411, 23448, 23507, 23985, 25568, 25600, 25641, 25647, 25800, 25831, 25922, 25978, 26015, 26016, 26018, 26051, 26137, 26140, 26286, 26295, 26341, 26345, 26520, 26643, 26663, 26682, 26701, 26712, 26759, 26861, 26922, 26986, 27174, 27180, 27247, 27289, 27291, 27384, 27426, 27470, 28102, 29763, 29829, 29855, 29987, 30004, 30006, 30037, 30104, 30155, 30265, 30442, 30550, 30654, 30699, 31781, 31813, 32021, 32121, 32187, 32203, 32282, 32346, 32358, 32467, 32497, 32534, 32581, 32596, 32772, 32842, 33017, 33023, 33042, 33123, 33137, 33232, 33394, 33417, 33484, 33625, 33628, 33684, 33732, 35948, 36002, 36267, 36283, 36357, 36465, 36774, 36893, 36900, 36911, 36928, 36979, 37034, 37155, 37169, 37320, 37338, 37442, 37475, 37476, 37544, 37555, 37591, 37703, 38055, 39991, 40186, 40255, 40279, 40340, 40503, 40600, 40687, 40745, 40751, 40779, 40909, 40920, 44428, 45210, 46086, 46123, 46161, 46226, 46228, 46233, 46355, 46472, 46501, 46559, 46614, 46673, 46766, 46772, 46815, 46876, 46916, 47044, 47069, 47086, 50183, 52666, 52761, 53211, 53298, 53367, 53419, 53552, 53657, 53715, 53771, 53775, 53854, 53929, 53947, 54148, 54209, 54218, 54231, 54262, 54278, 54338, 54424, 54427, 54517, 54518, 54590, 54752, 54753, 54776, 54787, 55289, 56096, 62711, 62828, 63092, 63190, 63198, 63305, 63387, 63390, 63401, 64011, 64203, 64257, 64339, 64513, 64612, 65000, 65206, 65379, 65401, 65999, 133617, 134952, 138611, 139692, 140549, 141391, 141730, 227171, 261050, 263092, 264085, 264245, 264379, 264493, 265039, 268652, 269062, 269948, 327869, 327928, 327933, 328007, 328226, 328369, 393266, 393305, 393314, 393320, 393322, 393377, 393446, 393491, 393493, 393588, 393866, 394076, 394156, 394183, 394293, 394376, 394402, 394519, 394607, 394721, 394787, 394788, 394856, 394879, 394936, 394939, 395270, 395281, 395350, 395438, 395514, 395858, 395898, 396015, 396330, 396993, 397096, 397186, 397306, 398083, 398118, 398480

List of Unregistered Origin ASNs

Far too many to list. See <http://thyme.apnic.net/current/data-badAS>:

Bad AS	Designation	Net Originated	Transit AS	Transit AS Name
53775	UNALLOCATED	8.20.88.0/24	7029	WINDSTREAM, US
62828	UNALLOCATED	8.21.130.0/24	3356	LEVEL3, US
393266	UNALLOCATED	8.23.52.0/24	46887	LIGHTTOWER, US
18604	UNALLOCATED	8.25.204.0/24	3356	LEVEL3, US
394936	UNALLOCATED	8.33.224.0/24	22442	HOU-PHONOSCOPE, US
54338	UNALLOCATED	8.33.241.0/24	6461	ZAYO-6461, US
18798	UNALLOCATED	8.40.106.0/24	6461	ZAYO-6461, US
394856	UNALLOCATED	8.40.216.0/24	3356	LEVEL3, US
395438	UNALLOCATED	8.42.206.0/24	3356	LEVEL3, US
395281	UNALLOCATED	12.4.40.0/23	7018	ATT-INTERNET4, US
395281	UNALLOCATED	12.4.42.0/23	7018	ATT-INTERNET4, US
15132	UNALLOCATED	12.9.150.0/24	1239	SPRINTLINK, US
13342	UNALLOCATED	12.17.5.0/24	174	COGENT-174, US
3577	UNALLOCATED	12.19.197.0/24	209	CENTURYLINK-US-LEGACY-QWEST,
26345	UNALLOCATED	12.21.93.0/24	20115	CHARTER-20115, US
26341	UNALLOCATED	12.33.109.0/24	7018	ATT-INTERNET4, US
21861	UNALLOCATED	12.37.59.0/24	7018	ATT-INTERNET4, US
33684	UNALLOCATED	12.37.144.0/24	6461	ZAYO-6461, US
13317	UNALLOCATED	12.44.10.0/24	7018	ATT-INTERNET4, US
397306	UNALLOCATED	12.44.212.0/24	209	CENTURYLINK-US-LEGACY-QWEST,
63305	UNALLOCATED	12.49.58.0/24	7018	ATT-INTERNET4, US
33684	UNALLOCATED	12.68.34.0/24	6461	ZAYO-6461, US
31781	UNALLOCATED	12.71.107.0/24	7018	ATT-INTERNET4, US
21861	UNALLOCATED	12.106.212.0/24	7018	ATT-INTERNET4, US
26295	UNALLOCATED	12.110.210.0/23	7018	ATT-INTERNET4, US

List of Unregistered Origin ASNs

Far too many to list. See <http://thyme.apnic.net/current/data-badAS>:

Bad AS	Designation	Net Originated	Transit AS	Transit AS Name
36928	UNALLOCATED	41.205.237.0/24	327903	MICG, SL
36928	UNALLOCATED	41.205.238.0/24	327903	MICG, SL
36928	UNALLOCATED	41.205.239.0/24	327903	MICG, SL
36928	UNALLOCATED	41.205.240.0/24	327903	MICG, SL
36928	UNALLOCATED	41.205.241.0/24	327903	MICG, SL
36900	UNALLOCATED	41.220.48.0/20	29614	GHANATEL-AS, GH
36979	UNALLOCATED	41.223.146.0/24	29091	IPNXng, NG
327933	UNALLOCATED	41.242.128.0/24	37451	CongoTelecom, CG
327933	UNALLOCATED	41.242.129.0/24	37451	CongoTelecom, CG
327933	UNALLOCATED	41.242.130.0/24	37451	CongoTelecom, CG
327933	UNALLOCATED	41.242.131.0/24	37451	CongoTelecom, CG
133617	UNALLOCATED	43.240.92.0/22	9304	HUTCHISON-AS-AP HGC Global C
133617	UNALLOCATED	43.240.92.0/24	135081	NTRP-AS-AP RP Global, HK
133617	UNALLOCATED	43.240.93.0/24	135081	NTRP-AS-AP RP Global, HK
133617	UNALLOCATED	43.240.94.0/24	135081	NTRP-AS-AP RP Global, HK
133617	UNALLOCATED	43.240.95.0/24	19551	INCAPSULA, US
394183	UNALLOCATED	45.75.202.0/24	49425	DIGITAL-REALTY-UK, GB
268652	UNALLOCATED	45.165.20.0/22	264493	UNASSIGNED
269062	UNALLOCATED	45.179.20.0/24	266233	NEWMASTER TELECOM, BR
269062	UNALLOCATED	45.179.22.0/24	266233	NEWMASTER TELECOM, BR
269062	UNALLOCATED	45.179.23.0/24	266932	UP NET TECNOLOGIA DE REDES L
22271	UNALLOCATED	47.19.86.0/24	17378	AS17378, US
19926	UNALLOCATED	47.19.143.0/24	54004	OPTIMUM-WIFI2, US
14552	UNALLOCATED	50.58.72.0/24	701	UUNET, US
54590	UNALLOCATED	50.58.74.0/24	3356	LEVEL3, US

List of Unassigned addresses

Far too many to list. See <http://thyme.apnic.net/current/data-add-IANA>:

Unassigned Network	ASN Information	AS Name
23.141.0.0/24	Origin: 395350	UNASSIGNED
	Transit: 11426	TWC-11426-CAROLINAS, US
27.100.7.0/24	Origin: 56096	UNASSIGNED
	Transit: 45455	TH-2S1N-AP Two S One N Co Ltd, Internet
41.57.124.0/22	Origin: 37442	UNASSIGNED
	Transit: 37204	TELONE, ZW
41.57.124.0/23	Origin: 37442	UNASSIGNED
	Transit: 37204	TELONE, ZW
<snip>		
41.67.224.0/22	Origin: 15964	CAMNET-AS, CM
	Transit: 12956	TELXIUS TELXIUS Cable, ES
41.72.0.0/23	Origin: 37155	UNASSIGNED
	Transit: 17400	EBONET, AO
<snip>		
41.74.44.0/24	Origin: 37544	UNASSIGNED
	Transit: 15964	CAMNET-AS, CM
41.77.64.0/21	Origin: 37320	UNASSIGNED
	Transit: 29614	GHANATEL-AS, GH
41.77.208.0/22	Origin: 37475	UNASSIGNED
	Transit: 15964	CAMNET-AS, CM
41.77.240.0/21	Origin: 35251	NETLAB, CA
	Transit: 8100	ASN-QUADRANET-GLOBAL, US
41.78.60.0/22	Origin: 6762	SEABONE-NET TELECOM ITALIA SPARKLE S.p.A
	Transit: 2516	KDDI KDDI CORPORATION, JP
41.78.204.0/22	Origin: 37475	UNASSIGNED
	Transit: 15964	CAMNET-AS, CM

List of Unassigned addresses

Far too many to list. See <http://thyme.apnic.net/current/data-add-IANA>:

Unassigned Network	ASN Information	AS Name
41.242.130.0/24	Origin: 327933	UNASSIGNED
	Transit: 37451	CongoTelecom, CG
41.242.131.0/24	Origin: 327933	UNASSIGNED
	Transit: 37451	CongoTelecom, CG
43.240.92.0/22	Origin: 133617	,
	Transit: 9304	HUTCHISON-AS-AP HGC Global Communication
43.240.92.0/24	Origin: 133617	,
	Transit: 135081	NTRP-AS-AP RP Global, HK
43.240.93.0/24	Origin: 133617	,
	Transit: 135081	NTRP-AS-AP RP Global, HK
43.240.94.0/24	Origin: 133617	,
	Transit: 135081	NTRP-AS-AP RP Global, HK
43.240.95.0/24	Origin: 133617	,
	Transit: 19551	INCAPSULA, US
43.250.235.0/24	Origin: 133948	DIL-AS-AP DONGFONG INC LIMITED, HK
	Transit: 4637	ASN-TELSTRA-GLOBAL Telstra Global, HK
45.252.60.0/22	Origin: 55933	CLOUDIE-AS-AP Cloudie Limited, HK
	Transit: 6939	HURRICANE, US
45.252.60.0/24	Origin: 55933	CLOUDIE-AS-AP Cloudie Limited, HK
	Transit: 400464	VMISS, CA
64.16.112.0/21	Origin: 3561	CENTURYLINK-LEGACY-SAVVIS, US
	Transit: 209	CENTURYLINK-US-LEGACY-QWEST, US
64.85.24.0/23	Origin: 262287	Maxihost LTDA, BR
	Transit: 16735	ALGAR TELECOM SA, BR
66.159.102.0/24	Origin: 17378	AS17378, US
	Transit: 6461	ZAYO-6461, US

List of Unassigned addresses

Far too many to list. See <http://thyme.apnic.net/current/data-add-IANA>:

Unassigned Network	ASN Information	AS Name
196.195.191.0/24	Origin: 132116	ANINETWORK-IN Ani Network Pvt Ltd, IN
	Transit: 9498	BBIL-AP BHARTI Airtel Ltd., IN
196.195.250.0/24	Origin: 131284	ETISALATAFG-AS-AP Etisalat Afghan, AF
	Transit: 138322	AWCC-AS-AP Afghan Wireless, AF
196.195.251.0/24	Origin: 131284	ETISALATAFG-AS-AP Etisalat Afghan, AF
	Transit: 38193	TWA-AS-AP Transworld Associates Pvt. Ltd
196.195.253.0/24	Origin: 131284	ETISALATAFG-AS-AP Etisalat Afghan, AF
	Transit: 38193	TWA-AS-AP Transworld Associates Pvt. Ltd
196.207.94.0/24	Origin: 137085	ANI89-AS-IN Ani Broadband Service Pvt Lt
	Transit: 4755	TATACOMM-AS TATA Communications formerly
196.207.124.0/24	Origin: 132116	ANINETWORK-IN Ani Network Pvt Ltd, IN
	Transit: 9498	BBIL-AP BHARTI Airtel Ltd., IN
197.255.248.0/23	Origin: 22351	INTELSAT-1, US
	Transit: 3356	LEVEL3, US
198.8.96.0/19	Origin: 17054	AS17054, US
	Transit: 10796	TWC-10796-MIDWEST, US
198.22.236.0/24	Origin: 26854	NYS, US
	Transit: 3356	LEVEL3, US
198.23.26.0/24	Origin: 33052	VZUNET, US
	Transit: 3356	LEVEL3, US
198.32.0.0/22	Origin: 8038	6CONNECT, US
	Transit: 6939	HURRICANE, US
198.32.7.0/24	Origin: 3944	PARTAN-LAB, US
	Transit: 16668	GBPSW-AS, US
198.49.80.0/24	Origin: 62711	UNASSIGNED
	Transit: 3356	LEVEL3, US

Number of IPv4 prefixes announced by prefix length

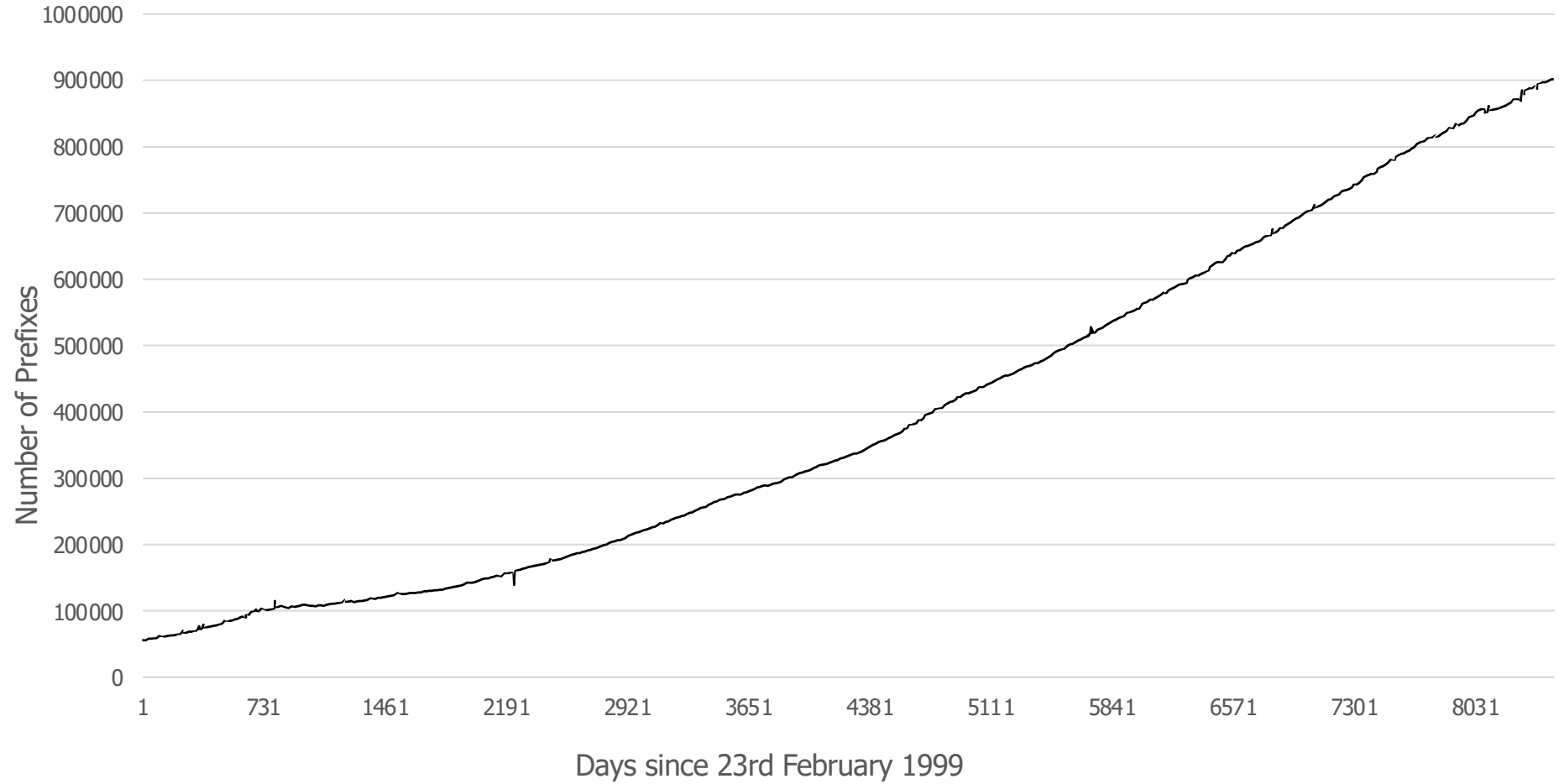
/1:0	/2:0	/3:0	/4:0	/5:0	/6:0	/7:0	/8:16
/9:13	/10:40	/11:100	/12:302	/13:592	/14:1207	/15:2060	/16:13539
/17:8322	/18:13884	/19:25099	/20:44394	/21:52282	/22:108861	/23:96690	/24:534623
/25:791	/26:0	/27:0	/28:0	/29:0	/30:0	/31:0	/32:0

11th July 2022↑

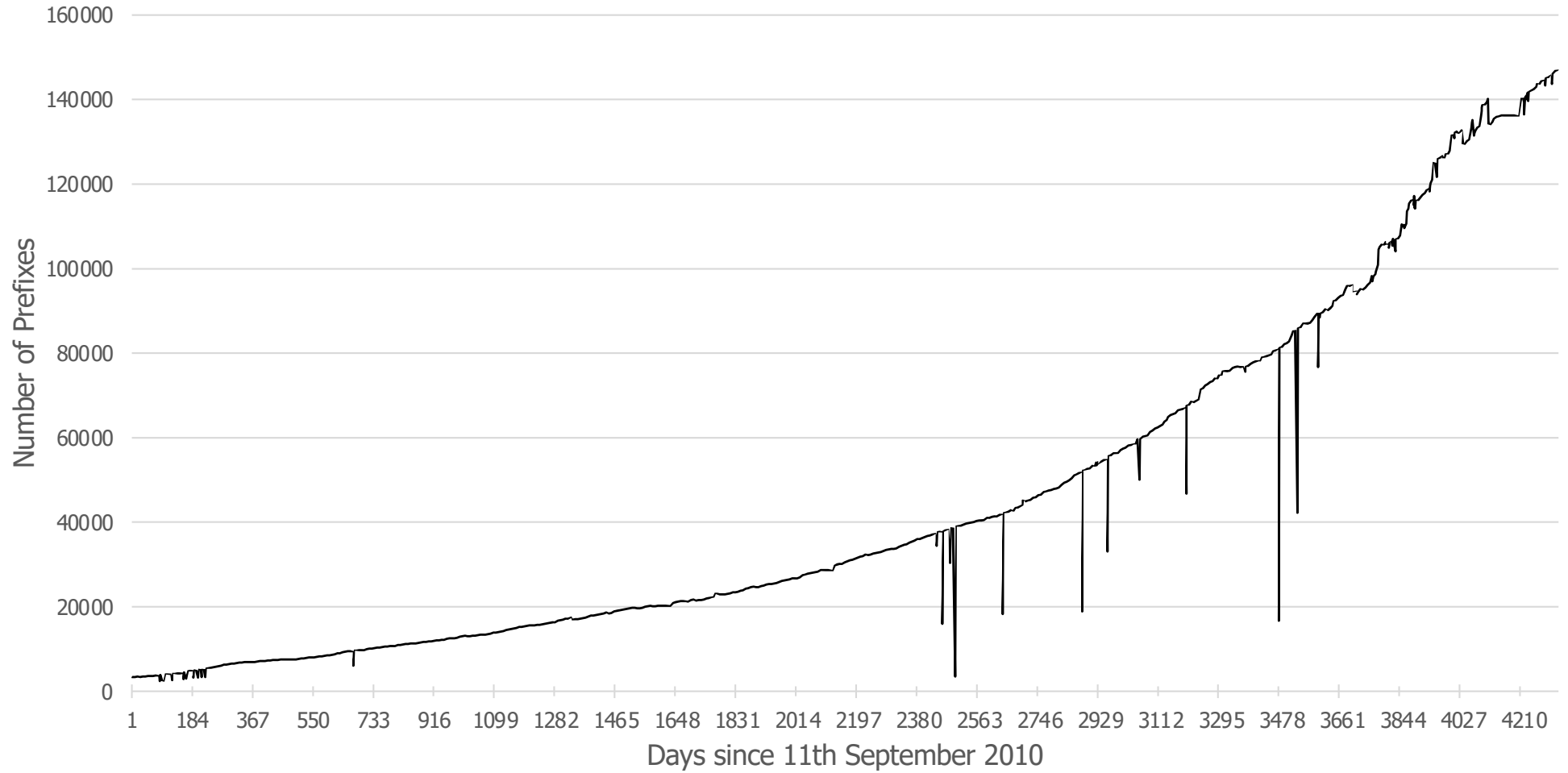
11th July 2021↓

/1:0	/2:0	/3:0	/4:0	/5:0	/6:0	/7:0	/8:17
/9:14	/10:41	/11:102	/12:305	/13:589	/14:1194	/15:1995	/16:13465
/17:8324	/18:13968	/19:25403	/20:42308	/21:50361	/22:106957	/23:91548	/24:498787
/25:1400	/26:0	/27:0	/28:0	/29:0	/30:0	/31:0	/32:0

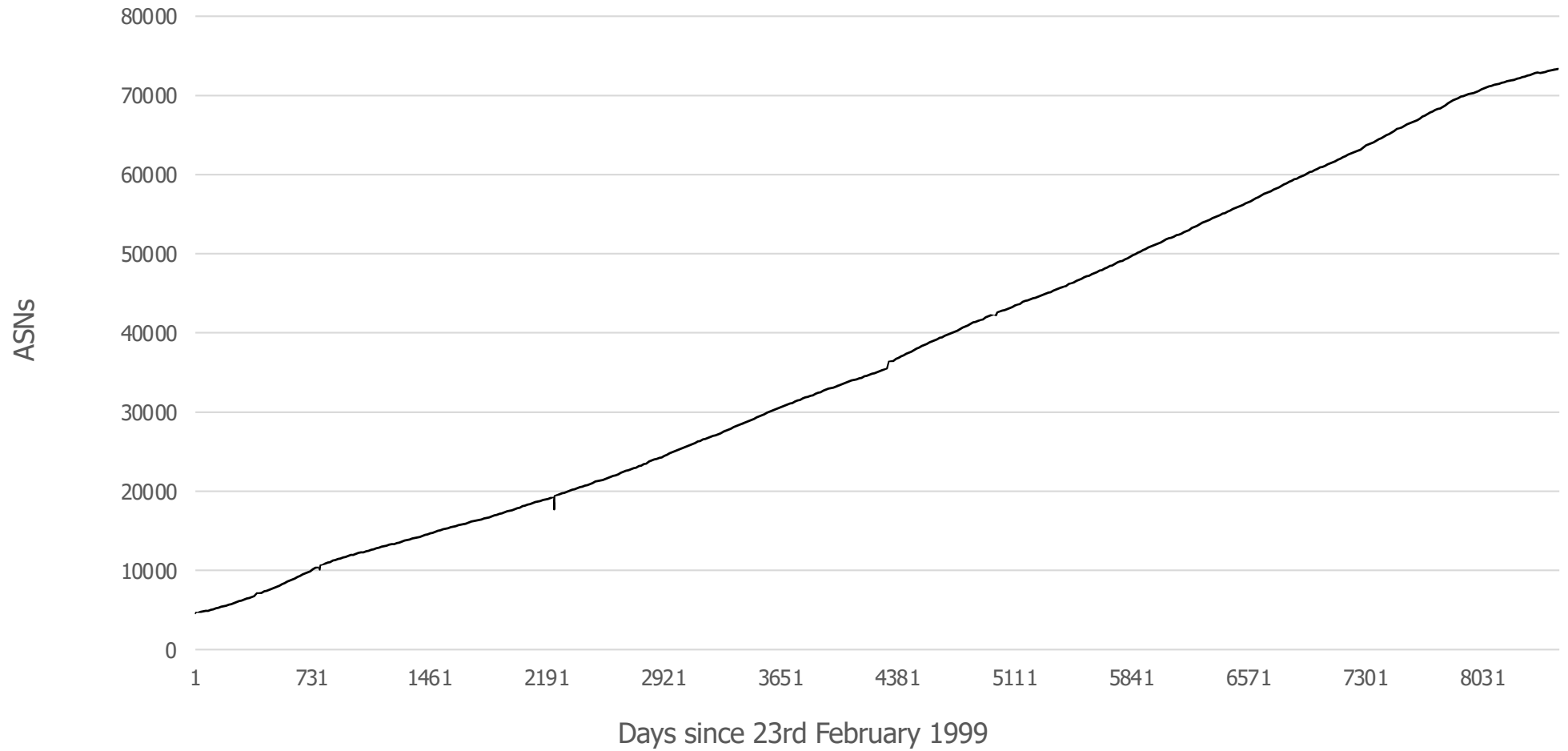
Global IPv4 Routing Table



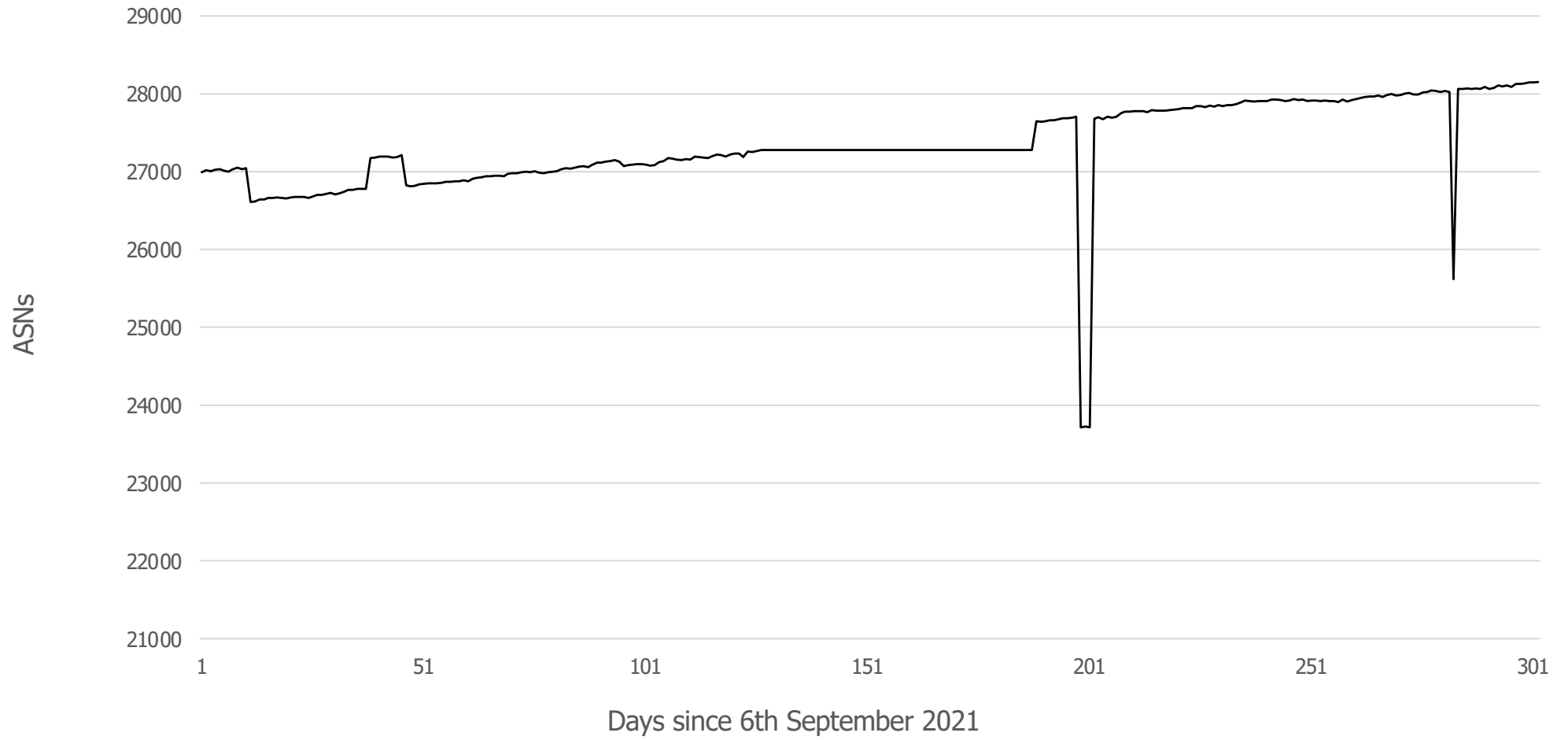
Global IPv6 Routing Table



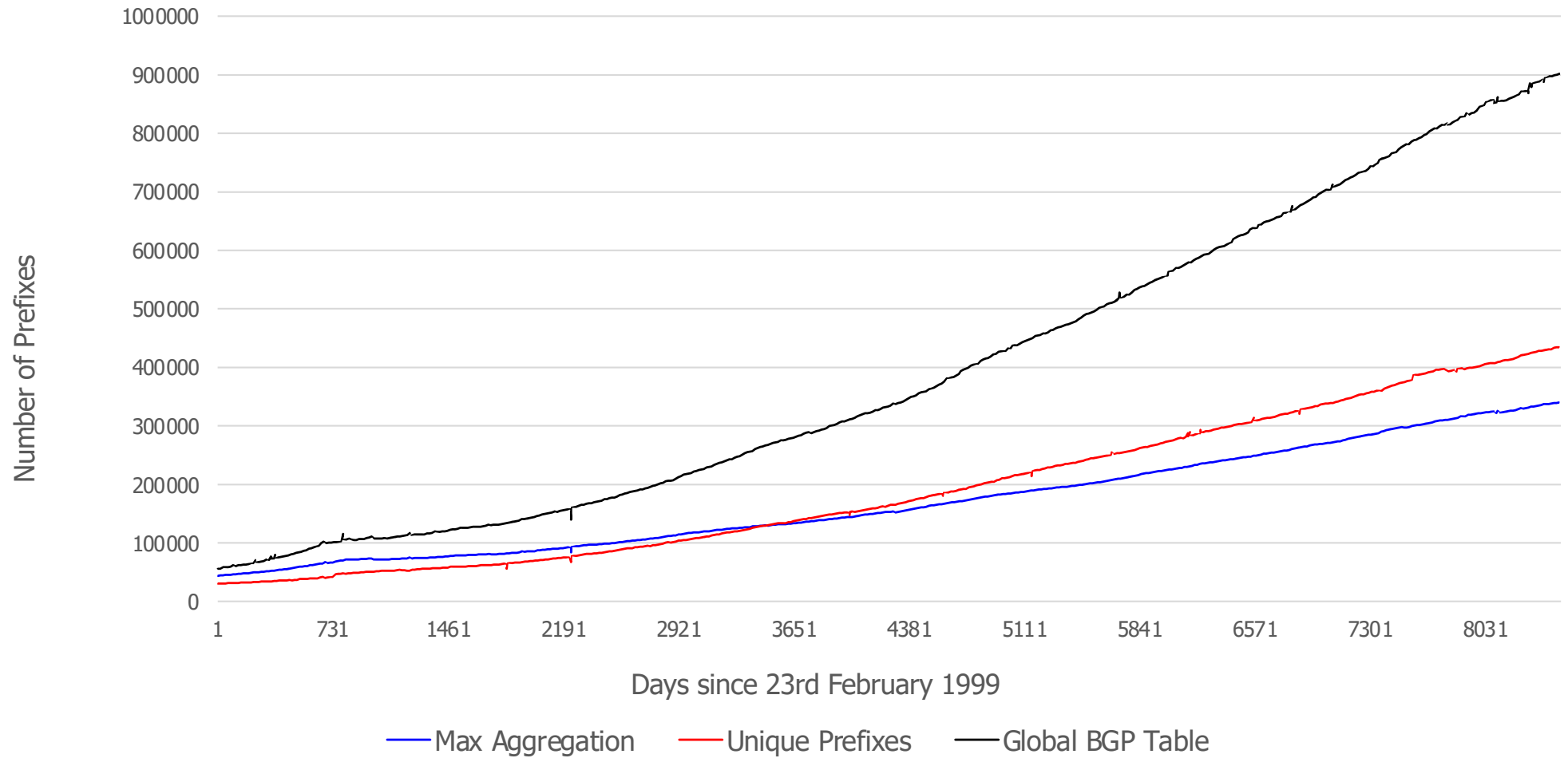
IPv4 AS Growth



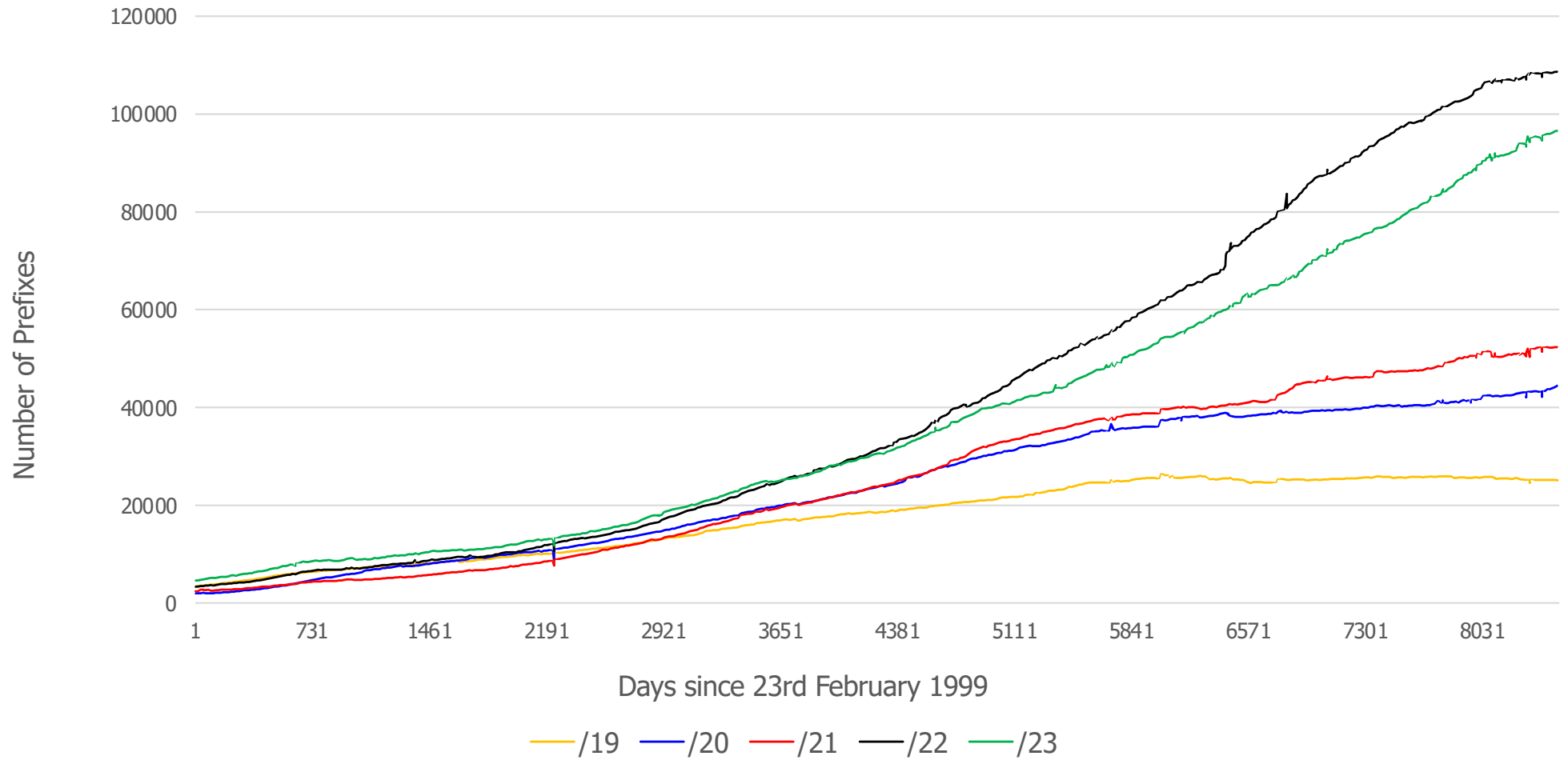
IPv6 AS Growth



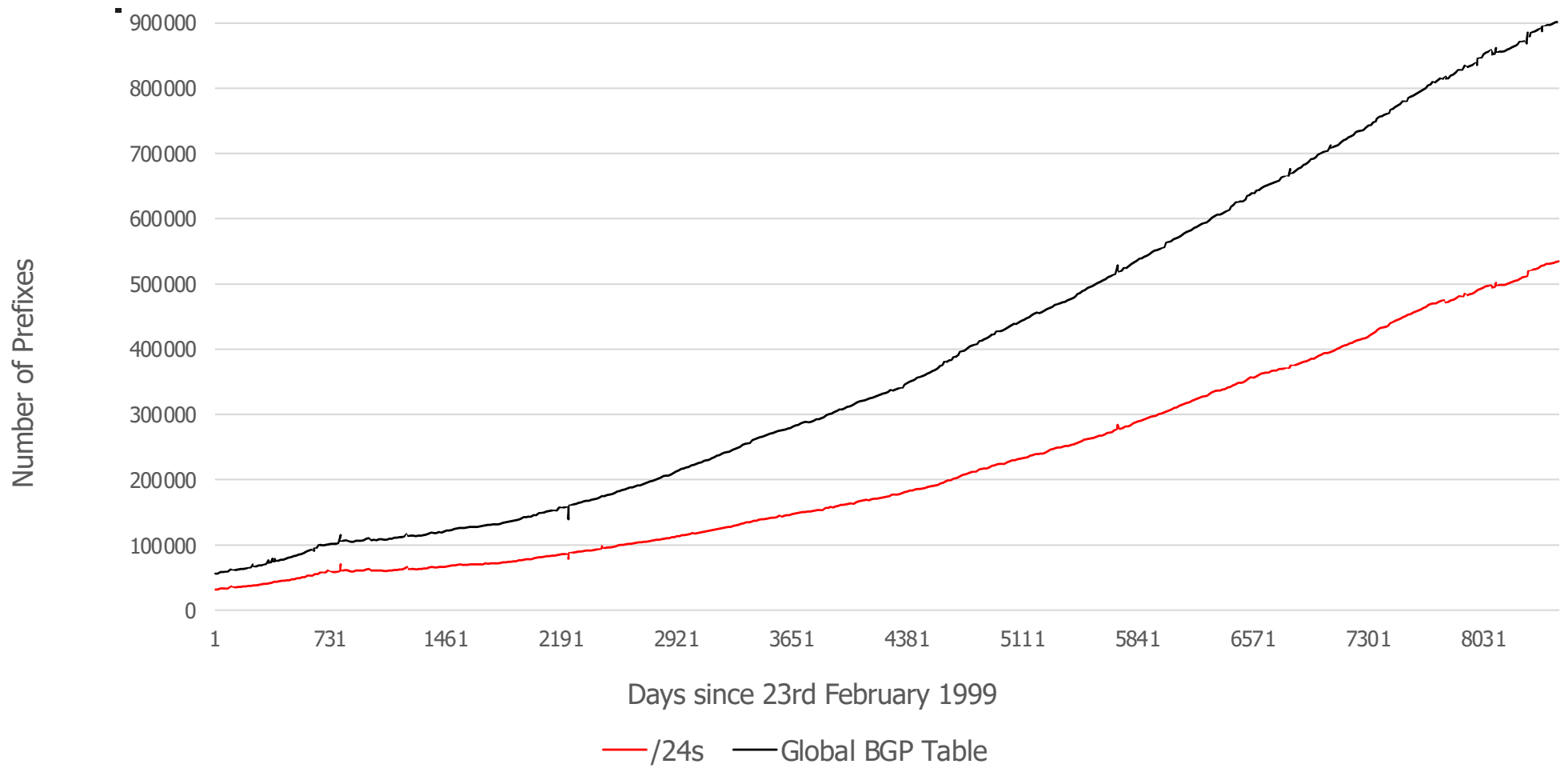
Max Aggregation vs Unique Prefixes



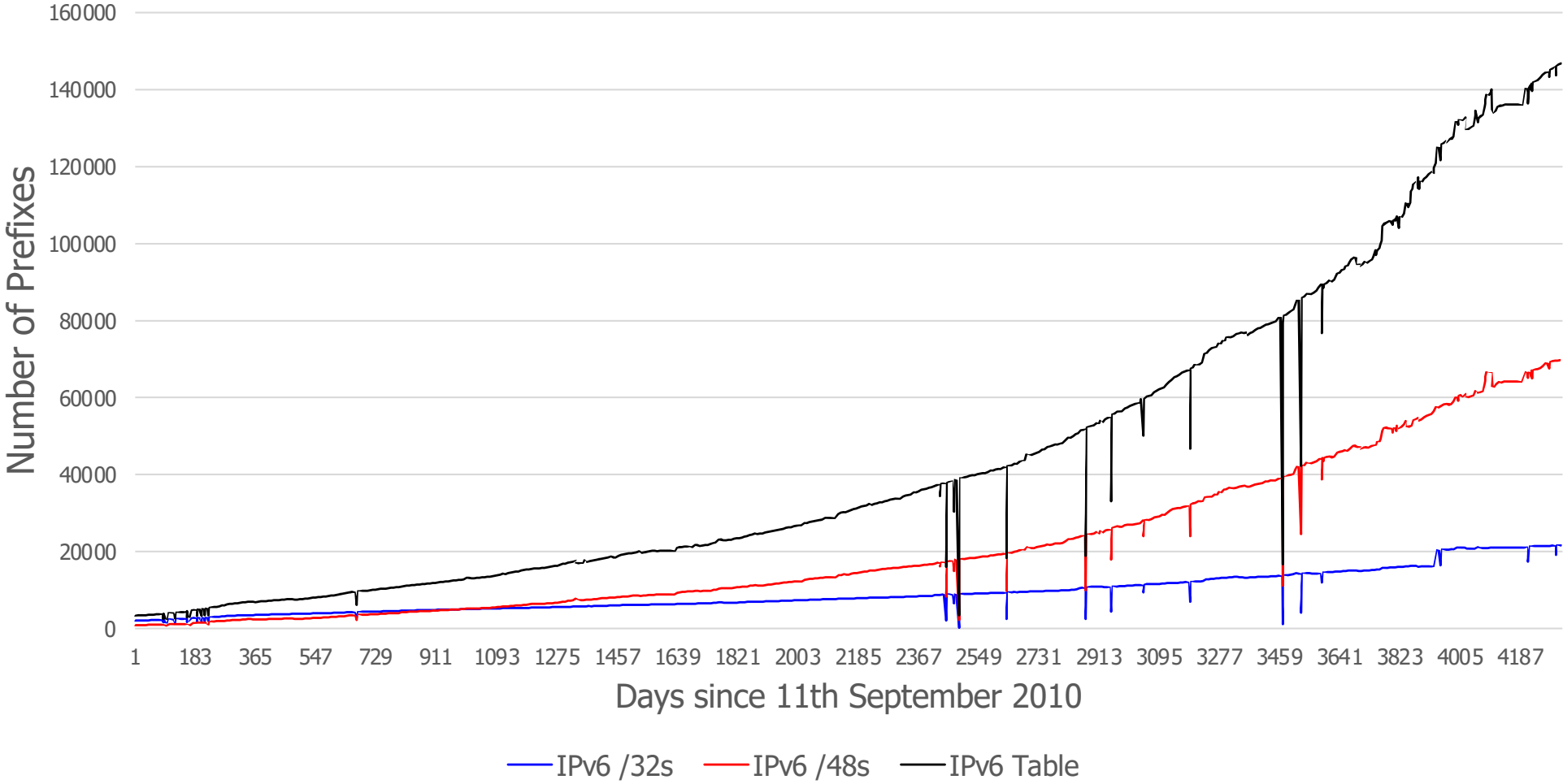
IPv4 Prefix sizes announced



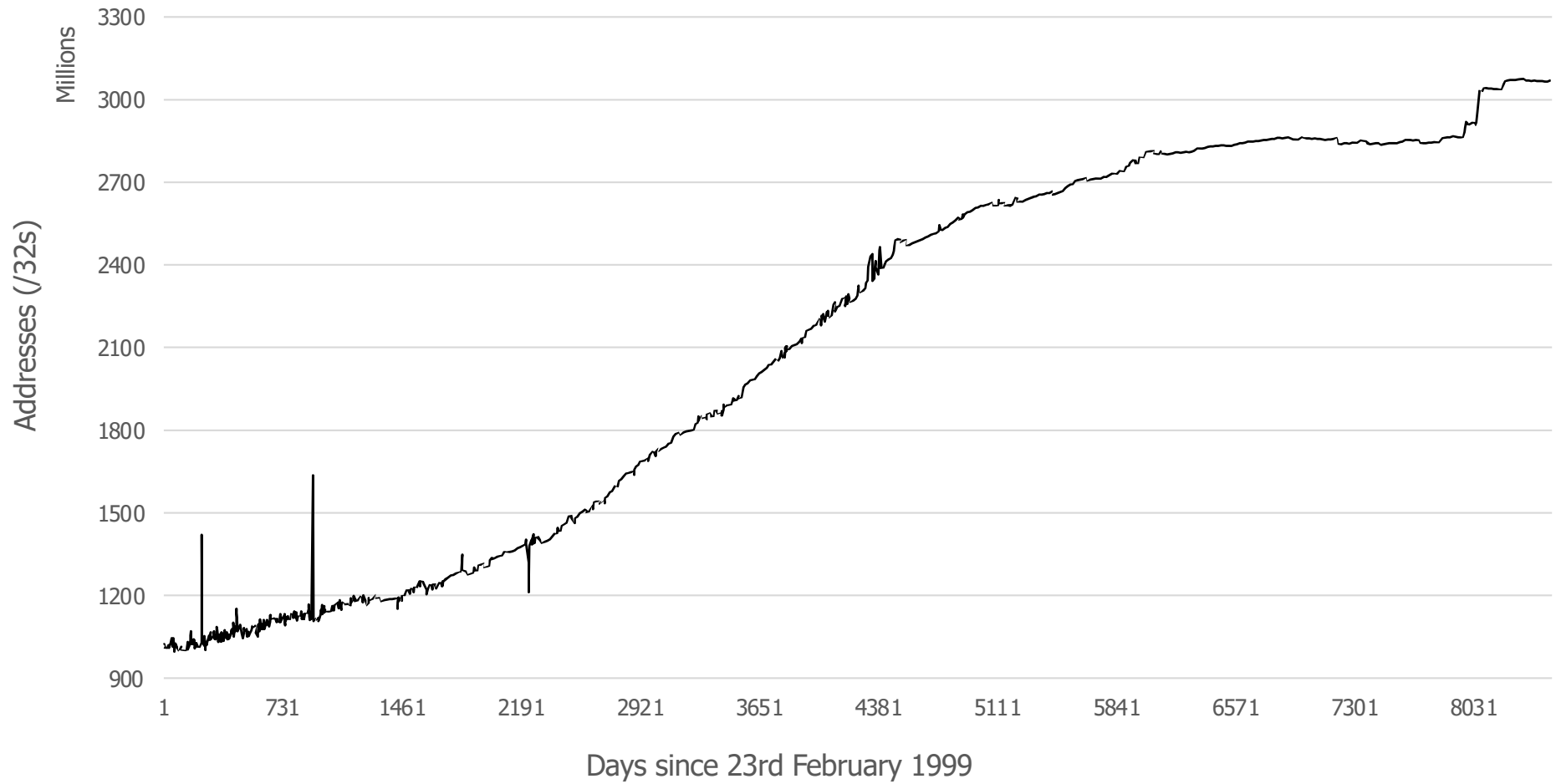
IPv4 /24s announced



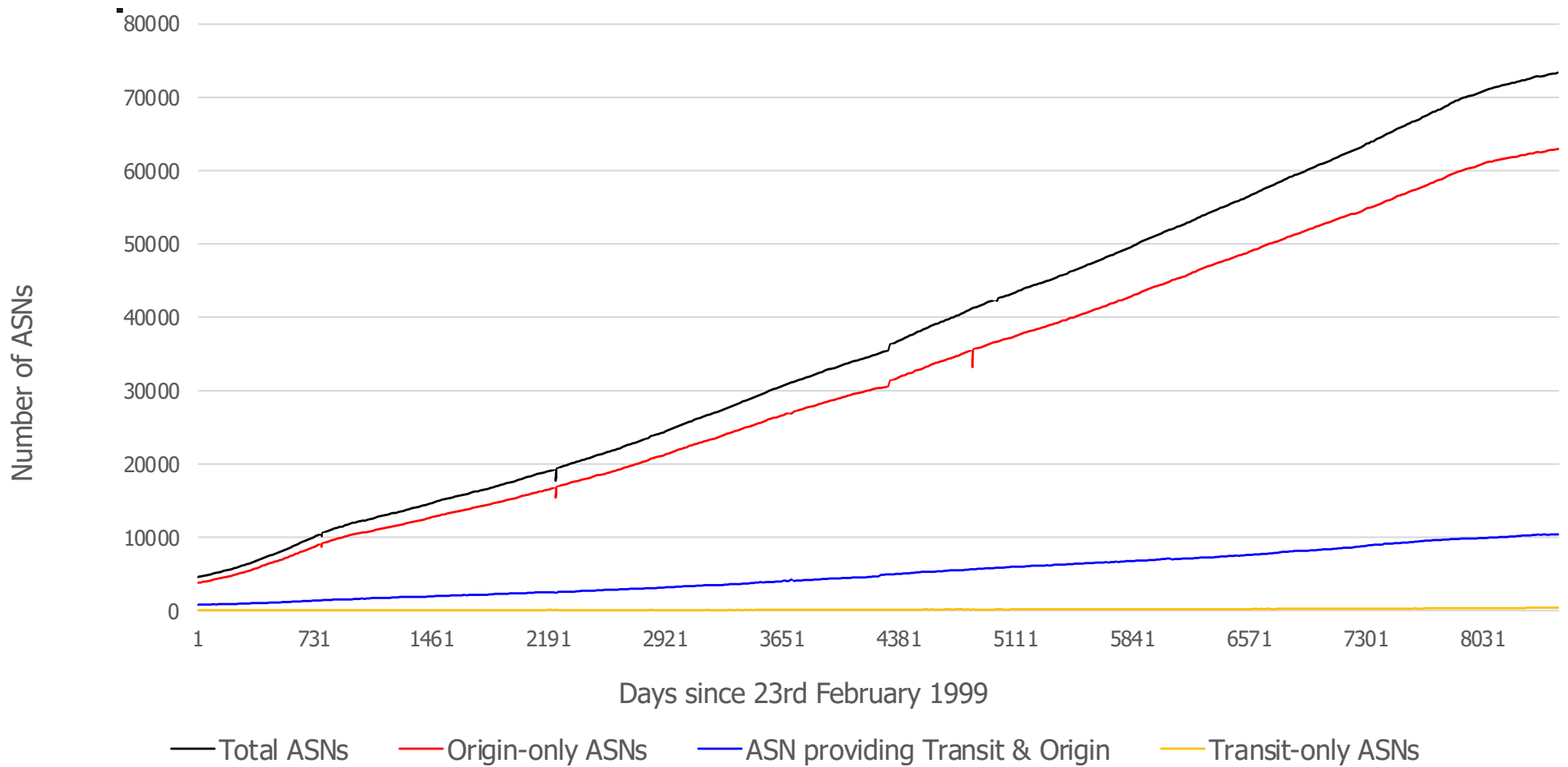
IPv6 /32s vs /48s



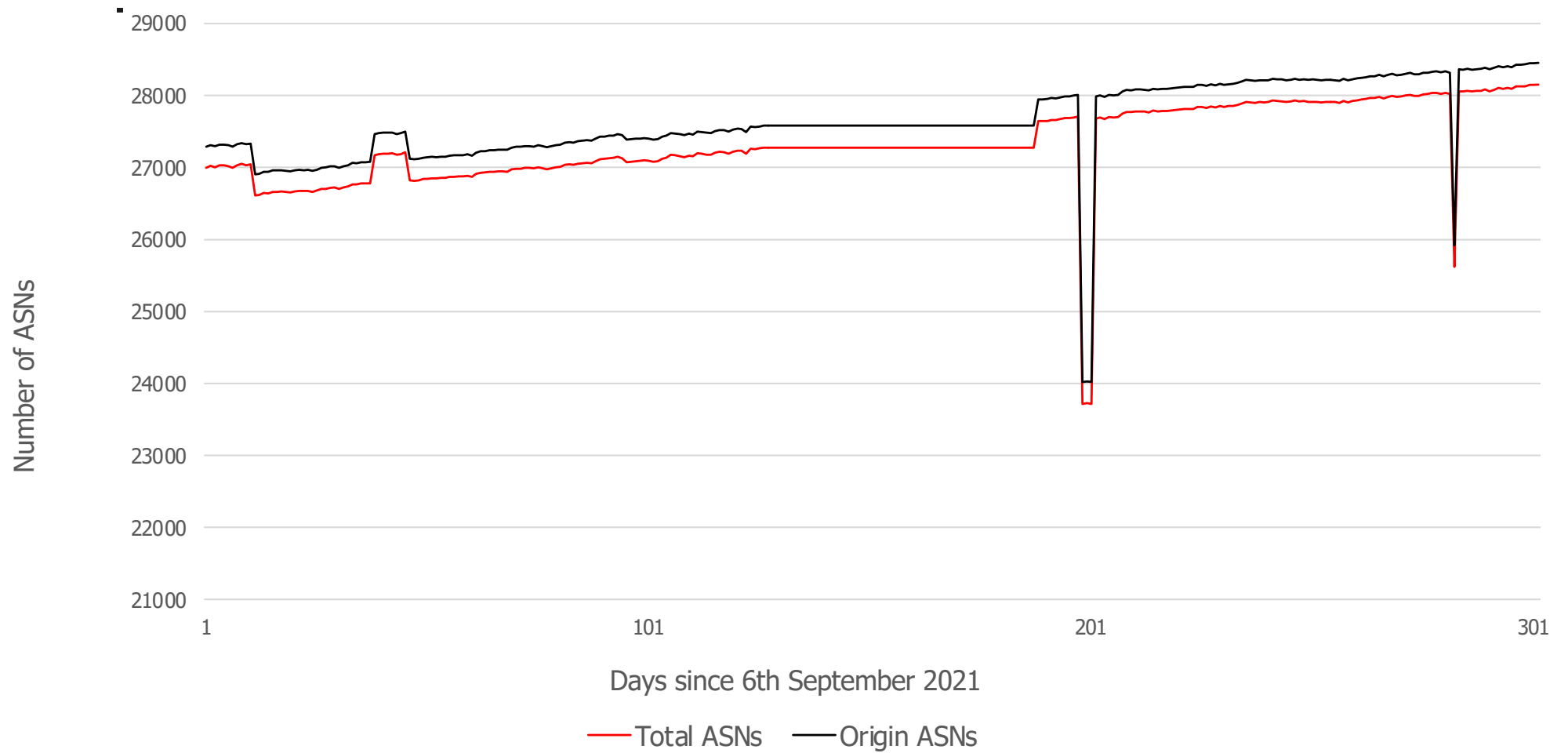
IPv4 Address Space announced



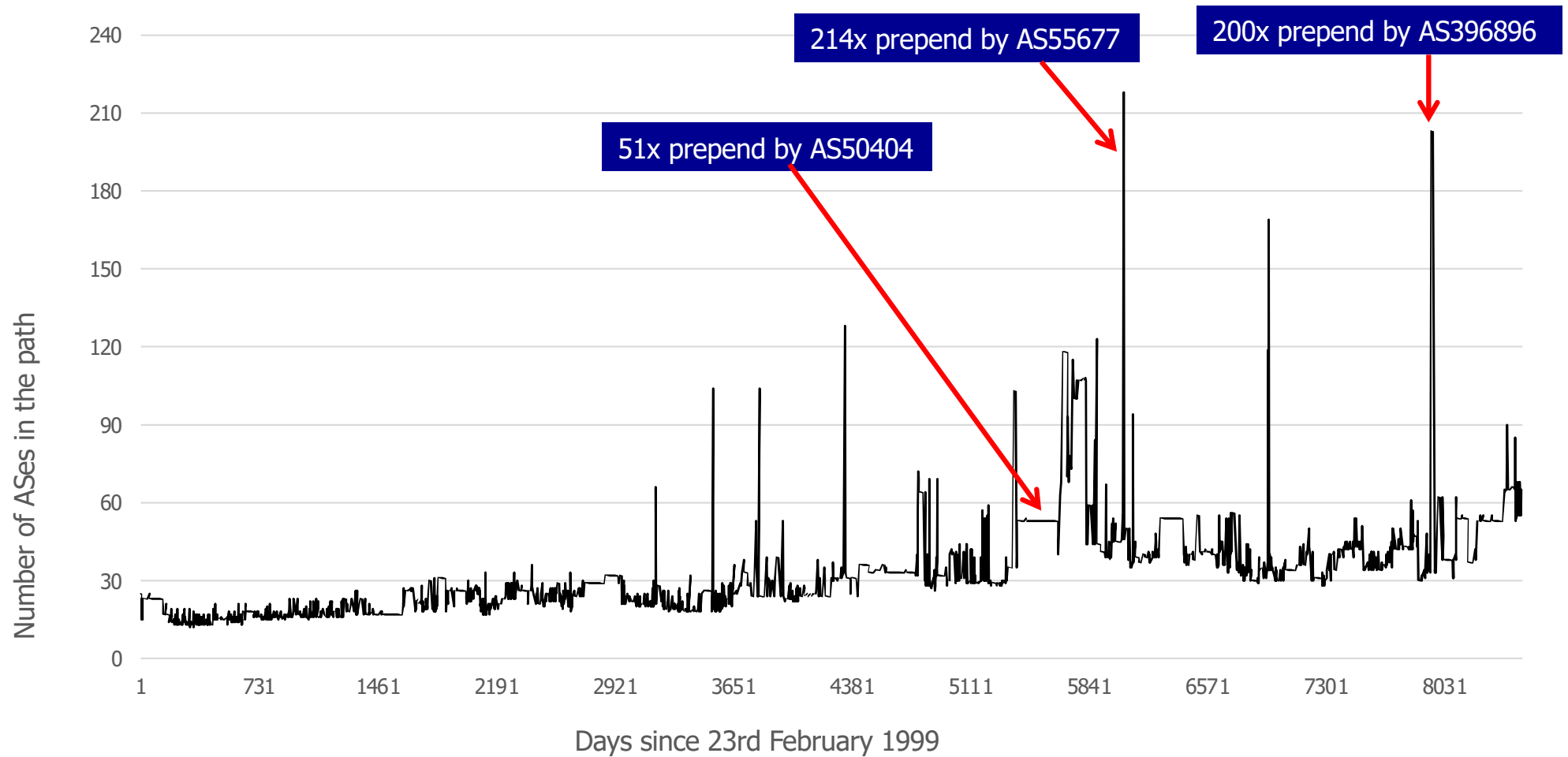
IPv4 AS Announcements



IPv6 AS Announcements



IPv4 Maximum AS Path Length





Looking at Deaggregation in IPv4

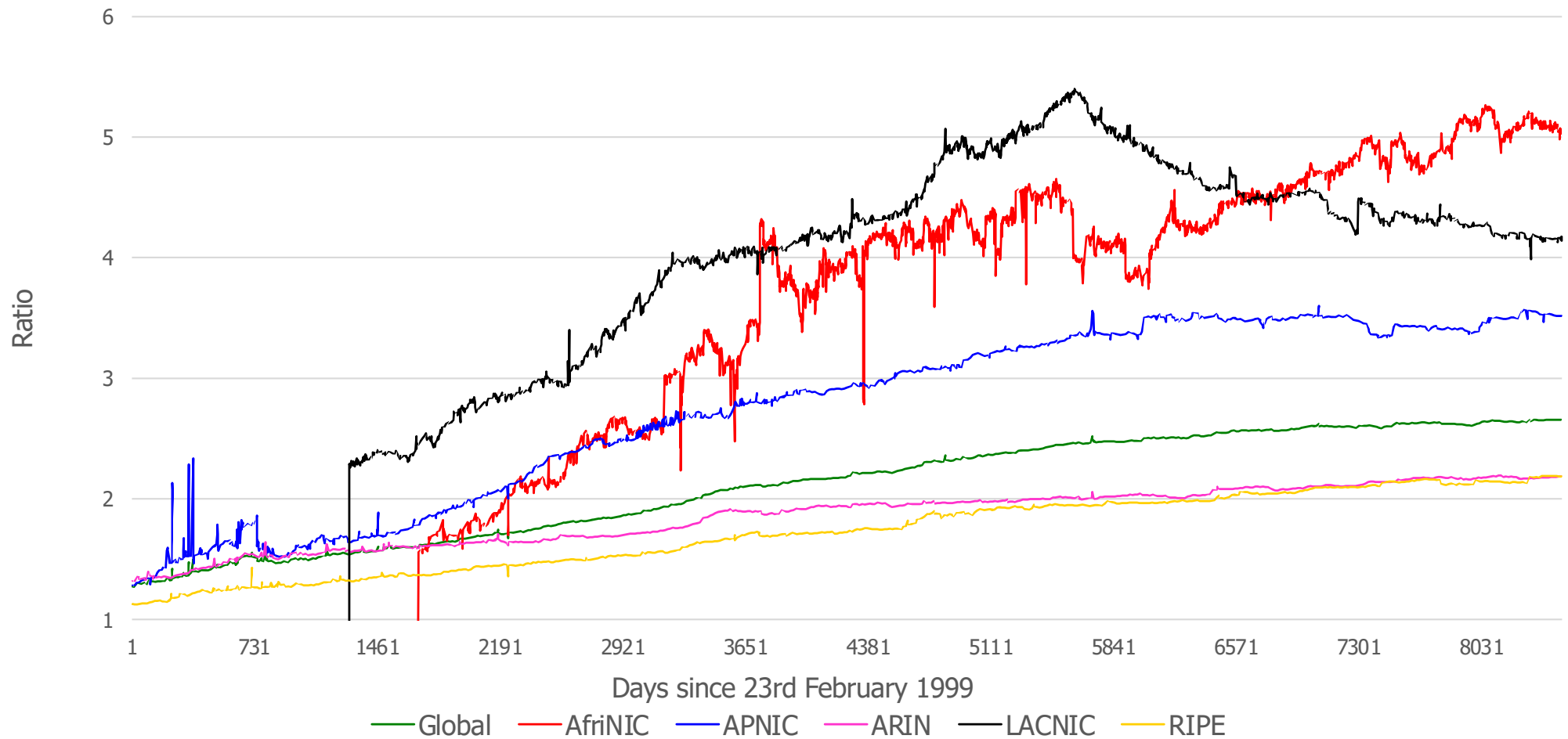
- Routing Report
 - One summary takes BGP table and aggregates prefixes by origin AS
 - Called “Max Aggregation” in report
 - Global and per RIR basis
 - <http://thyme.apnic.net/current/>
- Calculates **Deaggregation** Factor:
 - Measure of Routing Table size/Aggregated Size
 - Global value has been increasing slowly and steadily since “records began”



July 2022

- **Total Prefixes**
- Global BGP Table
 - 903k prefixes
- North America
 - 264k prefixes
- Europe & Middle East
 - 259k prefixes
- Asia & Pacific
 - 236k prefixes
- Latin America & Caribbean
 - 116k prefixes
- Africa
 - 28k prefixes
- **Deaggregation Factor**
- Global Average
 - 2.65
- North America
 - 2.19
- Europe & Middle East
 - 2.18
- Asia & Pacific
 - 3.52
- Latin America & Caribbean
 - 4.18
- Africa
 - 5.07

Deaggregation: RIR Regions vs Global



Asia Pacific Aggregation Savings Summary

ASN	No of Nets	Savings	Description
9808	8993	8944	CHINAMOBILE-CN China Mobile Communications Grou
7545	5920	5226	TPG-INTERNET-AP TPG Telecom Limited, AU
4538	4714	4639	ERX-CERNET-BKB China Education and Research Net
7552	3549	3530	VIETEL-AS-AP Viettel Group, VN
7713	3512	3453	TELKOMNET-AS-AP PT Telekomunikasi Indonesia, ID
45899	3426	3370	VNPT-AS-VN VNPT Corp, VN
9498	2426	2189	BBIL-AP BHARTI Airtel Ltd., IN
45090	2172	2093	TENCENT-NET-AP Shenzhen Tencent Computer System
23969	1958	1942	TOT-NET TOT Public Company Limited, TH
4755	2124	1907	TATACOMM-AS TATA Communications formerly VSNL i
4766	2496	1895	KIXS-AS-KR Korea Telecom, KR
9829	1892	1855	BSNL-NIB National Internet Backbone, IN
18403	1871	1830	FPT-AS-AP FPT Telecom Company, VN
24560	2107	1700	AIRTELBROADBAND-AS-AP Bharti Airtel Ltd., Telem
45609	1806	1480	BHARTI-MOBILITY-AS-AP Bharti Airtel Ltd. AS for
56047	1454	1421	CMNET-HUNAN-AP China Mobile communications corp
56041	1470	1403	CMNET-ZHEJIANG-AP China Mobile communications c
56046	1379	1295	CMNET-JIANGSU-AP China Mobile communications co
9583	1756	1229	SIFY-AS-IN Sify Limited, IN
9394	1150	1128	CTTNET China TieTong Telecommunications Corpora

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

India Aggregation Savings Summary

ASN	No of Nets	Savings	Description
9498	2426	2189	BBIL-AP BHARTI Airtel Ltd., IN
4755	2124	1907	TATACOMM-AS TATA Communications formerly VSNL i
9829	1892	1855	BSNL-NIB National Internet Backbone, IN
24560	2107	1700	AIRTELBROADBAND-AS-AP Bharti Airtel Ltd., Telem
45609	1806	1480	BHARTI-MOBILITY-AS-AP Bharti Airtel Ltd. AS for
9583	1756	1229	SIFY-AS-IN Sify Limited, IN
17488	1250	1121	HATHWAY-NET-AP Hathway IP Over Cable Internet,
55410	865	836	VIL-AS-AP Vodafone Idea Ltd, IN
45820	907	813	TTSL-MEISISP Tata Teleservices ISP AS, IN
45271	863	664	ICLNET-AS-AP Idea Cellular Limited, IN

Pakistan Aggregation Savings Summary

ASN	No of Nets	Savings	Description
17557	805	775	PKTELECOM-AS-PK Pakistan Telecommunication Comp
9541	572	461	CYBERNET-AP Cyber Internet Services Pvt Ltd., P
132165	458	415	CONNECT-AS-AP Connect Communications, PK
23674	424	399	NAYATEL-PK Nayatel Pvt Ltd, PK
55714	291	197	APNIC-FIBERLINK-PK Fiberlink Pvt.Ltd, PK
139879	191	178	GALAXY-AS-AP Galaxy Broadband, PK
23966	167	154	LDN-AS-PK LINKdotNET Telecom Limited, PK
38264	200	144	WATEEN-IMS-PK-AS-AP National WiMAXIMS environme
58895	196	139	EBONE1-PK Ebone Network PVT. Limited, PK
136525	136	126	WANCOMPVTLTD-AS-AP Wancom Pvt Ltd., PK

Bangladesh Aggregation Savings Summary

ASN	No of Nets	Savings	Description
23956	185	180	AMBERIT-BD-AS AmberIT Limited, BD
58715	144	128	EARTHTELECOMMUNICATION-AS EARTH TELECOMMUNICATI
24342	132	127	BRAC-BDMAIL-AS-BD BRACNet Limited, BD
23688	115	108	LINK3-TECH-AS-BD-AP Link3 Technologies Ltd., BD
23923	98	94	AGNI-AS Agni Systems Limited, BD
17469	92	83	ACCESSTEL-AS-AP Access Telecom BD Ltd., BD
7565	85	83	BDCOM-BD Rang Nilu Square, 5th Floor, House 75
24323	93	77	AAMRA-NETWORKS-AS-AP aamra networks limited, BD
24389	81	62	GRAMEENPHONE-AS-AP GrameenPhone Ltd., BD
17471	67	62	CYBERNET-BD-AS Grameen Cybernet Ltd. Bangladesh

Sri Lanka Aggregation Savings Summary

ASN	No of Nets	Savings	Description
9329	131	117	SLTINT-AS-AP Sri Lanka Telecom Internet, LK
18001	75	62	DIALOG-AS Dialog Axiata PLC., LK
5087	81	57	LANKA-COM Lanka Communication Services, LK
45224	60	57	BELLNET-AS-AP Lanka Bell Limited, LK
132045	58	53	AIRTEL-AS-ISP Bharti Airtel Lanka Pvt. Limited,
17904	21	19	SLTASUL-LK Sri Lankan Airlines, LK
45356	22	15	MOBITEL-LK Mobitel Pvt Ltd, LK
17470	16	13	HUTCHISON-LK Hutchison Telecommunications Lanka
132447	9	7	HUTCHISON-LK 234, Galle Road, Colombo 4, LK
38229	8	6	LEARN-LK Lanka Education & Research Network, NR

Nepal Aggregation Savings Summary

ASN	No of Nets	Savings	Description
17501	110	100	WLINK-NEPAL-AS-AP WorldLink Communications Pvt
23752	106	100	NPTELECOM-NP-AS Nepal Telecommunications Corpor
4007	88	76	SUBISU-CABLENET-AS-AP Subisu Cablenet Pvt Ltd,
4613	66	60	MOS-NP Mercantile Office Systems, NP
38565	54	50	NCELL-AS-NP Ncell Pvt. Ltd., NP
24550	55	49	WEBSURFERNP-AS-NP Websurfer Nepal Internet Serv
45650	45	29	VIANET-NP Vianet Communications Pvt. Ltd., NP
55915	32	24	CLASSIC-NP Classic Tech Pvt. Ltd., NP
58504	19	14	TECHMINDS-NP TECHMINDS NETWORKS PVT. LTD., NP
141047	15	12	NDSPL-AS-AP Nepal Digital Service Pvt. Ltd., NP

Afghanistan Aggregation Savings Summary

ASN	No of Nets	Savings	Description
55330	70	49	GCN-DCN-AS AFGHANTELECOM GOVERNMENT COMMUNICATI
38742	63	46	AWCC-AS-AP AWCC, AF
131284	49	37	ETISALATAFG-AS-AP Etisalat Afghan, AF
138322	41	25	AWCC-AS-AP Afghan Wireless, AF
55424	28	22	INSTATELECOM-AS-AP Instatelecom Limited, AF
132471	24	14	MTNAFGHANISTAN-AS-AP MTNAFGHANISTAN, AF
55732	8	7	RANATECHNET-AF RANA Technologies, Kabul, AF
133066	13	5	ANS-AS-AP Ariana Network Services Co, AF
55745	10	4	NEDA-AS-AP Neda Telecommunications, AF
134134	8	4	NORTHTELECOM-AF North Telecom, AF

Maldives Aggregation Savings Summary

ASN	No of Nets	Savings	Description
7642	124	112	DHIRAAGU-MV-AP DHIVEHI RAAJJEYGE GULHUN PLC, MV
55944	48	44	OOEDOO-MV Ooredoo Maldives Plc, MV
136238	6	2	SATLINKPVT LTD-AS-AP SatLink Pvt Ltd, MV

Bhutan Aggregation Savings Summary

ASN	No of Nets	Savings	Description
134715	17	13	DRUKREN-MOIC-AS Ministry of Information & Commu
23955	16	12	TASHICELL-DOMESTIC-AS Tashi InfoComm Limited, B
136039	6	4	NANO-AS-AP NANO, Bhutan, BT
18024	7	3	BTTELECOM-AS-AP Bhutan Telecom Ltd, BT
17660	6	1	DRUKNET-AS DrukNet ISP, BT
135666	5	1	MOIC-AS-AP Government Data Center DITTMoIC, BT
141680	2	1	SUPERNET1-AS-AP SuperNet Infocomm, BT



IPv4 Observations

- Routing table continues to grow
 - Linear growth for last 8 years
 - Even though total address space announced has levelled off over the last 3 years
- /24 announcements continue to grow
 - Clearly many operators are deaggregating down to the smallest prefix size considered routable
 - Do operators still filter prefix sizes smaller than /24?
 - (A few /25s through /32s are visible)
- Overall global deaggregation ratio growth has slowed
 - Significant improvements in Latin America



IPv6 Observations

- Routing table growth has continued in 2022
 - How to interpret this?
- /48 announcements continue to grow rapidly
 - Operators seem to believe that IPv6 /48 needs to be treated like IPv4 /24 🙄🙄
- Noticeable increases:
 - According to RIR allocation boundaries
 - Along nibble boundaries



Internet Routing Table Analysis Update

Questions?