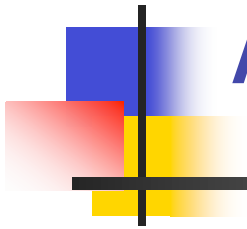

Internet Routing Table Analysis Update

Philip Smith
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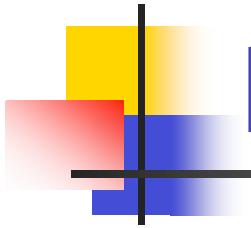
MENOG 5, Beirut, 29th October 2009



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 reporting report started 23rd February 1999:
  - Routing table size
  - CIDR-Report style reporting on a per-RIR basis
  - …and many other interesting features

Routing Report 28 October 2009

BGP routing table entries examined:	301687
Prefixes after maximum aggregation:	141242
Deaggregation factor:	2.14
Unique aggregates announced to Internet:	149261
Total ASes present in the Internet Routing Table:	32539
Prefixes per ASN:	9.27
Origin-only ASes present in the Internet Routing Table:	28259
Origin ASes announcing only one prefix:	13778
Transit ASes present in the Internet Routing Table:	4280
Transit-only ASes present in the Internet Routing Table:	103
Average AS path length visible in the Internet Routing Table:	3.6
Max AS path length visible:	30
Max AS path prepend of ASN (12026)	22
Prefixes from unregistered ASNs in the Routing Table:	602
Unregistered ASNs in the Routing Table:	126
Number of 32-bit ASNs allocated by the RIRs:	301
Prefixes from 32-bit ASNs in the Routing Table:	242
Special use prefixes present in the Routing Table:	0
Prefixes being announced from unallocated address space:	191
Number of addresses announced to Internet:	2121978592
Equivalent to 126 /8s, 122 /16s and 210 /24s	
Percentage of available address space announced:	57.3
Percentage of allocated address space announced:	64.9
Percentage of available address space allocated:	88.2
Percentage of address space in use by end-sites:	79.5
Total number of prefixes smaller than registry allocations:	145252

APNIC Region

Prefixes being announced by APNIC Region ASes:	72507
Total APNIC prefixes after maximum aggregation:	25330
APNIC Deaggregation factor:	2.86
Prefixes being announced from the APNIC address blocks:	69045
Unique aggregates announced from the APNIC address blocks:	30402
APNIC Region origin ASes present in the Internet Routing Table:	3846
APNIC Prefixes per ASN:	17.95
APNIC Region origin ASes announcing only one prefix:	1042
APNIC Region transit ASes present in the Internet Routing Table:	592
Average APNIC Region AS path length visible:	3.6
Max APNIC Region AS path length visible:	14
Number of APNIC addresses announced to Internet:	467142176
Equivalent to 27 /8s, 216 /16s and 6 /24s	
Percentage of available APNIC address space announced:	79.6

APNIC AS Blocks	4608-4864, 7467-7722, 9216-10239, 17408-18431
(pre-ERX allocations)	23552-24575, 37888-38911, 45056-46079
	55296-56319, 131072-132095
APNIC Address Blocks	43/8, 58/8 to 61/8, 110/8 to 126/8, 175/8, 180/8,
	182/8, 183/8, 202/8, 203/8, 210/8, 211/8,
	218/8 to 222/8

ARIN Region

Prefixes being announced by ARIN Region ASes:	127392
Total ARIN prefixes after maximum aggregation:	67069
ARIN Deaggregation factor:	1.90
Prefixes being announced from the ARIN address blocks:	101695
Unique aggregates announced from the ARIN address blocks:	38714
ARIN Region origin ASes present in the Internet Routing Table:	13308
ARIN Prefixes per ASN:	7.64
ARIN Region origin ASes announcing only one prefix:	5137
ARIN Region transit ASes present in the Internet Routing Table:	1313
Average ARIN Region AS path length visible:	3.3
Max ARIN Region AS path length visible:	24
Number of ARIN addresses announced to Internet:	708956672
Equivalent to 42 /8s, 65 /16s and 210 /24s	
Percentage of available ARIN address space announced:	62.1

ARIN AS Blocks (pre-ERX allocations)	1-1876, 1902-2042, 2044-2046, 2048-2106, 2138-2584, 2615-2772, 2823-2829, 2880-3153 3354-4607, 4865-5119, 5632-6655, 6912-7466 7723-8191, 10240-12287, 13312-15359, 16384-17407 18432-20479, 21504-23551, 25600-26591, 26624-27647, 29696-30719, 31744-33791, 35840-36863, 39936-40959, 46080-47103, 53248-55295, 393216-394239
ARIN Address Blocks	3/8, 4/8, 6/8 to 9/8, 11/8 to 13/8, 15/8 to 22/8, 24/8, 26/8, 28/8 to 30/8, 32/8 to 35/8, 38/8 40/8, 44/8, 45/8, 47/8, 48/8, 52/8, 54/8 to 56/8, 63/8 to 76/8, 96/8 to 99/8, 108/8, 173/8, 174/8, 184/8, 199/8, 204/8 to 209/8, 214/8 to 216/8,

RIPE NCC Region

Prefixes being announced by RIPE Region ASes:	69388
Total RIPE prefixes after maximum aggregation:	40640
RIPE Deaggregation factor:	1.71
Prefixes being announced from the RIPE address blocks:	62827
Unique aggregates announced from the RIPE address blocks:	42215
RIPE Region origin ASes present in the Internet Routing Table:	13667
RIPE Prefixes per ASN:	4.60
RIPE Region origin ASes announcing only one prefix:	7118
RIPE Region transit ASes present in the Internet Routing Table:	2058
Average RIPE Region AS path length visible:	3.9
Max RIPE Region AS path length visible:	20
Number of RIPE addresses announced to Internet:	402741824
Equivalent to 24 /8s, 1 /16s and 90 /24s	
Percentage of available RIPE address space announced:	75.0

RIPE AS Blocks	1877-1901, 2043, 2047, 2107-2136, 2585-2614
(pre-ERX allocations)	2773-2822, 2830-2879, 3154-3353, 5377-5631
	6656-6911, 8192-9215, 12288-13311, 15360-16383
	20480-21503, 24576-25599, 28672-29695
	30720-31743, 33792-35839, 38912-39935
	40960-45055, 47104-52223, 196608-197631
RIPE Address Blocks	2/8, 25/8, 46/8, 51/8, 62/8, 77/8 to 95/8,
	109/8, 178/8, 193/8 to 195/8, 212/8, 213/8, 217/8

LACNIC Region

Prefixes being announced by LACNIC Region ASes:	25922
Total LACNIC prefixes after maximum aggregation:	6352
LACNIC Deaggregation factor:	4.08
Prefixes being announced from the LACNIC address blocks:	24245
Unique aggregates announced from the LACNIC address blocks:	13348
LACNIC Region origin ASes present in the Internet Routing Table:	1197
LACNIC Prefixes per ASN:	20.25
LACNIC Region origin ASes announcing only one prefix:	383
LACNIC Region transit ASes present in the Internet Routing Table:	199
Average LACNIC Region AS path length visible:	4.1
Max LACNIC Region AS path length visible:	30
Number of LACNIC addresses announced to Internet:	67654400
Equivalent to 4 /8s, 8 /16s and 83 /24s	
Percentage of available LACNIC address space announced:	67.2

LACNIC AS Blocks	26592-26623, 27648-28671, 52224-53247, 262144-263167 plus ERX transfers
LACNIC Address Blocks	186/8 to 189/8, 190/8, 200/8, 201/8,

AfriNIC Region

Prefixes being announced by AfriNIC Region ASes:	6009
Total AfriNIC prefixes after maximum aggregation:	1570
AfriNIC Deaggregation factor:	3.83
Prefixes being announced from the AfriNIC address blocks:	4373
Unique aggregates announced from the AfriNIC address blocks:	1584
AfriNIC Region origin ASes present in the Internet Routing Table:	331
AfriNIC Prefixes per ASN:	13.21
AfriNIC Region origin ASes announcing only one prefix:	98
AfriNIC Region transit ASes present in the Internet Routing Table:	70
Average AfriNIC Region AS path length visible:	3.8
Max AfriNIC Region AS path length visible:	15
Number of AfriNIC addresses announced to Internet:	12880384
Equivalent to 0 /8s, 196 /16s and 138 /24s	
Percentage of available AfriNIC address space announced:	38.4

AfriNIC AS Blocks	36864-37887, 327680-328703 & ERX transfers
AfriNIC Address Blocks	41/8, 197/8,

Global per AS prefix count summary

ASN	No of nets	/20 equiv	Max Agg	Description
6389	4164	3882	312	bellsouth.net, inc.
4323	3708	1035	384	Time Warner Telecom
1785	1777	714	139	PaeTec Communications, Inc.
4766	1764	6991	454	Korea Telecom (KIX)
7018	1581	5845	1058	AT&T WorldNet Services
8151	1519	2899	237	UniNet S.A. de C.V.
17488	1486	139	140	Hathway IP Over Cable Interne
20115	1486	1481	670	Charter Communications
6478	1327	271	419	AT&T Worldnet Services
2386	1304	637	943	AT&T Data Communications Serv
4755	1269	292	147	TATA Communications formerly
3356	1221	10964	439	Level 3 Communications, LLC
11492	1136	206	13	Cable One
22773	1113	2604	67	Cox Communications, Inc.
9583	1104	98	469	Sify Limited
18566	1062	296	10	Covad Communications
7011	1029	244	620	Citizens Utilities
19262	1026	4182	235	Verizon Global Networks
10620	1021	227	100	TVCABLE BOGOTA
4134	1005	19185	392	CHINANET-BACKBONE

Global Aggregation Savings Summary

ASN	No of Nets	Net Savings	Description
4323	3708	3324	Time Warner Telecom
1785	1777	1638	PaeTec Communications, Inc.
17488	1486	1346	Hathway IP Over Cable Interne
4766	1764	1310	Korea Telecom (KIX)
8151	1519	1282	UniNet S.A. de C.V.
11492	1136	1123	Cable One
4755	1269	1122	TATA Communications formerly
18566	1062	1052	Covad Communications
22773	1113	1046	Cox Communications, Inc.
8452	989	982	TEDATA
18101	980	948	Reliance Infocom Ltd Internet
10620	1021	921	TVCABLE BOGOTA
6478	1327	908	AT&T Worldnet Services
24863	936	863	LINKdotNET AS number
9829	849	829	BSNL National Internet Backbo
20115	1486	816	Charter Communications
7545	900	800	TPG Internet Pty Ltd
19262	1026	791	Verizon Global Networks
3356	1221	782	Level 3 Communications, LLC
5668	803	767	CenturyTel Internet Holdings,

Number of prefixes announced by prefix length

/1:0	/2:0	/3:0	/4:0	/5:0	/6:0
/7:0	/8:20	/9:10	/10:25	/11:63	/12:177
/13:355	/14:631	/15:1213	/16:10701	/17:4897	/18:8473
/19:17524	/20:21119	/21:21115	/22:27398	/23:27044	/24:158110
/25:937	/26:1126	/27:565	/28:158	/29:10	/30:8
/31:0	/32:8				

October 2009 ↑

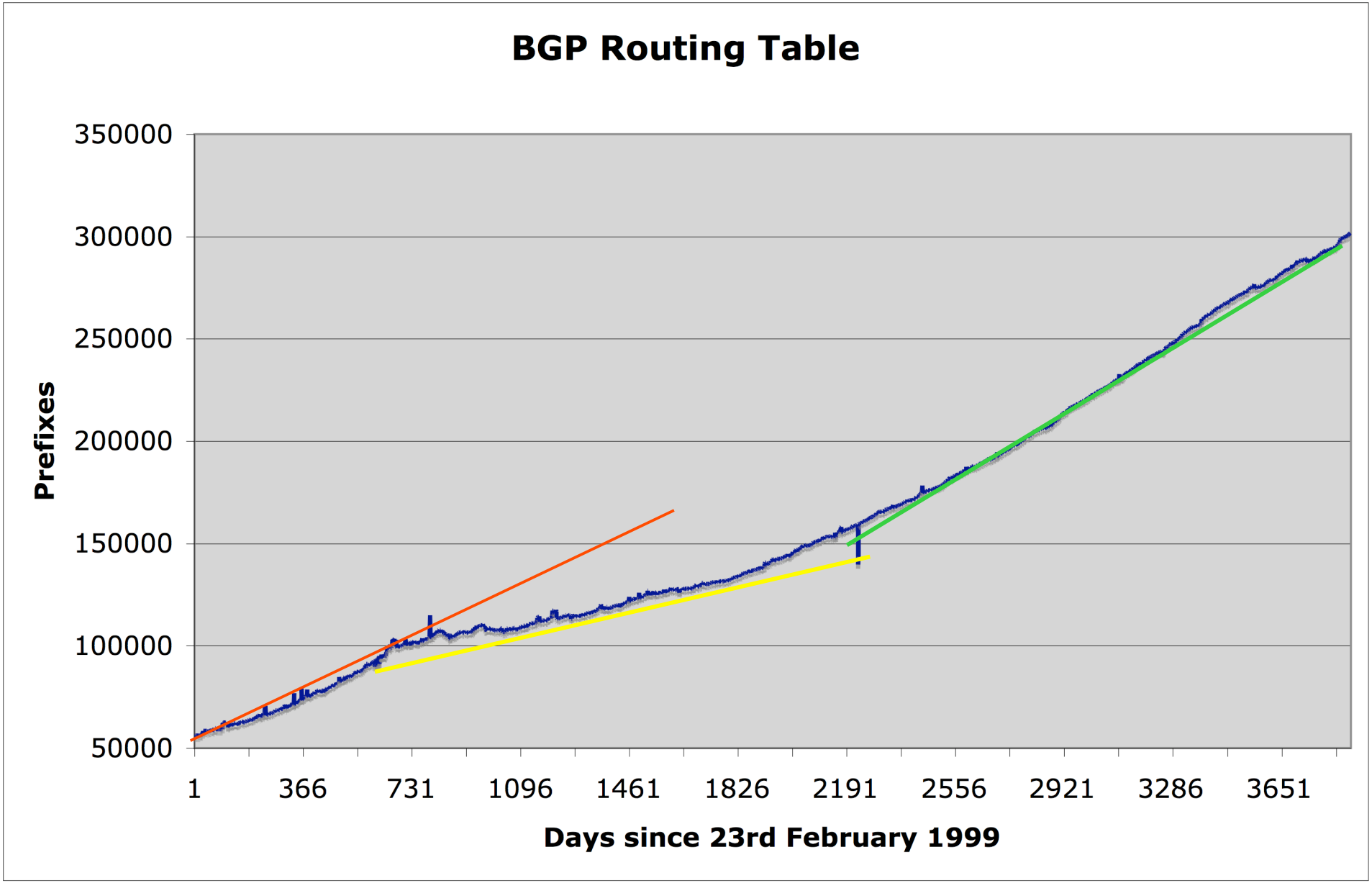
October 2008 ↓

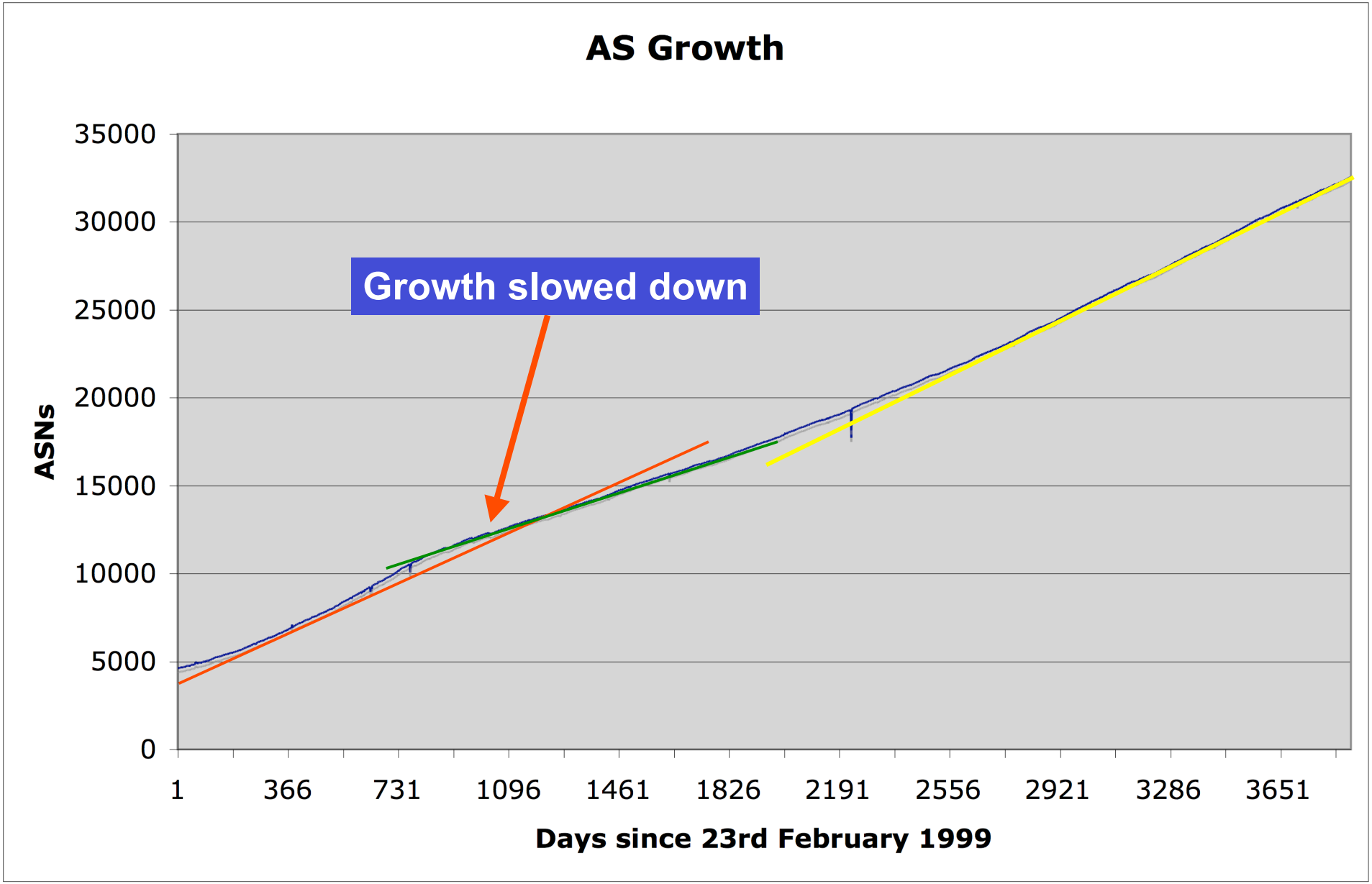
Number of prefixes announced by prefix length

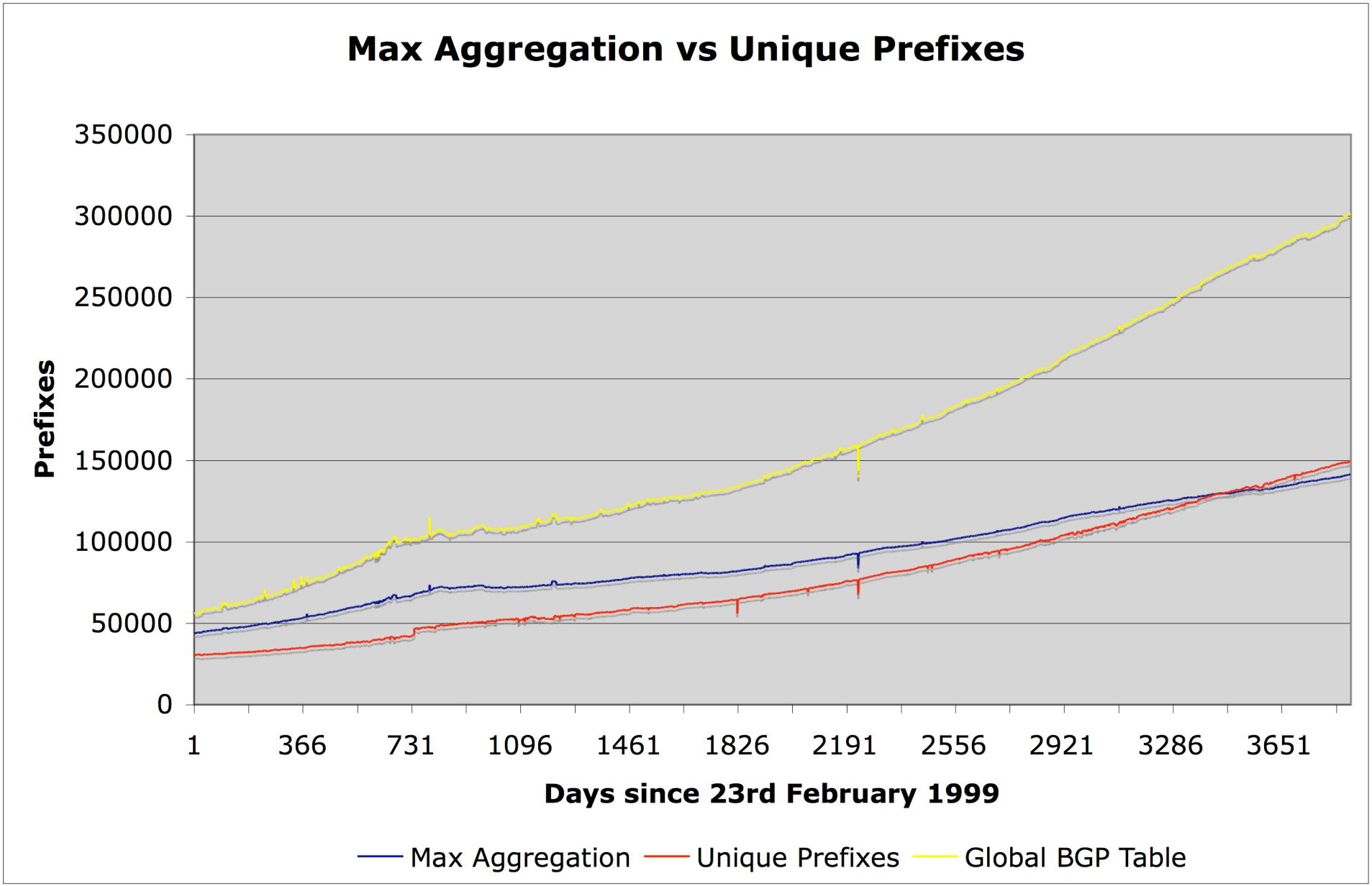
/1:0	/2:0	/3:0	/4:0	/5:0	/6:0
/7:0	/8:18	/9:9	/10:17	/11:46	/12:148
/13:298	/14:538	/15:1064	/16:10115	/17:4404	/18:7632
/19:16421	/20:19283	/21:18728	/22:23831	/23:24772	/24:141712
/25:819	/26:1002	/27:834	/28:82	/29:9	/30:1
/31:0	/32:7				

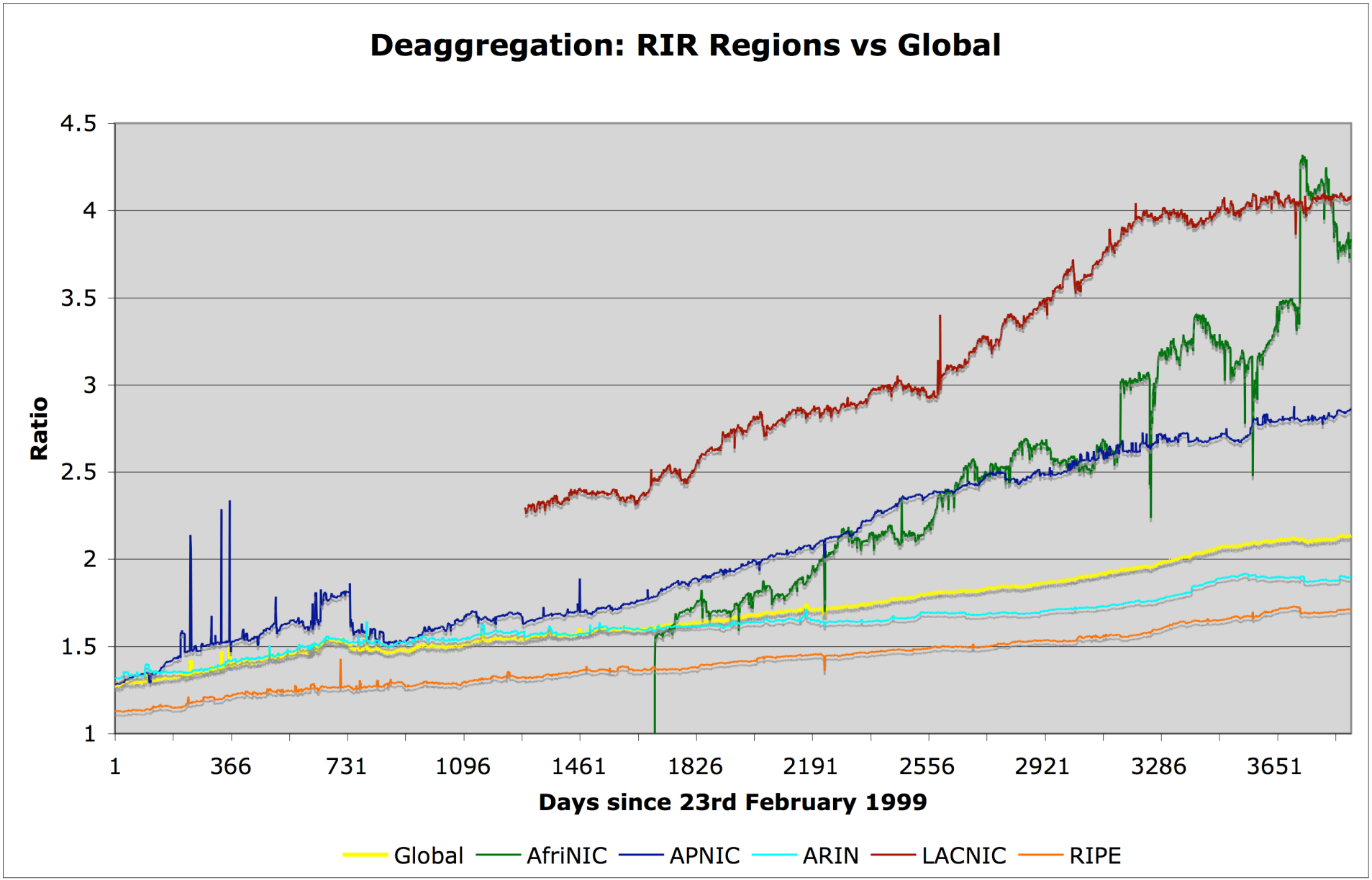
Prefixes Smaller than Registry Allocations

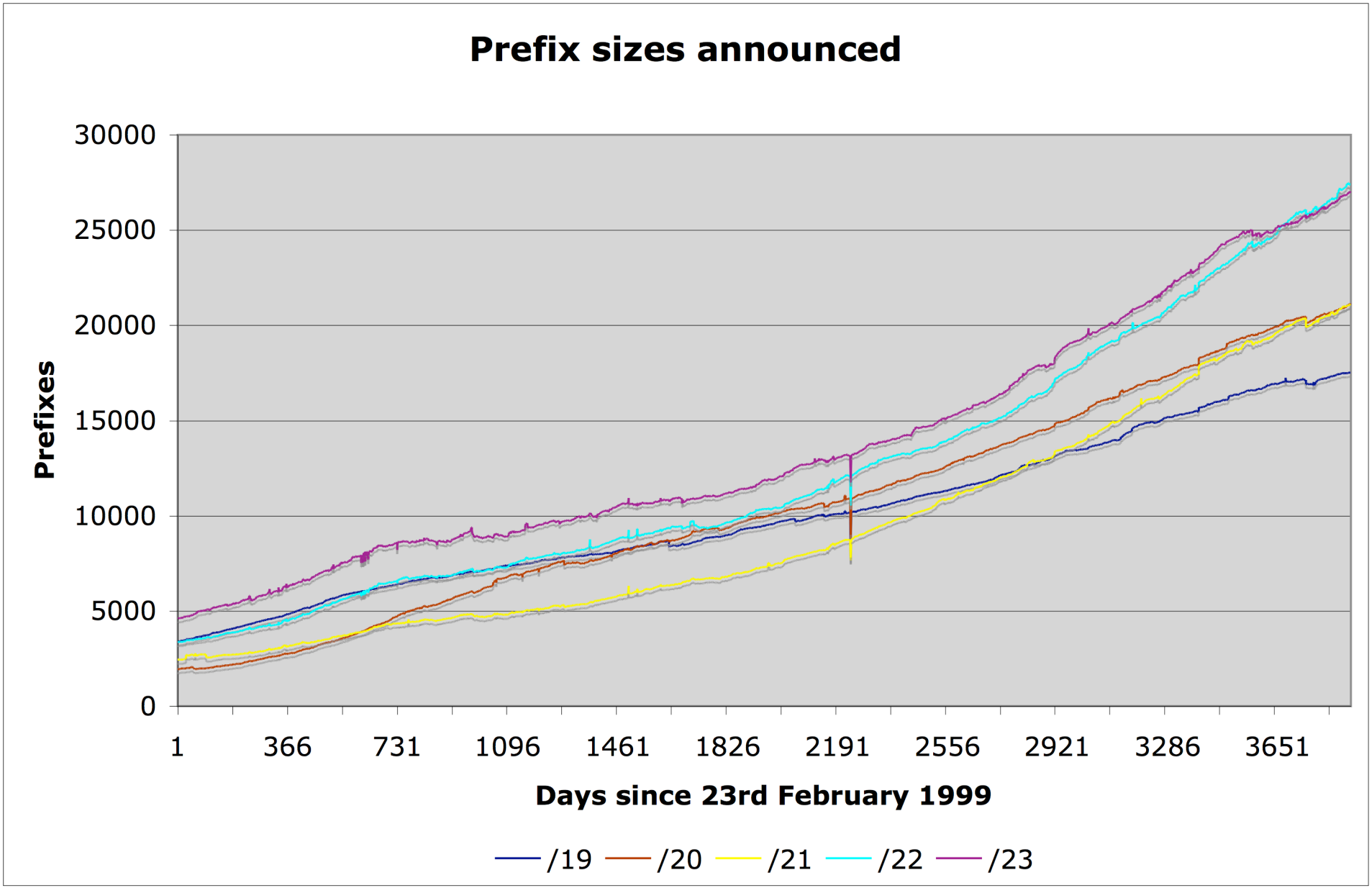
ASN	No of nets	Total ann.	Description
6389	2691	4164	bellsouth.net, inc.
4323	2353	3708	Time Warner Telecom
4766	1436	1764	Korea Telecom (KIX)
17488	1247	1486	Hathway IP Over Cable Interne
1785	1241	1777	PaeTec Communications, Inc.
11492	1060	1136	Cable One
18566	1043	1062	Covad Communications
9583	955	1104	Sify Limited
7018	938	1581	AT&T WorldNet Services
10620	926	1021	TVCABLE BOGOTA
8452	919	989	TEDATA
18101	869	980	Reliance Infocom Ltd Internet
3356	824	1221	Level 3 Communications, LLC
7011	819	1029	Citizens Utilities
23577	688	693	Korea Telecom (ATM-MPLS)
24560	685	783	Bharti Airtel Ltd., Telemedia
22773	676	1113	Cox Communications, Inc.
6517	640	681	Yipes Communications, Inc.
4755	634	1269	TATA Communications formerly
5668	633	803	CenturyTel Internet Holdings

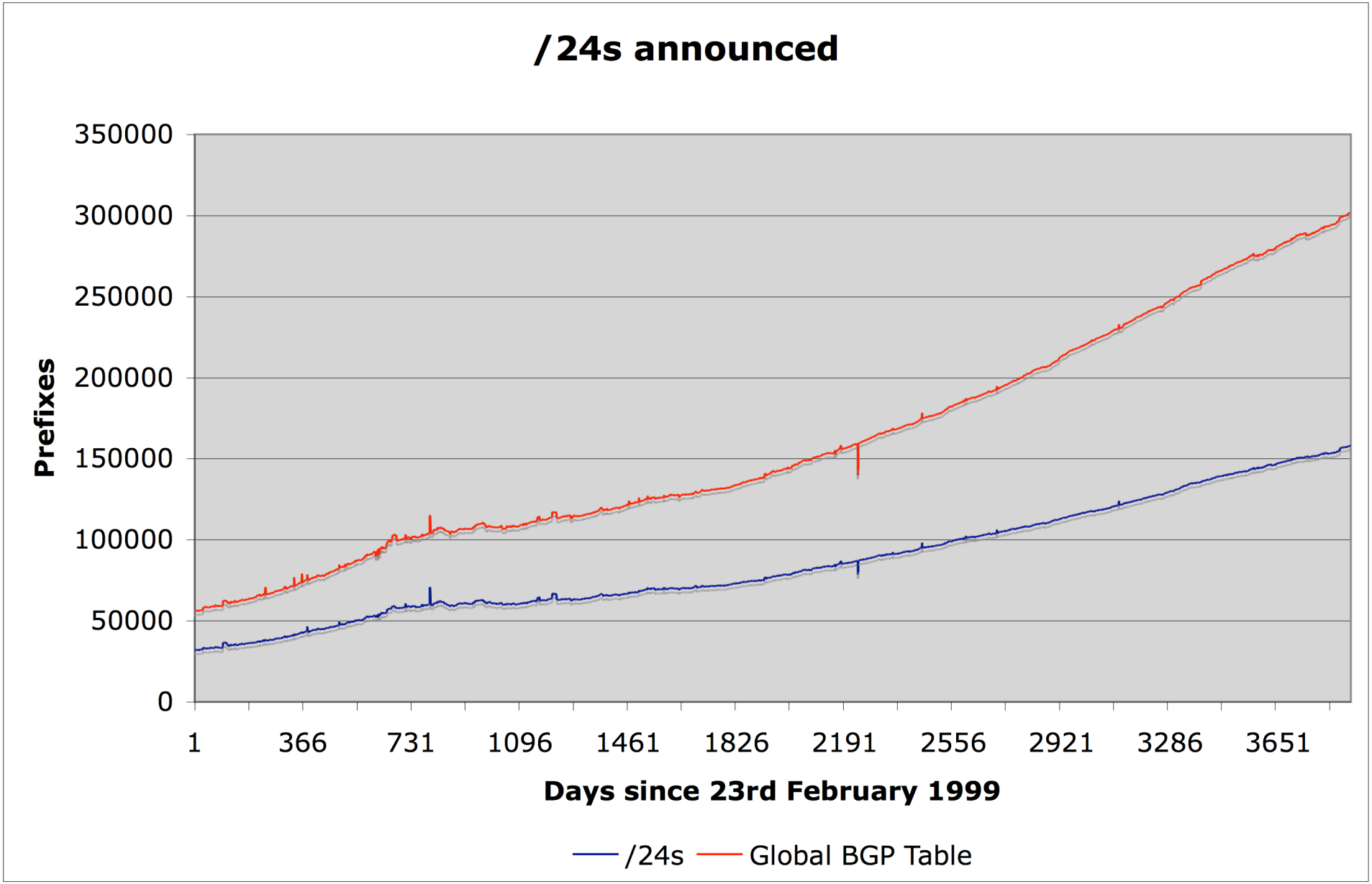

BGP Routing Table
350000
300000
250000
200000
150000
100000
50000
Prefixes
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999

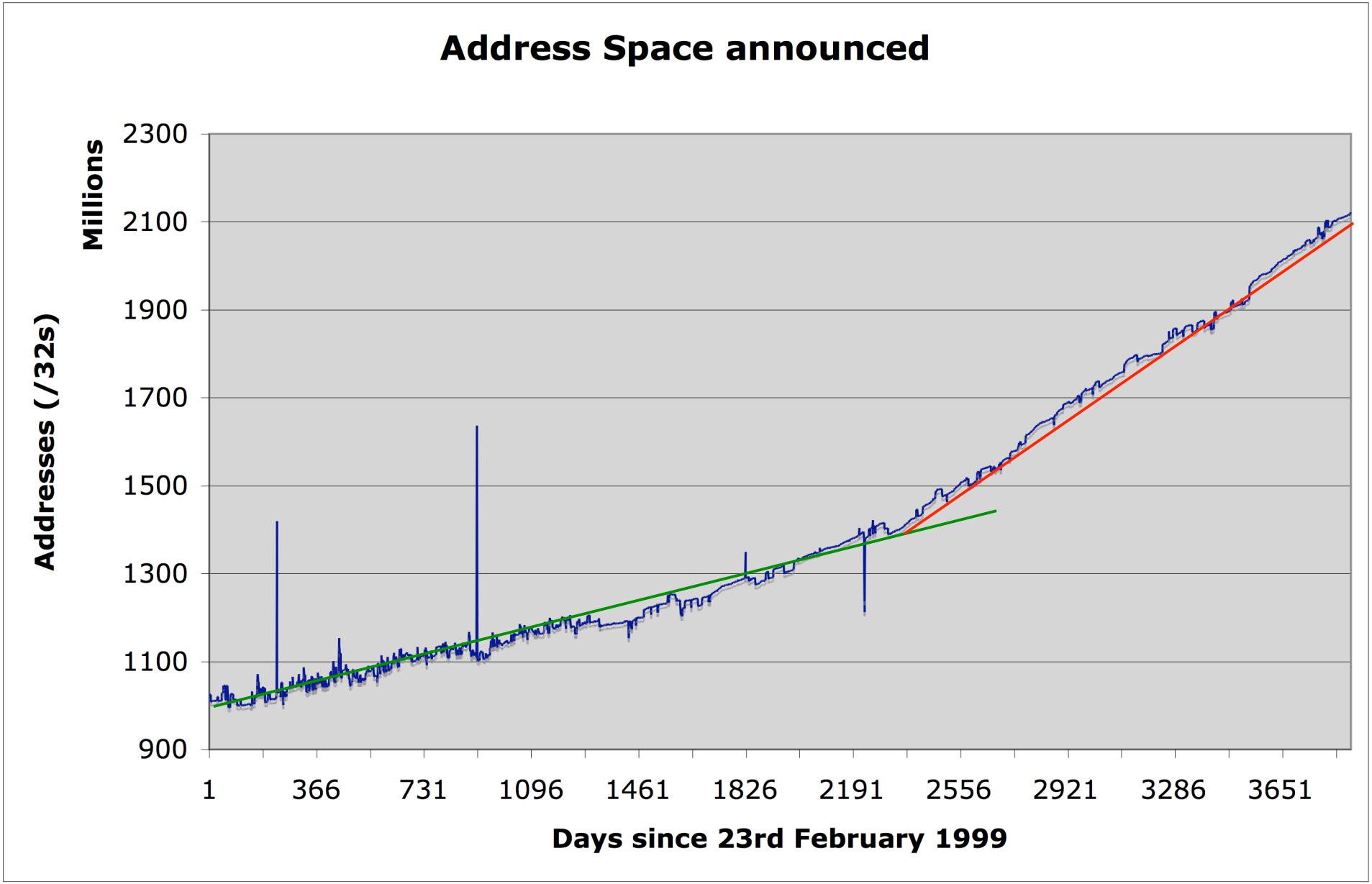

AS Growth
35000
30000
25000
20000
15000
10000
5000
0
ASNs
Growth slowed down
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999

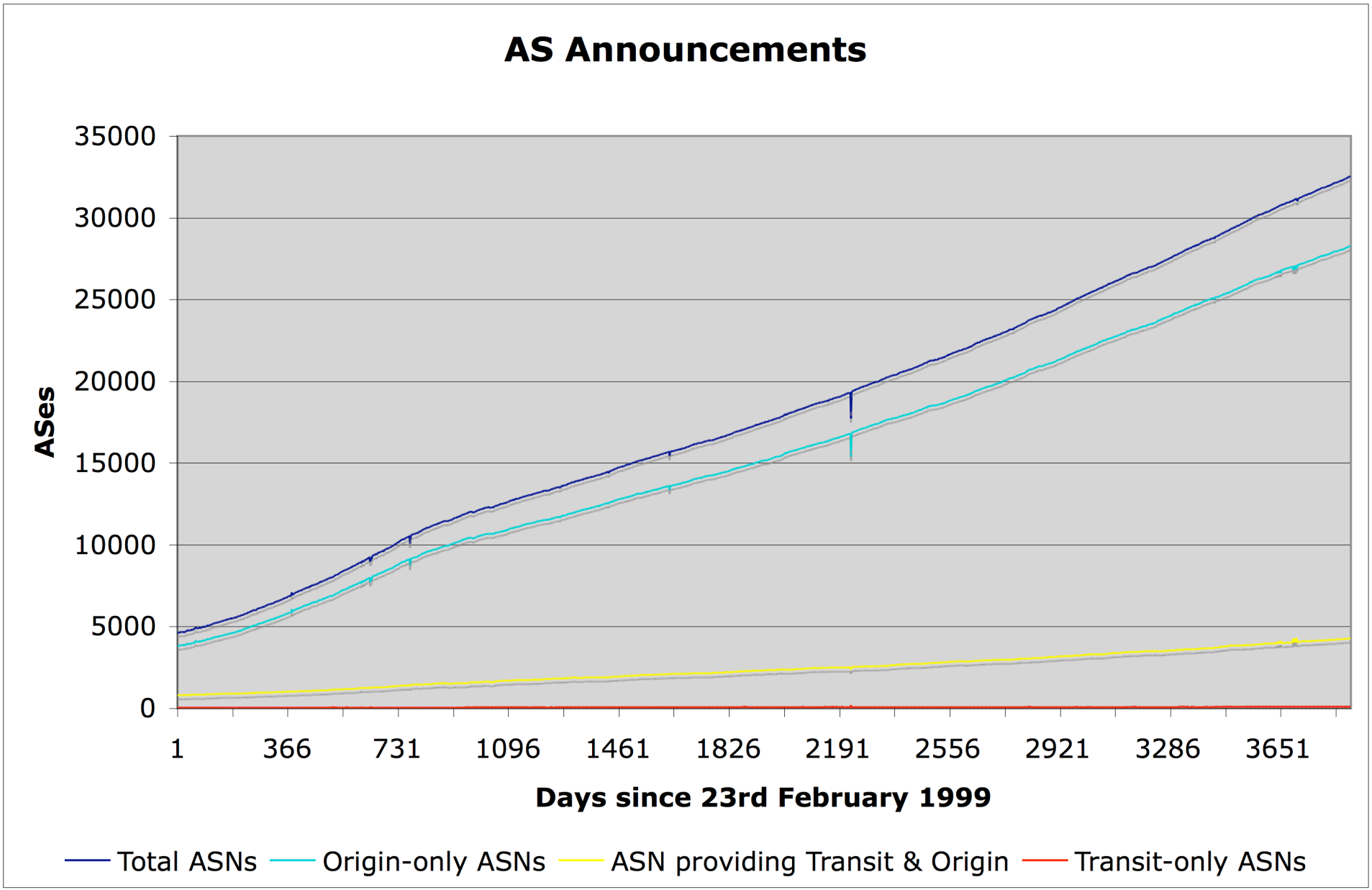

Max Aggregation vs Unique Prefixes
Prefixes
350000
300000
250000
200000
150000
100000
50000
0
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999
Max Aggregation
Unique Prefixes
Global BGP Table

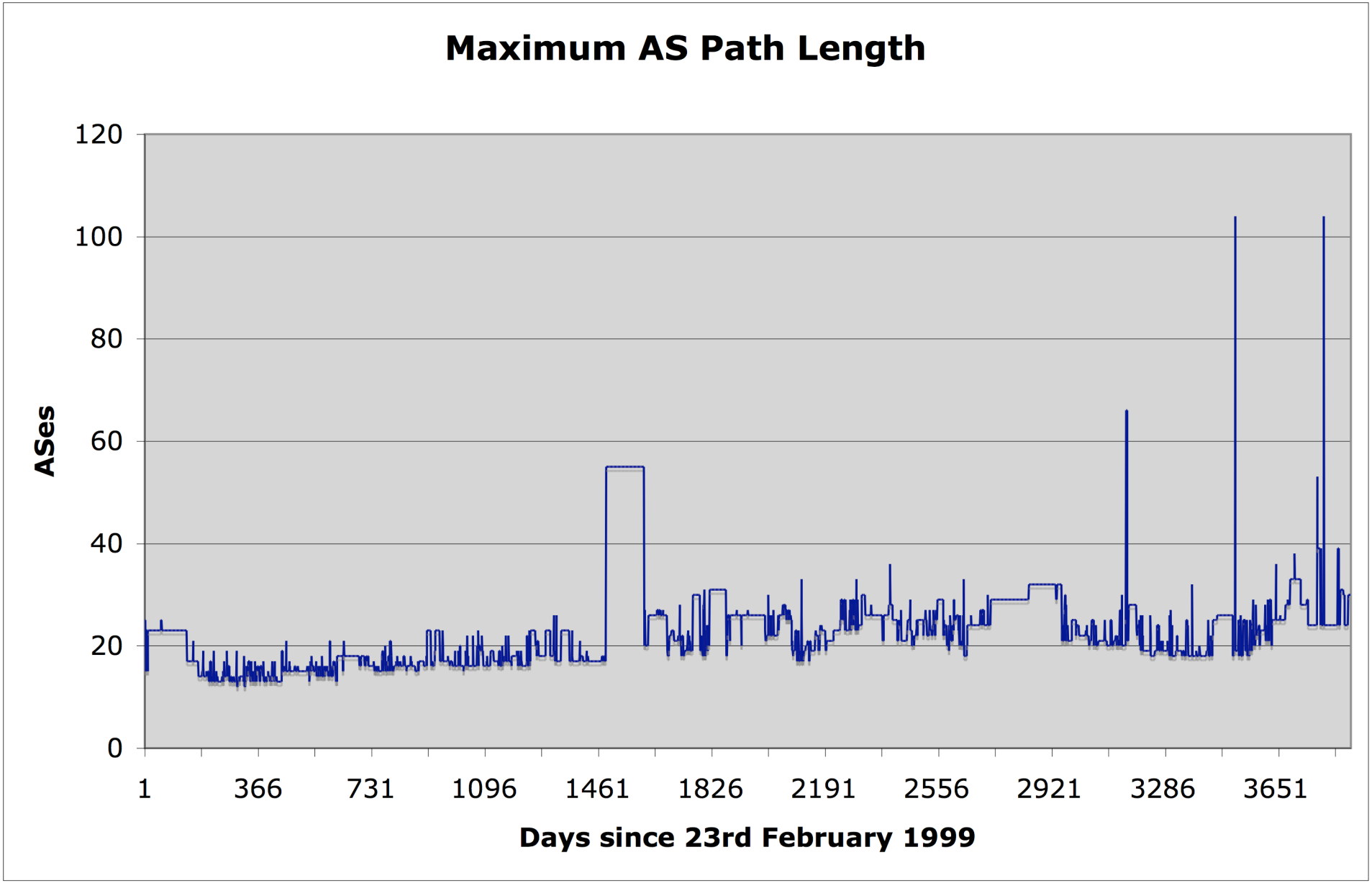

Deaggregation: RIR Regions vs Global
Ratio
4.5
4
3.5
3
2.5
2
1.5
1
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999
Global
AfriNIC
APNIC
ARIN
LACNIC
RIPE

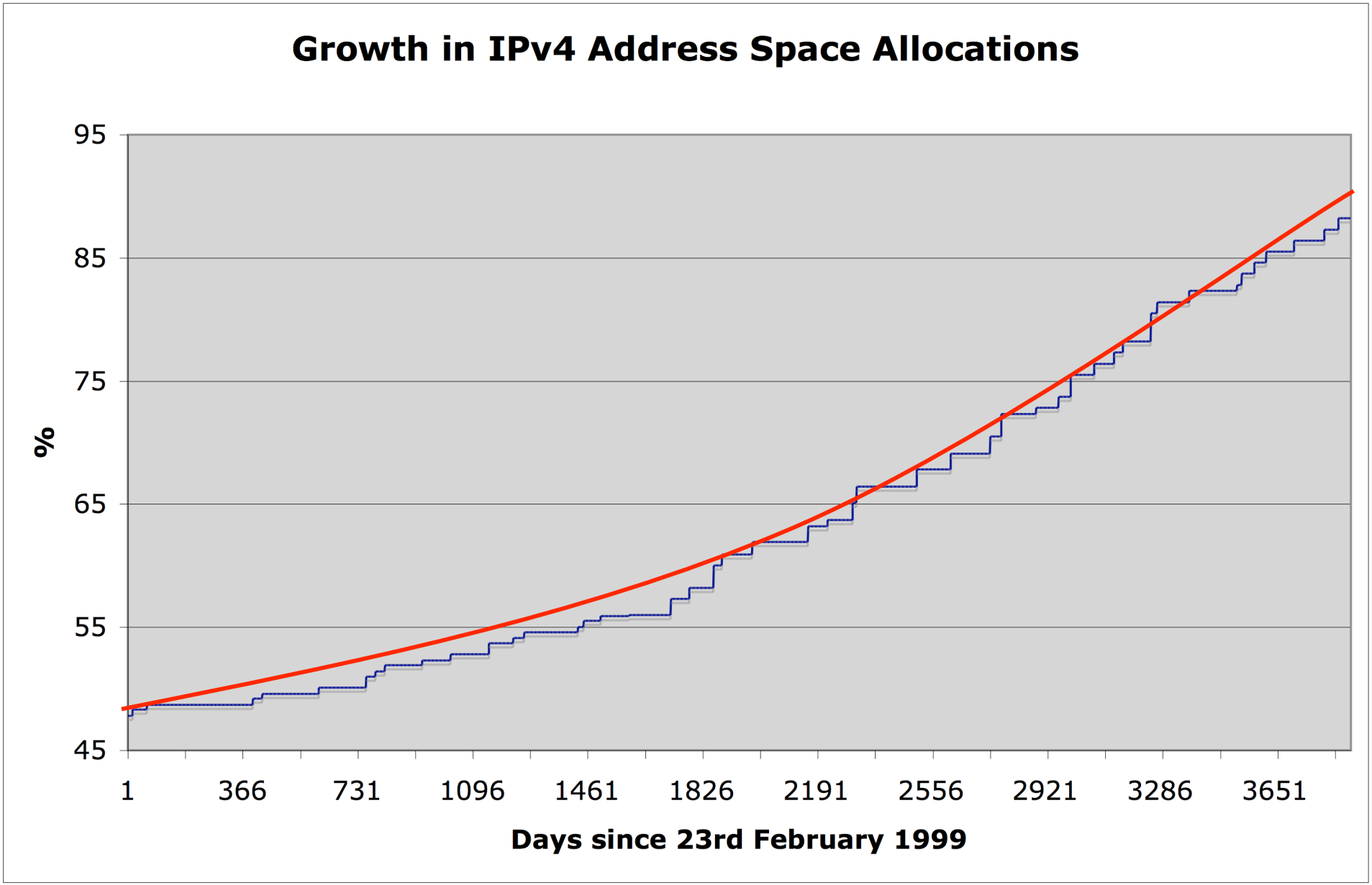

Prefix sizes announced
Prefixes
30000
25000
20000
15000
10000
5000
0
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999
/19
/20
/21
/22
/23

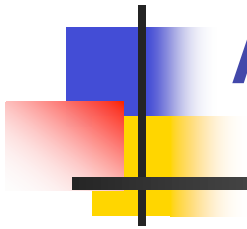

/24s announced
350000
300000
250000
200000
150000
100000
50000
0
Prefixes
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999
/24s
Global BGP Table


Address Space announced
Addresses (/32s)
Millions
2300
2100
1900
1700
1500
1300
1100
900
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999


AS Announcements
35000
30000
25000
20000
15000
10000
5000
0
ASes
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999
Total ASNs
Origin-only ASNs
ASN providing Transit & Origin
Transit-only ASNs


Maximum AS Path Length
ASes
120
100
80
60
40
20
0
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999


Growth in IPv4 Address Space Allocations
95
85
75
65
55
45
%
1
366
731
1096
1461
1826
2191
2556
2921
3286
3651
Days since 23rd February 1999



Internet Routing Table Analysis Update

Questions?