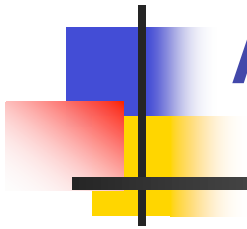

Internet Routing Table Analysis Update

Philip Smith
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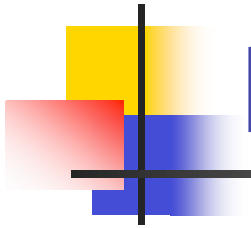
SANOG 9
Colombo, January 2007



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 22 January 2007

BGP routing table entries examined:	208252
Prefixes after maximum aggregation:	112504
Deaggregation factor:	1.85
Unique aggregates announced to Internet:	101342
Total ASes present in the Internet Routing Table:	24170
Origin-only ASes present in the Internet Routing Table:	21053
Origin ASes announcing only one prefix:	10190
Transit ASes present in the Internet Routing Table:	3117
Transit-only ASes present in the Internet Routing Table:	77
Average AS path length visible in the Internet Routing Table:	3.6
Max AS path length visible:	32
Max AS path prepend of ASN (20858)	18
Prefixes from unregistered ASNs in the Routing Table:	4
Unregistered ASNs in the Routing Table:	6
Special use prefixes present in the Routing Table:	0
Prefixes being announced from unallocated address space:	27
Number of addresses announced to Internet:	1660603468
Equivalent to 98 /8s, 250 /16s and 204 /24s	
Percentage of available address space announced:	44.8
Percentage of allocated address space announced:	63.6
Percentage of available address space allocated:	70.5
Total number of prefixes smaller than registry allocations:	106493

APNIC Region

Prefixes being announced by APNIC Region ASes:	46386
Total APNIC prefixes after maximum aggregation:	18674
APNIC Deaggregation factor:	2.48
Prefixes being announced from the APNIC address blocks:	43848
Unique aggregates announced from the APNIC address blocks:	19097
APNIC Region origin ASes present in the Internet Routing Table:	2827
APNIC Region origin ASes announcing only one prefix:	793
APNIC Region transit ASes present in the Internet Routing Table:	418
Average APNIC Region AS path length visible:	3.6
Max APNIC Region AS path length visible:	17
Number of APNIC addresses announced to Internet:	275908576
Equivalent to 16 /8s, 114 /16s and 7 /24s	
Percentage of available APNIC address space announced:	86.3

APNIC AS Blocks	4608-4864, 7467-7722, 9216-10239, 17408-18431
(pre-ERX allocations)	23552-24575, 37888-38911
APNIC Address Blocks	58/7, 60/7, 121/8, 122/7, 124/7, 126/8, 202/7
	210/7, 218/7, 220/7 and 222/8

ARIN Region

Prefixes being announced by ARIN Region ASes:	102621
Total ARIN prefixes after maximum aggregation:	60697
ARIN Deaggregation factor:	1.69
Prefixes being announced from the ARIN address blocks:	75611
Unique aggregates announced from the ARIN address blocks:	28906
ARIN Region origin ASes present in the Internet Routing Table:	11273
ARIN Region origin ASes announcing only one prefix:	4312
ARIN Region transit ASes present in the Internet Routing Table:	1038
Average ARIN Region AS path length visible:	3.4
Max ARIN Region AS path length visible:	21
Number of ARIN addresses announced to Internet:	313853824
Equivalent to 18 /8s, 181 /16s and 7 /24s	
Percentage of available ARIN address space announced:	69.3

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
ARIN Address Blocks	24/8, 63/8, 64/5, 72/6, 76/8, 96/6, 199/8, 204/6, 208/7 and 216/8

RIPE NCC Region

Prefixes being announced by RIPE Region ASes:	43079
Total RIPE prefixes after maximum aggregation:	28148
RIPE Deaggregation factor:	1.53
Prefixes being announced from the RIPE address blocks:	39776
Unique aggregates announced from the RIPE address blocks:	26524
RIPE Region origin ASes present in the Internet Routing Table:	9058
RIPE Region origin ASes announcing only one prefix:	4783
RIPE Region transit ASes present in the Internet Routing Table:	1463
Average RIPE Region AS path length visible:	4.0
Max RIPE Region AS path length visible:	32
Number of RIPE addresses announced to Internet:	286567076
Equivalent to 17 /8s, 20 /16s and 170 /24s	
Percentage of available RIPE address space announced:	77.6

RIPE AS Blocks (pre-ERX allocations)	1877-1901, 2043, 2047, 2107-2136, 2585-2614 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 40960-43007
RIPE Address Blocks	62/8, 77/8, 78/7, 80/5, 88/6, 193/8, 194/7, 212/7 and 217/8

LACNIC Region

Prefixes being announced by LACNIC Region ASes:	13680
Total LACNIC prefixes after maximum aggregation:	4023
LACNIC Deaggregation factor:	3.40
Prefixes being announced from the LACNIC address blocks:	11673
Unique aggregates announced from the LACNIC address blocks:	7206
LACNIC Region origin ASes present in the Internet Routing Table:	760
LACNIC Region origin ASes announcing only one prefix:	249
LACNIC Region transit ASes present in the Internet Routing Table:	135
Average LACNIC Region AS path length visible:	4.2
Max LACNIC Region AS path length visible:	20
Number of LACNIC addresses announced to Internet:	36291584
Equivalent to 2 /8s, 41 /16s and 196 /24s	
Percentage of available LACNIC address space announced:	54.1

LACNIC AS Blocks	26592-26623, 27648-28671, plus ERX transfers
LACNIC Address Blocks	189/8, 190/8, 200/7

AfriNIC Region

Prefixes being announced by AfriNIC Region ASes:	2483
Total AfriNIC prefixes after maximum aggregation:	961
AfriNIC Deaggregation factor:	2.58
Prefixes being announced from the AfriNIC address blocks:	1772
Unique aggregates announced from the AfriNIC address blocks:	1150
AfriNIC Region origin ASes present in the Internet Routing Table:	174
AfriNIC Region origin ASes announcing only one prefix:	53
AfriNIC Region transit ASes present in the Internet Routing Table:	32
Average AfriNIC Region AS path length visible:	3.6
Max AfriNIC Region AS path length visible:	15
Number of AfriNIC addresses announced to Internet:	5366528
Equivalent to 0 /8s, 81 /16s and 227 /24s	
Percentage of available AfriNIC address space announced:	16.0

AfriNIC AS Blocks	36864-37887 & ERX transfers
AfriNIC Address Blocks	41/8, 196/8

Global per AS prefix count summary

ASN	No of nets	/20 equiv	Max Agg	Description
7018	1546	6129	993	AT&T WorldNet Services
4134	1270	8655	268	CHINANET-BACKBONE
4755	1091	383	76	Videsh Sanchar Nigam Ltd. Aut
2386	1065	585	732	AT&T Data Communications Serv
4323	1065	818	298	Time Warner Telecom
6197	1022	645	500	BellSouth Network Solutions,
9583	1021	109	17	Sify Limited
18566	986	272	8	Covad Communications
701	938	6692	749	UUNET Technologies, Inc.
174	934	6789	865	Cogent Communications
9498	929	467	64	BHARTI BT INTERNET LTD.
11492	910	99	14	Cable One
8151	843	2013	203	UniNet S.A. de C.V.
1239	824	2730	578	Sprint
19262	792	2570	184	Verizon Global Networks
20115	789	685	414	Charter Communications
23577	773	34	702	Korea Telecom (MPLS)
4766	760	4944	312	Korea Telecom (KIX)
7011	722	214	448	Citizens Utilities
22773	717	1744	42	Cox Communications, Inc.

Global Aggregation Savings Summary

ASN	No of Nets	Net Savings	Description
4755	1091	1015	Videsh Sanchar Nigam Ltd. Aut
9583	1021	1004	Sify Limited
4134	1270	1002	CHINANET-BACKBONE
18566	986	978	Covad Communications
11492	910	896	Cable One
9498	929	865	BHARTI BT INTERNET LTD.
4323	1065	767	Time Warner Telecom
22773	717	675	Cox Communications, Inc.
8151	843	640	UniNet S.A. de C.V.
19262	792	608	Verizon Global Networks
17488	584	564	Hathway IP Over Cable Interne
5668	568	549	CenturyTel Internet Holdings,
6197	1022	522	BellSouth Network Solutions,
19916	568	514	OLM LLC
7545	562	487	TPG Internet Pty Ltd
855	560	487	Canadian Research Network
18101	512	485	Reliance Infocom Ltd Internet
15270	498	464	PaeTec.net -a division of Pae
11830	482	463	Instituto Costarricense de El
4766	760	448	Korea Telecom (KIX)

Number of prefixes announced by prefix length

/1:0	/2:0	/3:0	/4:0	/5:0	/6:0
/7:0	/8:19	/9:10	/10:13	/11:32	/12:117
/13:230	/14:412	/15:810	/16:9129	/17:3649	/18:5920
/19:12912	/20:14533	/21:12995	/22:16585	/23:17830	/24:111351
/25:641	/26:463	/27:373	/28:66	/29:39	/30:90
/31:0	/32:33				

January 2007 ↑

January 2006 ↓

Number of prefixes announced by prefix length

/1:0	/2:0	/3:0	/4:0	/5:0	/6:0
/7:0	/8:18	/9:5	/10:8	/11:20	/12:87
/13:196	/14:349	/15:680	/16:8655	/17:2967	/18:4979
/19:11209	/20:12377	/21:10691	/22:13696	/23:14912	/24:97275
/25:311	/26:252	/27:202	/28:62	/29:26	/30:55
/31:3	/32:39				

Advertised IANA Reserved Addresses

Network	Origin AS	Description
132.0.0.0/10	721	DLA Systems Automation Center
137.0.0.0/13	721	DLA Systems Automation Center
158.0.0.0/13	721	DLA Systems Automation Center
192.43.230.0/24	7575	Australian Academic and Rease
192.44.0.0/24	5501	Fraunhofer Gesellschaft
192.44.0.0/19	702	UUNET - Commercial IP service
192.70.164.0/24	25689	National Research Council of
192.72.0.0/18	4780	Digital United Inc.
192.72.0.0/16	4780	Digital United Inc.
192.84.205.0/24	719	LANLINK autonomous system
192.119.135.0/24	270	NASA
192.172.0.0/19	721	DLA Systems Automation Center

Private and Non-Routed Address Space

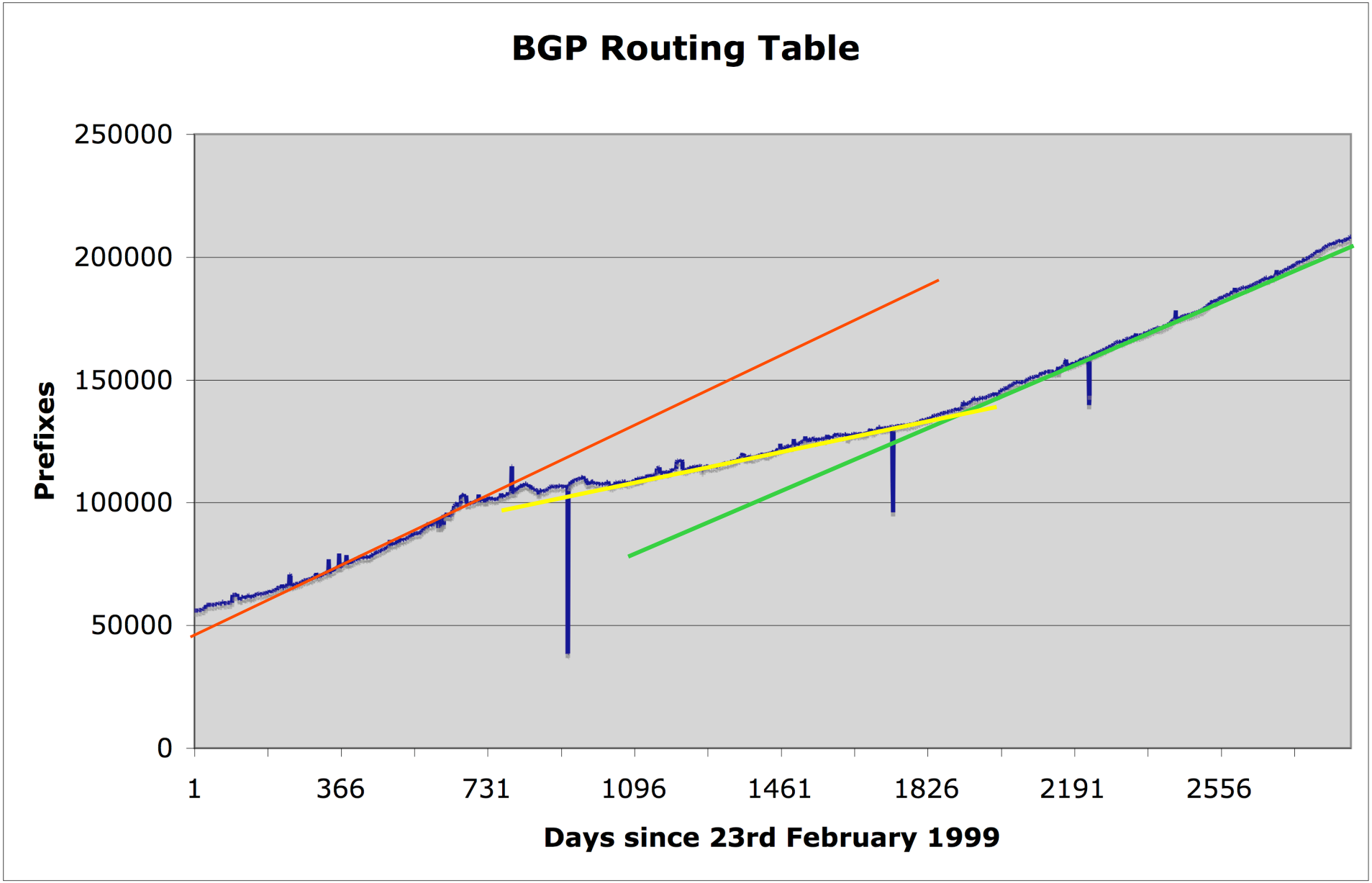
Prefix	Origin AS	Description

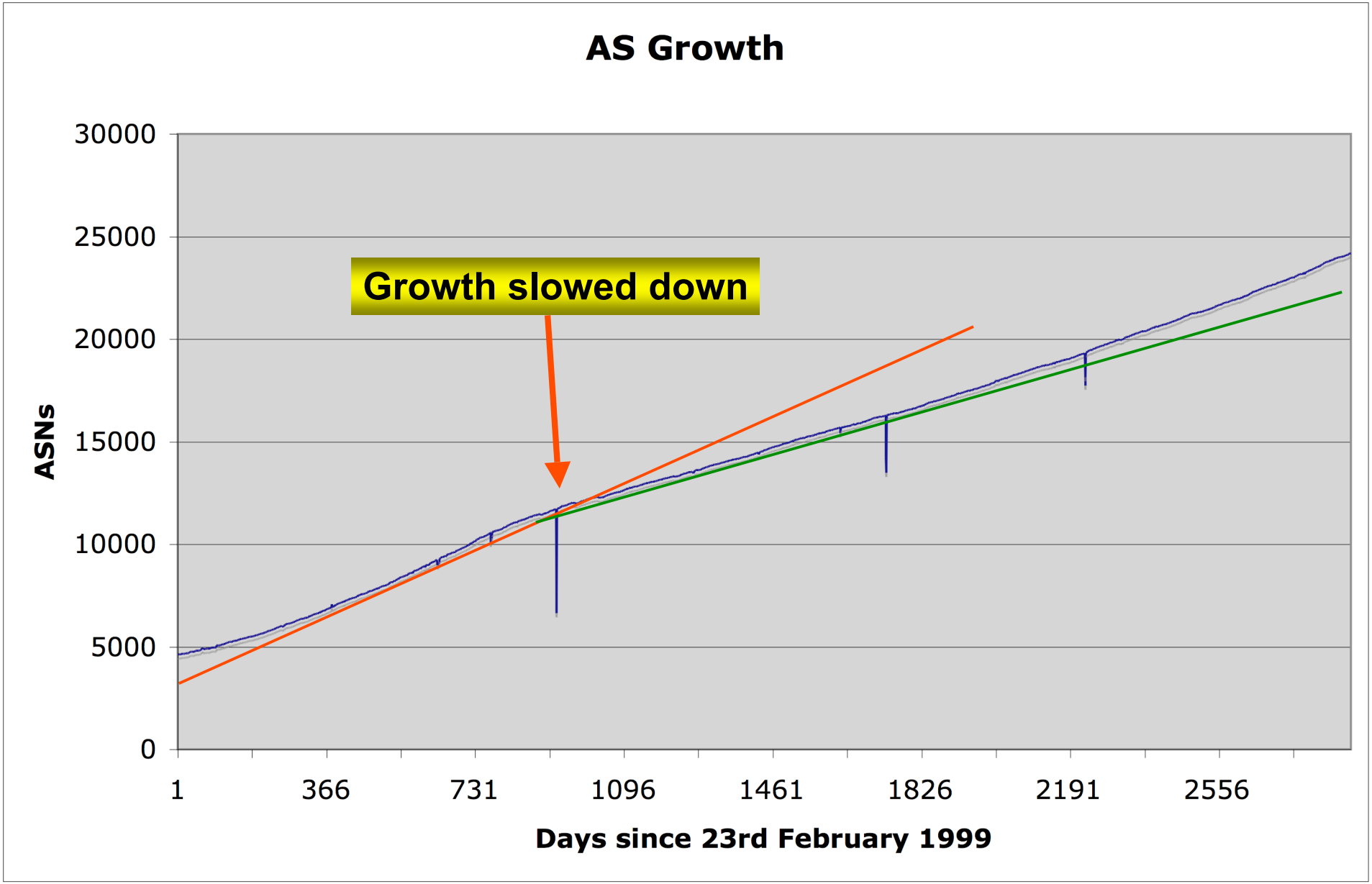
List of Unregistered AS's

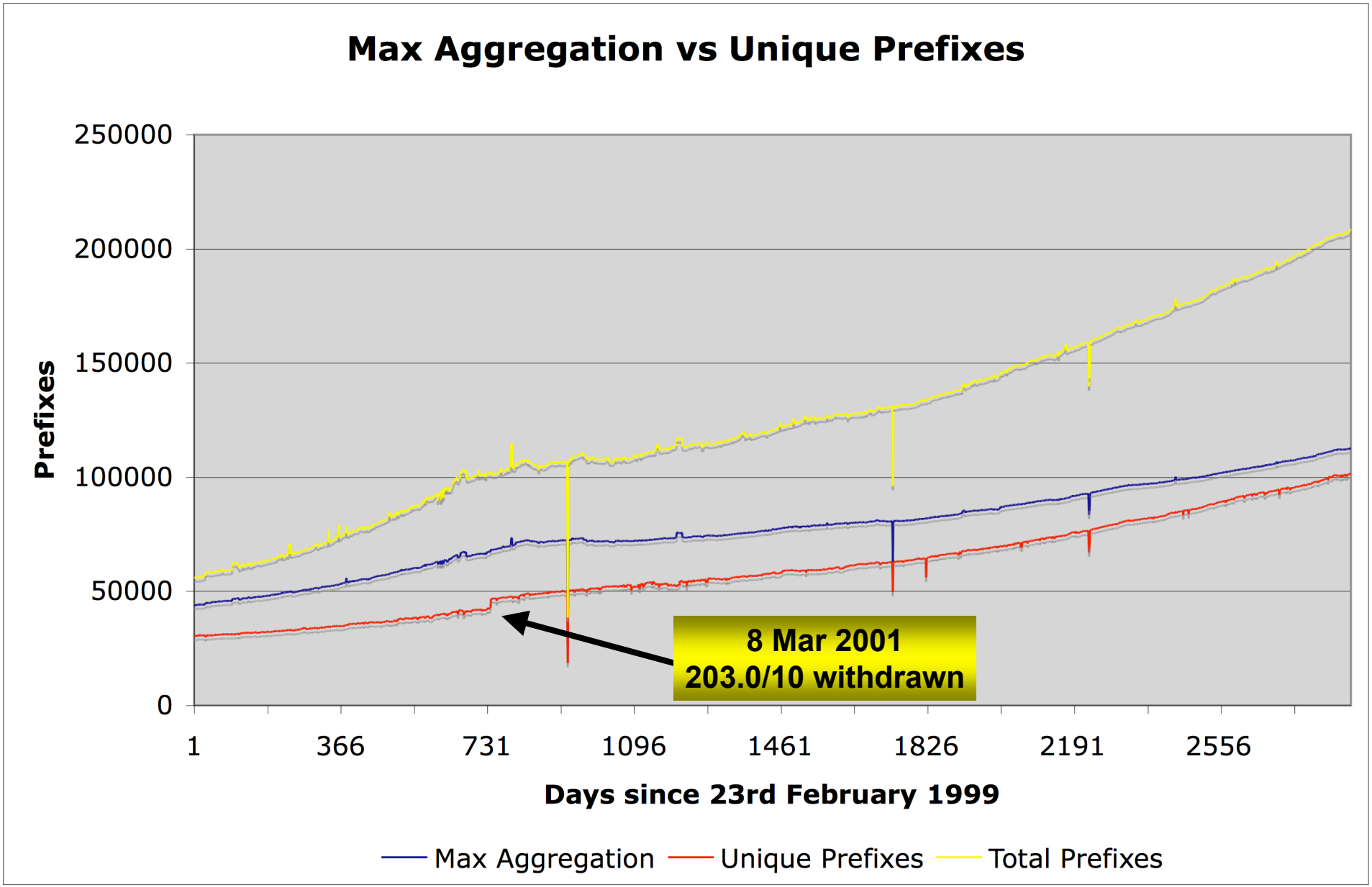
Bad AS	Designation	Network	Transit AS	Description
65005	PRIVATE	159.153.148.0/22	24989	IX Europe Frankfurt

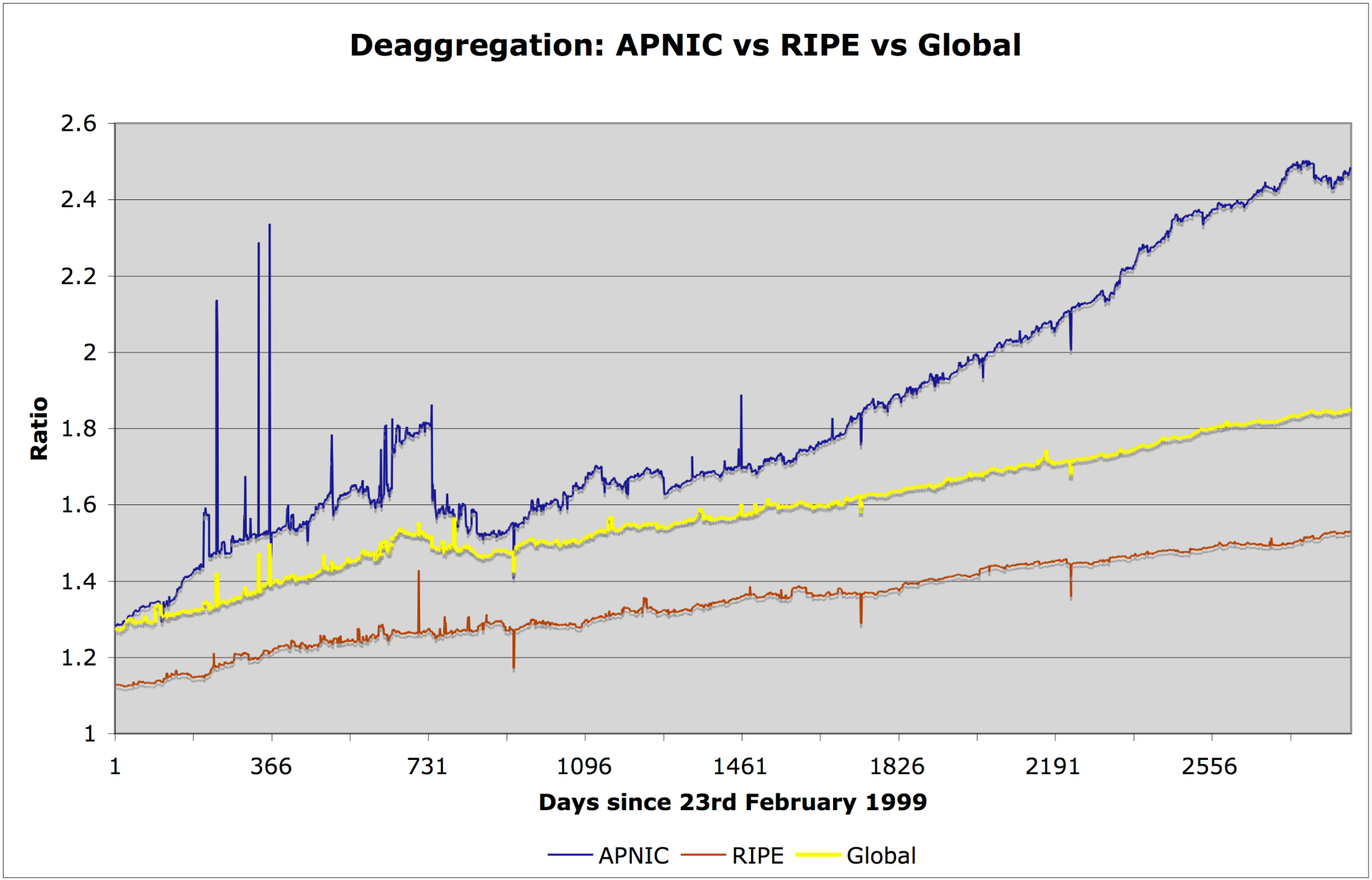
Prefixes Smaller than Registry Allocations

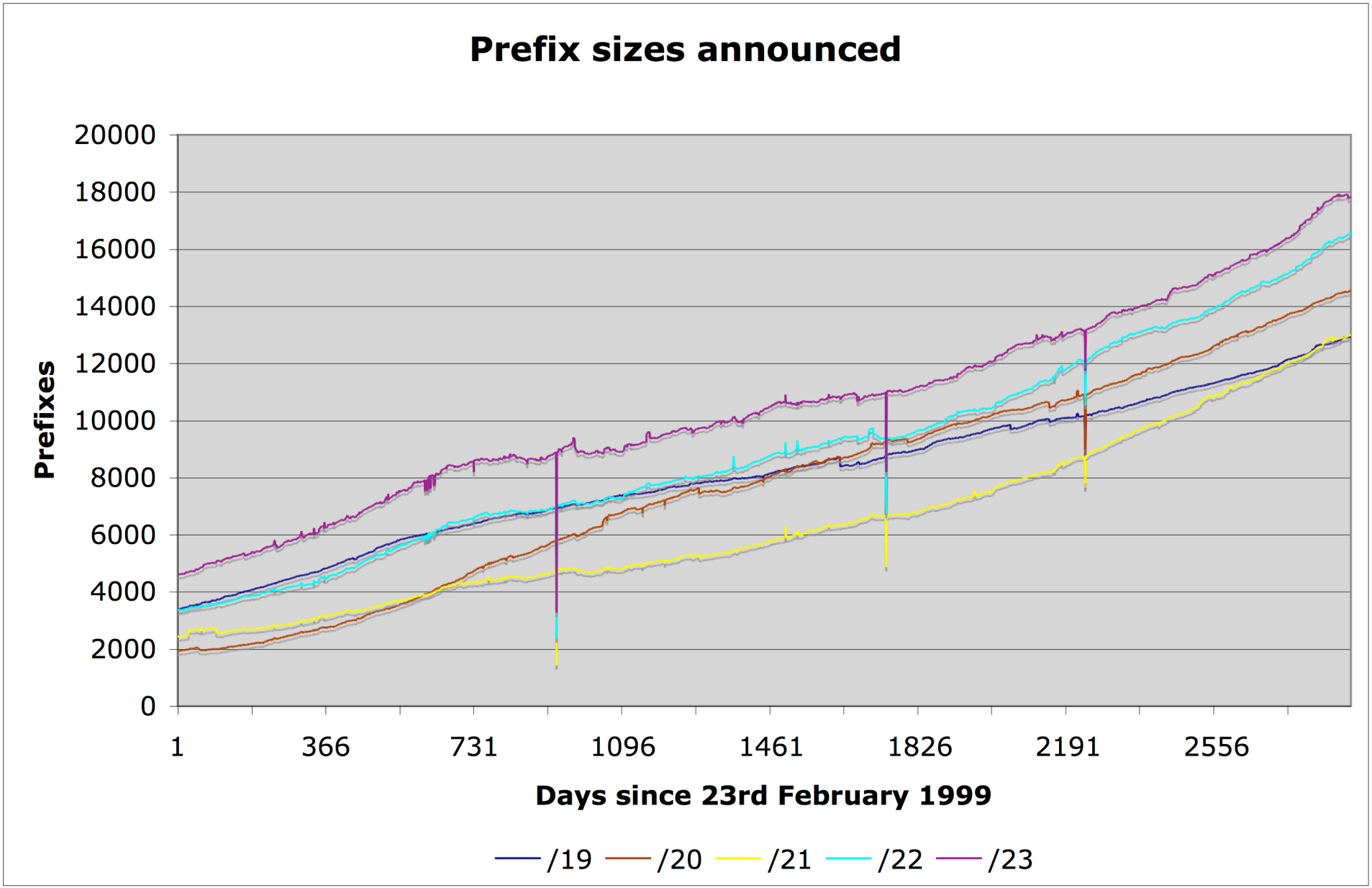
ASN	No of nets	Total ann.	Description
18566	875	892	Covad Communications
6197	785	973	BellSouth Network Solutions,
7018	748	1467	AT&T WorldNet Services
9583	660	838	Sify Limited
11492	635	644	Cable One
2386	613	879	AT&T Data Communications Serv
4323	578	1203	Time Warner Telecom
19916	557	563	OLM LLC
4766	519	719	Korea Telecom (KIX)
855	443	571	Canadian Research Network
5668	407	518	CenturyTel Internet Holdings,
7011	402	468	Citizens Utilities
702	372	587	UUNET - Commercial IP service
1239	361	844	Sprint
6198	357	500	BellSouth Network Solutions,
6517	342	370	Yipes Communications, Inc.
15270	334	361	PaeTec.net -a division of Pae
812	317	438	Rogers WAVE
22773	315	610	Cox Communications, Inc.
13609	290	332	Choice One Communications Inc

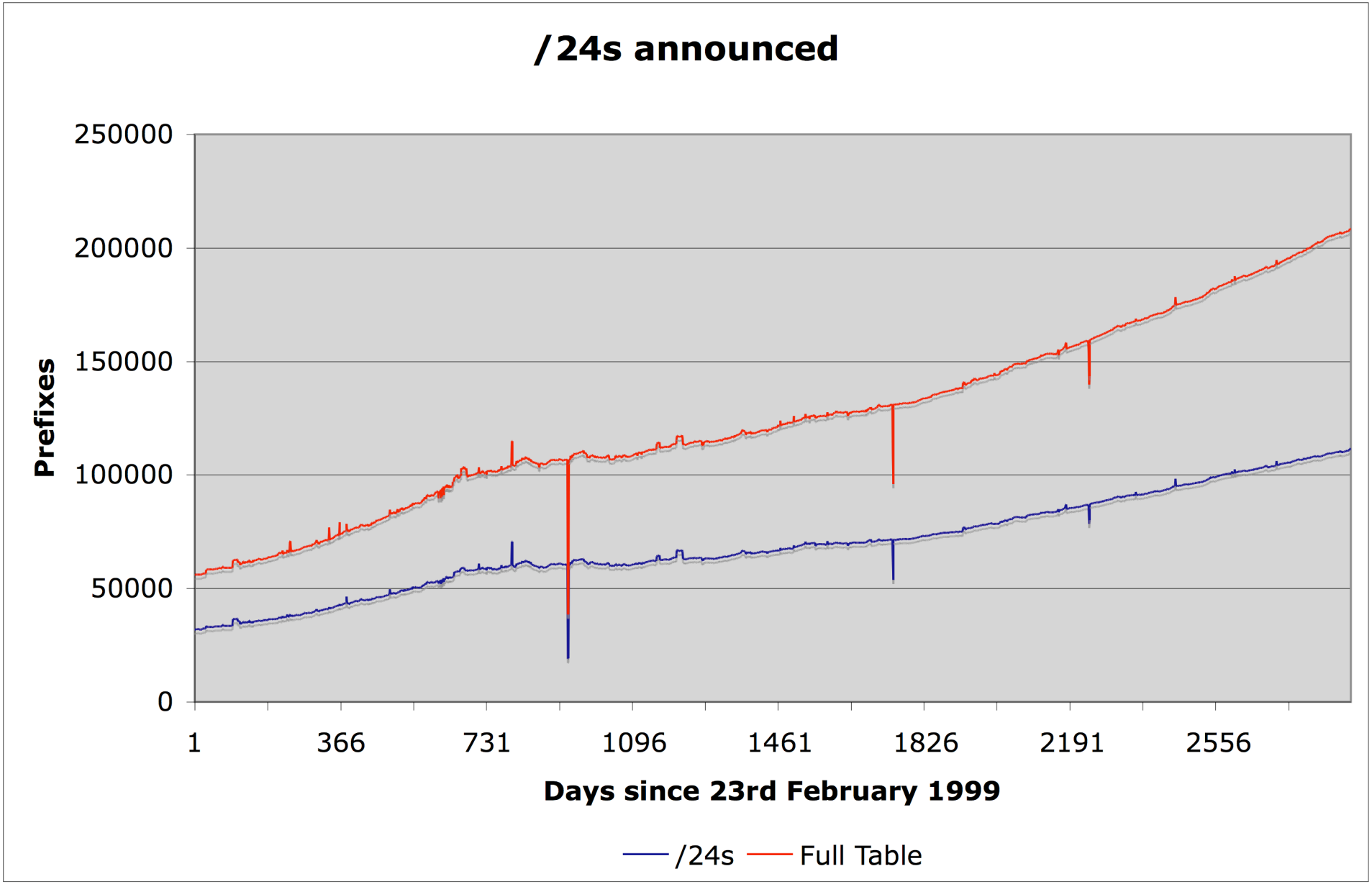

BGP Routing Table
250000
200000
150000
100000
50000
0
Prefixes
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999

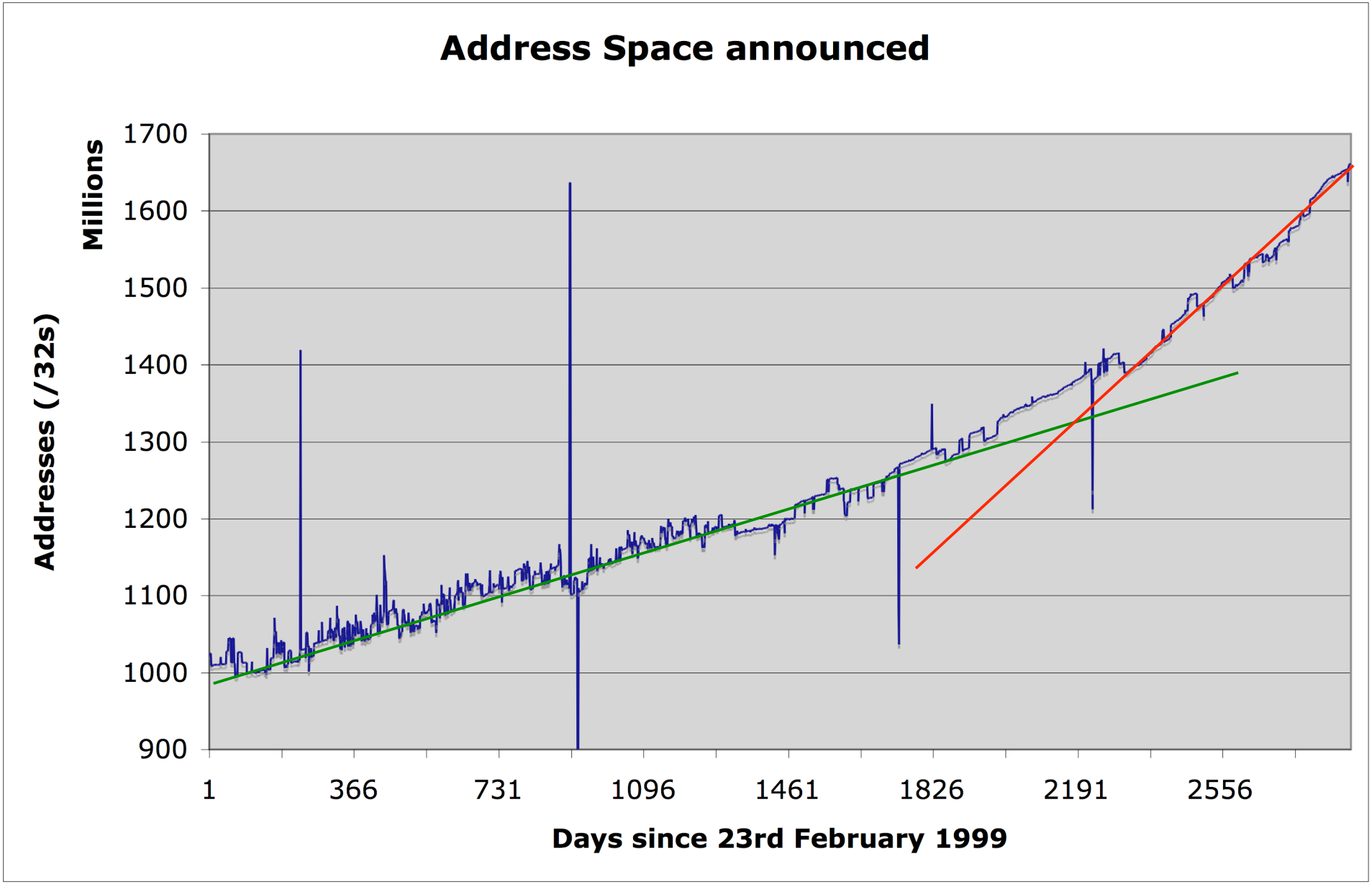

AS Growth
Growth slowed down
ASNs
30000
25000
20000
15000
10000
5000
0
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999

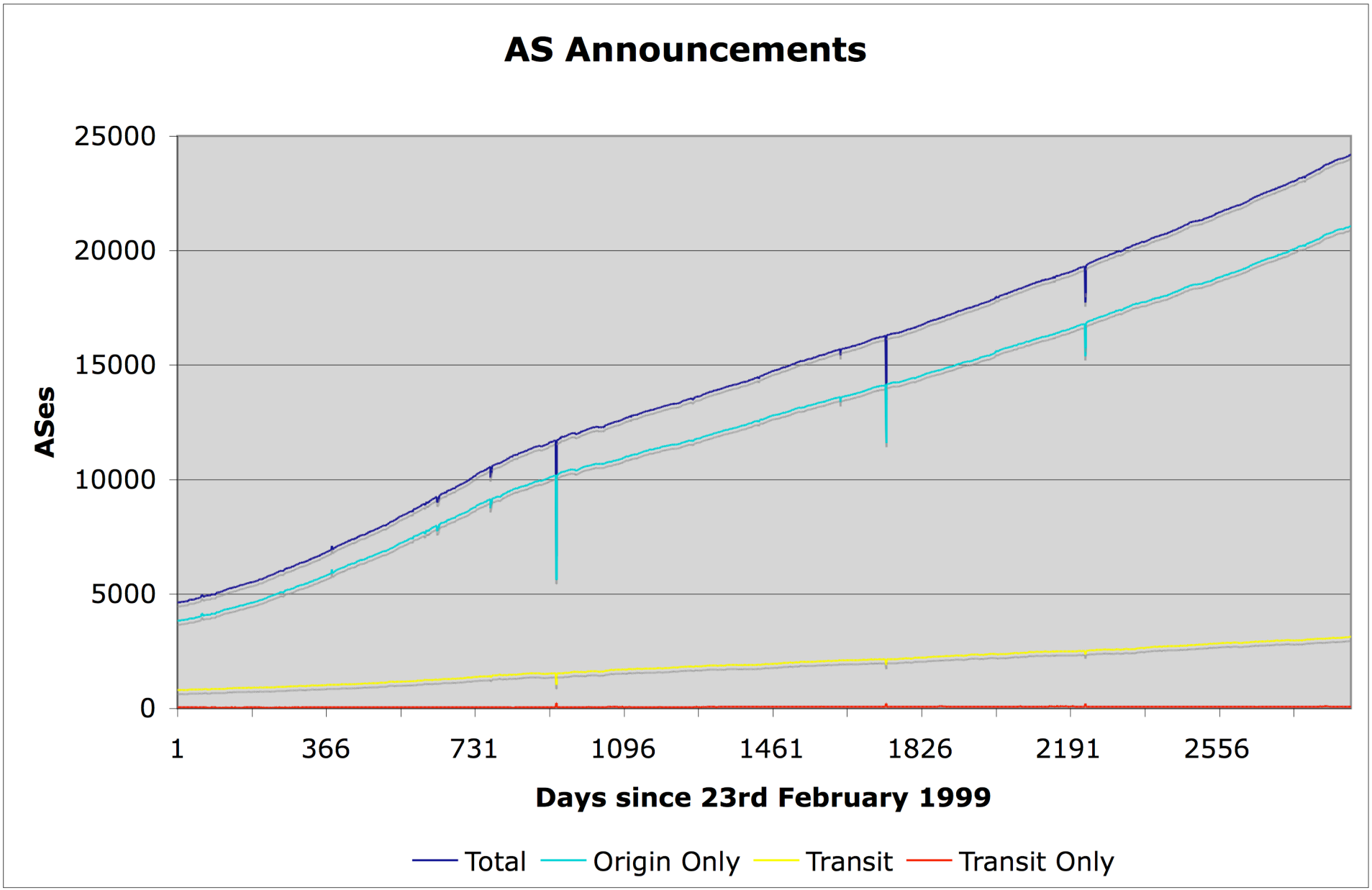

Max Aggregation vs Unique Prefixes
250000
200000
150000
100000
50000
0
Prefixes
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999
8 Mar 2001
203.0/10 withdrawn
Max Aggregation
Unique Prefixes
Total Prefixes

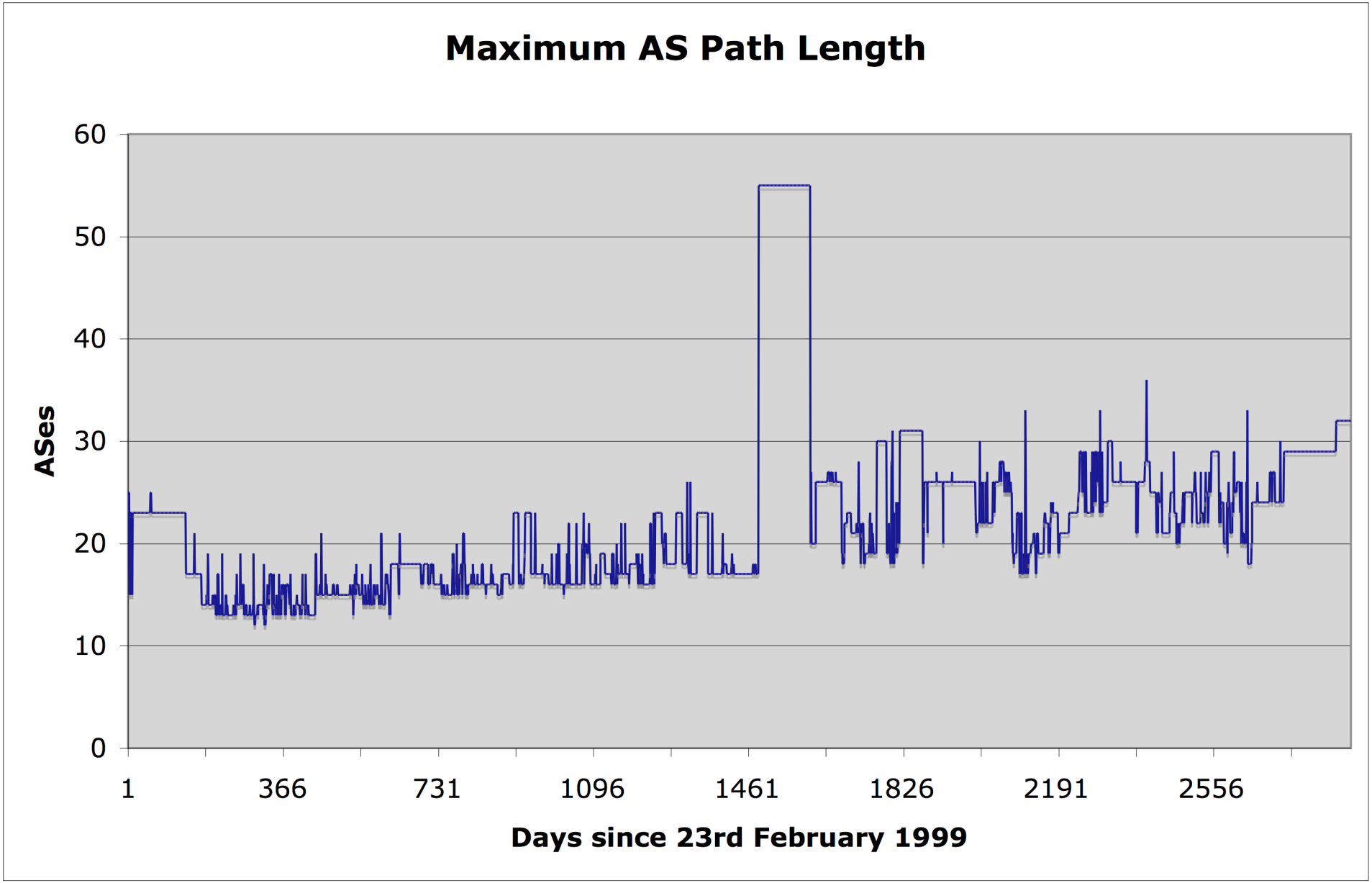

Deaggregation: APNIC vs RIPE vs Global
Ratio
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999
APNIC
RIPE
Global

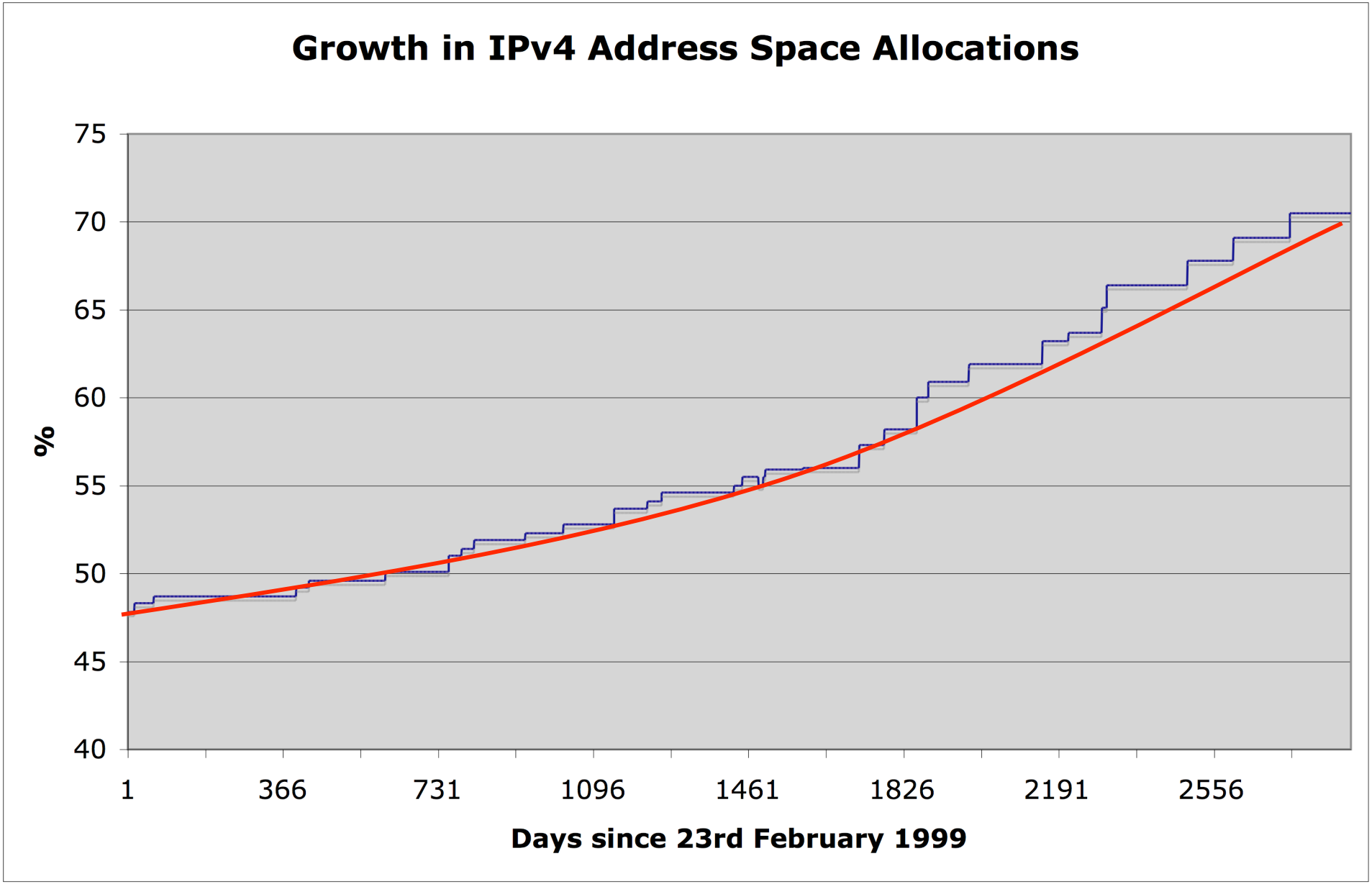

Prefix sizes announced
Prefixes
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999
/19
/20
/21
/22
/23

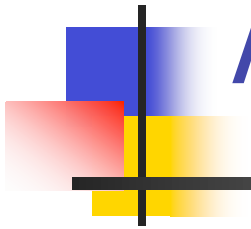

/24s announced
250000
200000
150000
100000
50000
0
Prefixes
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999
/24s
Full Table


Address Space announced
Addresses (/32s)
Millions
1700
1600
1500
1400
1300
1200
1100
1000
900
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999


AS Announcements
25000
20000
15000
10000
5000
0
ASes
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999
Total
Origin Only
Transit
Transit Only


Maximum AS Path Length
60
50
40
30
20
10
0
ASes
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999


Growth in IPv4 Address Space Allocations
75
70
65
60
55
50
45
40
%
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999



Internet Routing Table Analysis Update

Questions?