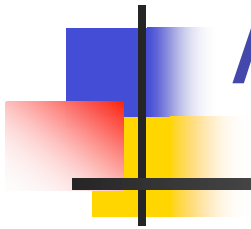

Internet Routing Table Analysis Update

Philip Smith
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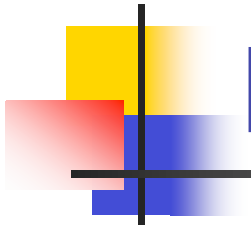
SANOG VIII
Karachi, July 2006



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 3 August 2006

BGP routing table entries examined:	193961
Prefixes after maximum aggregation:	106687
Unique aggregates announced to Internet:	94871
Total ASes present in the Internet Routing Table:	22790
Origin-only ASes present in the Internet Routing Table:	19826
Origin ASes announcing only one prefix:	9498
Transit ASes present in the Internet Routing Table:	2964
Transit-only ASes present in the Internet Routing Table:	66
Average AS path length visible in the Internet Routing Table:	3.5
Max AS path length visible:	24
Max AS path prepend of ASN (24076)	20
Prefixes from unregistered ASNs in the Routing Table:	22
Unregistered ASNs in the Routing Table:	3
Special use prefixes present in the Routing Table:	1
Prefixes being announced from unallocated address space:	9
Number of addresses announced to Internet:	1560110252
Equivalent to 92 /8s, 253 /16s and 100 /24s	
Percentage of available address space announced:	42.1
Percentage of allocated address space announced:	60.9
Percentage of available address space allocated:	69.1
Total number of prefixes smaller than registry allocations:	96186

APNIC Region

Prefixes being announced by APNIC Region ASes:	42411
Total APNIC prefixes after maximum aggregation:	17498
Prefixes being announced from the APNIC address blocks:	40109
Unique aggregates announced from the APNIC address blocks:	18723
APNIC Region origin ASes present in the Internet Routing Table:	2664
APNIC Region origin ASes announcing only one prefix:	753
APNIC Region transit ASes present in the Internet Routing Table:	398
Average APNIC Region AS path length visible:	3.5
Max APNIC Region AS path length visible:	24
Number of APNIC addresses announced to Internet:	243959392
Equivalent to 14 /8s, 138 /16s and 134 /24s	
Percentage of available APNIC address space announced:	76.3

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:	98316
Total ARIN prefixes after maximum aggregation:	58481
Prefixes being announced from the ARIN address blocks:	72081
Unique aggregates announced from the ARIN address blocks:	27242
ARIN Region origin ASes present in the Internet Routing Table:	10857
ARIN Region origin ASes announcing only one prefix:	4093
ARIN Region transit ASes present in the Internet Routing Table:	1008
Average ARIN Region AS path length visible:	3.3
Max ARIN Region AS path length visible:	18
Number of ARIN addresses announced to Internet:	298648320
Equivalent to 17 /8s, 205 /16s and 3 /24s	
Percentage of available ARIN address space announced:	77.4

ARIN AS Blocks	1-1876, 1902-2042, 2044-2046, 2048-2106
(pre-ERX allocations)	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, 199/8, 204/6,
	208/7 and 216/8

RIPE NCC Region

Prefixes being announced by RIPE Region ASes:	38928
Total RIPE prefixes after maximum aggregation:	26081
Prefixes being announced from the RIPE address blocks:	35912
Unique aggregates announced from the RIPE address blocks:	24223
RIPE Region origin ASes present in the Internet Routing Table:	8332
RIPE Region origin ASes announcing only one prefix:	4372
RIPE Region transit ASes present in the Internet Routing Table:	1372
Average RIPE Region AS path length visible:	4.0
Max RIPE Region AS path length visible:	18
Number of RIPE addresses announced to Internet:	261103940
Equivalent to 15 /8s, 144 /16s and 33 /24s	
Percentage of available RIPE address space announced:	81.9

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
	40960-41983
RIPE Address Blocks	62/8, 80/5, 88/6, 193/8, 194/7, 212/7
	and 217/8

LACNIC Region

Prefixes being announced by LACNIC Region ASes:	12047
Total LACNIC prefixes after maximum aggregation:	3716
Prefixes being announced from the LACNIC address blocks:	10134
Unique aggregates announced from the LACNIC address blocks:	5780
LACNIC Region origin ASes present in the Internet Routing Table:	713
LACNIC Region origin ASes announcing only one prefix:	237
LACNIC Region transit ASes present in the Internet Routing Table:	130
Average LACNIC Region AS path length visible:	4.1
Max LACNIC Region AS path length visible:	24
Number of LACNIC addresses announced to Internet:	31419392
Equivalent to 1 /8s, 223 /16s and 108 /24s	
Percentage of available LACNIC address space announced:	46.8

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:	2237
Total AfriNIC prefixes after maximum aggregation:	911
Prefixes being announced from the AfriNIC address blocks:	1550
Unique aggregates announced from the AfriNIC address blocks:	971
AfriNIC Region origin ASes present in the Internet Routing Table:	158
AfriNIC Region origin ASes announcing only one prefix:	43
AfriNIC Region transit ASes present in the Internet Routing Table:	24
Average AfriNIC Region AS path length visible:	3.5
Max AfriNIC Region AS path length visible:	14
Number of AfriNIC addresses announced to Internet:	4196352
Equivalent to 0 /8s, 64 /16s and 8 /24s	
Percentage of available AfriNIC address space announced:	12.5

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	1485	6256	954	AT&T WorldNet Services
4134	1288	7914	238	CHINANET-BACKBONE
6197	1018	635	477	BellSouth Network Solutions,
721	1010	21926	312	DLA Systems Automation Center
701	964	6769	789	UUNET Technologies, Inc.
4323	963	746	272	Time Warner Telecom
4755	956	255	69	Videsh Sanchar Nigam Ltd. Aut
18566	951	272	8	Covad Communications
9583	940	109	15	Sify Limited
174	938	5769	887	Cogent Communications
2386	914	559	704	AT&T Data Communications Serv
1239	857	2783	604	Sprint
8151	776	1803	229	UniNet S.A. de C.V.
9498	762	211	70	BHARTI BT INTERNET LTD.
19262	728	2228	187	Verizon Global Networks
11492	720	89	15	Cable One
20115	717	624	383	Charter Communications
4766	699	4435	302	Korea Telecom (KIX)
209	699	3663	547	Qwest
22773	680	1741	41	Cox Communications, Inc.

Global Aggregation Savings Summary

ASN	No of Nets	Net Savings	Description
4134	1288	1050	CHINANET-BACKBONE
18566	951	943	Covad Communications
9583	940	925	Sify Limited
4755	956	887	Videsh Sanchar Nigam Ltd. Aut
11492	720	705	Cable One
721	1010	698	DLA Systems Automation Center
9498	762	692	BHARTI BT INTERNET LTD.
4323	963	691	Time Warner Telecom
22773	680	639	Cox Communications, Inc.
8151	776	547	UniNet S.A. de C.V.
6197	1018	541	BellSouth Network Solutions,
19262	728	541	Verizon Global Networks
19916	563	509	OLM LLC
5668	544	504	CenturyTel Internet Holdings,
17488	519	502	Hathway IP Over Cable Interne
855	567	493	Canadian Research Network
7545	551	479	TPG Internet Pty Ltd
15270	453	420	PaeTec.net -a division of Pae
3602	521	416	Sprint Canada, Inc.
22047	424	413	VTR PUNTO NET S.A.

Number of prefixes announced by prefix length

/1:0	/2:0	/3:0	/4:0	/5:0	/6:0
/7:0	/8:17	/9:9	/10:11	/11:28	/12:97
/13:205	/14:374	/15:732	/16:8935	/17:3392	/18:5521
/19:12011	/20:13581	/21:11851	/22:15043	/23:16232	/24:104826
/25:377	/26:296	/27:195	/28:64	/29:39	/30:79
/31:0	/32:46				

August 2006 ↑

August 2005 ↓

Number of prefixes announced by prefix length

/1:0	/2:0	/3:0	/4:0	/5:0	/6:0
/7:0	/8:17	/9:3	/10:8	/11:15	/12:75
/13:166	/14:317	/15:606	/16:8468	/17:2667	/18:4535
/19:10534	/20:11529	/21:9540	/22:12988	/23:13832	/24:91477
/25:372	/26:315	/27:179	/28:49	/29:27	/30:75
/31:0	/32:35				

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
192.44.0.0/24	5501	Fraunhofer Gesellschaft
192.44.0.0/19	702	UUNET - Commercial IP service
192.70.164.0/24	25689	National Research Council of
192.84.205.0/24	719	LANLINK autonomous system
192.172.0.0/19	721	DLA Systems Automation Center
192.249.0.0/20	3450	University of Tennessee, Knox

Private and Non-Routed Address Space

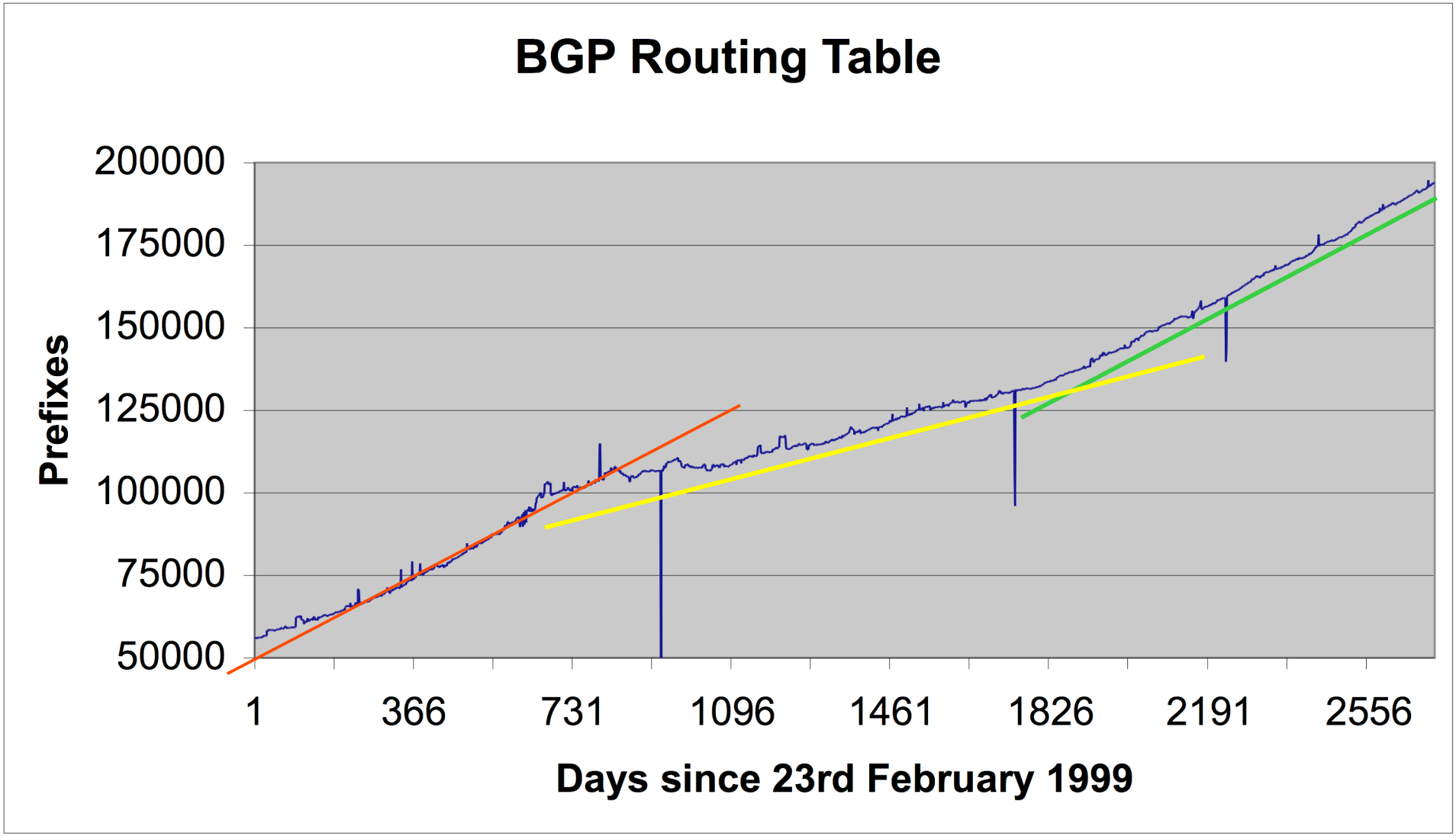
Prefix	Origin AS	Description
198.18.1.0/24	3301	TeliaNet Sweden

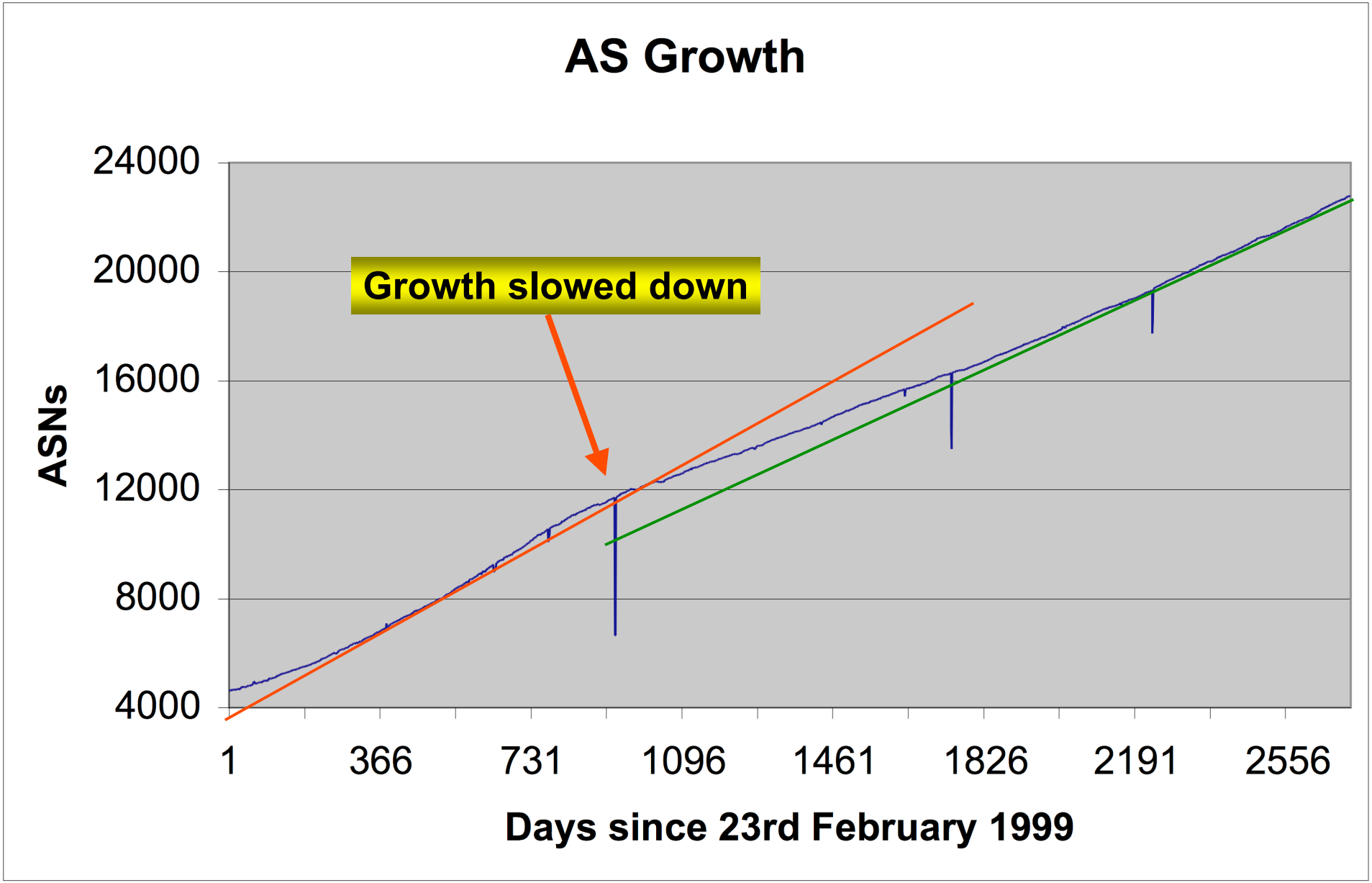
List of Unregistered AS's

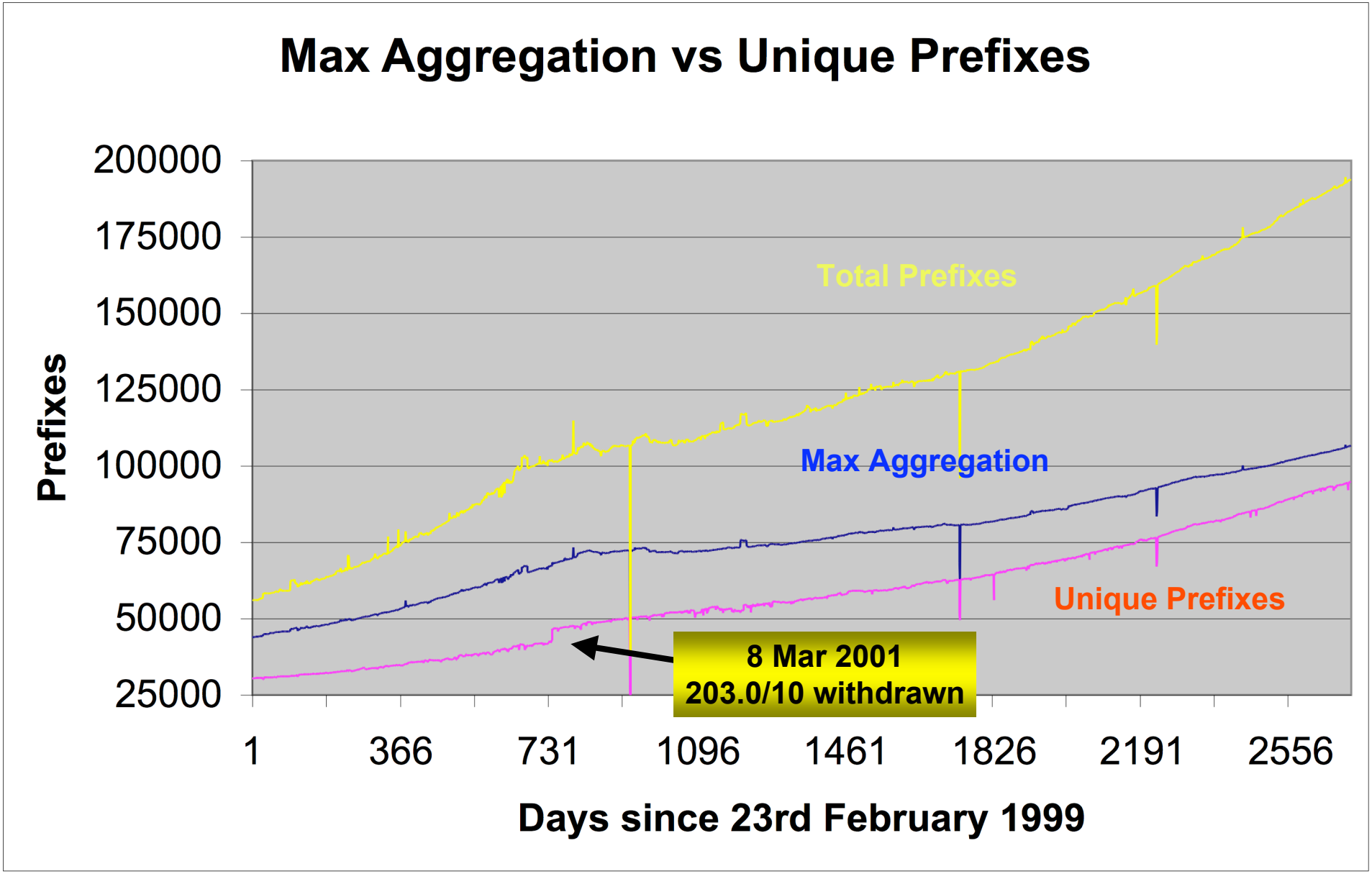
Bad AS	Designation	Network	Transit AS	Description
65350	PRIVATE	124.236.240.0/20	17672	asn for Hebei Provin
65128	PRIVATE	193.110.50.0/24	24652	Juniper Networks, Eu
24409	UNALLOCATED	203.119.29.0/24	9808	Guangdong Mobile Com
65350	PRIVATE	219.148.0.0/22	17672	asn for Hebei Provin
65350	PRIVATE	219.148.4.0/23	17672	asn for Hebei Provin
65350	PRIVATE	219.148.8.0/21	17672	asn for Hebei Provin
65350	PRIVATE	219.148.24.0/21	17672	asn for Hebei Provin
65350	PRIVATE	219.148.32.0/19	17672	asn for Hebei Provin
65350	PRIVATE	222.222.0.0/21	17672	asn for Hebei Provin
65350	PRIVATE	222.222.8.0/21	17672	asn for Hebei Provin
65350	PRIVATE	222.222.16.0/20	17672	asn for Hebei Provin
65350	PRIVATE	222.222.32.0/20	17672	asn for Hebei Provin
65350	PRIVATE	222.222.48.0/20	17672	asn for Hebei Provin
65350	PRIVATE	222.222.208.0/21	17672	asn for Hebei Provin
65350	PRIVATE	222.222.216.0/21	17672	asn for Hebei Provin
65350	PRIVATE	222.223.187.0/24	17672	asn for Hebei Provin
65350	PRIVATE	222.223.188.0/22	17672	asn for Hebei Provin
65350	PRIVATE	222.223.192.0/22	17672	asn for Hebei Provin
65350	PRIVATE	222.223.196.0/23	17672	asn for Hebei Provin
65350	PRIVATE	222.223.200.0/22	17672	asn for Hebei Provin
65350	PRIVATE	222.223.206.0/23	17672	asn for Hebei Provin
65350	PRIVATE	222.223.224.0/19	17672	asn for Hebei Provin

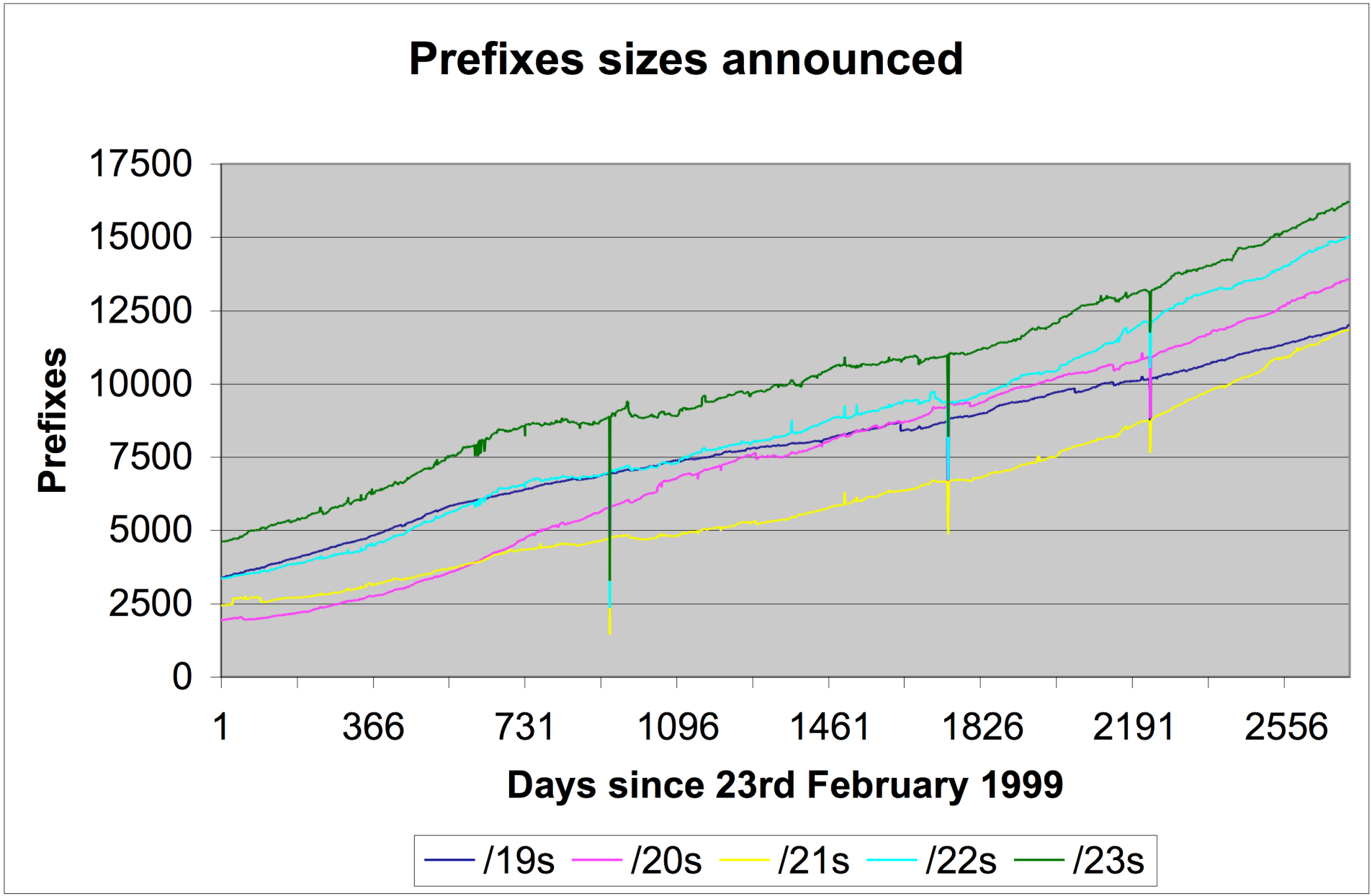
Prefixes Smaller than Registry Allocations

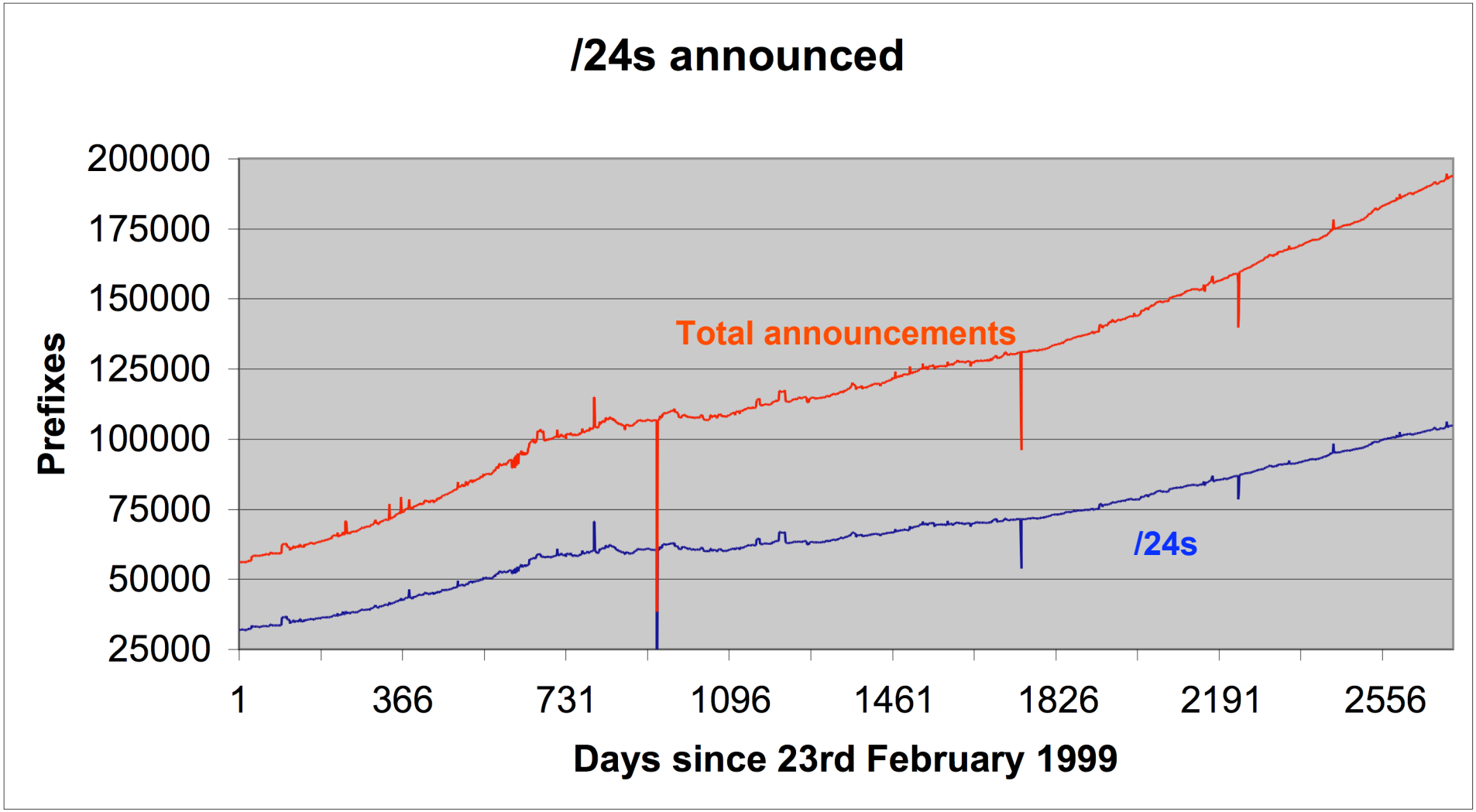
ASN	No of nets	Total ann.	Description
18566	934	951	Covad Communications
6197	798	1018	BellSouth Network Solutions,
7018	783	1485	AT&T WorldNet Services
9583	771	940	Sify Limited
11492	708	720	Cable One
2386	632	914	AT&T Data Communications Serv
7011	563	655	Citizens Utilities
19916	557	563	OLM LLC
4766	510	699	Korea Telecom (KIX)
9498	444	762	BHARTI BT INTERNET LTD.
855	441	567	Canadian Research Network
6198	441	598	BellSouth Network Solutions,
5668	427	544	CenturyTel Internet Holdings,
15270	422	453	PaeTec.net -a division of Pae
1239	402	857	Sprint
4755	398	956	Videsh Sanchar Nigam Ltd. Aut
17849	397	410	Telecommunications Technology
6517	382	415	Yipes Communications, Inc.
18101	370	434	Reliance Infocom Ltd Internet
22773	359	680	Cox Communications, Inc.

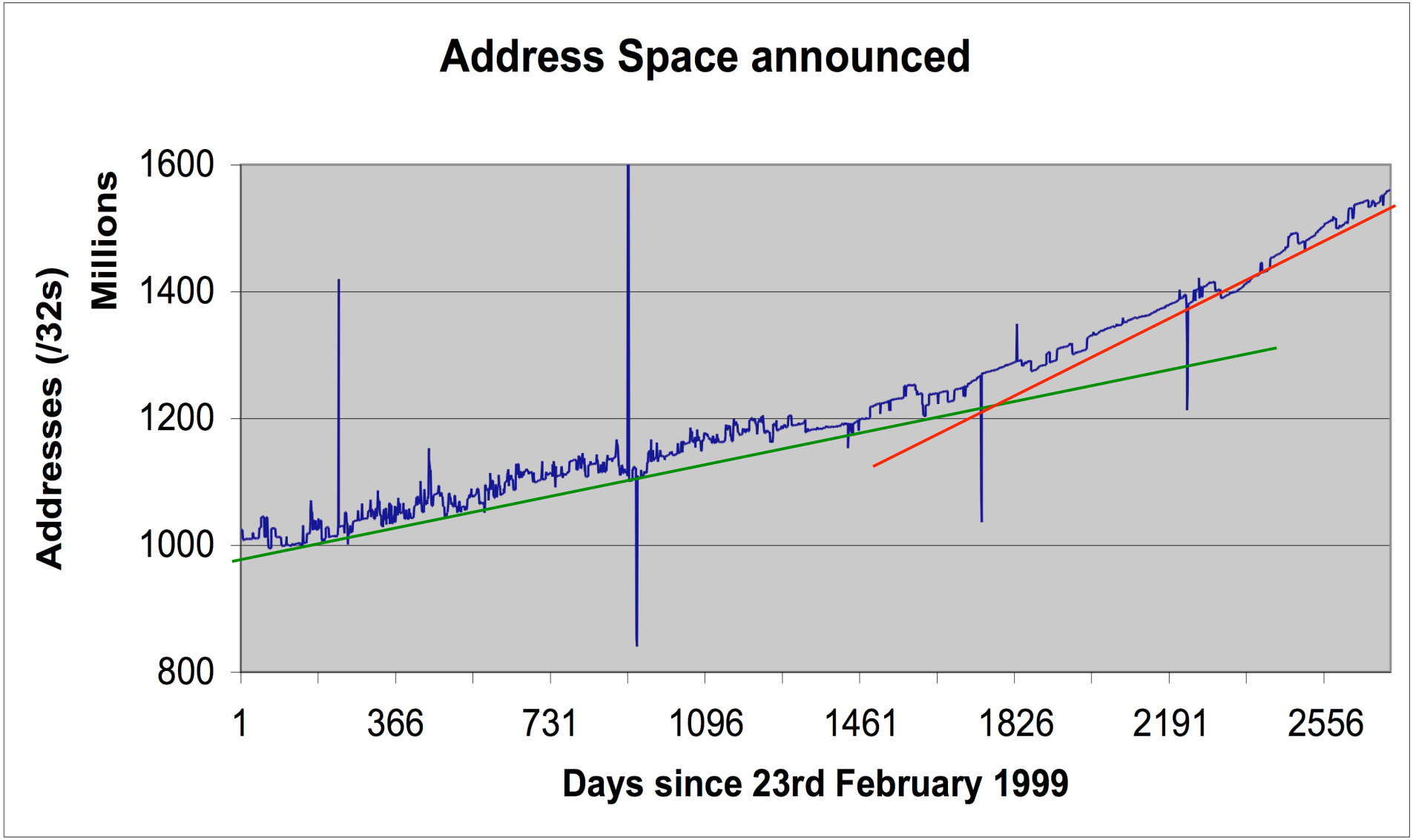

BGP Routing Table
200000
175000
150000
125000
100000
75000
50000
Prefixes
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999

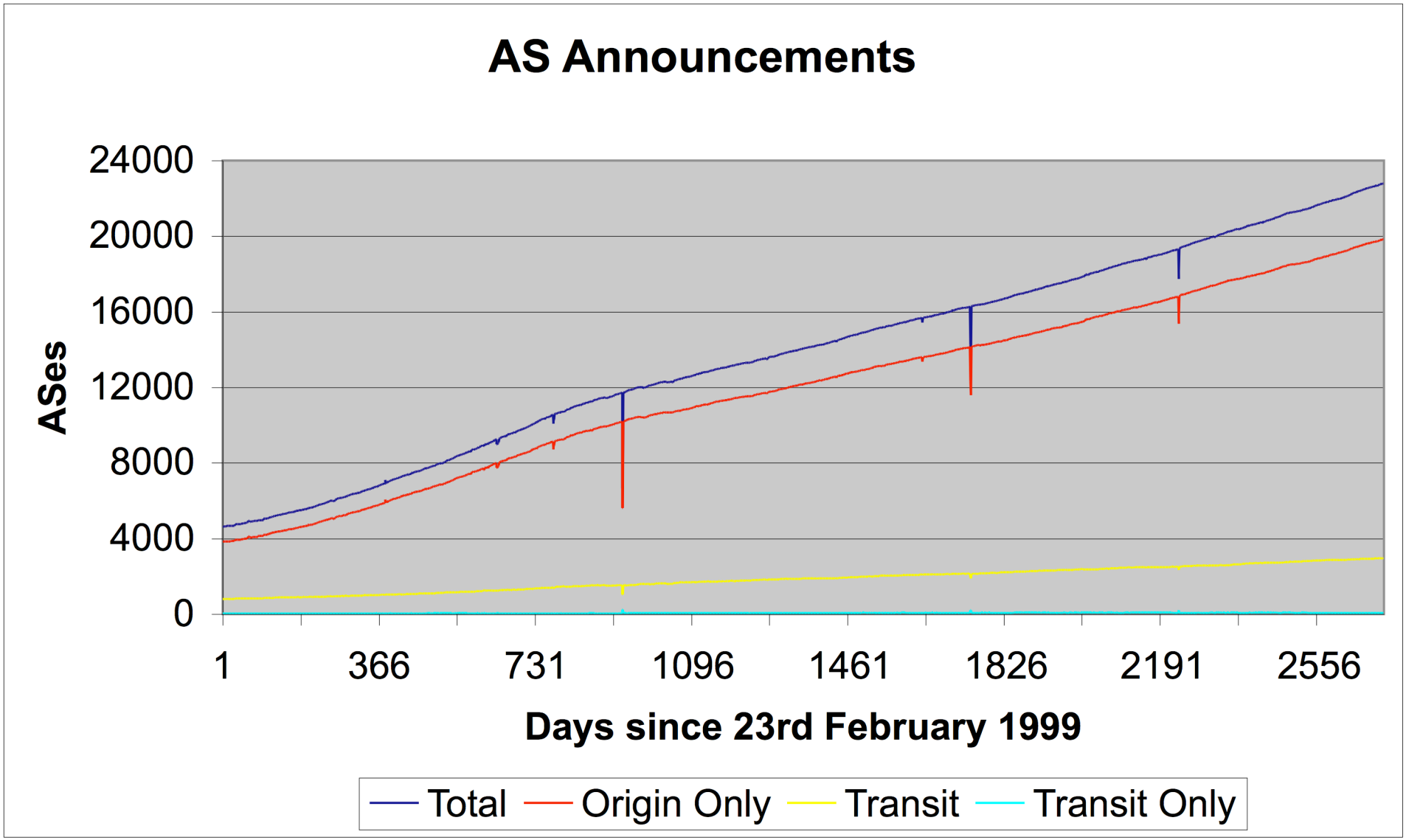

AS Growth
24000
20000
16000
12000
8000
4000
ASNs
Growth slowed down
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999

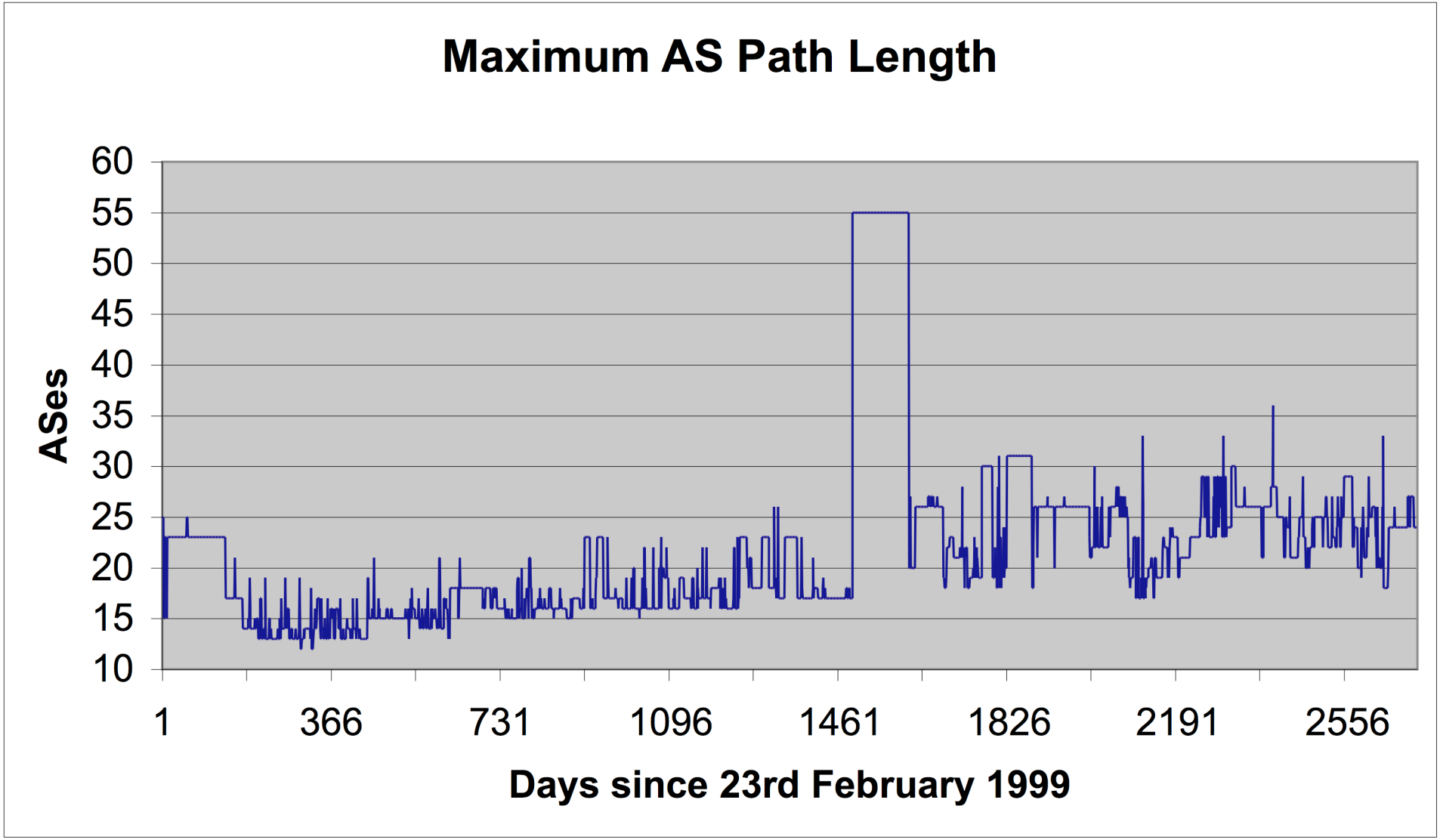

Max Aggregation vs Unique Prefixes
Prefixes
200000
175000
150000
125000
100000
75000
50000
25000
Total Prefixes
Max Aggregation
Unique Prefixes
8 Mar 2001
203.0/10 withdrawn
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999

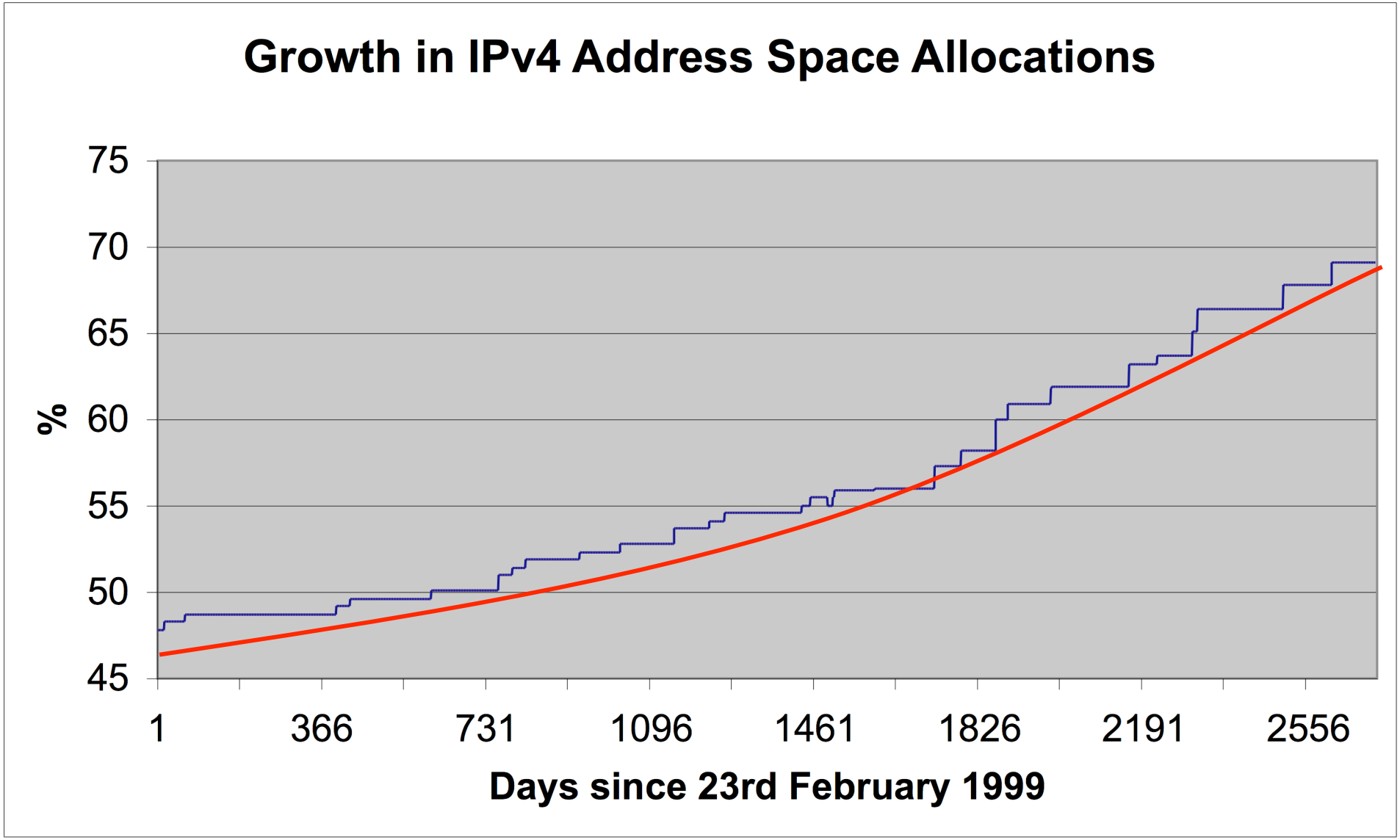

Prefixes sizes announced
Prefixes
17500
15000
12500
10000
7500
5000
2500
0
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999
/19s
/20s
/21s
/22s
/23s

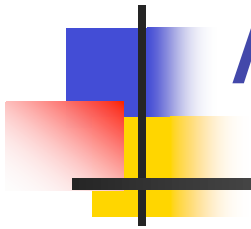

/24s announced
Prefixes
200000
175000
150000
125000
100000
75000
50000
25000
Total announcements
/24s
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999


Address Space announced
Addresses (/32s)
Millions
1600
1400
1200
1000
800
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999


AS Announcements
ASes
24000
20000
16000
12000
8000
4000
0
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999
Total
Origin Only
Transit
Transit Only


Maximum AS Path Length
ASes
60
55
50
45
40
35
30
25
20
15
10
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
%
1
366
731
1096
1461
1826
2191
2556
Days since 23rd February 1999



Internet Routing Table Analysis Update

Questions?