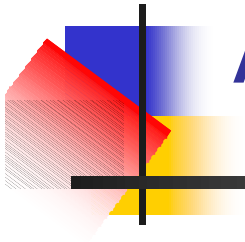


Internet Routing Table Analysis Update

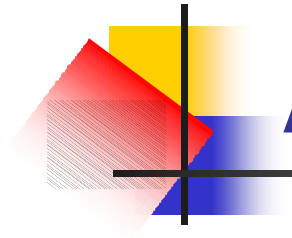
Philip Smith

pfs@cisco.com

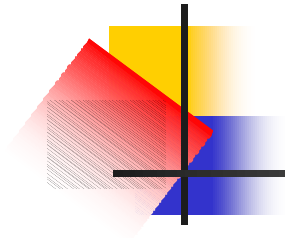
IEPG

Yokohama, July 2002

Internet Routing Table Analysis

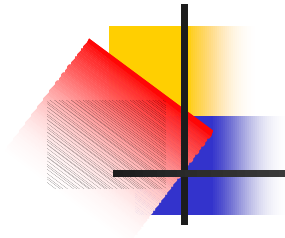


- Recent Changes:
  - Exhaustive search of 192/8 space for unassigned addresses
    - Now combined with IANA listing of former A-space and my search of former B-space
  - Count of prefixes smaller than registry allocation fixed
  - “Unique prefixes” & “maximum aggregation”
- Full Stats on APNIC web page
  - http://www.apnic.net/stats/bgp



Recent Changes

- Unique Prefixes
  - Eliminate all subnets of prefixes appearing in routing table
  - E.g. when 158.43.0.0/16 is announced, all subnets are ignored/dropped
  - Represents the smallest the Internet Routing table can be without losing address space
    - Probably not a very sensible concept to use on a router given the topology of the Internet



Recent Changes (continued)

- Prefixes after maximum aggregation
  - Eliminates all subnets of prefixes appearing in the routing table and originated by the same AS
  - E.g if 158.43.0.0/16 is originated by AS1849, all subnets of 158.43.0.0/16 originated by AS1849 will be ignored/dropped
  - Represents aggregation effort by the AS (but obviously cannot account for traffic engineering)
  - Represents the smallest the Internet Routing Table could be without the loss of *any* reachability information

Routing Report 10 July, 2002

BGP routing table entries examined	113433
Prefixes after maximum aggregation	73440
Unique aggregates announced to Internet	52059
Total ASes present in the Internet Routing Table	13306
Origin-only ASes present in the Internet Routing Table	11527
Origin ASes announcing only one prefix	5099
Transit ASes present in the Internet Routing Table	1779
Transit-only ASes present in the Internet Routing Table	45
Average AS path length visible in the Internet Routing Table	5.4
Max AS path length visible	16
Illegal AS announcements present in the Routing Table	1
Non-routable prefixes present in the Routing Table	0
Prefixes being announced from the IANA Reserved Address blocks	36
Number of addresses announced to Internet	1204676092
Equivalent to 71 /8s, 205 /16s and 229 /24s	
Percentage of available address space announced	32.5
Percentage of allocated address space announced	60.1
Percentage of available address space allocated	54.1
Total number of prefixes smaller than registry allocations	45787

Global per AS prefix count summary

ASN	No of nets	/20 equiv	Max Agg	Description
701	1847	9245	1380	UUNET Technologies, Inc.
7018	1294	7424	938	AT&T
1221	1259	1206	901	Telstra Pty Ltd
702	947	2460	781	UUNET Technologies, Inc.
3908	928	1643	502	Supernet, Inc.
1239	843	3340	661	Sprint
852	750	1173	447	Telus Advanced Communications
1	697	8075	446	GENUITY
4323	637	439	259	Time Warner Communications, I
7843	614	359	231	Adelphia Corp.
209	610	2010	348	Qwest
7132	579	659	133	Southwestern Bell Internet Se
7046	561	889	358	UUNET Technologies, Inc.
690	512	75	317	Merit Network
7066	481	203	251	Virginia Polytechnic Institut
7029	462	165	56	Alltel Information Services,
4538	449	1258	18	China Education and Research
2149	440	180	333	Performance Systems, Inc.
3549	439	839	316	Global Crossing
703	409	361	323	UUNET Technologies, Inc.

Global Aggregation Savings Summary

ASN	No of Nets	Net Savings	Description
7132	579	446	Southwestern Bell Internet Se
4538	449	431	China Education and Research
3908	928	426	Supernet, Inc.
7029	462	406	Alltel Information Services,
7843	614	383	Adelphia Corp.
4323	637	378	Time Warner Communications, I
1221	1259	358	Telstra Pty Ltd
7018	1294	356	AT&T
6197	367	331	BellSouth Network Solutions,
852	750	303	Telus Advanced Communications
11371	292	286	Rhythms NetConnections
4151	286	270	USDA
209	610	262	Qwest
6347	338	261	SAVVIS Communications Corpora
1	697	251	GENUITY
4355	303	251	EarthLink, Inc.
3352	276	247	Ibernet, Internet Access Netw
7066	481	230	Virginia Polytechnic Institut
18566	229	225	Covad Communications
4755	305	222	Videsh Sanchar Nigam Ltd. Aut

List of Illegal AS's

Bad AS	Designation	Network	Transit AS	Description
5757	UNALLOCATED	207.19.224.0/24	701	UUNET Technologies,

Number of prefixes announced by prefix length

/1:0	/2:0	/3:0	/4:0	/5:0	/6:0
/7:0	/8:23	/9:6	/10:7	/11:12	/12:36
/13:88	/14:234	/15:419	/16:7235	/17:1458	/18:2646
/19:7679	/20:7345	/21:5154	/22:7914	/23:9632	/24:62868
/25:201	/26:169	/27:87	/28:72	/29:53	/30:74
/31:0	/32:21				

Advertised IANA Reserved Addresses

Network	Origin AS	Description
39.0.0.0/8	4554	Exchange Point Blocks
60.162.252.0/24	14172	Advanced Projects Internation
132.0.0.0/10	568	DISO-UNRRA
134.137.0.0/16	7170	AT&T Government Markets
135.0.0.0/13	10455	Lucent Technologies
137.0.0.0/13	568	DISO-UNRRA
138.94.0.0/16	1	GENUITY
158.0.0.0/13	568	DISO-UNRRA
164.233.0.0/16	6020	DISA NETWORK SERVICES
192.5.154.0/24	16588	Spider Web Hosting Solutions
192.44.0.0/19	702	UUNET Technologies, Inc.
192.72.0.0/18	4780	Digital United Inc.
192.72.0.0/16	4780	Digital United Inc.
192.83.16.0/20	5515	Sonera Finland Autonomous Sys
192.83.32.0/19	5515	Sonera Finland Autonomous Sys
192.83.96.0/22	5515	Sonera Finland Autonomous Sys
192.83.100.0/24	5515	Sonera Finland Autonomous Sys
192.91.198.0/24	2568	CTS Network Services
192.92.167.0/24	297	NASA Science Network
192.119.135.0/24	270	NASA
192.135.50.0/24	7018	AT&T

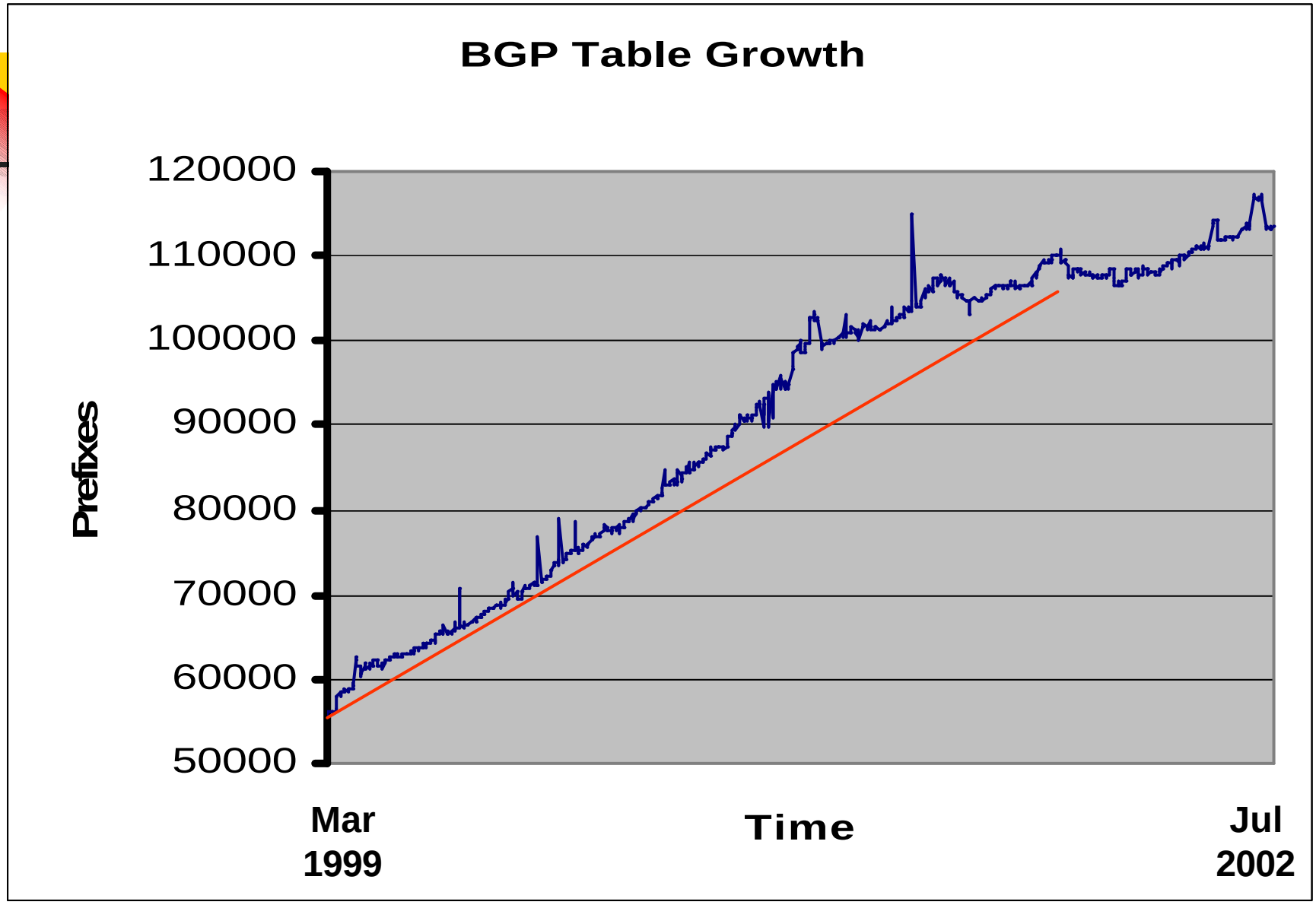
continued...

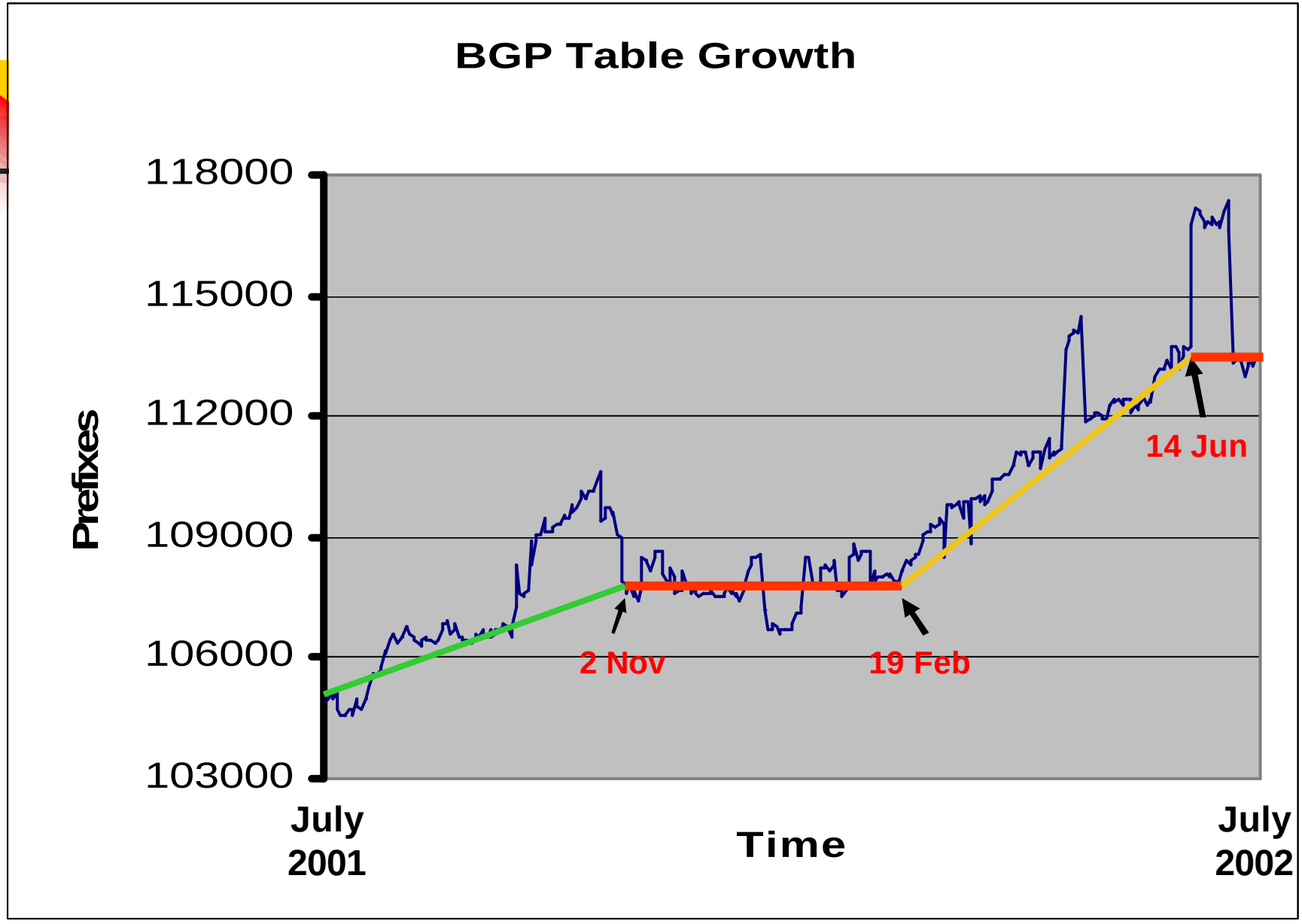
Advertised IANA Reserved Addresses

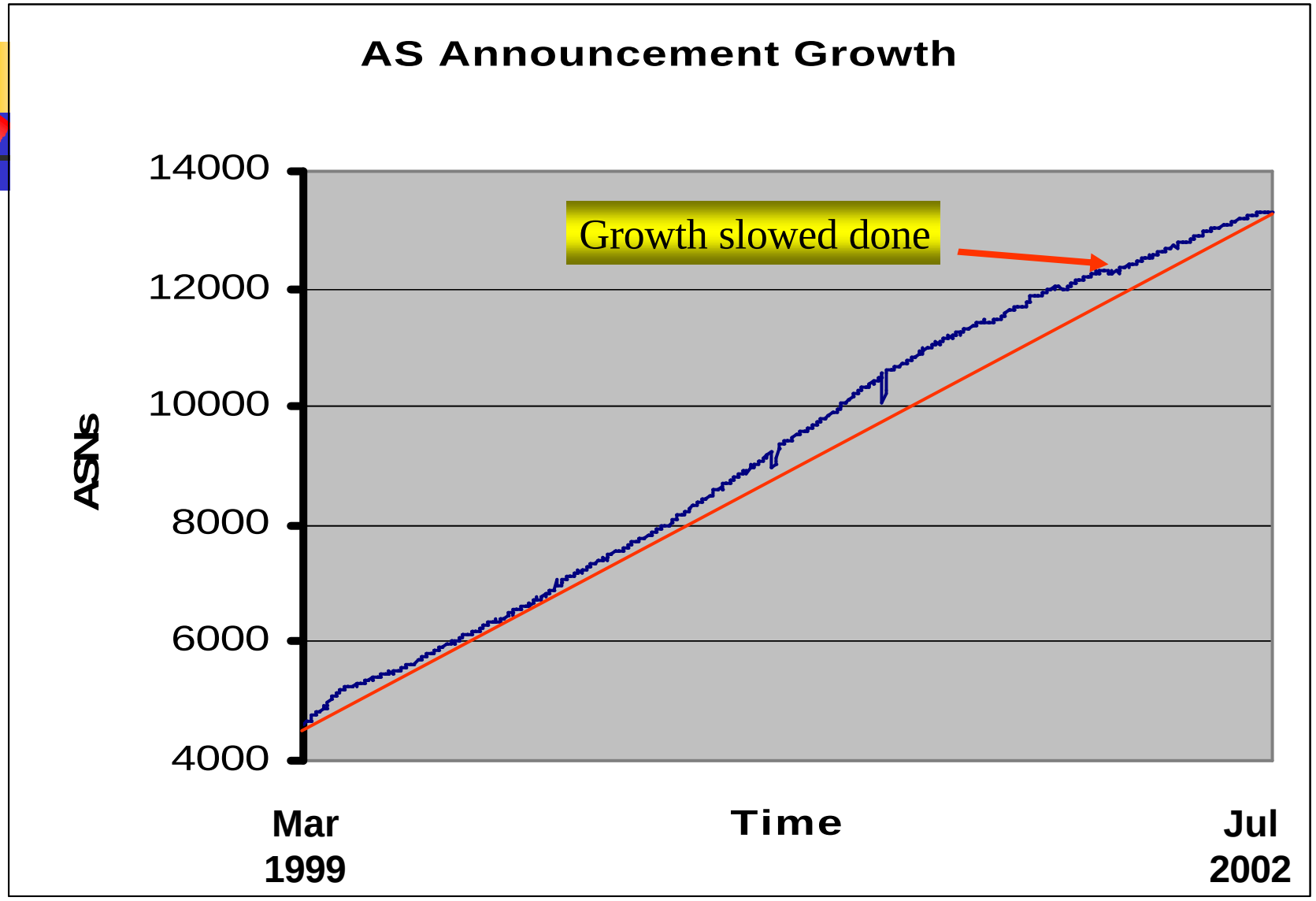
Network	Origin AS	Description
192.135.248.0/23	109	Cisco Systems, Inc.
192.136.79.0/24	719	LANLINK autonomous system
192.136.86.0/24	719	LANLINK autonomous system
192.136.87.0/24	719	LANLINK autonomous system
192.136.88.0/24	719	LANLINK autonomous system
192.139.62.0/24	6539	GT Group Telecom Services Cor
192.140.0.0/16	5511	France Telecom
192.152.213.0/24	1239	Sprint
192.153.136.0/21	568	DISO-UNRRA
192.156.0.0/19	568	DISO-UNRRA
192.172.0.0/19	568	DISO-UNRRA
192.195.253.0/24	237	Merit Network
192.208.29.0/24	3908	Supernet, Inc.
192.208.30.0/23	3908	Supernet, Inc.
192.243.36.0/23	7168	Northwest Link

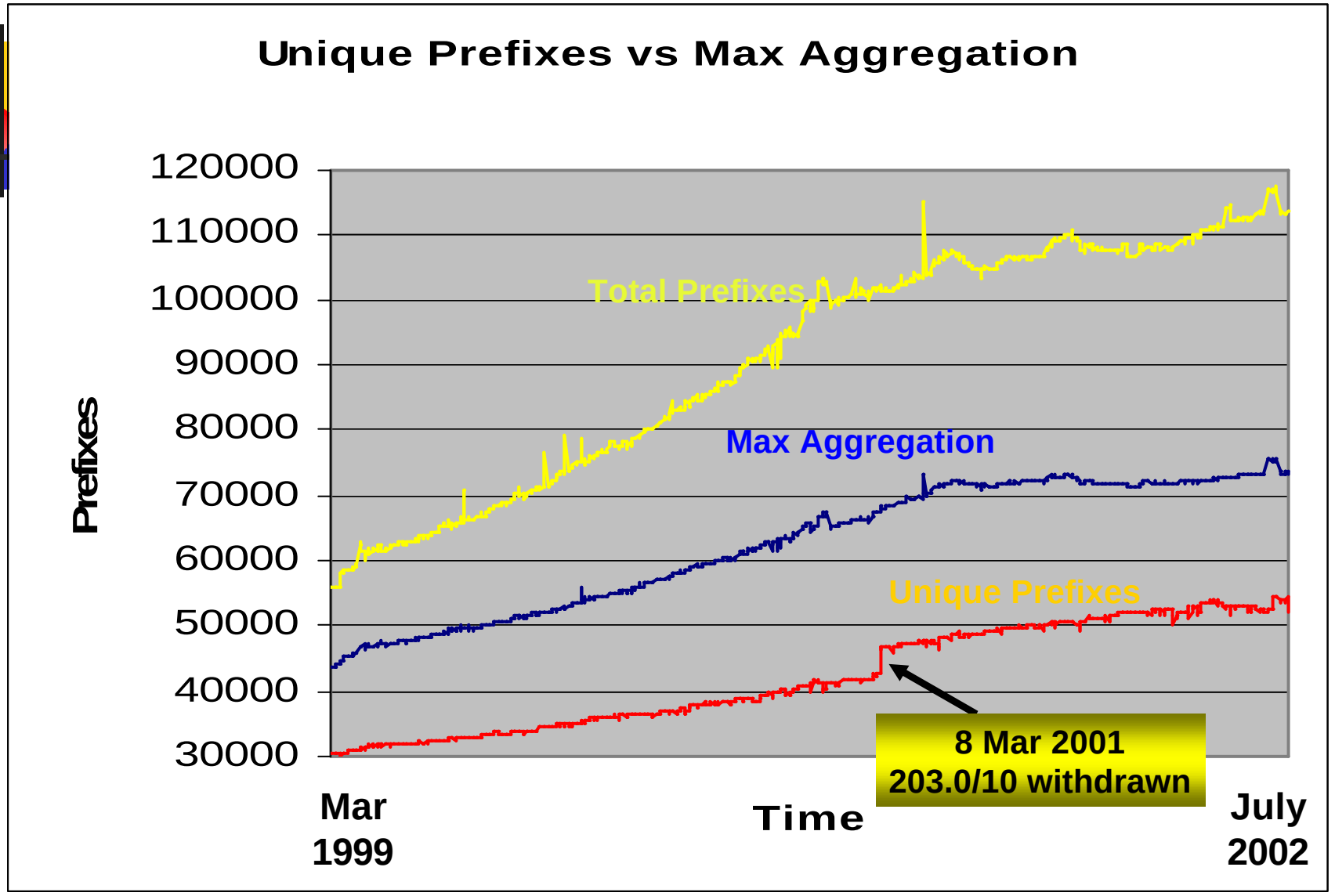
Prefixes Smaller than Registry Allocations

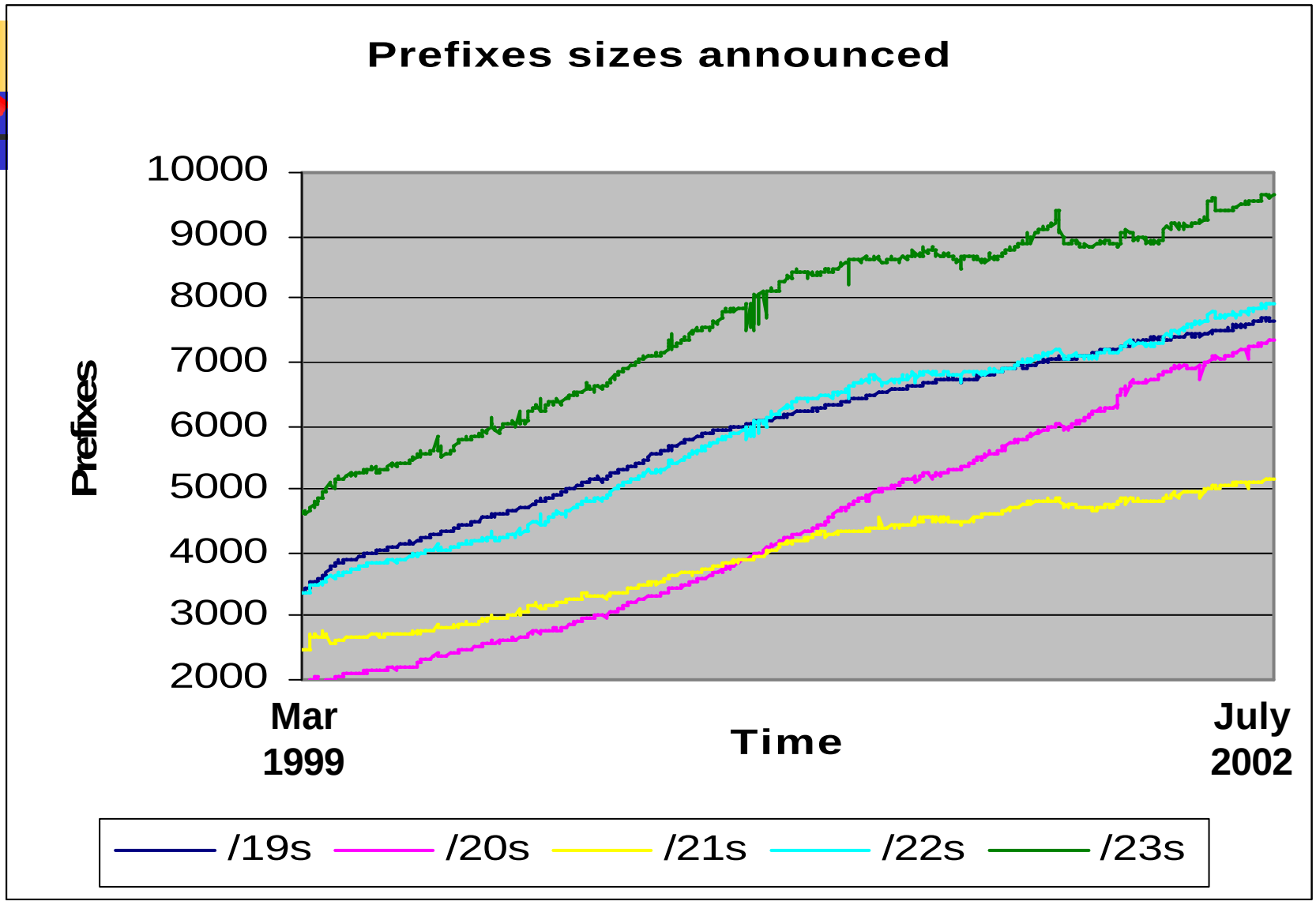
ASN	No of nets	Total ann.	Description
702	584	947	UUNET Technologies, Inc.
3908	515	928	Supernet, Inc.
701	505	1847	UUNET Technologies, Inc.
690	453	512	Merit Network
7843	420	614	Adelphia Corp.
7066	386	481	Virginia Polytechnic Institut
7029	365	462	Alltel Information Services,
7018	349	1294	AT&T
209	275	610	Qwest
6197	253	367	BellSouth Network Solutions,
11371	245	292	Rhythms NetConnections
6198	238	310	BellSouth Network Solutions,
3301	233	395	TeliaNet Sweden
18566	225	229	Covad Communications
1239	217	843	Sprint
7046	216	561	UUNET Technologies, Inc.
1580	202	215	HQ, 5th Signal Command
3352	200	276	Ibernet, Internet Access Netw
3215	199	266	France Telecom / &Equant
1	192	697	GENUITY

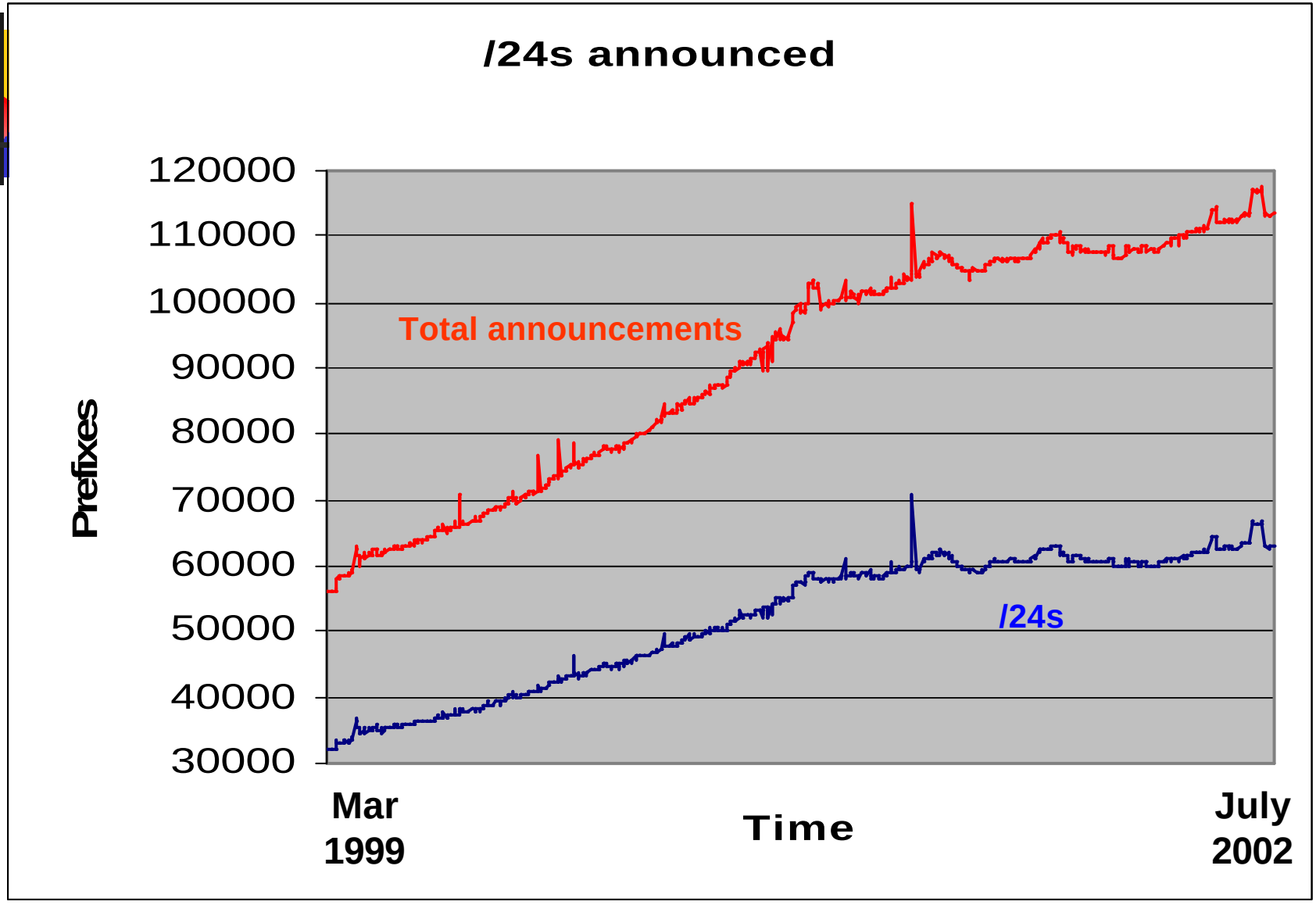

BGP Table Growth
120000
110000
100000
90000
80000
70000
60000
50000
Prefixes
Mar
1999
Time
Jul
2002

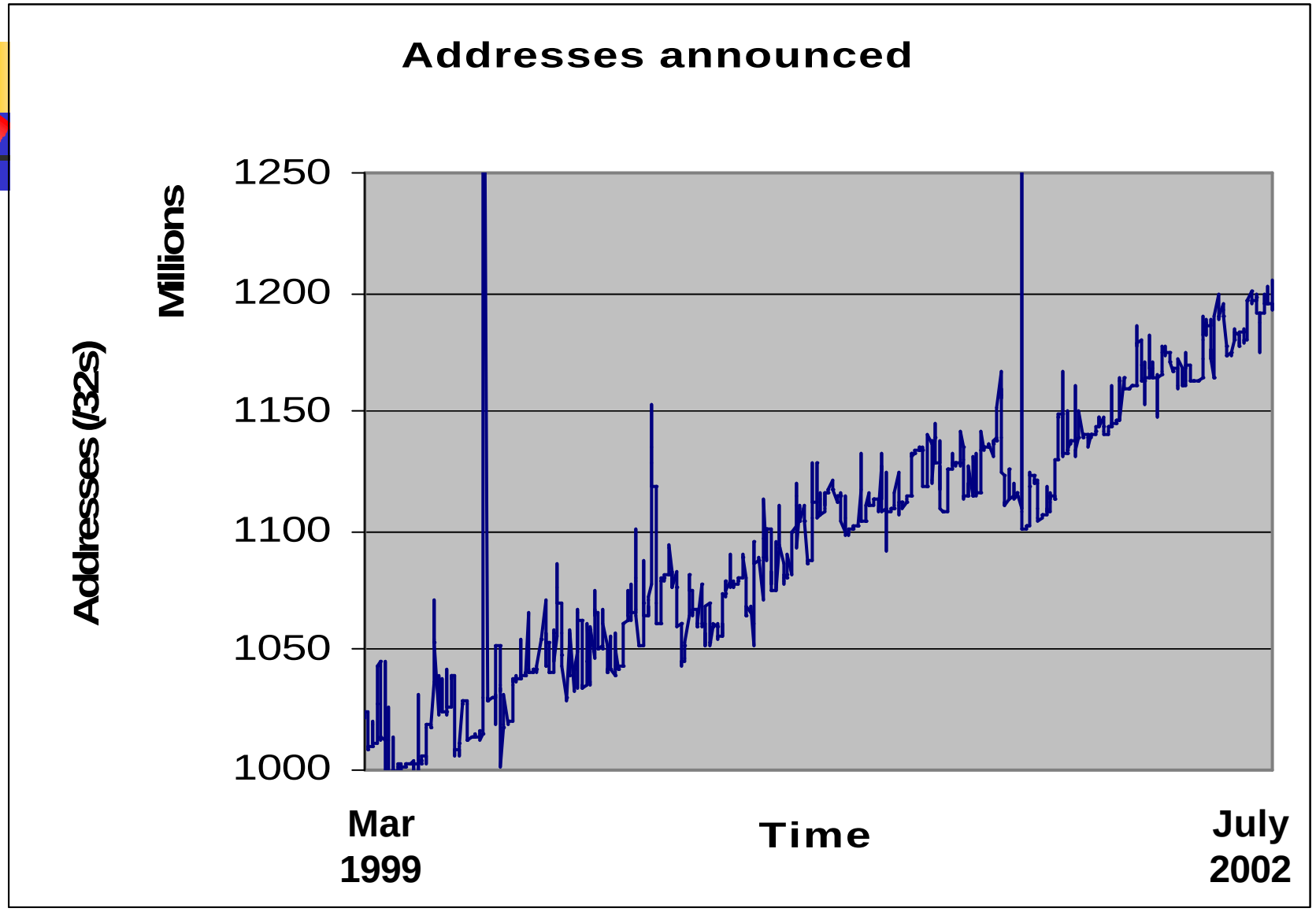

BGP Table Growth
118000
115000
112000
109000
106000
103000
Prefixes
2 Nov
19 Feb
14 Jun
July
2001
Time
July
2002

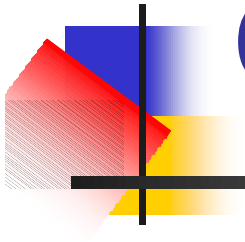

AS Announcement Growth
14000
12000
10000
8000
6000
4000
ASNs
Growth slowed done
Mar
1999
Time
Jul
2002


Unique Prefixes vs Max Aggregation
120000
110000
100000
90000
80000
70000
60000
50000
40000
30000
Prefixes
Total Prefixes
Max Aggregation
Unique Prefixes
8 Mar 2001
203.0/10 withdrawn
Mar
1999
Time
July
2002

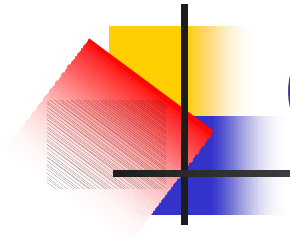

Prefixes sizes announced
10000
9000
8000
7000
6000
5000
4000
3000
2000
Prefixes
Mar
1999
Time
July
2002
/19s
/20s
/21s
/22s
/23s


/24s announced
120000
110000
100000
90000
80000
70000
60000
50000
40000
30000
Prefixes
Total announcements
/24s
Mar
1999
Time
July
2002


Addresses announced
Addresses (/32s)
Millions
1250
1200
1150
1100
1050
1000
Mar
1999
Time
July
2002

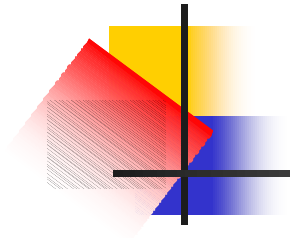


CIDR Report Update



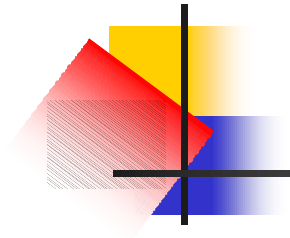
CIDR Report

- Still running!
  - www.employees.org site is currently down
  - Added CIDRisation breakdown for each of the registry regions
  - Added flat file listing ASNs in use on the Internet today
  - Routing view is from “MAE-East”
- Is it providing a useful service?
  - Or is the “max aggregation” table I’m producing more helpful?



Routing Reports

- How do we use the output of these reports to make newer ISPs “do the right thing”
  - Most “newbies” still living in Classful Land because that’s what they were taught at University/College
  - Many don’t realise aggregation is important
  - Most have never heard of the CIDR Report
  - But community tells me that such are useful
- So...? What next?



Final Slide…

- Any comments/discussion?