Have We Reached 1000 Prefixes Yet?

A snapshot of the global IPv6 routing table

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Overview

- numbers
- pictures & trends
- things that should not be there...
- conclusions & recommendations
- references

Slides online at: http://www.space.net/~gert/RIPE/R52-v6-table/

Numbers - AS numbers

- as of 2006/04/24: 589 unique AS numbers visible (06/10: 563)
  - 391 origin-only ASes (no transit paths seen) (375)
  - 182 ASes originate & give transit (175)
  - 16 transit-only ASes (e.g. 2153, 3856, 4774, 6667, . . .) (13)
- mixture of RIR (2xxx::) and 6Bone (3FFE::) space announced
  - 447 ASes originate 1 RIR prefix (408)
  - 25 ASes originate 1 6Bone prefix (35)
  - 41 ASes originate 1 6Bone + 1 RIR prefix (44)
  - 31 ASes originate 2 RIR prefixes (4 due to /32+/35)
  - 29 ASes with “more than that”, maximum is 7 prefixes
- 5 ASes still announce their prefix as /32 and /35
- note: all paths observed from AS5539

ASes - why are people announcing 2 prefixes?

- 6bone to RIR migration: 1 6bone, 1 RIR prefix, *temporary*

```
2001:420::/35          109 i
3FFE:C00::/24          109 i
```

- /35 to /32 migration: 2 RIR prefixes, *temporary*

```
2001:258::/32          2914 2510 i
2001:258::/35          2914 2510 i
```

- sub-allocations to (non?-)multihomed customers?

```
2001:388::/32           7575 i
2001:388:1000::/48      7575 18062 i
2001:388:1002::/48      7575 18062 i
2001:388:2::/48         7575 18062 i
2001:388:3002::/48      7575 18062 i
2001:388:6002::/48      7575 18062 i
2001:388:608C::/48      7575 18062 i
2001:388:A000::/40      7575 18062 i
```

- mergers and acquisitions, business units, growth, ...

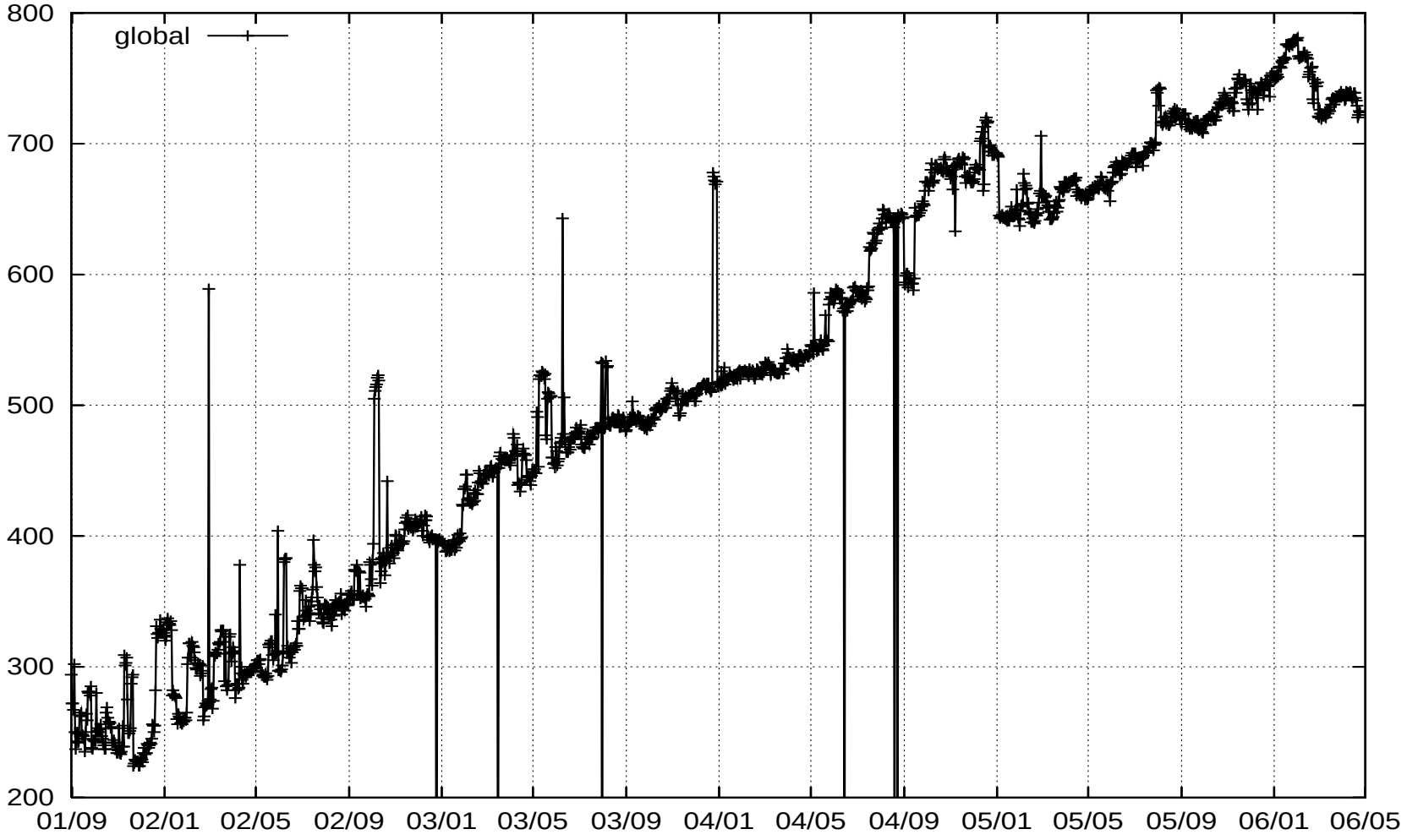
```
2001:360::/32          1221 i
2001:8000::/20         1221 i
```

Numbers - Prefixes

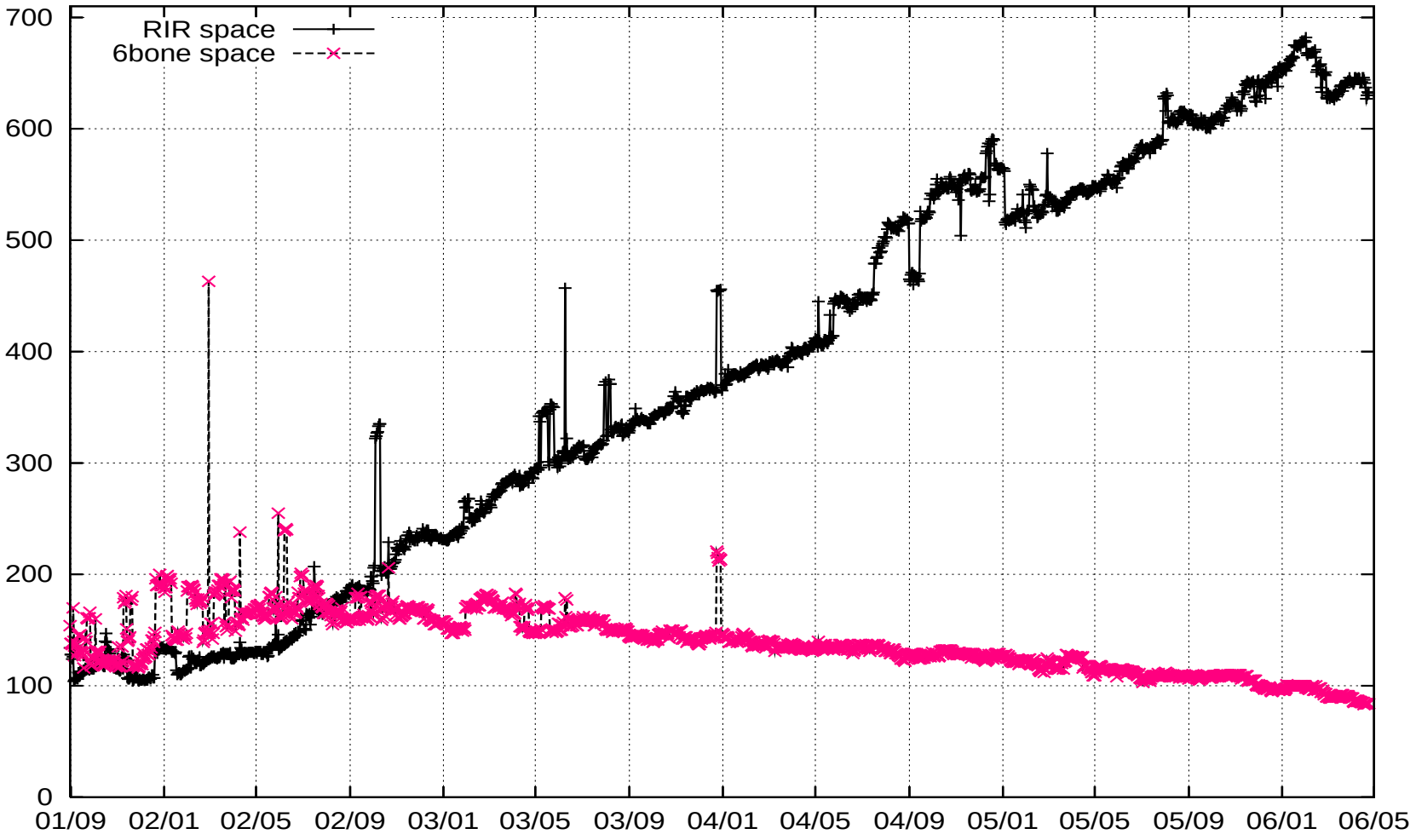
As of 2006/04/24: 724 prefixes in total (2005/10/11: 720)

/n	global	RIR space	6bone	6to4	(2005/10/11)
/16	1	0	0	1	(1 0 0 1)
/19-21	6	6	0	0	(5 5 0 0)
/24	30	0	30	0	(34 0 34 0)
/27	1	1	0	0	(1 1 0 0)
/28	22	1	21	0	(33 1 32 0)
/29-/30	3	3	0	0	(2 2 0 0)
/32	538	513	25	0	(494 468 26 0)
/33-/34	4	4	0	0	(3 3 0 0)
/35	24	24	0	0	(24 24 0 0)
/36-/39	1	1	0	0	(3 2 1 0)
/40	6	5	1	0	(11 10 1 0)
/41-/47	3	3	0	0	(2 2 0 0)
/48	84	77	7	0	(101 88 13 0)
/52-/60	1	1	0	0	(0 0 0 0)
/64	0	0	0	0	(5 3 2 0)
/65-/128	0	0	0	0	(1 1 0 0)

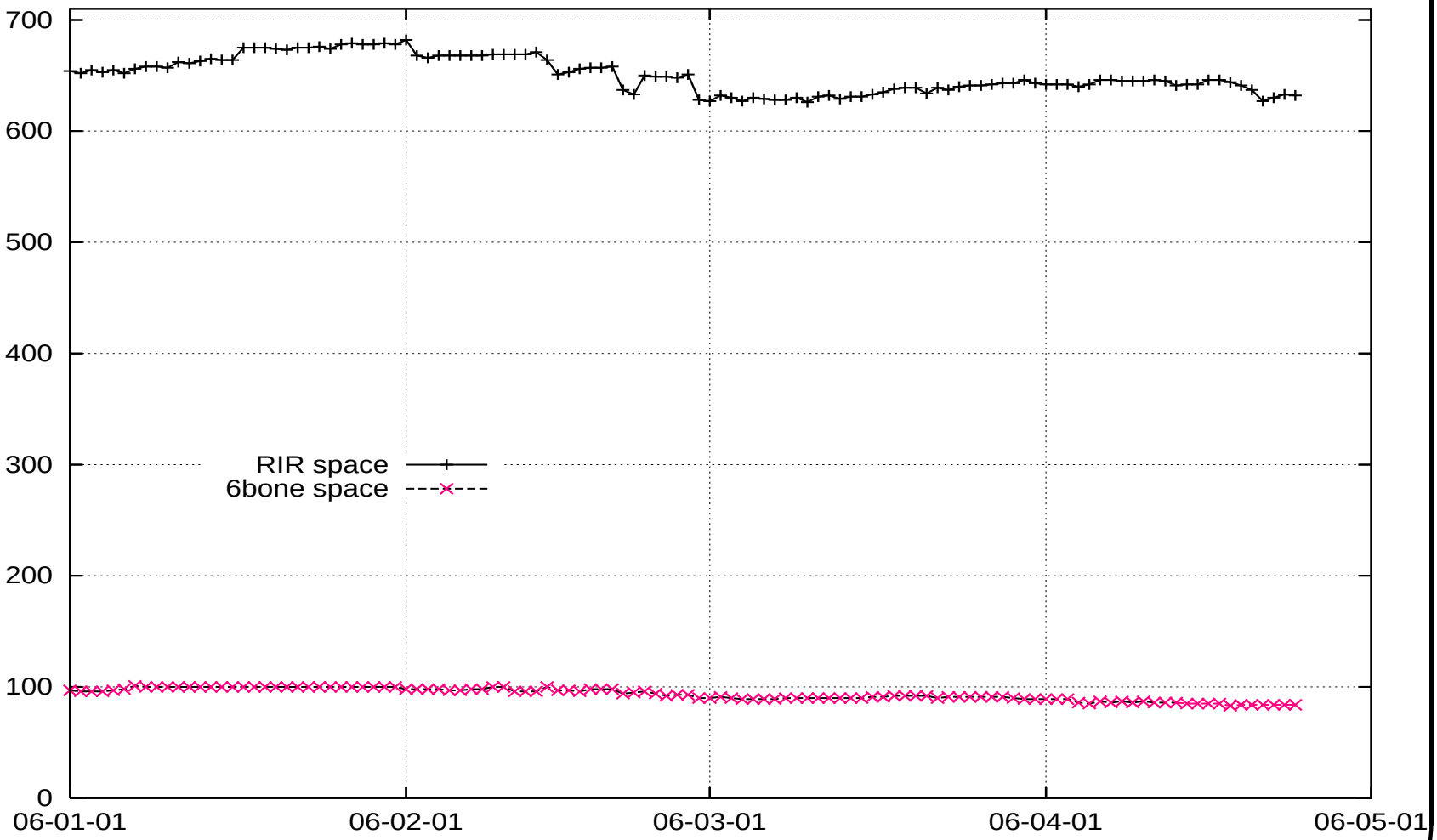
Graphics: Total Prefixes - 4.5 years



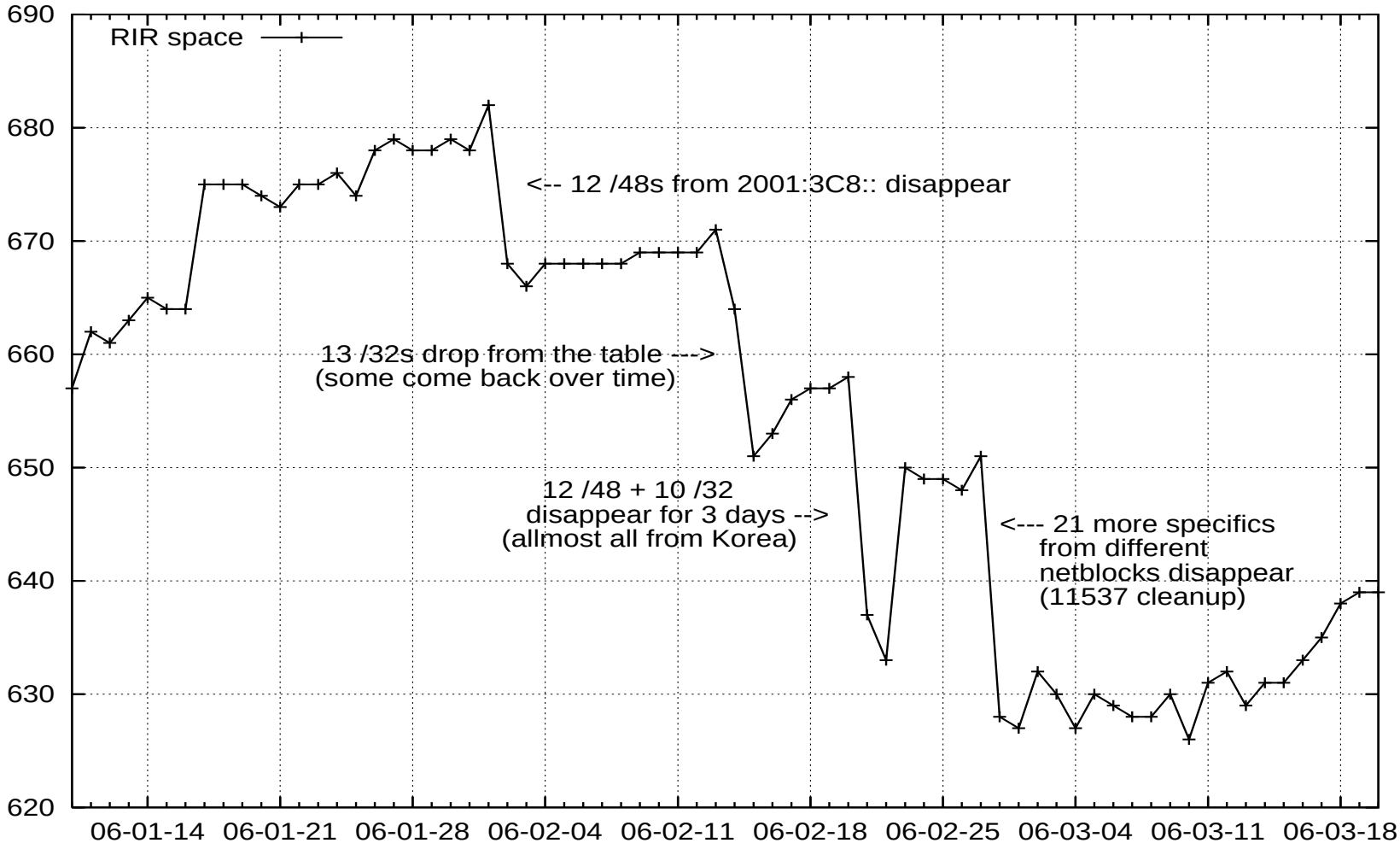
Graphics: RIR vs. 6Bone Prefixes - 4.5 years



Graphics: RIR vs. 6Bone Prefixes - 4 months



Graphics: The Big Drop (02/2006)



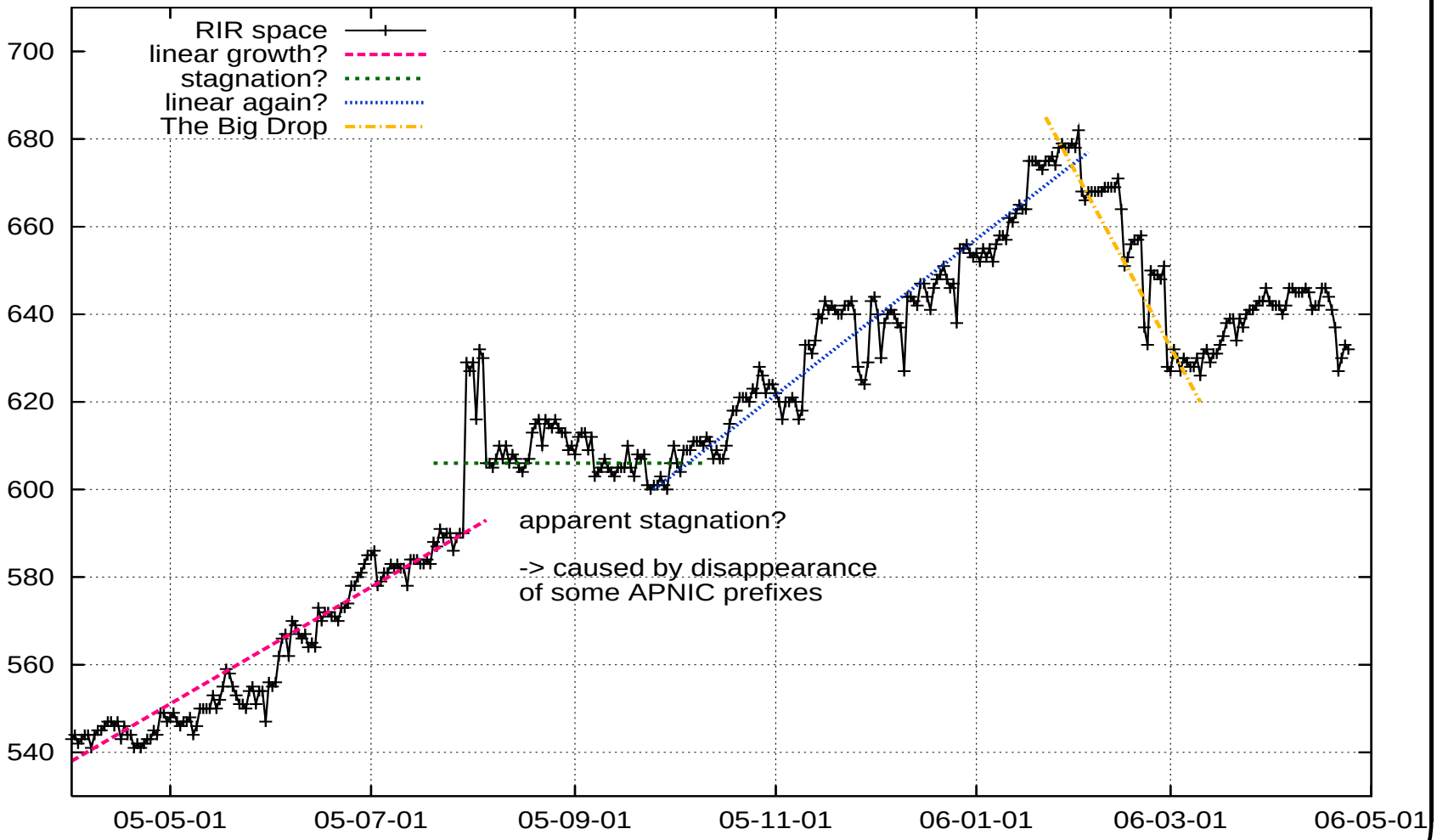
where did those /32s go?? (2006/02/14⇒15)

- BGP paths for all dropped /32s contain same elements in tail:

Network	common path tail
2001:4F0::/32	... 3320 680 1273 6830 6830 6830 6830 6175 13944
2001:588::/32	... 3320 680 1273 12702 2905
2001:598::/32	... 3320 680 1273 4436 21548
2001:5C0::/32	... 3320 680 1273 6830 6830 6830 6830 6175 33018
2001:850::/32	... 3320 680 1273 6830 6830 6830 6830 5424
2001:970::/32	... 3320 680 20965 11537 17579 1237 17832 9270 2200 2609
2001:A68::/32	... 3320 680 1273 12702 16023
2001:D58::/32	... 3320 680 20965 11537 9264 17717 9416
2001:E08::/32	... 3320 680 1273 6830 6830 6830 6830 6939 4538 23911
2001:12E0::/32	... 3320 680 1273 12956 10429
2001:1360::/32	... 3320 680 1273 30071 10586
2001:1598::/32	... 3320 680 3257 9009
2001:1B38::/32	... 3320 680 1273 13193 8554

- looks like a major ghosting problem 680 ⇒ 3302
- BGP-Session 680 → 3320 reset at 2006/02/14 16:00
- IOS involved: 12.3(11)T7 - no “old and unmaintained box”!

Graphics: trends? (12 months)



Numbers: RIRs, Allocations, . . .

- On 2006/04/24, 1056 LIR blocks (2000::/4) allocated by RIRs:

RIR	alloc.	members	perc.	on 2005/10/09
ARIN	198	~ 2440	8.1%	169 (+17%)
APNIC	249	~ ?1890	13.2%	219 (+13%)
RIPE	547	~ 4311	12.7%	497 (+10%)
LACNIC	51	~ 561	9.1%	39 (+30%)
AfriNIC	11	~ 810	1.4%	-

- note: not counting /48 microallocs and /35⇒/32 extentions
- actual *percentage* with IPv6 similar for RIPE and APNIC
- 437 (R51: 483) allocations visible in routing table (*only 41%!*)

Numbers: RIRs: notable allocations (1)

- more "very large" allocations seen:
  - 2001:44d0::/28 Korea Cable Television, KR (2005/11/10)
  - 2001:4510::/29 Beijing ShenZhou Greatwall, CN (2006/01/23)
  - 2001:4540::/27 Taiwan Fixed Network Co., TW (2005/12/22)
  - 2001:4580::/26 Seednet Digital United, TW (2005/12/12)
  - 2001:b000::/21 HiNet Taiwan, TW (2006/03/15)
  - 2404::/26 Asia Pacific Online Service, TW (2006/01/25)
  - 2404:80::/28 SONET Taiwan, TW (2006/01/25)
  - 2800:20::/28 Comsat Argentina, AR (2005/12/14)
  - 2a01:b0::/31 IT Solid Solutions, BE (2006/04/13)
  - 2a01:800::/23 Vodafone Deutschland, DE (2006/04/12)
  - 2a01:1000::/21 Polish Telecom, PL (2006/02/01)
  - 2a01:c000::/19 France Telecom, FR (2005/12/30)
  - 2a01:00b8::/32 Vatican City State, VA (2006/04/18) *
- ⇒ **check your BGP filters!!**

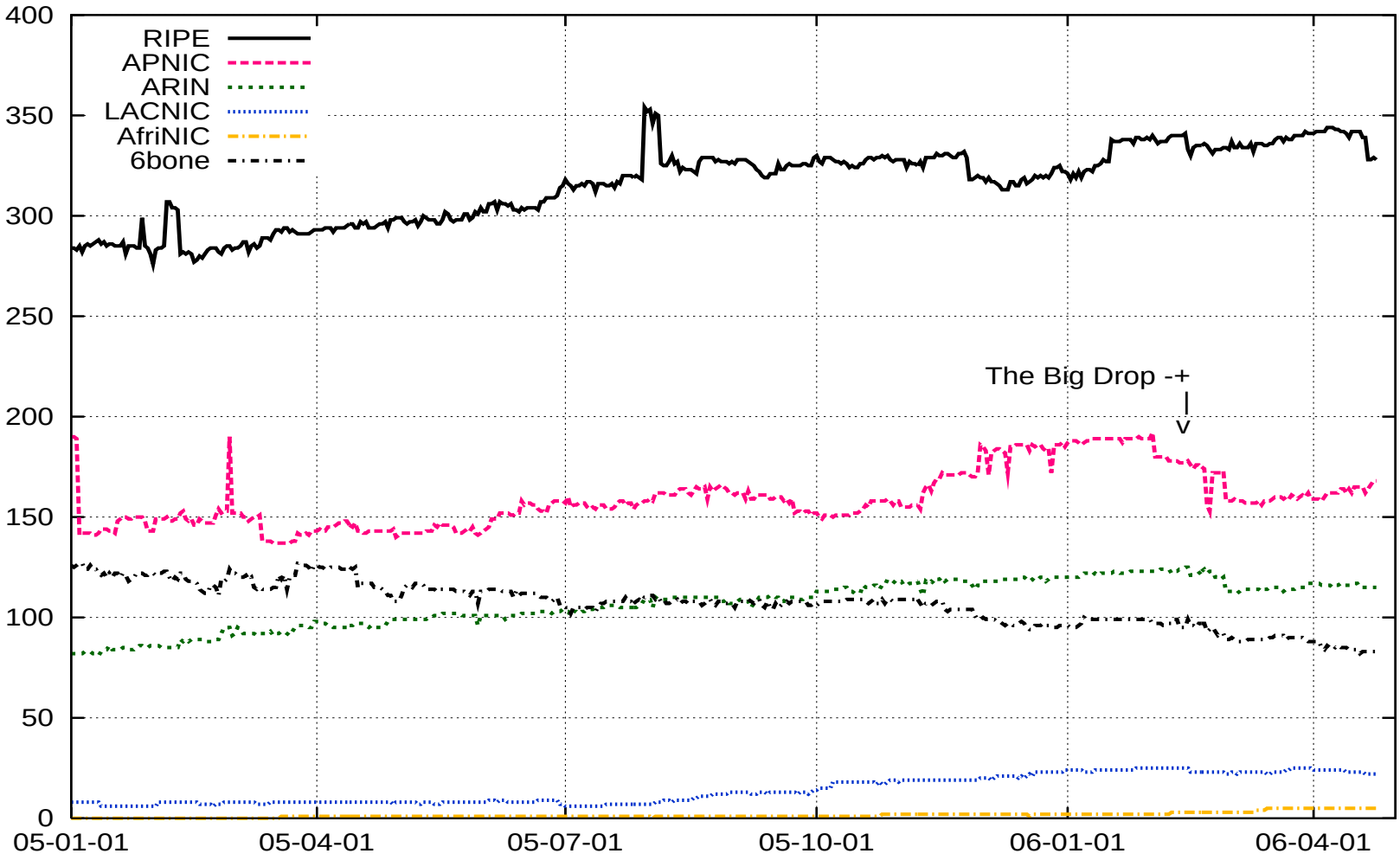
Numbers: RIRs: notable allocations (2)

- Allocations ICANN ⇒ RIRs since RIPE 51

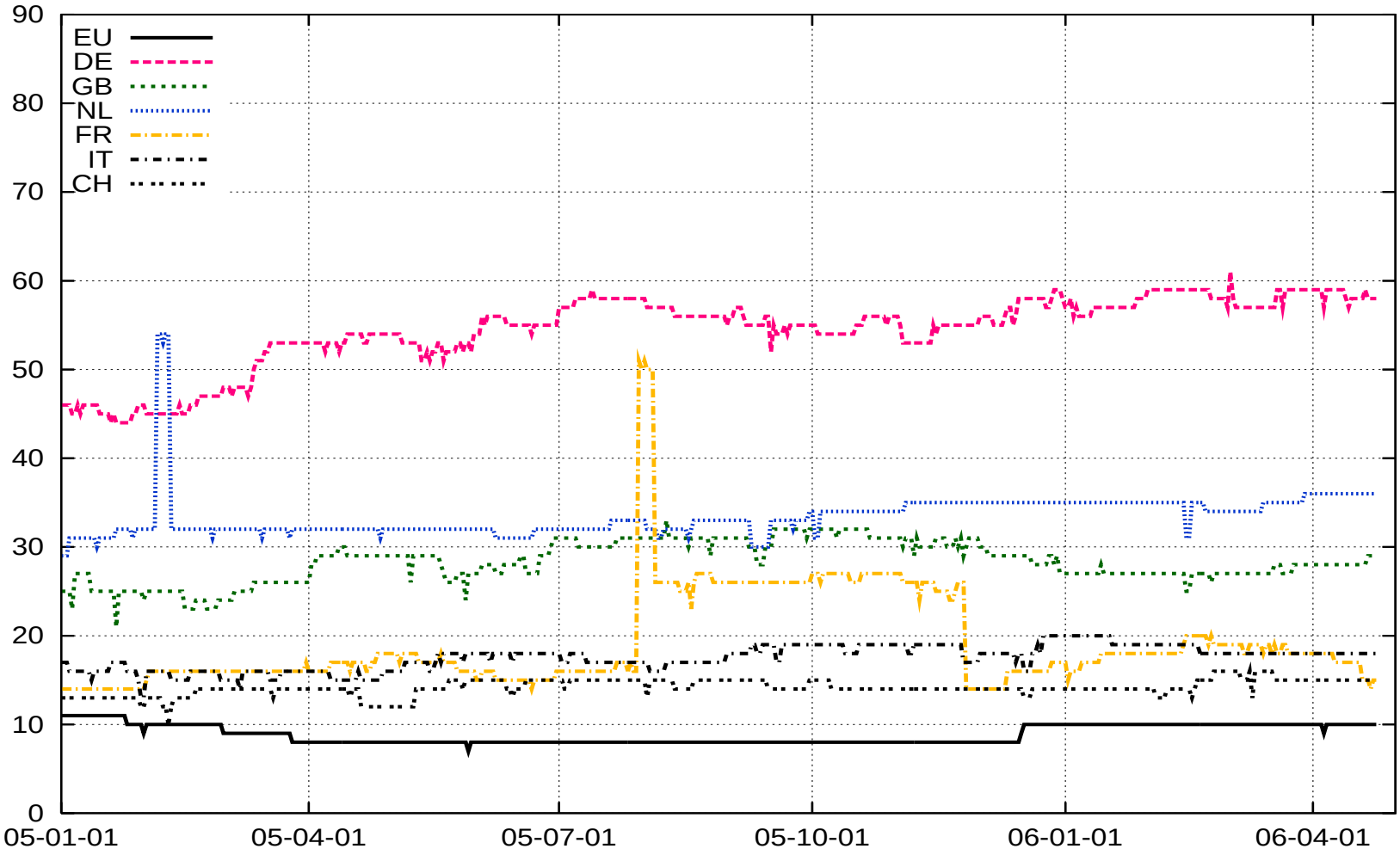
Prefix	RIR	Date	Comment
2001:4400::/23	AfriNIC	(reassigned)	
2001:B000::/20	APNIC	08 Mar 06	TW/HiNet /21
2404:0000::/23	APNIC	19 Jan 06	
2610:0000::/23	ARIN	17 Nov 05	
2800:0000::/23	LACNIC	17 Nov 05	
2A01:0000::/16	RIPE NCC	15 Dec 05	PL/21, FR/19

- http://www.iana.org/assignments/ipv6-unicast-address-assignments

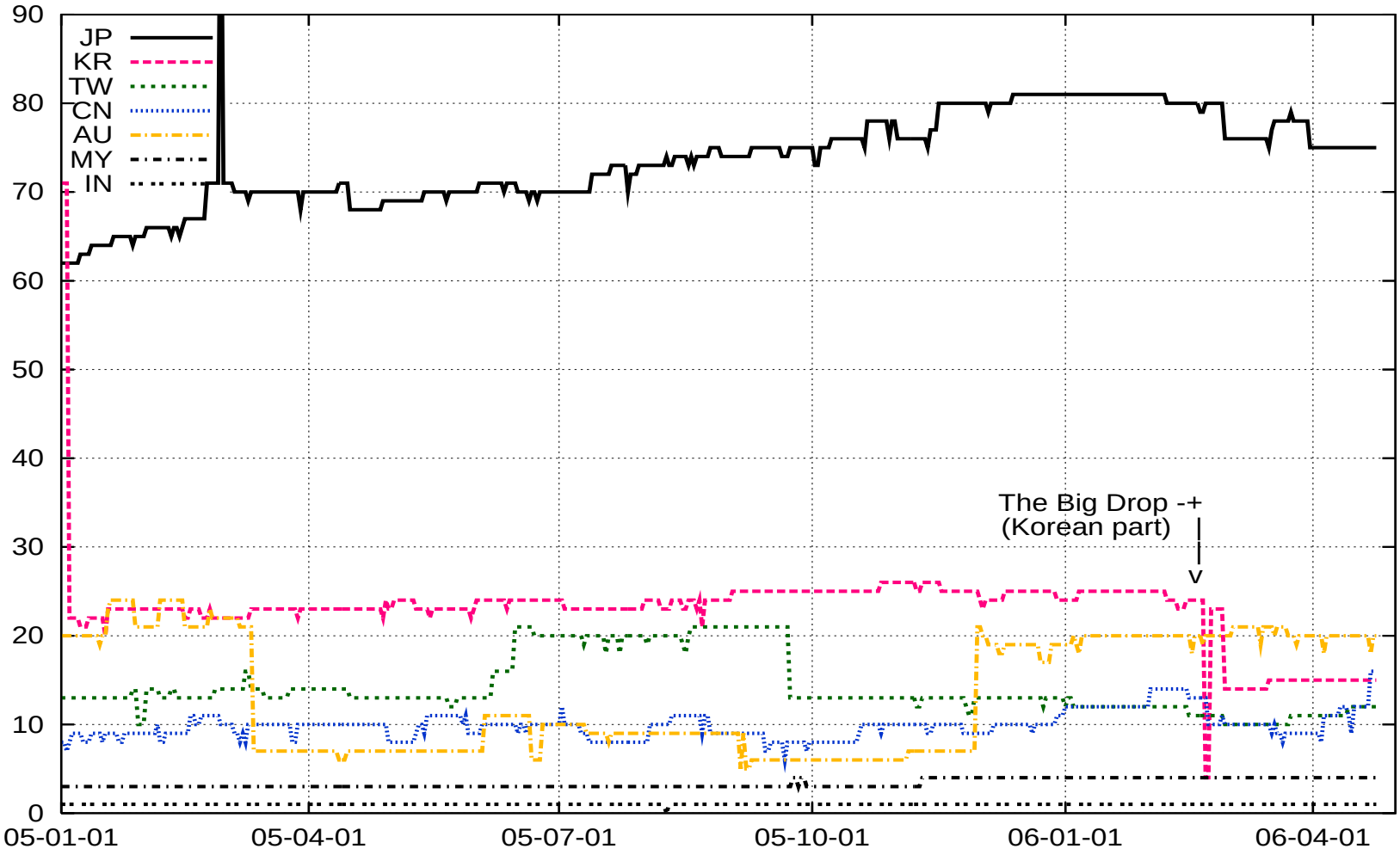
Graphics: prefixes by RIR region



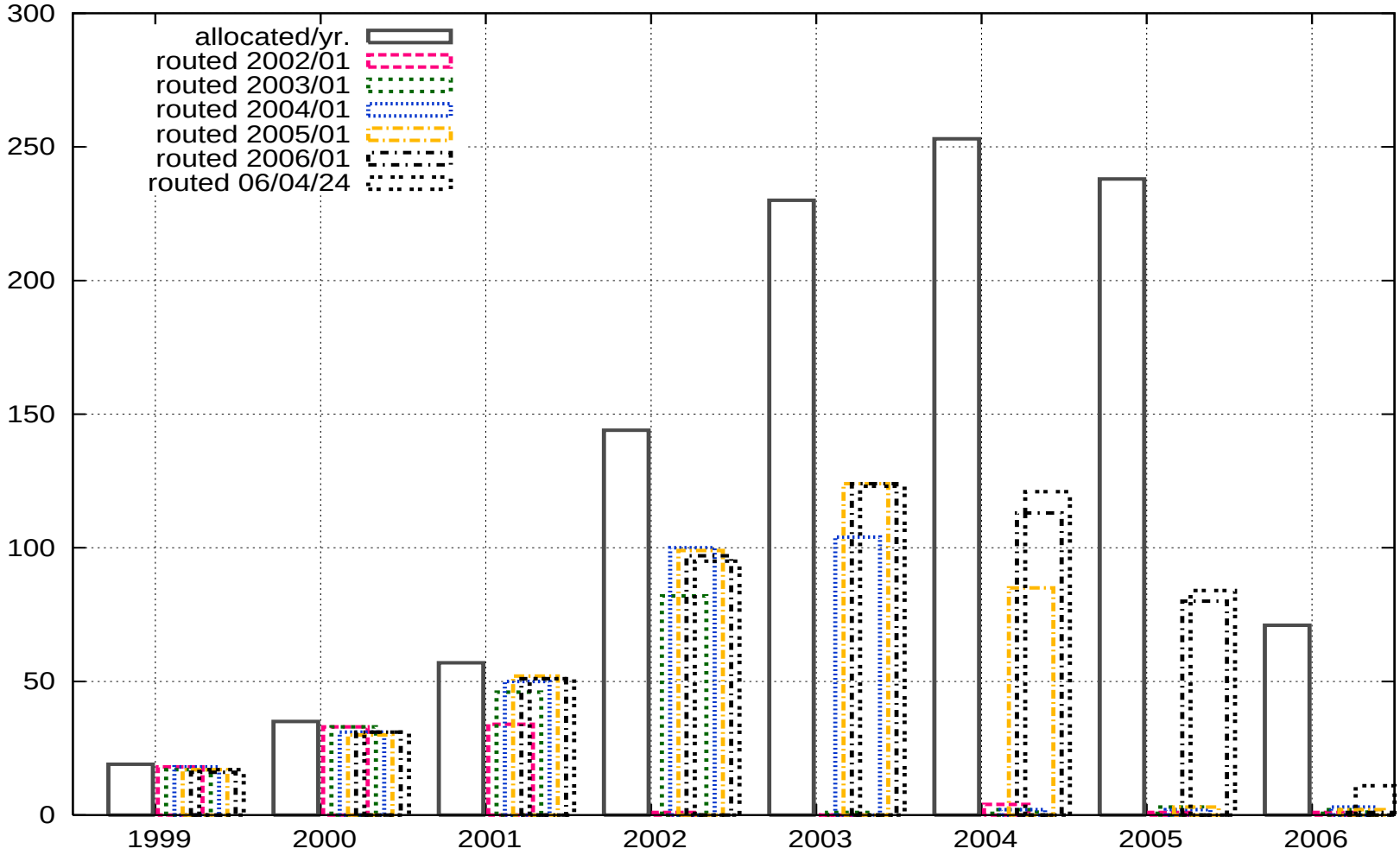
Graphics: prefixes by country (RIPE)



Graphics: prefixes by country (APNIC)



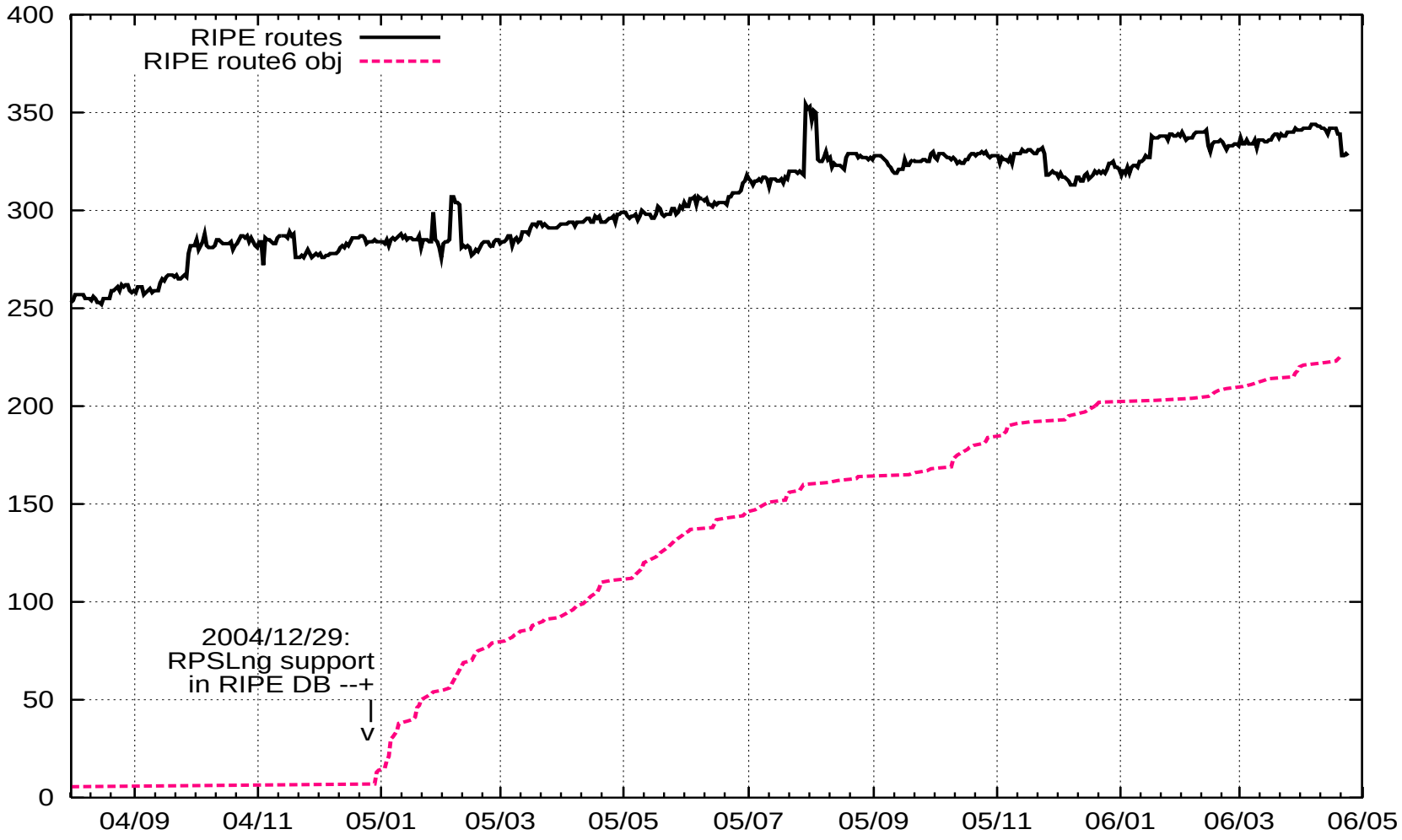
Graphics: Allocated vs. Routed



Why are those prefixes not visible?

- looking at prefixes allocated in 2004 (255)
- visible today: 121, at some point: 25, never: 109
- categorizing 109 prefixes never seen in routing tables:
  - by region: APNIC: 24, ARIN: 26, LACNIC: 2, RIPE: 57
  - by size: 1x /21, /24, /27, 106x /32
  - (specifically not looking at IXP /48s)
  - by organizational type (guessing from whois)
    - commercial 105
    - research 2 (.in, .kr)
    - military/governmental 2 (CNY, US DoT)

Graphics: route6 objects vs. routes seen



route6 object example

- it's as easy as this...

```
route6:         2001:608::/32
descr:          DE-SPACE-2001-0608
descr:          SpaceNET AG, Munich
origin:         AS5539
notify:         noc@space.net
mnt-by:         SPACENET-N
changed:        gert@space.net 20041230
source:         RIPE
```

- strongly recommended, helps upstream/peer ASes build decent BGP filters, based on IRR data

miscellaneous news

- 2006/06/06 is the offical end of the 6bone (next month!)
  - ⇒ 3FFE address allocations are no longer valid anymore
  - consequences for the routing table? filtering police?
- 2001::/32 assigned for Teredo routing on January 10, 2006
  - expect "inconsistant" announcements, as for 2002::/16

```
route6:         2001:0000::/32
descr:          Teredo-ITGate
remarks:        Teredo anycast route. See TEREDO-MNT for details.
origin:         AS12779
mnt-by:         ITGATE-NCC
mnt-routes:     TEREDO-MNT
```

References

- Ghost Route Hunter: http://www.sixxs.net/tools/grh/
- List of IPv6 blocks allocated by the RIRs:
  http://www.ripe.net/rs/ipv6/stats/index.html
- MIPP (minimum peering policy) project:
  http://ip6.de.easynet.net/ipv6-minimum-peering.txt
- IPv6 sample prefix filter page
  http://www.space.net/~gert/RIPE/ipv6-filters.html
- Slides are available at:
  http://www.space.net/~gert/RIPE/R52-v6-table/

Questions?

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