Have We Reached 1000 Prefixes Yet?

A snapshot of the global IPv6 routing table

Gert Döring, SpaceNet AG, Munich, Germany

May 8th, 2007

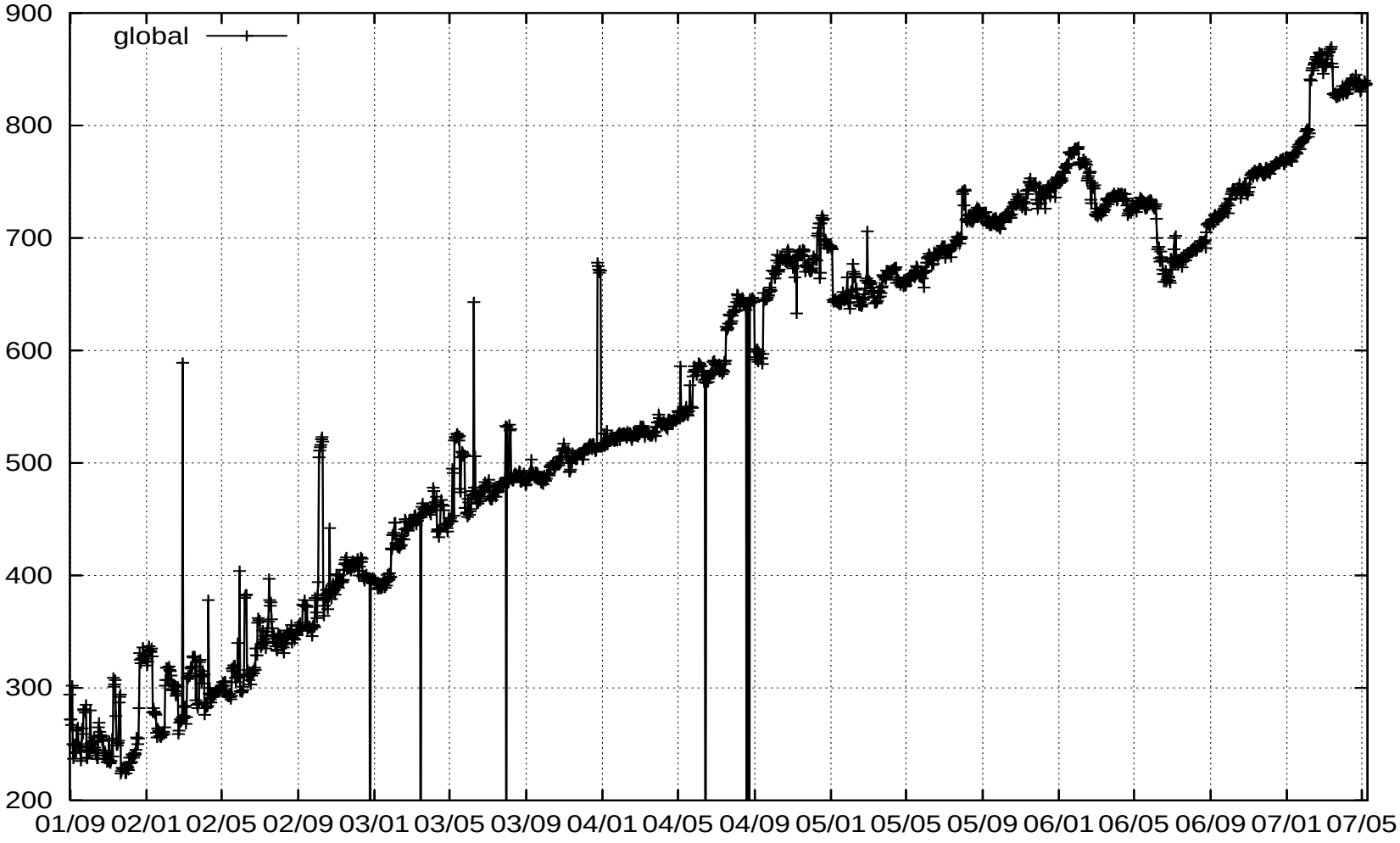
RIPE 54, Tallinn, Estonia

Overview

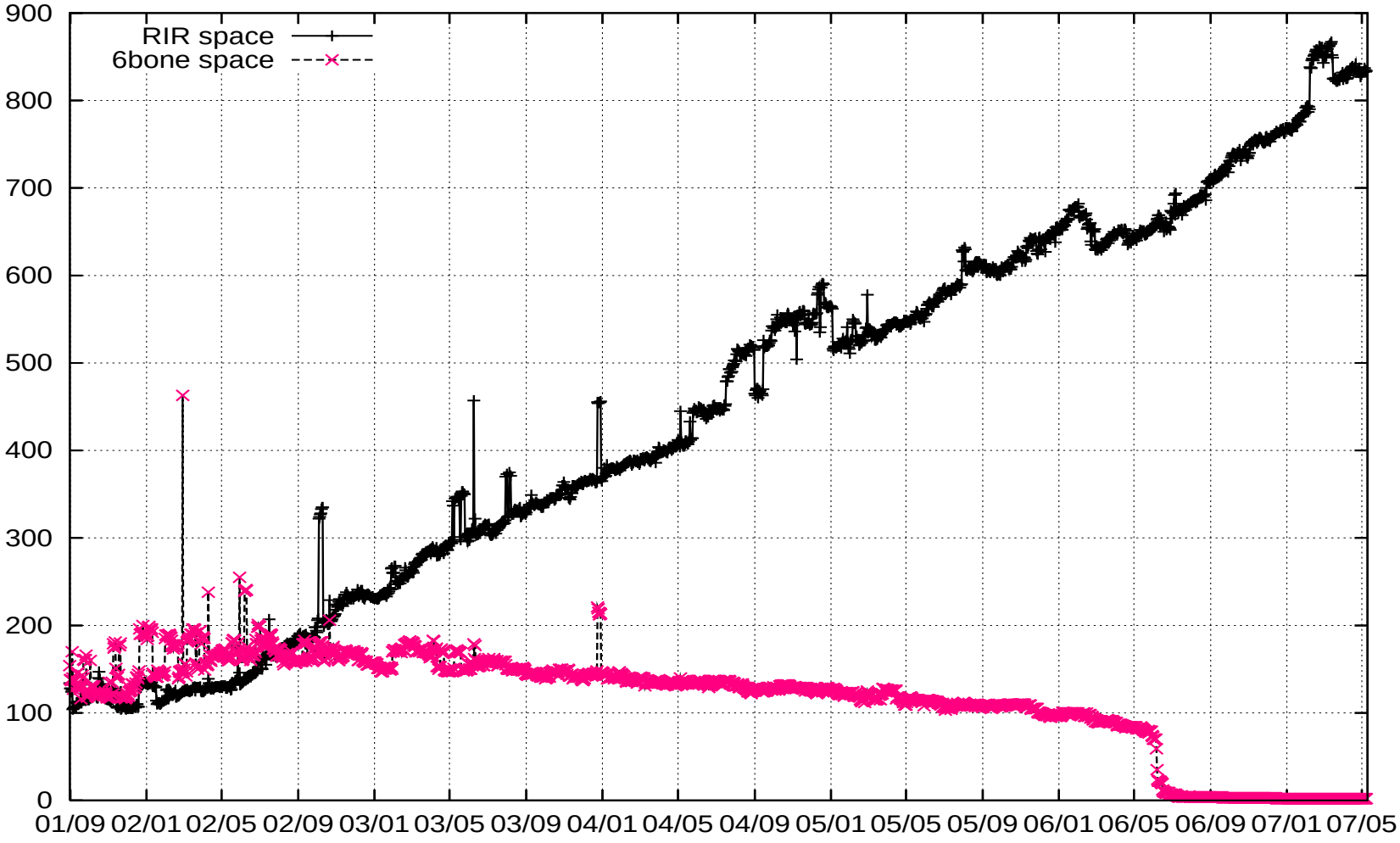
- pictures & trends
- the end of the 6bone
- numbers...
- references

Slides online at: http://www.space.net/~gert/RIPE/R54-v6-table/

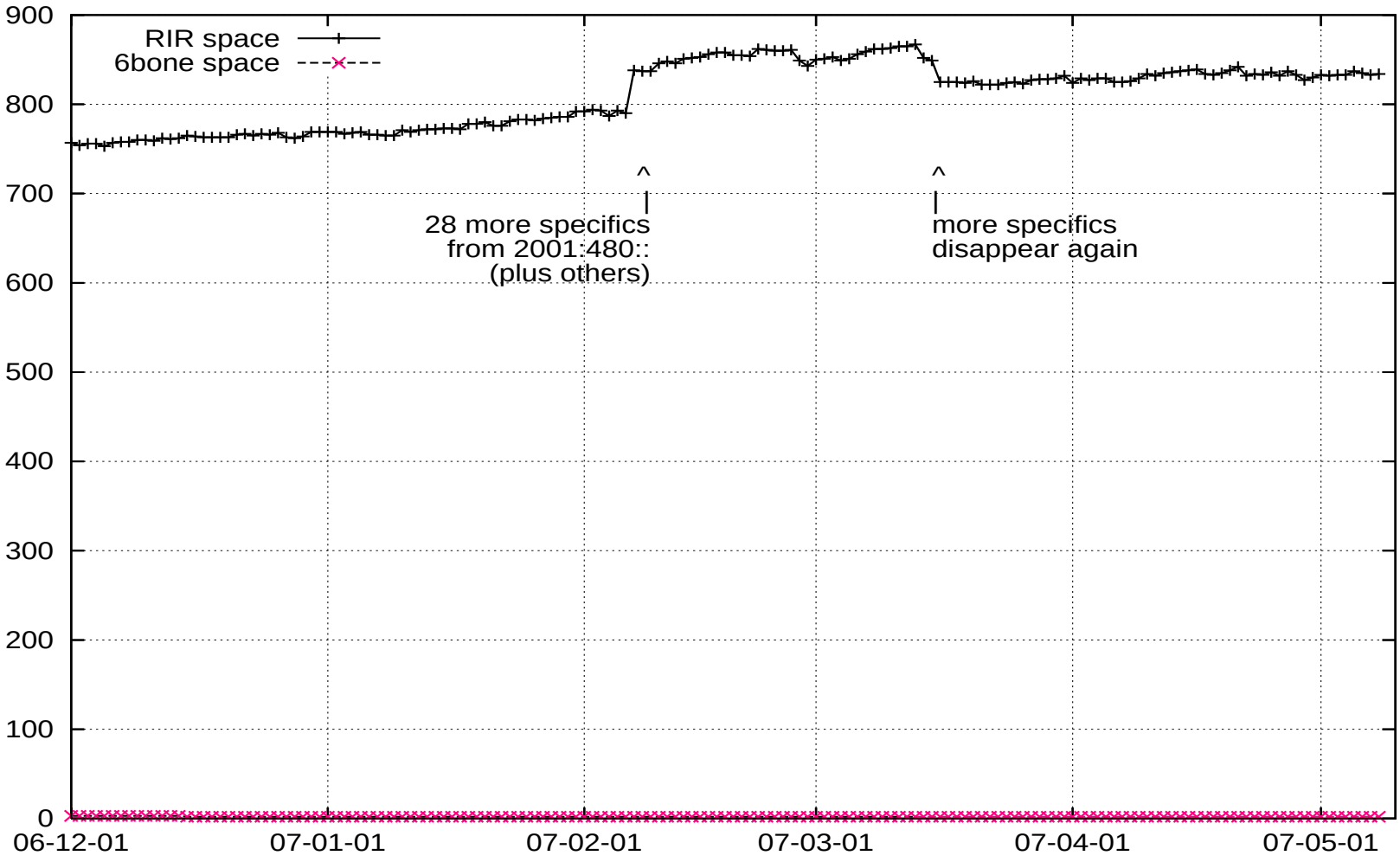
Graphics: Total Prefixes - 5.5 years



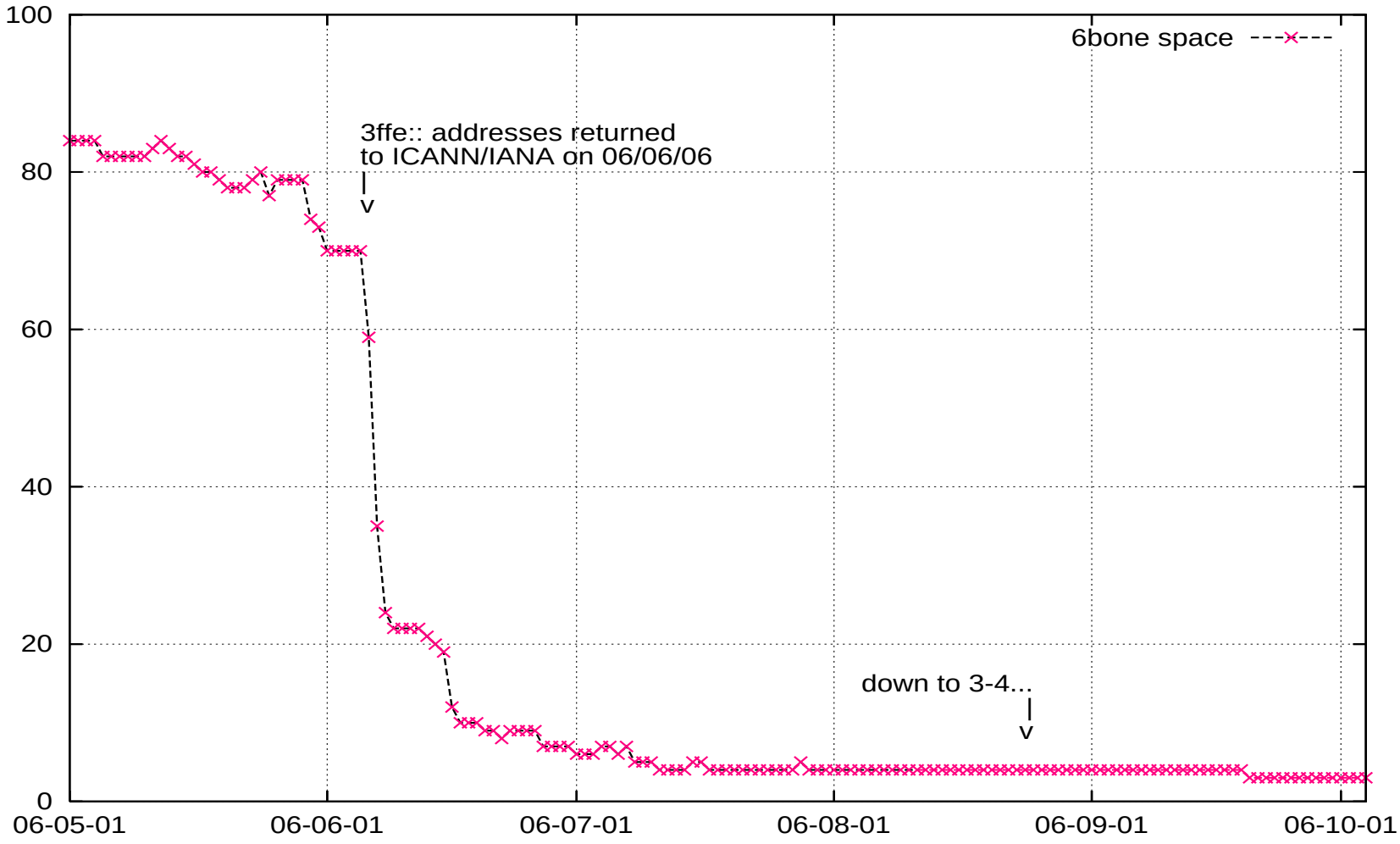
Graphics: RIR vs. 6Bone Prefixes - 5.5 years



Graphics: RIR vs. 6Bone Prefixes - 5 months



Graphics: The End Of The 6bone



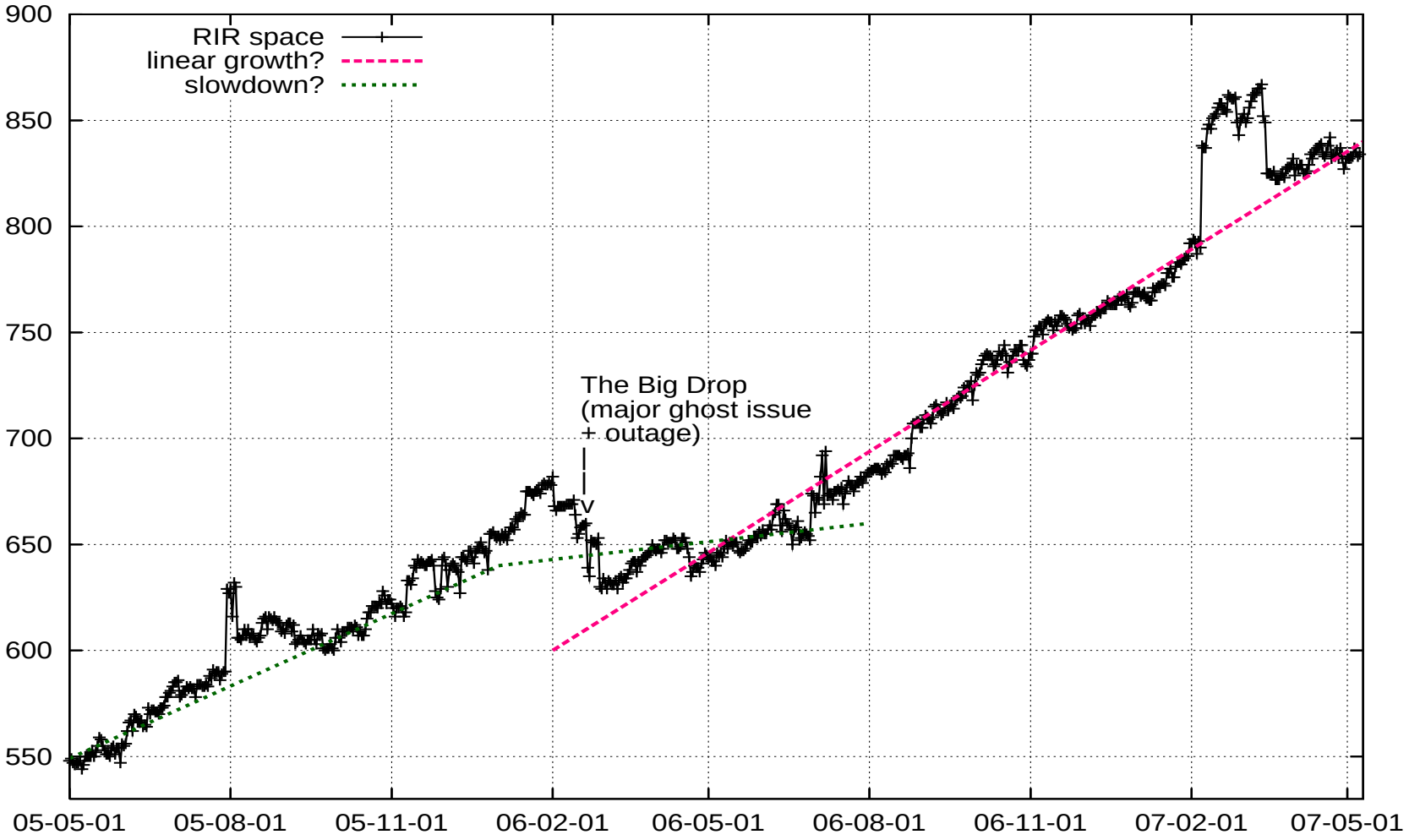
The End Of The 6bone

- on 06/06/06, the 3FFE addresses allocated to the 6Bone test network have been returned to ICANN/IANA (rfc3701)
- this means: there are no official address holders from 3FFE anymore, anybody still announcing space is an address hijacker

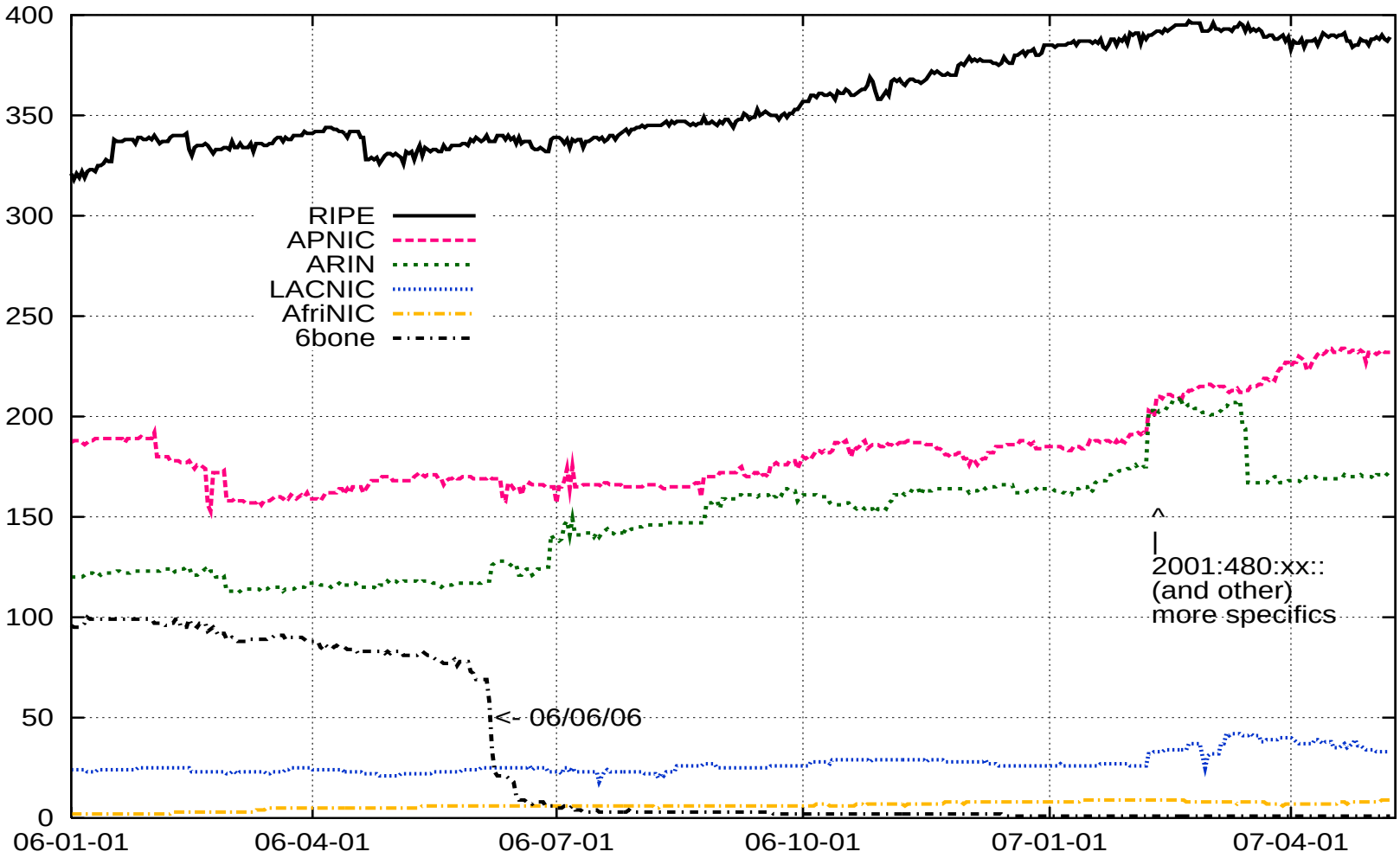
```
*  3FFE::/24          2001:470:1FFF:2::     3549 6939 4555 i
*  3FFE:800::/24      2001:470:1FFF:2::     3549 6939 4555 i
```

- this does NOT mean
  - "the end of the IPv6 Internet!"
  - "early IPv6 networks will be disconnected!"
- but: please stop using 3FFE transfer networks
- please *STOP* giving transit to 3FFE announcements!

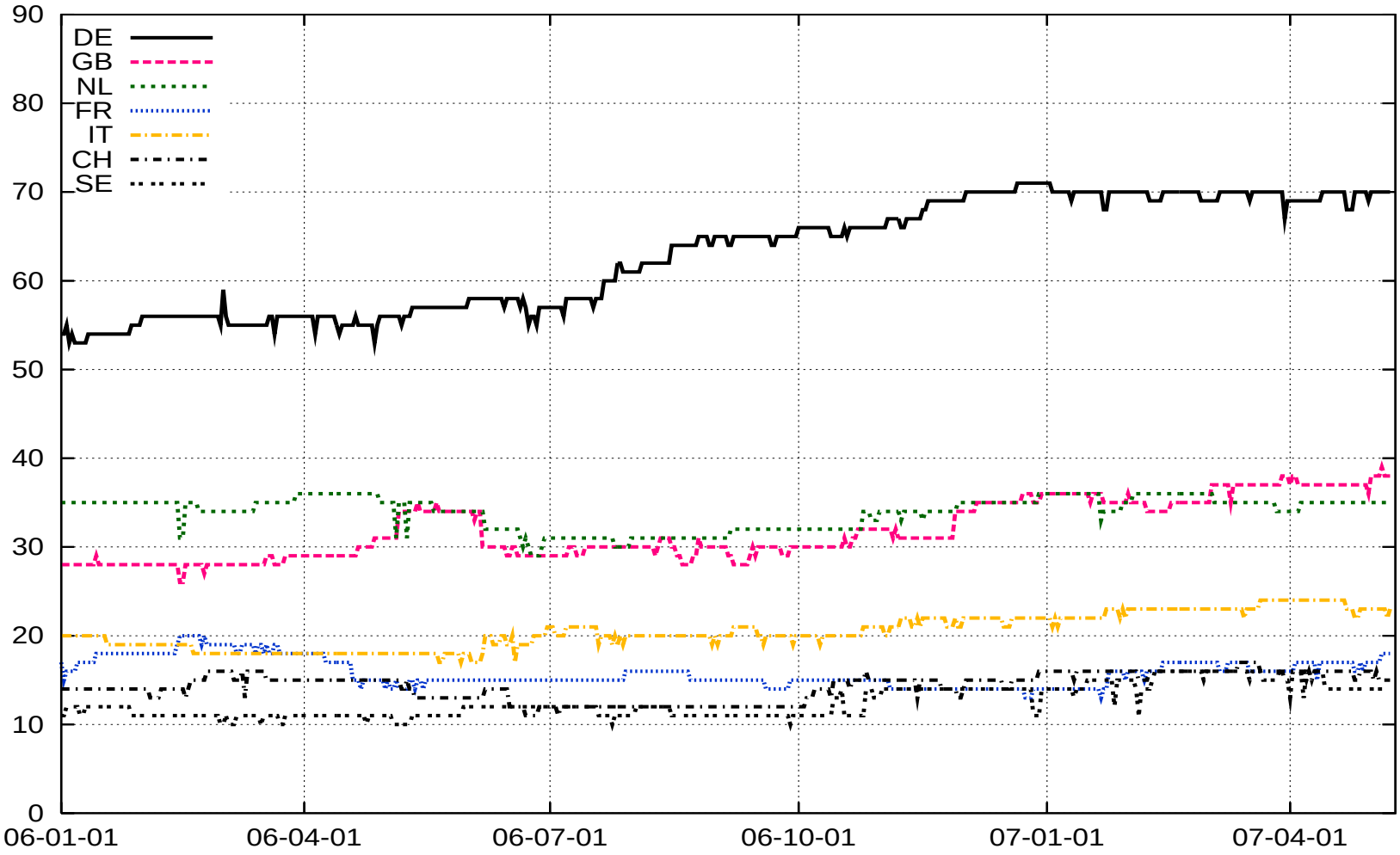
Graphics: trends? (RIR prefixes, 24 months)



Graphics: prefixes by RIR region



Graphics: prefixes by country (RIPE)



Numbers - AS numbers

- as of 2007/05/06: 720 unique AS numbers visible (10/02: 629)
  - 488 origin-only ASes (no transit paths seen) (426)
  - 200 ASes originate & give transit (179)
  - 32 transit-only ASes (e.g. 57, 2153, 5549, 6667, . . .) (24)
- mixture of RIR (2xxx::) and 6Bone (3ffe::*) space announced
  - 604 ASes originate 1 RIR prefix (536)
  - 0 ASes originate only 6Bone prefixes (0)
  - 1 AS originates 2 6Bone + 2 RIR prefixes (1)
  - 53 ASes originate 2 RIR prefixes (4 due to /32+/35)
  - 30 ASes with “more than that”, maximum is 14 prefixes
- 4 ASes still announce their prefix as /32 and /35
- note: all paths observed from AS5539

ASes - why are people announcing 2+ prefixes

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

```
2001:420::/35          109 i
2001:420::/32          109 i
```

- Traffic Engineering? Internal aggregation leaking out?

```
2001:12F0::/32          3549 1916 i
2001:12F0:500::/42      109 5511 10764 11537 27750 1916 i
```

- ISP/LIR address space plus IXP prefixes

```
2001:5000::/21          1273 i    (C&W LIR space)
2001:7F8:2B::/48        1273 i    (IXP: INXS HAM)
2001:7F8:2C::/48        1273 i    (IXP: INXS MUC)
```

- mergers and acquisitions, business units, customer pfxs, ...

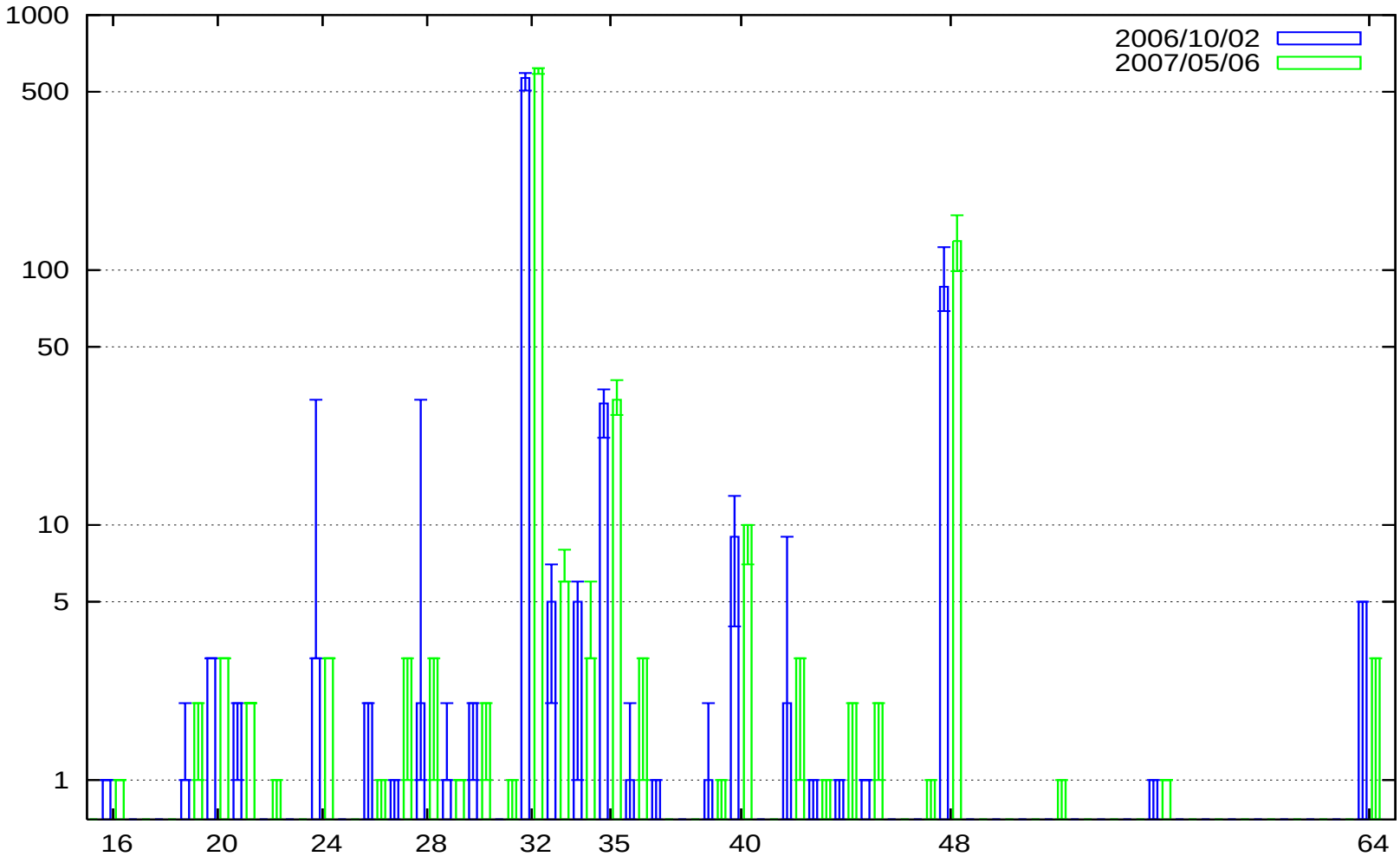
```
2001:218::/32           2914 i      NTT JP
2001:418::/32           2914 i      NTT America
2001:49F0::/32          2914 i      FDCServers
2001:728::/32           2914 i      Verio Europe
2610:150::/32           2914 i      Sharktech Internet
2610:F8::/32            2914 i      Command Information Inc.
```

Numbers - Prefixes

As of 2007/05/06: 838 prefixes in total (2006/10/02: 734)

/n	global	RIR space	6bone	6to4	(2006/10/02)
/16	1	0	0	**1**	(1 0 0 1)
/19-22	8	8	0	0	(6 6 0 0)
/24	3	1	**2**	0	(3 1 2 0)
/25-/27	4	4	0	0	(3 3 0 0)
/28	3	3	**0**	0	(2 1 1 0)
/29-/30	3	3	0	0	(3 3 0 0)
/32	617	**617**	**0**	0	(567 567 0 0)
/33-/34	9	9	0	0	(10 10 0 0)
/35	31	31	0	0	(30 30 0 0)
/36-/39	4	4	0	0	(3 3 0 0)
/40	10	10	0	0	(9 9 0 0)
/41-/47	9	9	0	0	(5 5 0 0)
/48	130	130	0	0	(86 86 0 0)
/52-/60	2	2	0	0	(1 1 0 0)
/64	3	3	0	0	(5 5 0 0)
/65-/128	0	0	0	0	(0 0 0 0)

Graphics - Prefixes



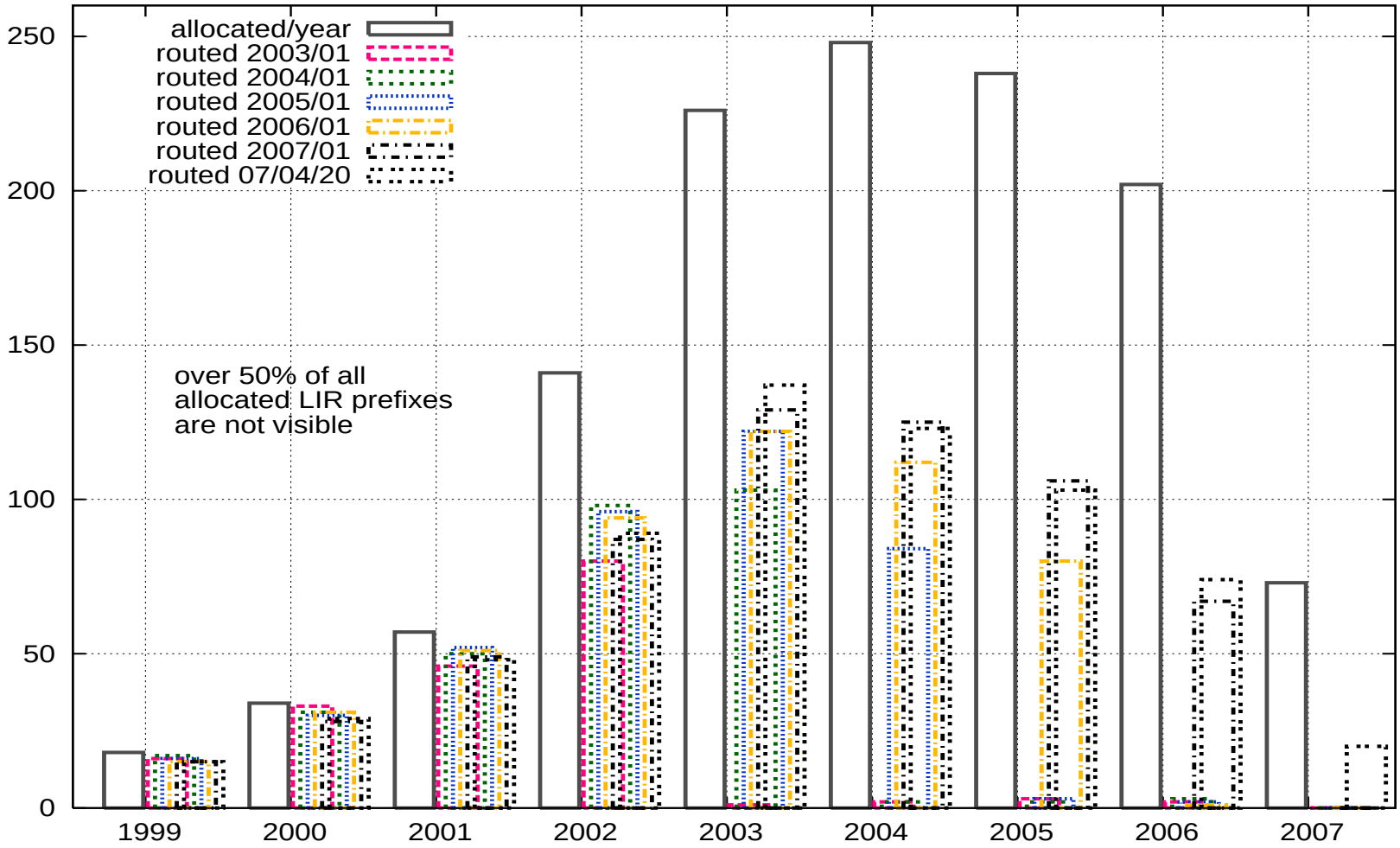
Numbers: RIRs, Allocations, ...

- On 2007/05/06, 1253 LIR blocks (2000::/4) allocated by RIRs:

RIR	alloc.	members	perc.	on 2006/10/03
ARIN	247	~ 2578	9.6%	212 (+16%)
APNIC	287	~ 2310	12.4%	263 (+9%)
RIPE	617	~ 4880	12.6%	583 (+6%)
LACNIC	74	~ 718	10.3%	63 (+17%)
AfriNIC	28	~ 235	11.9%	23 (+22%)

- note: not counting /48 microallocs and /35⇒/32 extentions
- actual *percentage* with IPv6 similar among regions
- 547 (R53: 489) allocations visible in routing table (*only 44%!*)

Graphics: Allocated vs. Routed



Allocated vs. Routed (2)

- look from a different angle: pfx *region* and *class* (2007/05/07)

RIR	type	alloc.	visible	perc.	subnets
ARIN	LIR	244	95	39%	45
	IXP	20	0	0%	0
	Critical Inf.	41	20	49%	5
	Internal Inf.	1	0	0%	0
	PI	47	6	13%	0
APNIC	LIR	287	161	56%	71
	IXP	21	1	5%	0
RIPE	LIR	618	340	55%	36
	IXP	60	9	15%	0
	Anycast DNS	5	2	20%	0
LACNIC	LIR	74	25	34%	8
	Critical Inf.	4	0	0 %	0
AfriNIC	LIR	28	9	32%	0

Numbers: RIRs: notable allocations (1)

- more "very large" allocations seen:
  - 2404:0e0::/28 MCI Asia Ptr, AP (2006/05/10)
  - 2404:180::/28 Samsung Networks, KR (2006/08/28)
  - 2610:080::/29 RCN Corporation, US (2006/06/02)
  - 2a01:110::/31 Microsoft, GB* (2006/06/01)
  - 2a01:2000::/20 Telecom Italia, IT (2006/05/16)
  - 2402::/22 Korean Education Network, KR (2006/10/20)
  - 2401:8000::/26 NCICNET, TW (2007/01/23)
  - 2001:500:6::/47 + 2001:500:8::/45 Afilias, CA (2006/10/19) **
  - 2600::/29 Sprint, US (2006/12/21)
  - 2600:800::/27 MCI / Verizon Business, US (2007/01/08)
  - 2a01:2e0::/28 Polkomtel S.A., PL (2007/03/19)
  - 2800:a0::/28 Administration Nacional d. Tel., UY (2007/01/15)

Numbers: RIRs: notable allocations (2)

- first IPv6 PI networks assigned by ARIN:
  - 2620::/48 U.S. Securities & Exchange C. (2006/09/13)
  - 2620:0:10::/48 S. D. Warren Services (2006/09/13)
  - 2620:0:20::/48 CollabNet (2006/09/13)
  - 2620:0:30::/48 Tellme Networks (2006/09/14)
  - 2620:0:40::/48 YouTube, Inc. (2006/09/19)
  - 2620:0:50::/48 Univ. of Texas at Austin (2006/09/21)
  - (47 "direct" assignents from ARIN so far, 6 in BGP)
- DNS anycast assignments from RIPE (2001:678::/29)
  - 2001:0678:0::/48 .FK – Falkland Islands (2006/10/09)
  - 2001:0678:1::/48 .CZ – CZ.NIC (2006/10/11) (in BGP)
  - 2001:0678:2::/48 .DE – DENIC eG (2006/10/13)
  - 2001:0678:3::/48 .CH – Switch (2006/12/12) (in BGP)
  - 2001:0678:4::/48 .CO.UK – Internet Comp. Bur. (2007/03/22)
- ⇒ **check your BGP filters!!**

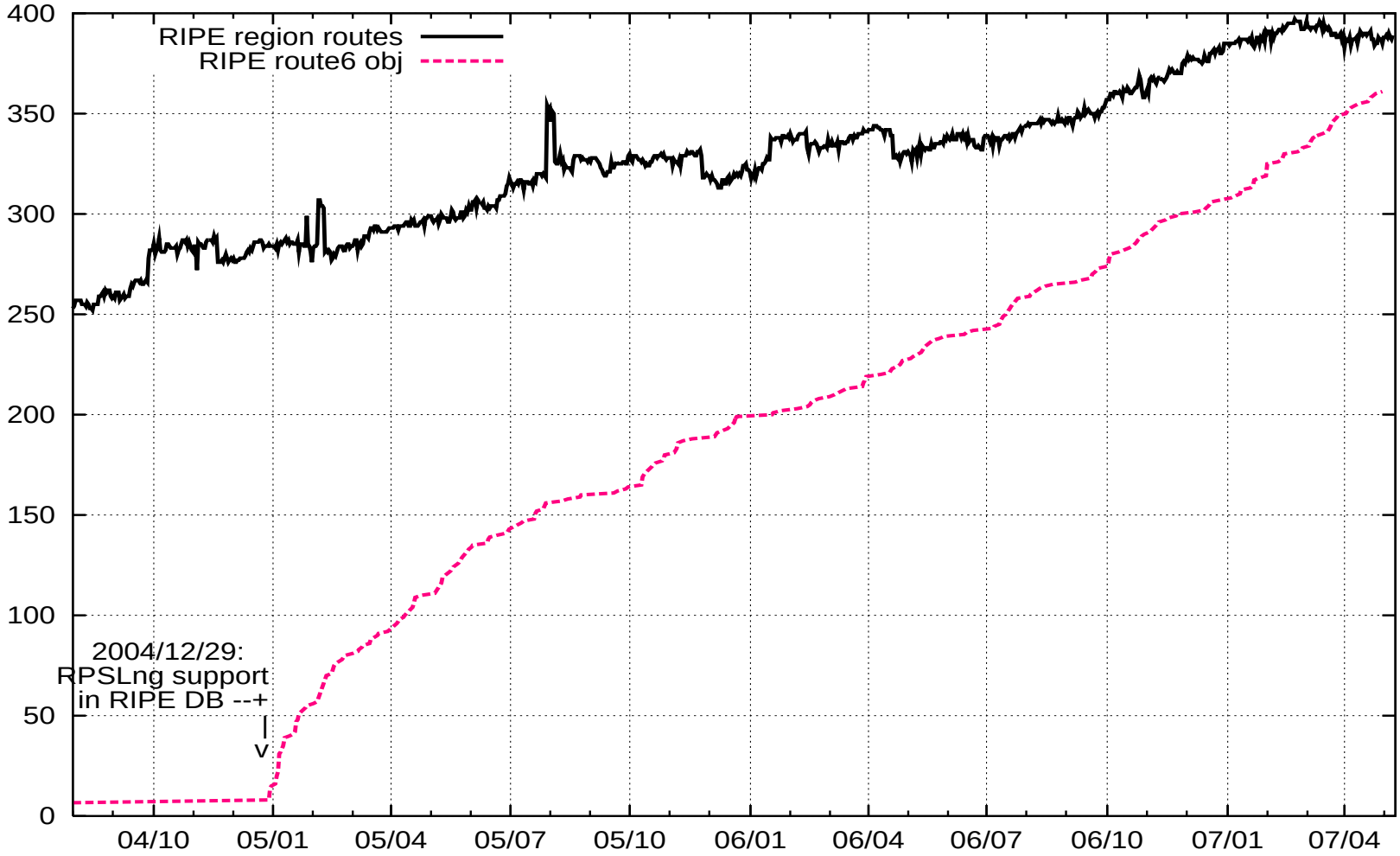
Numbers: RIRs: notable allocations (3)

- Allocations ICANN ⇒ RIRs since RIPE 52

Prefix	RIR	Date	Comment
2620:0000::/23	ARIN	12 Sep 06	last /23
2400:0000::/12	APNIC	03 Oct 06	
2600:0000::/12	ARIN	03 Oct 06	
2800:0000::/12	LACNIC	03 Oct 06	
2A00:0000::/12	RIPE NCC	03 Oct 06	
2C00:0000::/12	AfriNIC	03 Oct 06	

- http://www.iana.org/assignments/ipv6-unicast-address-assignments
- new global IPv6 distribution policy has been ratified by ICANN ⇒ /12 allocations to RIRs on Oct 03
- hopefully these will last for a while

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

new tool: GRH Longest Distance Routing

- http://www.sixxs.net/archive/sixxs/2007-04-01-GRH-LongestDistanceRouting.html
- approximate the *geographical* AS path length for a given prefix
- originally meant as a April Fool's joke, but actually it's quite useful to quickly find *really* bad paths
- and the winner is...

  `2001:200:a000::/35 25441 3257 3549 6939 2516 7660 22388 11537 2500`

  at 40760 km (Ireland, Germany, NL, US, JP, US and Japan), and

  `2001:200:a000::/35 1836 3549 6939 2516 7660 22388 11537 2500`

  at 39500 km (Switzerland, NL, US, JP, US, and Japan)
- kudos goes to Jeroen Massar

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/R54-v6-table/

Questions?

gert@space.net