

*Are We Growing Fast Enough?*

A snapshot of the global IPv6 routing table

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RIPE 58, Amsterdam

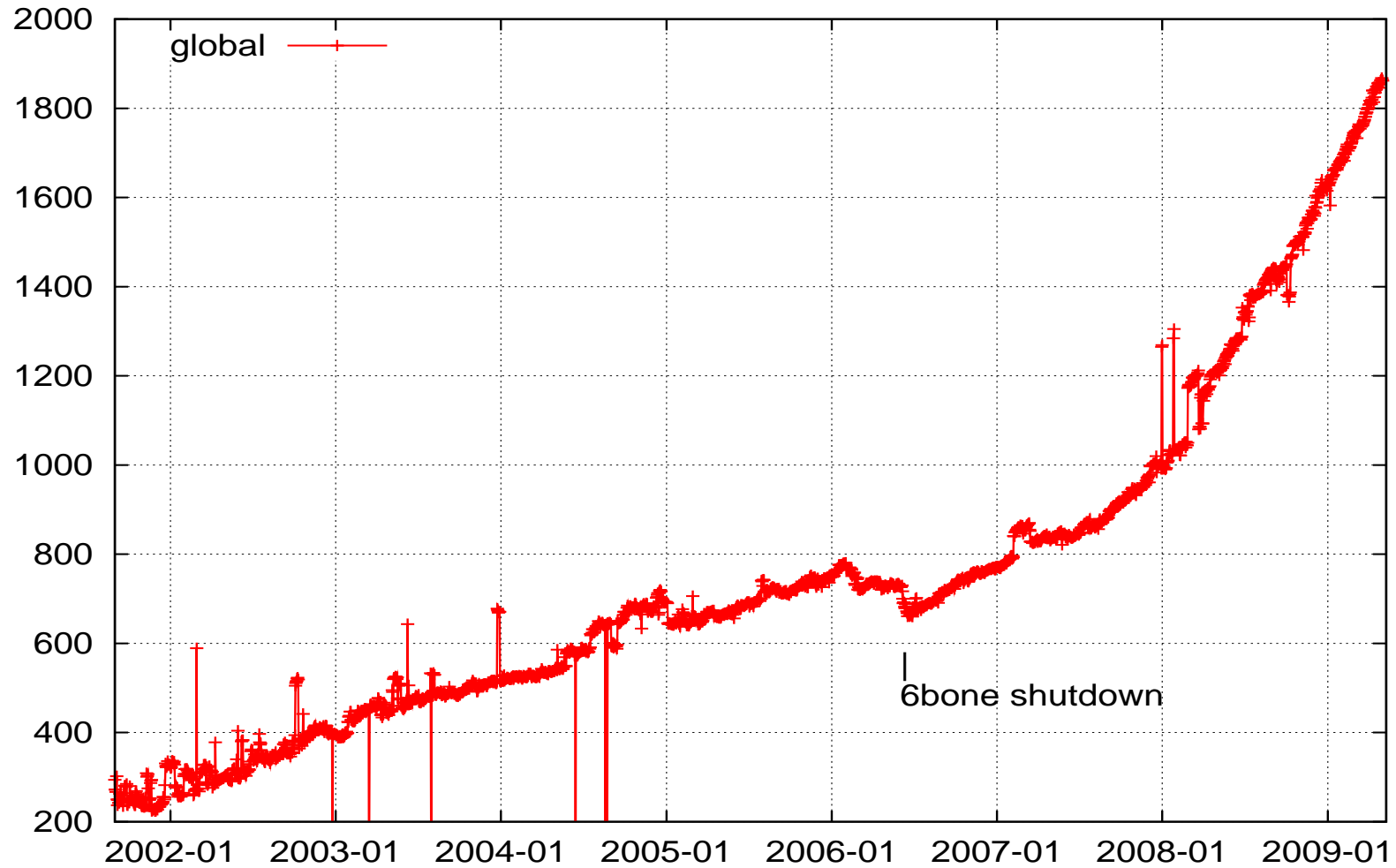
## Overview

- pictures & trends
- numbers...
- things that should not be there...
- route6 current practices
- references

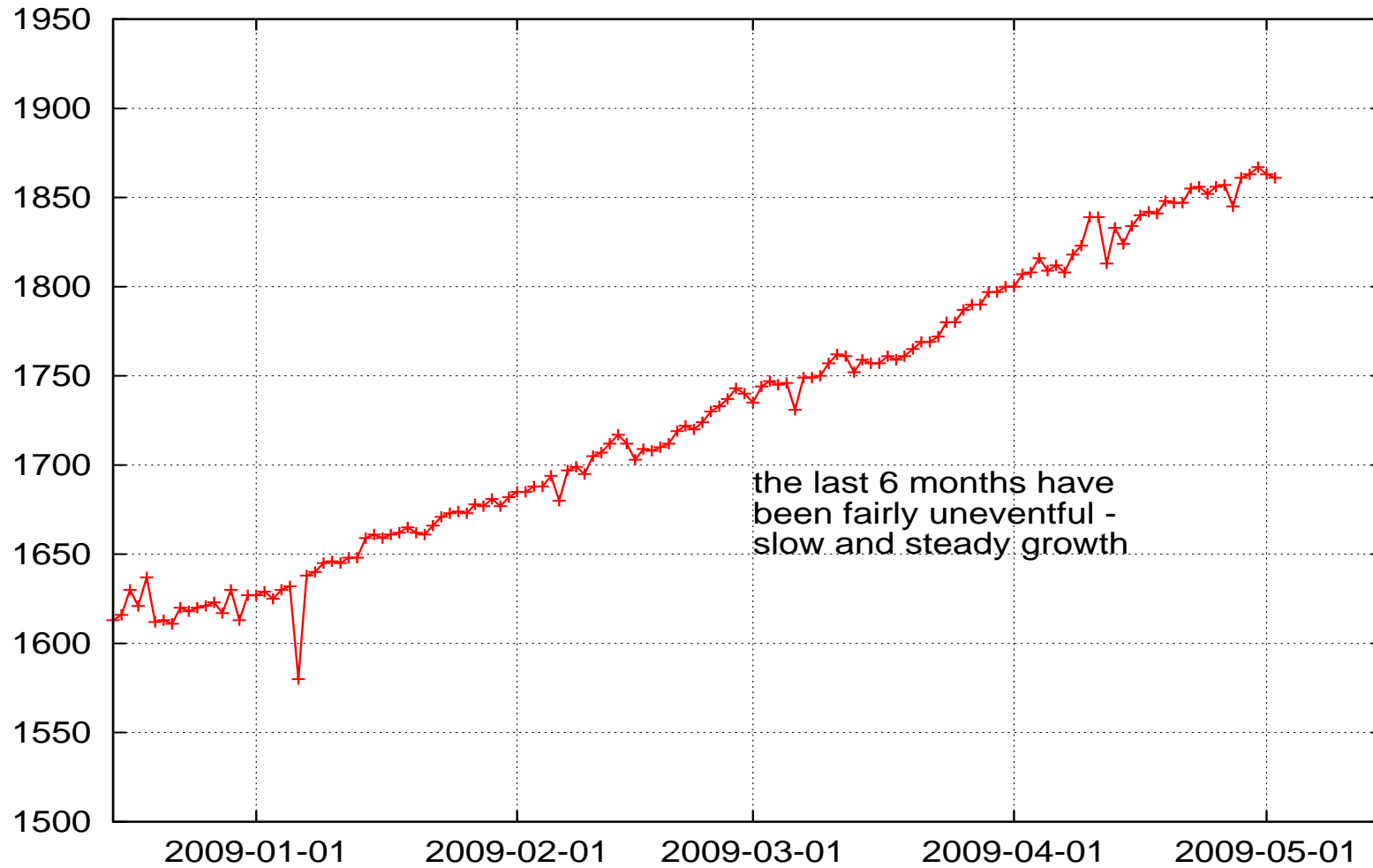
Slides online at: <http://www.space.net/~gert/RIPE/R58-v6-table/>

**Prefixes in BGP Table**

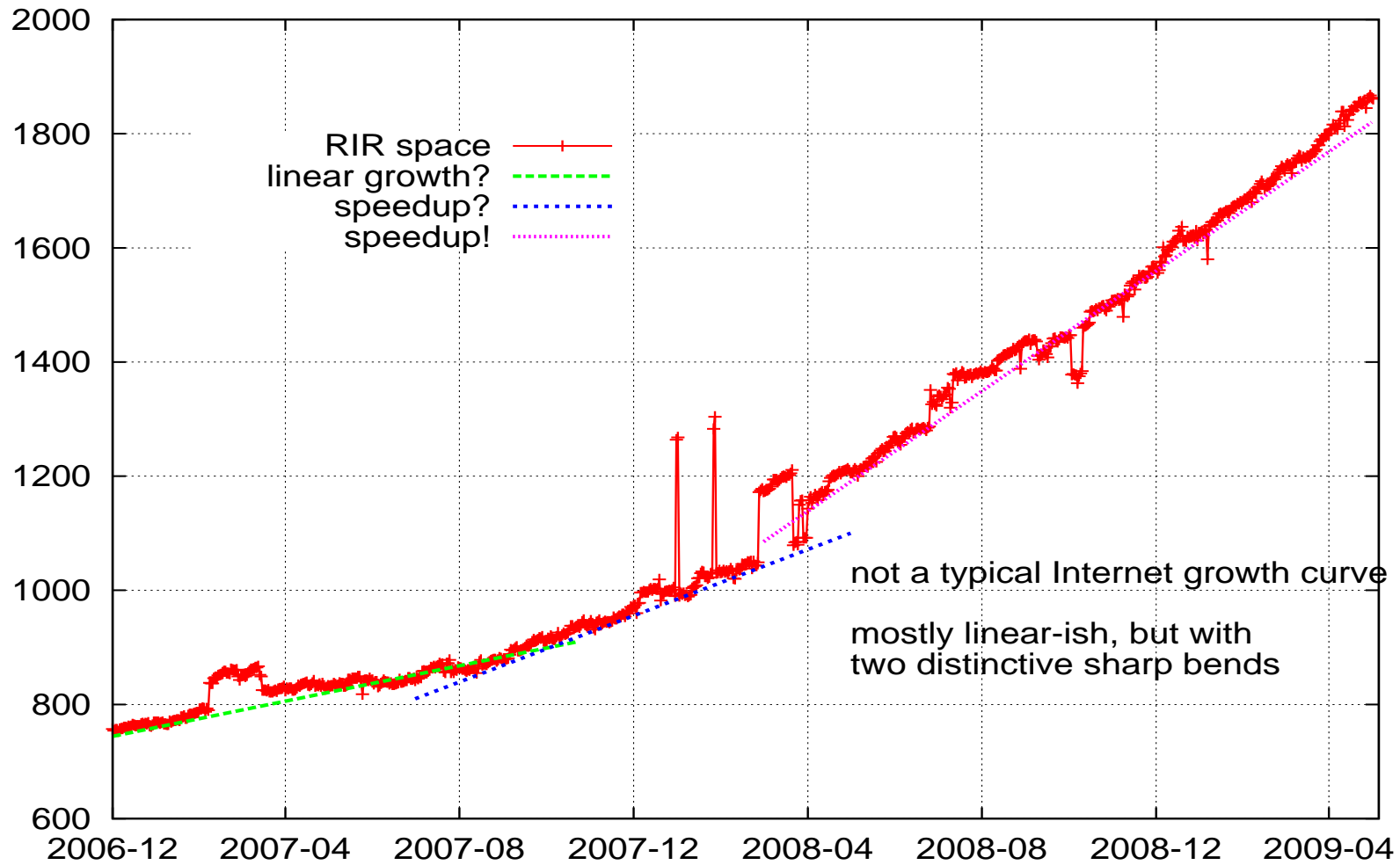
## Graphics: Total Prefixes - 7 years



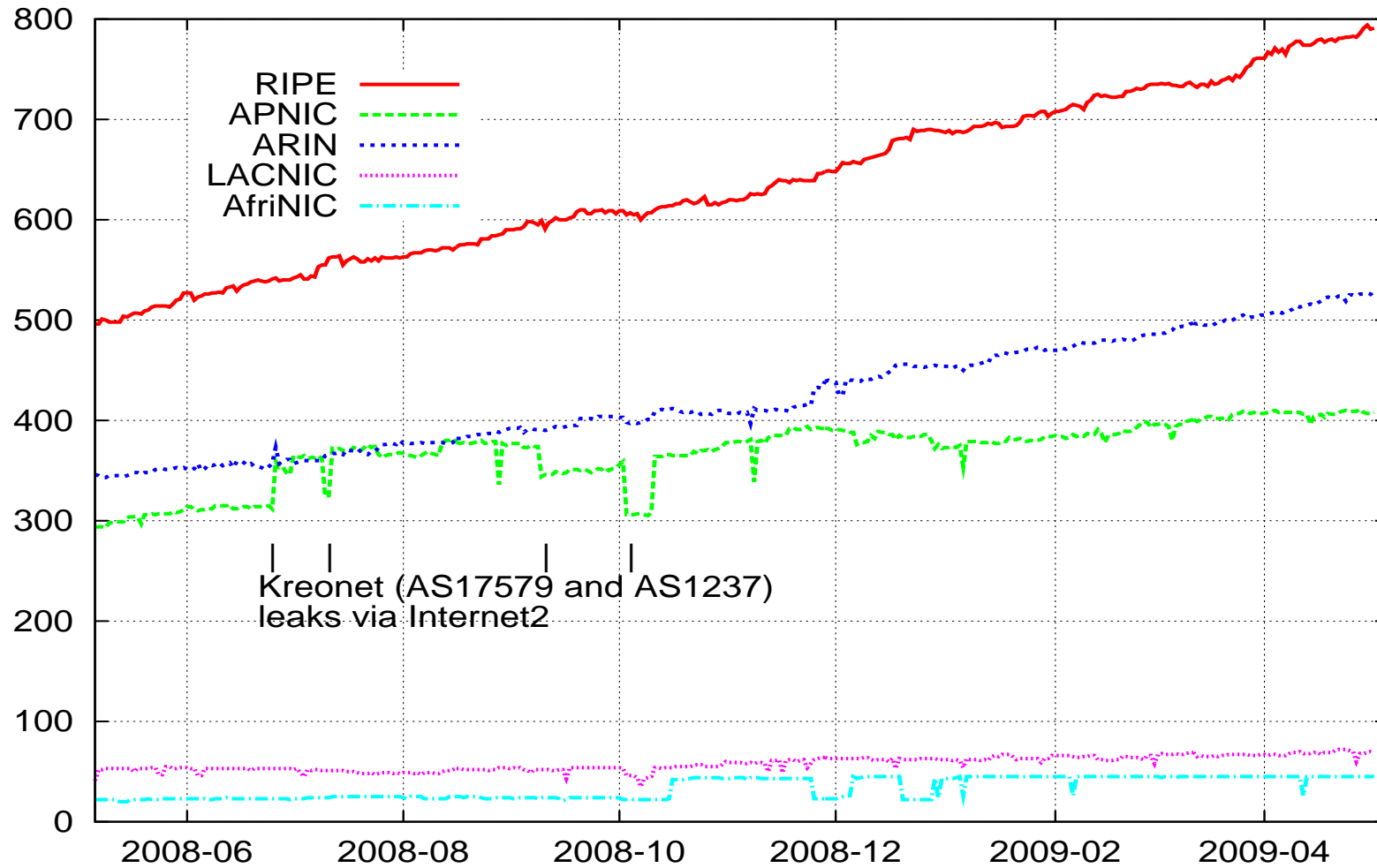
## Graphics: zoom into last 6 months



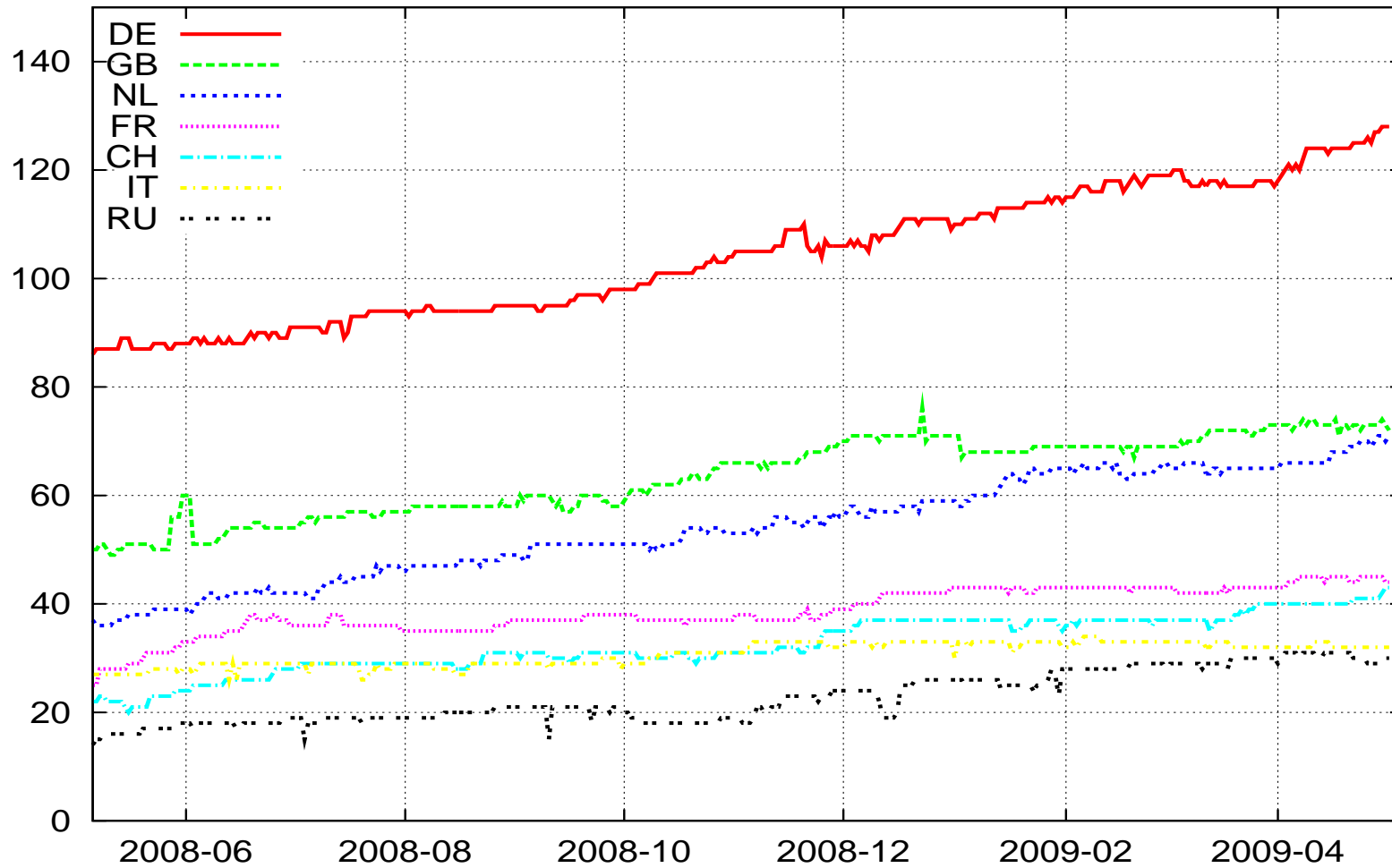
## Graphics: trends? (30 months)



## Graphics: prefixes by RIR region



## Graphics: prefixes by country (RIPE)





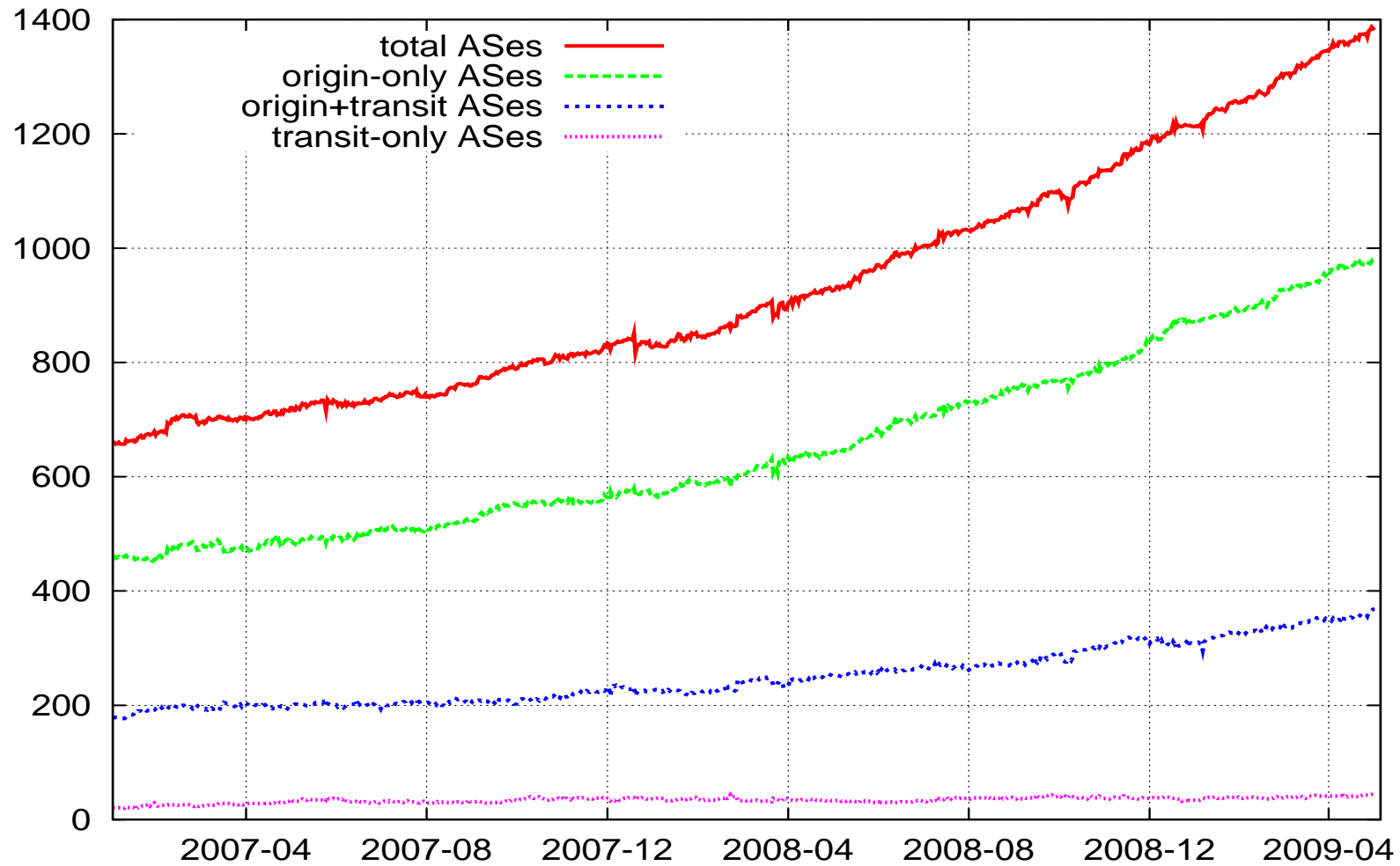


**AS Numbers**

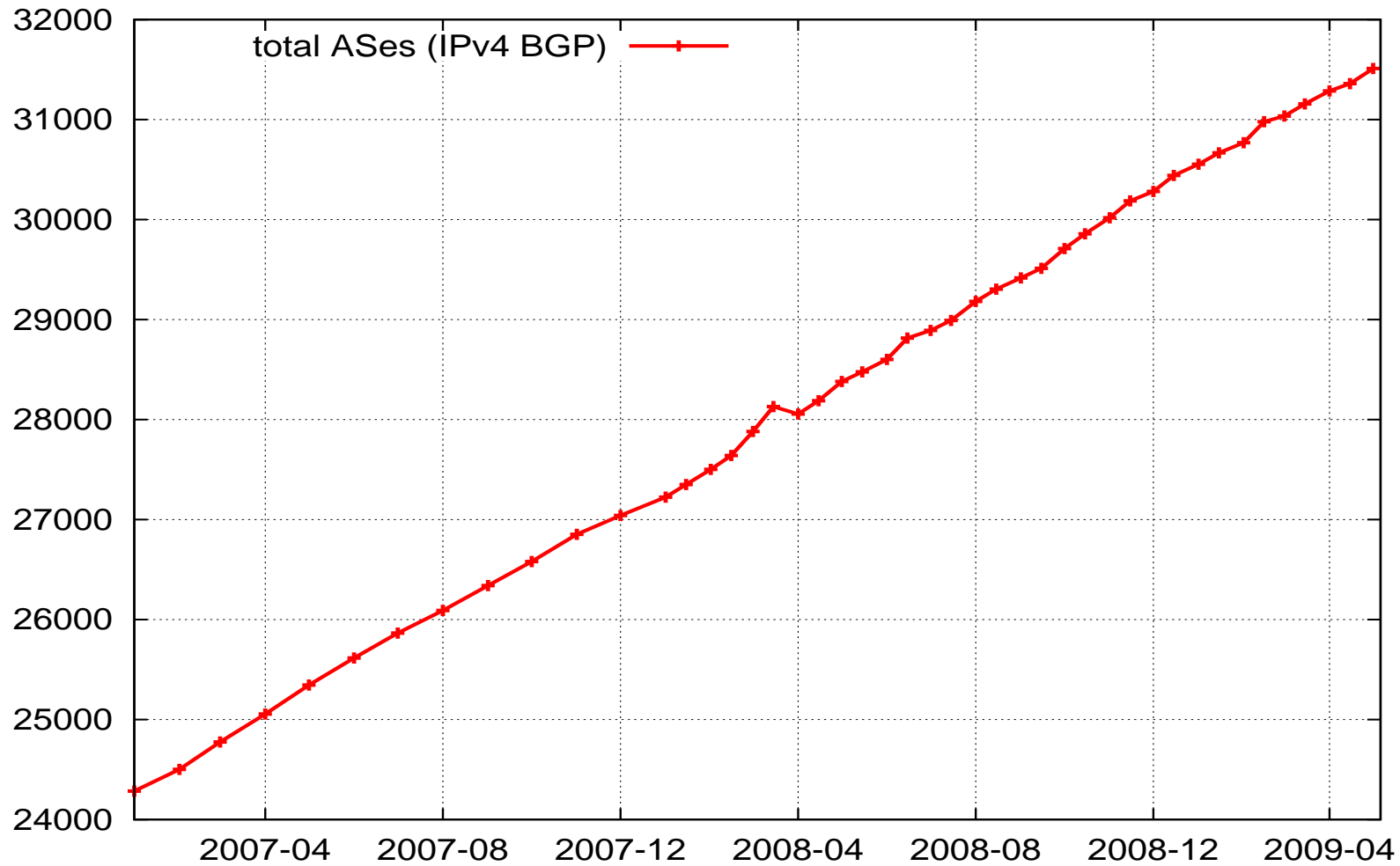
## Numbers - AS numbers

- as of 2009-05-02: 1382 unique AS#s visible (2008-10-29: 1137)
  - 970 origin-only ASes (no transit paths seen) (795)
  - 368 ASes originate & give transit (301)
  - 44 transit-only ASes (e.g. 760, 1125, 1659, 6667, ...) (41)
- different number of prefixes announced
  - 1157 ASes originate 1 prefix (936)
  - 110 ASes originate 2 prefixes (2 due to /32+/35)
  - 27 ASes originate 3 prefixes
  - 18 ASes originate 4 prefixes
  - 26 ASes with “more than that”, max. is 32 & 34 prefixes
- 2 ASes still announce their prefix as /32 and /35
- note: all paths observed from AS5539

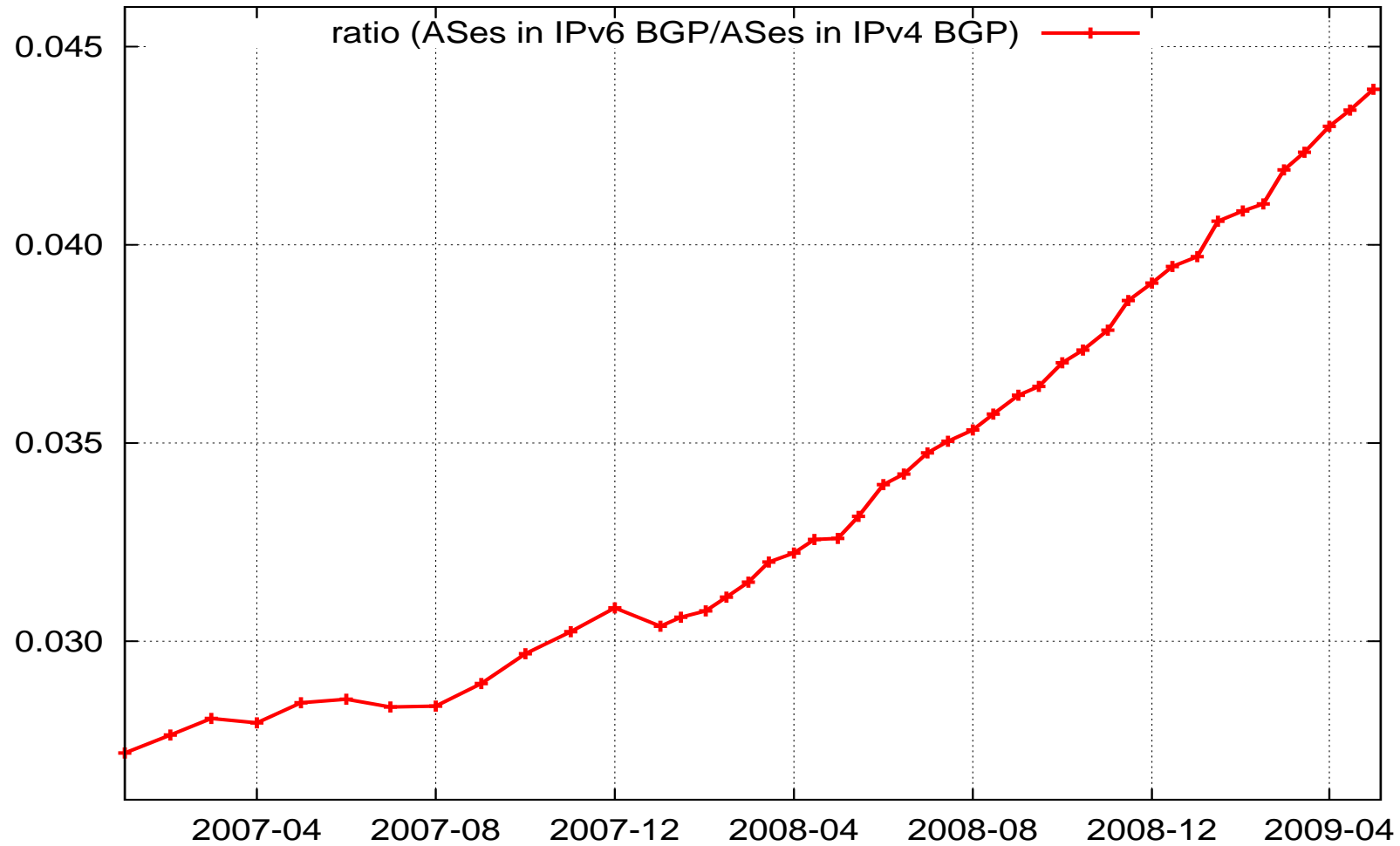
## Graphics: AS Numbers (v6 BGP)



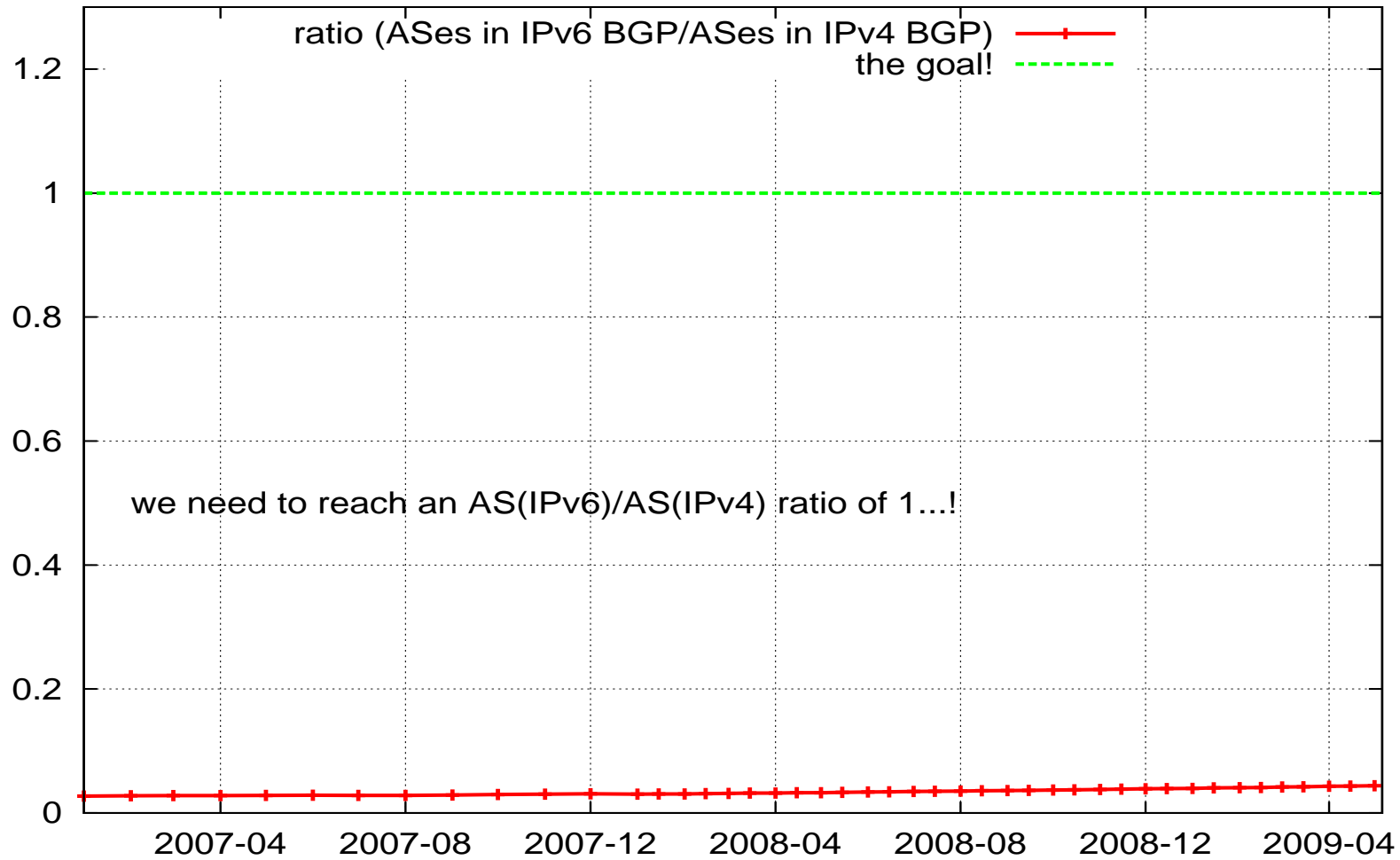
## Graphics: AS Numbers (v4 BGP)



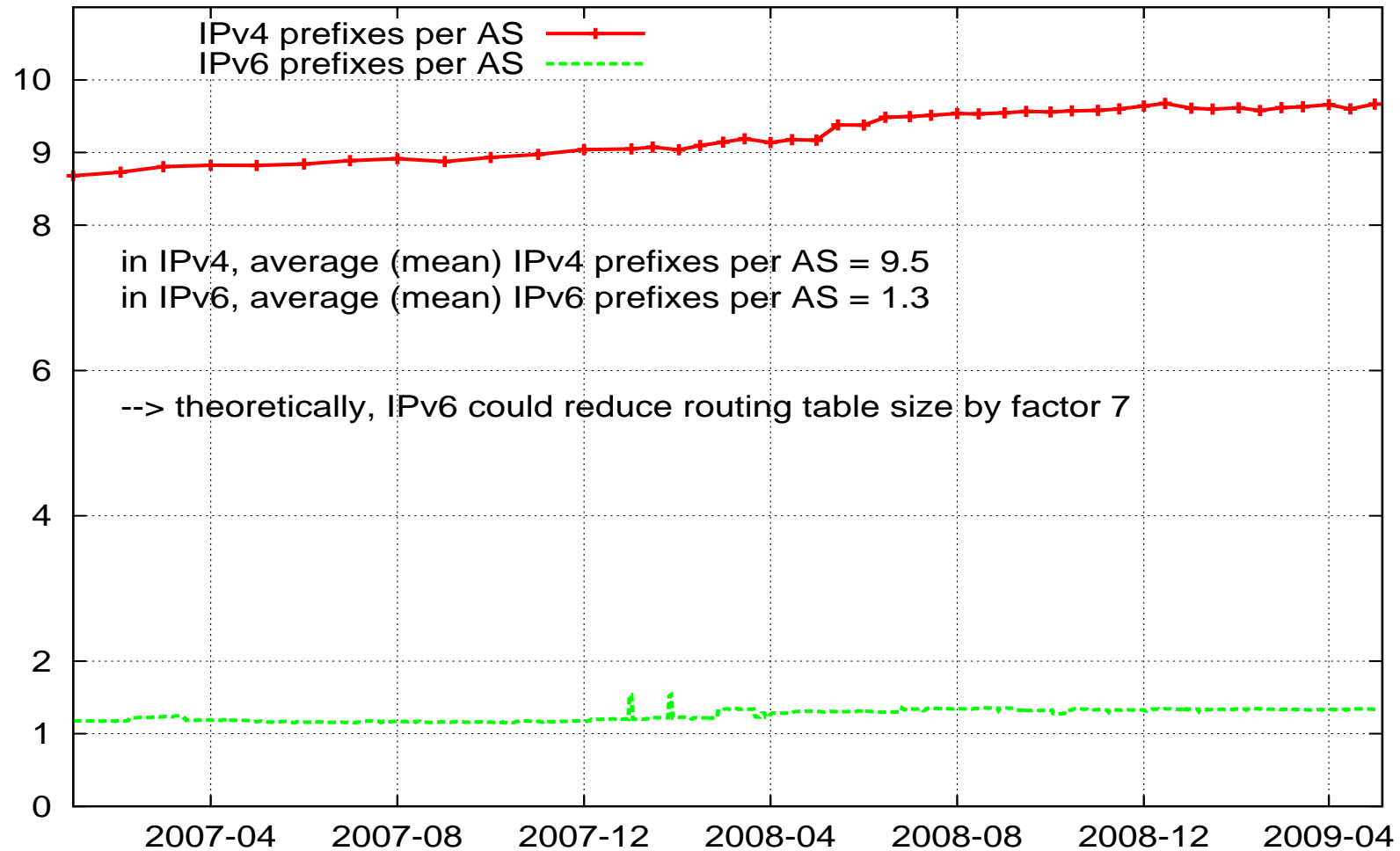
## Graphics: AS Number Ratio (v6 BGP/v4 BGP)



## Graphics: AS Number Ratio (v6 BGP/v4 BGP)



## Graphics: Prefixes per AS (v4+v6)





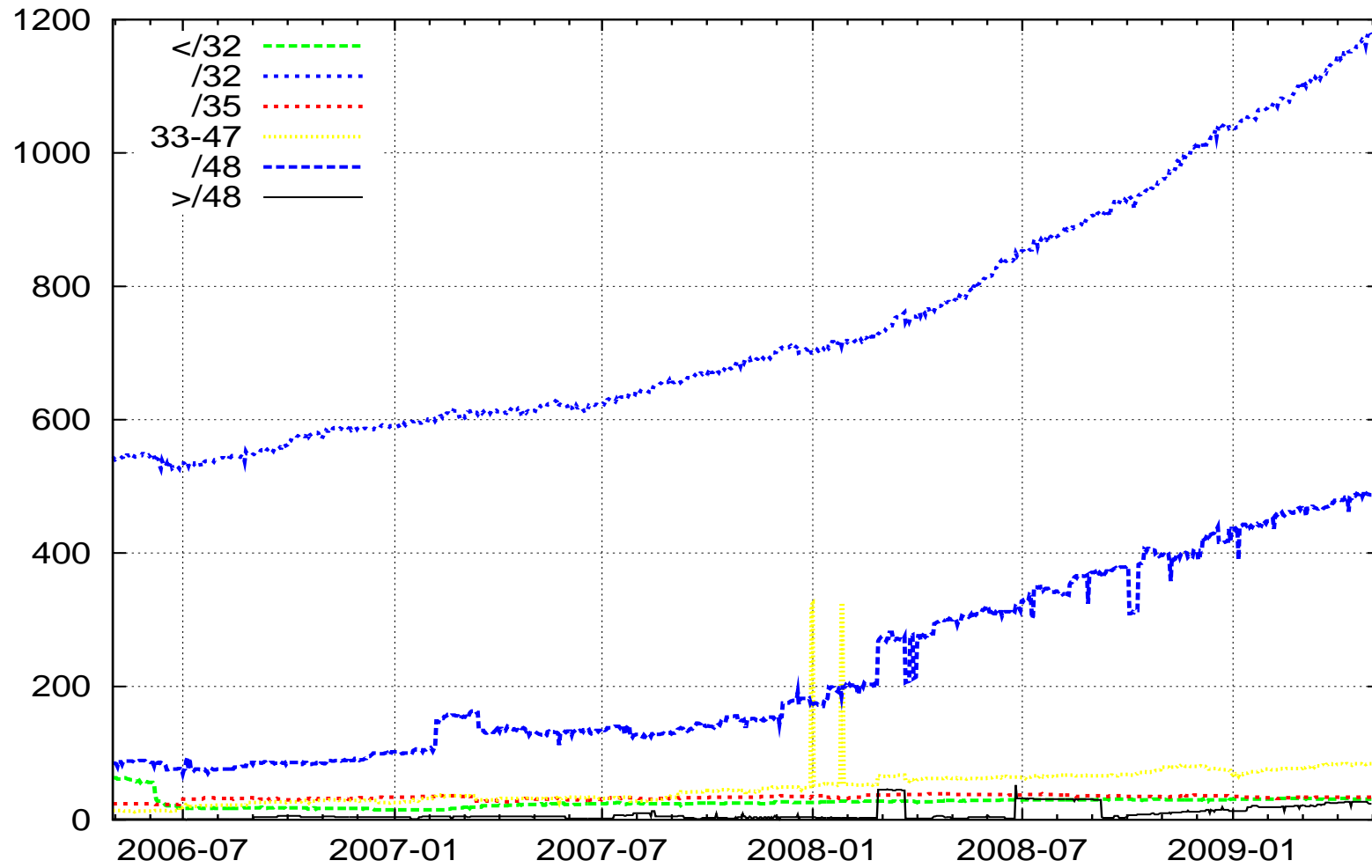
**Looking at Prefixes again**

## Numbers - Prefixes

As of 2009-05-02: 1840 prefixes in total (2008-10-28: 1501)

/n	global	RIPE	APNIC	ARIN	Lacn.	Afri.	oth
/16	1	0	0	0	0	0	1
/19	2	2	0	0	0	0	0
/20..23	8	4	4	0	0	0	0
/24..27	9	5	3	1	0	0	0
/28..31	11	2	6	0	3	0	0
/32	1180	658	221	230	47	19	5
/33..34	23	10	8	5	0	0	0
/35	34	9	18	7	0	0	0
/36..39	9	3	0	6	0	0	0
/40	26	8	4	11	1	2	0
/42..47	26	8	1	16	0	1	0
/48	487	77	129	240	18	23	0
/49..63	7	0	6	1	0	0	0
/64..128	17	2	6	8	1	0	0

## Graphics - Prefixes / Size



**Allocations**

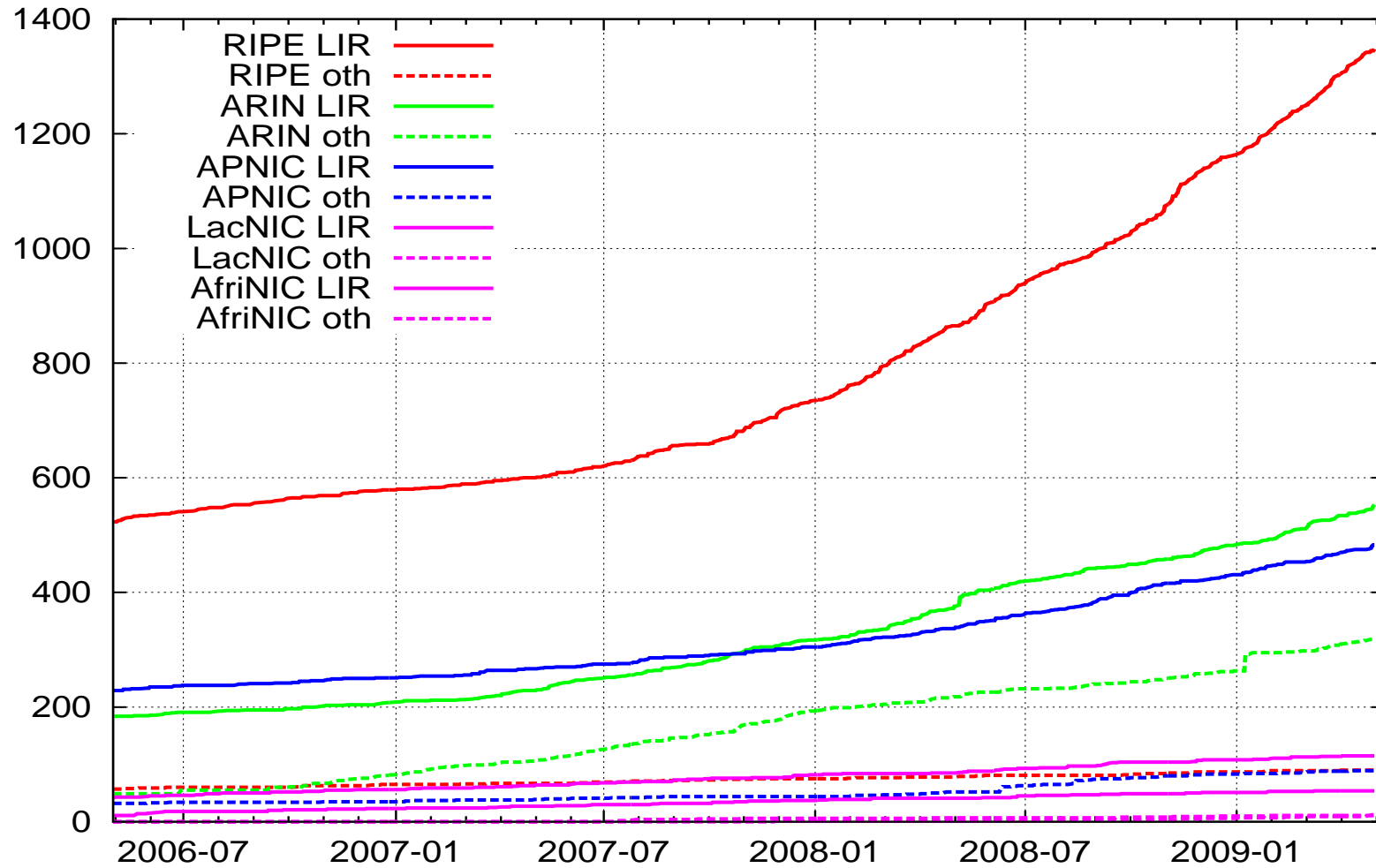
## Numbers: RIRs, Allocations, ...

- On 2008-10-12, 2122 LIR blocks (2000:: $/4$ ) allocated by RIRs:

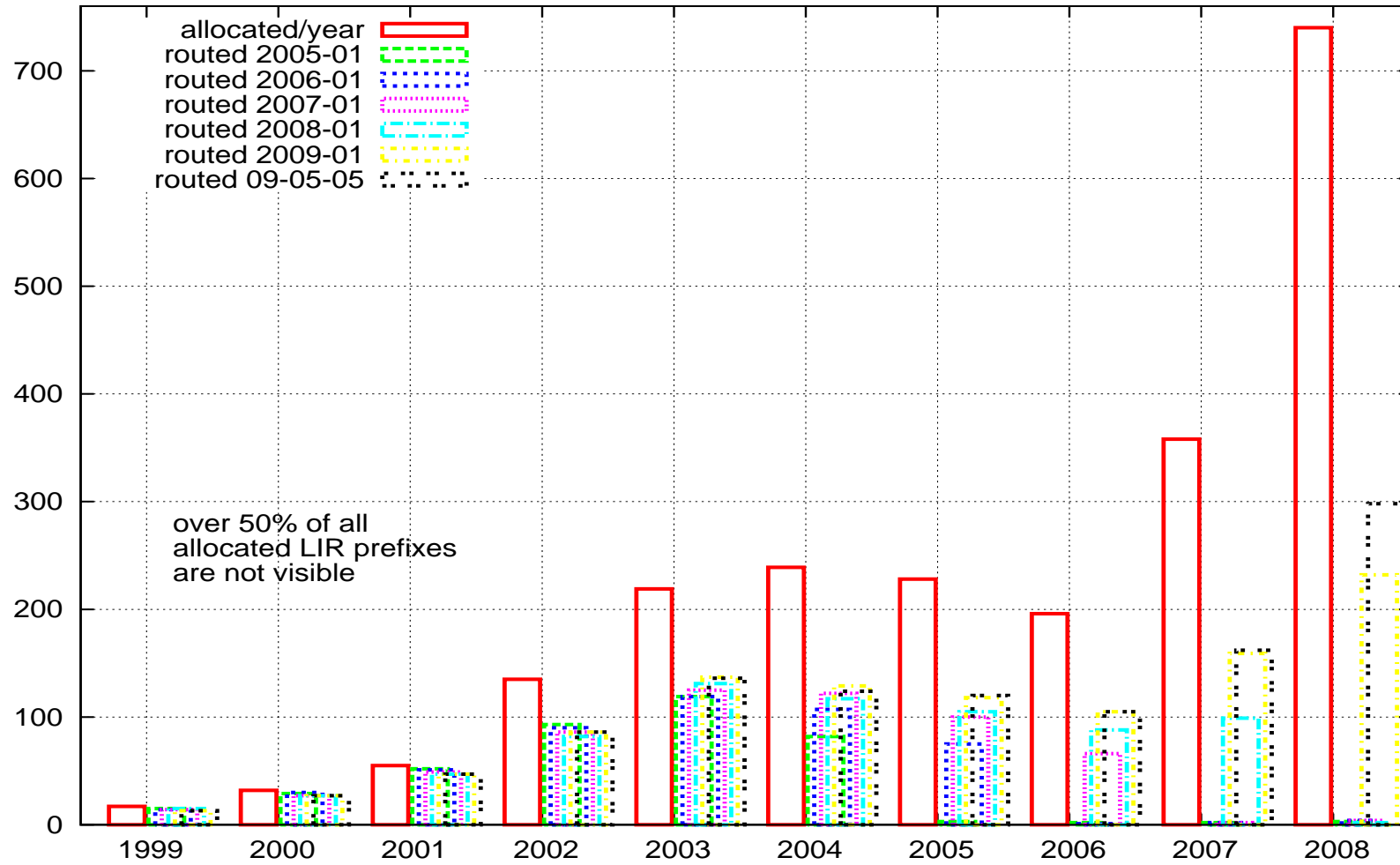
RIR	alloc.	members	perc.	on 2008-05-04
ARIN	487	~ 3200	15.2%	408 (+19%)
APNIC	430	~ 2863	15.0%	366 (+17%)
RIPE	1052	~ 5920	17.7%	878 (+20%)
LACNIC	101	~ 1006	10.1%	95 (+6%)
AfriNIC	52	~ 347	15.0%	43 (+21%)

- note: not counting  $/48$  microallocs and  $/35 \Rightarrow /32$  extentions
- actual *percentage* with IPv6 similar among regions
- 949 (R56: 799) allocations visible in routing table (*only 45%!*)

## Graphics: Allocations over Time



## Graphics: Allocated vs. Routed (LIRs)



## Allocated vs. Routed - by region & class

RIR	type	alloc.	visible	perc.	subnets	
ARIN	LIR	553	227	41%	104	
	IXP	23	0	0%	6	
	Critical Inf.	86	30	35%	54	
	Internal Inf.	4	0	0%	0	
	PI	207	51	25%	50	(*)
APNIC	LIR	483	225	47%	129	
	IXP	21	1	5%	1	
	PI	68	22	32%	29	(*)
RIPE	LIR	1349	661	49%	85	
	IXP	75	16	21%	0	
	Anycast DNS	11	7	64%	0	
LACNIC	LIR	111	40	36%	25	(NIR)
	Crit.Inf.+PI	16	4	25%	0	
AfriNIC	LIR	54	19	35%	23	
	PI	11	3	27%	0	

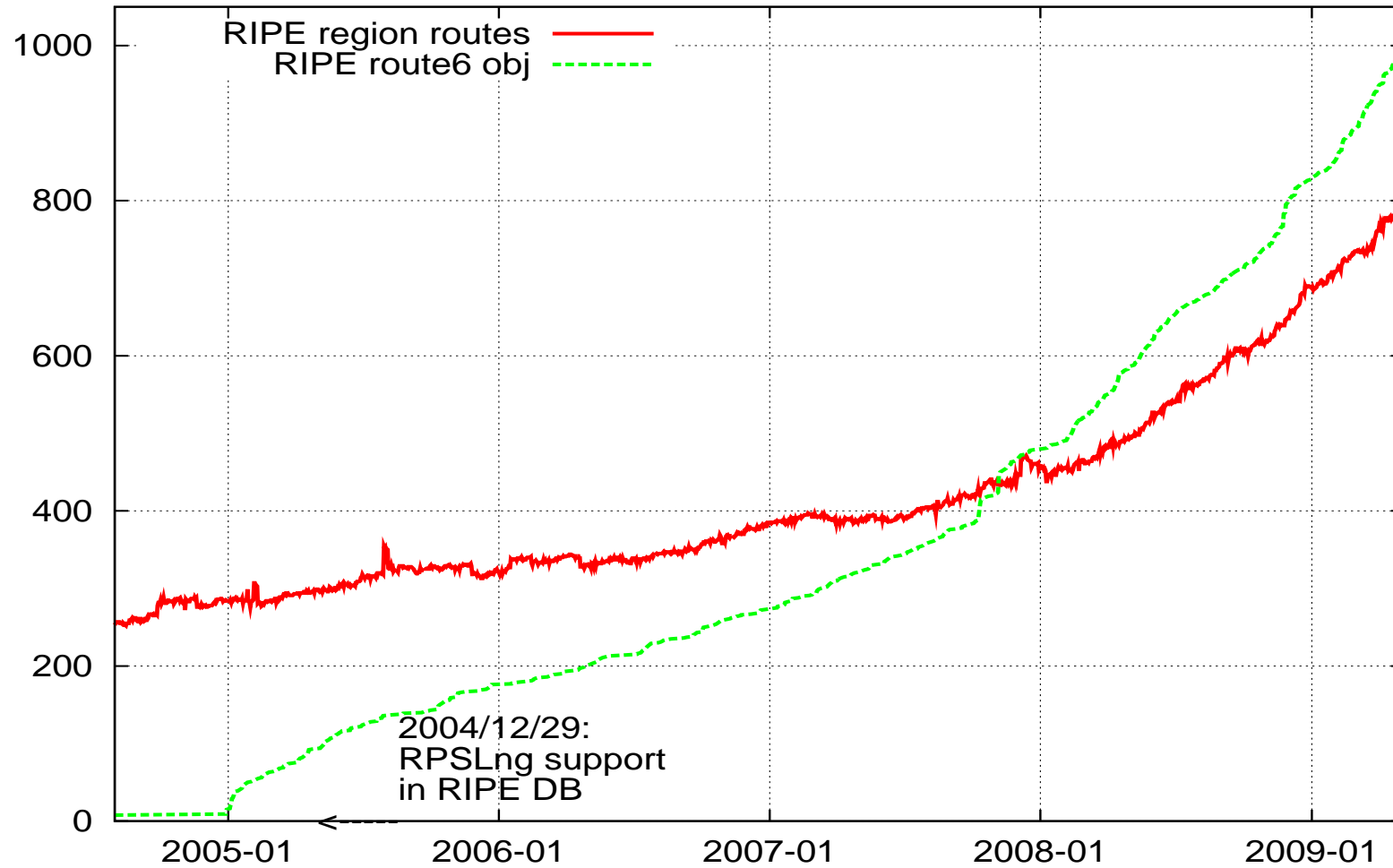


## Allocated vs. Routed - reasons?

- “early adopters” already losing interest in IPv6?
- “prepare for the future” allocations?
- “for internal use” allocations? (some, yes)
- distribution of non-announced prefixes does not show any specific characteristic, like “academia” vs. “commercial networks” etc.
- some delay between prefix allocation and announcement is to be expected (expect some more statistics in this space...)
  - but this cannot explain effects seen on 2003+2004 allocations – about 40% don’t show up after over 3 years...

**Route Registry - route6**

## Graphics: route6 objects vs. routes seen



## route6 correlation (RIPE region)

- on 2009-05-02:
  - 791 BGP routes from RIPE region
  - 985 route6: objects in RIPE DB
- correlation?
  - multiple origin route6's (16x 2002::/16, 13x 2001::/32, ...)
  - $\Rightarrow$  953 route6 objects for *unique* prefixes
  - 69 route6 objects for prefixes from *other* RIRs...
- so...

## route6 correlation (2)

- ... and this is what I found:

RIPE prefix, route6 ok	601	:-)
RIPE prefix, route6 missing	174	!!!
RIPE prefix, route6 origin mismatch	13	
RIPE prefix, BGP inconsistant AS	3	
route6 objects without BGP route	270	???
other region, route6 ok	50	
other region, route6 missing	980	
other region, route6 origin mismatch	19	
other region, BGP inconsistant AS	7	

- $\Rightarrow$  close-up view shows “more work needed”
- in other RIR regions, situation is worse (no IRR DBs yet, etc.)

## 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

## 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/R58-v6-table/>

Questions?

[gert@space.net](mailto:gert@space.net)

...and to answer the question from the title page:

**NO**, we are **not** growing fast enough!