ASN Missing In Action

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Agenda

- Motivation
- Data sources
- Results
- Modeling
- Conclusions

Motivation

- Assume that you know what an AS is
- Each AS needs an unique identifier, its ASN
- ASN are assigned in a hierarchical way
  - IANA → RIRs → LIRs → End-Users
  - Guarantees uniqueness
  - Public registers available of all ASN
- ASN are a limited resource
  - 16 bits
  - Private use and some overhead
  - 64510 available

Motivation (2)

- Who has an ASN?
- ASN Assignment Policy
  - Based on “Demonstrated Need”
  - Global assignment policy, RFC 1930
  - Local policies by the RIRs
  - If you meet the requirements, ask for one
- Policies say that one has to return the ASN if the need disappears

Motivation (2)

- Can we see which ASN are in use?

- The Internet is a network of AS
- Each AS wants to be able to send traffic to any other AS
- RIB in your router has a list of all ASN in use
- ASN are assigned based on demonstrated need

So, all assigned ASN are in the RIB, right?

Motivation (4)

- Euuhh, well, not quite…

- Early 2003:
  - RIRs
    - 20000 ASN assigned
    - 300 new/month
  - RIBs:
    - 14000 ASN visible
    - 200 new/month

What is happening here?

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Data sources

- The RIRs publish Stats Files

- List of ASN and date assigned
- Daily report since 2002
- Extrapolate back in time for earlier dates
- Corrected for mistakes, double-counts, etc.

Data sources (2)

- RIPE NCC Routing Information Service, RIS
  - One of the projects to collect BGP info
  - RIBs from 450 peers (IPv4 and IPv6)
  - All BGP updates
- Data from 18 August 2000 to 1 August 2005
- Each AS path
  - Break down into its components
  - Generate a list of AS and when they were in use
  - Remove private ASN
  - Remove ASN seen for less than 1 week

Data sources (3)

- CIDR report
  - Weekly report on the Internet from AS4637
  - Available since 1994
  - Includes number of ASN seen in the RIB

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What do we have after this?

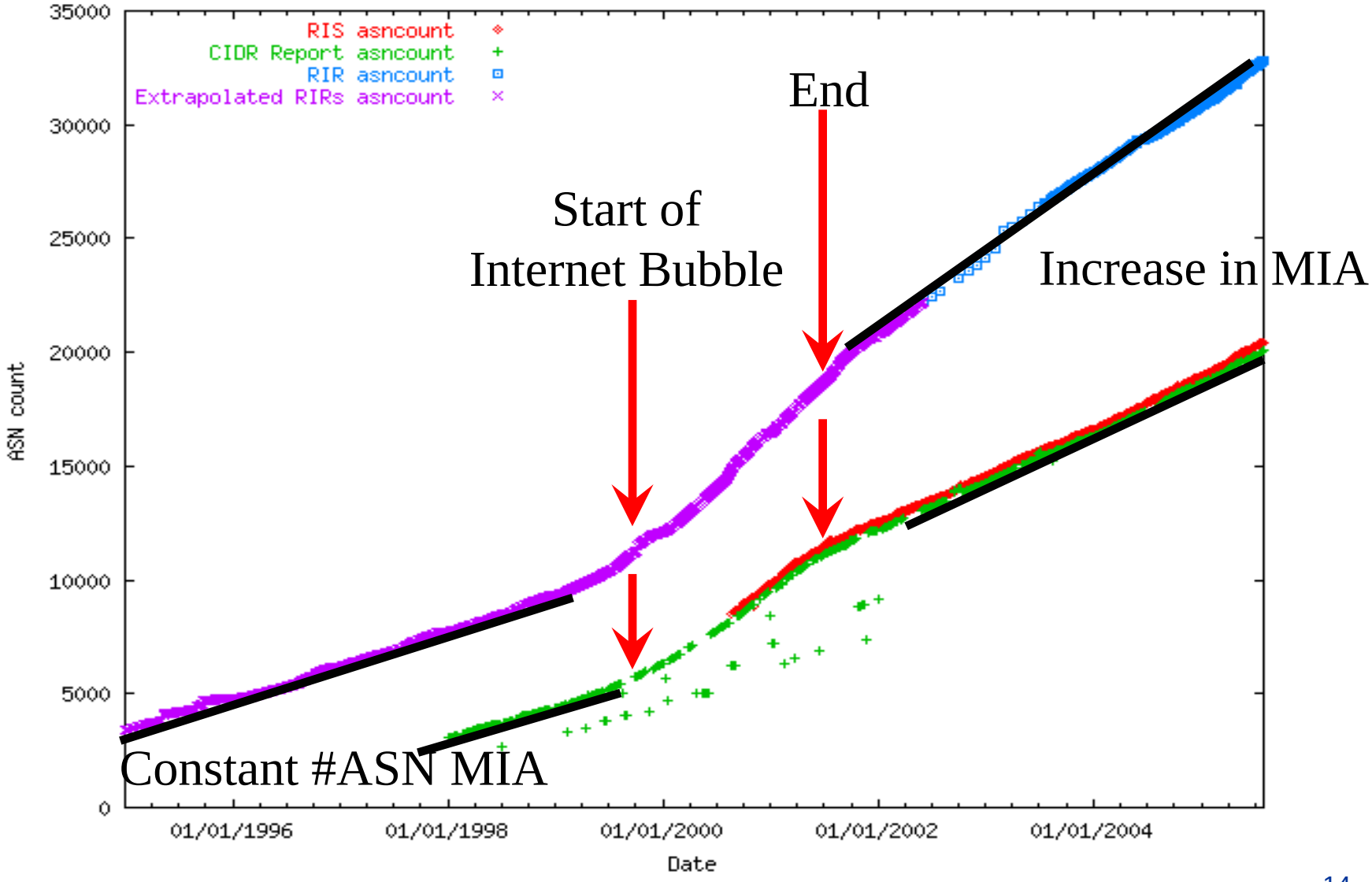
- 2 lists:
  - ASN assigned: RIR Stats Files (“Theory”)
  - ASN in use: RIS and CIDR report (“Practice”)
- Compare the two
  1. An ASN appears in both: normal case
  2. ASN in use but not assigned
     - Inappropriate use
     - Problem with the registration mechanism
  3. ASN assigned but not in use
     - Missing In Action or MIA

ASN in use but not registered

- 436 ASN used but not registered
- 255 still visible on 1/8/2005
  - 215 in RIPE NCC's ranges
    - Old registrations
    - Found other data for 214
  - 40 in ARIN's ranges
- 7 ASN outside all RIR ranges
- Accuracy
  - At most 41 out of 33000 with no records (0.12%)
  - 1 out of 10000 for the RIPE NCC

Total Number of ASN seen

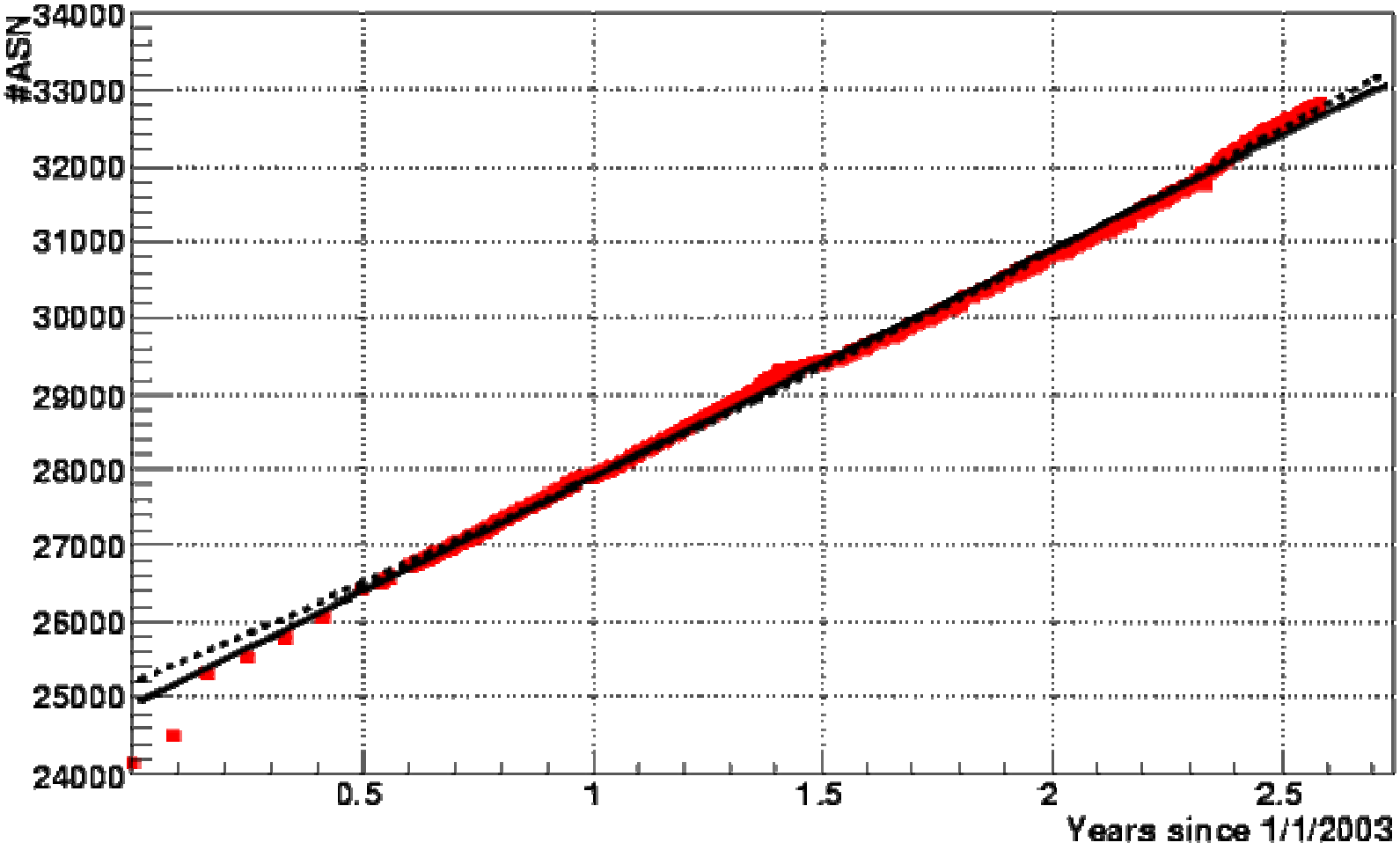
Assigned (■,■) Actual (■,■)



Linear or Exponential growth

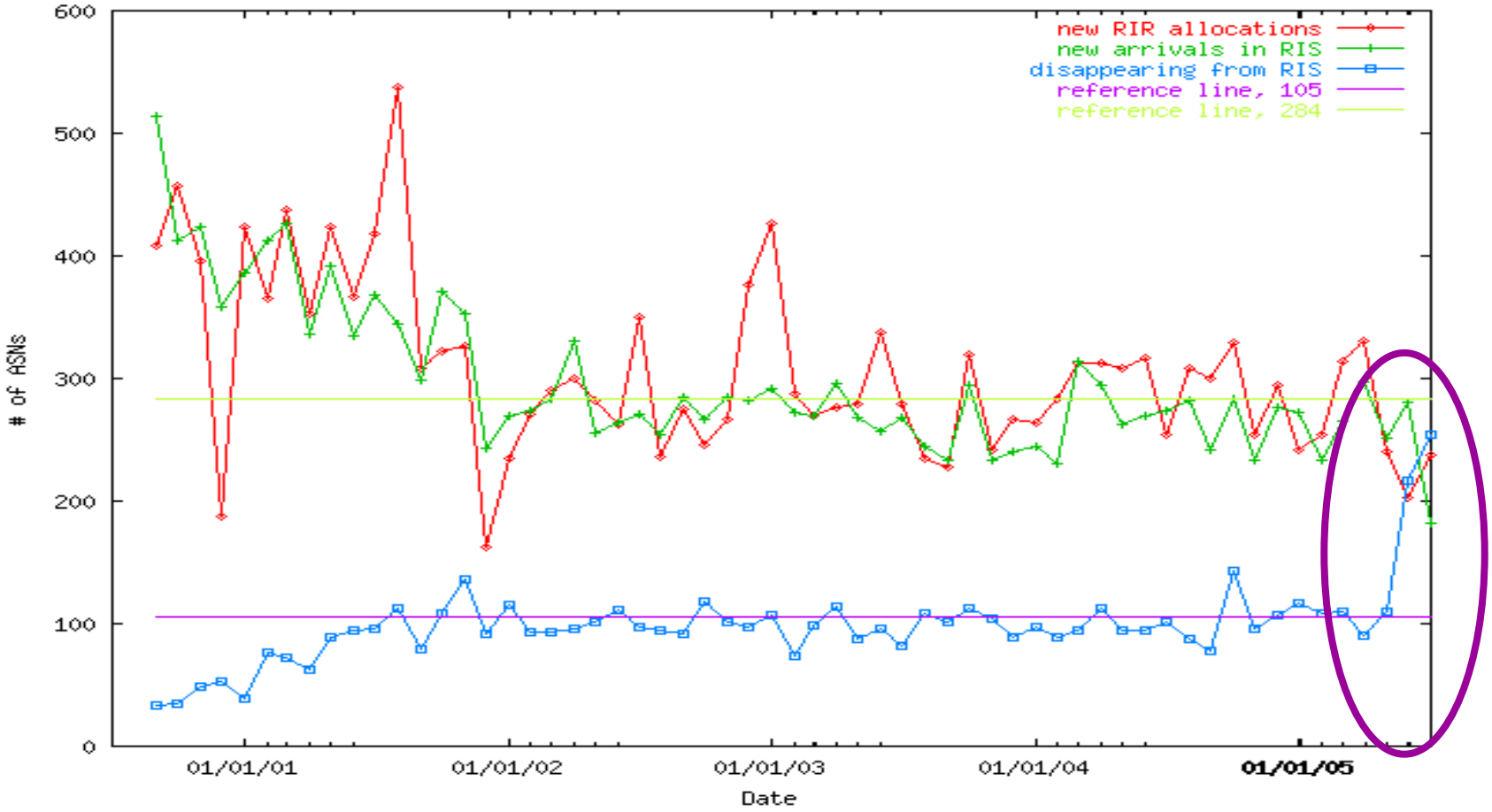
- Looking at the plots indicates that growth is linear
- Tests:
  - Fit to linear and exponential curve
  - Linear describes the data best
  - Look at derivatives
- All indicate linear growth

Linear or Exponential



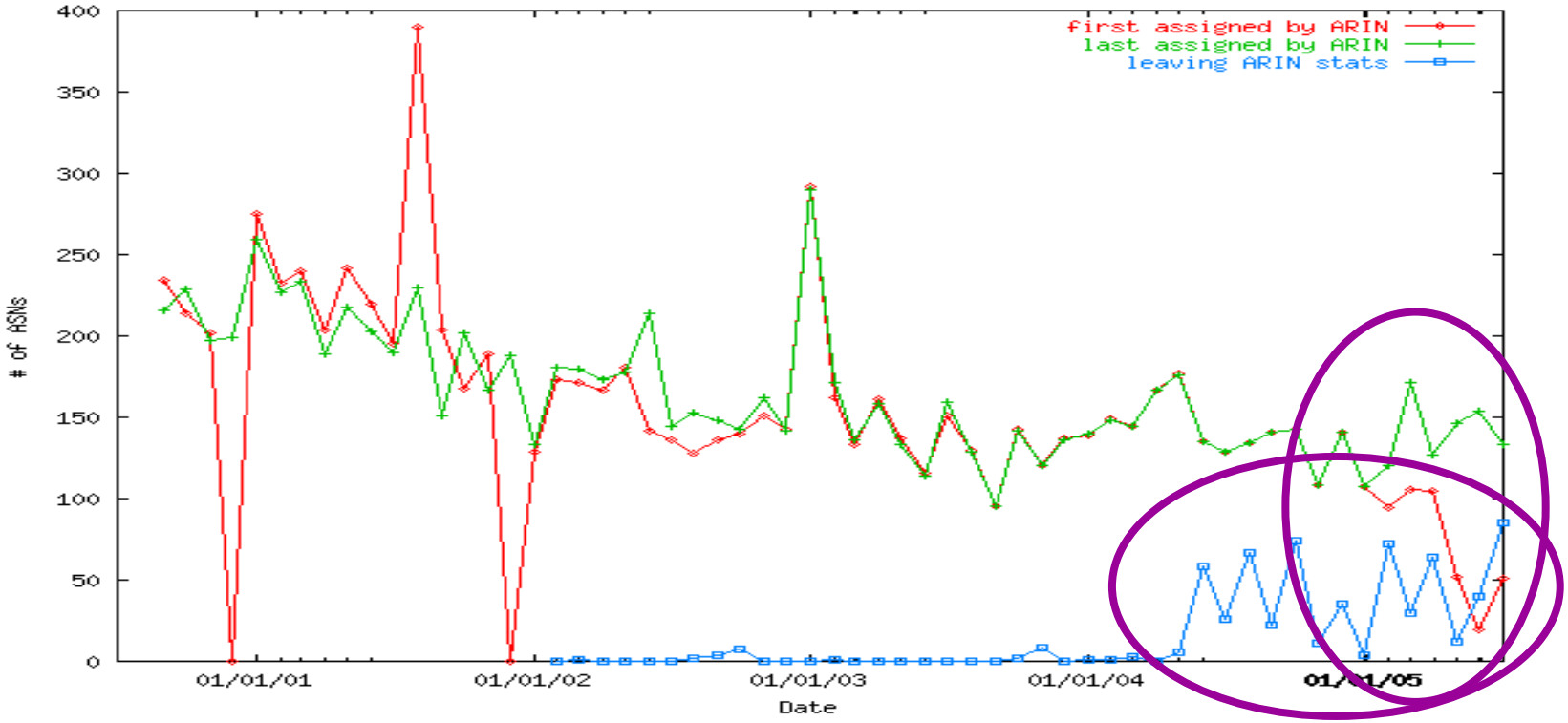
■ Data ——— Linear fit ····· Exponential fit

Growth rates



- 284 ± 43 ASN new allocations/month
- 105 ± 31 ASN disappear (note peak at the end)

Growth rate per registry (ARIN)



3 Curves:

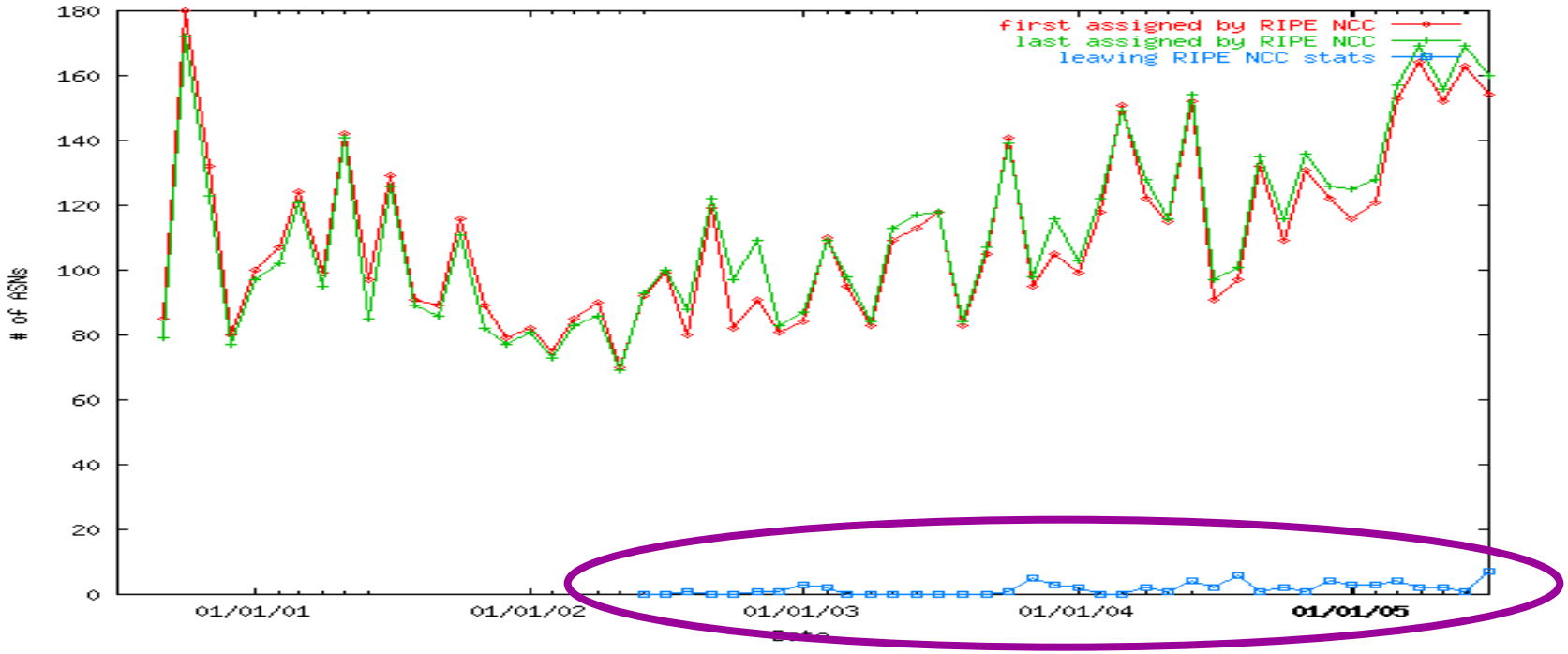
New assignments

New/re- assignment

Disappearing

- Recovery of ASN since 2004
- Reassigning since 2005

Growth rate per registry (RIPE NCC)



3 Curves:

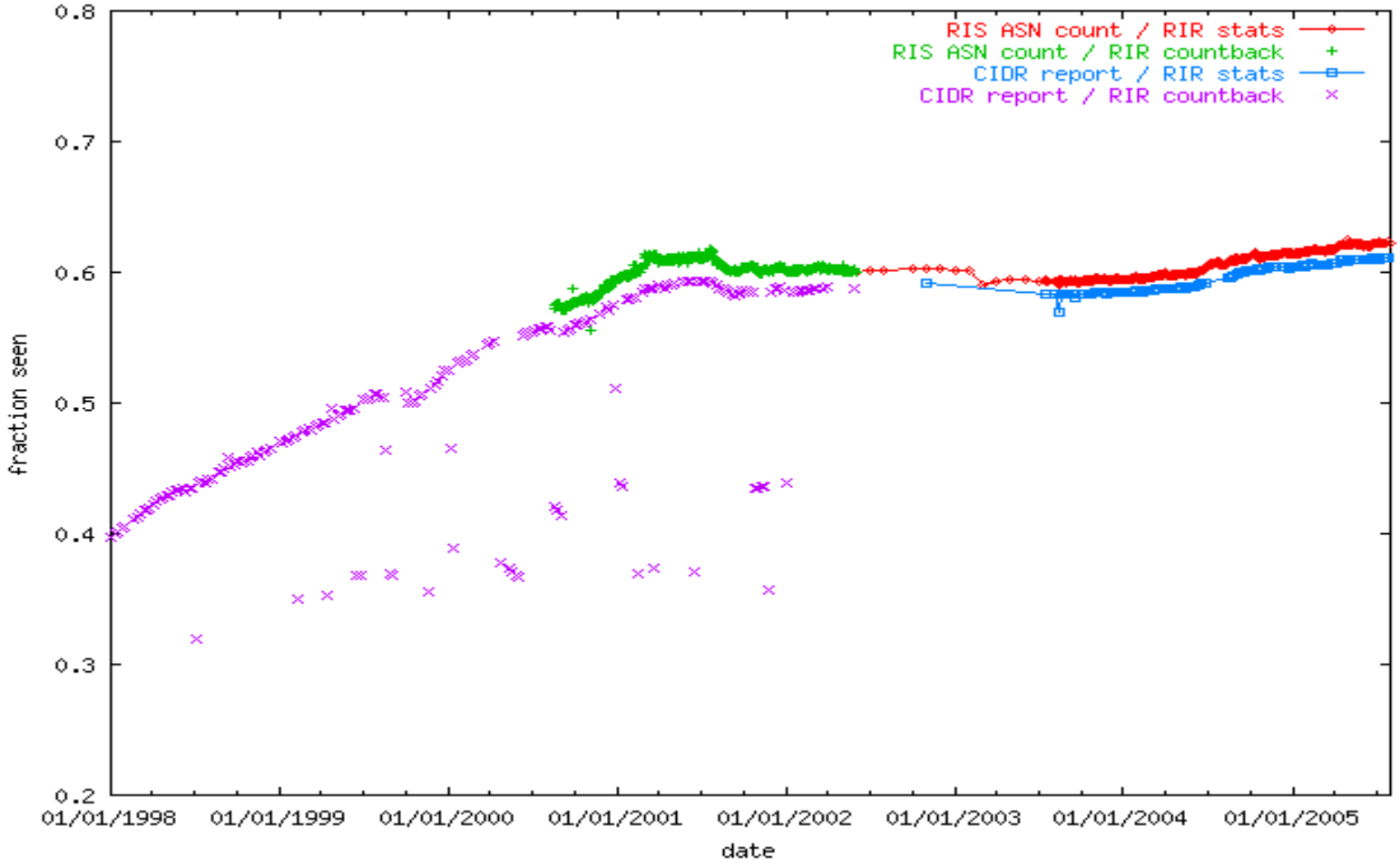
New assignments

New/re- assignment

Disappearing

- Very little recovery
- Rate seems to increase
  - Total rate compensated by ARIN's recovery

Fraction of ASN seen

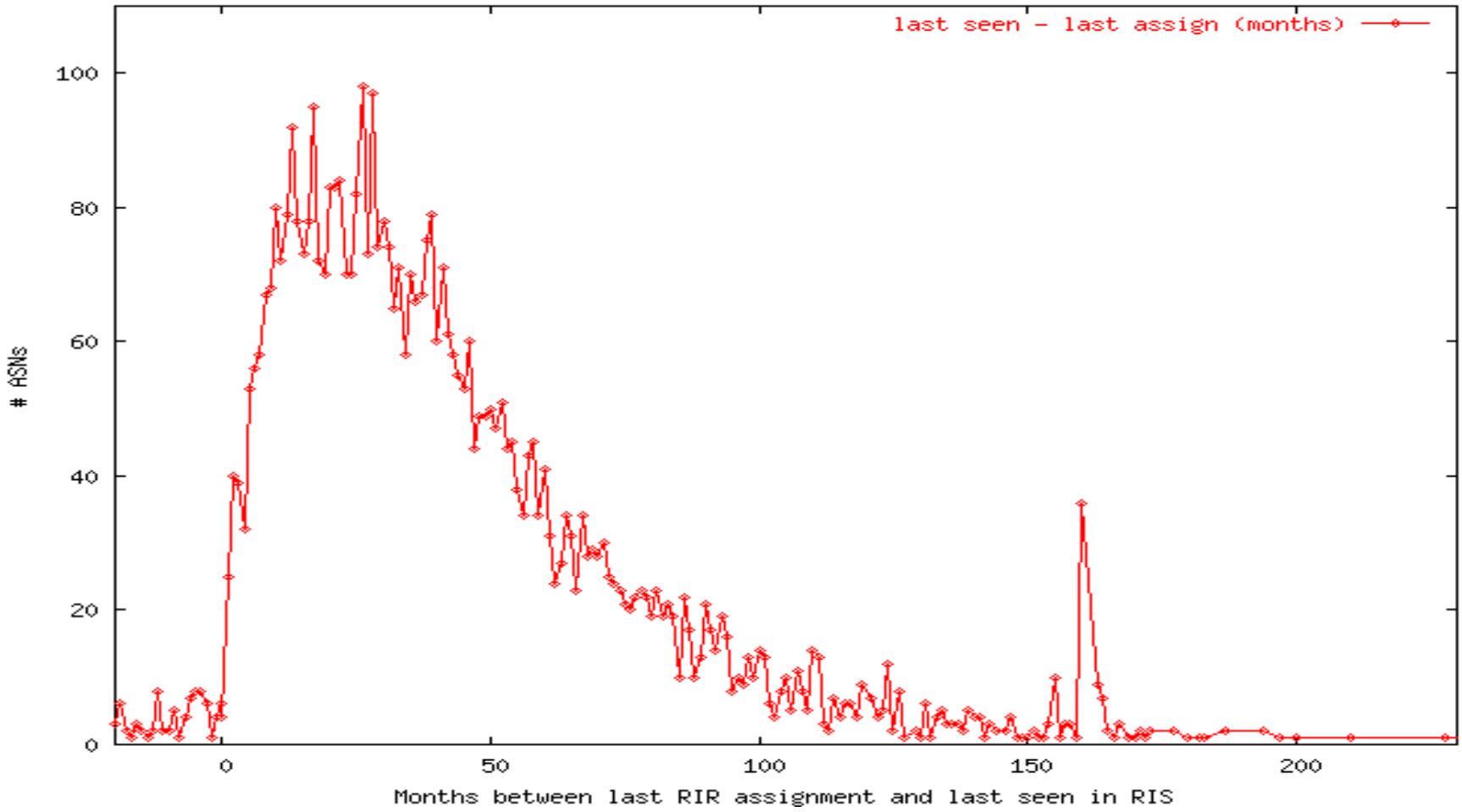


Only 60-63% of all assigned ASN are visible on the net

ASN Not Seen on the Internet

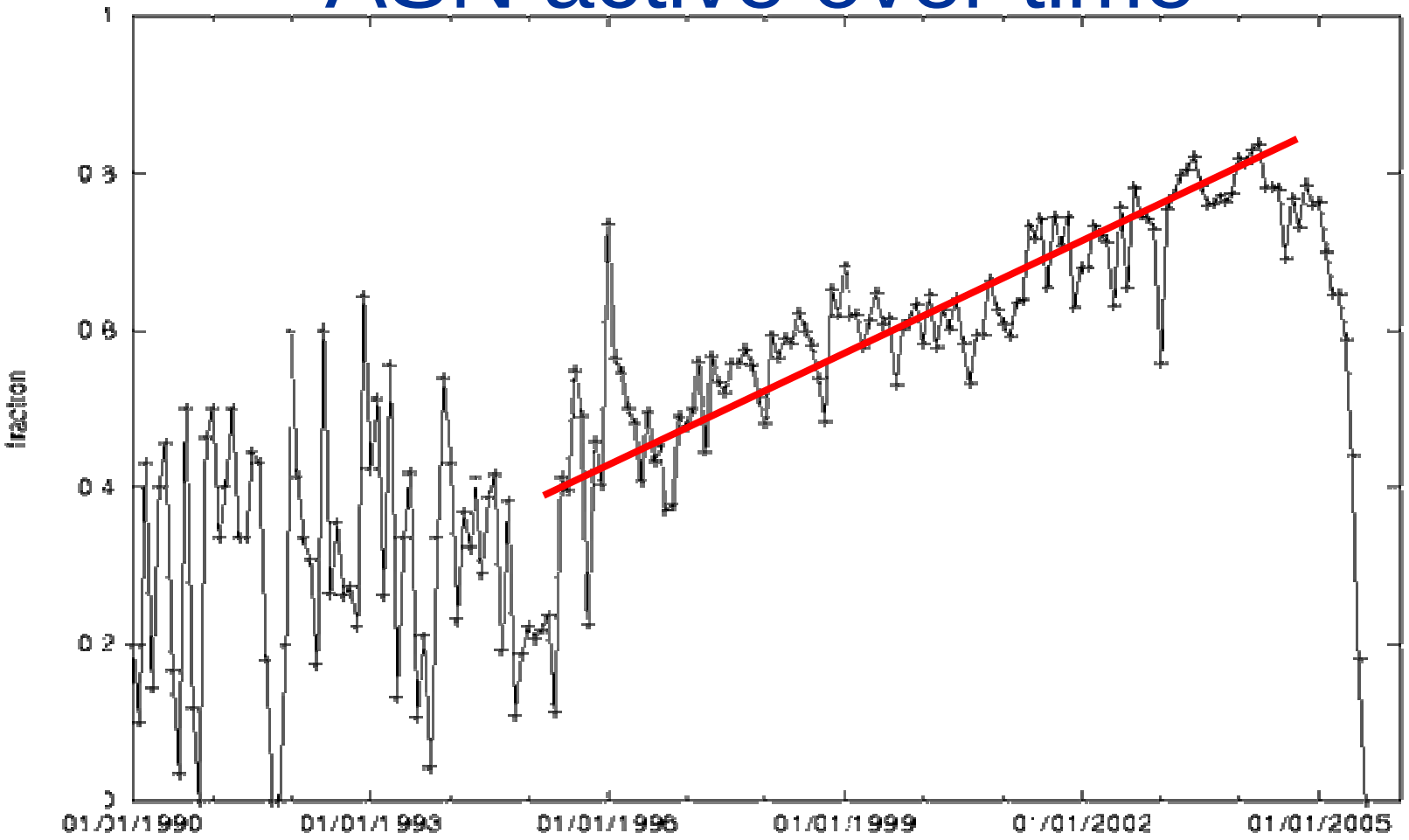
- 32802 ASN assigned on 1/8/2005
- 20101 in the RIS
- 7037 ASN have never been used
- 5046 were retired

Age of Retired ASN



People use an AS for a few years, then stop using it

ASN active over time



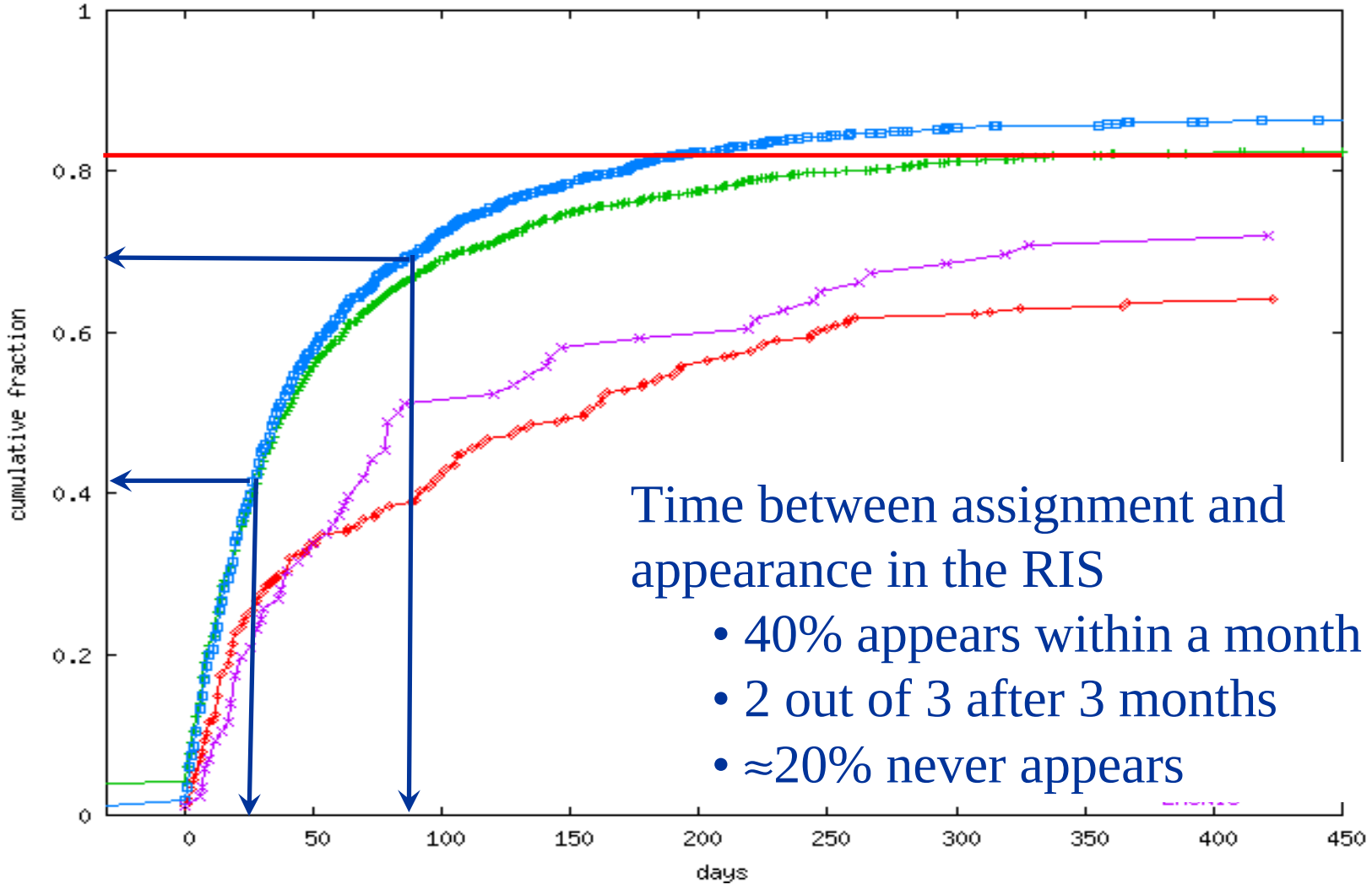
- ≈ 80% active after one year
- ≈ 40% still active after 10 years

ASN active over time (2)

- Why does this drop? Two effects:
- Sites go out of business
  - No incentive to return an ASN
  - Little recovery by RIRs
- Networks merge
  - Need for one ASN (often) disappears
  - No incentive to return the unused ASN

Activation Delay (2004)

APNIC, ARIN, LACNIC, RIPE NCC



Time between assignment and appearance in the RIS

- 40% appears within a month
- 2 out of 3 after 3 months
- ≈20% never appears

Activation in Practice and Reality

- ARIN: Policy is that there must be plans to use the ASN within 30 days after assignment
- RIPE NCC: No policy, but people think 3 months is reasonable
- This does not happen in practice
  - Time is considerably longer
  - ≈ 20% never appears on the net even though there was demonstrated need

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When will the Internet run out of 16 bit ASN?

- 64511 ASN
  - 33681 assigned on 1/8/2005
  - 30830 still available
- 284 ± 31 assignments/month from the unused pool
- 108.5 months to go
- Run out in 8 to 11 years, or 2013 to 2016

Can we make the pool last longer?

- Reclaim what disappears:
  - 284 - 105 = 179 assignments/month
  - 15 ± 4 years, or 2016 to 2024
- Reclaim what is assigned but not used:
  - 160 ± 40 assignments/month
  - 23 ± 5 years, or 2023 to 2033
- Use 4 bytes for the ASN
  - 4×10^9 numbers and that will last for a million years
  - Draft exists
  - Has to be implemented and deployed
  - Ask your vendor, make plans

Policy changes

- Current policies based on demonstrated need
- But:
  - Only 63% is actively used
  - 20% is never used
- It is too easy to demonstrate need
- Revisit policies and use stricter criteria
- This should be discussed in the policy WG of the RIRs

Reclaim unused resources

- Uniqueness is essential
- What if somebody starts using assigned resources again?
- No good mechanism for recovery

- Certification might be the answer
- Efforts in the APNIC and RIPE Region

Certification

- Certificate to show that a resource is assigned to somebody
  - 1 year period
  - Renewable
  - No need to renumber
- If the certificate expires, one can reuse the resource
- Will require people to check…
- … but this is expected to become standard practice for securing the routing system

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Conclusions

- Number of ASN assigned
  - 284 ASN assigned per month from the unused pool
  - Actual growth is only 160/month
- At this rate, the pool will be empty by 2013 -2016
  - Reclamation will make the pool last longer
  - Certification might help to accomplish this
- If one does not want this, then one should start to think about deploying 4 byte ASN

- Full paper: www.ripe.net/ripe/docs/ripe-353.html

Acknowledgements

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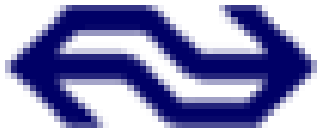
- Registration departments of the RIRs
-  and 

Questions, Discussion