

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 a unique identifier, its ASN
- ASNs are assigned in a hierarchical way
 - IANA → RIRs → (NIRs →) LIRs → End-Users
 - Guarantees uniqueness
 - Public registers available of all ASNs
- ASNs are a limited resource
 - 16 bits
 - Private use and some overhead
 - 64510 available



Motivation (3)

- 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)

- Euuuh, 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**

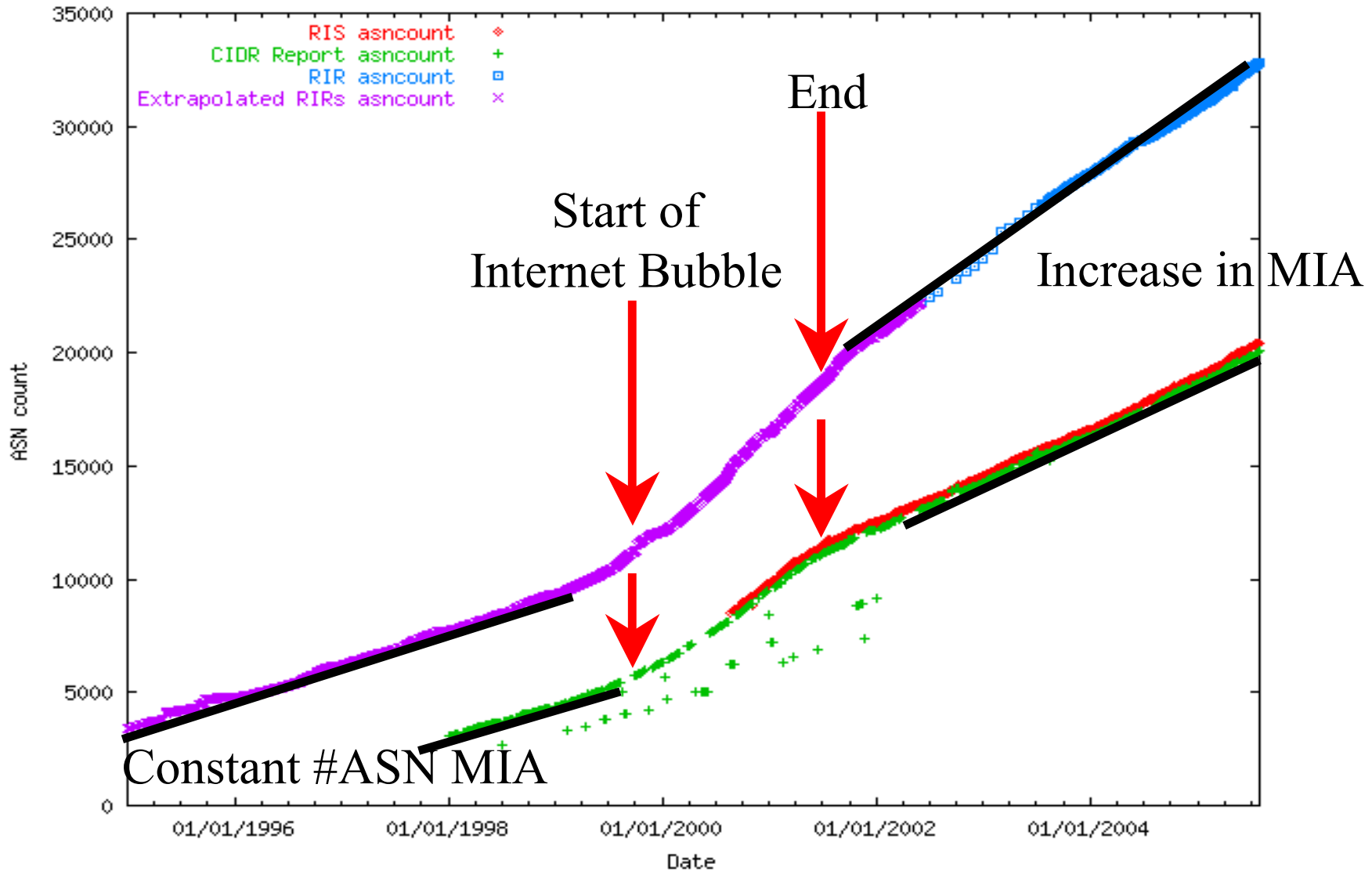


ASN in use but not registered

- 436 ASN used but not registered
- 255 still visible on 1/8/2005
 - 215 in RIPE NCCs ranges
 - Old registrations
 - Found other data for 214
 - 40 in ARINs ranges
 - 0 in APNICs 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 (■,■)

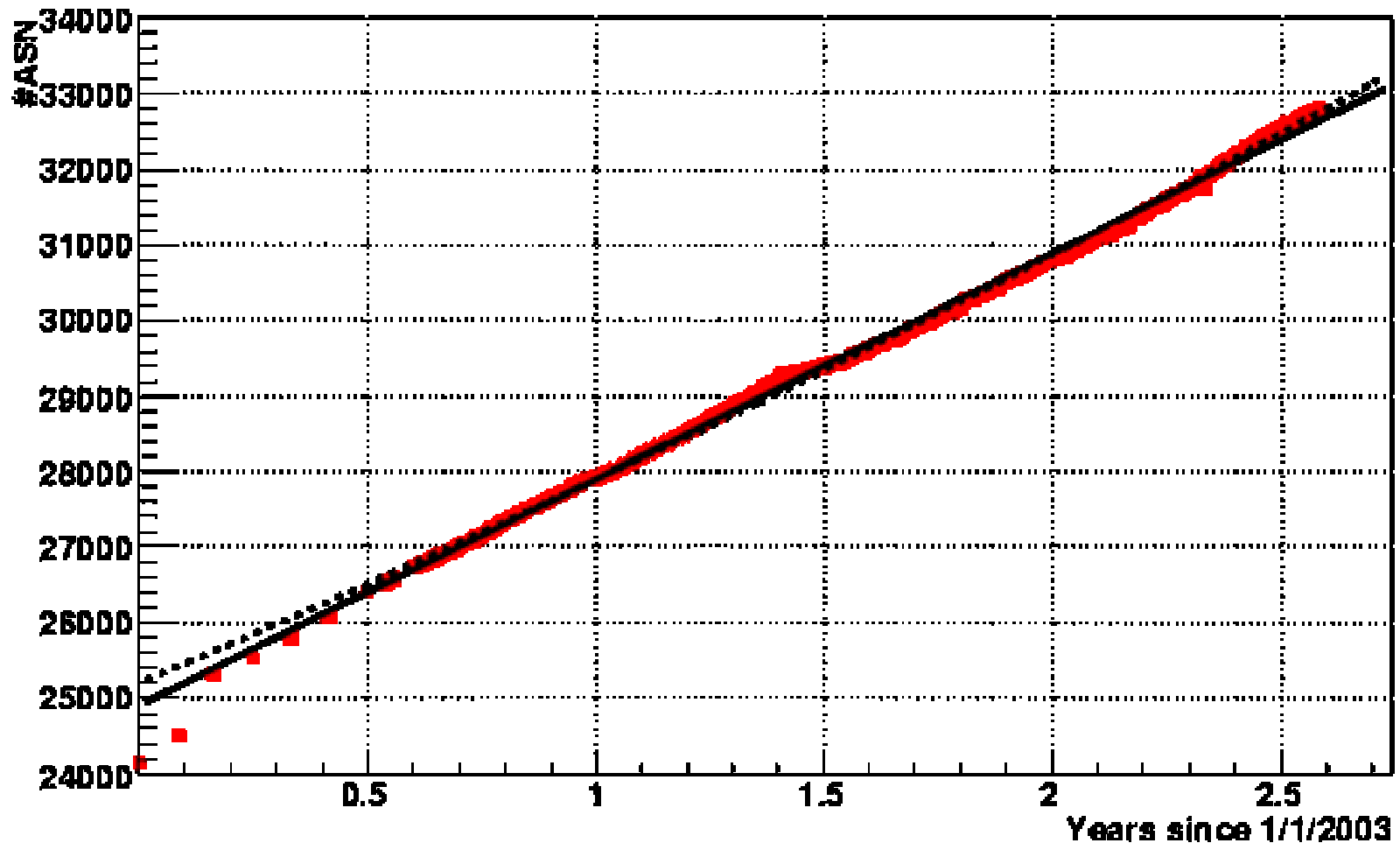




Linear or Exponential growth

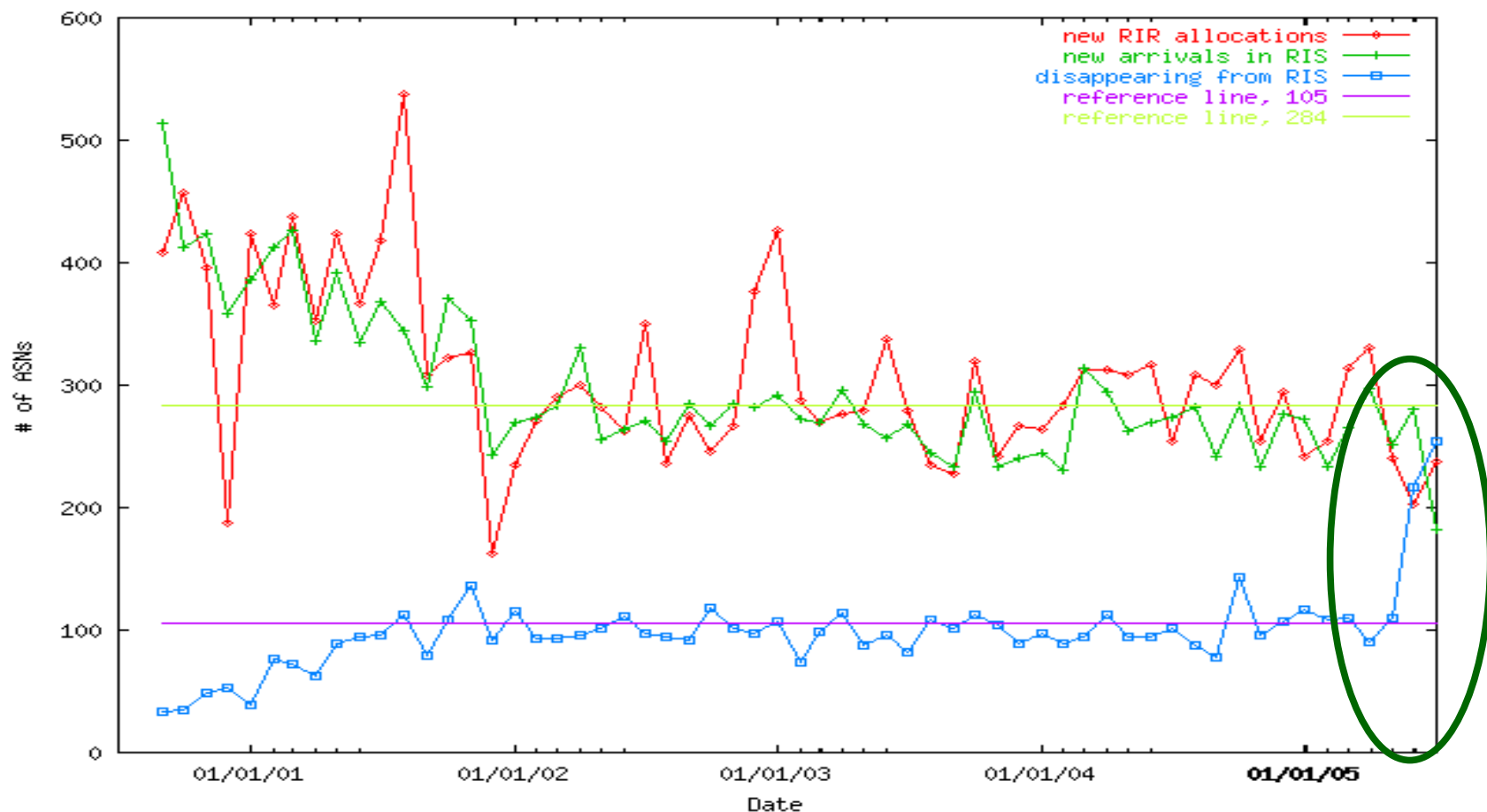
- Looking at the plots indicates that growth is linear
- Tests:
 - Fit to linear and exponential curve
 - Linear describes the data best
 - Look at derivatives
- All indicate linear growth

Linear or Exponential



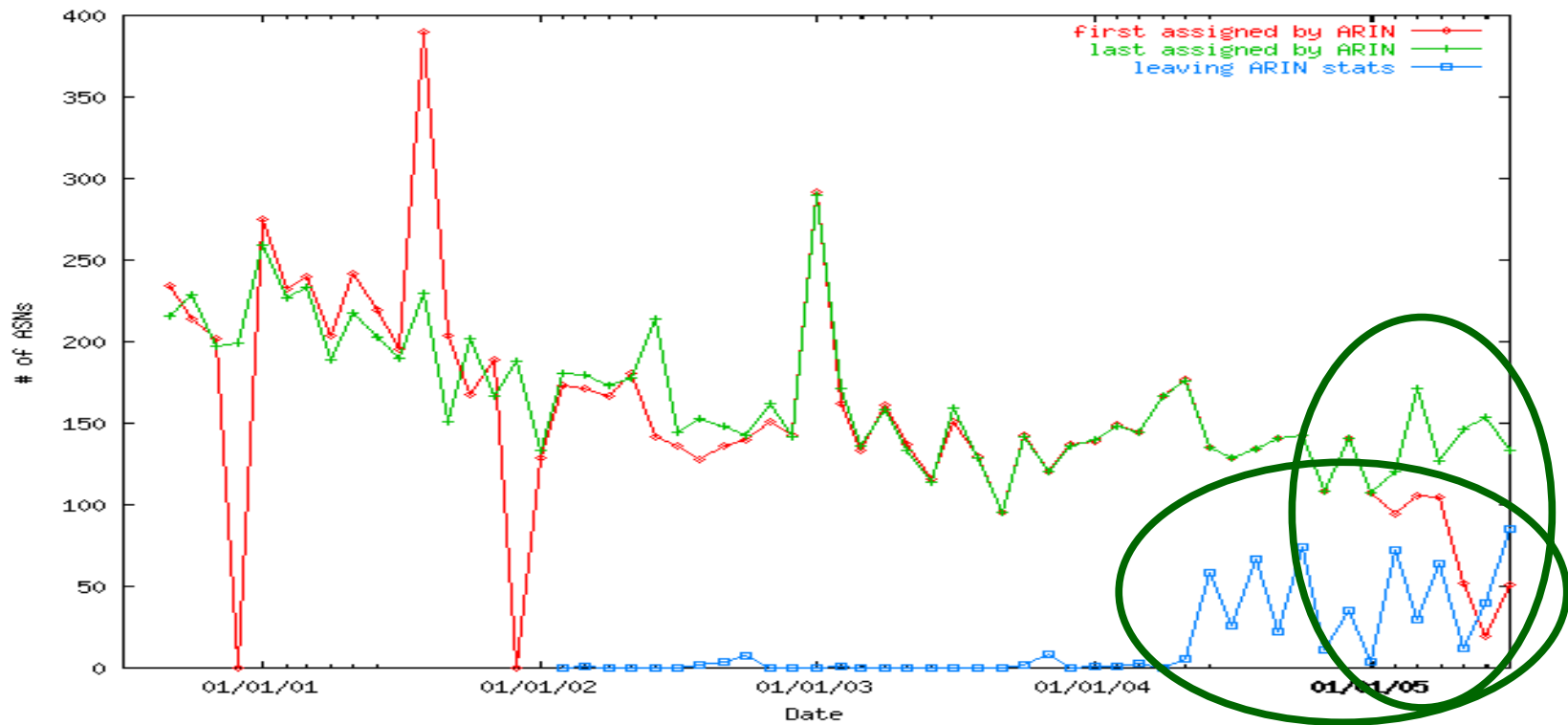
■ Data
 Linear fit
 Exponential fit

Growth rates



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

Growth rate per registry (ARIN)



3 Curves:

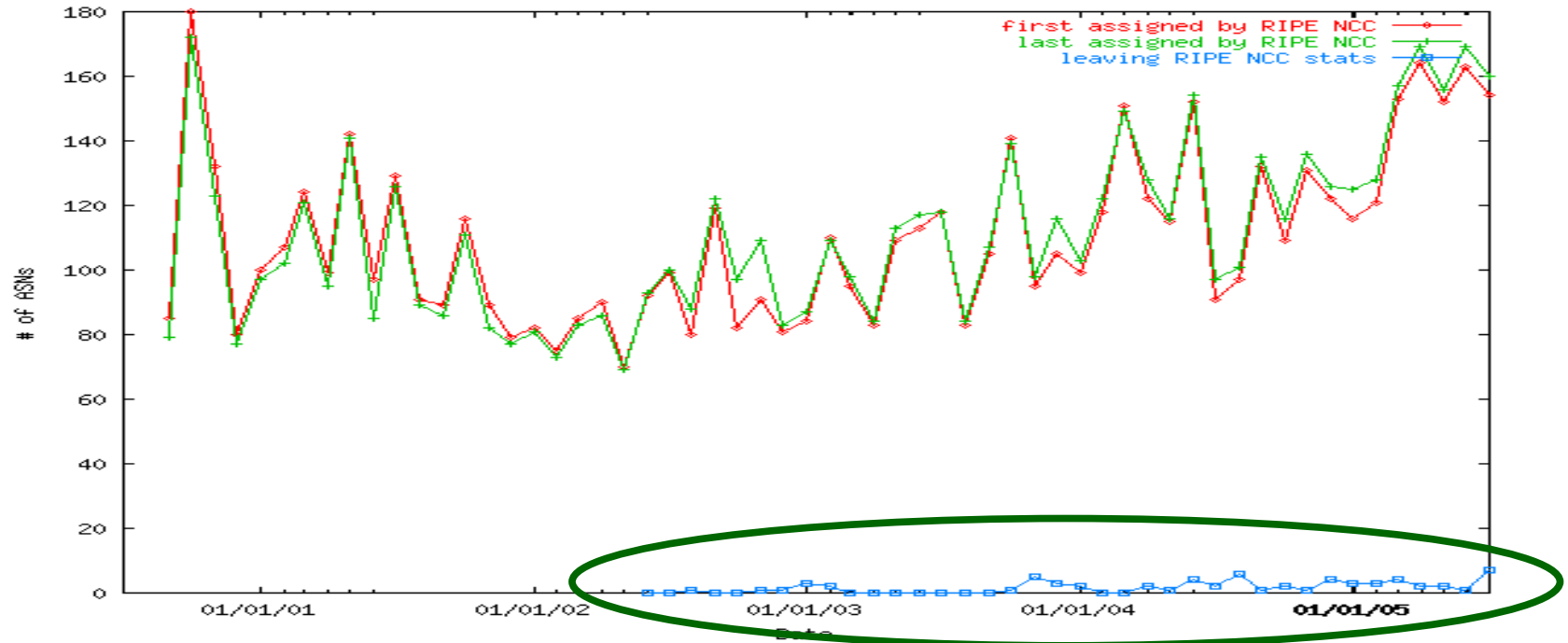
New assignments

New/re-assignment

Disappearing

- Recovery of ASN since 2004
- Reassigning since 2005

Growth rate per registry (RIPE NCC)



3 Curves:

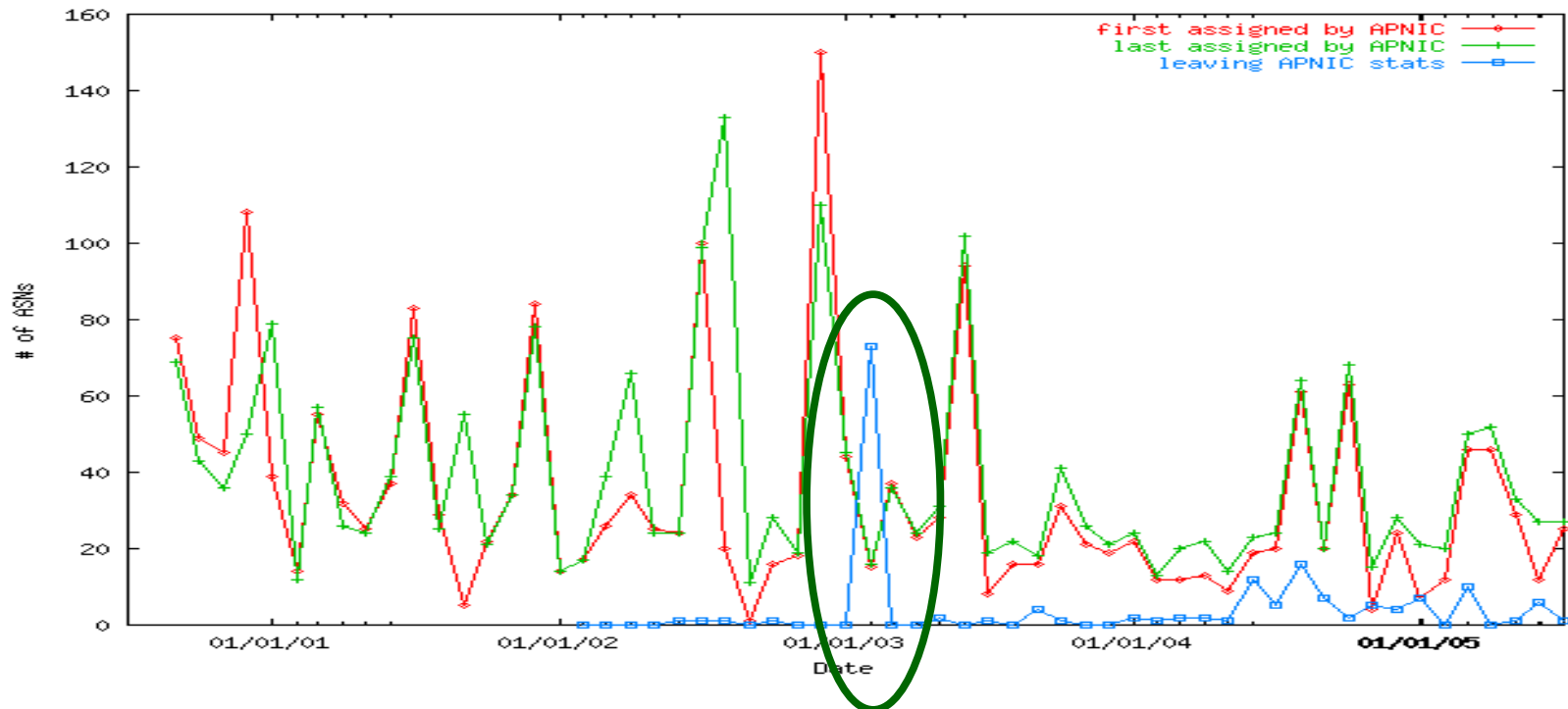
New assignments

New/re-assignment

Disappearing

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

Growth rate per registry (APNIC)



3 Curves:

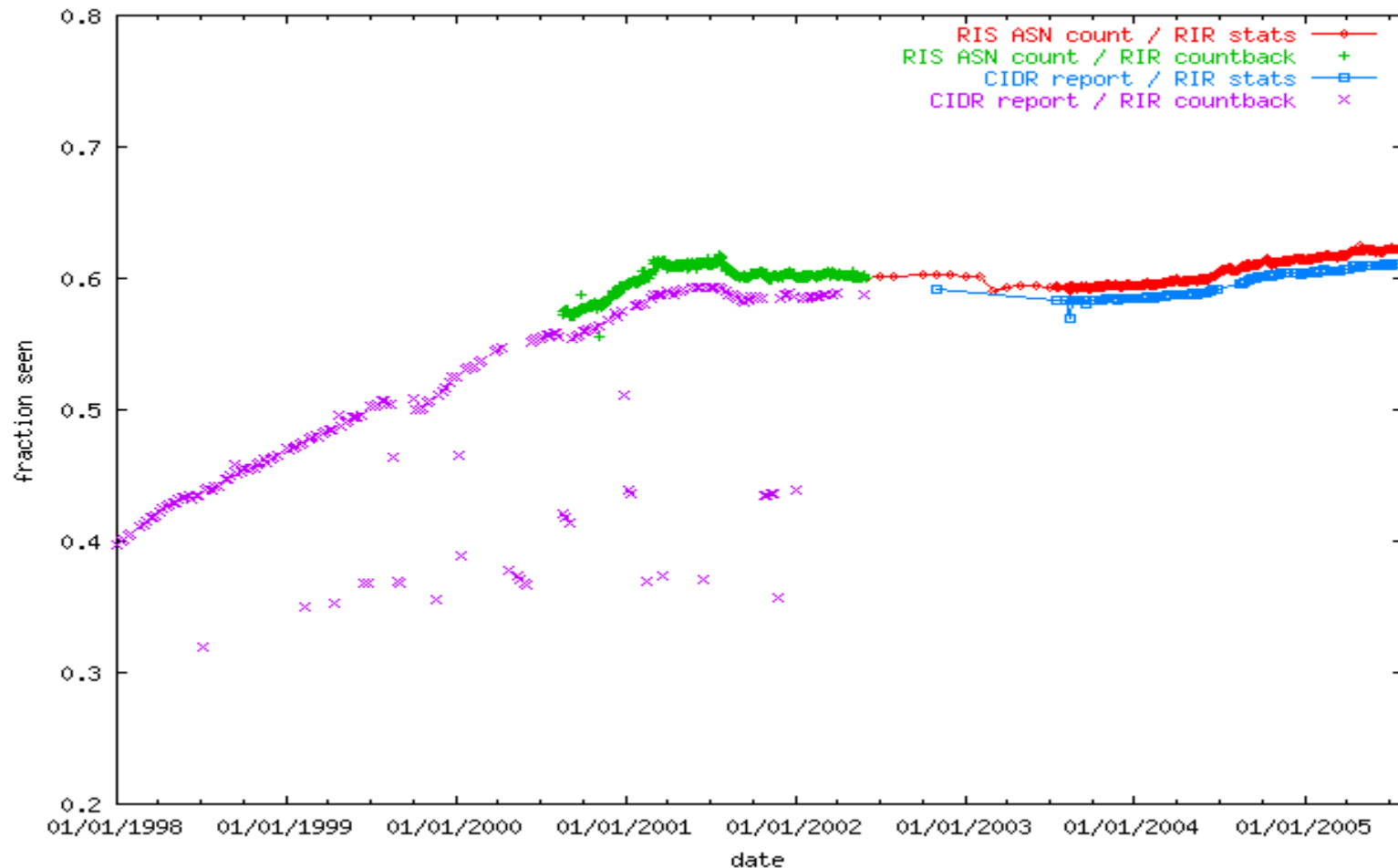
New assignments

New/re-assignment

Disappearing

- Very little recovery with 1 exception
- Rate constant since mid 2003

Fraction of ASN seen



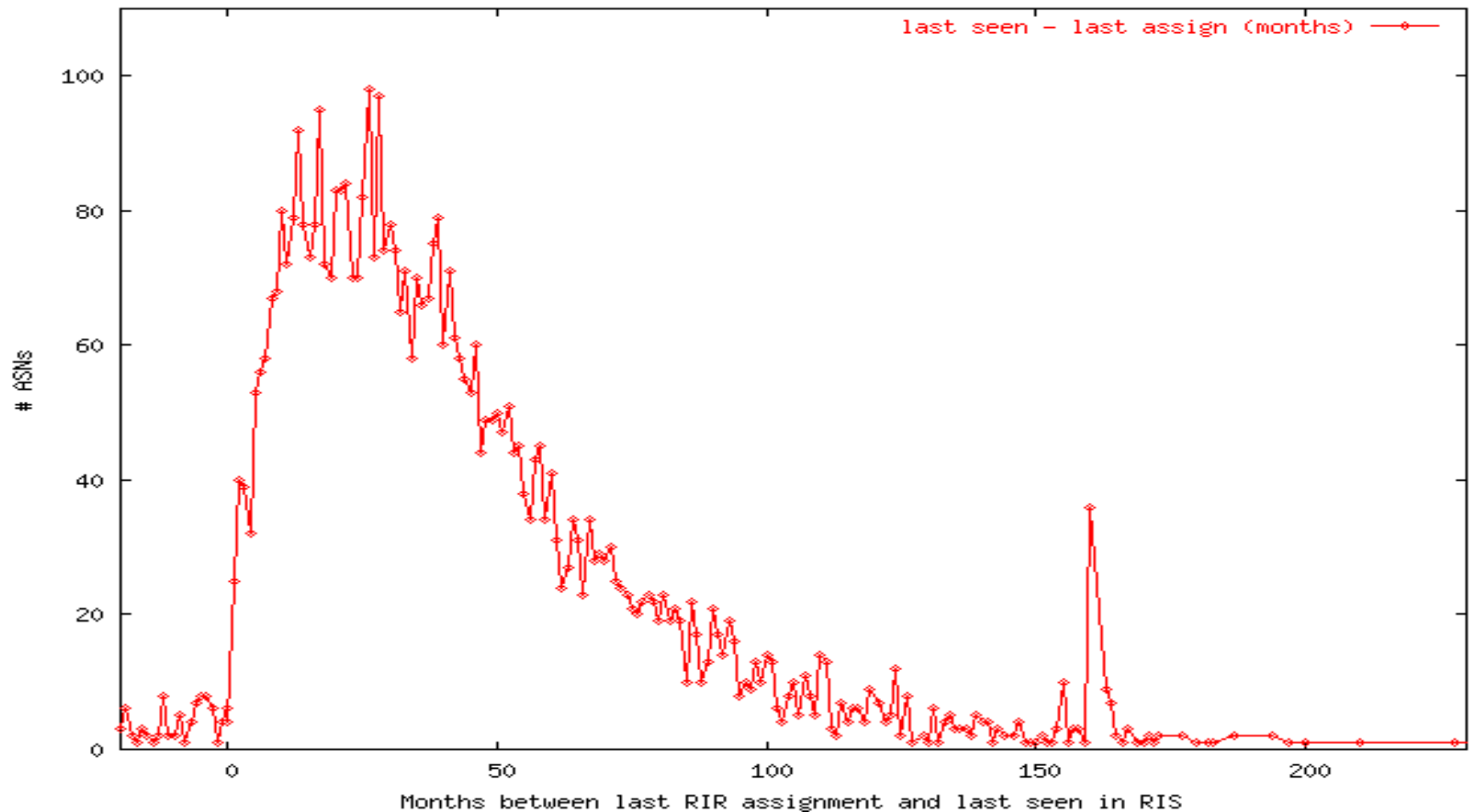
Only 60-63% of all assigned ASN are visible on the net



ASN Not Seen on the Internet

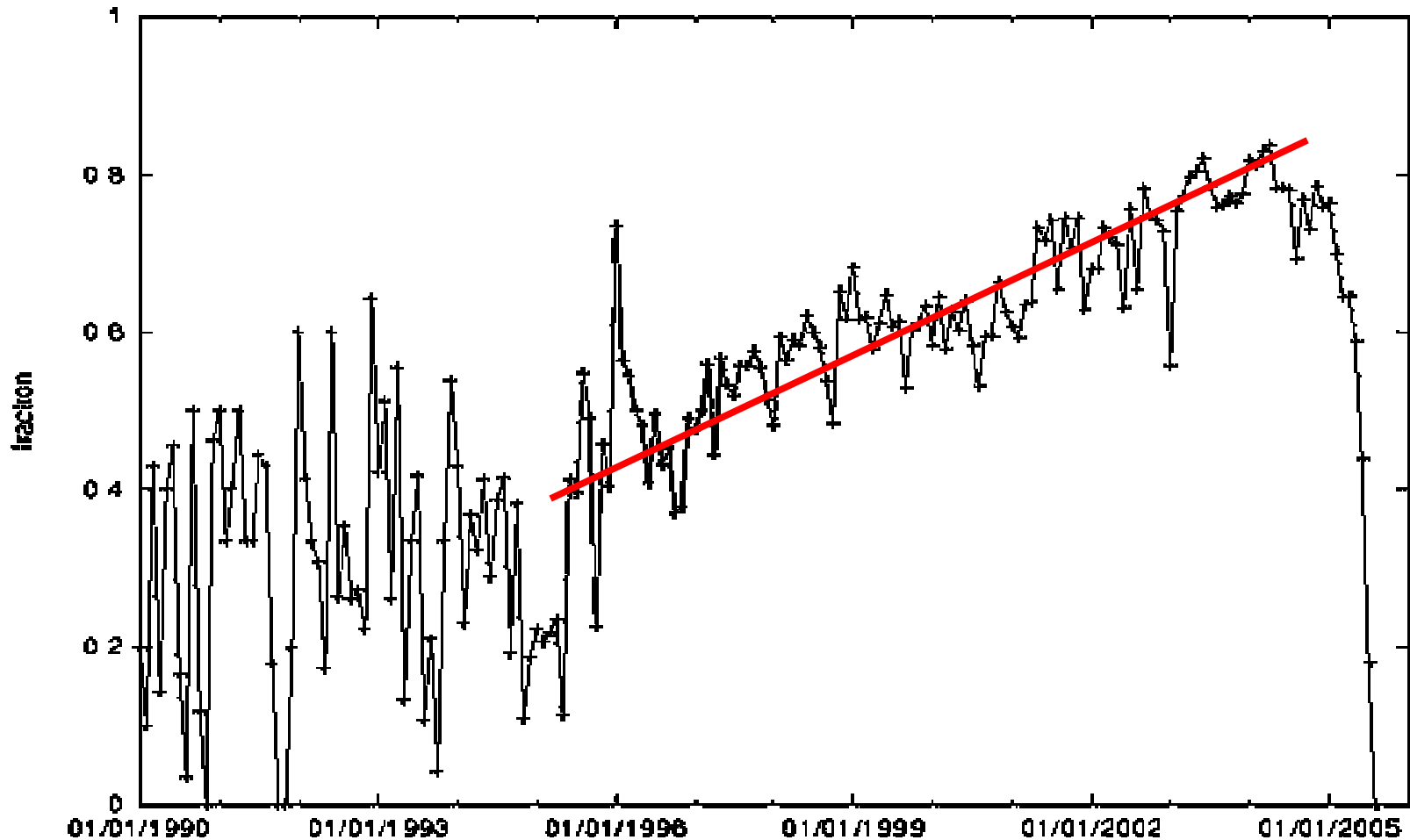
- 33681 ASN assigned on 1/8/2005
- 20101 in the RIS
- 7037 ASN have never been used
- 5046 were retired

Age of Retired ASN



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

ASN active over time



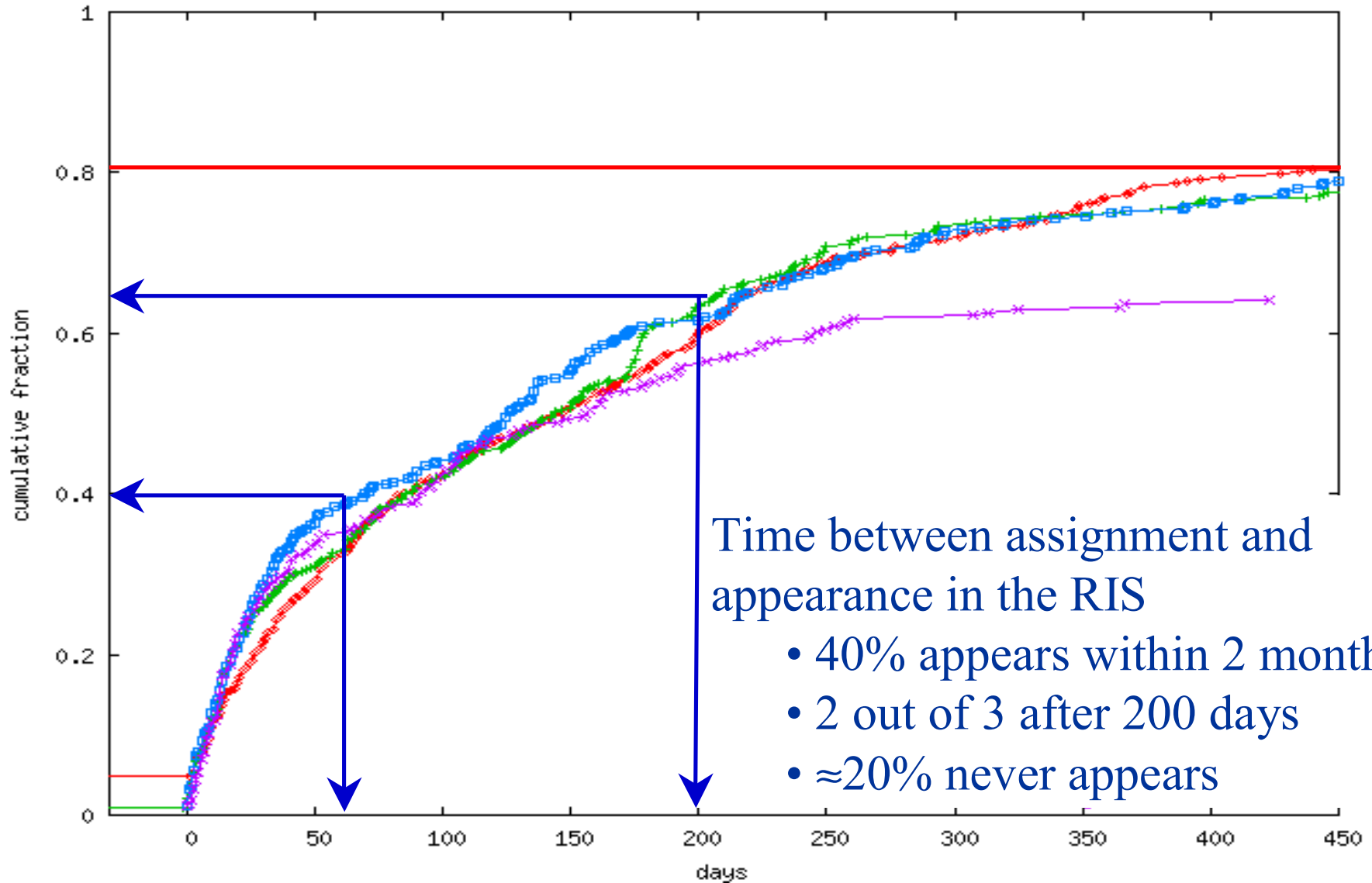
- $\approx 80\%$ active after one year
- $\approx 40\%$ still active after 10 years



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 (APNIC 2001/2002/2003/2004)





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, informal discussion 3 months
- APNIC: Policy: meet requirements upon receiving an ASN (or reasonably soon thereafter)

- This does not happen in practice
 - Time is considerably longer
 - $\approx 20\%$ 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 \pm 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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-  and 

Questions?