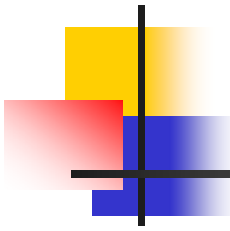


BGP AS Number Exhaustion

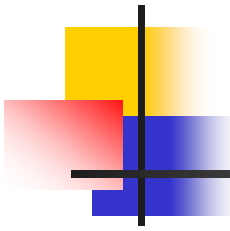
Geoff Huston

Research activity
supported by APNIC



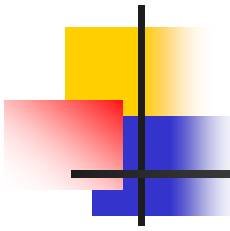
The Problem

- The 16 bit AS number field in BGP has 64,510 available values to use in the Internet's public routing space
- Some 30,000 AS numbers have already been assigned by the RIRs
- This BGP protocol field will be exhausted at some point in the future



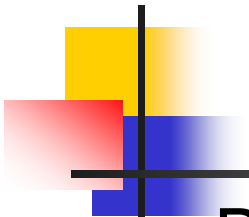
The Solution

- Use a 32 bit field for this value
 - draft-ietf-idr-as4bytes-06.txt describes how
 - This is proposed for publication as an experimental RFC



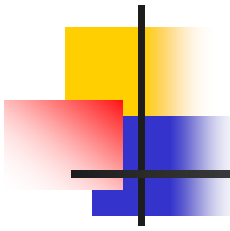
The Issue

- At some point we will need to start testing various transition plans and vendor implementations, set up a new AS number registry, and commence deployment of these extended length protocol objects in BGP



When?

- Before we run completely out of 16 bit AS numbers!
- Need to allow a lead time for testing, deployment of 4-byte AS BGP implementations and development of appropriate transition arrangements
 - Allow 2 – 3 years to undertake this smoothly
- So we'd like to know when we have 3 years to go before we run out of AS numbers

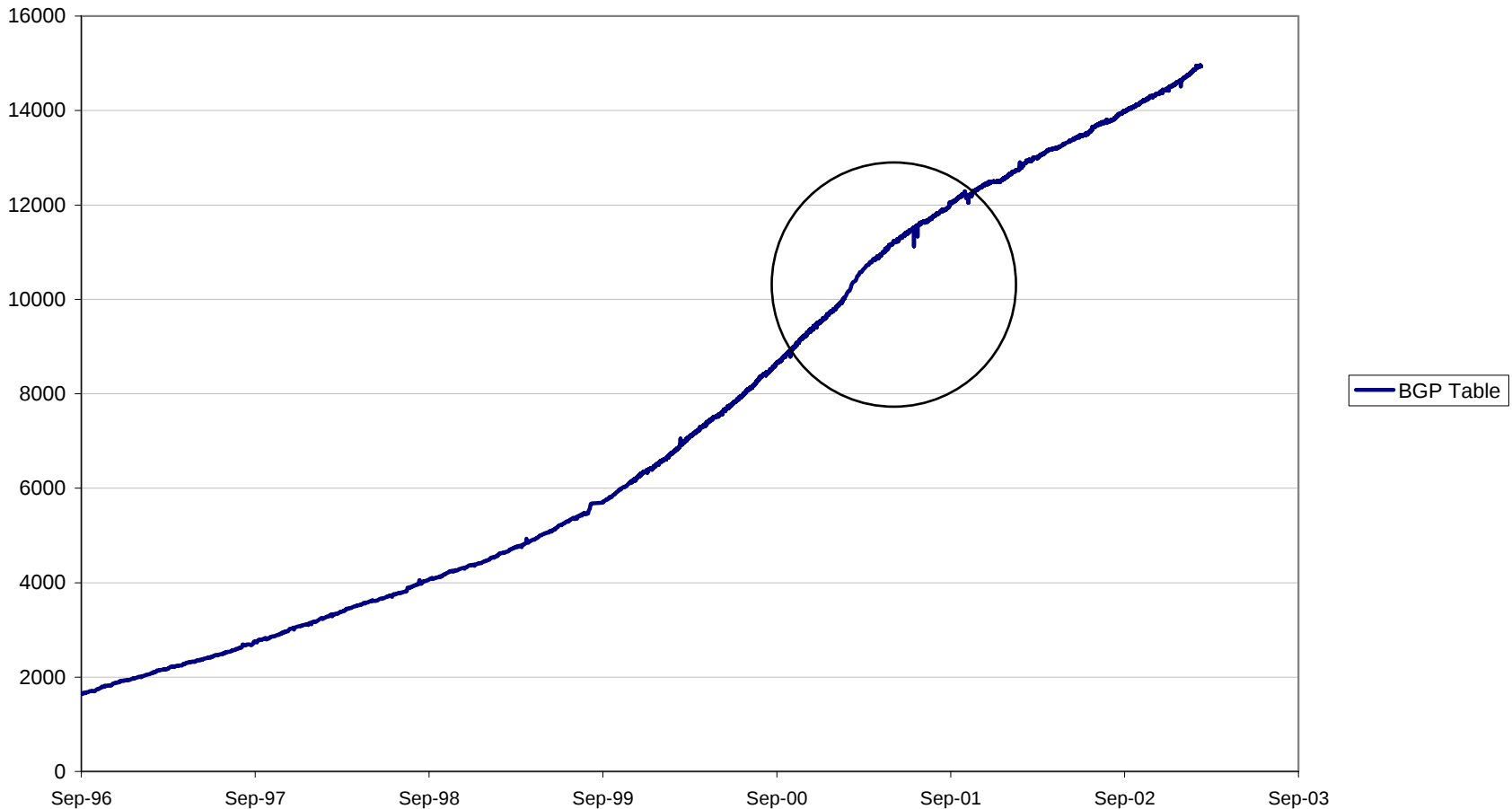


When?

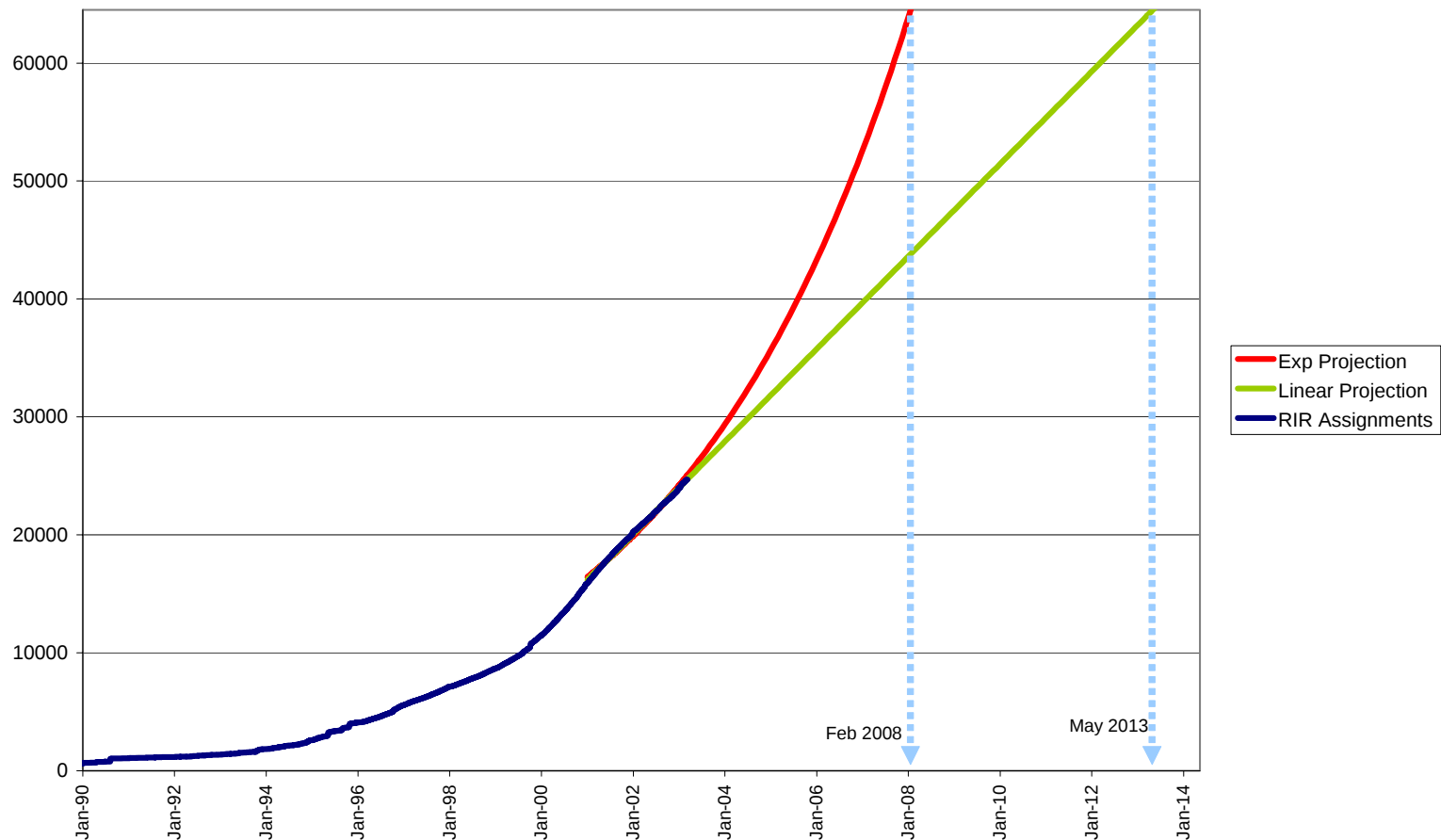
- A number of views can be used to make forward projections:
 - The growth of the number of announced AS's in the BGP routing table
 - The rate at which AS number blocks are passed from IANA to the RIRs
 - The rate at which RIRs undertake assignments of As's to LIRs and end users

The BGP Routing Table Announced AS's

BGP Table - AS Count



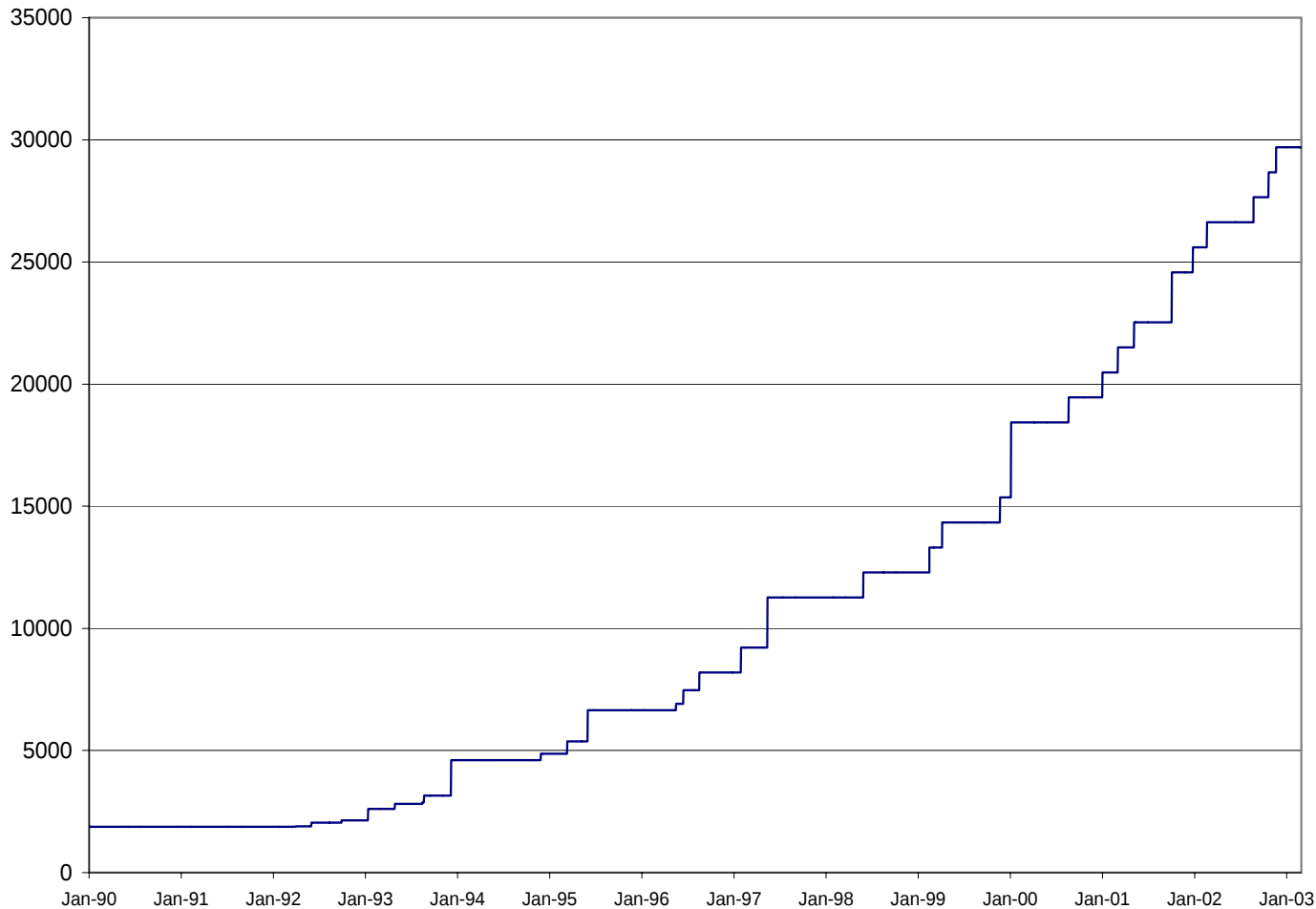
The BGP Routing Table Growth Projections



IANA AS block Allocations

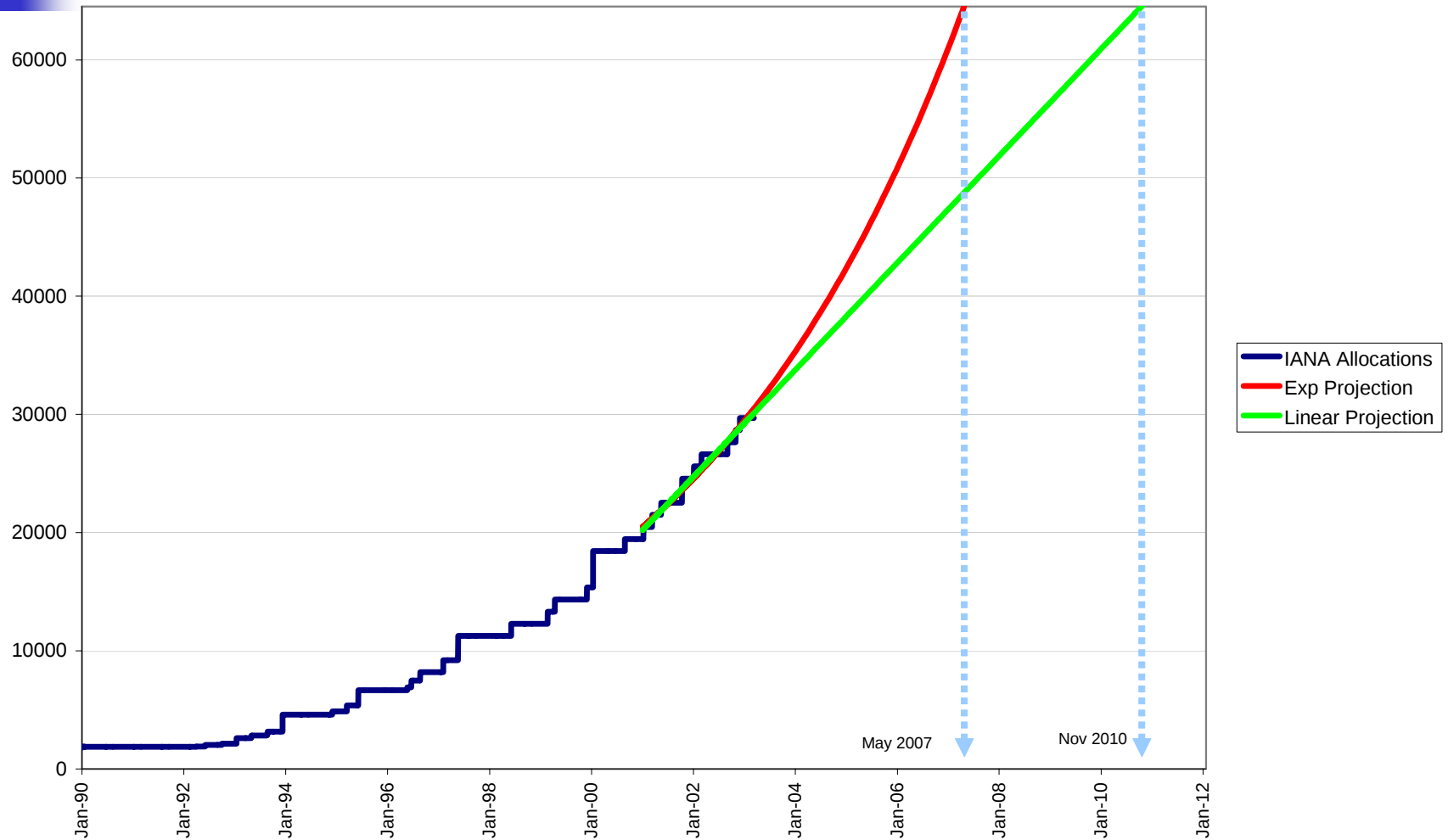


IANA AS Allocations



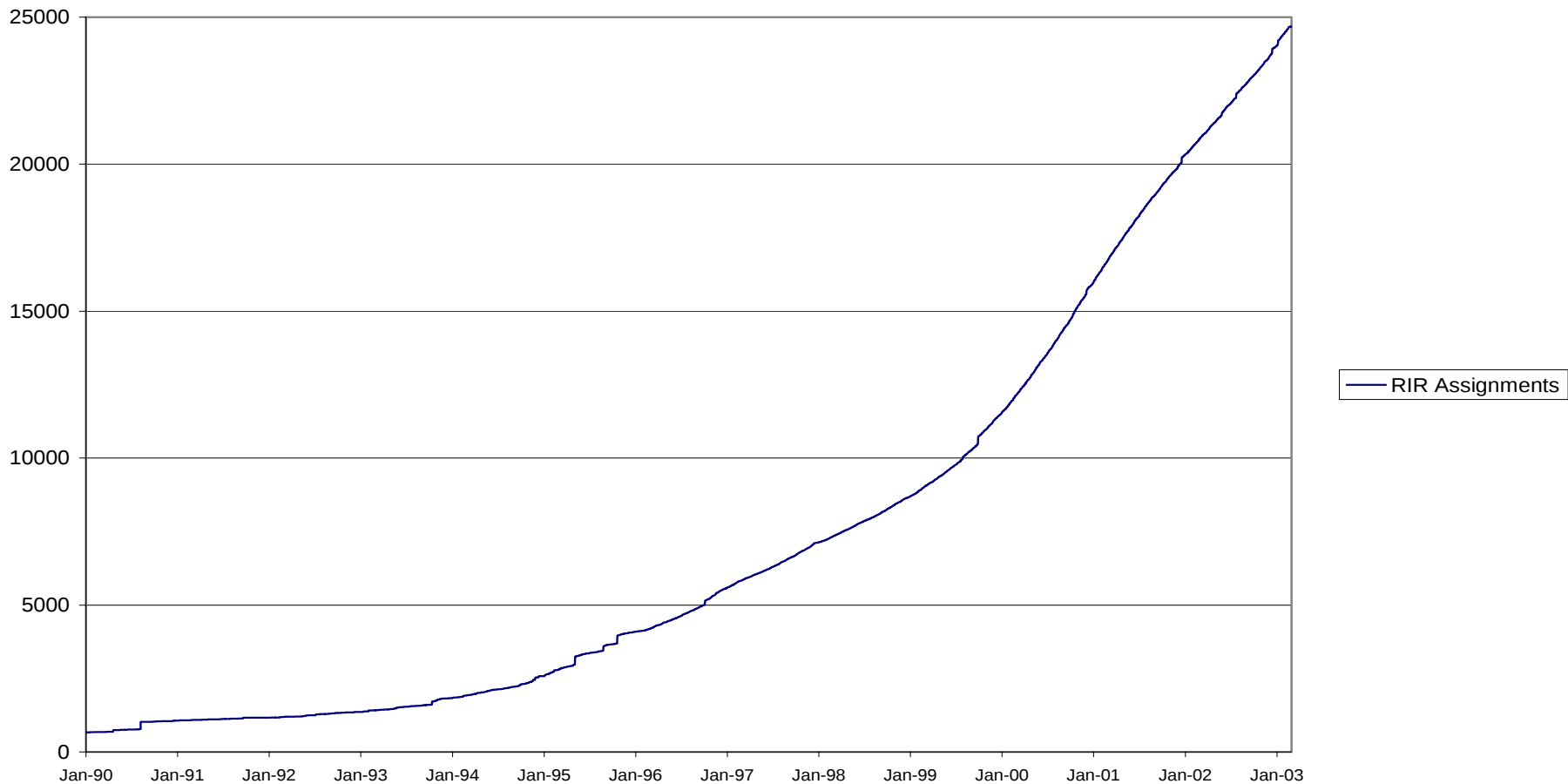
IANA AS Allocations

IANA AS Allocation Projection

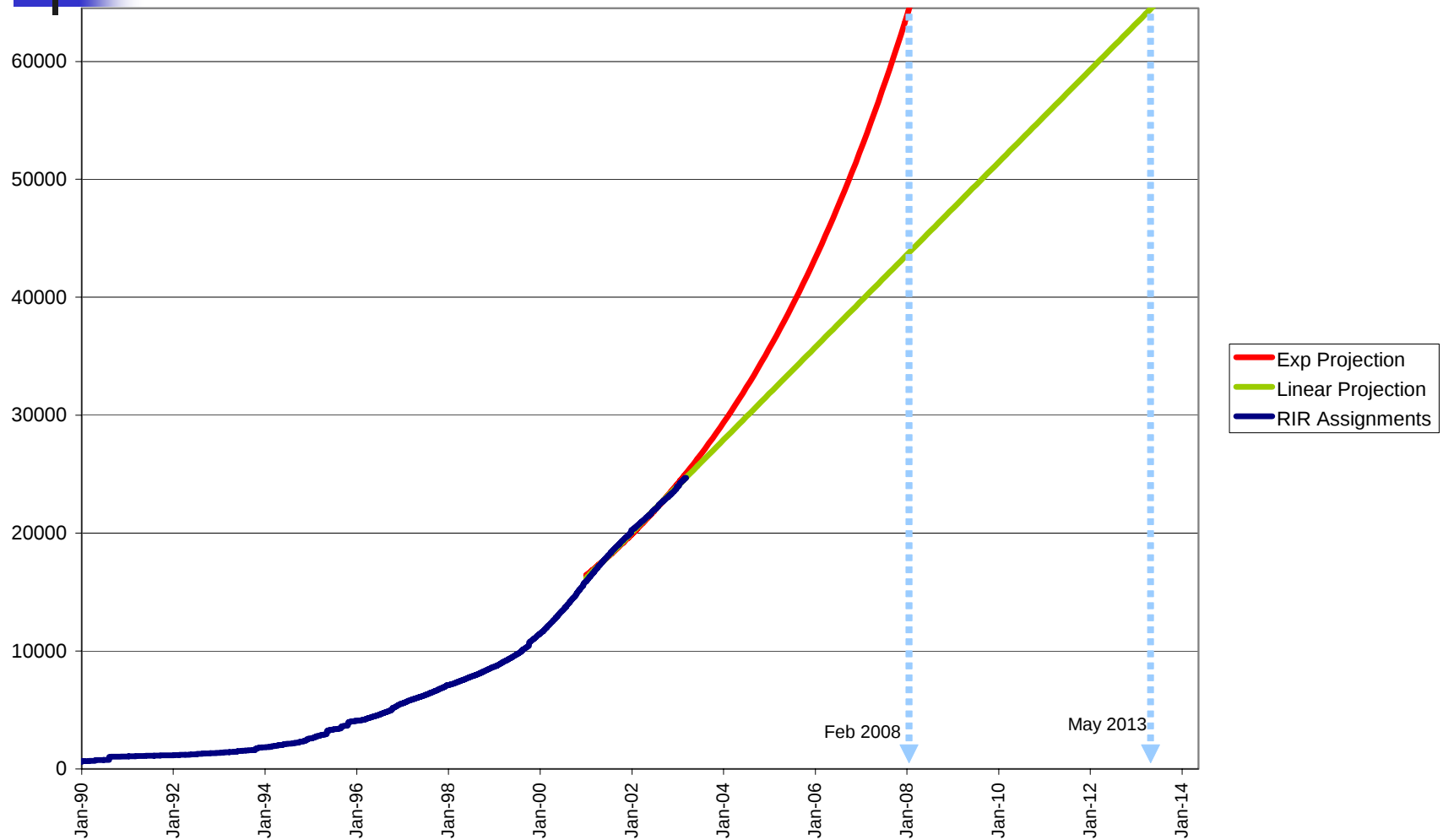


RIR Assignments

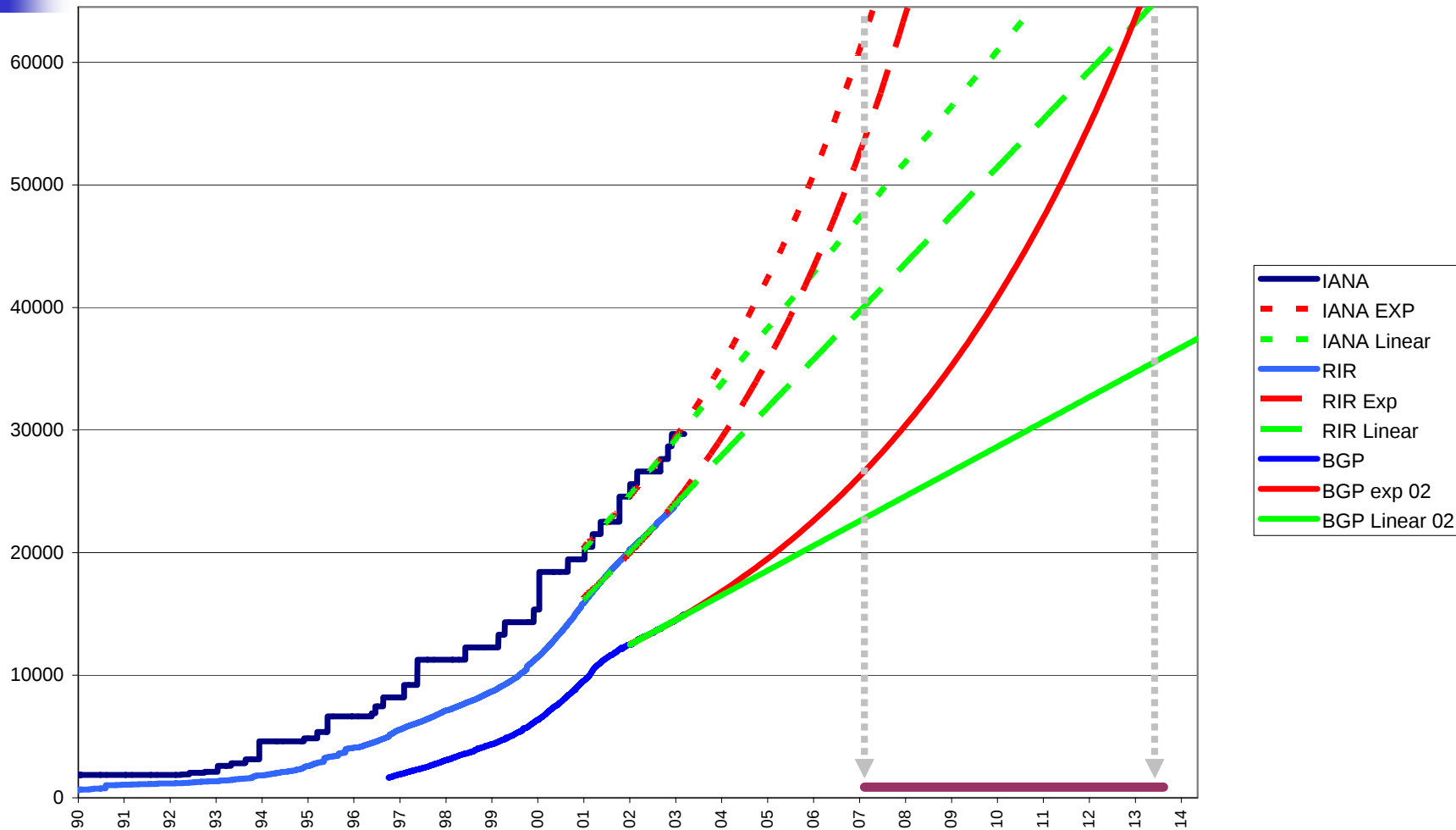
RIR Assignments



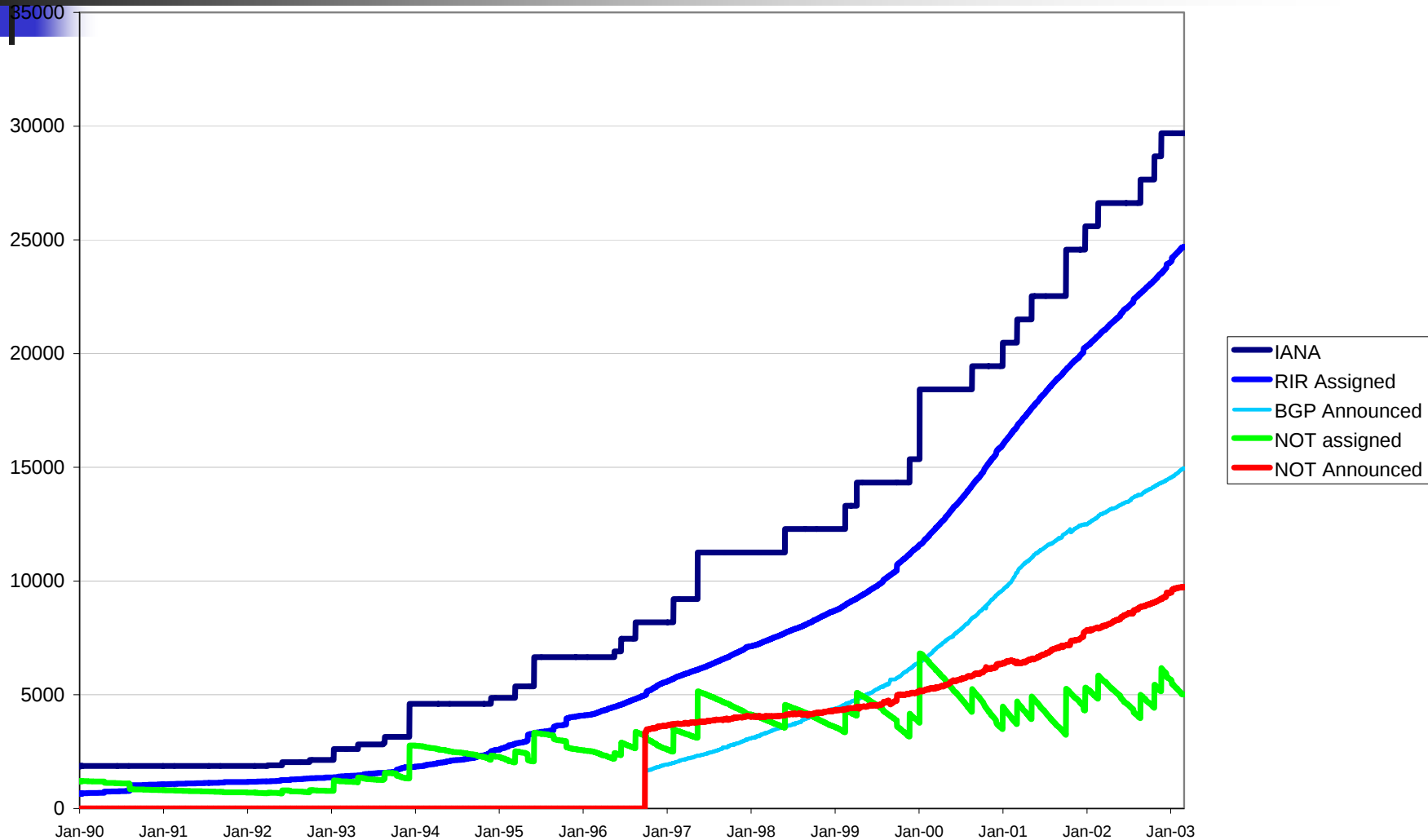
RIR Projection

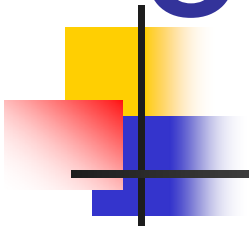


Combining these views



Combined View + differences

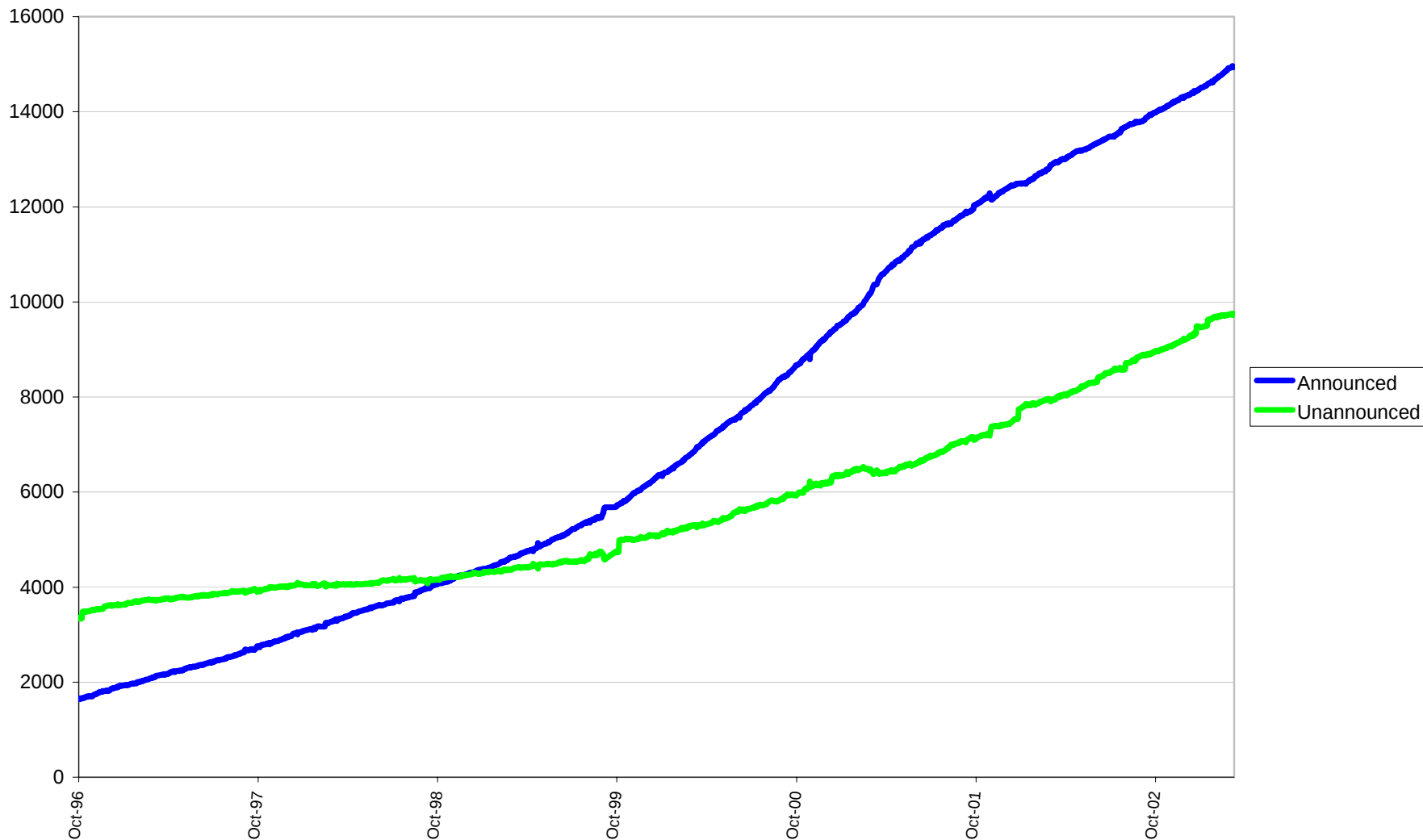




Observations

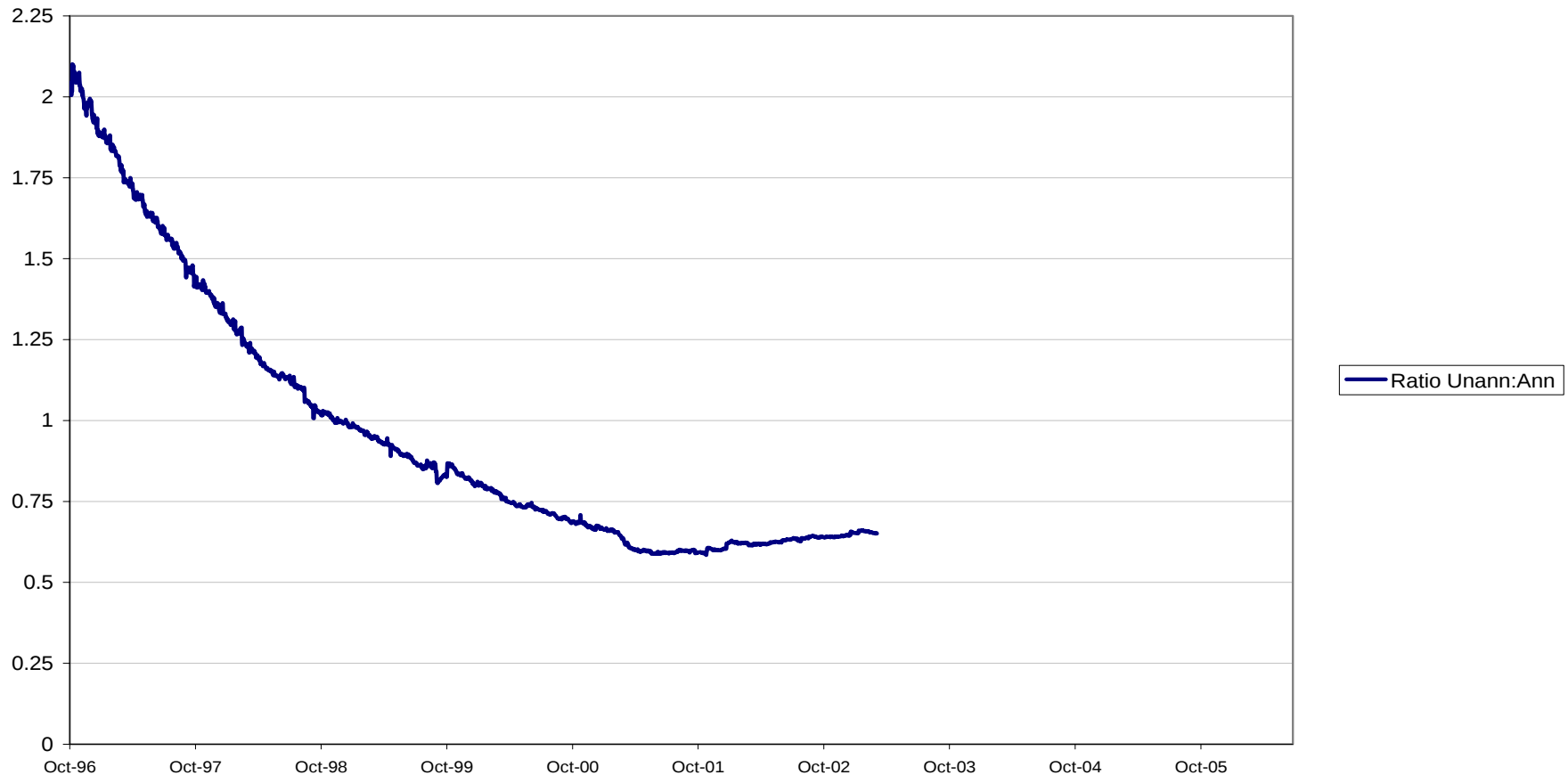
- RIRs operate with an allocation buffer of around 5,000 numbers
- 10,000 AS numbers (40% of the assigned AS numbers) are not announced in the BGP table.
 - Is this the result of old AS assignments falling into disuse?
 - Or recent AS assignments being hoarded?
 - This pool creates uncertainty in 2 byte AS number pool exhaustion predictions

Announced and Unannounced ASs

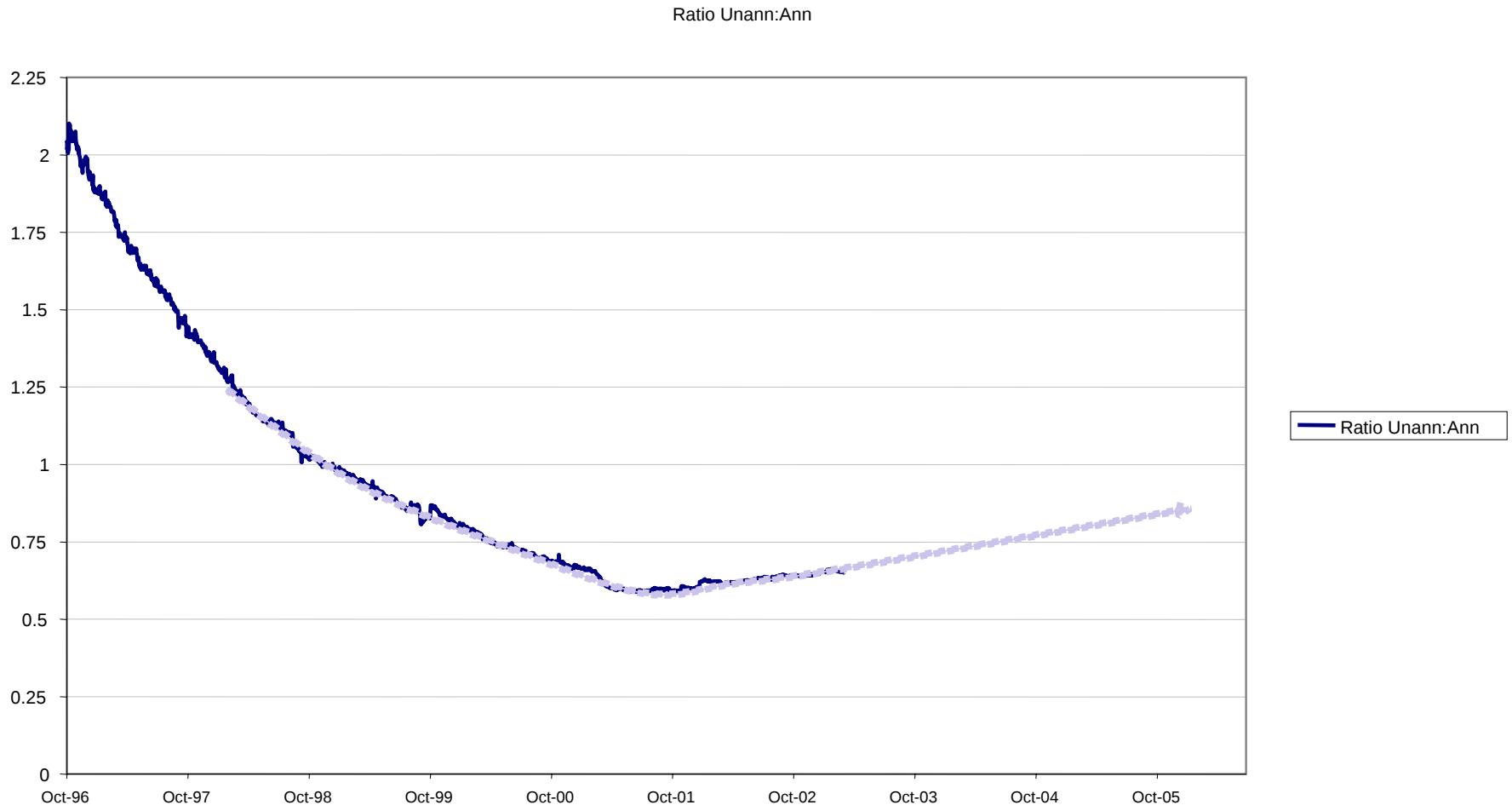


Unannounced : Announced AS's

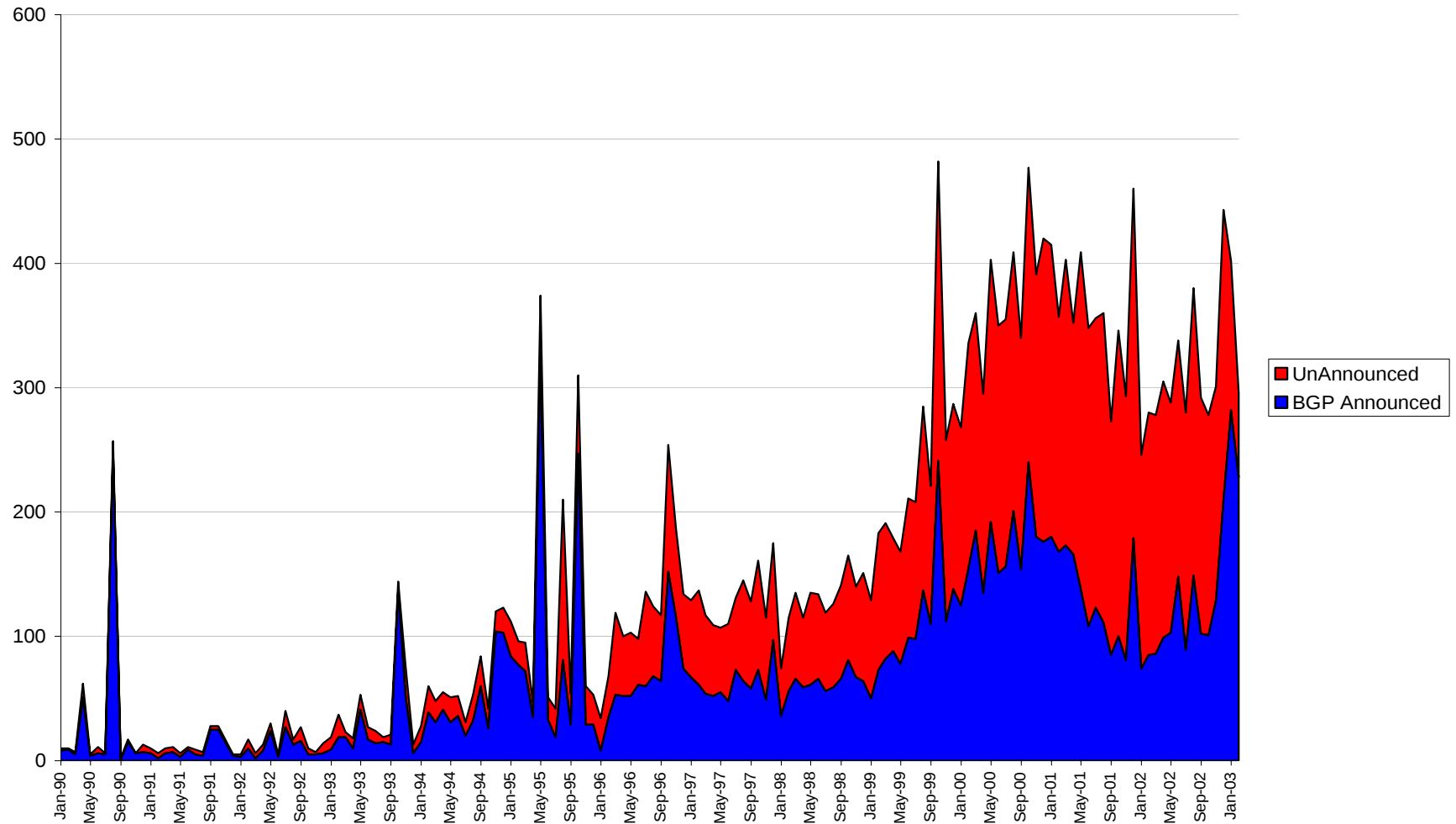
Ratio Unann:Ann



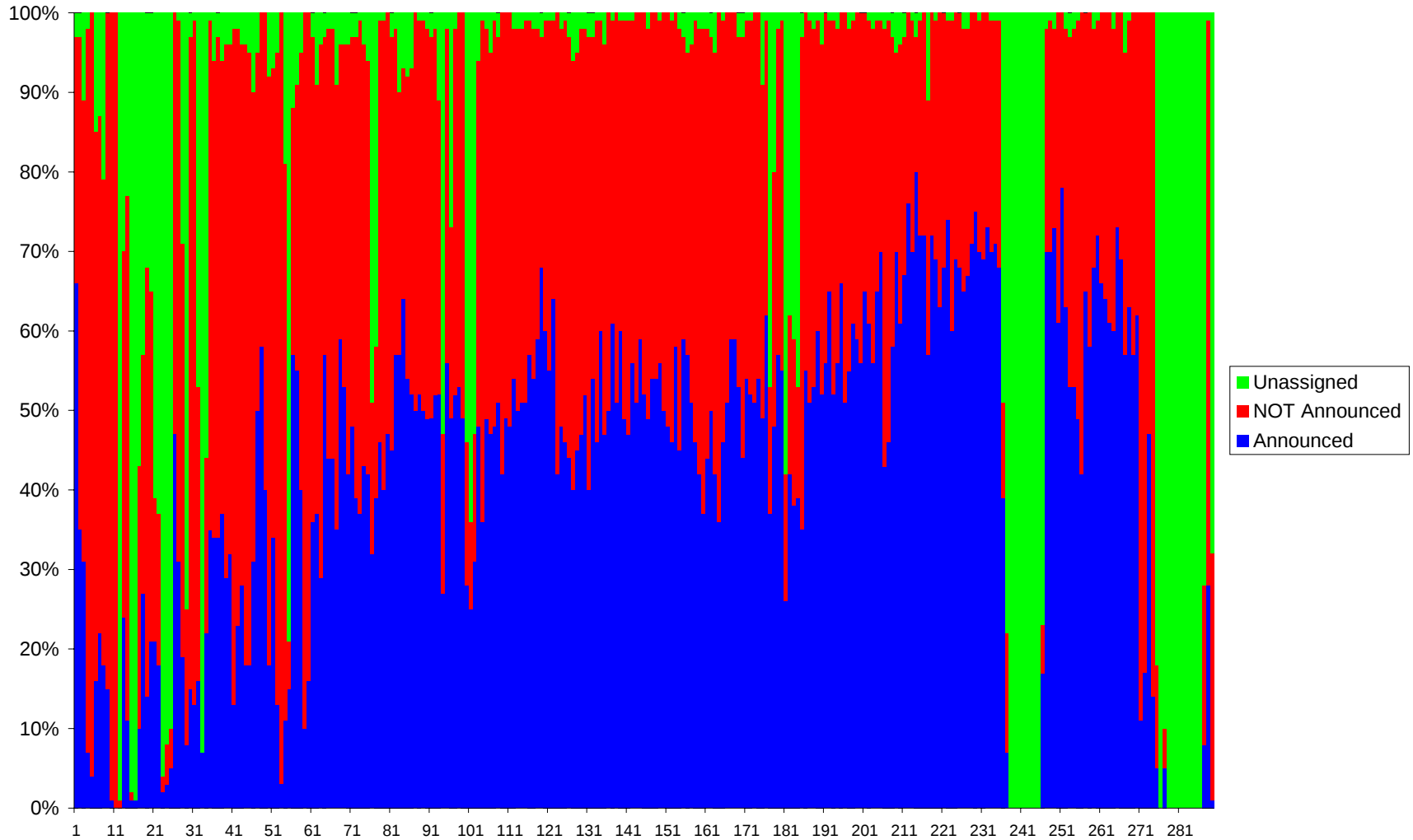
Trend: unannounced : announced ratio

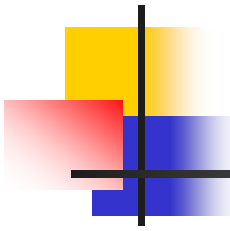


Announced / Unannounced Distribution by Date



Distribution by AS Number Range



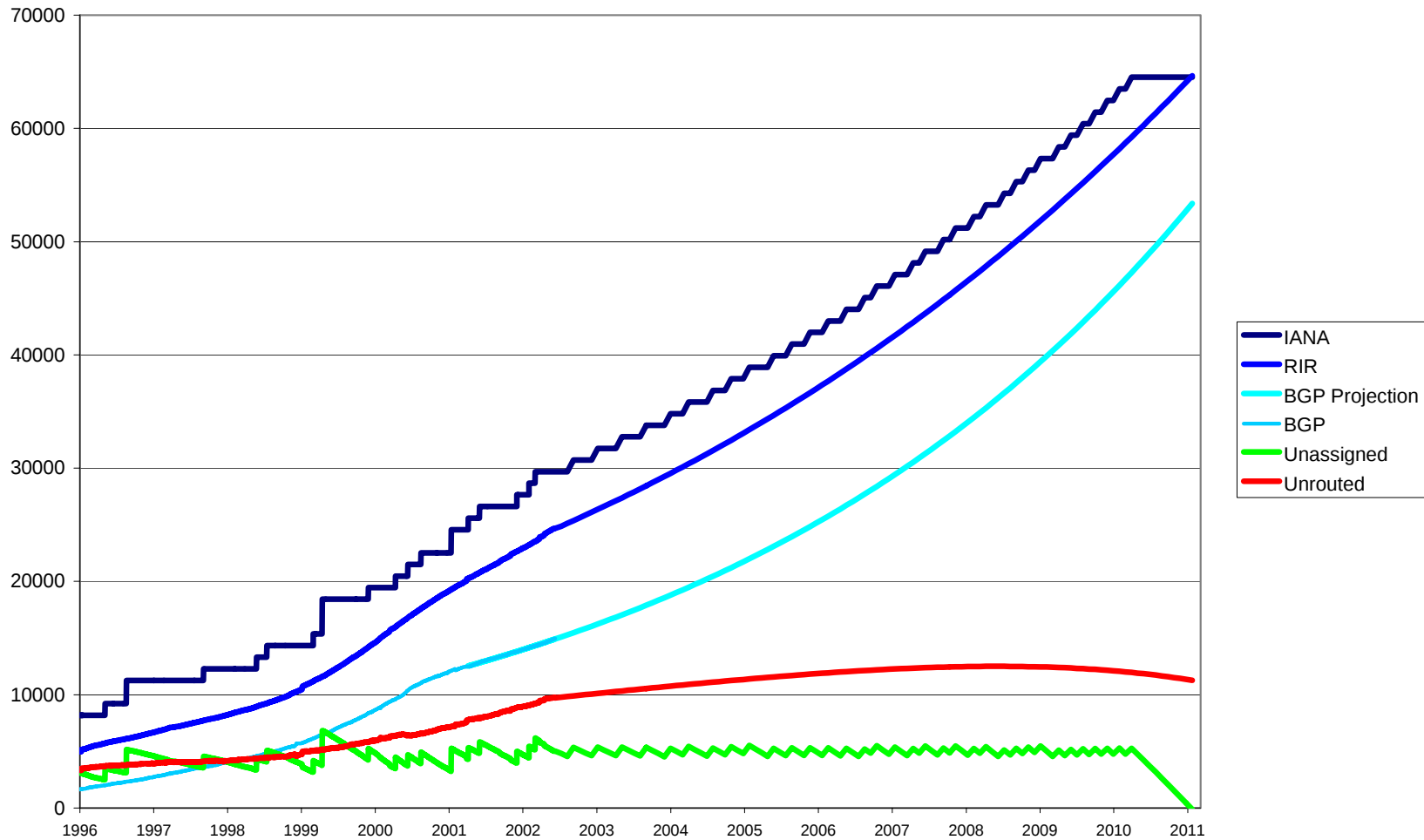


Observations

- Low AS number ranges have the highest unannounced / announced ratios
 - Reclamation of unused AS numbers in the low number ranges is likely to be a useful exercise
- Recent assignments show a 60% announcement utilization ratio for AS numbers
 - LIR staging point factors
 - Inadequate incentives to return if no immediate requirement for deployment

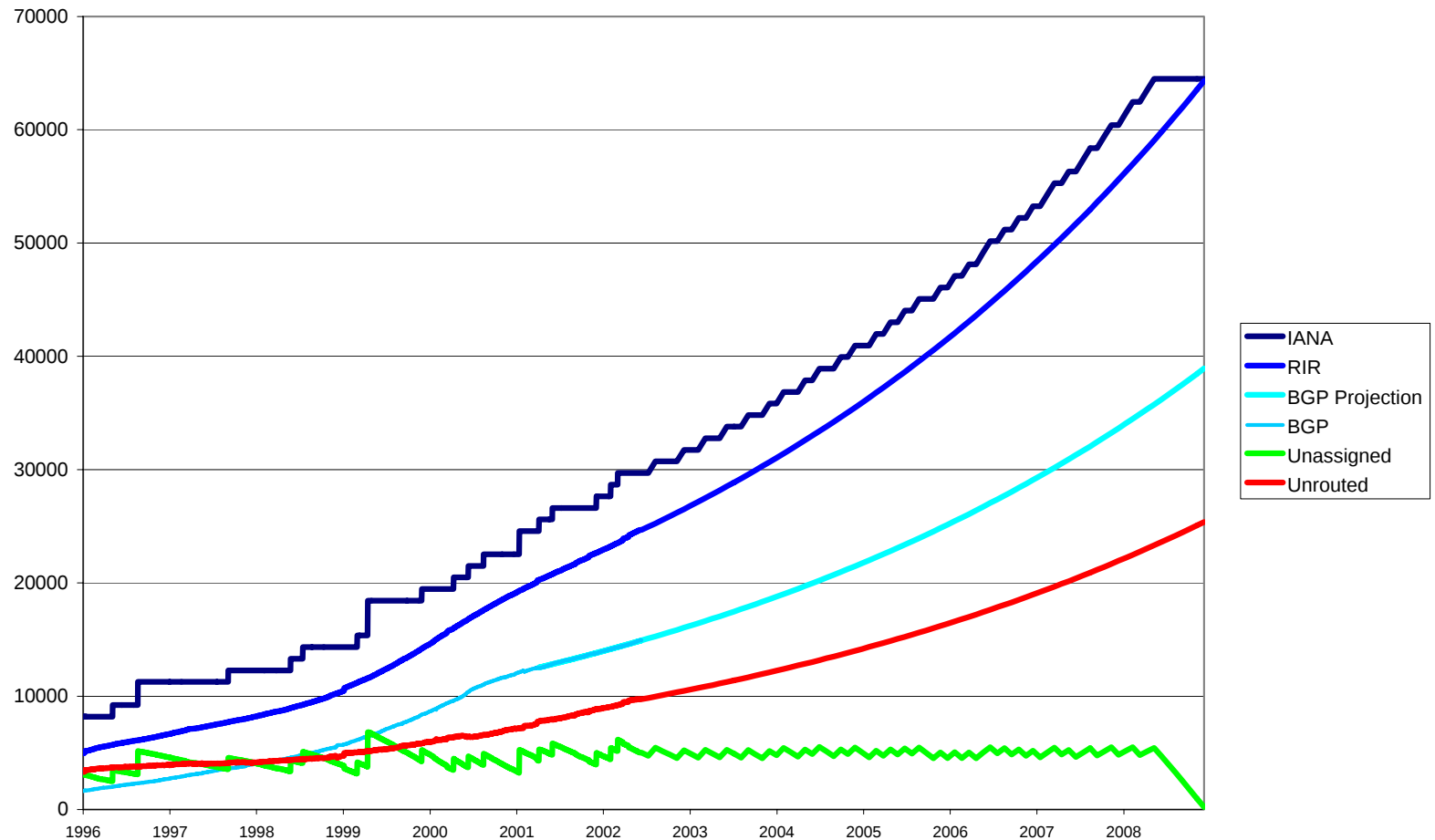
Forecast

1 – AS recovery in effect - 2011

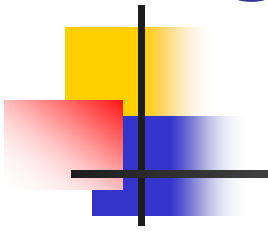


Forecast

2 – No significant recovery – 2009



Current AS Forecast



- The available AS number pool will exhaust in the timeframe of 2009-2011 if current AS use trends continue

2009

- no significant reclamation in old AS number space
- No coordinated effort to increase utilization density of AS numbers

2011

- reclamation and increased deployment efficiency