

# AS Consumption Patterns

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# AS Numbers

- The 16 bit AS number field in BGP has 64,510 available values to use in the Internet's public routing space
- Some 38,000 AS numbers have already been assigned by the RIRs
- This number space will be exhausted at some point in the future

# 32 Bit AS Numbers

- Use a 32 bit field for this value
  - draft-ietf-idr-as4bytes-09.txt describes how
  - This is proposed for publication as an Experimental RFC

Has been in this state for some years. Unclear whether it has stalled or just moving very slowly through the IETF standards process.

# The Issue – Transition Planning

- 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?

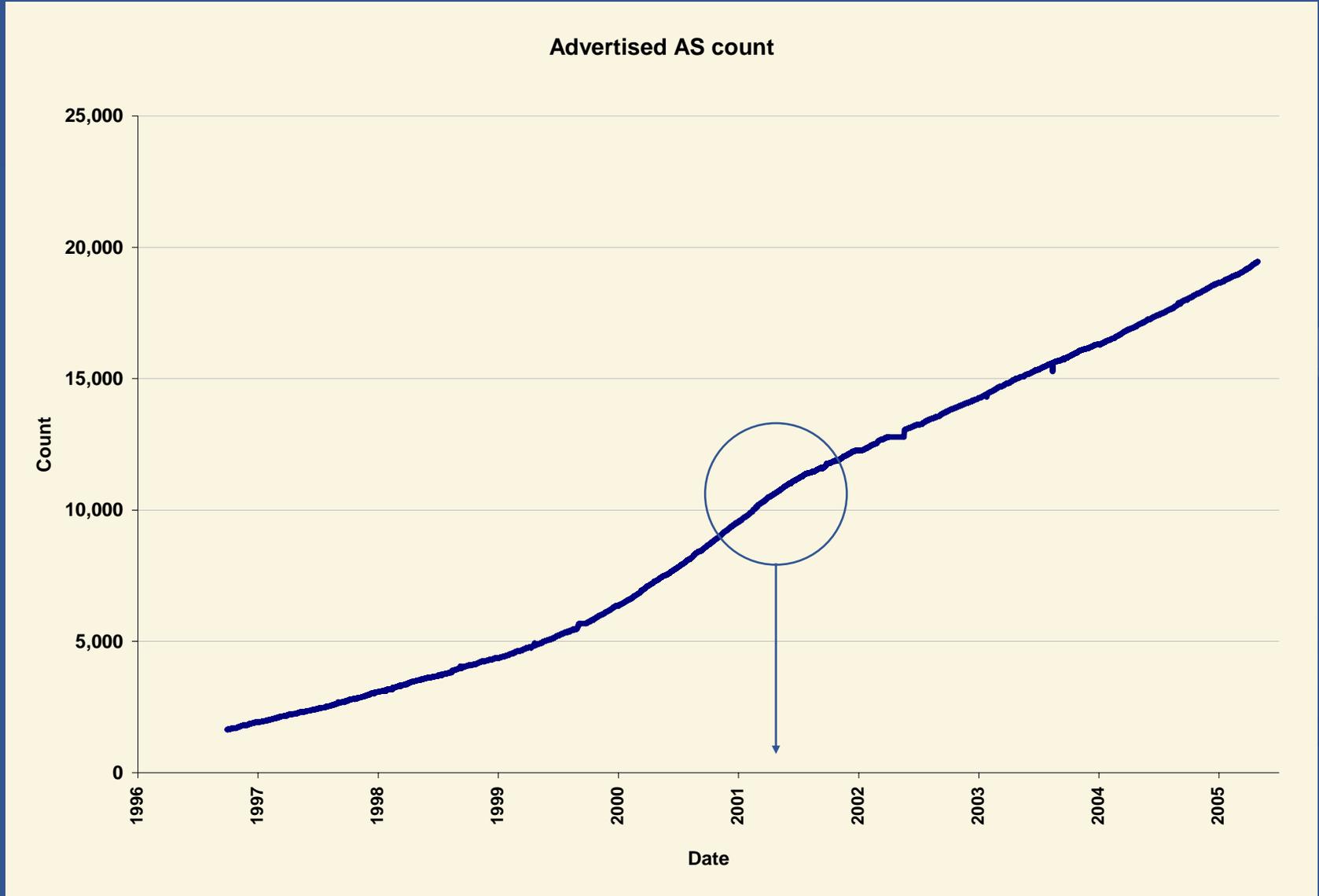
- Before we run completely out of 16 bit AS numbers
- Need to allow a lead time for testing, deployment of 4-byte AS BGP implementations and development of appropriate transition arrangements
  - Allow some 3-4 years to undertake this smoothly
- So we'd like to know when we have 4 years to go before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

# When?

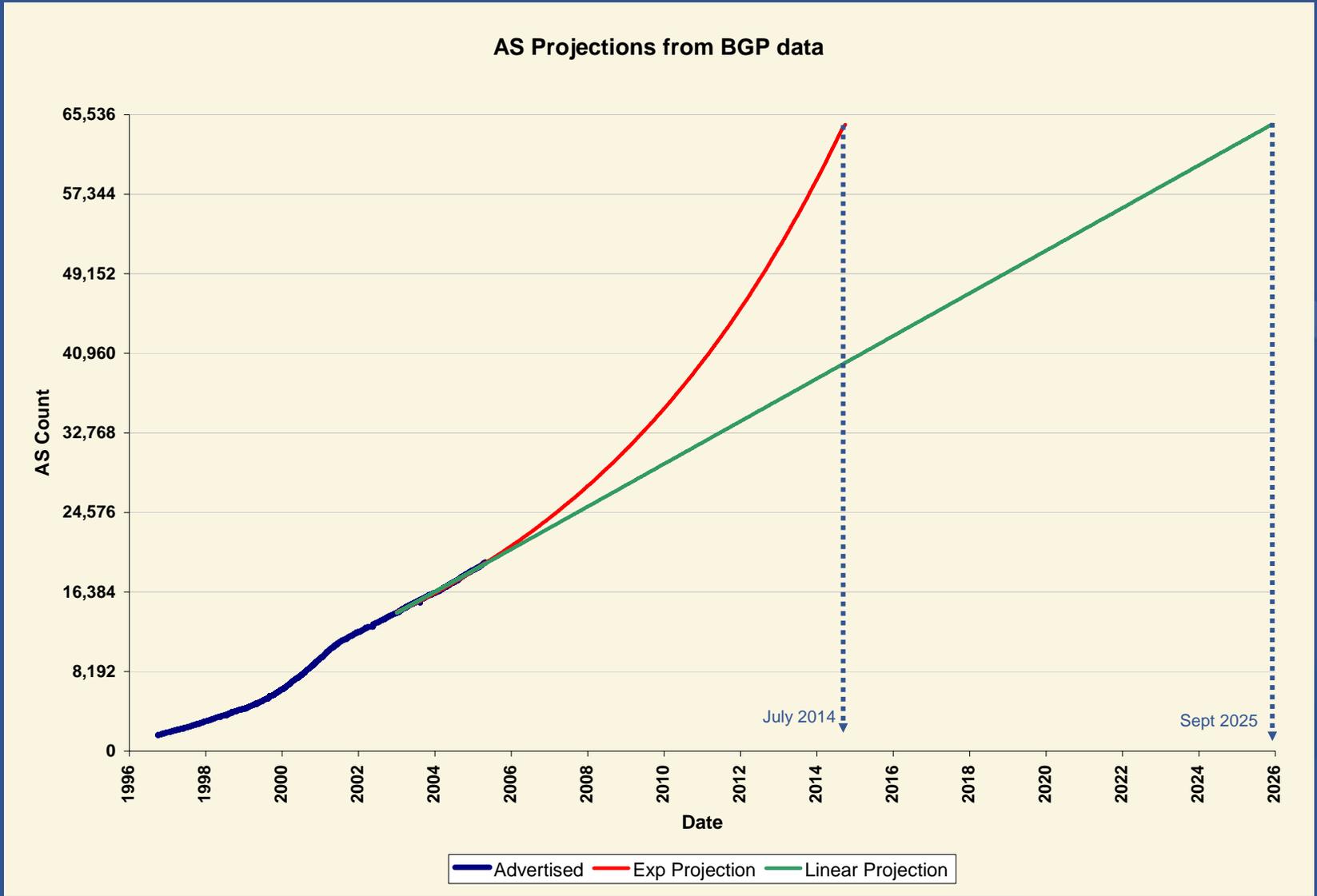
- A number of views can be used to make forward projections:
  - The growth of the number of announced AS's in the BGP routing table
  - The rate at which AS number blocks are passed from IANA to the RIRs
  - The rate at which RIRs undertake assignments of As's to LIRs and end users



# The BGP Routing Table: Announced AS's

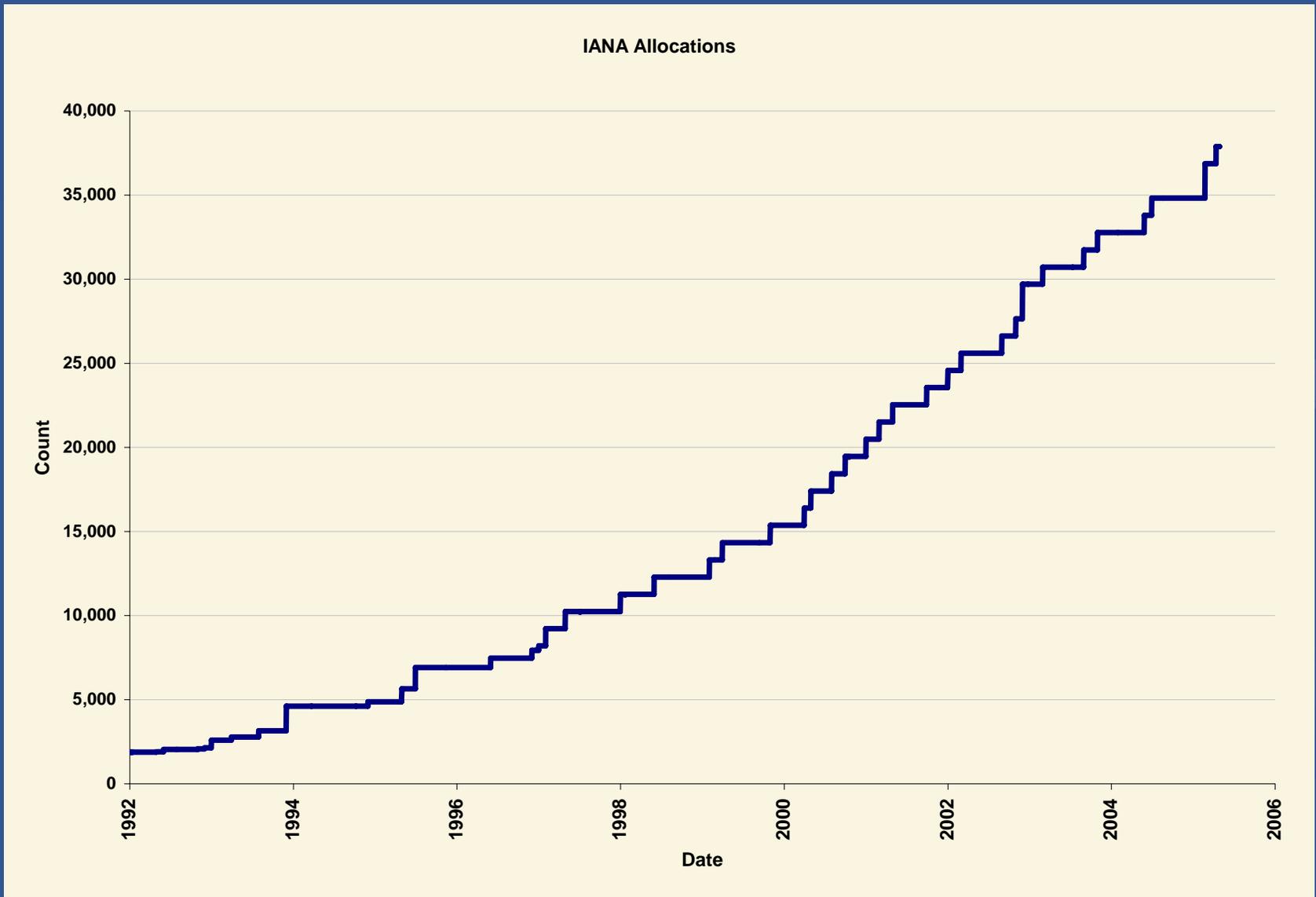


# The BGP Routing Table: Growth Projections

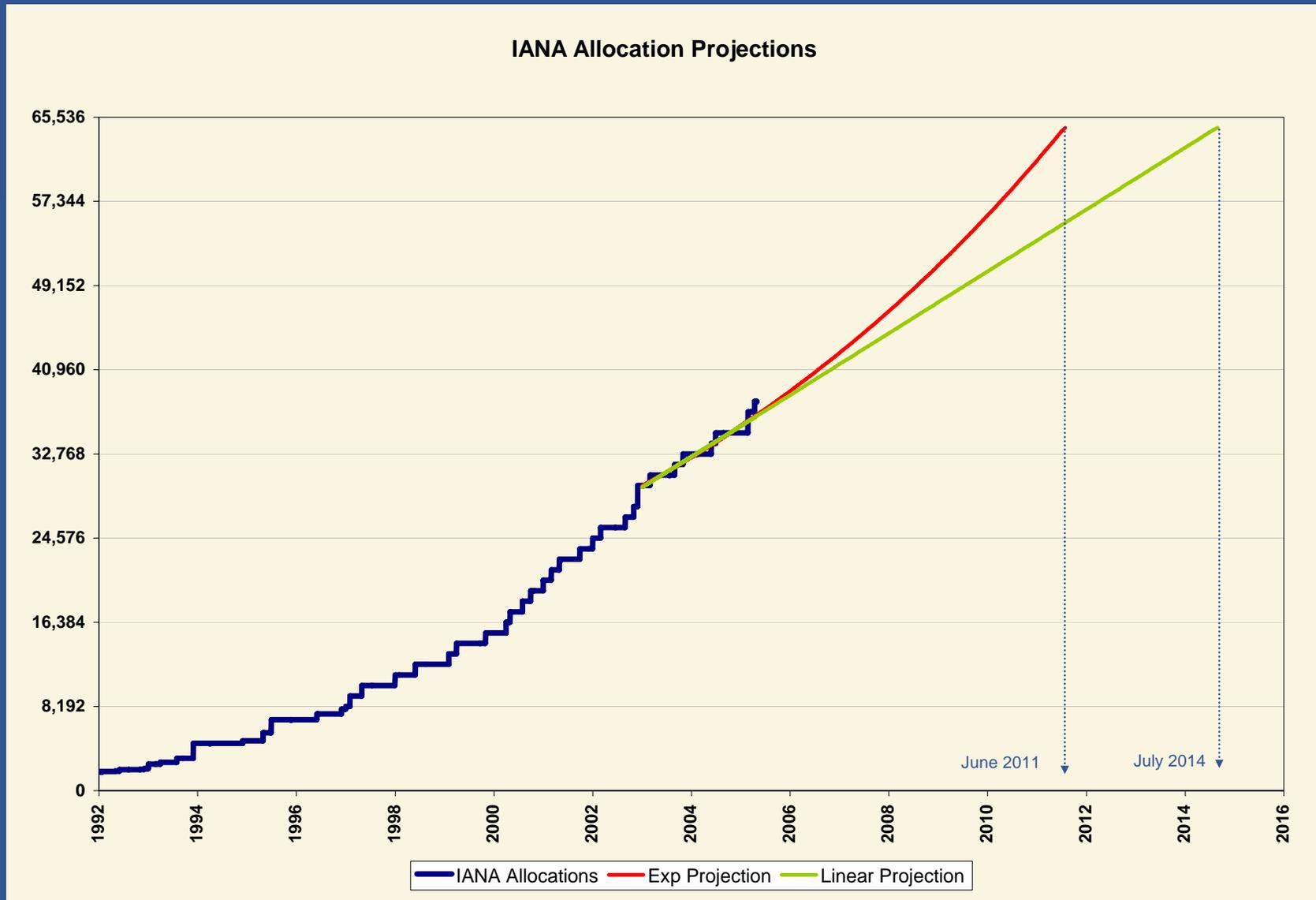




# IANA AS block allocations to RIRs



# IANA AS Allocation Projection

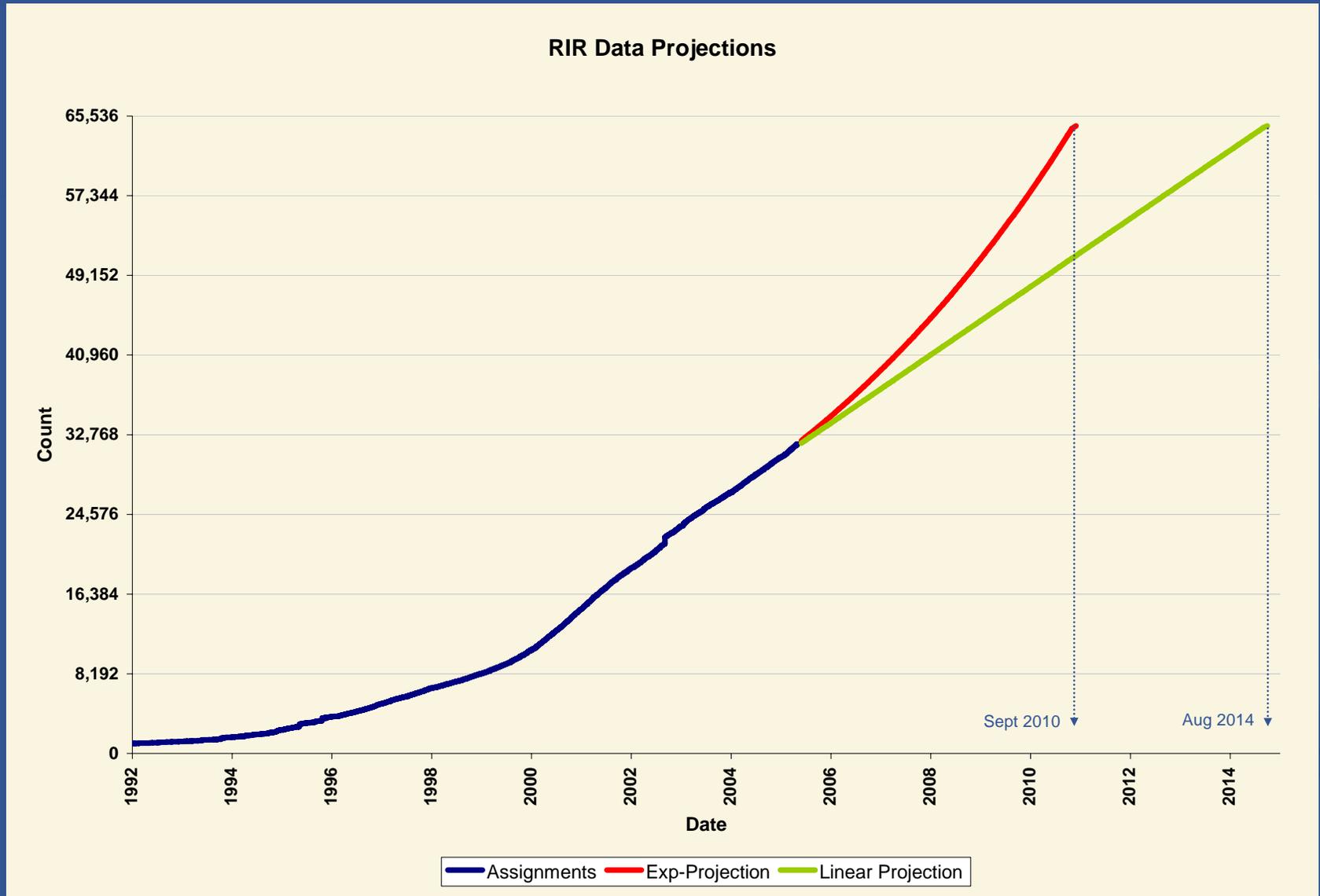


# RIR Assignments



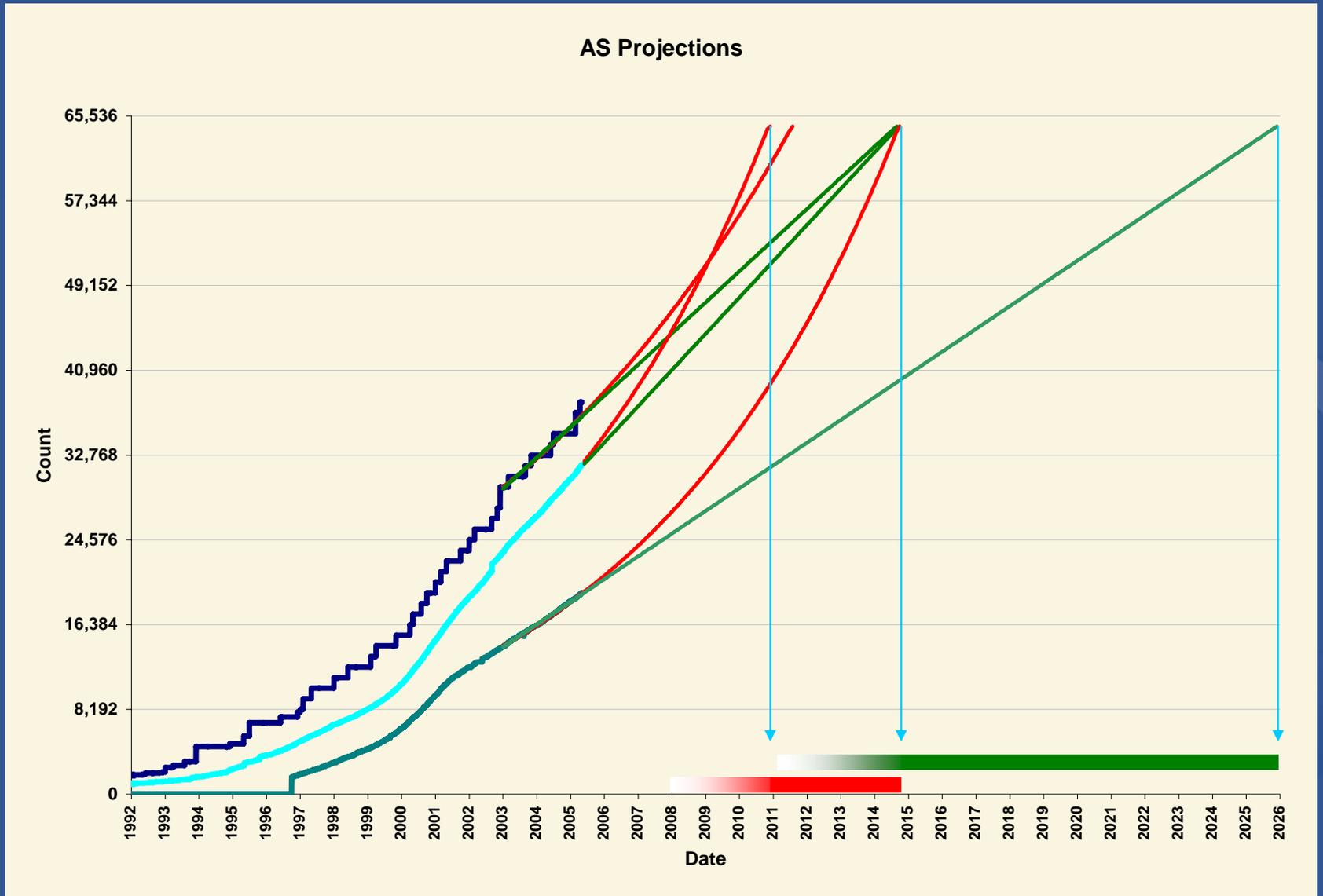
There are some inconsistencies in the data

# RIR Allocation Projection

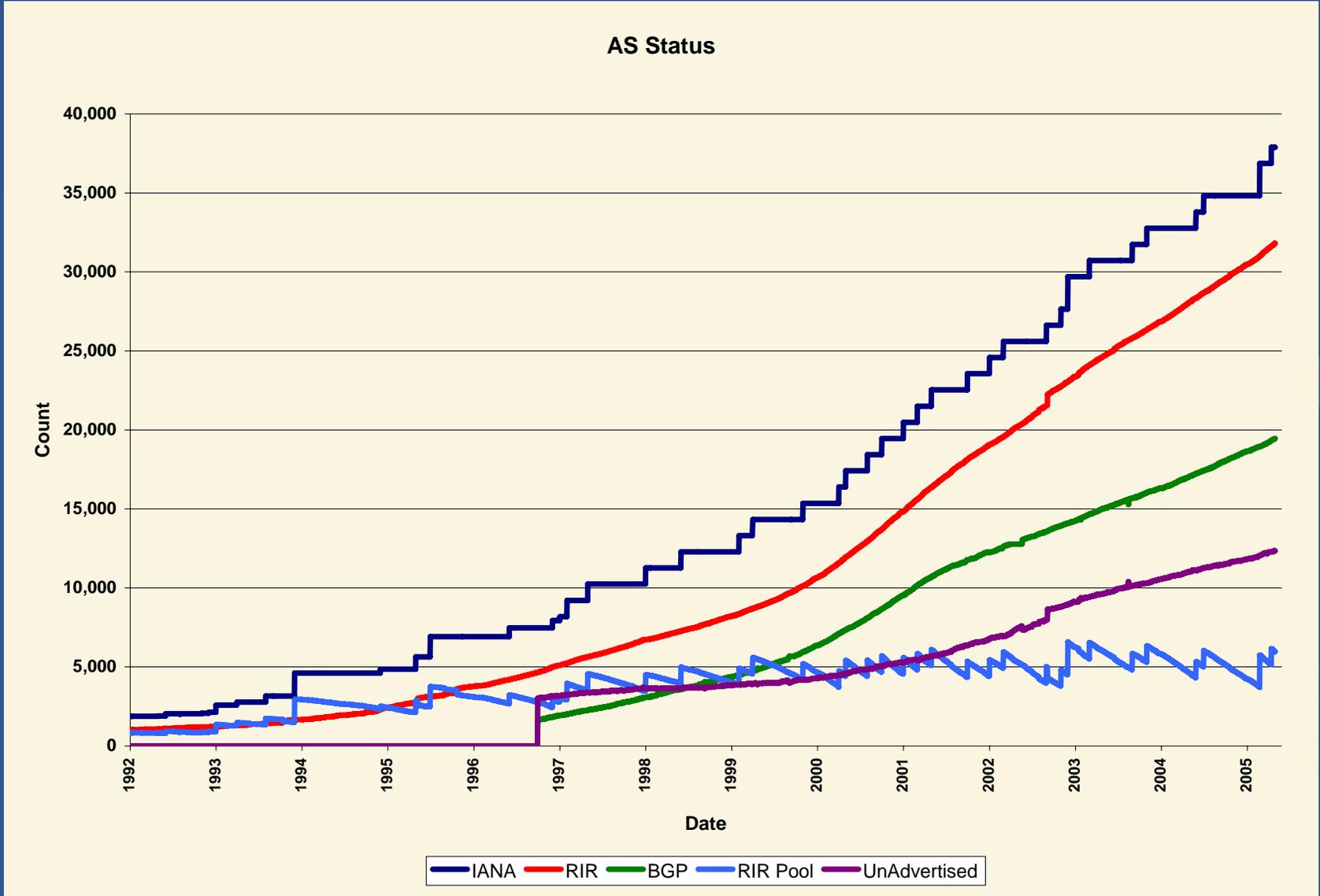




# Combining these views



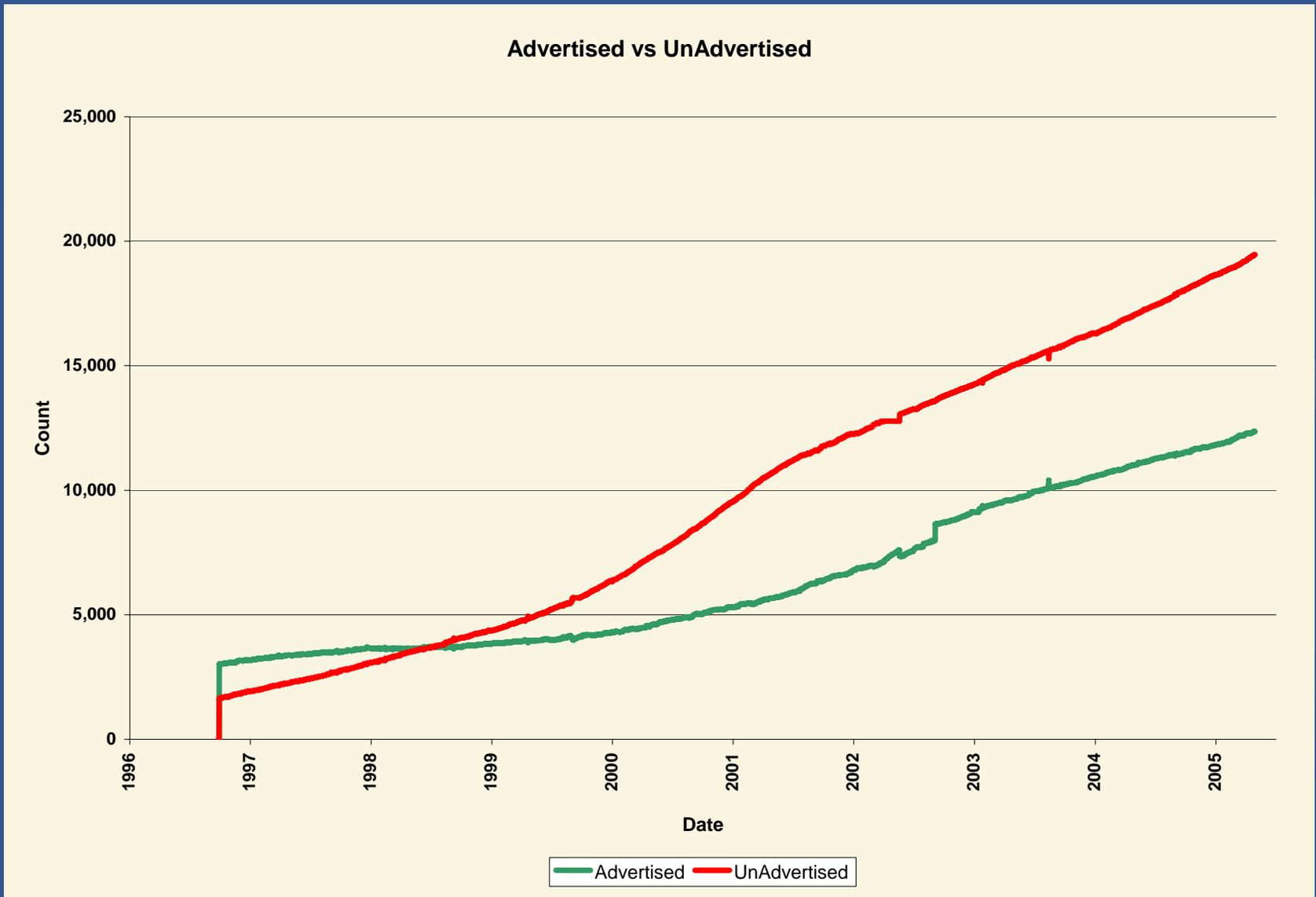
# Combined View + Differences



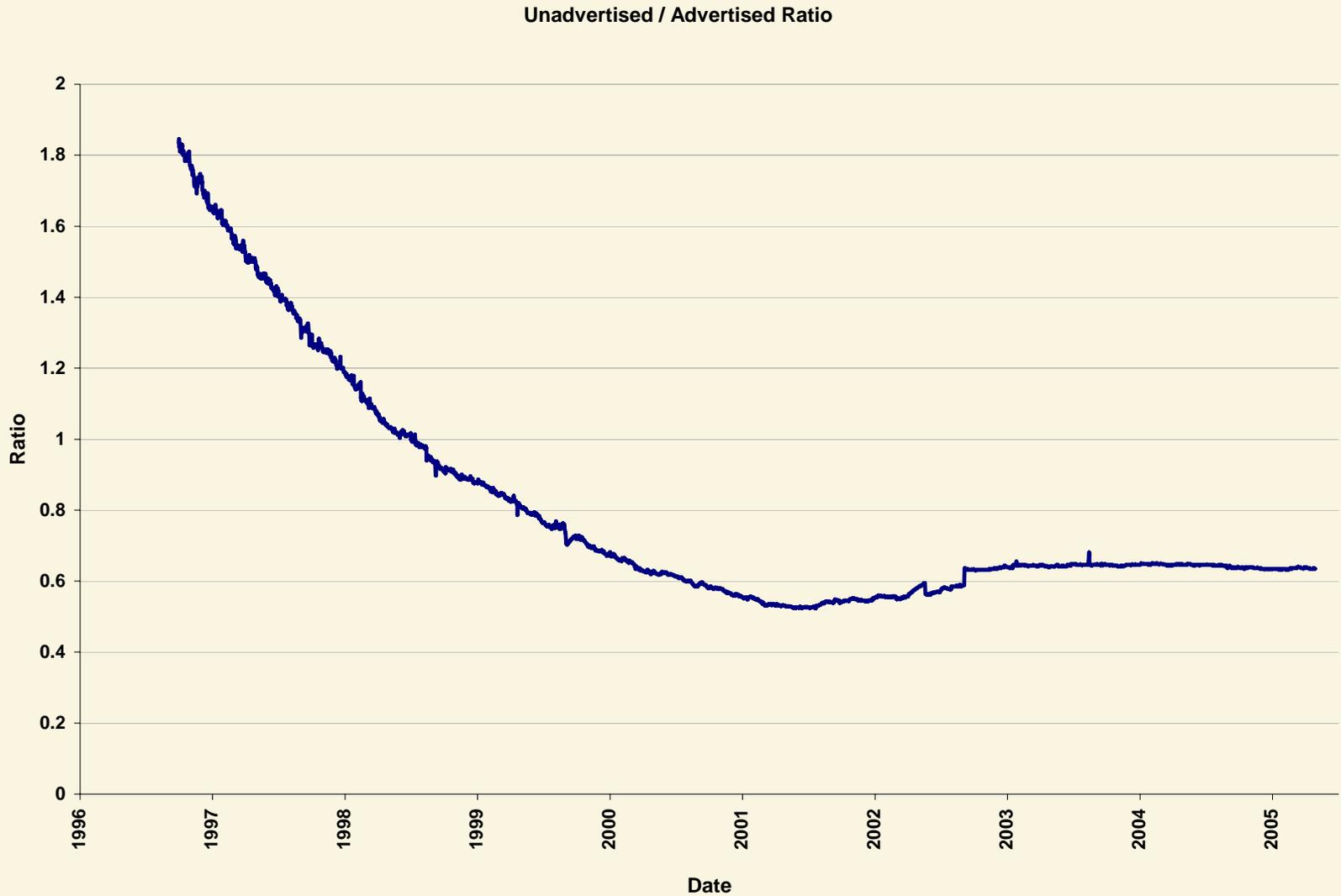
# Observations

- RIRs operate with an allocation buffer of an average of 5,000 numbers
- 12,348 AS numbers (39% 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 AS number pool exhaustion predictions

# UnAdvertised and Advertised ASs

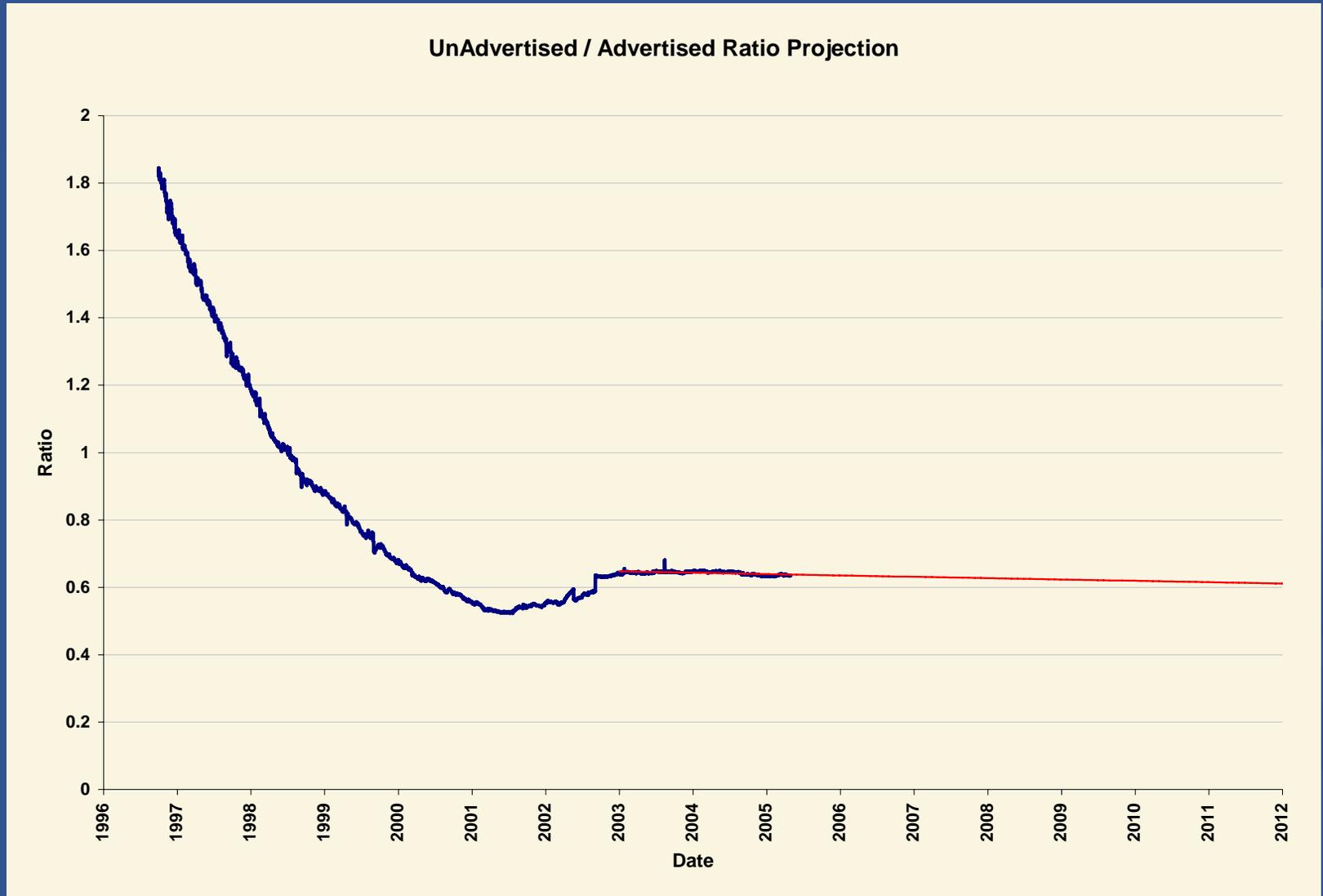


# UnAdvertised : Advertised AS's



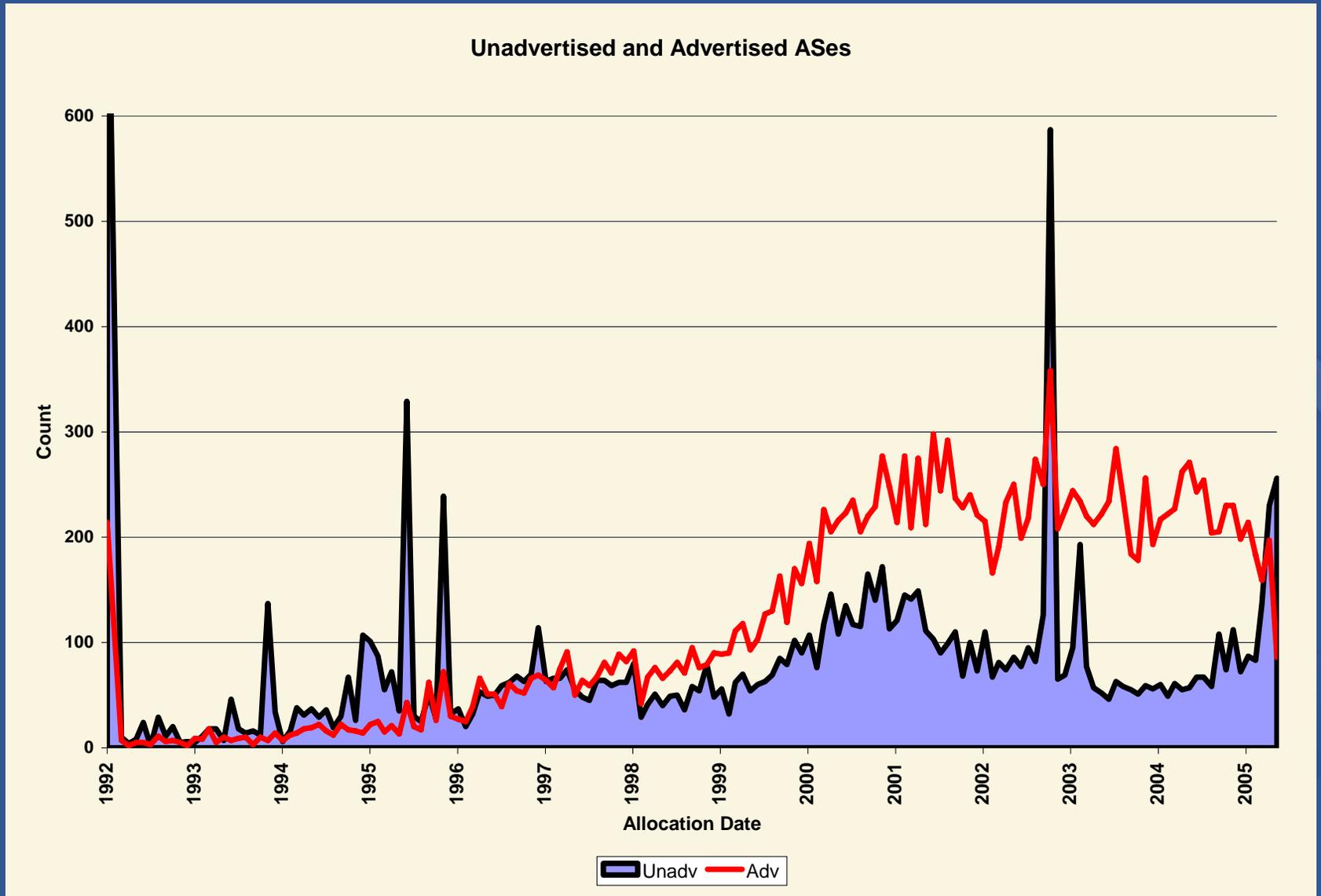


# Trend: UnAdvertised : Advertised Ratio



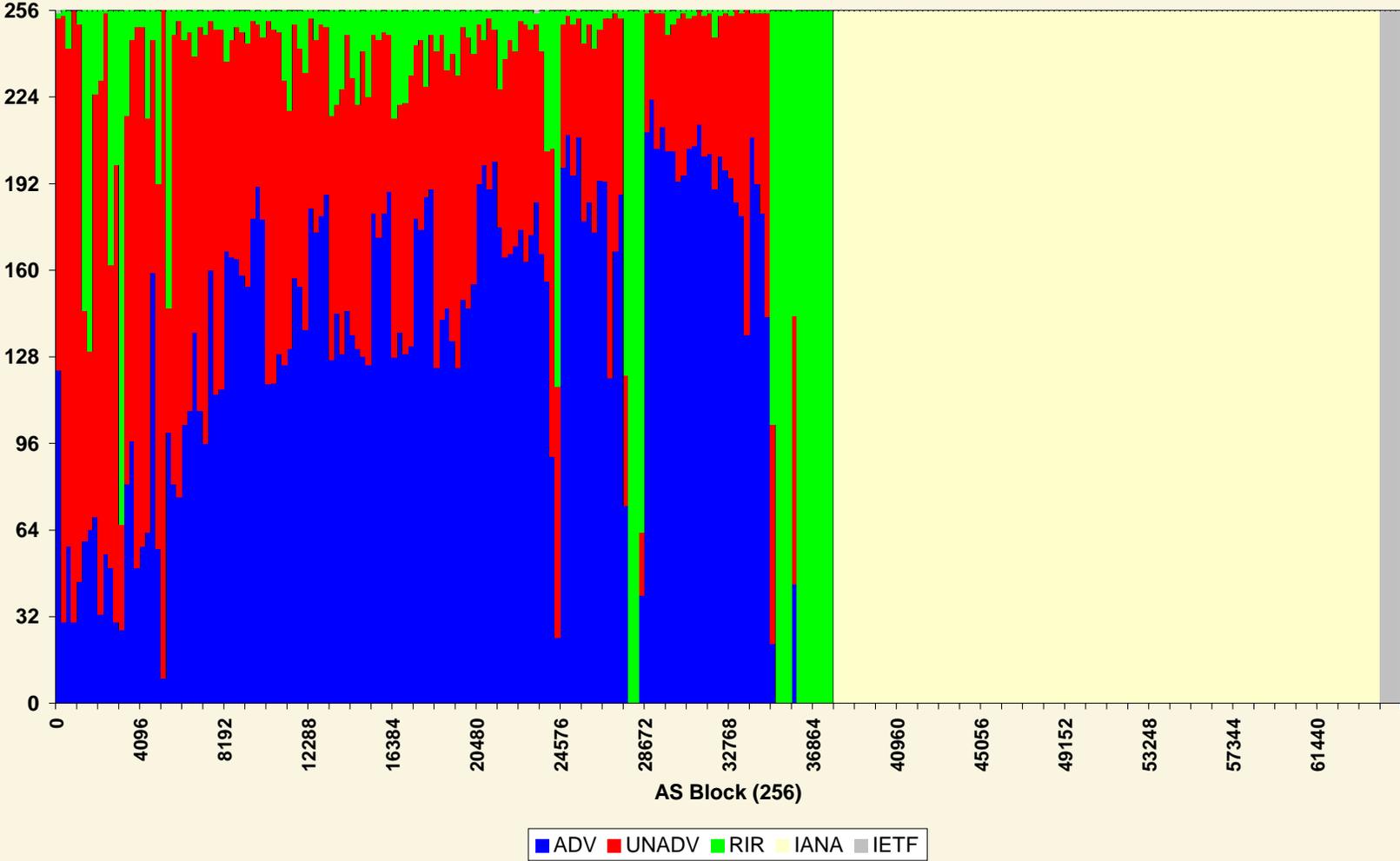


# UnAdvertised / Advertised Distribution by Date



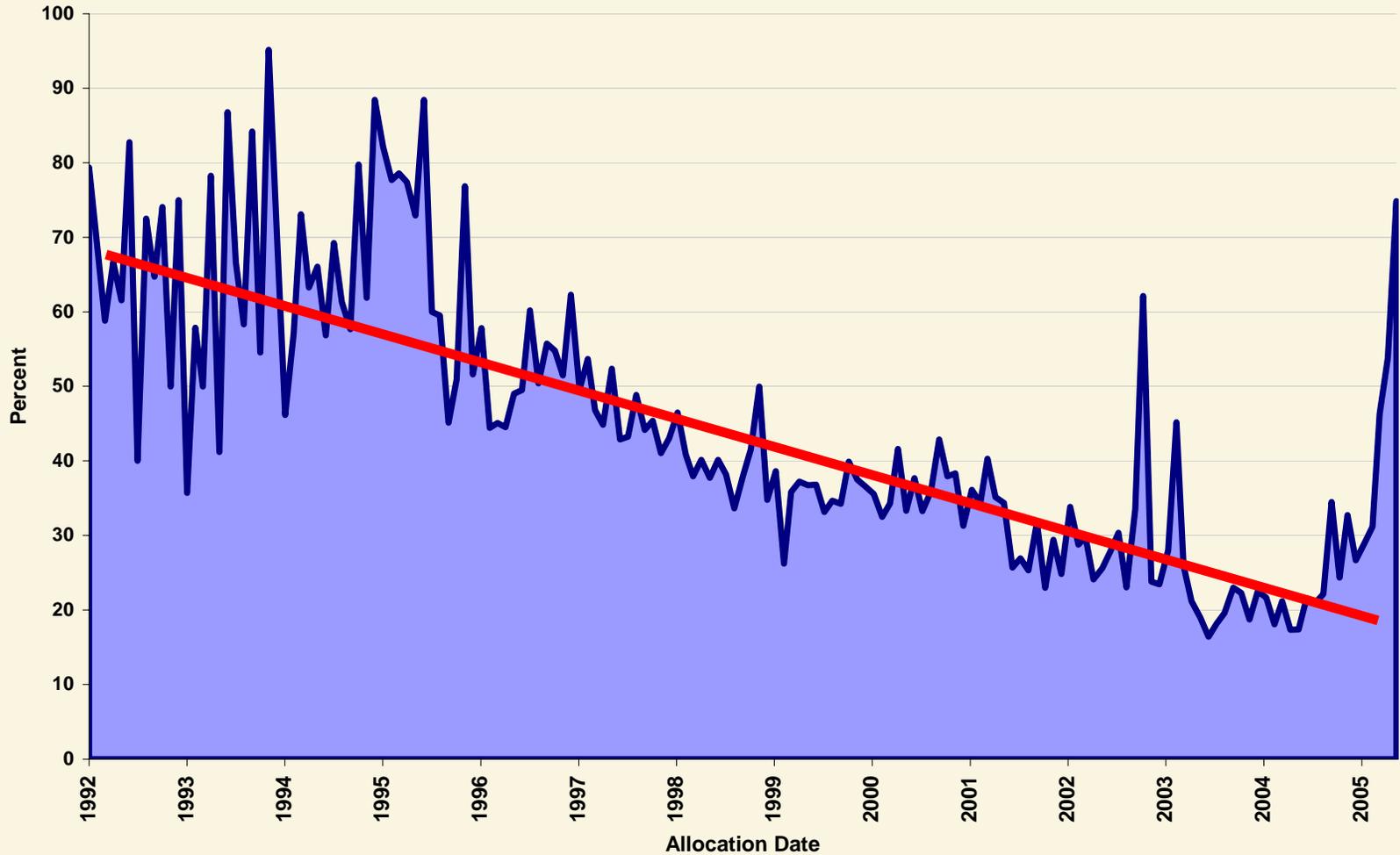
# Distribution by AS Number Range

AS Status - April 2005



# UnAdvertised / Advertised Relative Proportion by Date

Unadvertised ASs (% of Allocated) by Date



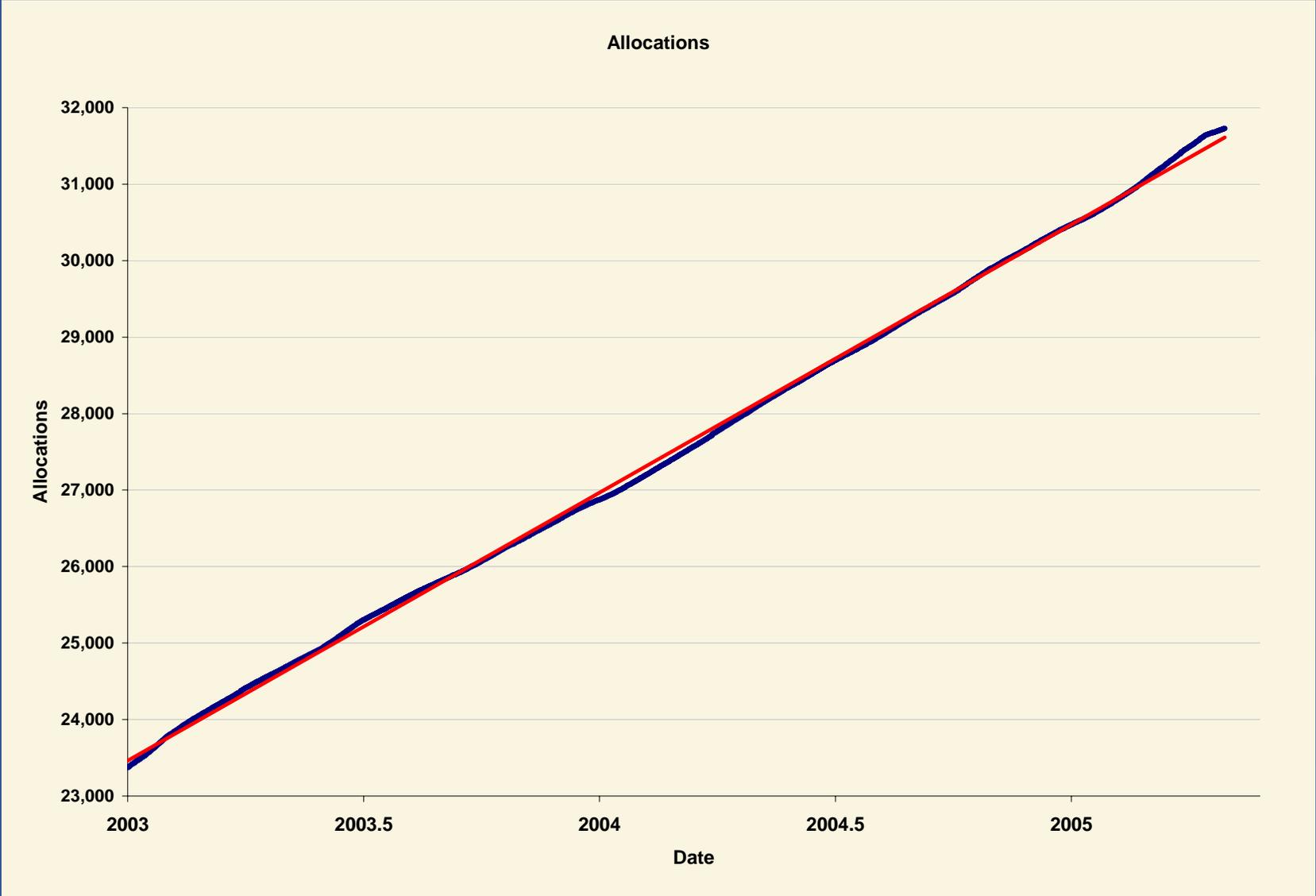
# Observations

- AS numbers age out and disappear
  - 5% attrition rate per year
- Old (low) AS number ranges have the highest unannounced / announced ratios
- Recent assignments take some 4 months to be advertised
  - LIR staging point factors
- Projections of AS number consumption should include a factor for Unadvertised / Advertised ratio that has a linear best fit (negative slope)

# Selecting a Best Fit to the Data

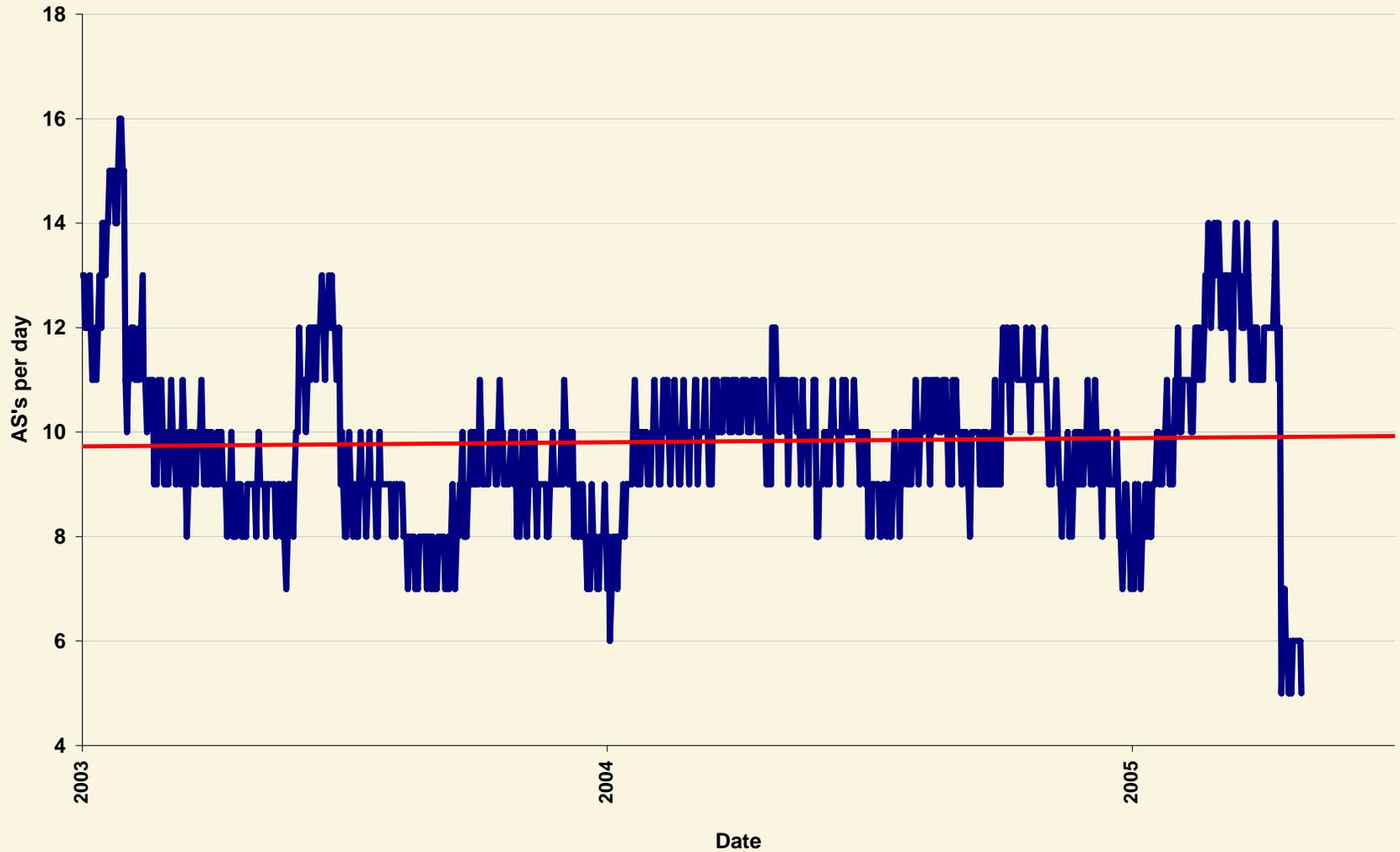
- A Linear growth model will have a constant first order differential
- An exponential growth model will have a linear best fit to the log of the data
- The data set for the best fit is to a smoothed (moving average) time series of the cumulative sum of RIR AS allocations

# Linear Model Fit

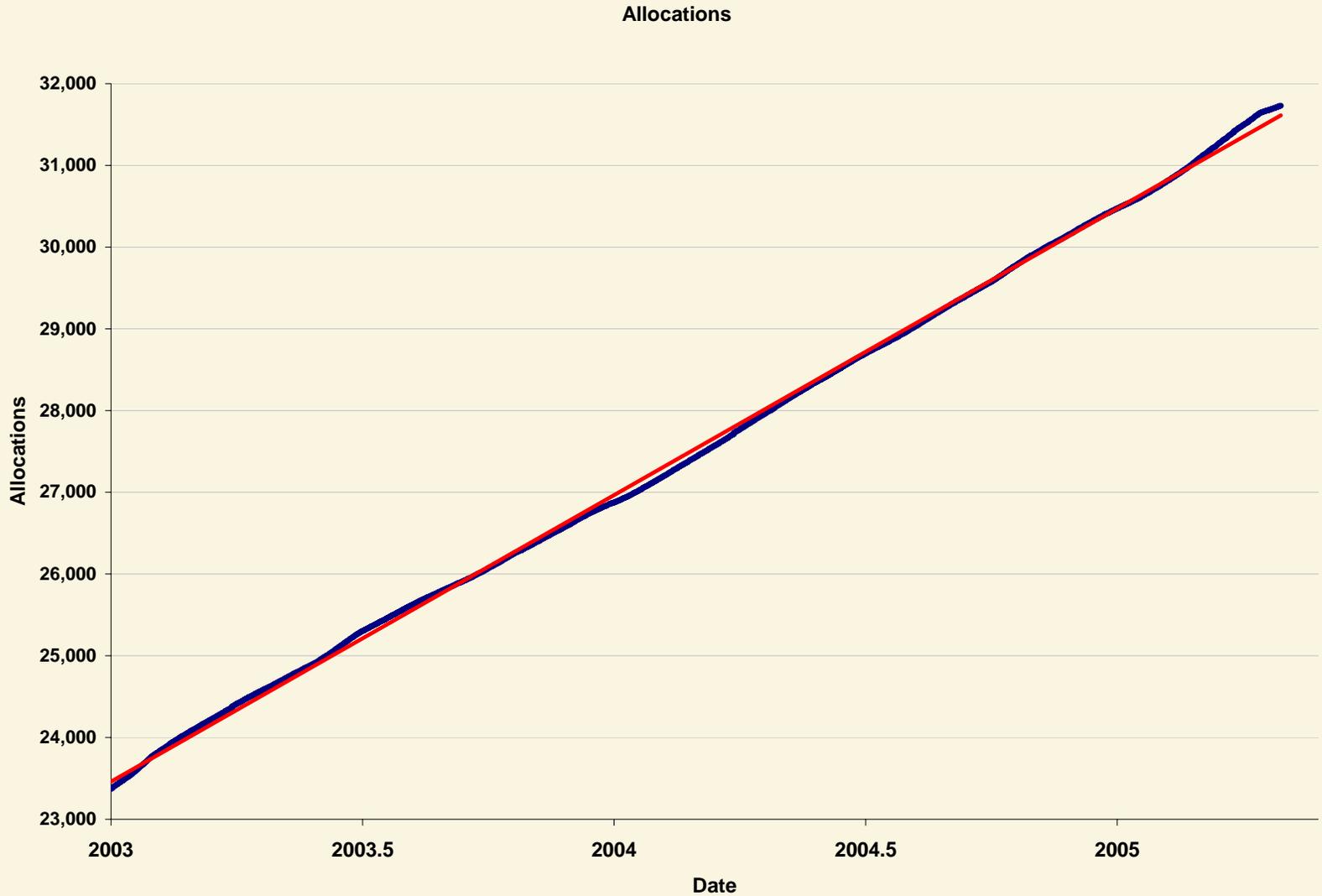


# Linear Model Fit

AS Allocations - 1st order differential

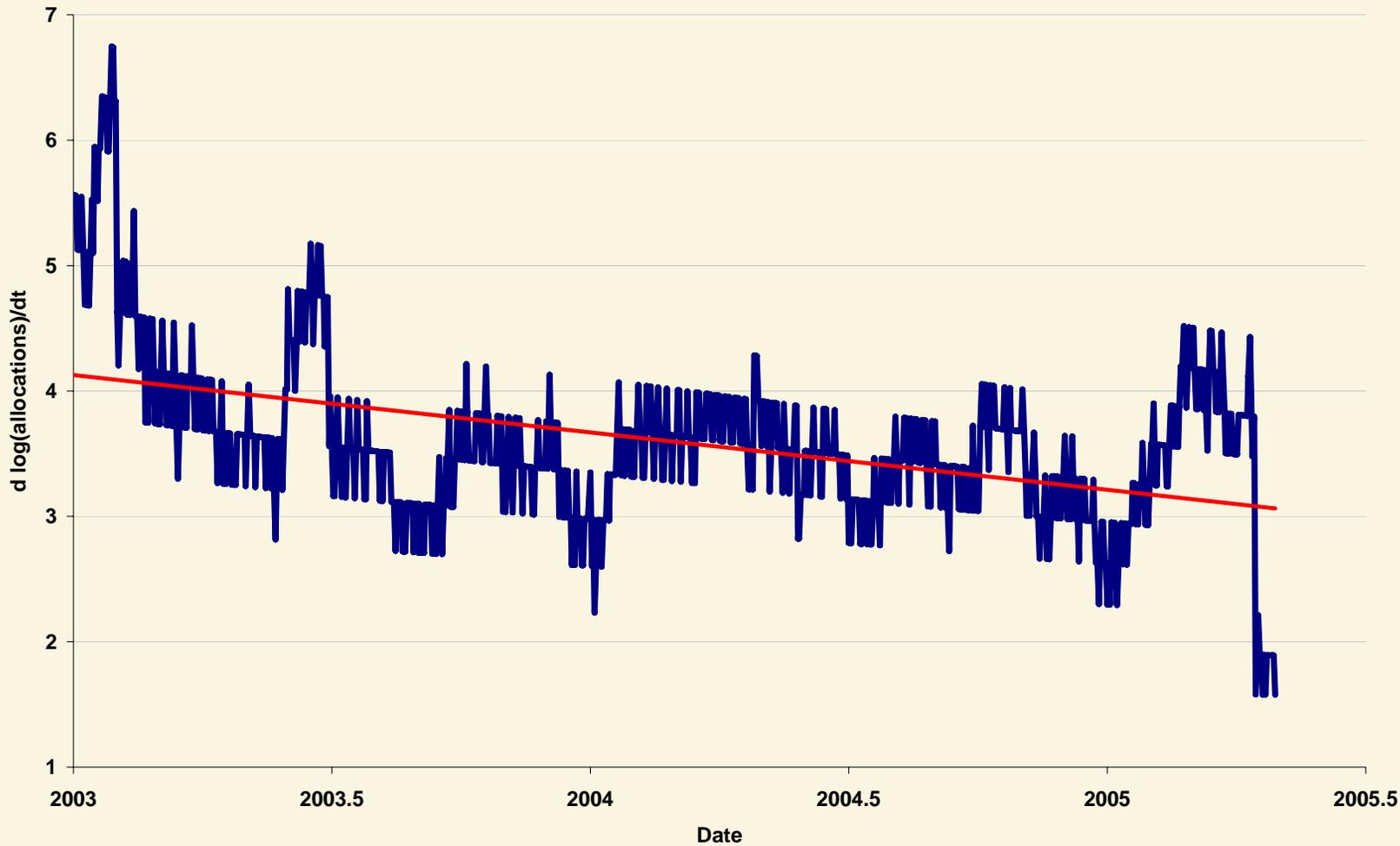


# Exponential Model Fit



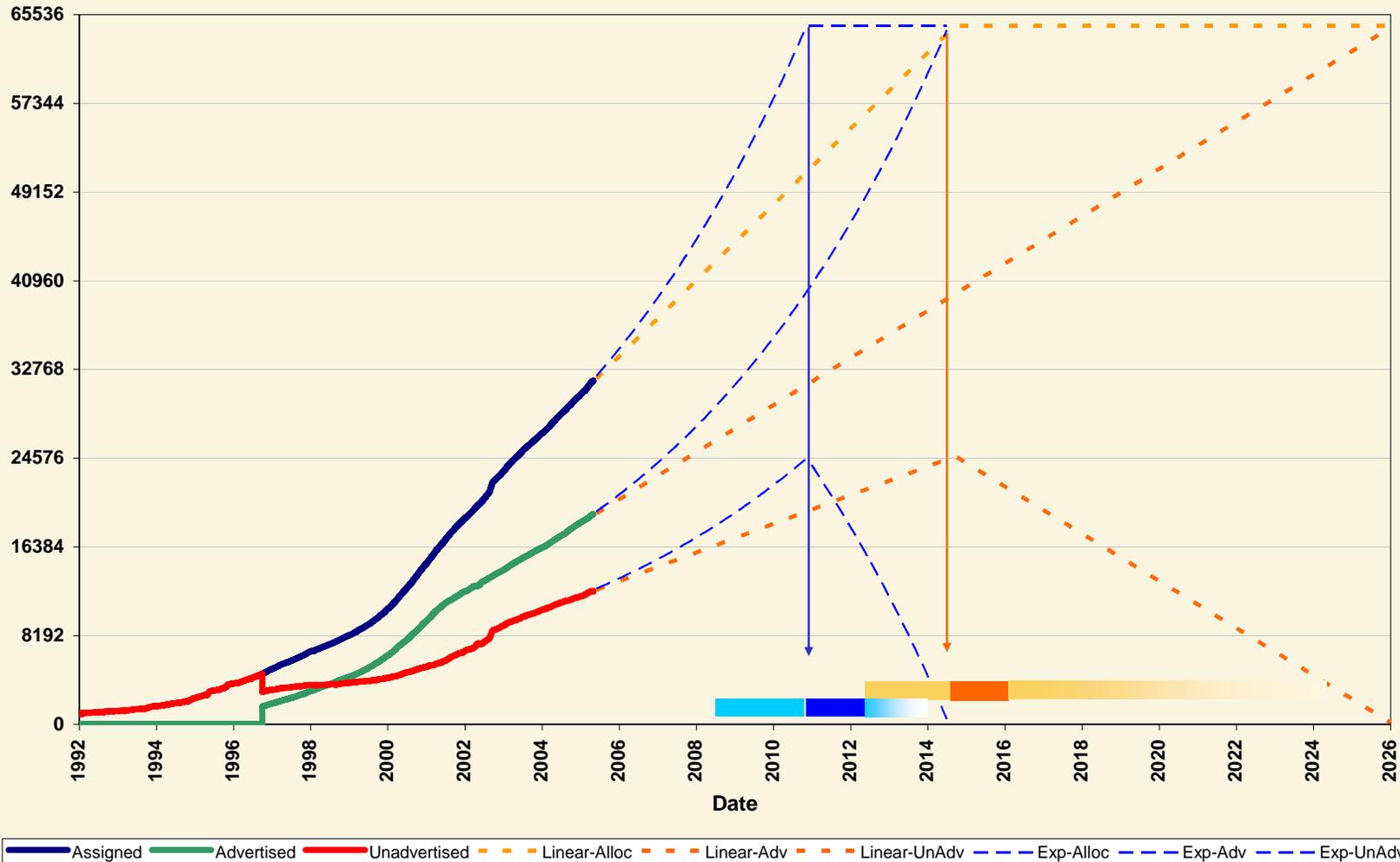
# Exponential Model Fit

1st Order Differential of Log(Allocations)



# Combining Allocation and Advertised AS Data Projections

AS Consumption Projections



# Current AS Use Projections

- The available AS number pool will exhaust in the timeframe of 2010 - 2020 if current AS use trends continue

## 2010

- No significant reclamation in old AS number space
- No coordinated effort to increase utilization density of AS numbers
- Increasing consumption trend
- Most likely outcome as a best fit to post 2003 consumption data

## 2020

- Extensive reuse of idle / unused AS numbers
- High use rate maintained
- Assuming a continued constant rate of demand

# Planning Considerations (again)

- Need to allow a lead time for testing, deployment of 4-byte AS BGP implementations and development and testing of appropriate transition arrangements
  - Allow some 3-4 years to undertake this smoothly
- So we'd like to know when we have around 4 years to go before we run out of AS numbers
- In the most likely consumption projection that advance planning date looks like being in 2006
- In a more tempered growth environment this may extend out to 2010