IPv4 Address Lifetime Revisiting the BGP data

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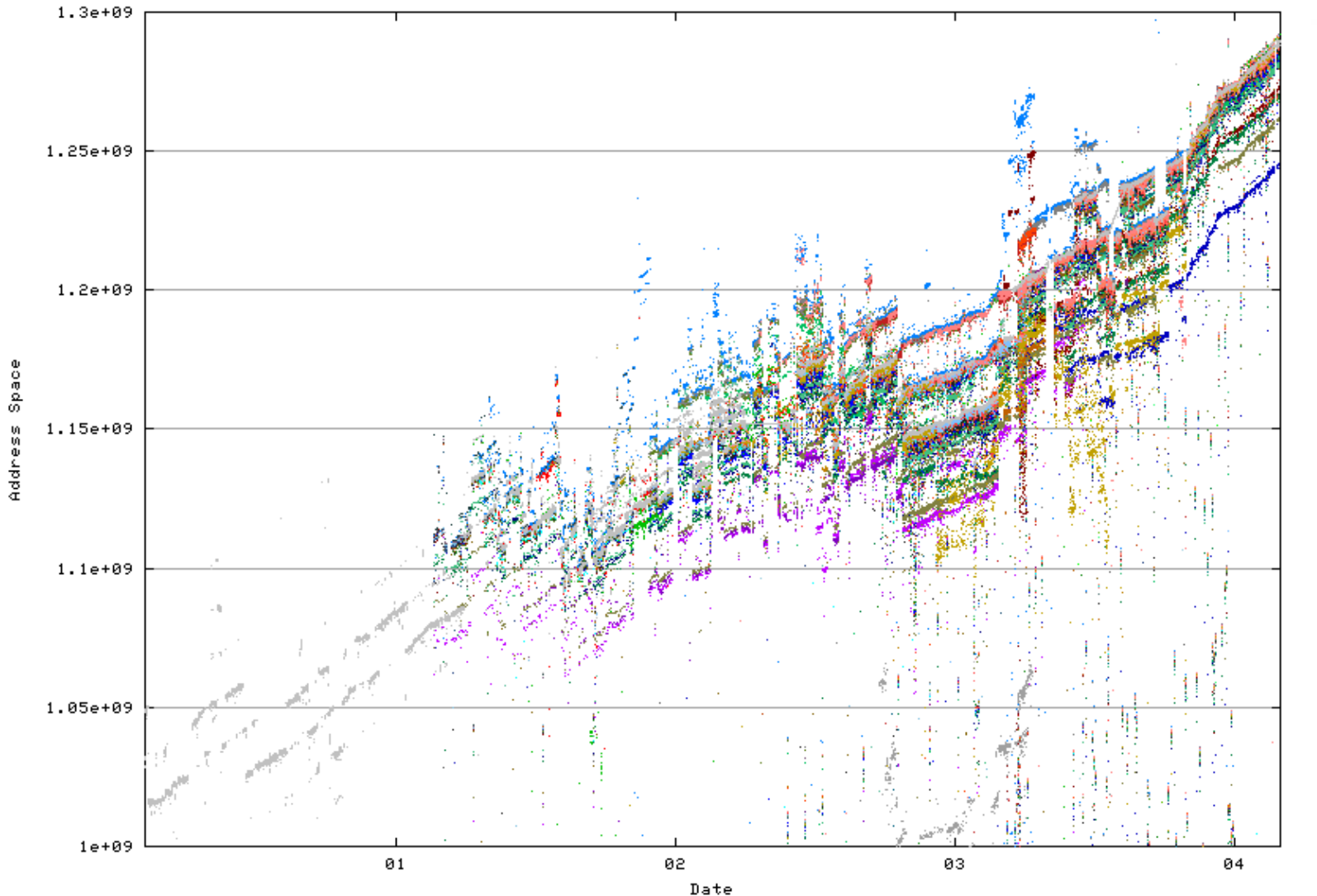
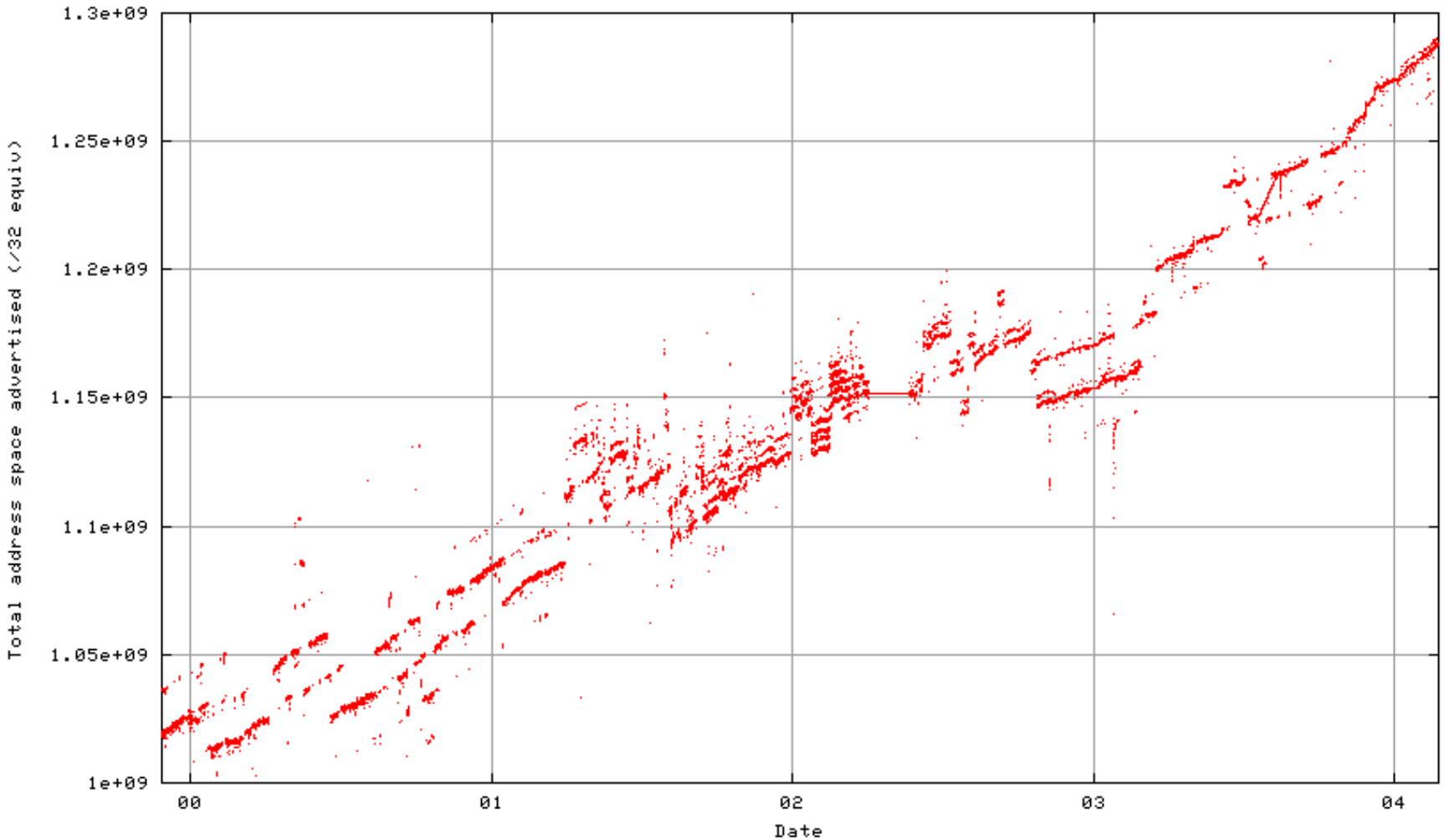
BGP Announcements - Projection

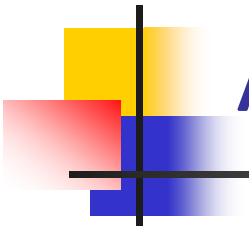
- Comments received about the projection work in 2003 have prompted a more detailed analysis of the BGP data
- It appears that there is a different view that can be formed from the data
- Firstly, here's the raw data – hourly measurements over 3 years…

Route-Views Data



Taking one ‘line’ (AS1221)





Another look at that BGP data…

- The most obvious noise comes from flaps in /8 advertisements.
- The first step is to remove this noise by recalculating the address data using a fixed number of /8 advertisements
- The value of 19 was used to select one of the ‘tracks’ in the data
- Now use gradient smoothing, limiting the absolute values of the first order differential of the data (gradient limiting) to smooth the data

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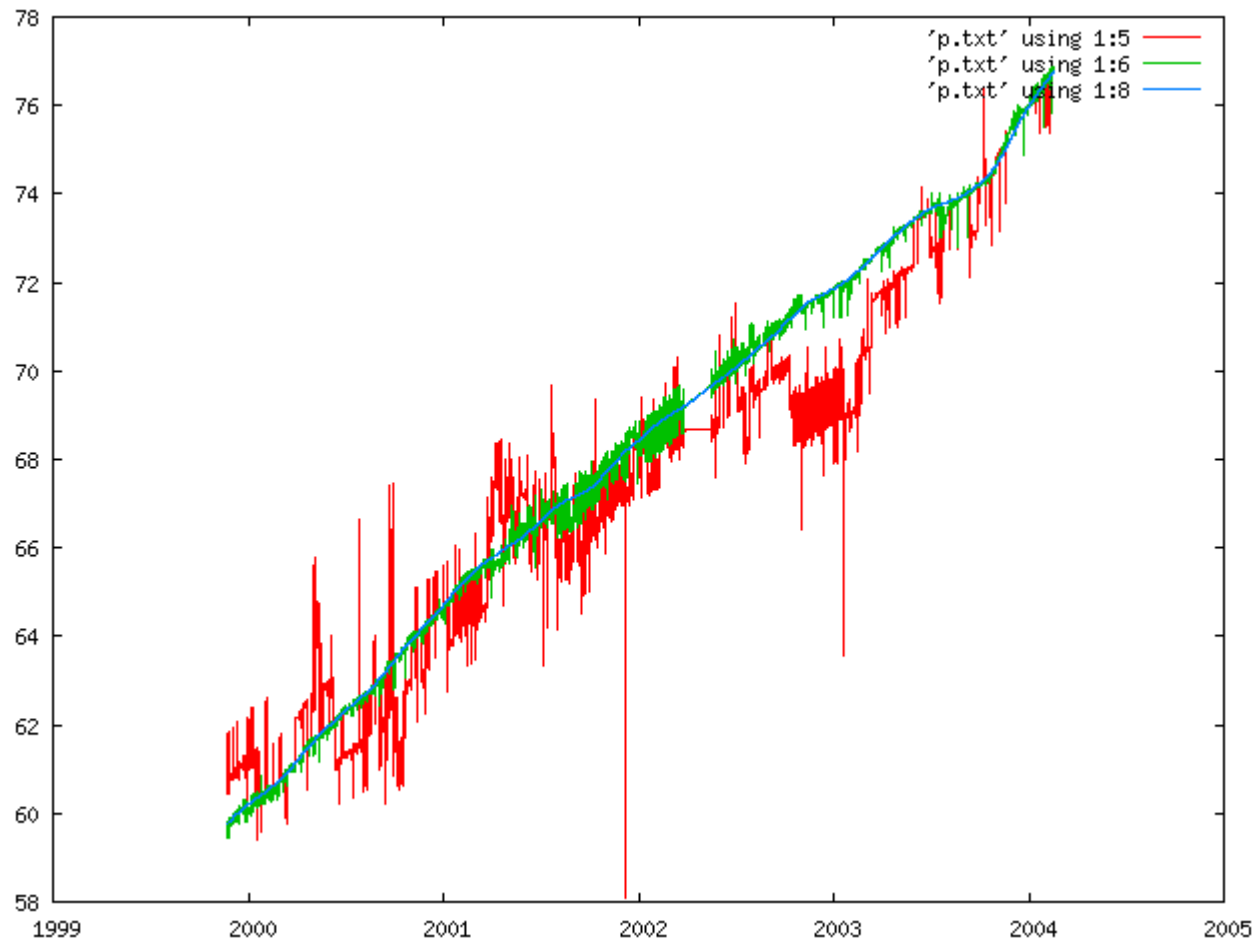

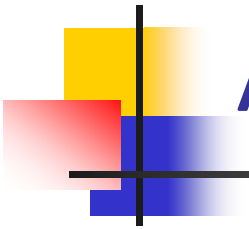

Another look at that BGP data…

- Its now possible to apply a best fit function to the data….

Another look at that BGP data…

- First order differential of total BGP announcement
  - Until 2000, exponential (accelerating) growth
  - Since 2000, oscillating differential and overall deceleration
- The least squares best fit to the first order differential of the smoothed BGP data

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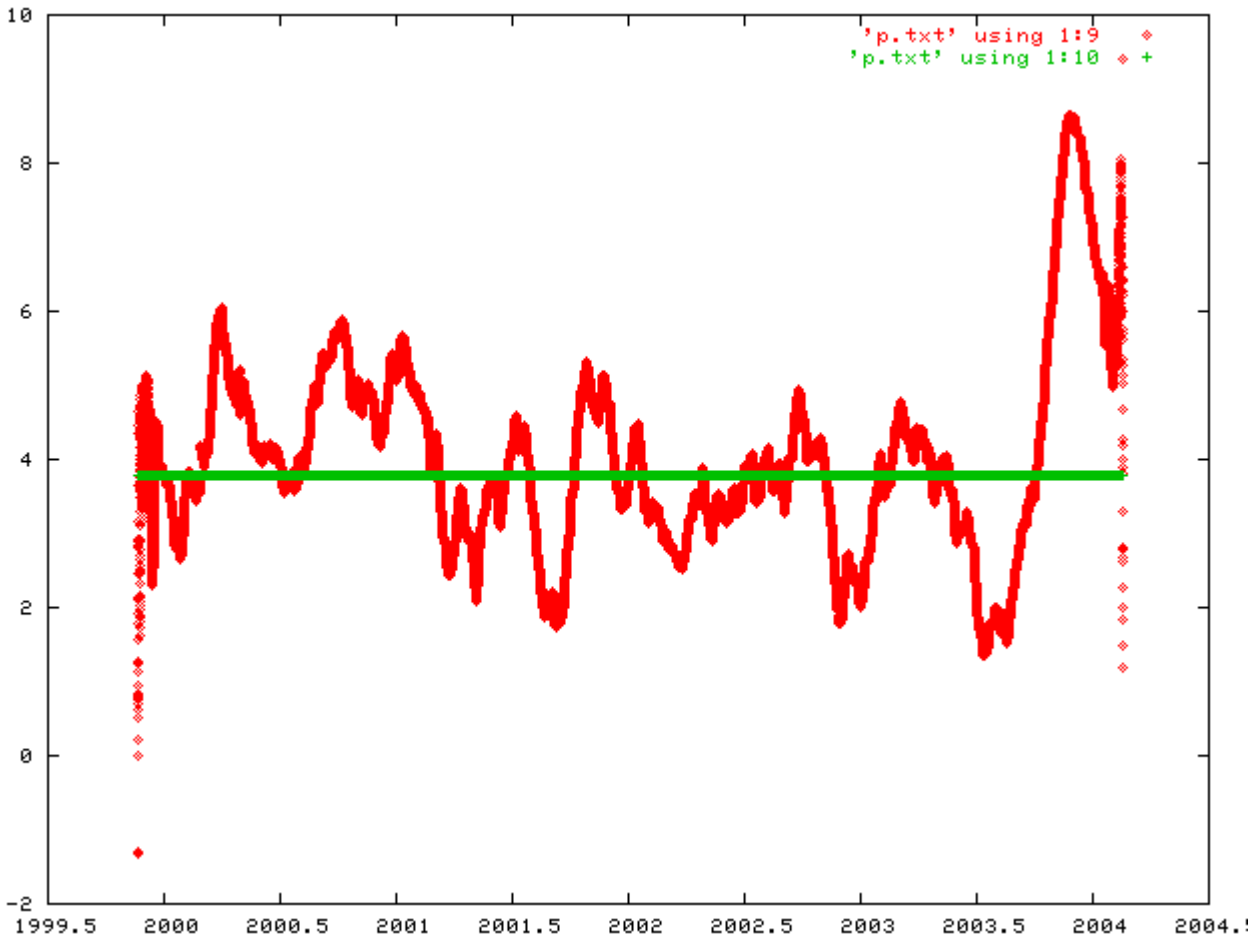

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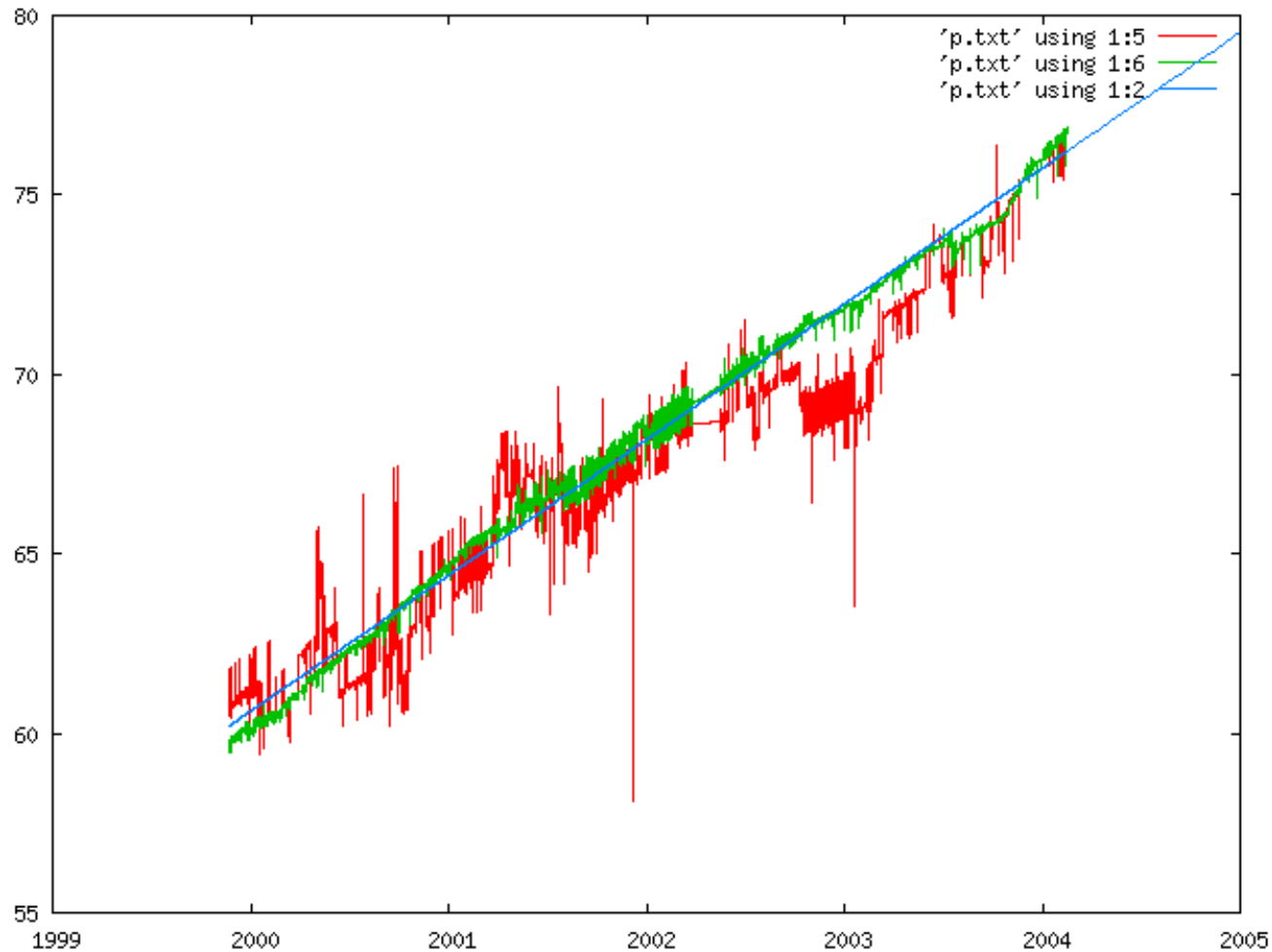

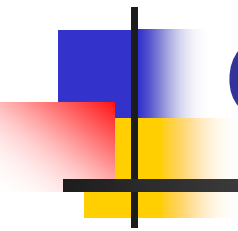

Combining the Data

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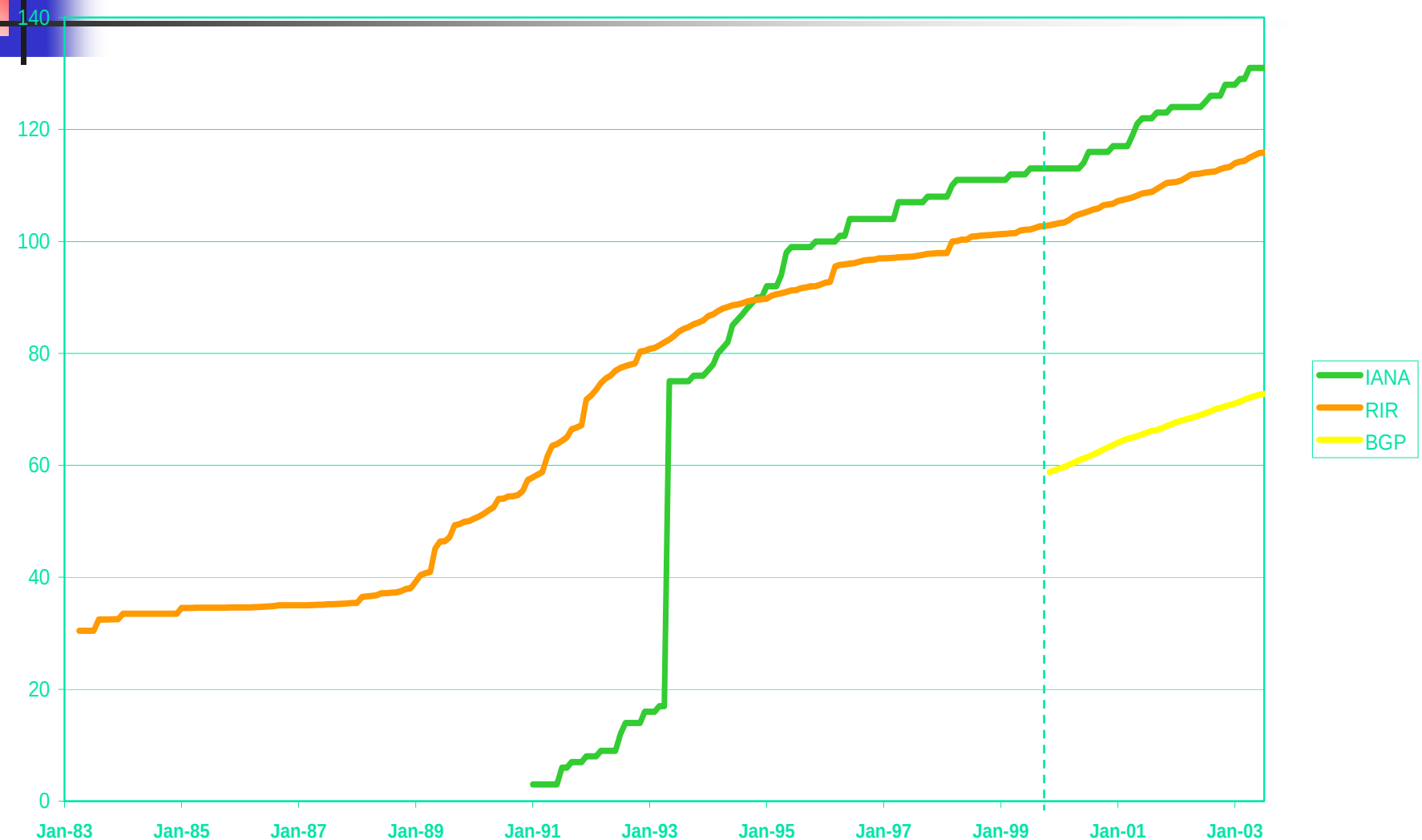
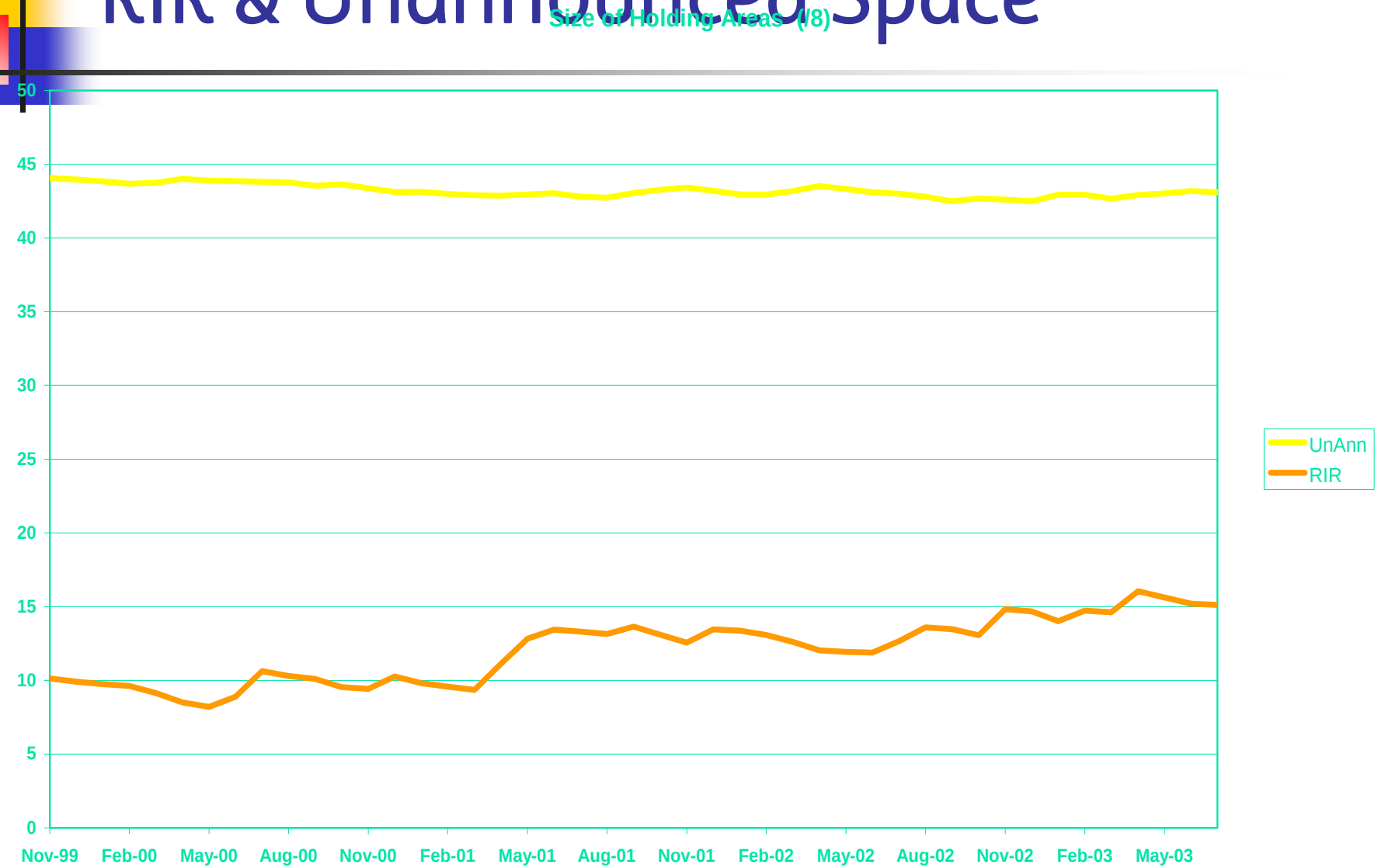


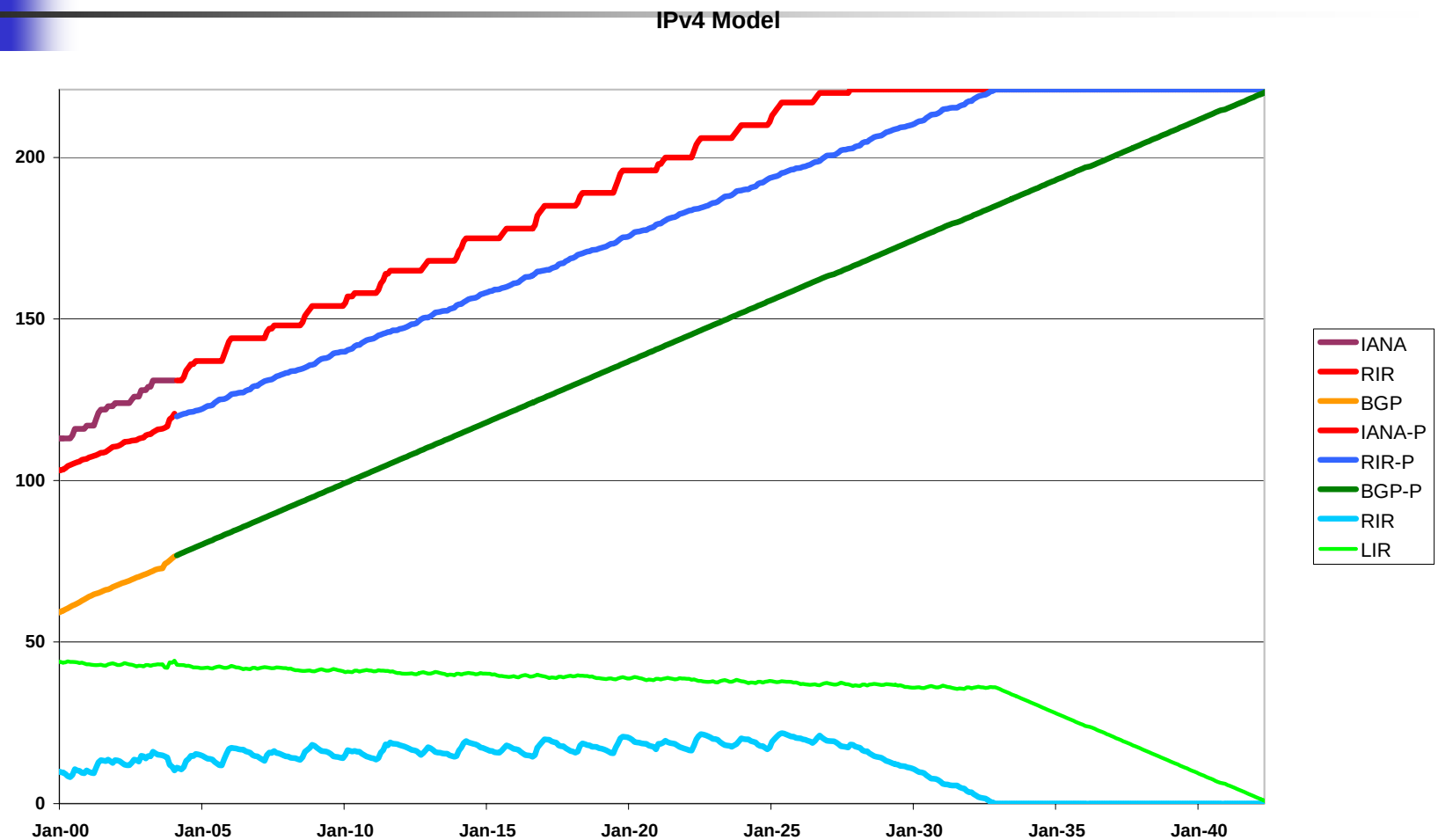
Holding Pools: RIR & Unannounced Space

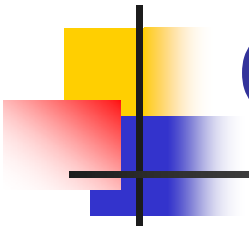


Modeling the Process

- Assume that the RIR efficiency in allocation slowly declines, so that the amount of RIR-held space increases over time
- Assume that the Unannounced space shrinks at the same rate as shown over the past 3 years

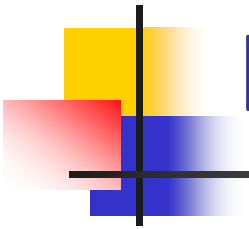
Modeling the Process





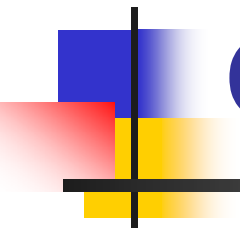
Observations

- Extrapolation of current allocation practices and BGP-based demand model
- Derived from 2000-2003 data
- Considering
  - IANA/RIR unallocated pool
  - Total address space including allocated but unannounced
- Assuming linear growth
  - Address space lasts until 2037 – 2047
  - Effective unallocated pool exhaustion: 2028



Issues

- This is just a model - reality will be different!
- Will the BGP routing table continue to reflect allocation rates?
- Is the model of the unadvertised pools and RIR holding pools appropriate?
- Externalities…
  - What are the underlying growth drivers (applications) and how are these best modeled?
  - What forms of disruptive events would alter this model, and to what extent?



Questions?