Asia Pacific Network Information Centre

APNIC

IPv4 Address Lifetime
SANOG IV

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Research activity
conducted by Geoff Huston
and supported by APNIC

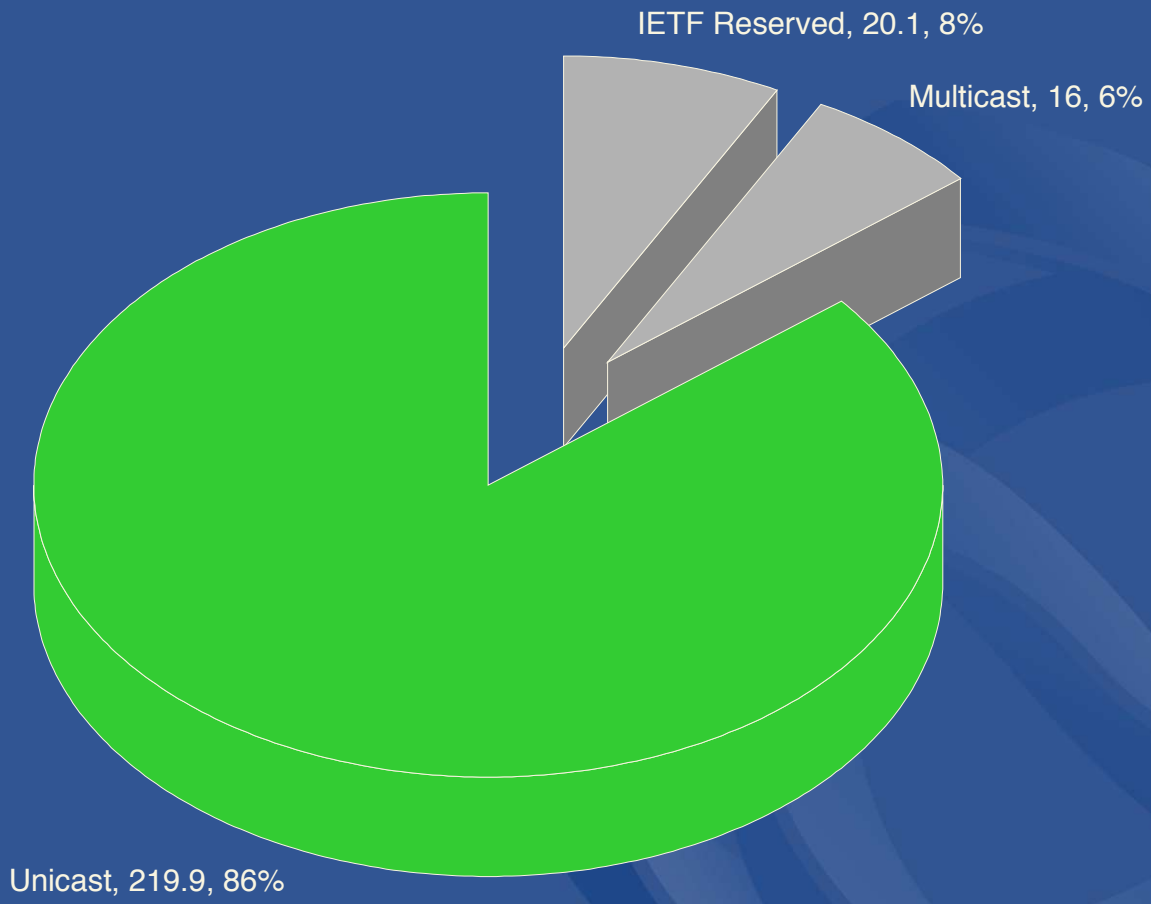
Are we running out of IP addresses?

- Recent media reports claiming we are running out of IP addresses
  - Some claim we've already run out in some parts of the world
- But what are the facts?
  - *Is the IPv4 sky falling?*
- Geoff Huston, chief scientist at APNIC, has studied the IPv4 consumption rates

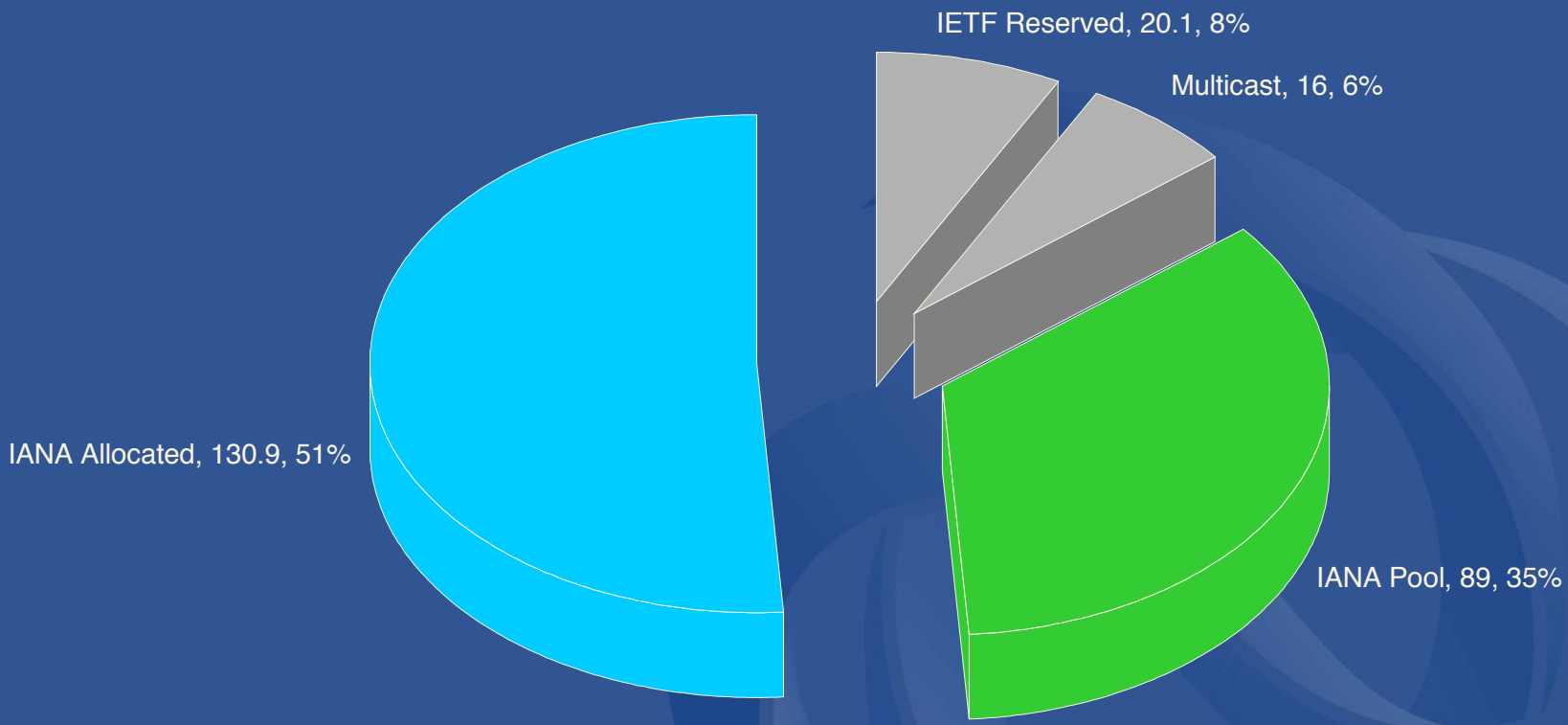
Modeling the Process

1. IETF definition of IPv4
   - Source: IETF standards (RFCs)
     - Delegation of address space for IANA administration
2. IANA allocations to RIRs
   - Source: IANA IPv4 Address Registry
     - Allocation of /8 blocks to RIRs and others
3. RIR allocations to ISPs
   - Source: RIR Stats files
     - Allocation of blocks to LIRs
4. ISP announcements
   - Source: BGP routing table
     - Amount of address space advertised

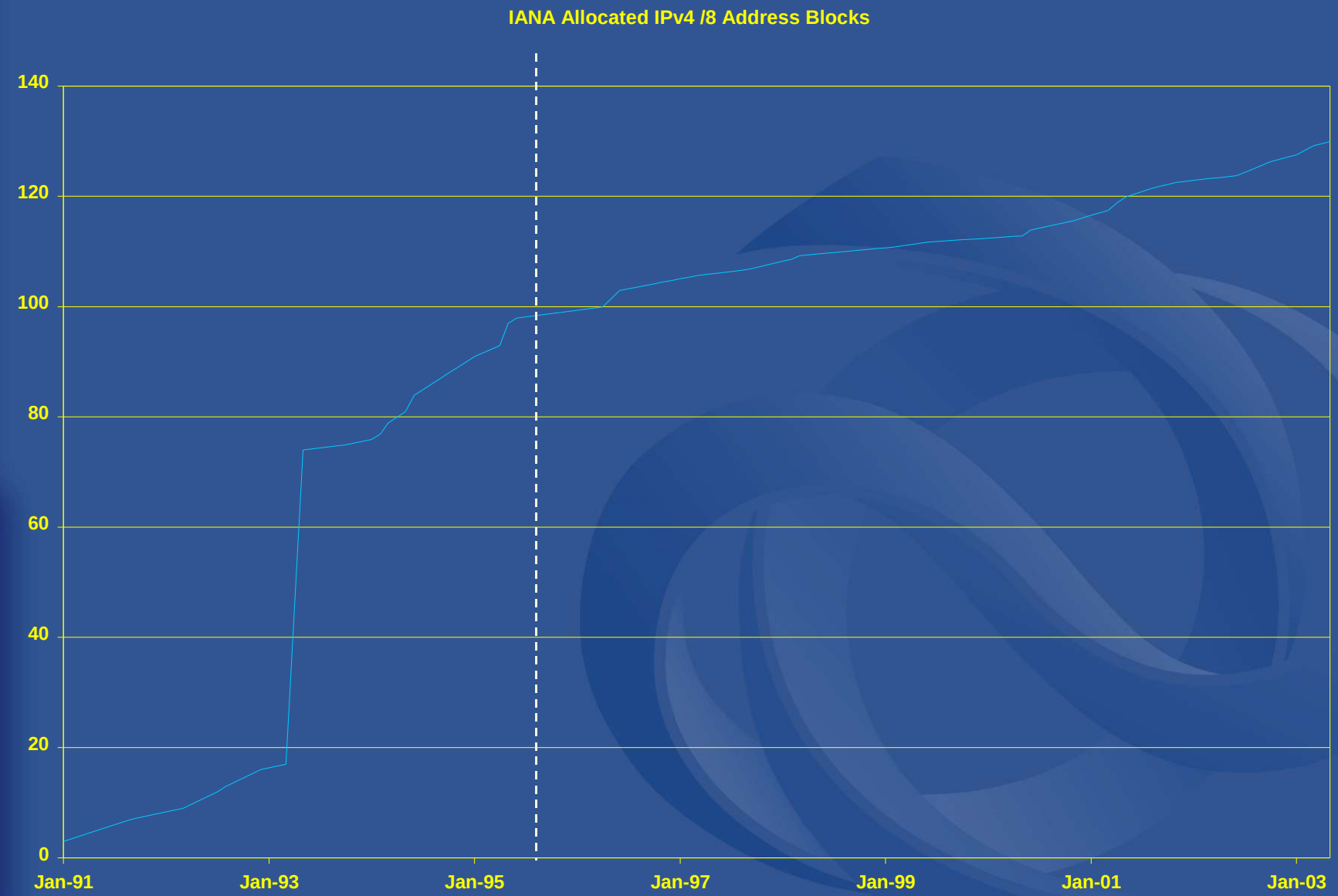
1. IETF Delegations – IPv4



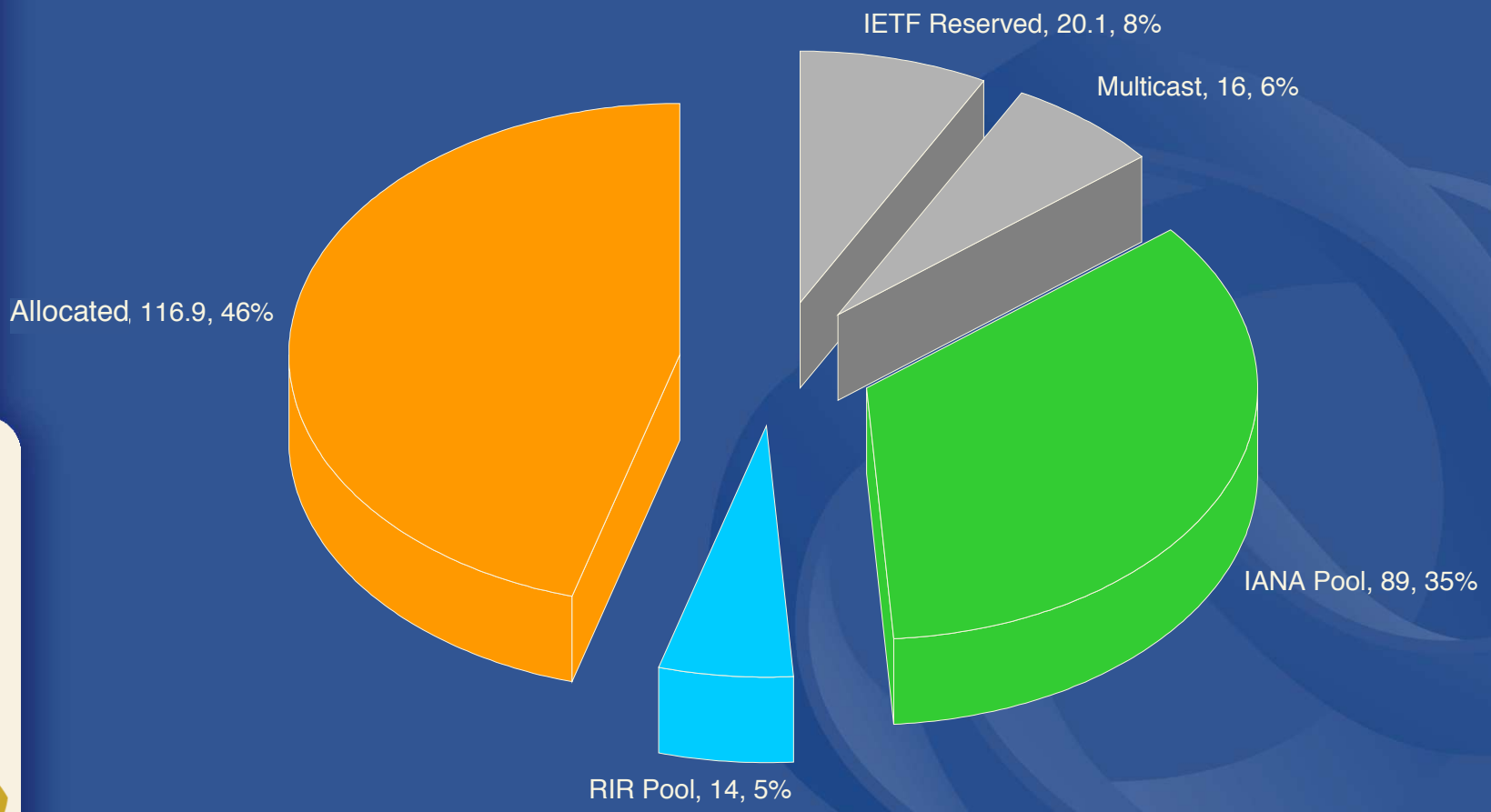
IANA Allocations - Current



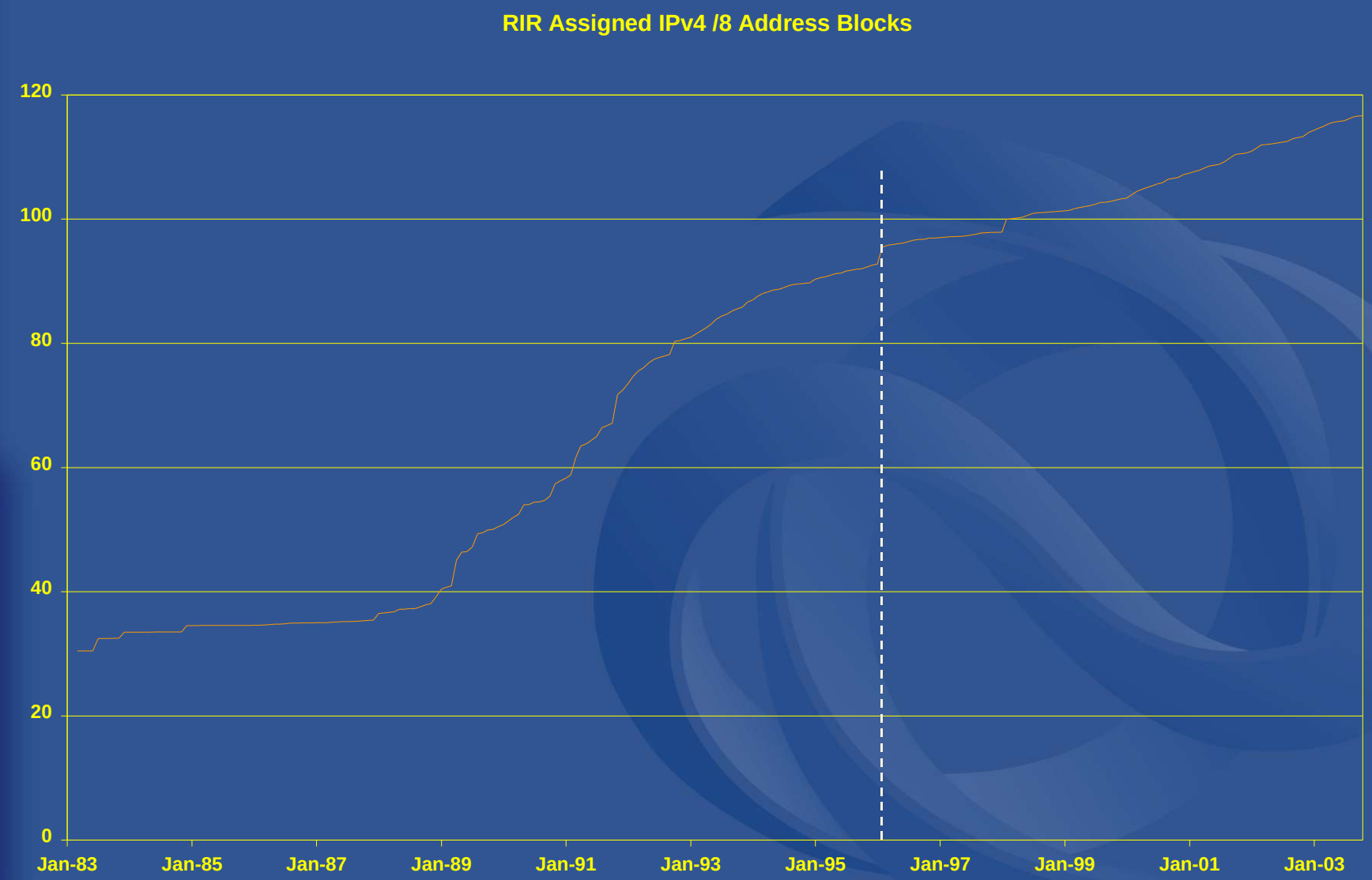
IANA Allocations - Historical



RIR Allocations - Current



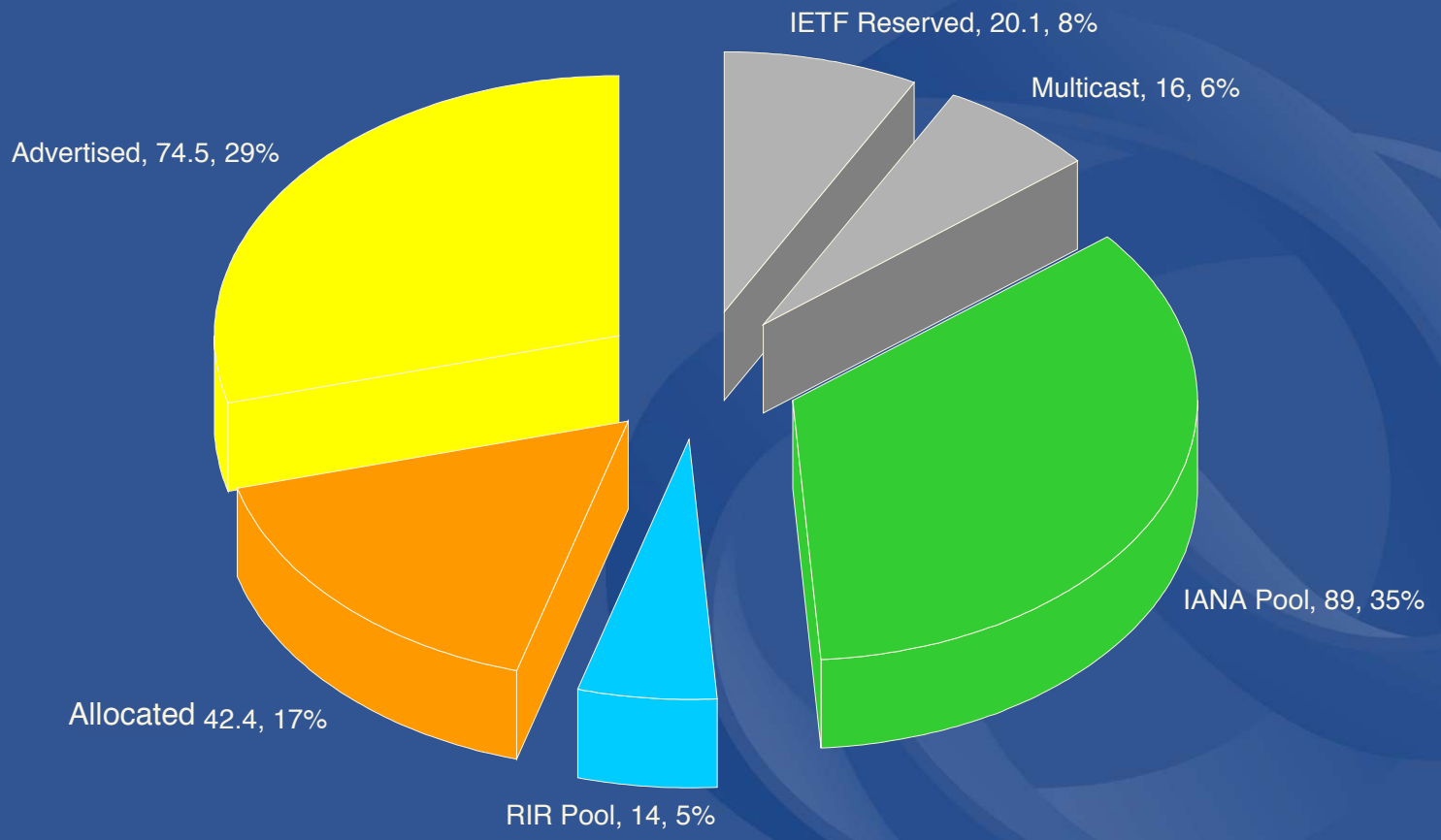
RIR Allocations - Historical



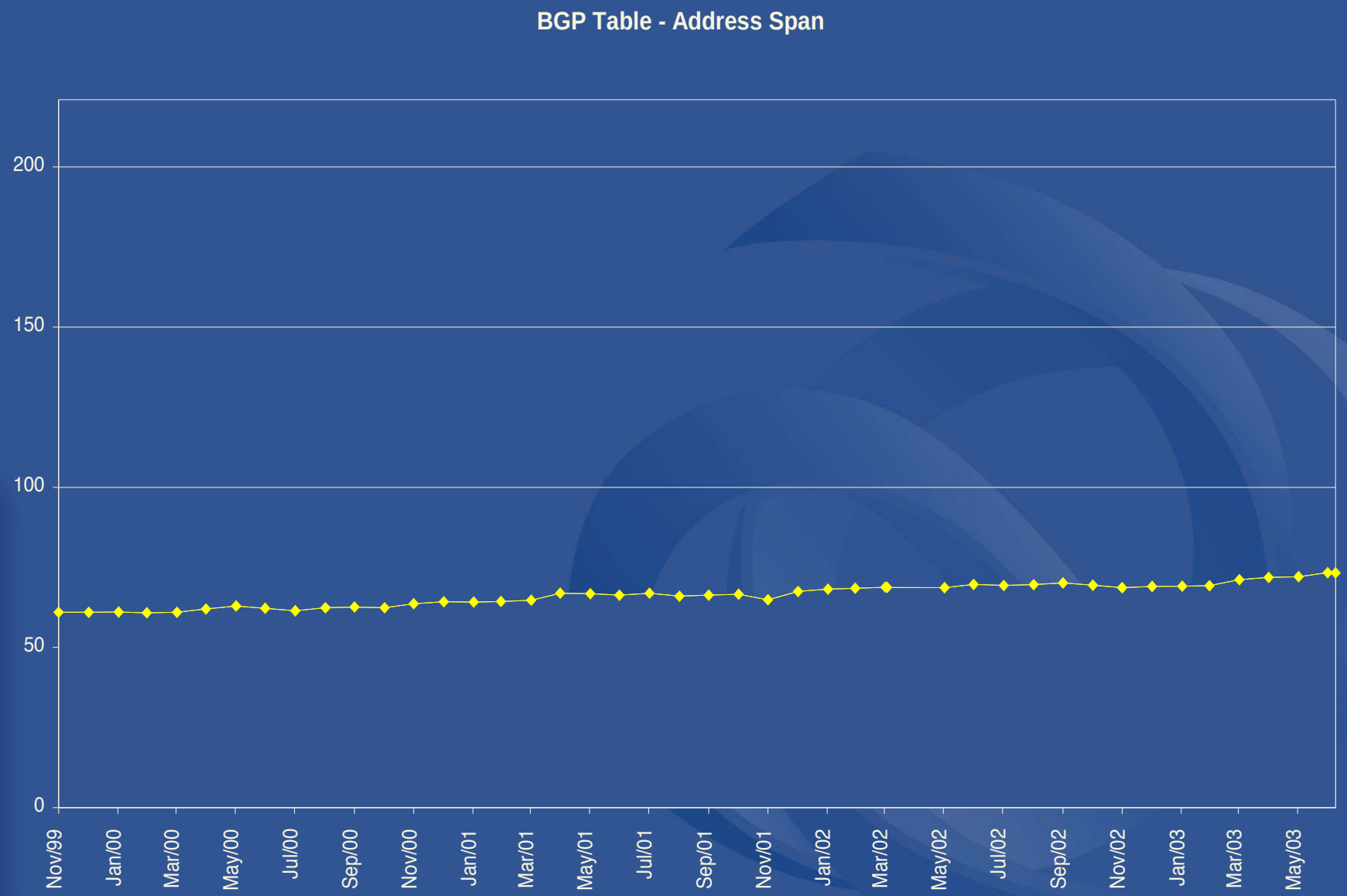
BGP Routing Table

- The BGP routing table spans a set of advertised addresses
  - Representing addresses in use by ISPs
- A similar analysis of usage and projection can be undertaken on this data
- Assumption: BGP routing table represents actual IP address usage
  - Therefore it “drives” the other trends

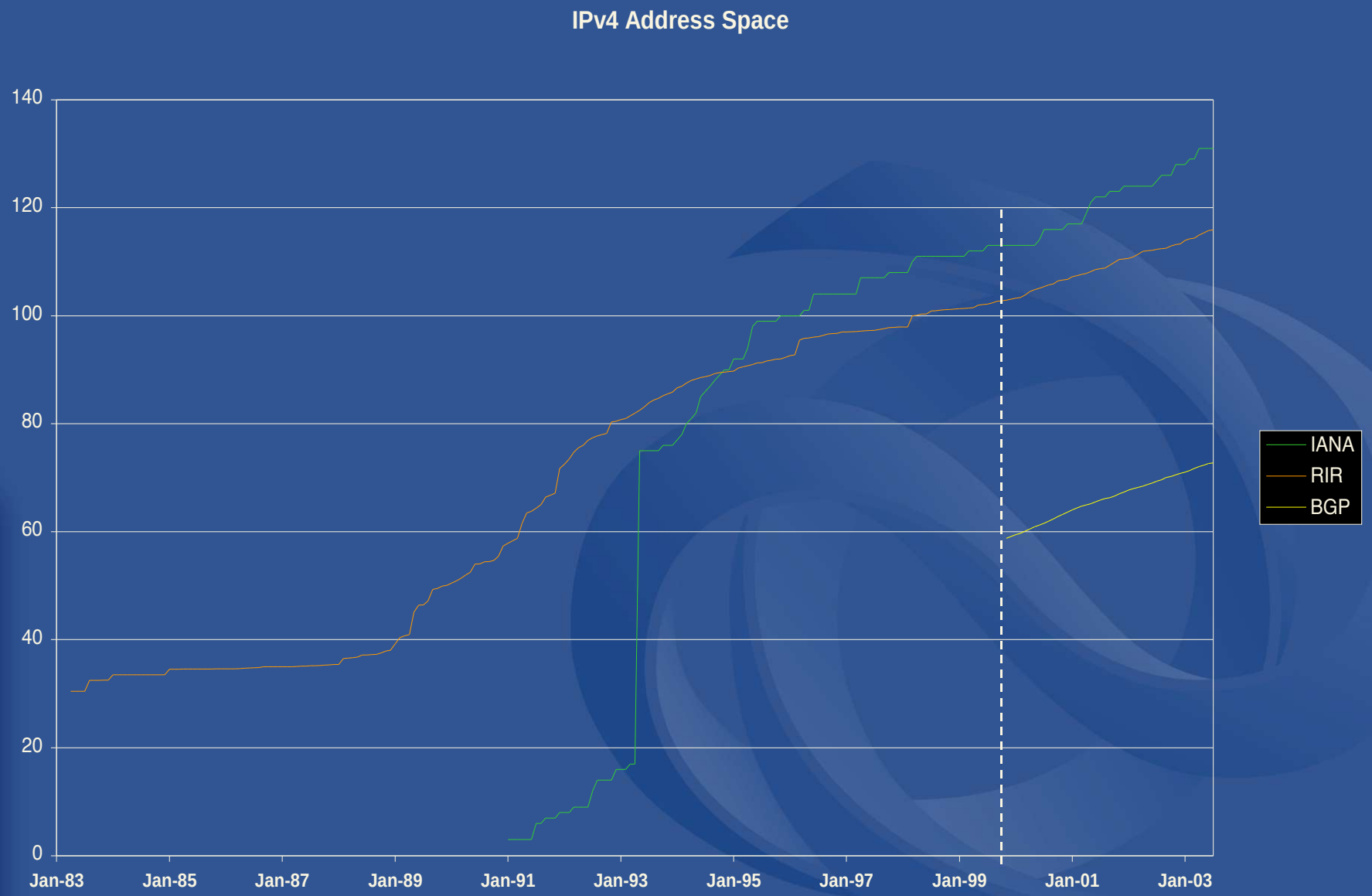
BGP Routing Table - Current



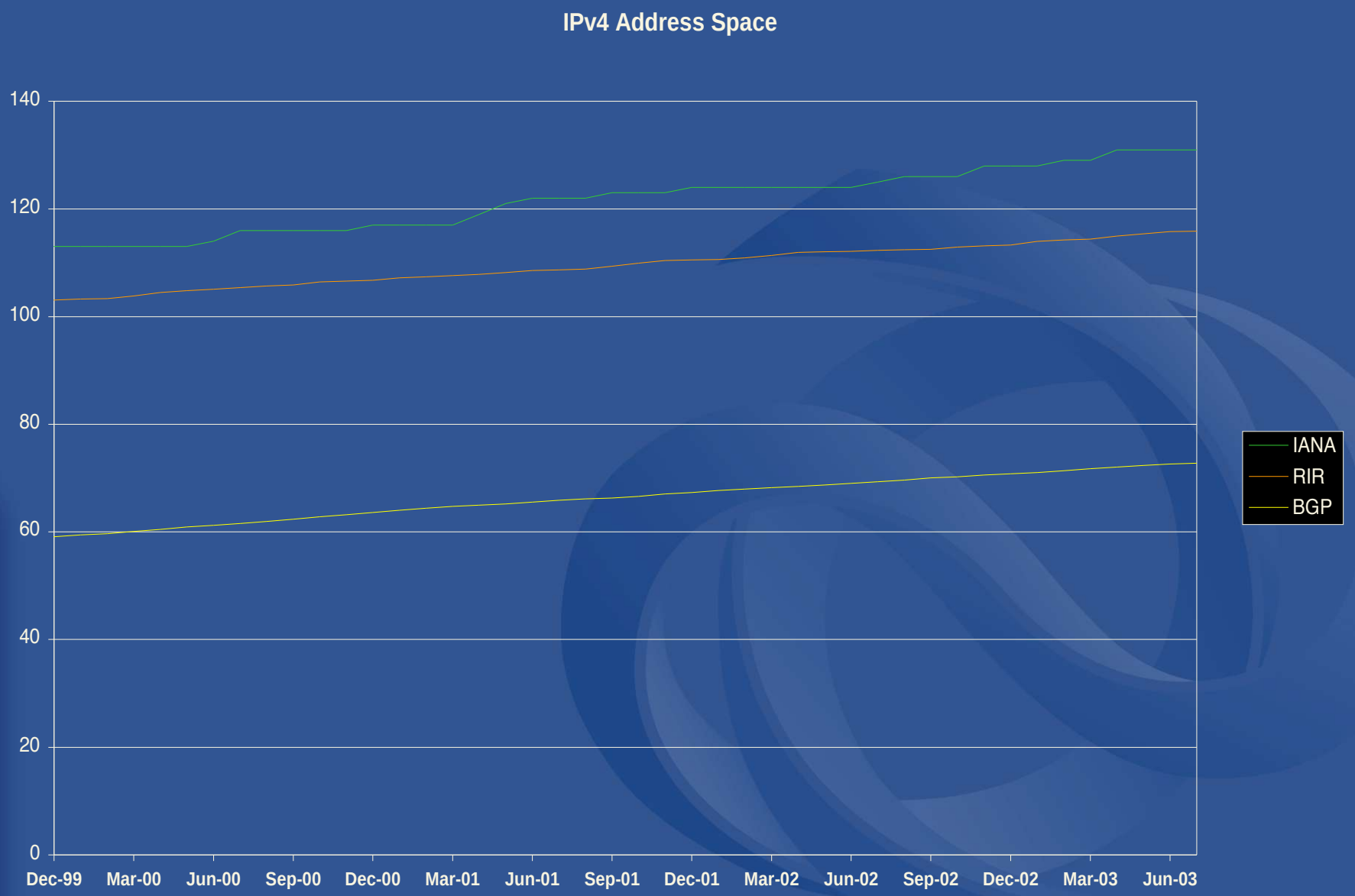
BGP Announcements - Historical



Combining the Data



Recent Data



Projections

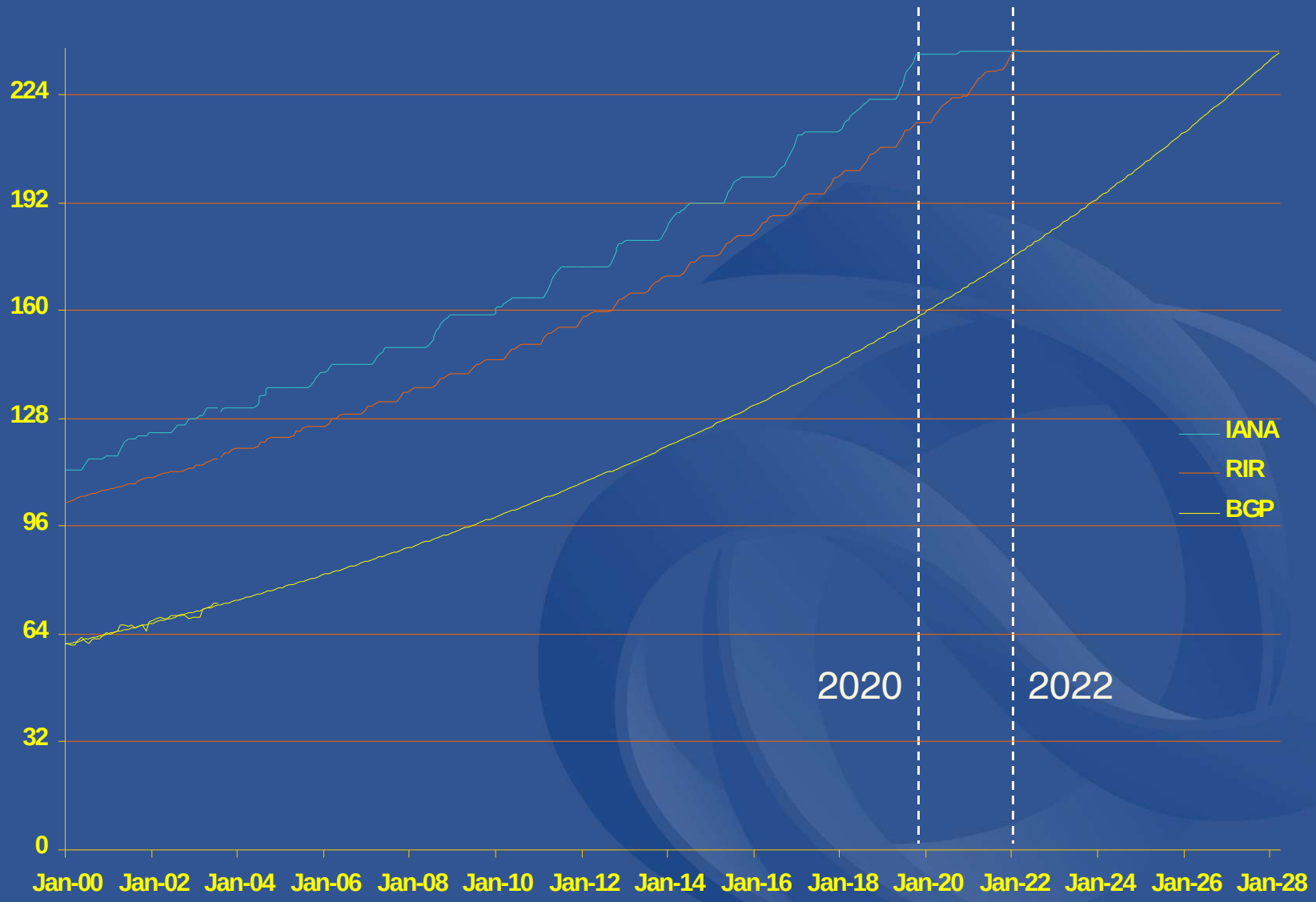
Projections – IANA & RIR Allocations

- Any projection is very uncertain because of:
  - Sensitivity of allocation rate to prevailing RIR policies
  - Sensitivity to any significant uptake up of new applications that require end-to-end IPv4 addressing vs use of NATs

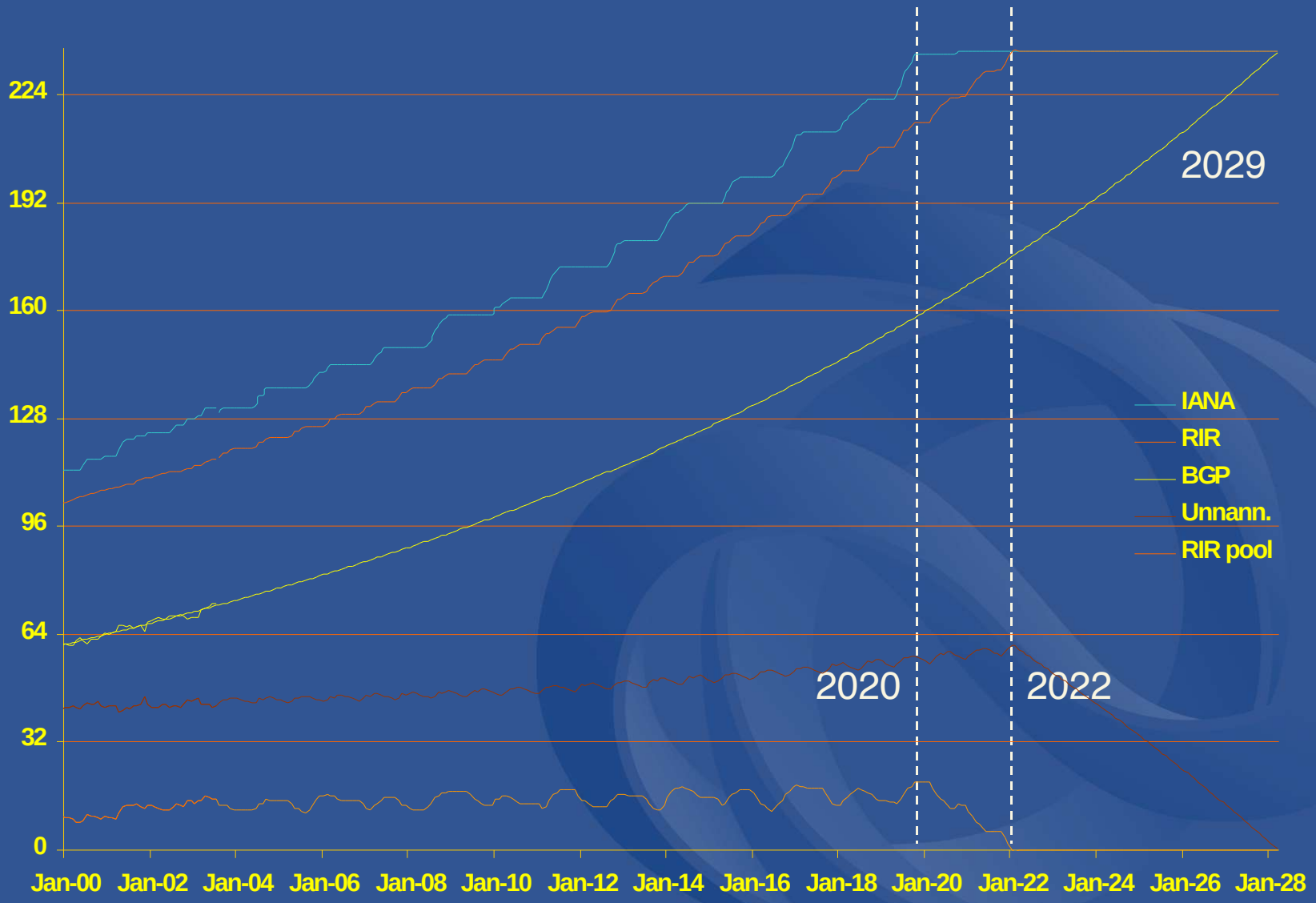
Projections – BGP Data

- 3 year data baseline
  - Much shorter baseline than the IANA and RIR projections
  - Considerable uncertainties with this projection
- First order differential of total BGP announcement
  - Until 2000, exponential growth
  - Since 2000, oscillating differential and overall deceleration
  - Last 6 months, differential approaching 0 (i.e. no growth)
- Linear fit seems most appropriate for this data

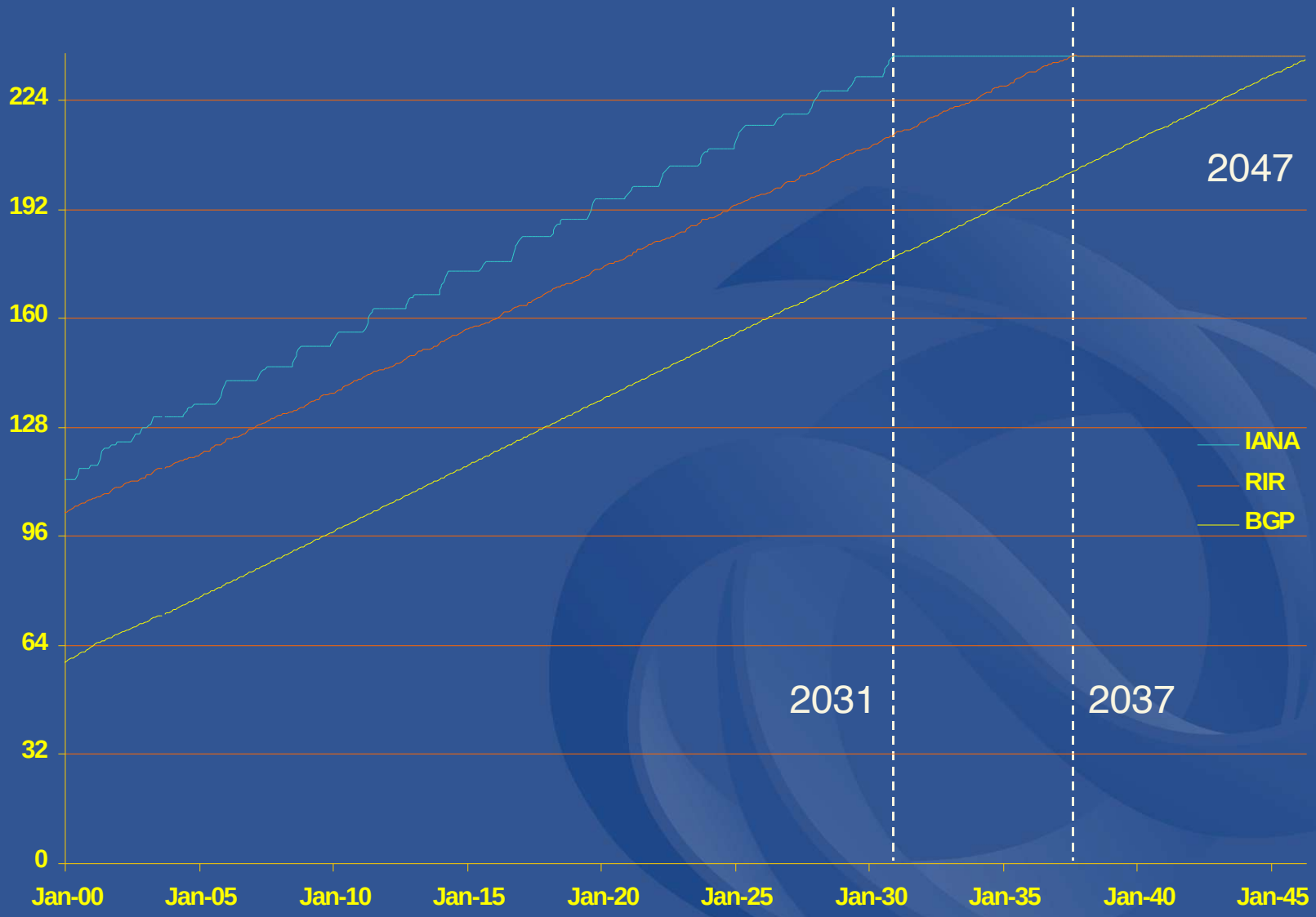
Process model - exponential



Process model - exponential



Process model - linear



Methodology and Caveats

- Projection of based on 2000-2003 data
  - IANA and RIR allocation practices
  - BGP-based demand model
- Incorporating
  - RIR unallocated pool
  - Total address space including allocated but unannounced
- Exponential growth model
  - Address space lasts until **2022**
  - (or **2029** if all unannounced space recovered)
- Linear growth model
  - Address space lasts until **2037** (or **2047**)

Some Big 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 unannounced pools and RIR holding pools appropriate?
- Externalities…
  - What are the underlying growth drivers (applications and services) and how are these best modeled?
  - What forms of disruptive events would alter this model, and to what extent?

Concluding thoughts…

- IP address management
  - Result of 20 year evolution on the Internet
    - Supported Internet growth to date
- We are not running out of IP addresses now
  - But impossible to predict future
    - Policies change
    - New technologies can emerge
    - Market behaviour can change

What about IPv6?

- RIRs support the deployment of IPv6
  - Transition will take time
    - Necessary to start now
    - IPv4 was slow to start, but grew exponentially over the last 10 years
  - Don't get left behind!
    - Be future ready!
- Responsible management essential to keep the Internet running

Questions?

http://www.potaroo.net

http://www.potaroo.net/ispcolumn/2003-07-v4-address-lifetime/ale.pdf