IP Address Management

The RIR System

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APNIC

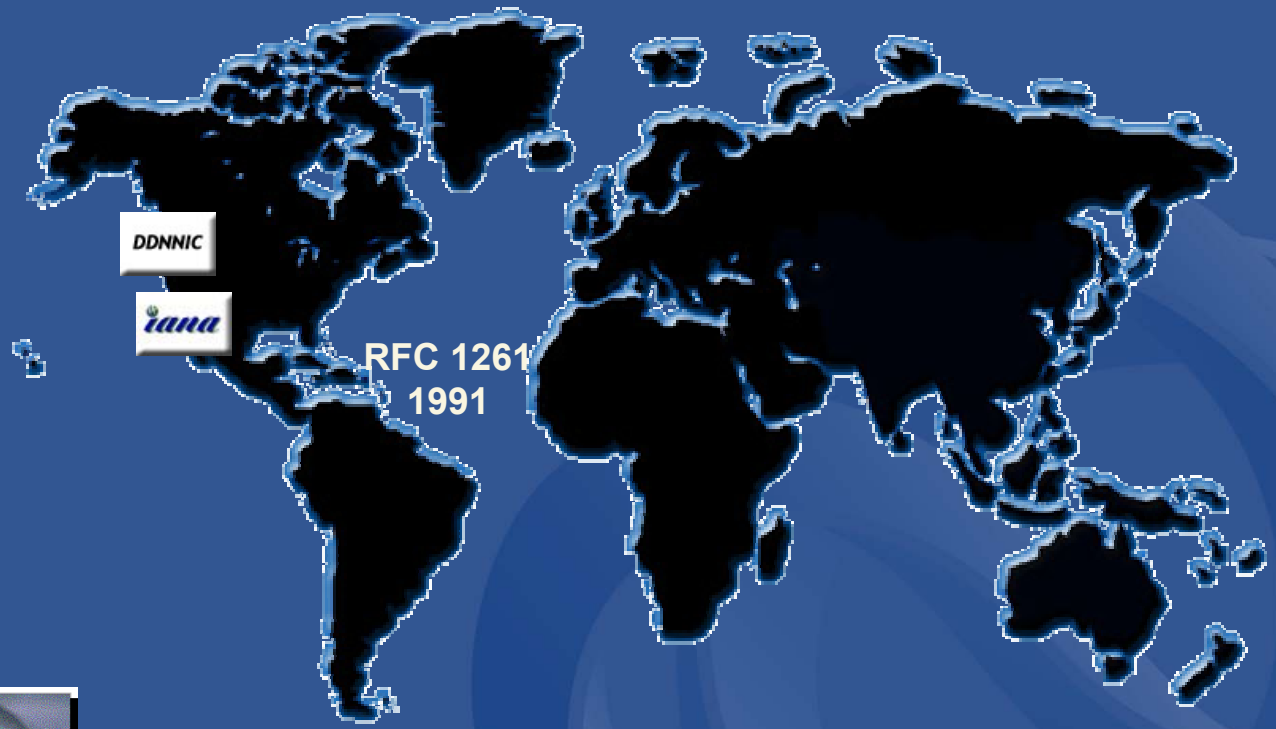
Overview

- The RIR structure
  - History of the RIR structure
  - Introduction to APNIC
  - IP address management principles
- Current status of the IPv4 address pool
  - Are we running out of IP addresses?
  - How long will IPv4 last?
- IPv6
  - The next generation protocol

What is APNIC?

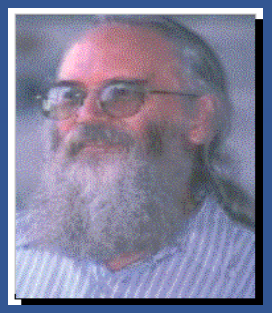
- Regional Internet Registry (RIR) for the Asia Pacific Region
  - Regional authority for Internet Resource distribution
  - IP addresses (IPv4 and IPv6), AS numbers, reverse DNS delegation
  - Provide services to ~850 members in the Asia Pacific

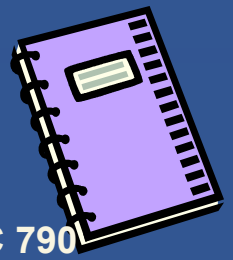
IP allocation Pre 1992



RFC 1020
1987

RFC 1261
1991



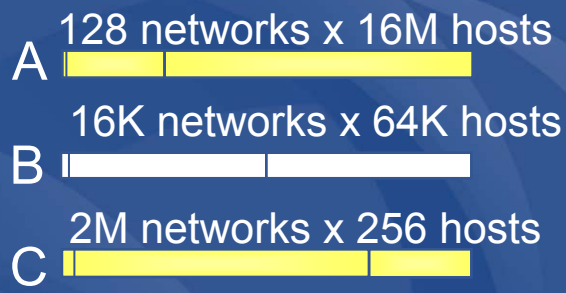


RFC 790
1981

"The assignment of numbers is also handled by Jon. If you are developing a protocol or application that will require the use of a link, socket, port, protocol, or network number **please contact Jon to receive a number assignment**."

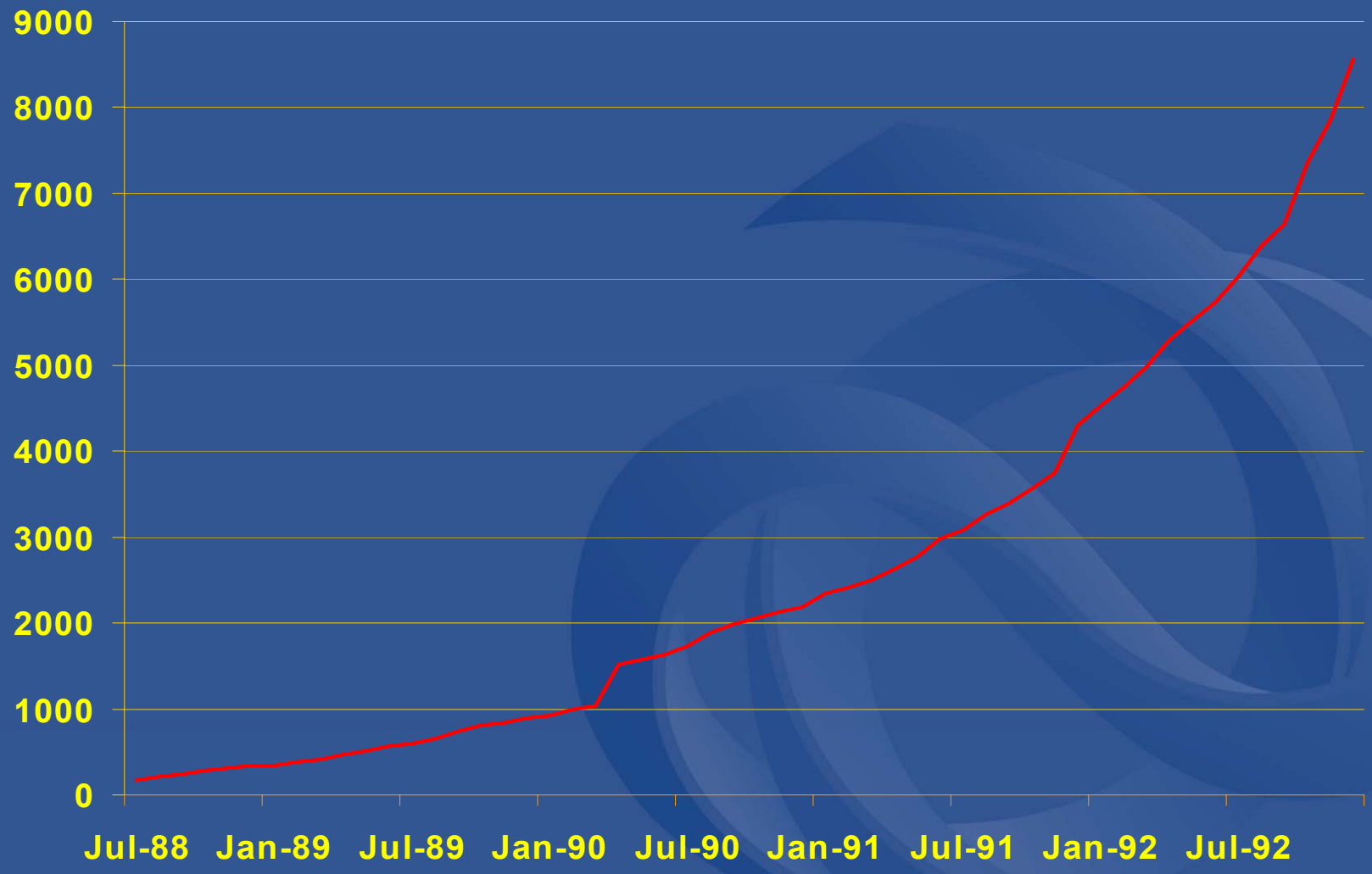
Early Address Management

- Early 1990's: Internet scaling problems
- Address depletion
  - due to classful architecture
  - 3 choices: A, B or C



- Routing table overload
  - Due to lack of route aggregation

Global Routing Table: ’88 - ’92

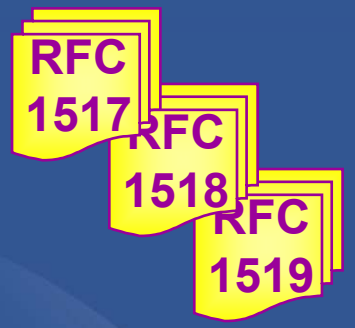


Early Address Management

- Internet widely projected to fail
  - Growth would stop by mid-’90s
  - Urgent measures required
  - Action taken by IETF / Internet community

Evolution of Address Management

- 1993: Development of “CIDR”
  - addressed both technical problems
- Address depletion
  - Through more accurate assignment
- Routing table overload
  - Through address space aggregation
- Administrative problems remained
  - Increasing complexity of CIDR-based allocations
  - Increasing awareness of conservation and aggregation goals
  - Need for fairness and consistency



Evolution of Address Policy

- RFC 1366 (1992)
  - Described the “growth of the Internet and its increasing globalization”
  - Additional complexity of address management
  - Set out the basis for a regionally distributed Internet registry system
- 1990s - establishment of RIRs
  - APNIC, ARIN, RIPE NCC (LACNIC later)
  - Regional open processes
  - Cooperative policy development
  - Industry self-regulatory model

Address Management Today

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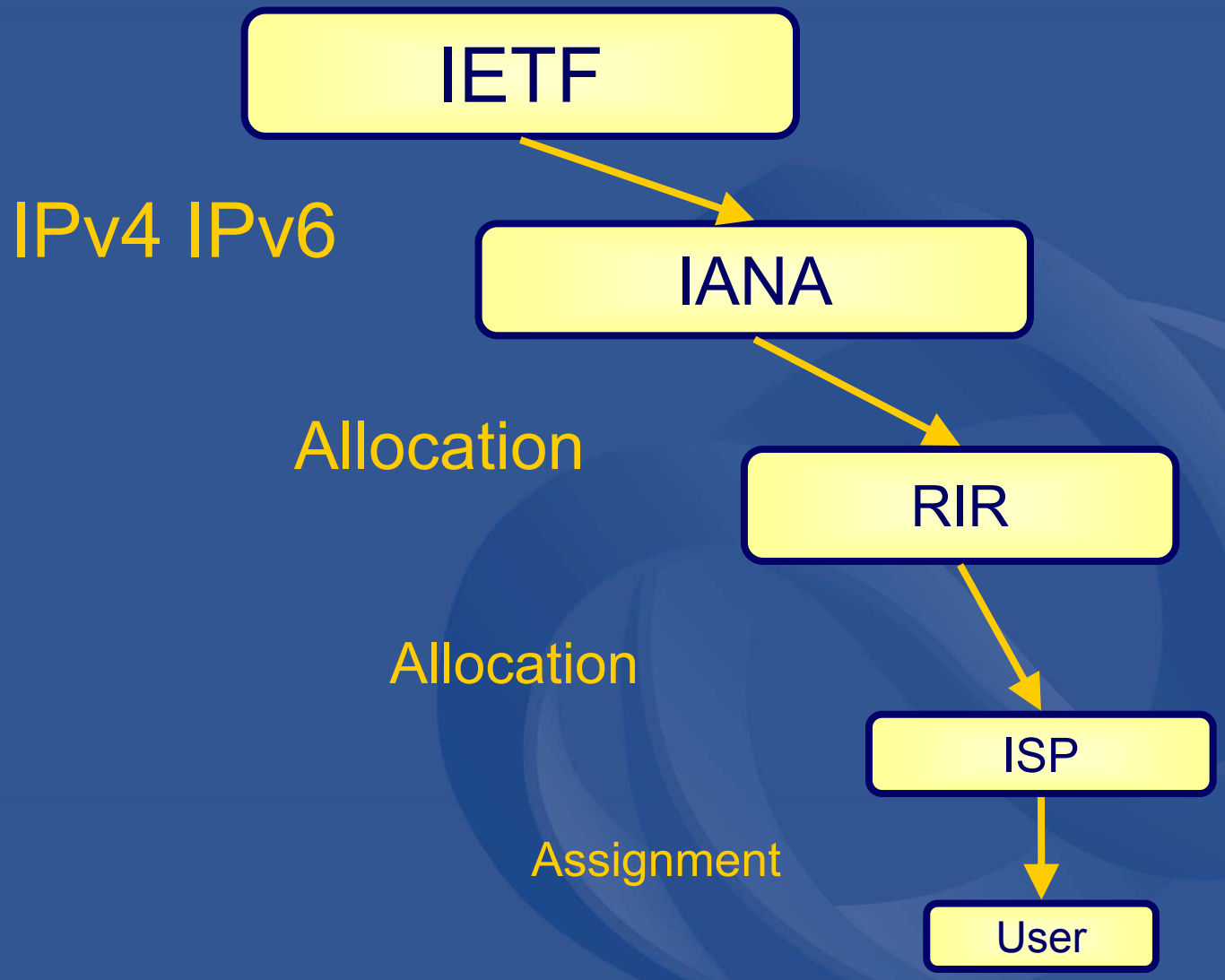
Address Management Today



Address Management Objectives

Conservation

- Efficient use of resources
- Based on demonstrated need

Aggregation

- Limit routing table growth
- Support provider-based routing

Registration

- Ensure uniqueness
- Facilitate trouble shooting

Common RIR Structures

- Bottom up self governing structure
  - Industry self regulatory
- Open and transparent
- Neutral and impartial
- Not for profit open membership organisation
  - Any interested party can join
- Policies developed by industry at large

What is APNIC?

- Regional Internet Registry for the Asia Pacific
  - Regional authority for Internet Resource distribution (IPv4 & IPv6 addresses, AS numbers, reverse DNS delegation)
- Non-profit, open membership
  - 850 ISP members in 42 economies
  - 7 National Internet Registries
  - membership elects Executive Board
  - membership approves budget & activities
- Industry self-regulatory body
  - Open Policy Meetings
  - Bottom-up structure

What does APNIC do?

1. Internet resource management
   - IP address allocation to LIRs (mainly ISPs) and NIRs
   - IP address assignment to end users
   - AS number assignments
2. Resource registration
   - Authoritative registration server: *whois.apnic.net*
   - Internet Routing Registry: *irr.apnic.net*
3. DNS management
   - Delegate reverse DNS zones/domains
   - Authoritative DNS servers
     - *in-addr.arpa, ip6.arpa (ip6.int)*

What else does APNIC do?

- Policy development and coordination
  - APNIC Open Policy Meetings: 2 per year
    - SIGs, WGs, BOFs, Training
  - ASO and ICANN processes
  - Liaison: IETF, ITU etc
- Training and outreach
  - Frequent regional training courses
  - Presentations at seminars, conferences etc
- Publications
  - Newsletter, web site, mailing lists etc
  - Regional and global resource reports

Global Allocations – Current Status

- Are we running out of IP addresses?

Are We Running Out of IP Addresses?

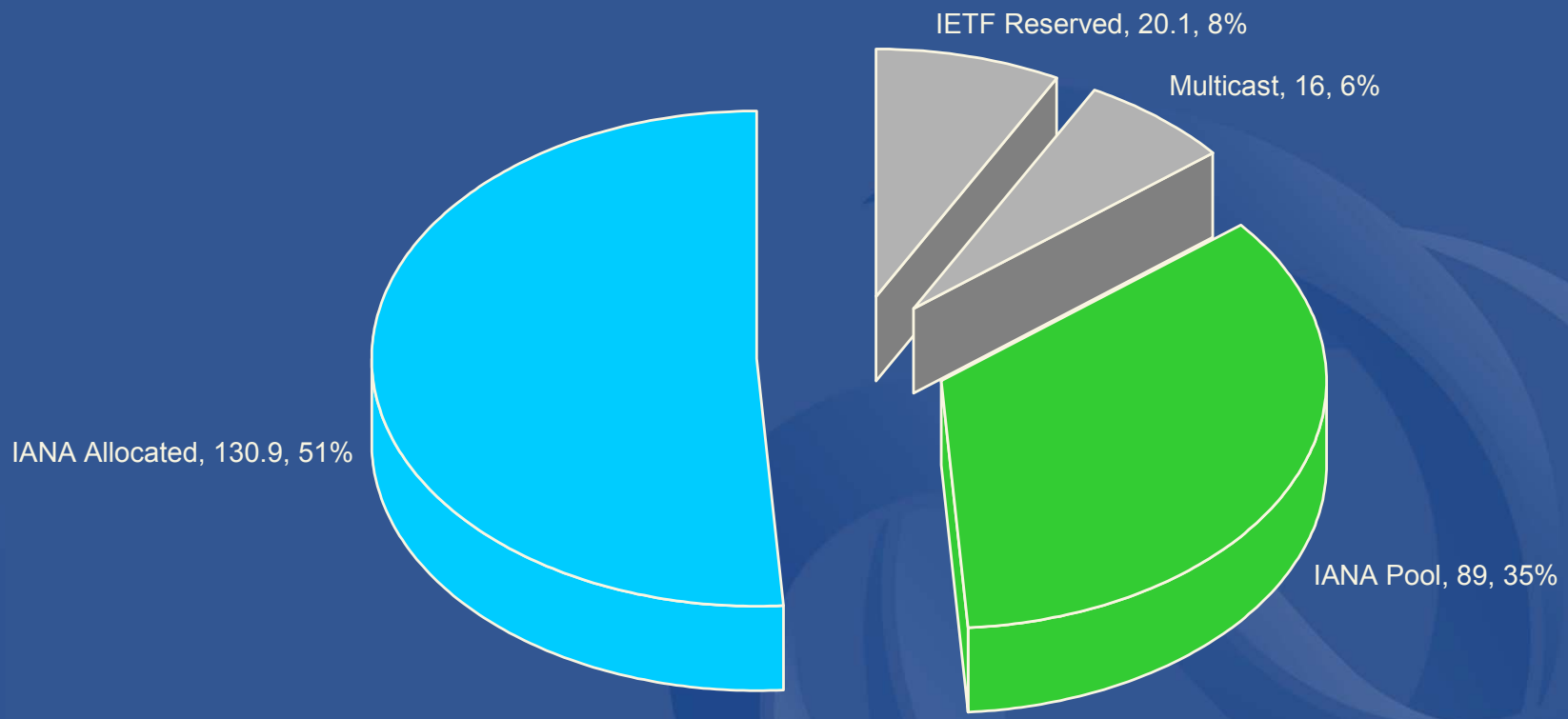
- Recent media reports claiming we are running out of IP addresses
  - Some claim we've already run out in some parts of the world
- But what are the facts?
  - *Is the IPv4 sky falling?*
- Geoff Huston, chief scientist in the Internet area at Telstra, has studied the IPv4 consumption rates

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

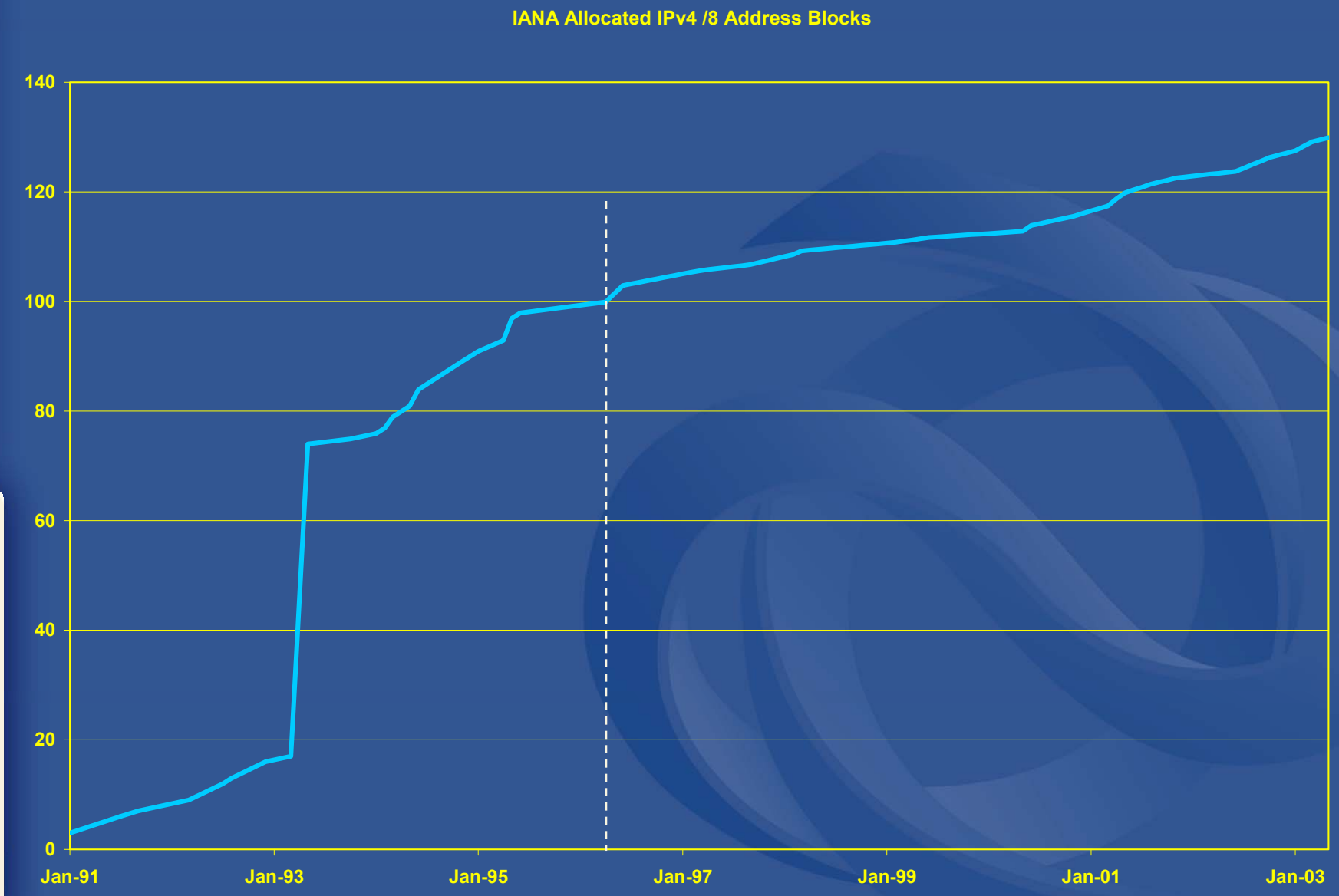
Data Analysed

- Three views to make forward projections:
  - The rate at which IPv4 number blocks are passed from IANA to the RIRs
  - The rate at which RIRs undertake assignments of IPv4 address blocks to LIRs and end users
  - The growth of the number of announced addresses in the BGP routing table

IANA Allocations – Current status



IANA Allocations - Historical



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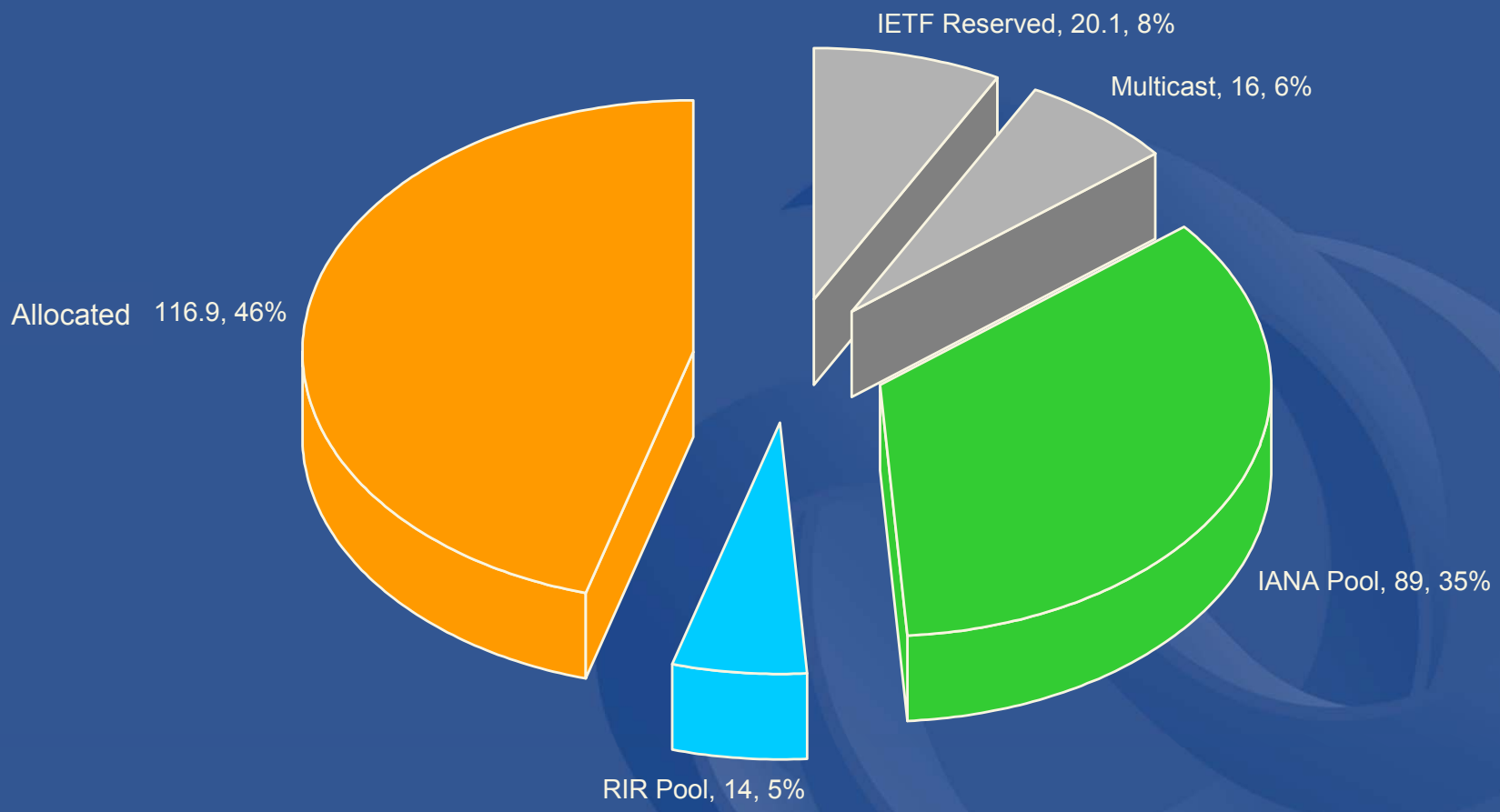
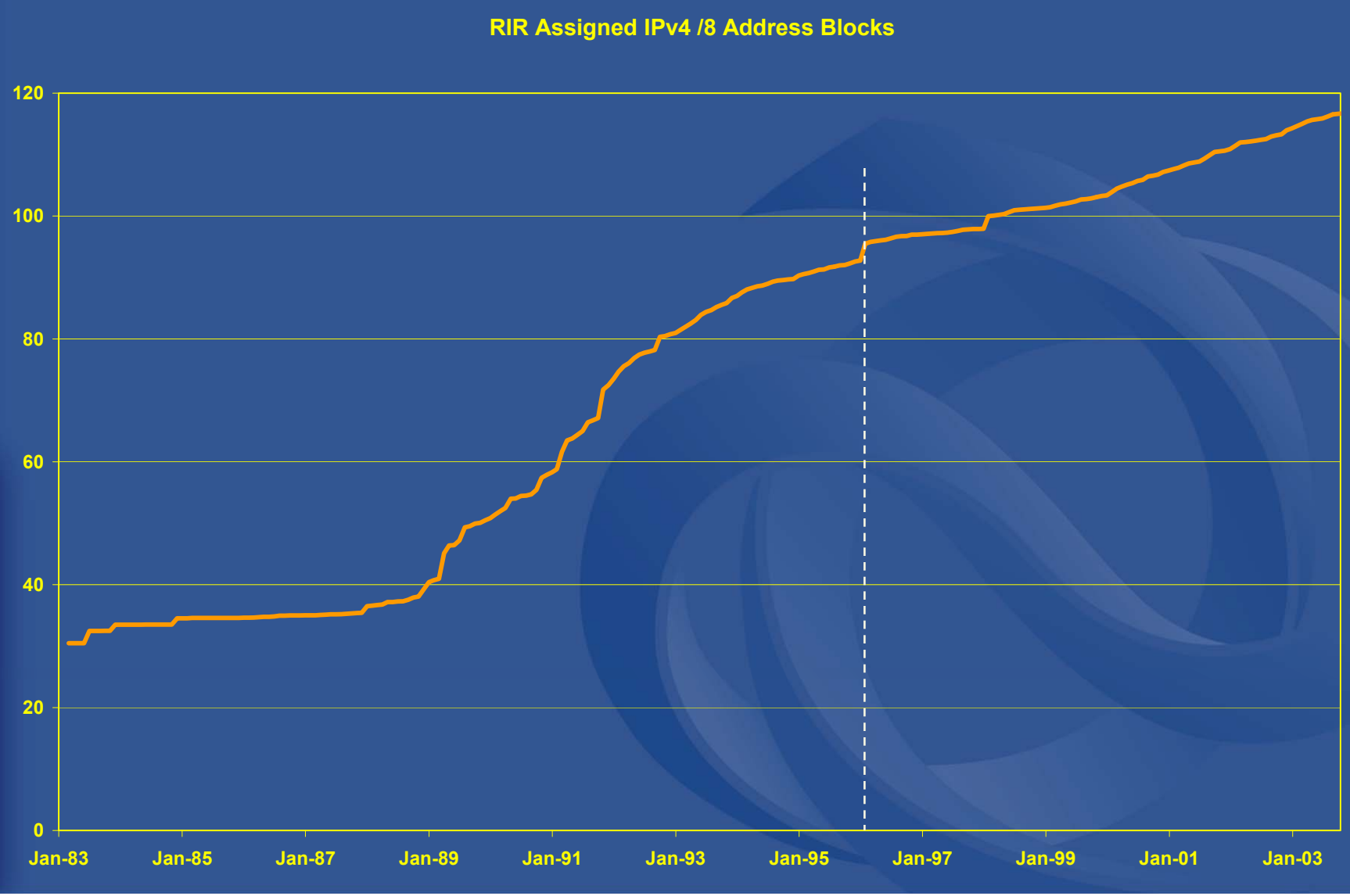
RIR Allocations – Current Status



RIR Allocations - Historical



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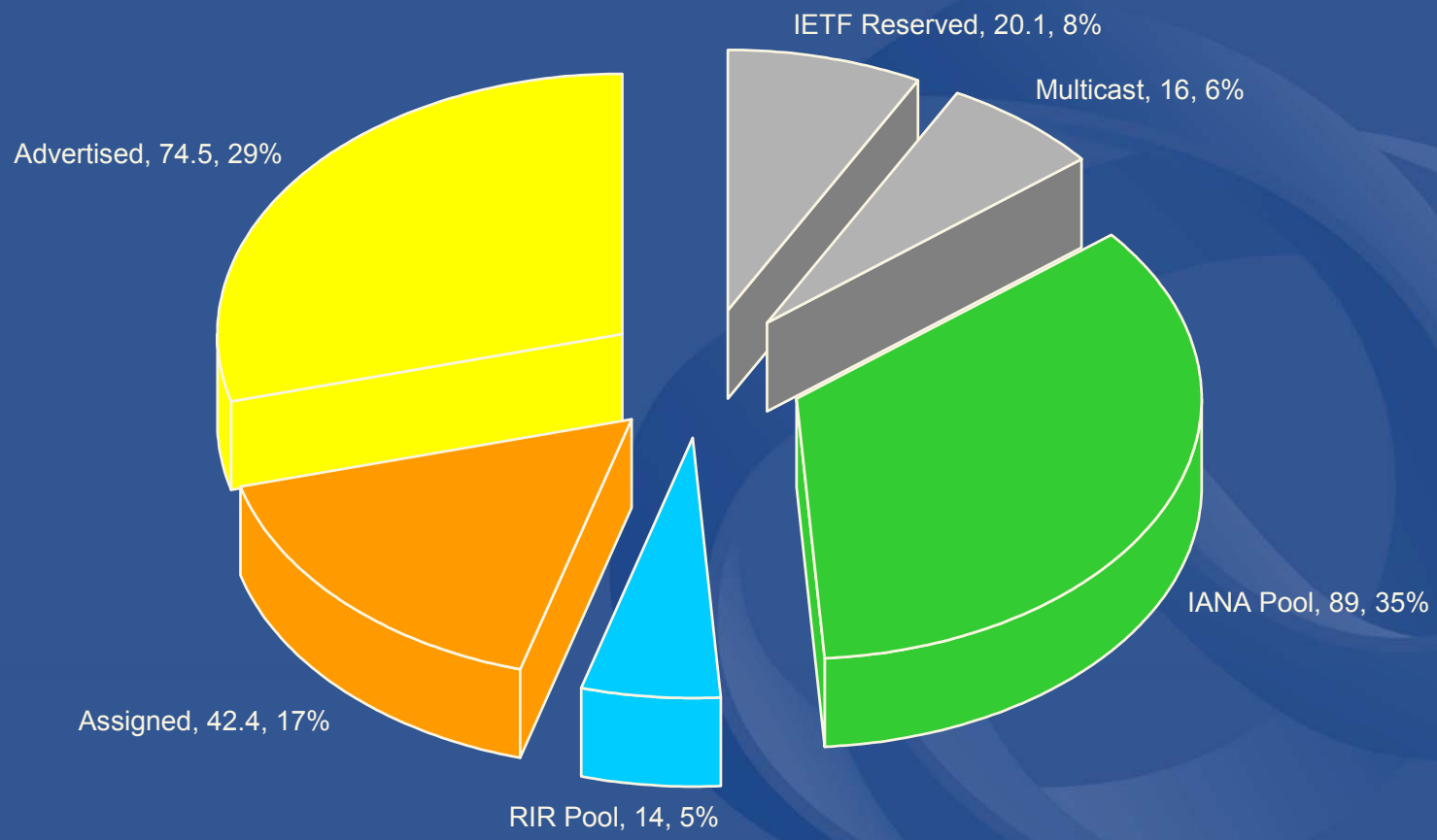
BGP Routing Table - Current



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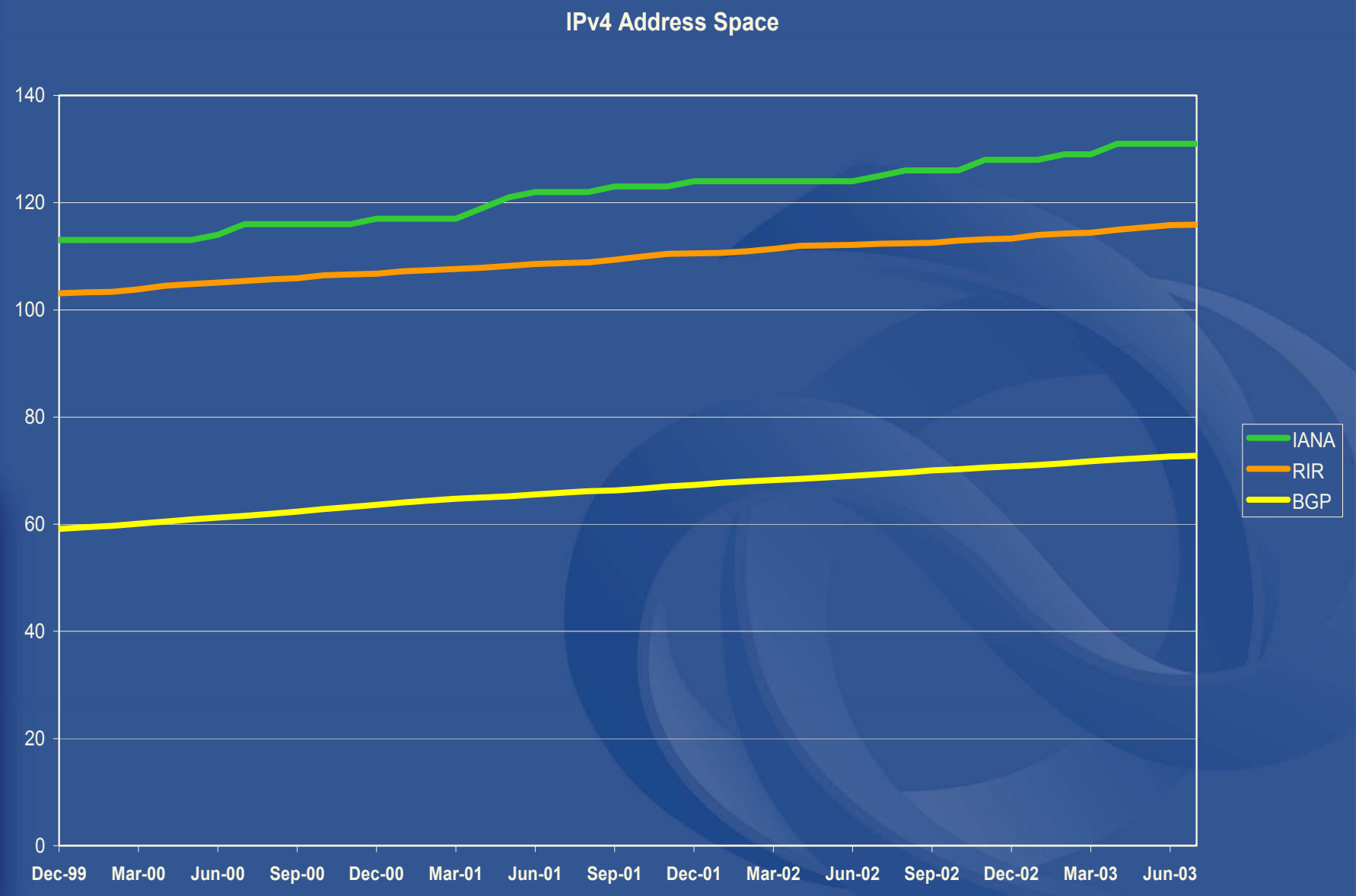
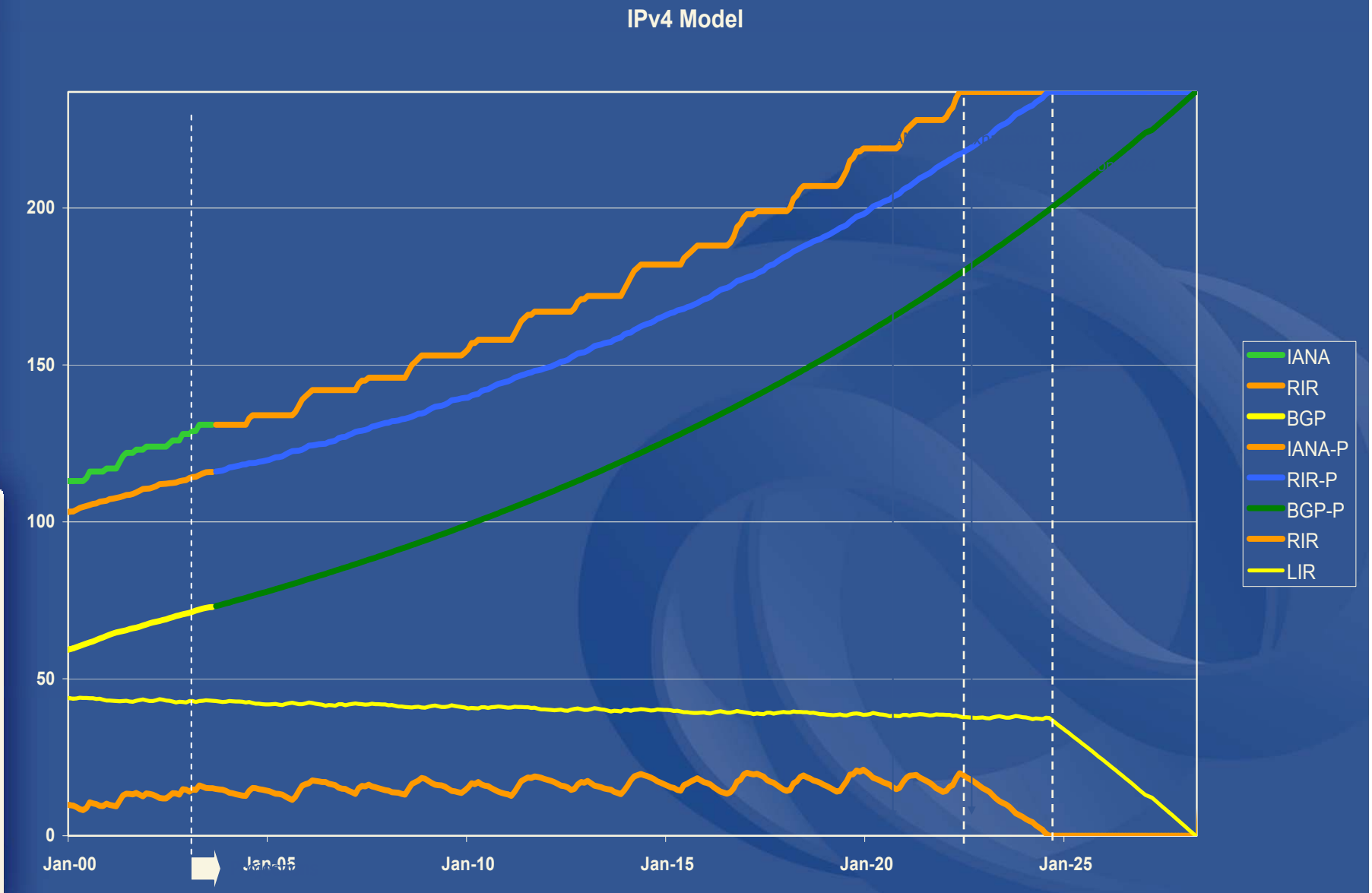
Recent Data



IPv4 Lifetime projections - Exponential



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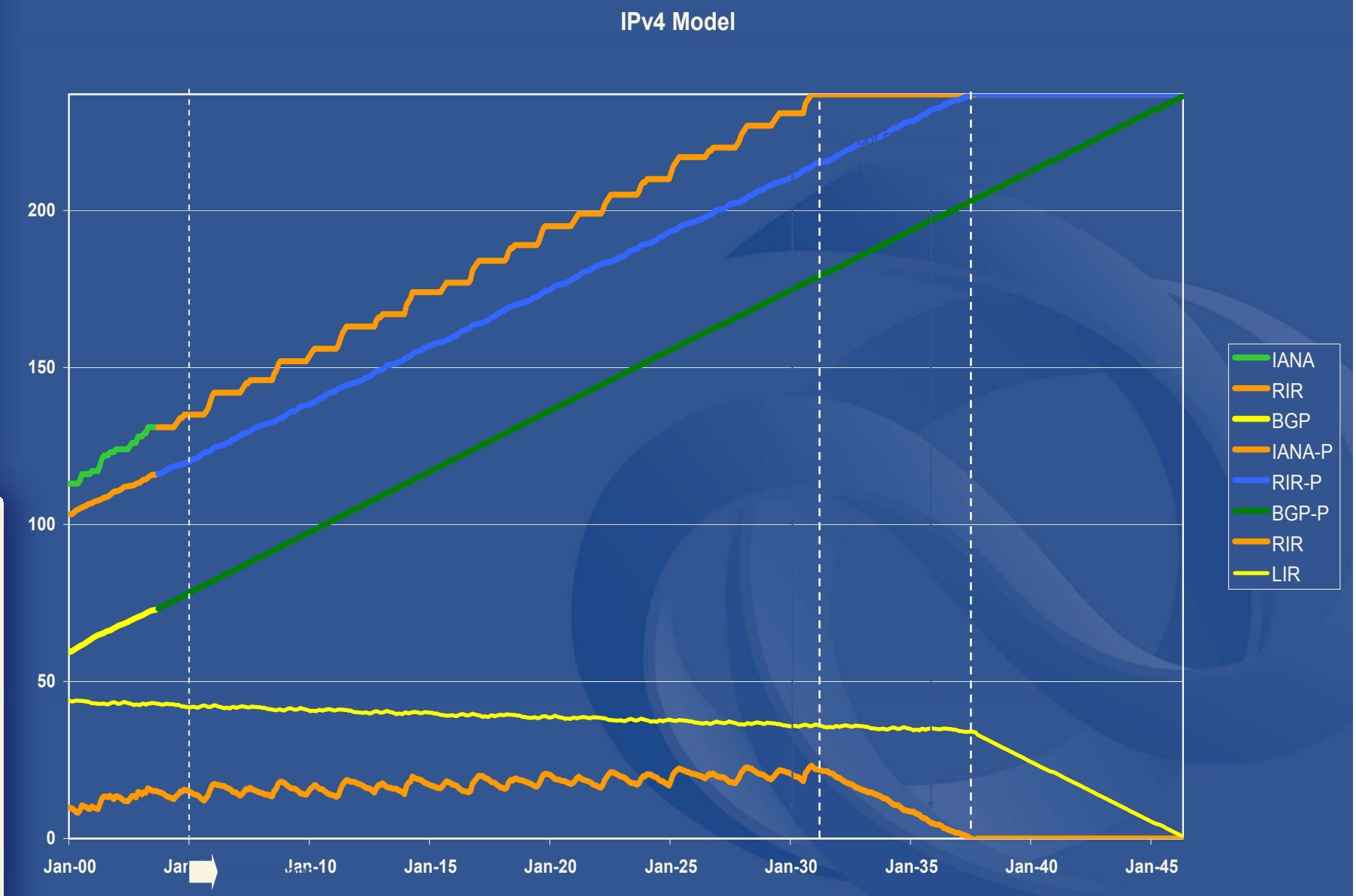
IPv4 Lifetime projections - Linear



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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 exponential growth
  - Address space lasts until 2025, or up to 2029
- Assuming linear growth
  - Address space lasts until 2037 - 2047

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?

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

IP Next Generation – IPv6

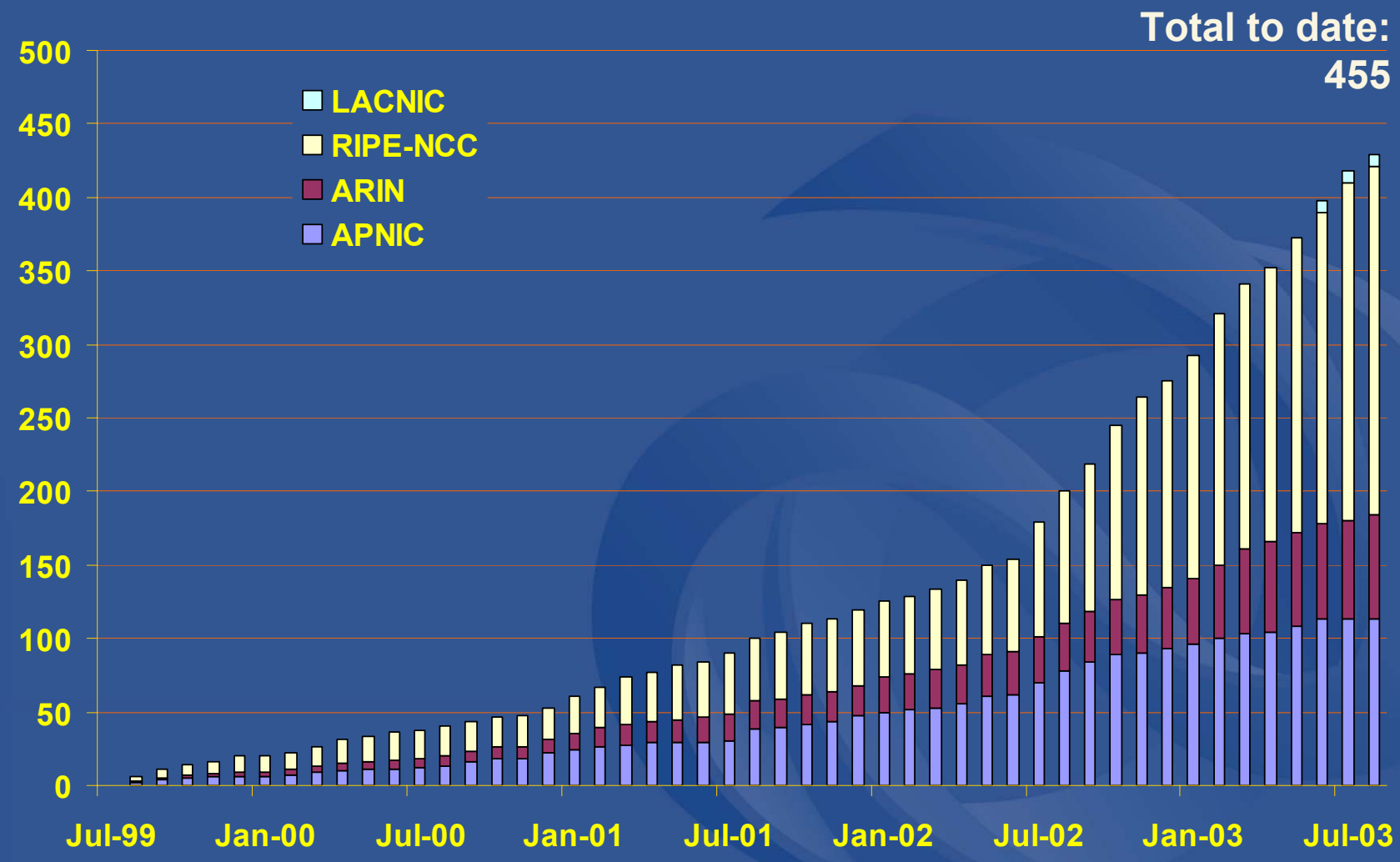
- 128 bits of address space
- Hexadecimal values of eight 16 bit fields
  - X:X:X:X:X:X:X:X (X=16 bit number, eg: A2FE)
  - 16 bit number is converted to a 4 digit hexadecimal number
- How many addresses?
  - 2^{128} =

  = 340 billion billion billion billion addresses available

IPv6 Addressing Architecture

- http://nori.apnic.net/ietf/rfc/rfc3513.txt

IPv6 Addresses Allocated



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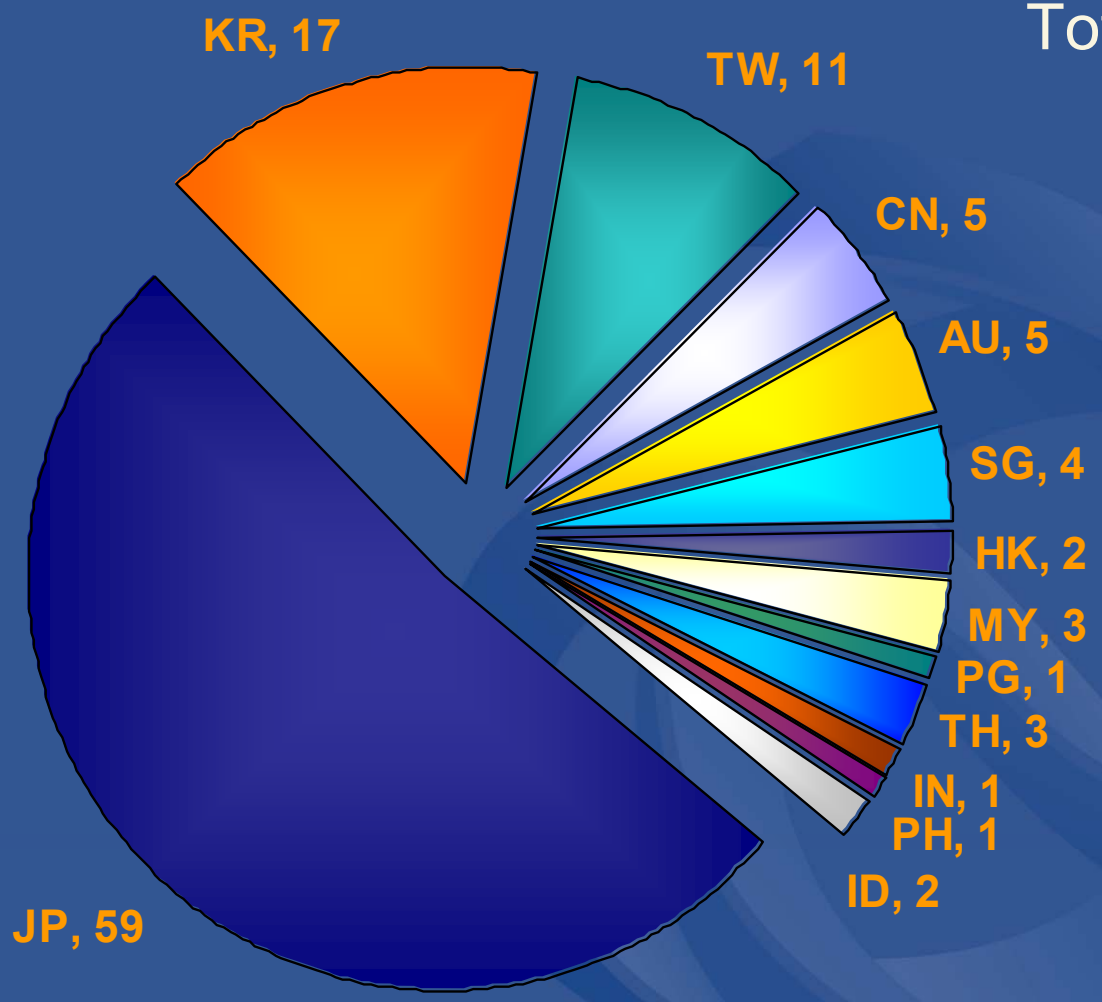
IPv6 allocations in Asia Pacific



Total to date: 114

Last updated Oct 2003

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IPv4 to IPv6 Transition

- Implementation rather than transition
- Necessary to maintain compatibility with IPv4 hosts and routers while deploying IPv6
  - Millions of IPv4 nodes already exist
  - Upgrading every IPv4 nodes to IPv6 at one time is not feasible
  - Transition process will be gradual and will take time
- Transition from IPv4 to IPv6 is very hard
  - Will take many years
  - Many details to be determined
  - Some still say it will never happen !

Future Address Management

- Current IPv6 allocation and assignment policies are simple and easy
  - Consciously support fast IPv6 deployment
  - However, wasteful in the long-term
  - We will eventually need to be more careful with address management
- Conclusion
  - IPv6 addresses are easy to get, at the moment
  - But we must make IPv6 last a long time, possibly “forever”

Conclusions

Conclusions

- IP address management
  - Result of 20 year evolution on the Internet
  - Supported Internet growth to date
  - Stable well-understood system
  - Open to all interested participants
- We are not running out of IP addresses now
  - Proper management of IPv4 will allow it to last for a while longer
- IPv6 is underway
  - Easy to get IPv6 addresses now
    - but transition will take time
    - necessary to start now
  - Responsible management essential to keep the Internet running

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Thank you

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