Centre

APNIC SAPNIC

IPv4 Address Lifetime

Presented by Axel Pawlik, RIPE NCC

Research activity conducted by Geoff Huston and supported by APNIC

Background

- All four RIRs publish their allocation data
 - Part of RIR responsibility
 - Published in response to need and increased interest in IPv4 consumption rates
 - <u>http://www.aso.icann.org/stats/</u>
- Few attempts in the past to predict future trends and consumption rates
 - Some based on market predictions, technology growth
 - Task not easy due to imperfect data
 - Recent efforts made by RIRs to clean up data
- Geoff Huston, chief scientist in the Internet area at Telstra, has studied the IPv4 allocation data
 Projections based on current and past utilisation rates

APNIC

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

APNIC STANIC

1. IETF Delegations – IPv4







APNIC



IANA Allocations - Historical

IANA Allocated IPv4 /8 Address Blocks





RIR Allocations - Current

RIR Allocations - Historical

RIR Assigned IPv4 /8 Address Blocks



APNIC 📎

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

APNIC

BGP Routing Table - Current



Centre

Network Information

BGP Announcements - Historical

BGP Table - Address Span



Combining the Data

IPv4 Address Space



Recent Data

IPv4 Address Space



Projections

APNIC SINIC

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
- BGP data
 - 3 year data baseline to obtain the projection
 - Much shorter baseline than the IANA and RIR projections
 - · Considerable uncertainties associated with this projection
 - First order differential of total BGP announcement
 - Until 2000, exponential (accelerating) 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

APNIC S

Process model - exponential



APNIC STANIC





APNIC STANIC

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)

APNIC S

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
- Responsible management essential to keep the Internet running

APNIC 📎

Centre



Questions?

gih@telstra.net http://www.potaroo.net

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