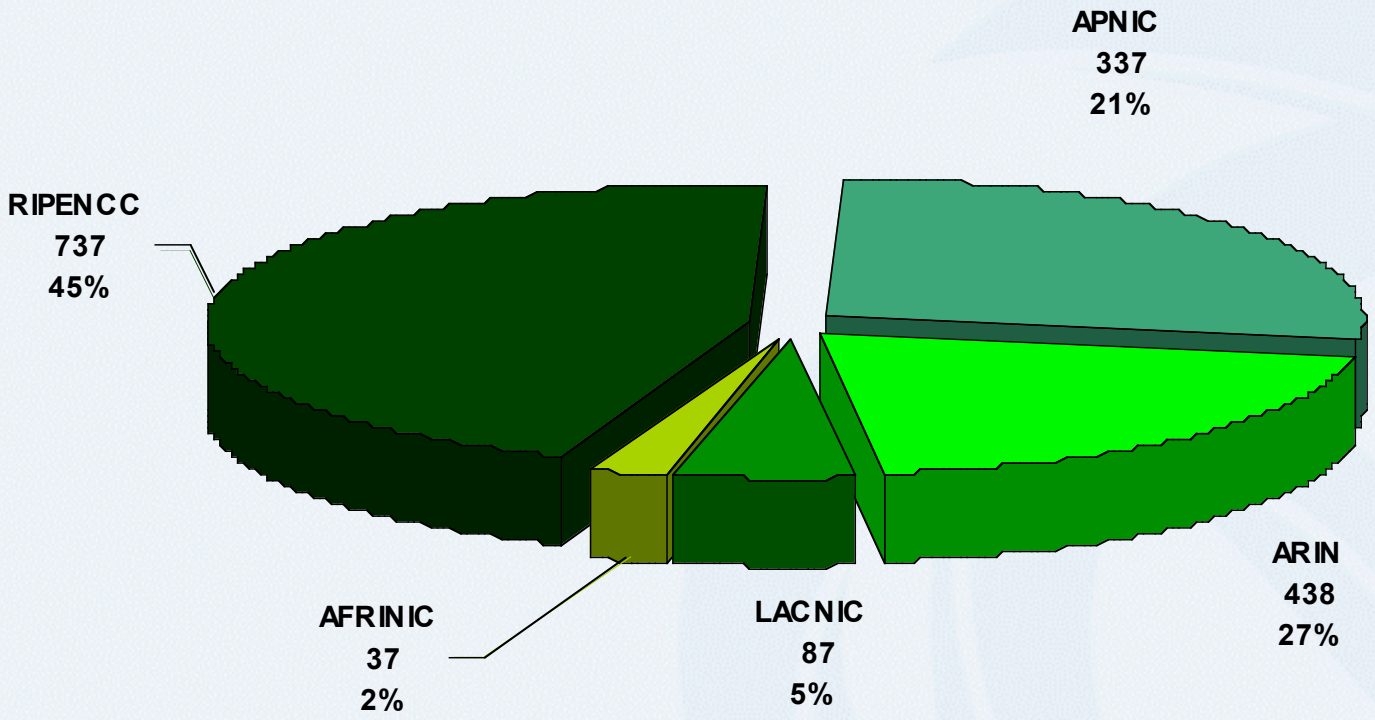
Internet Evolution and IPv6

Paul Wilson
APNIC

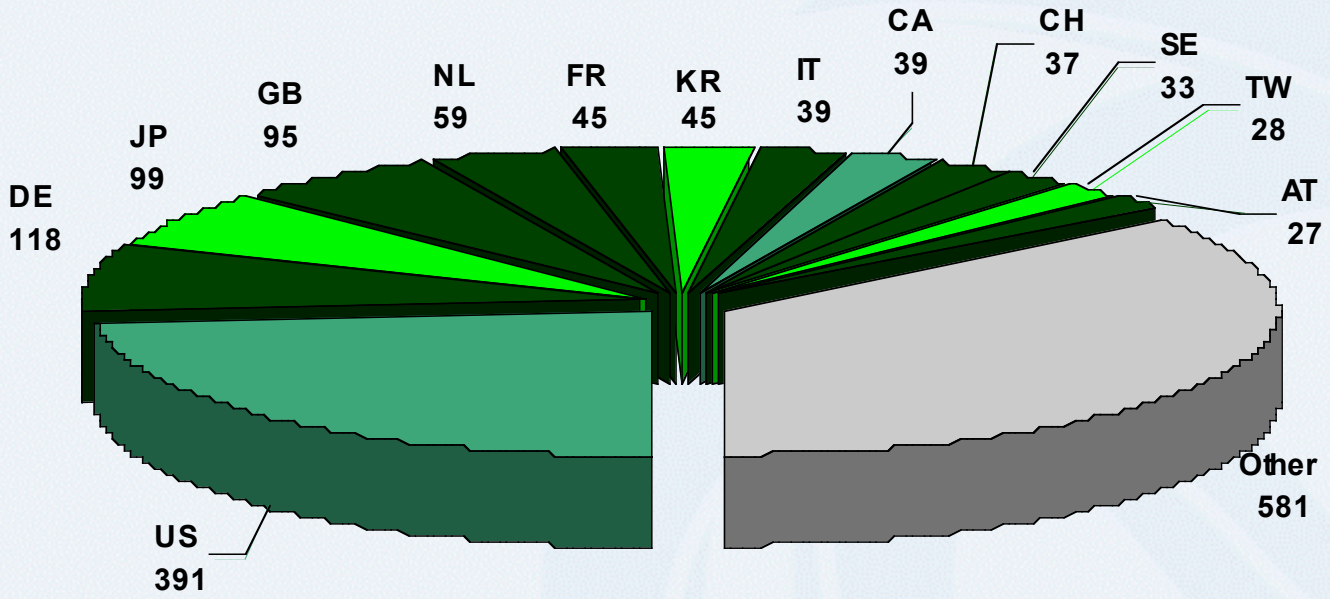
Where are IPv6 addresses today?

IPv6 – Global allocations by RIR



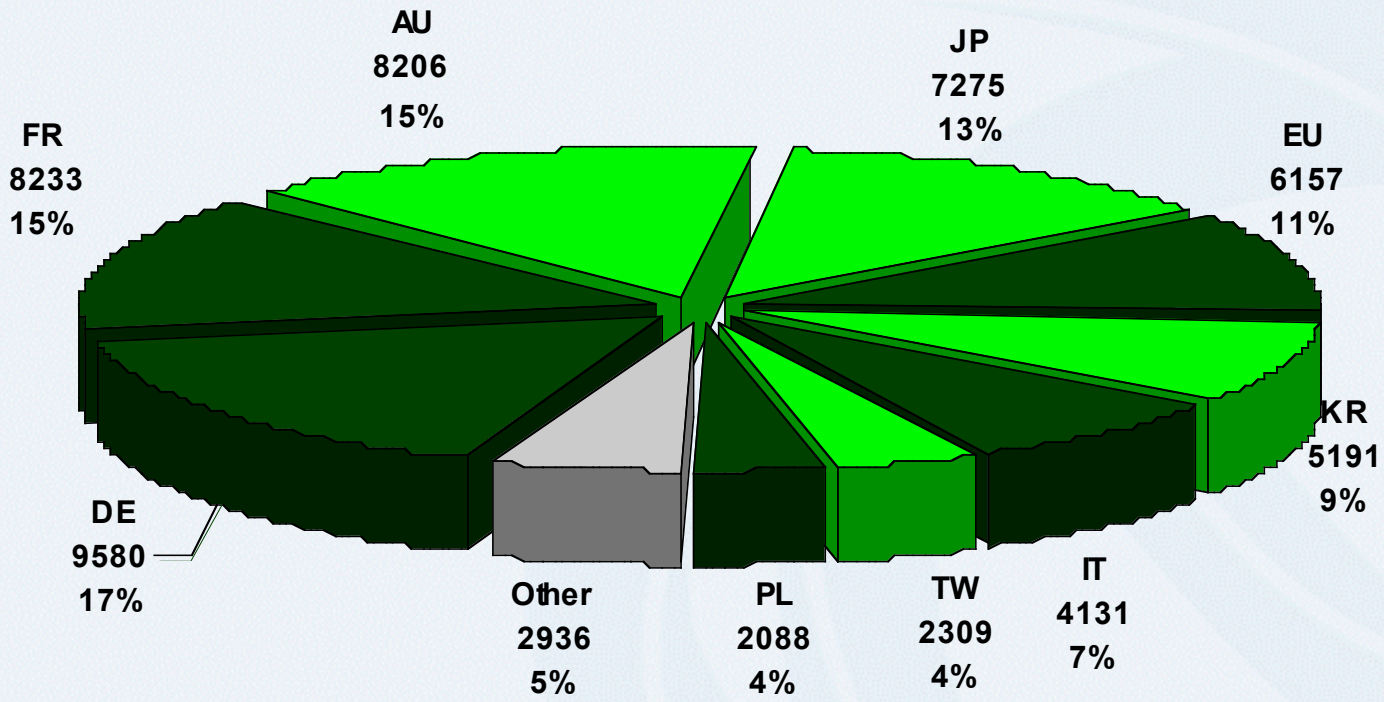
Unit: IPv6 prefix

IPv6 – Global allocations by CC



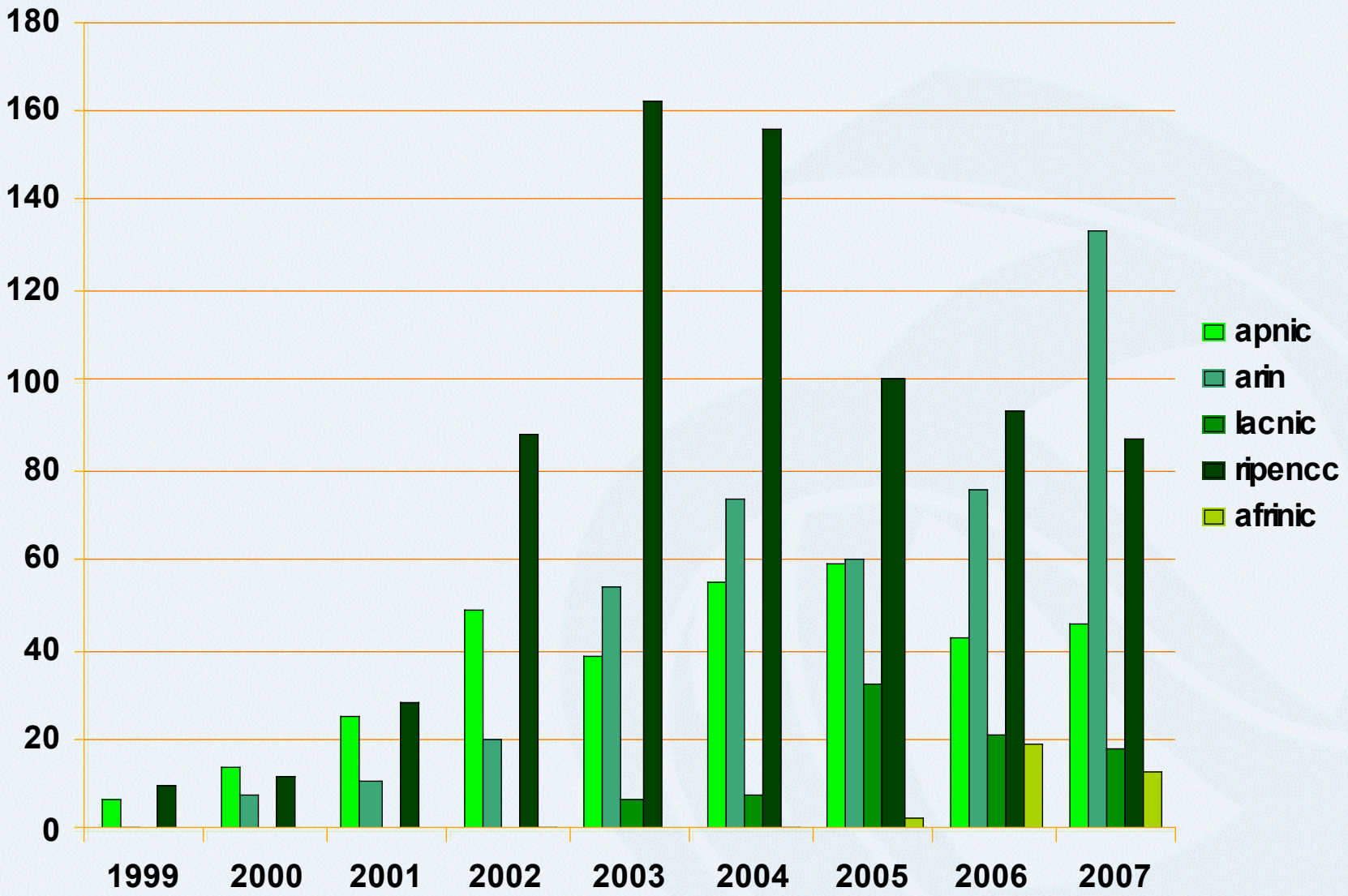
Unit: IPv6 prefix

IPv6 – Global allocations by CC



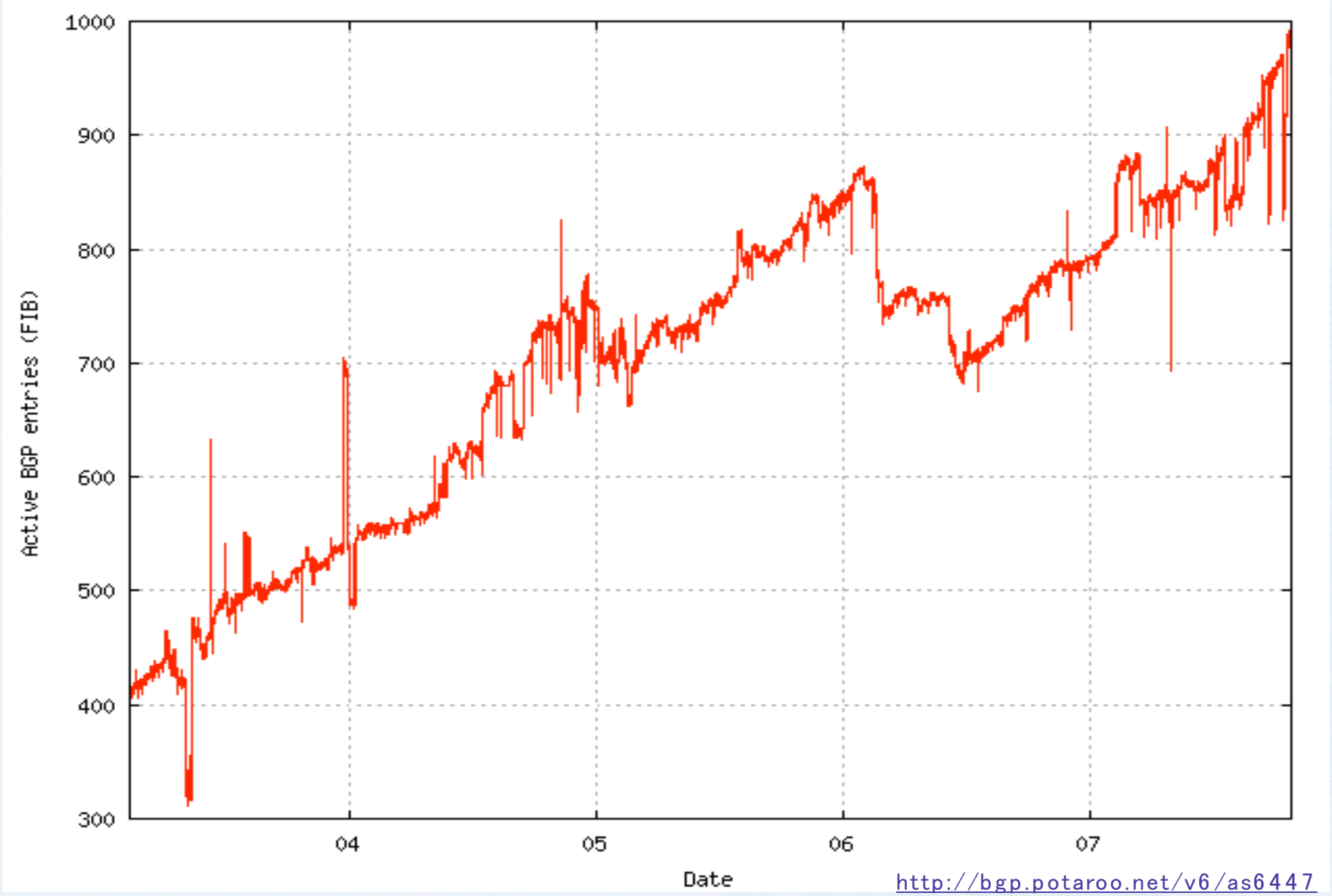
Unit: 32 prefix

IPv6 – Global allocation growth



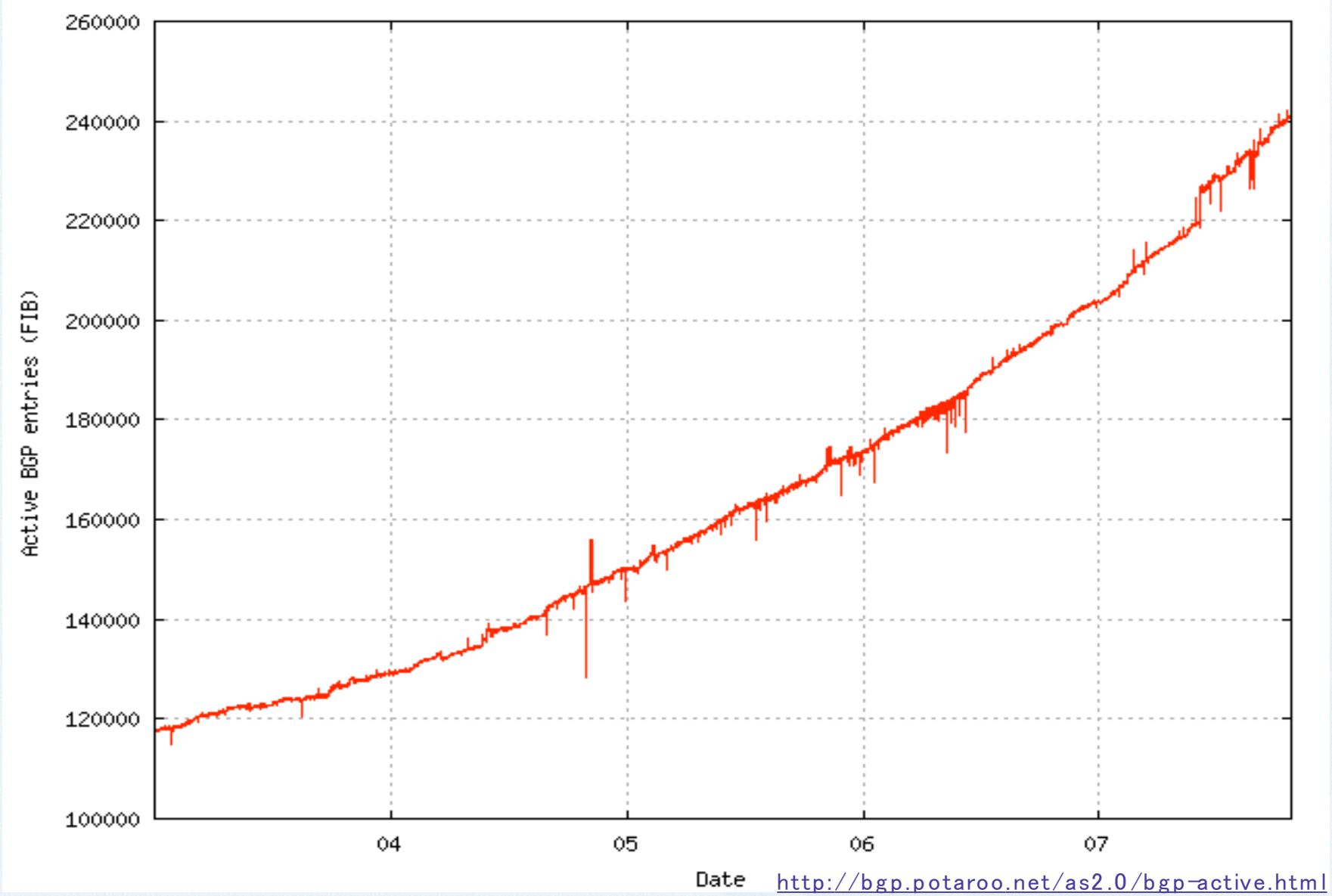
Where is IPv6 being used today?

IPv6 – routed prefixes



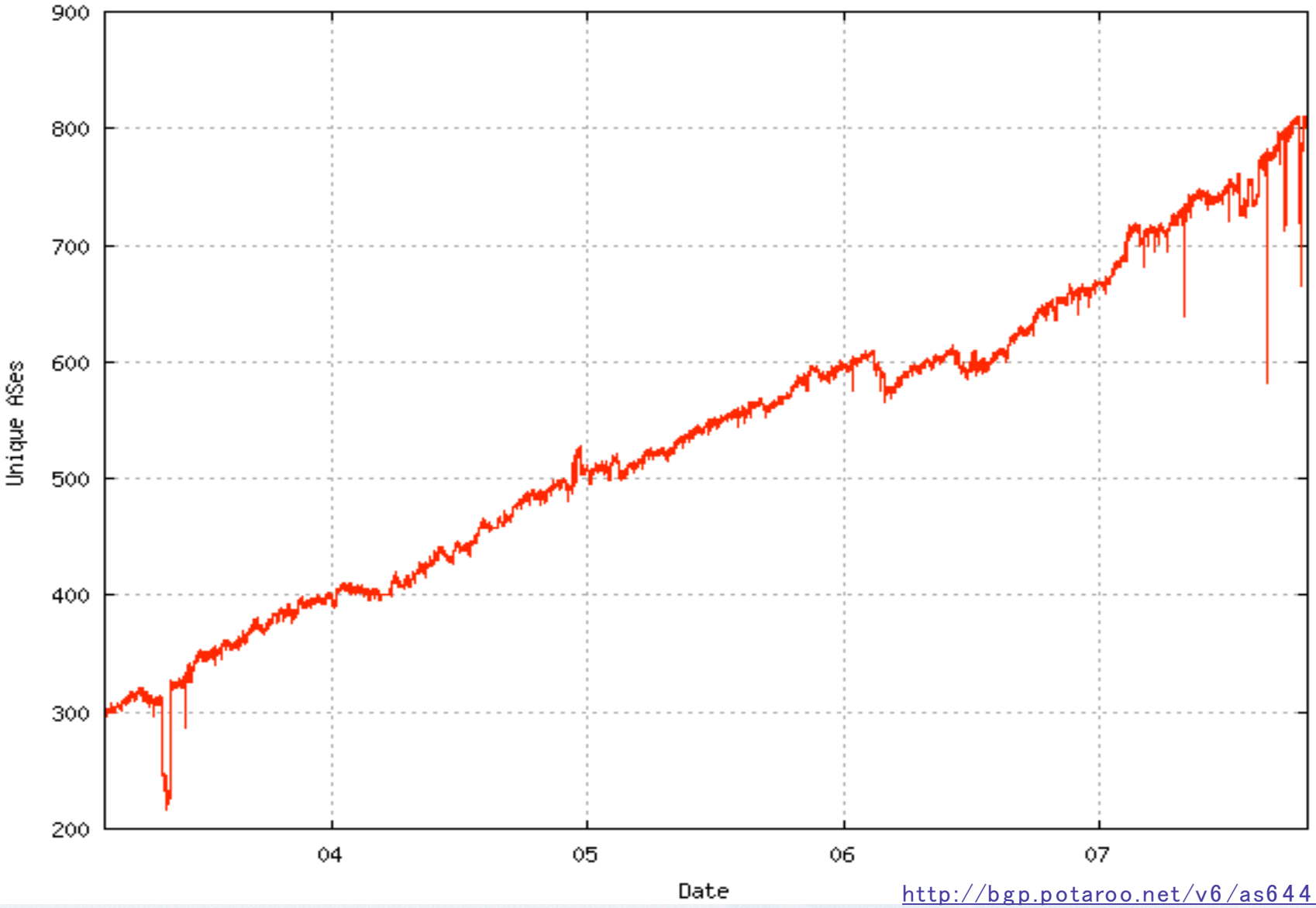
http://bgp.potaroo.net/v6/as6447

IPv4 – routed prefixes



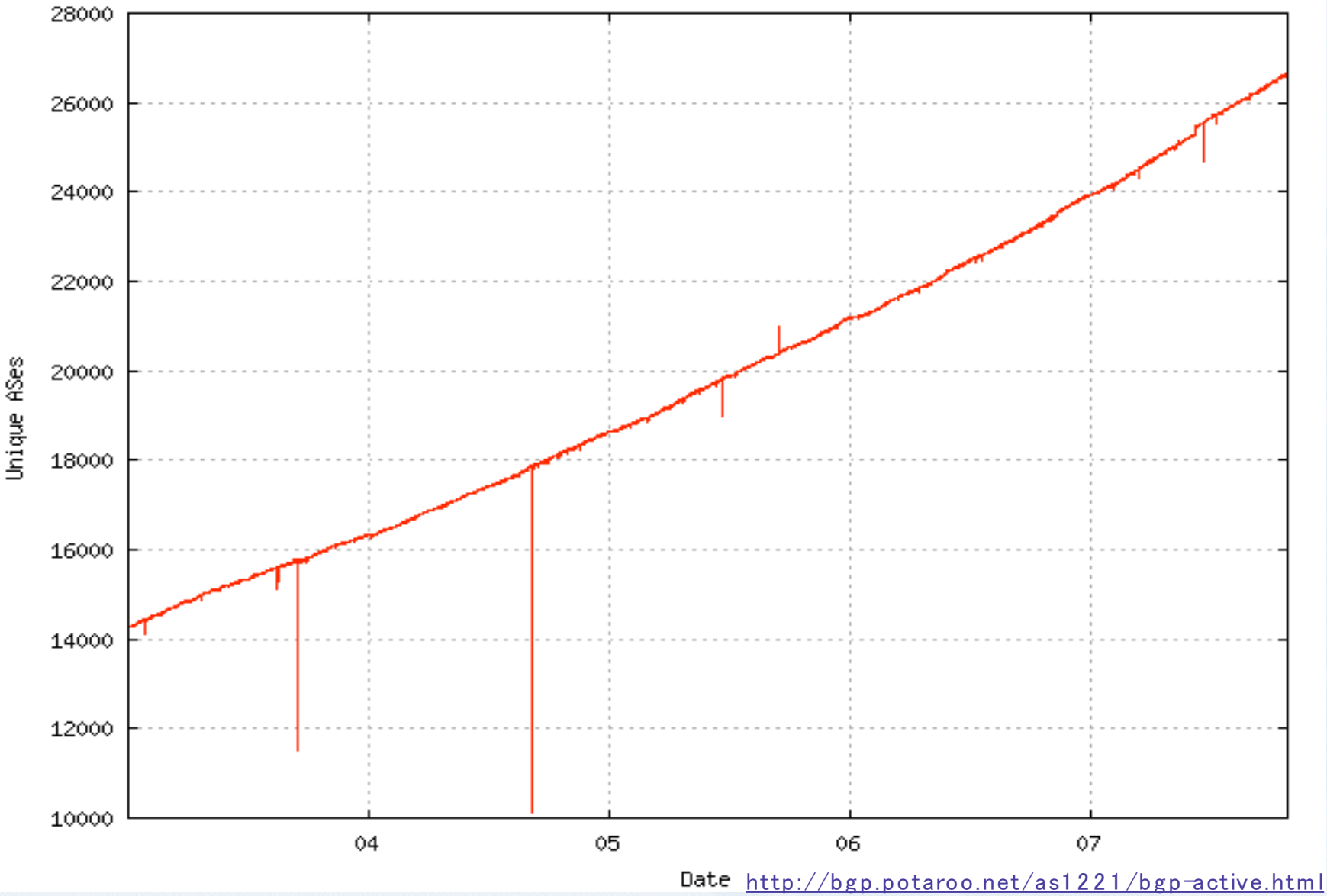
http://bgp.potaroo.net/as2.0/bgp-active.html

IPv6 – routed ASNs

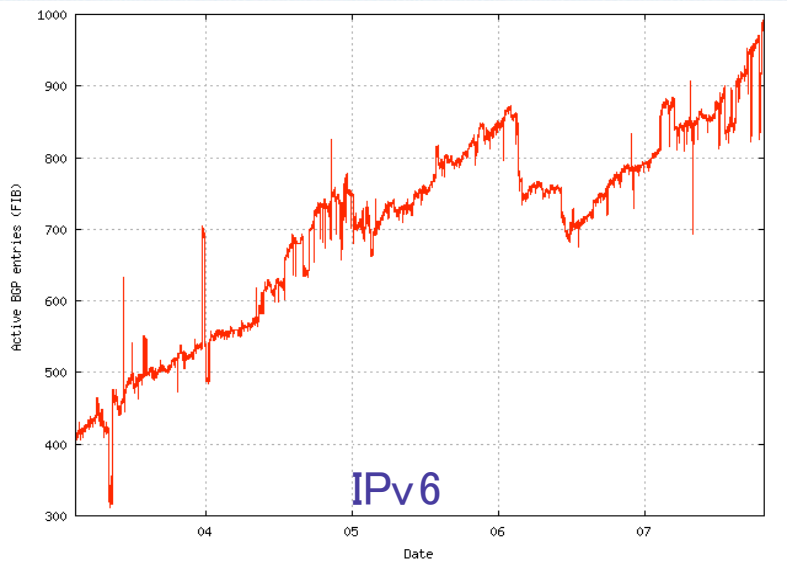


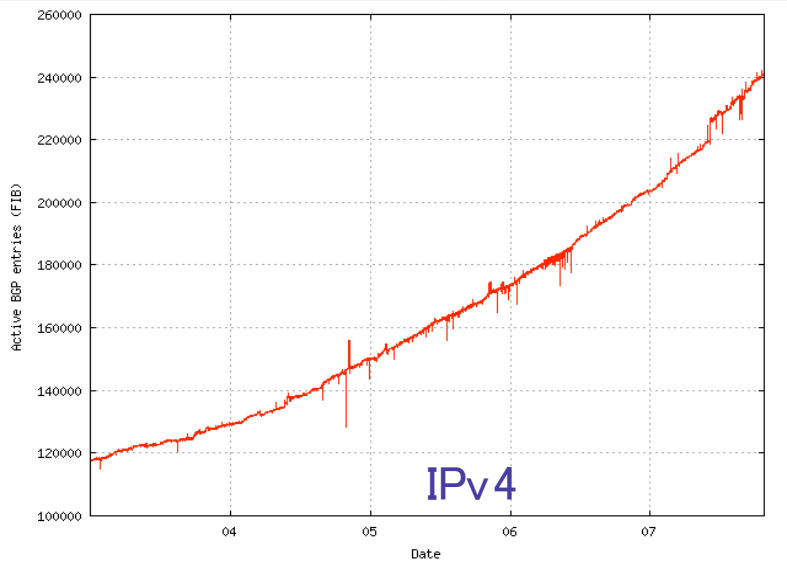
http://bgp.potaroo.net/v6/as6447

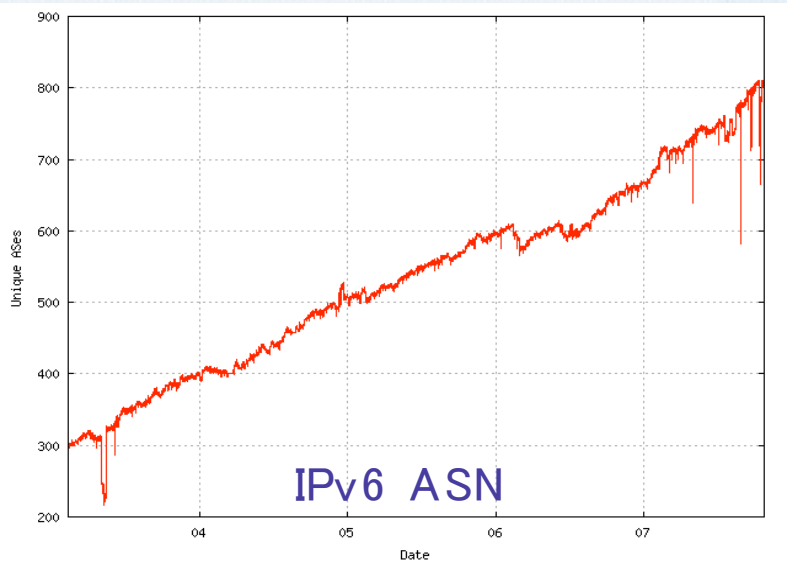
IPv4 – routed ASNs

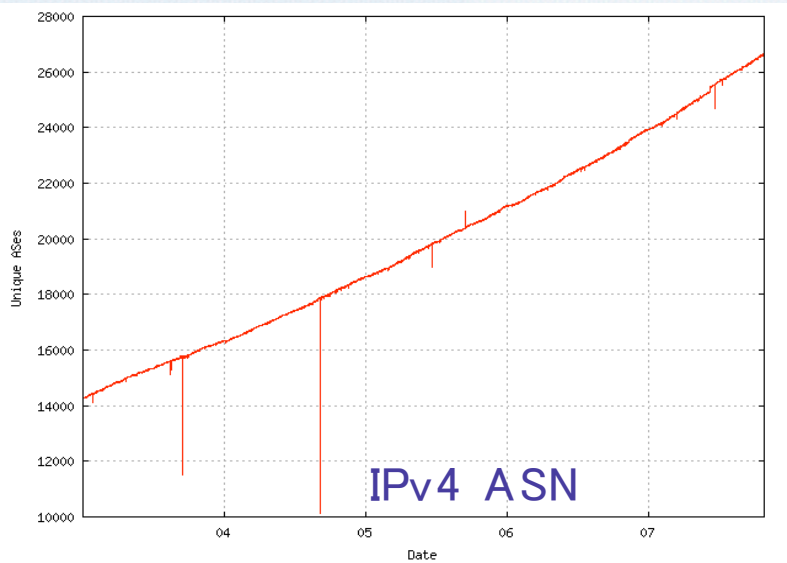


Those graphs again…









The InterNAT today

The InterNAT Today

- Everything now engineered for NAT
  - Client-initiated transactions
  - Application-layer identities
  - Server agents for multi-party rendezvous
  - Multi-party shared NAT state
- Who bears the cost?
  - End users buy the NATs
  - Applications developers do the hard work
  - ISP costs are externalised
- Seems to work!

Where is the ISP Industry?

- Telco consolidation…
  - Intense competition in the ISP industry has finished
  - The focus has shifted away from the ISP and away carriage services and towards to content services
- Commoditization…
  - Mass market access deployment has marginal rates of return on capital
  - ISP products remain undifferentiated – triple play, NGN and IMS based products have so far failed to achieve visible takeup
- Stasis…
  - Low margins and poor capital return have created a sluggish industry that is unresponsive to change
  - Resistive to efforts to evolve the IP level service model

So what's the problem?

The problem is reality

- Technical
  - IPv6 is stable and well tested
  - But many technical issues are still being debated…
    - "The perfect is the enemy of the good"
  - Industry needs confidence and certainty
- Business
  - NAT has worked too well
  - Existing industry based on externalizing the costs for address scarcity, and insecurity
  - Lack of investor interest in more infrastructure investment
    - Short term interests vs long term imperatives
  - IPv6 promotion - too much too early?
    - IPv6 may be seen as "tired" and not "wired"

The result…

- Short term business pressures support the case for further deferral of IPv6 infrastructure investment
- There is insufficient linkage between the added cost, complexity and fragility of NAT-based applications and the costs of infrastructure deployment of IPv6
- An evolutionary adoption seems unlikely in today's environment
  - …or in the foreseeable future

The IPv4 revolution

- The 1990's – a new world of…
  - Cheaper switching technologies
  - Cheaper bandwidth
  - Lower operational costs
  - The PC revolution, funded by users
- The Internet boom
  - The dumb (and cheap) network
  - Technical and business innovation at the ends
  - Many rewards for new services and innovation

An IPv6 revolution…

- The 2000's – a new world of…
  - Commodity Internet provision, lean and mean
  - Massive reduction in cost of consumer electronics
  - A network-ready society
- The IPv6 boom?
  - "Internet for Everything"
  - Serving the communications requirements of a device-dense world
  - Device population some 2–3 orders of magnitude larger than today's Internet
  - Service costs must be cheaper by 2-3 orders of magnitude – per packet

IPv6 – From PC to iPOD to iPOT

- A world of billions of chattering devices

- Or even trillions…

In conclusion…

The IPv6 Challenge

- There are still too few compelling feature or revenue levers in IPv6 to drive new investments in existing service platforms
- But the silicon industry has made the shift from value to volume years ago
- The Internet industry might follow this lead
  - From value to volume in IP(v6) packets
  - Reducing packet transmission costs by orders of magnitude
  - To an IPv6 Internet embracing a world of trillions of devices
  - To a true utility model of service provision

Thank you

pwilson@apnic.net