Transforming the Internet: from IPv4 to IPv6

7th Annual CTO Forum

Nadi, Fiji
15 September 2009

Overview

- Broadband Internet Evolution
- Internet Addressing
- IP Address Status Report
- The Next Step: IPv6
- Conclusions

Internet Fundamentals

- Open network, open standards
  - Developed within IETF system (RFC series)
  - TCP/IP, DNS, DHCP, HTTP, IPSEC, etc etc
  - "Dumb network" – global point-to-point datagram service
- "IP over Everything"
  - Layered networking model (a la OSI)
  - Relying on ITU and IEEE standards
  - Serial line, Modem, Ethernet, ISDN, xDSL, cable/fibre, MPLS, 802.11x, Mobile 2G/3G…

Internet Fundamentals

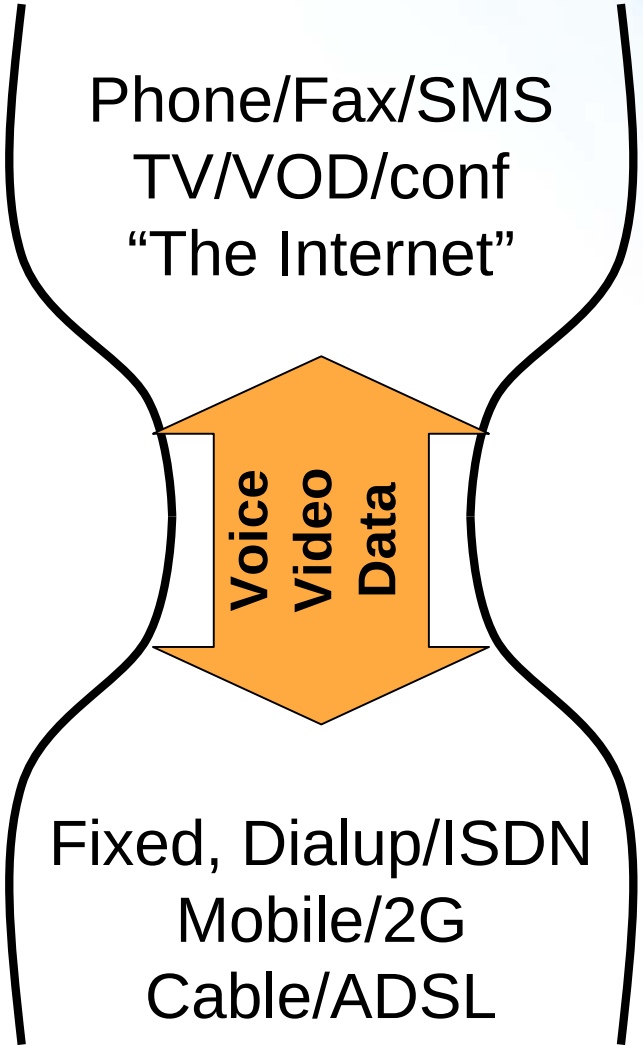
- Also platform for competition among ad hoc standards and innovations
  - Application protocols: VOIP, IM, VOD
  - Applications: search, social networking, ASPs
  - Often standardisation comes later
- Product of deregulation over 15 years
  - Vertical disintegration
    - Content and commerce, services, ISPs, Telcos
  - Competition at all levels
    - Price and service competition
    - Survival by horizontal aggregation and economies of scale

The “Narrow Waist”

Applications

Network

Infrastructure

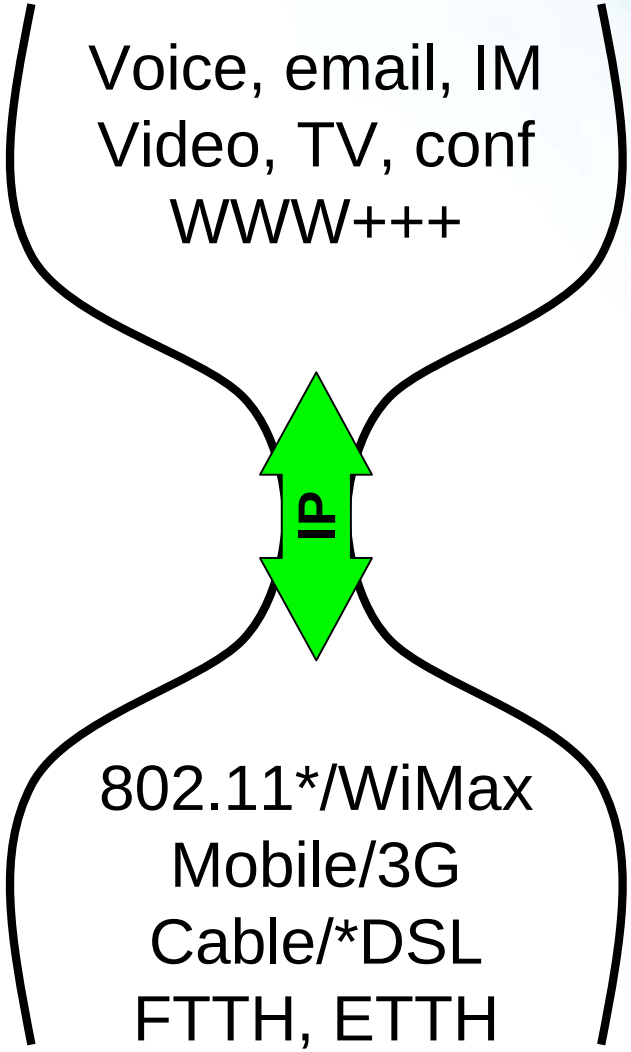


The “Narrow Waist” – Tomorrow

Applications

Network

Infrastructure



Impact of “Broadband”

- Acceleration of Internet function and growth, simultaneously
  - More speed means more applications
  - More applications means more demand
- Separation of services from infrastructure
  - Vertical disintegration
  - Greater innovation and competition
- “Always-on” services assumed
  - Huge increase in IP address requirements…

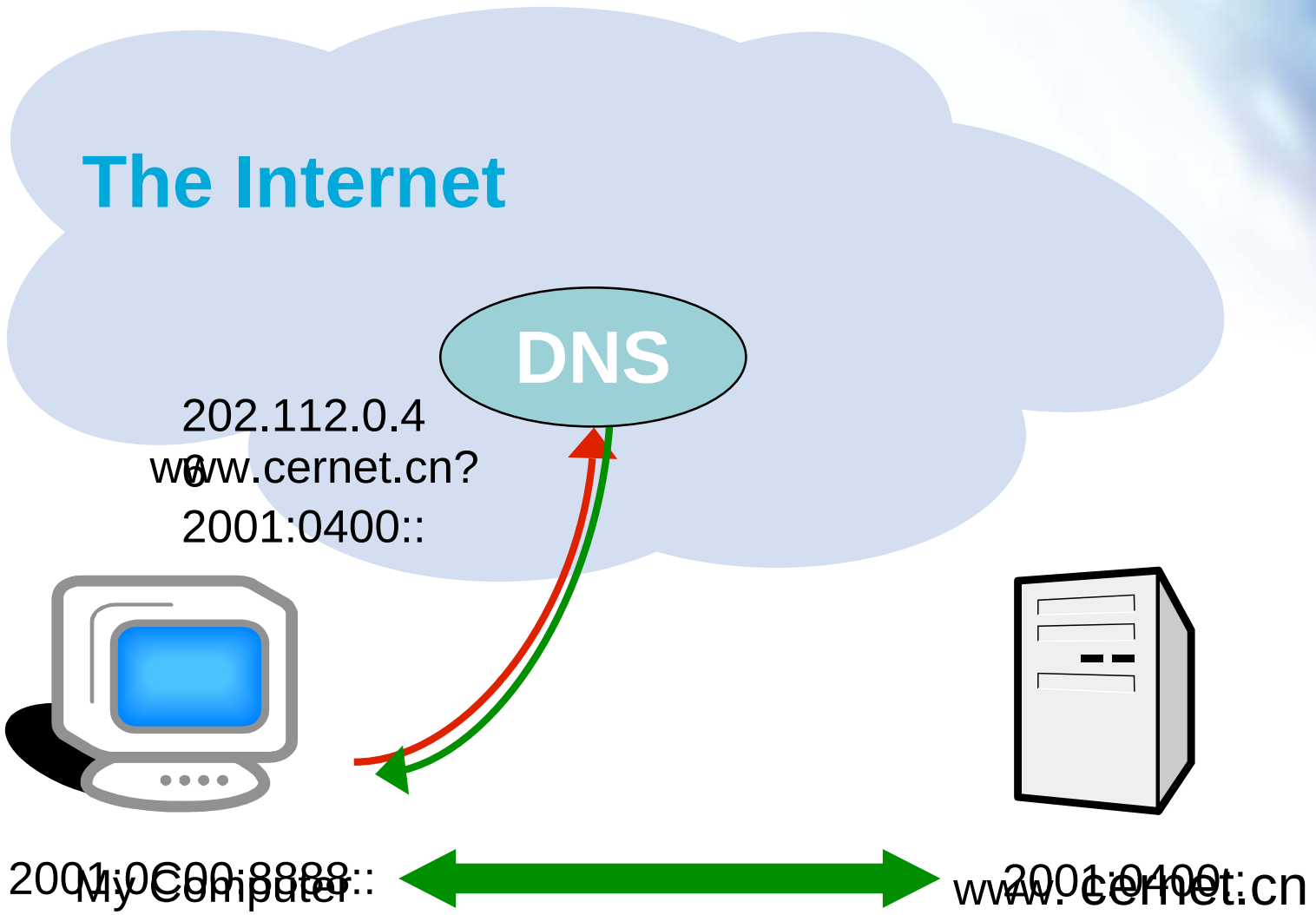
Internet Addressing

What is an IP address?

- The Internet Protocol
  - Packets, addressing and routing
  - Two types: IPv4 and IPv6
- An IP address is a number
  - Every device directly connected to the Internet needs a unique IP address
  - IP address space is finite

- ***Not the same as a Domain Name !***

IP Addresses vs Domain Names



IP Addresses vs Domain Names

IP Address	Domain Name
Numeric ***202.12.29.20*** ***2001:DB8:0234:AB00:0123:4567:8901:ABCD***	Alphabetic www.cto.int www.apnic.net
Computer-friendly ***Router-friendly***	Human-friendly
Locator: Network end-point	Label: Translates to IP Address
Intrinsic to the Internet Protocol	Service running on IP (DNS)
Managed regionally	Managed globally (gTLD) Or nationally (ccTLD)
Primarily technical management priorities	Primarily commercial management priorities
Competition provided by ISPs as "registrars"	Competition provided by "Registry/Registrar" model

IP Addresses: IPv4 vs IPv6

IPv4	IPv6
Deployed 1981	***Deployed 1999***
32-bit address 192.149.252.76	***128-bit address*** ***2001:DB8:0234:AB00:0123:4567:8901:ABCD***
Address space 2^{32} = ~4,000,000,000	***Address space*** ***2^{128} = ~340,000,000,*** ***000,000,000,000,000,*** ***000,000,000,000,000***
Security, autoconfig, QoS, mobility added later (IPSec etc)	***Security, autoconfig, QoS*** ***"built-in" (IPSec etc)***
Projected lifetime: 2012	***Projected lifetime: Indefinite***

How are IP Addresses Managed?

- Regional Internet address Registries
  - Open membership-based industry bodies
  - Non-profit, neutral, and independent
  - Allocation, registration and other services
  - APNIC: training, infrastructure, cooperation
- First established in early 1990s
  - Voluntarily by consensus of community
  - To ensure responsible address management, according to technical and administrative needs
  - To support Internet development
- In the “Internet tradition”
  - Consensus-based, open, and transparent

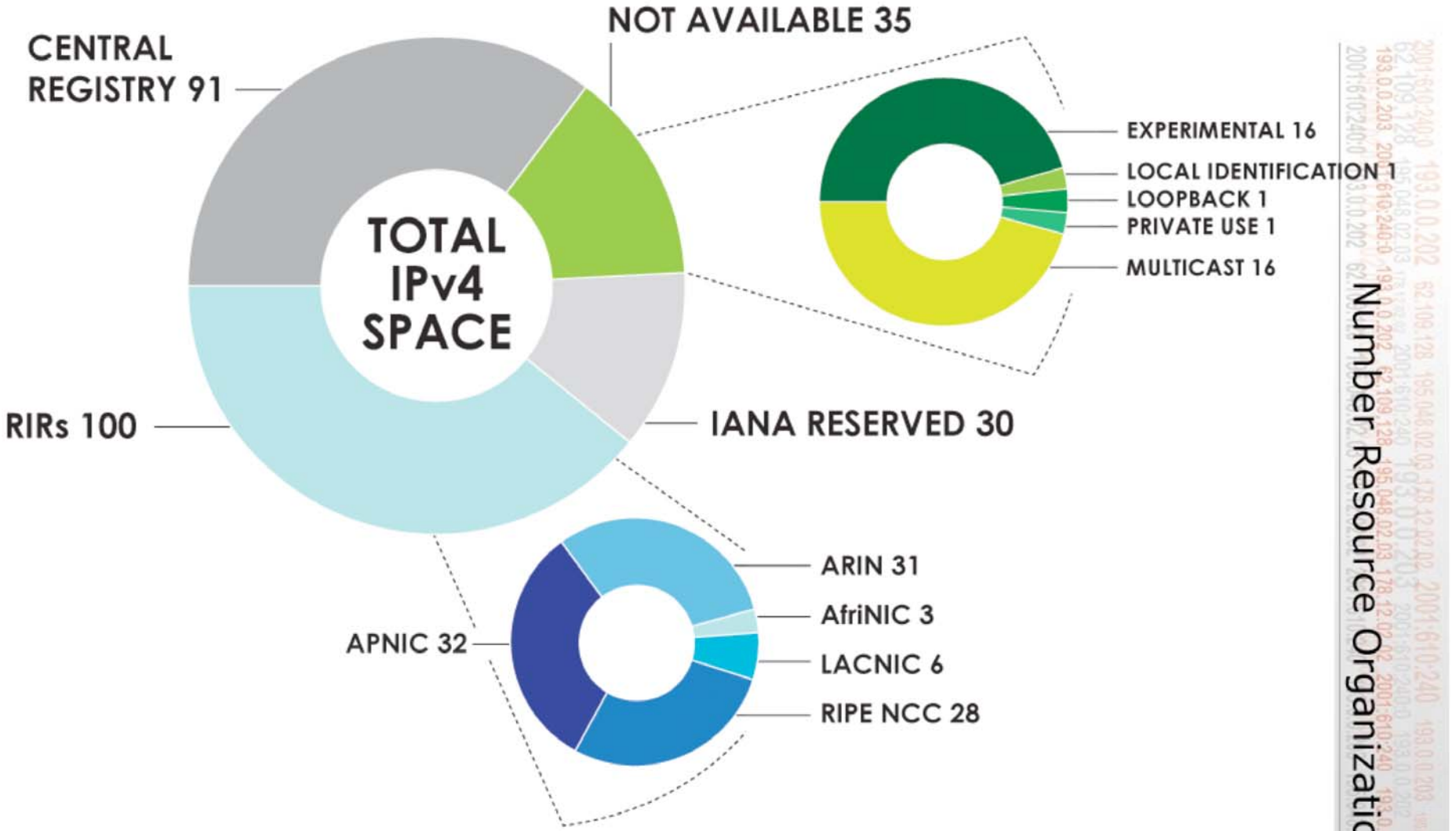
Regional Internet Registries

1992: "…it is [now] desirable to consider delegating the registration function to an organization in each of those geographic areas." (RFC 1338)

IP Address Status Report

IPv4 ADDRESS SPACE

What is the status of each of the 256 /8s?

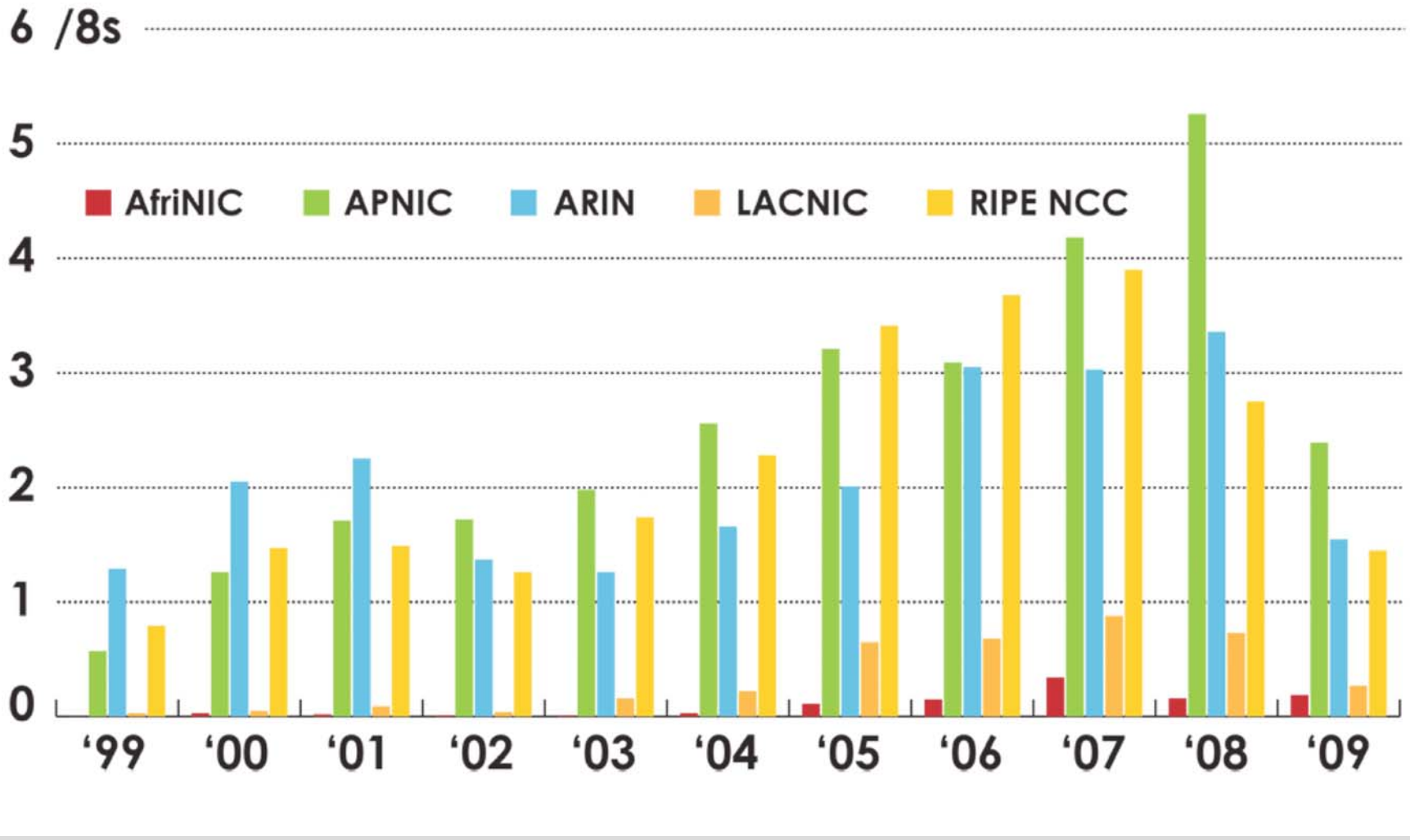


Number Resource Organization

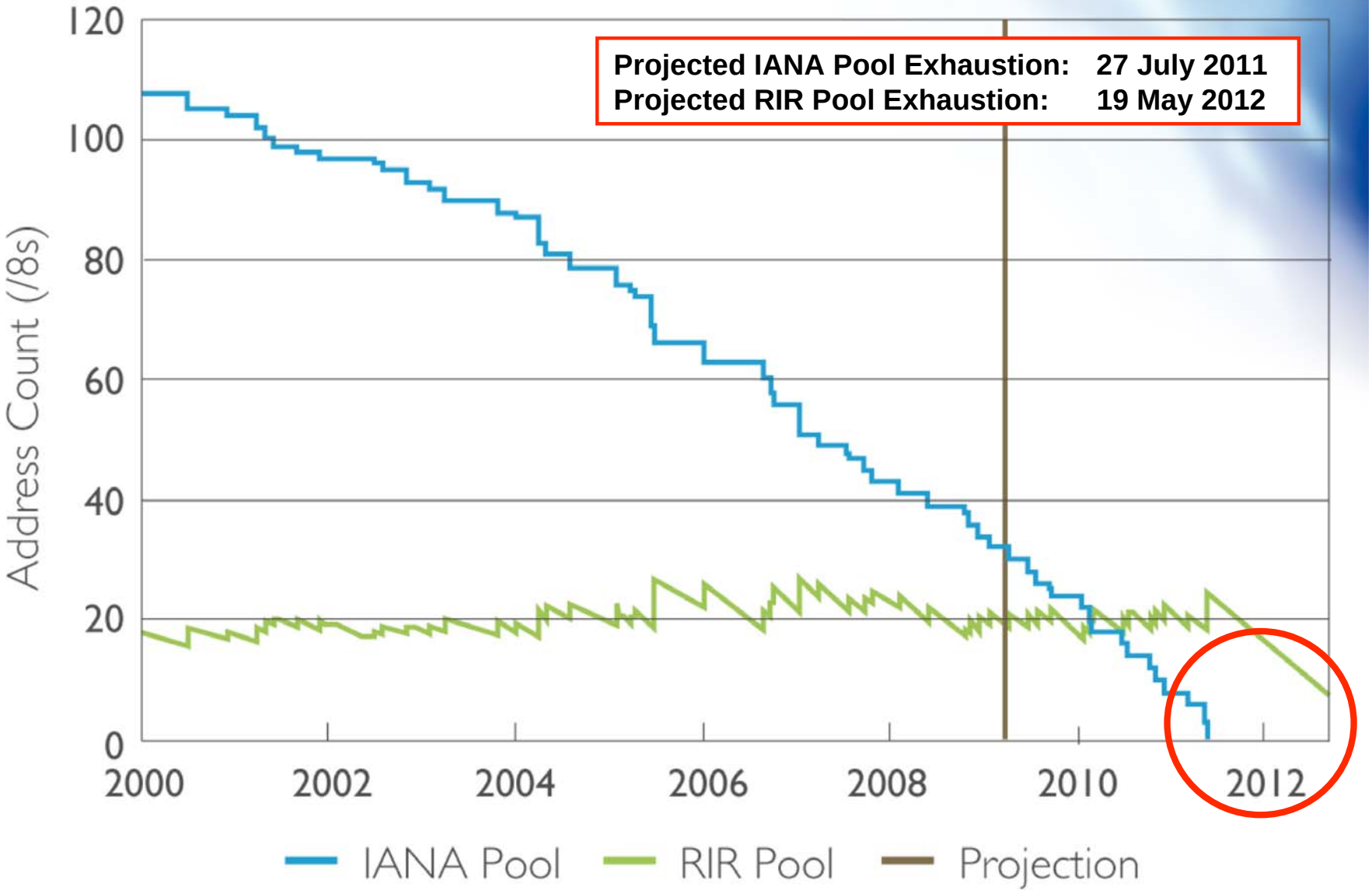
IPv4 ADDRESS SPACE ISSUED

(RIRs TO CUSTOMERS)

In terms of /8s, how much space did each RIR allocate by year?



IPv4 Consumption: Projection



and more devices coming!

- Billions of devices and objects will be connected to the Internet
  - Always on, broadband connected
  - Multiple addresses per device

A quick summary

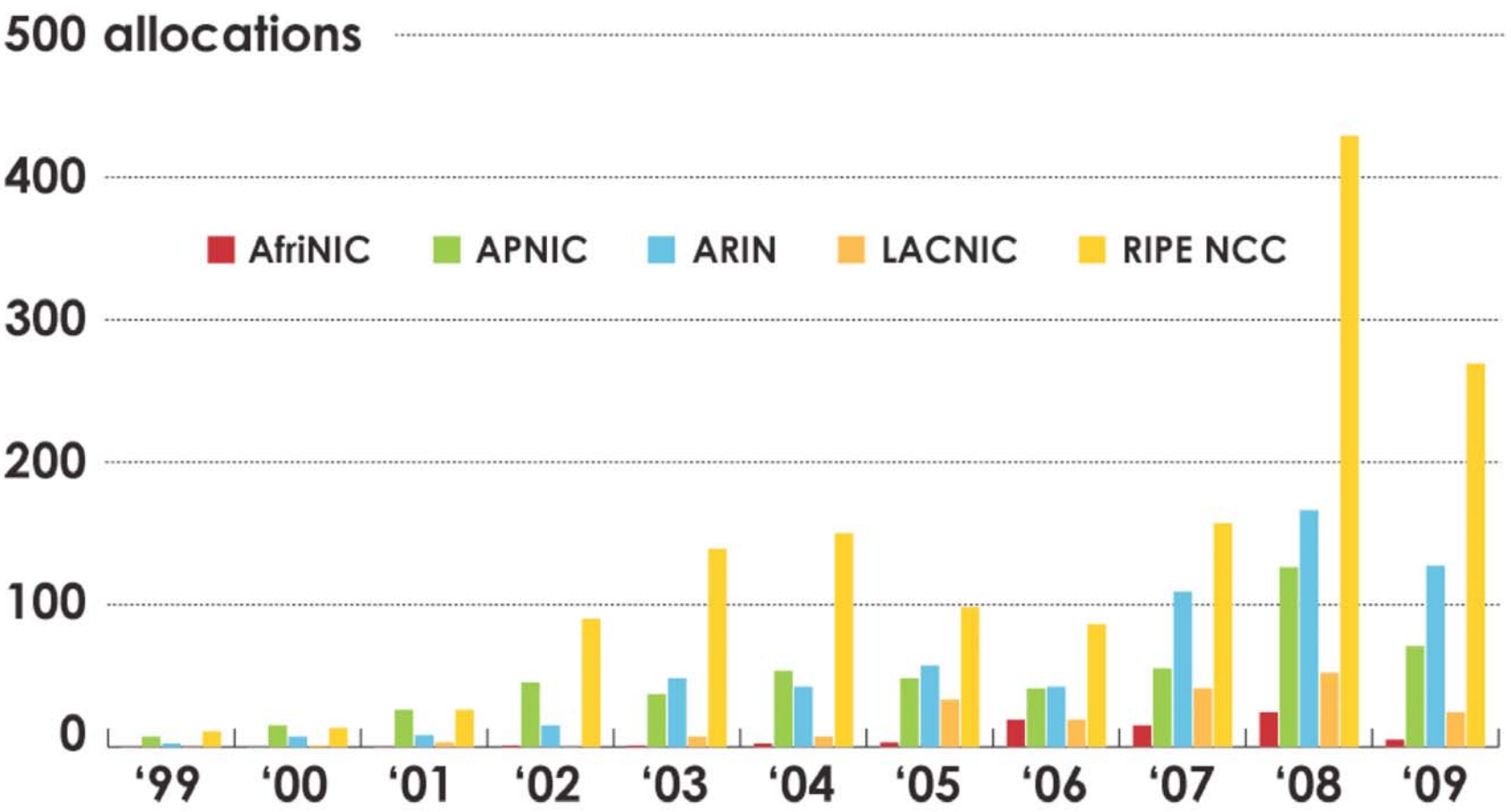
- IPv4 addresses are a finite resource
  - Only about 10% remain
- But the demand for IP addresses will keep growing
  - More devices are requiring IP addresses
  - IP addresses are a pre-requisite for broadband penetration
- The remaining 10% is not large enough to support such demand

- ***IPv6 is the only solution !***

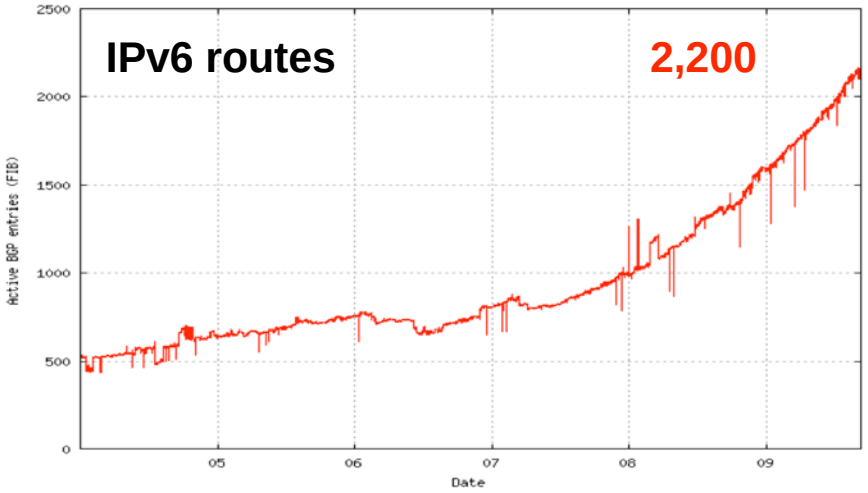
IPv6 status

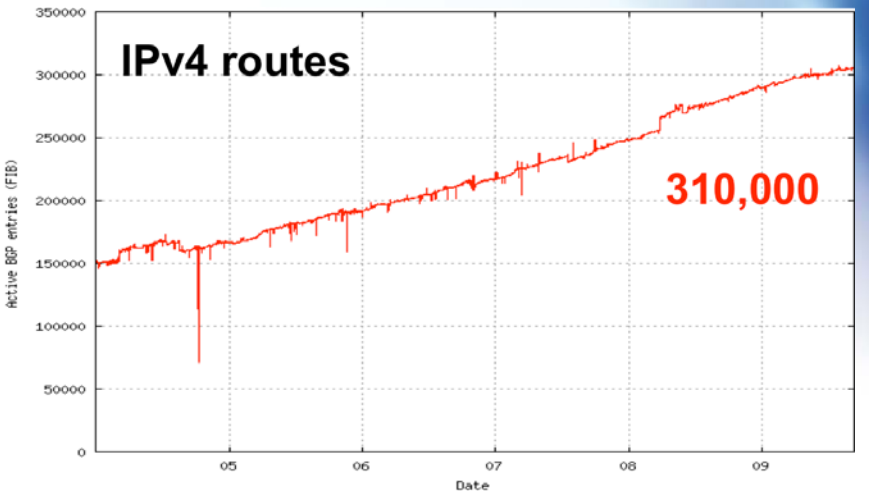
IPv6 Allocations RIRs to LIRs/ISPs

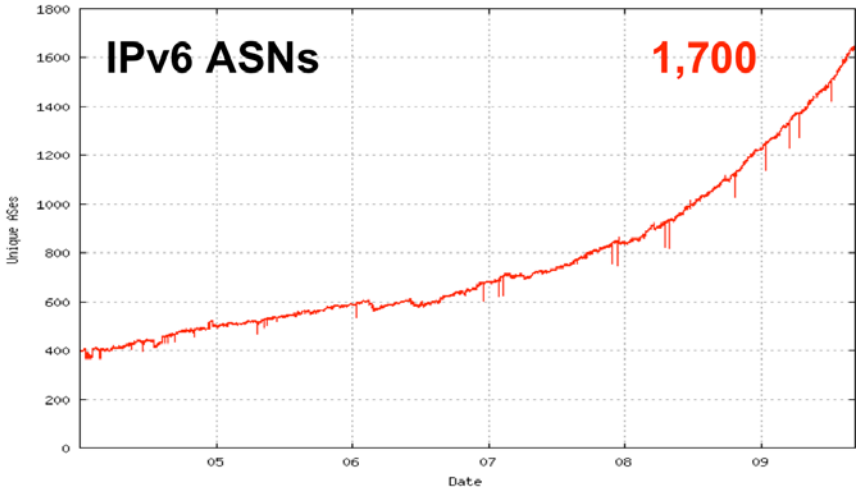
How many allocations have been made by each RIR by year?

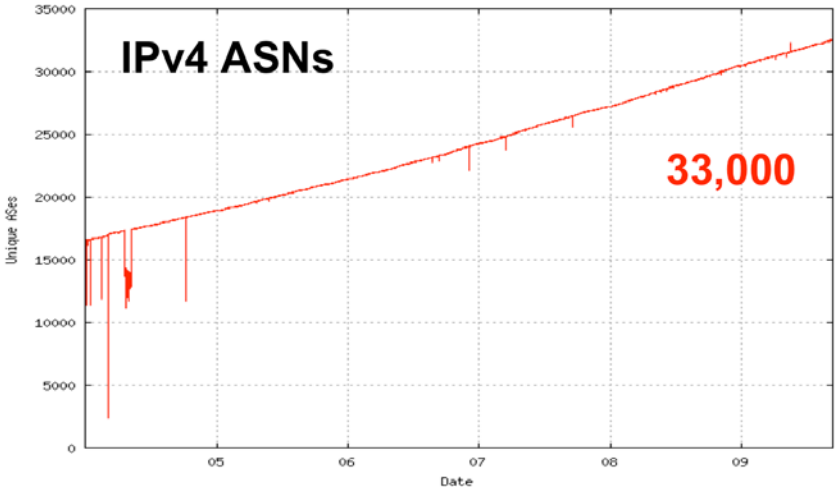


IPv6 deployment

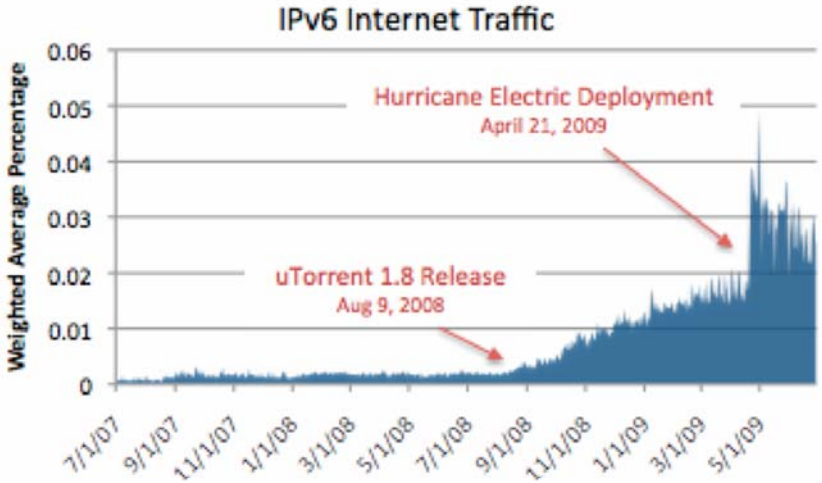


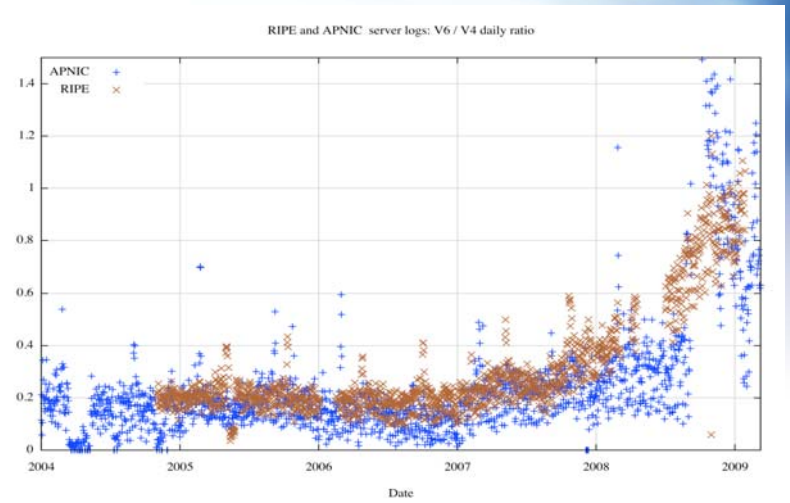


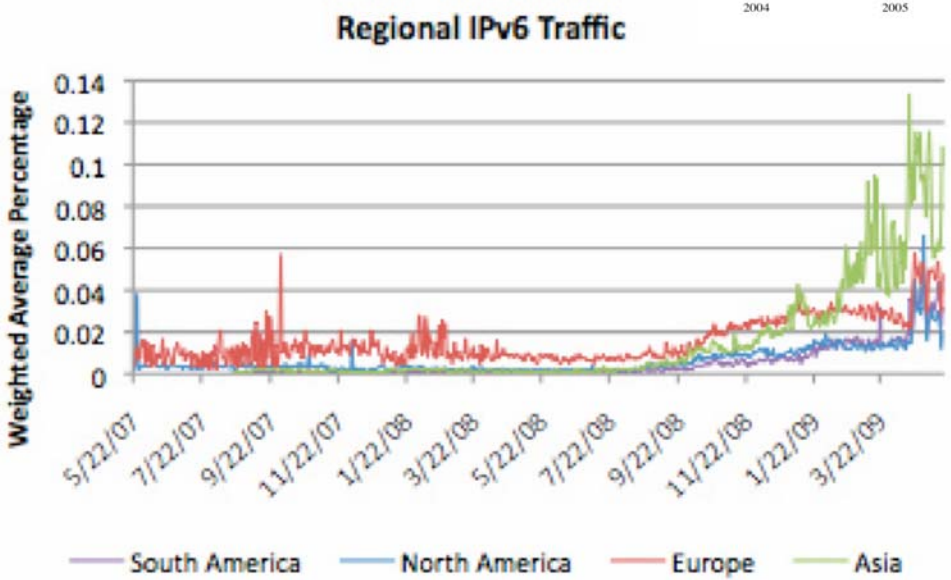




IPv6 traffic

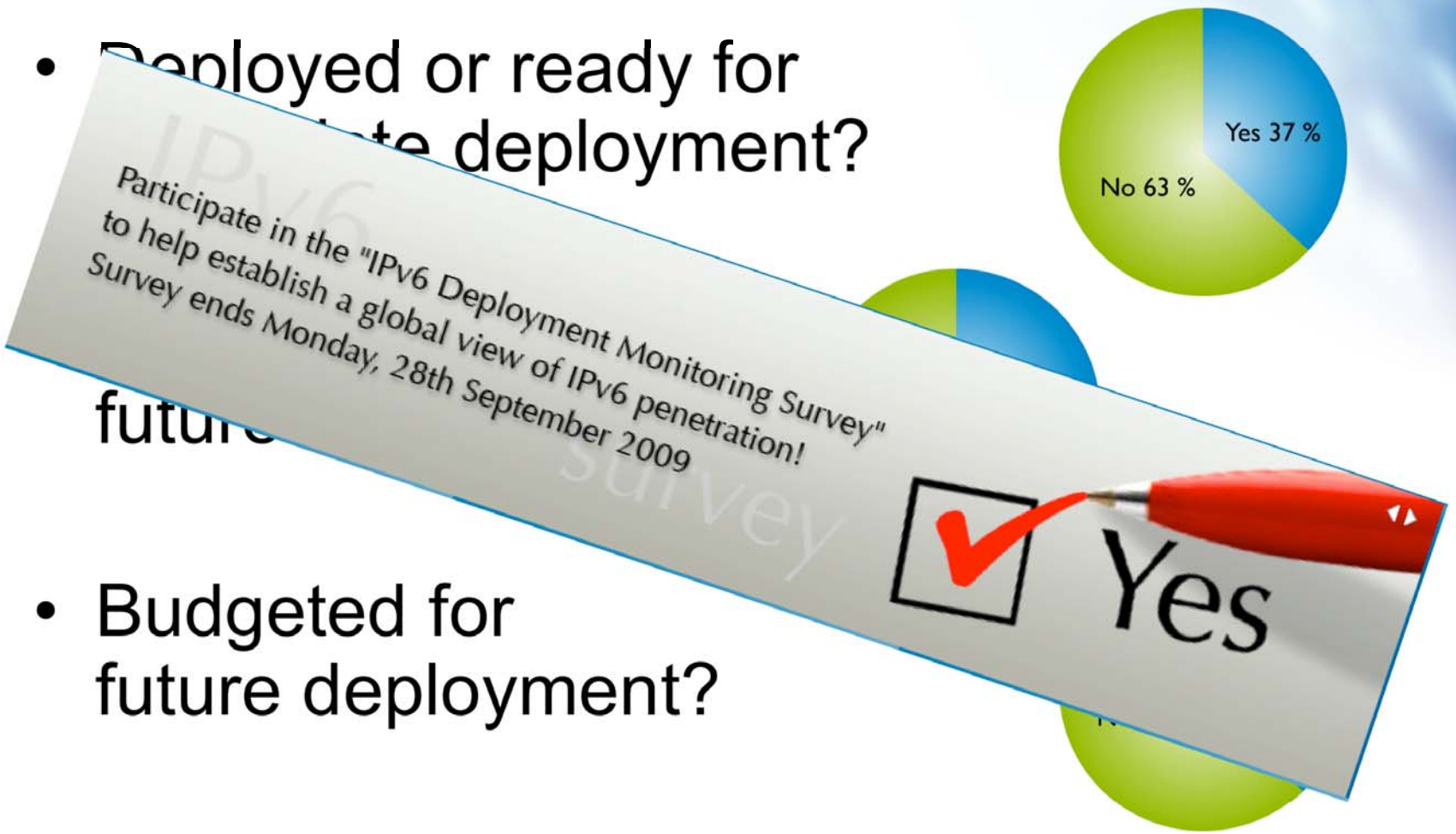






APNIC IPv6 Readiness Survey 2009

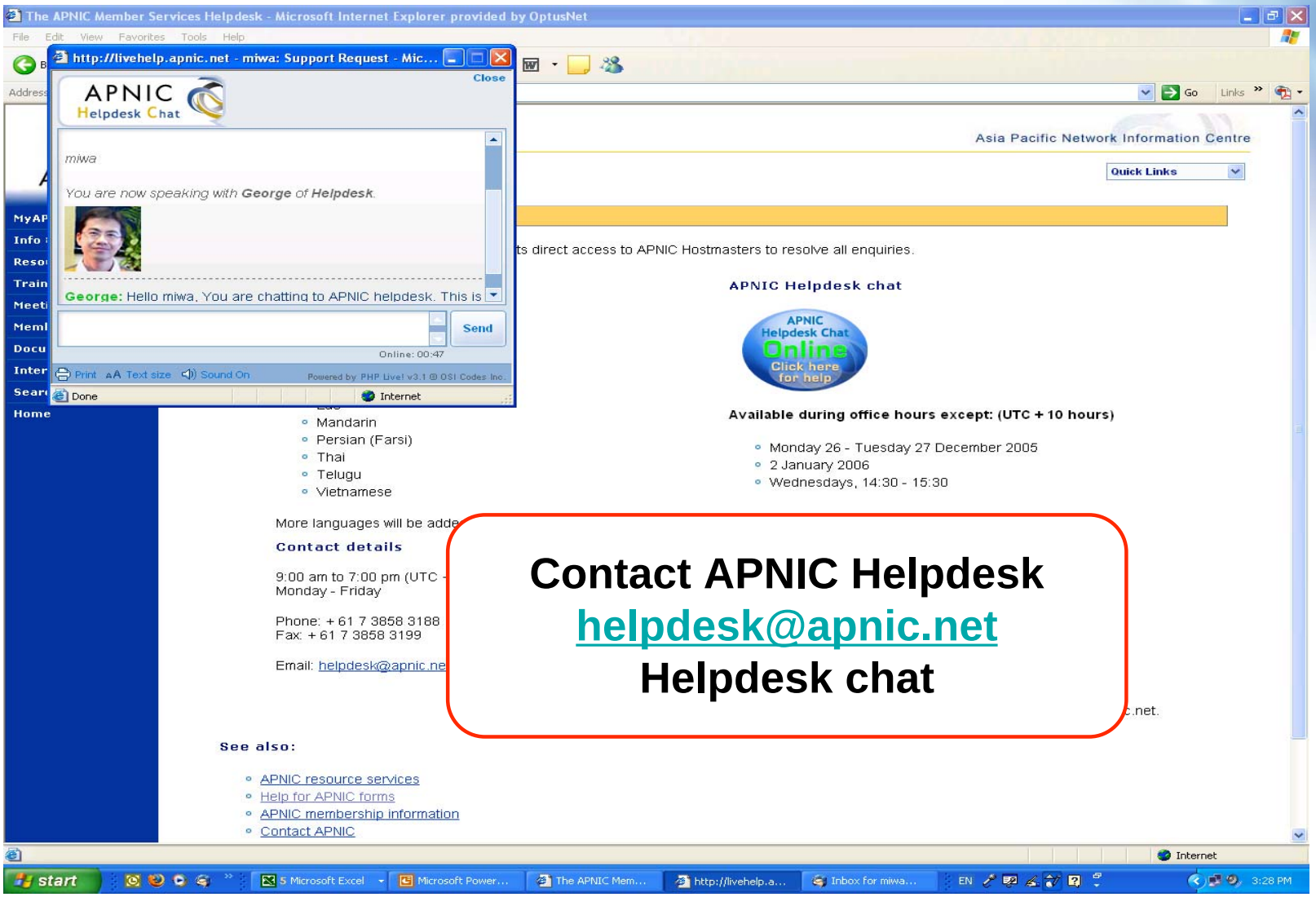
- Deployed or ready for
  te deployment?
  futur
- Budgeted for
  future deployment?



Where are we now

- IPv6 addresses are easy to obtain
  - Policies are established and stable
  - Minimal barriers to allocations
  - No reservations, but supply is huge
- IPv6 deployment strongly encouraged
  - Increasing promotion and awareness
  - Technical training and support
- Readiness is increasing but deployment is still slow

Need IPv6 addresses?



Contact APNIC Helpdesk
helpdesk@apnic.net
Helpdesk chat

The Next Step: IPv6

What we know…

- The Internet needs IPv6!
  - Imperative from 2012
  - Deployment will take time and cost money
  - Business case may not be enough
- A “Chicken and Egg” problem…
  - Demand from users to applications, ISPs
  - Demand from applications to ISPs, vendors
  - Demand from ISPs to vendors, peers
- Transition will be a long process
  - But needs to be underway “RSN”

Government Responses

- Hands off ?
  - Leave it to the industry and market (NZ)
- Hands on – incentives
  - Taxation relief (JP)
  - Procurement requirements (US, AU and others)
- Hands on – leadership
  - Working groups, Task forces (JP, KR, SG)
  - Facilitating industry responses (IPv6 Forum)
- Hands on – deployment
  - Major infrastructure development (CNGI and Olympics, CN; NBN, AU)

Government Responses

- Promote IPv6
  - To ISP and telco Industries
  - Encourage IPv6 readiness if not deployment
  - Opportunity to “leapfrog” to latest technology
- Specify IPv6
  - Government equipment procurement
  - Network servers and services
  - Public infrastructure deployments
- Require IPv6
  - To the extent possible (cf digital TV)

Conclusions…

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 edges
  - Many compelling business cases for new services and innovation

An IPv6 revolution…

- The 2010's – a new world of…
  - Commodity Internet service provision
  - Massive reduction in cost of consumer electronics
  - A network-ready society
- An IPv6 boom?
  - Ubiquitous pervasive networking
  - Bringing online the "Next 4 Billion"
  - Plus a device population some 2–3 orders of magnitude larger than today's Internet
  - "Internet for Everything"

- *Let's get ready for IPv6 !*

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