Asia Pacific Network Information Centre

APNIC

APNIC

IPv6 Address Allocation and Assignment

5 July 2004, Seoul

In conjunction with Global IPv6 Summit in Korea

Introduction

- Presenters
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Schedule

- Introduction to APNIC
- APNIC community & policy development
- IPv6 policies
- IPv6 policy update
- Current status and potential future
- Statistics update

Asia Pacific Network Information Centre

APNIC

Introduction to APNIC

Asia Pacific Network Information Centre

Overview

- What is APNIC?
- What does APNIC do?
- Where is APNIC?
- APNIC membership

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 ~900 ISPs
- Industry self-regulatory body
  - Established in 1993
  - Consensus-based, open and transparent
  - Non-profit, neutral and independent
  - Open membership-based structure

What does APNIC do?

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

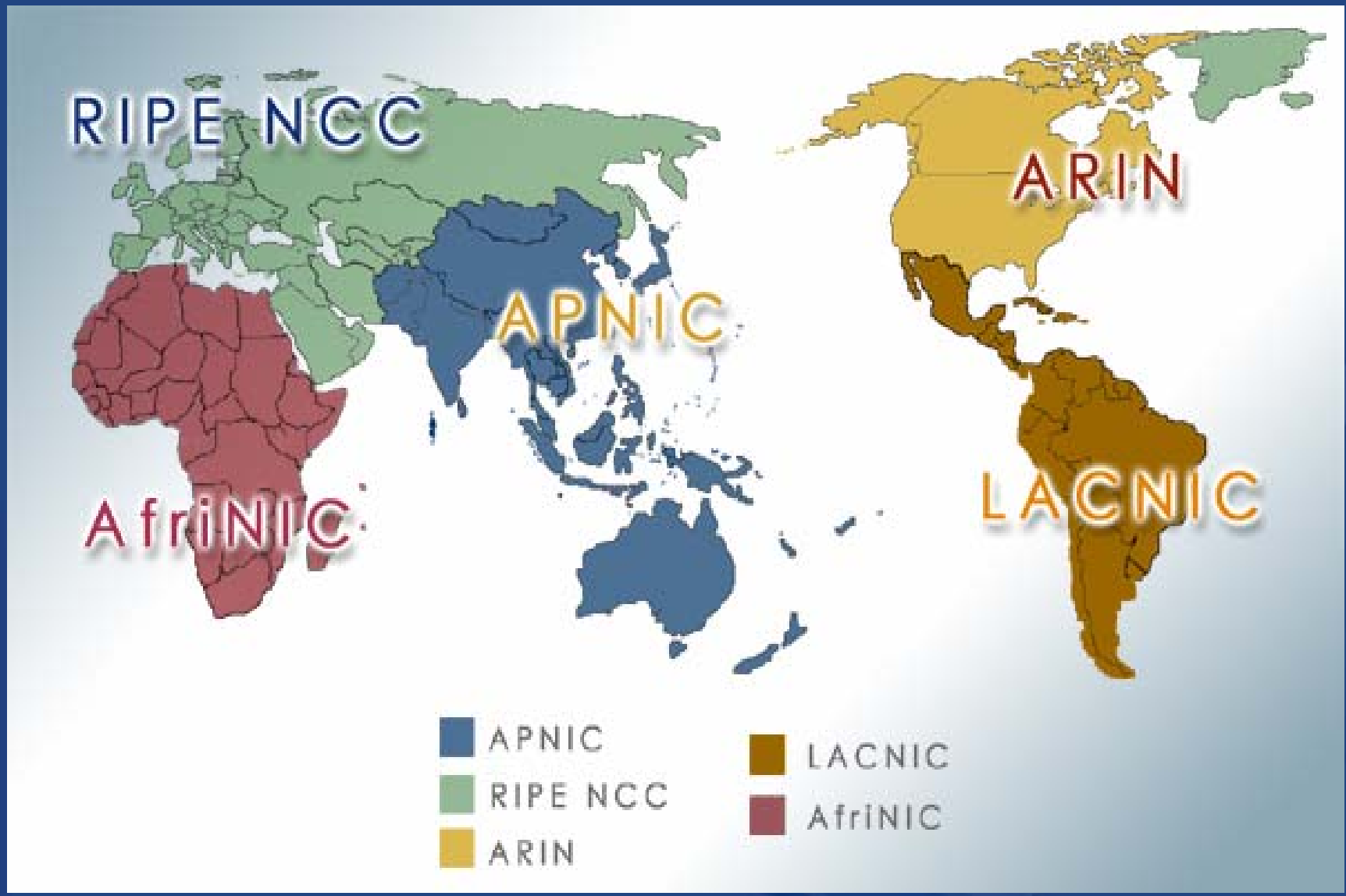
What else does APNIC do?

- 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

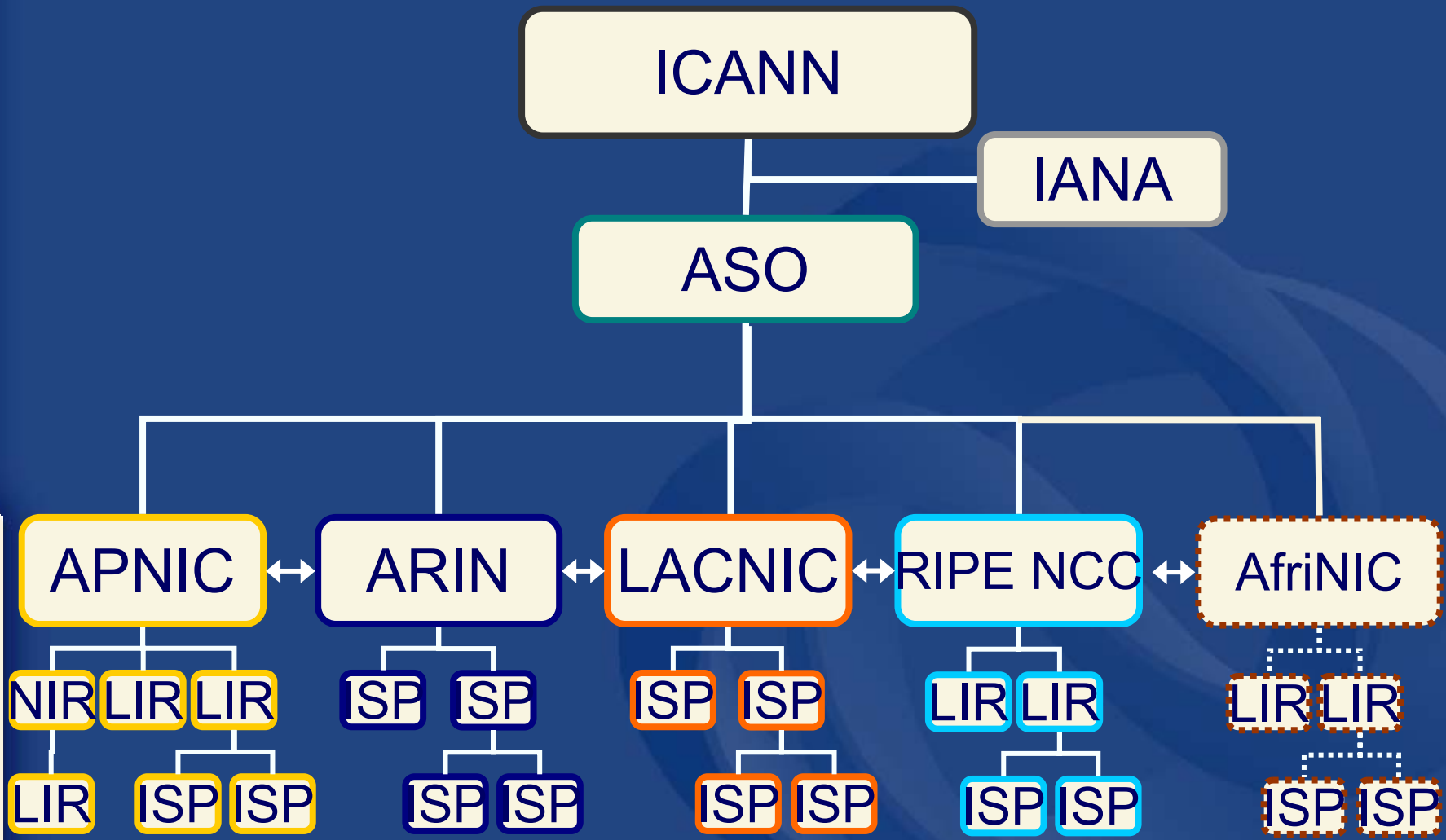
APNIC is…

- Not a network operator
  - Does not provide networking services
    - Works closely with APRICOT forum
- Not a standards body
  - Does not develop technical standards
    - Works within IETF in relevant areas (IPv6 etc)
- Not a domain name registry or registrar
    - Will refer queries to relevant parties

Where is APNIC region?



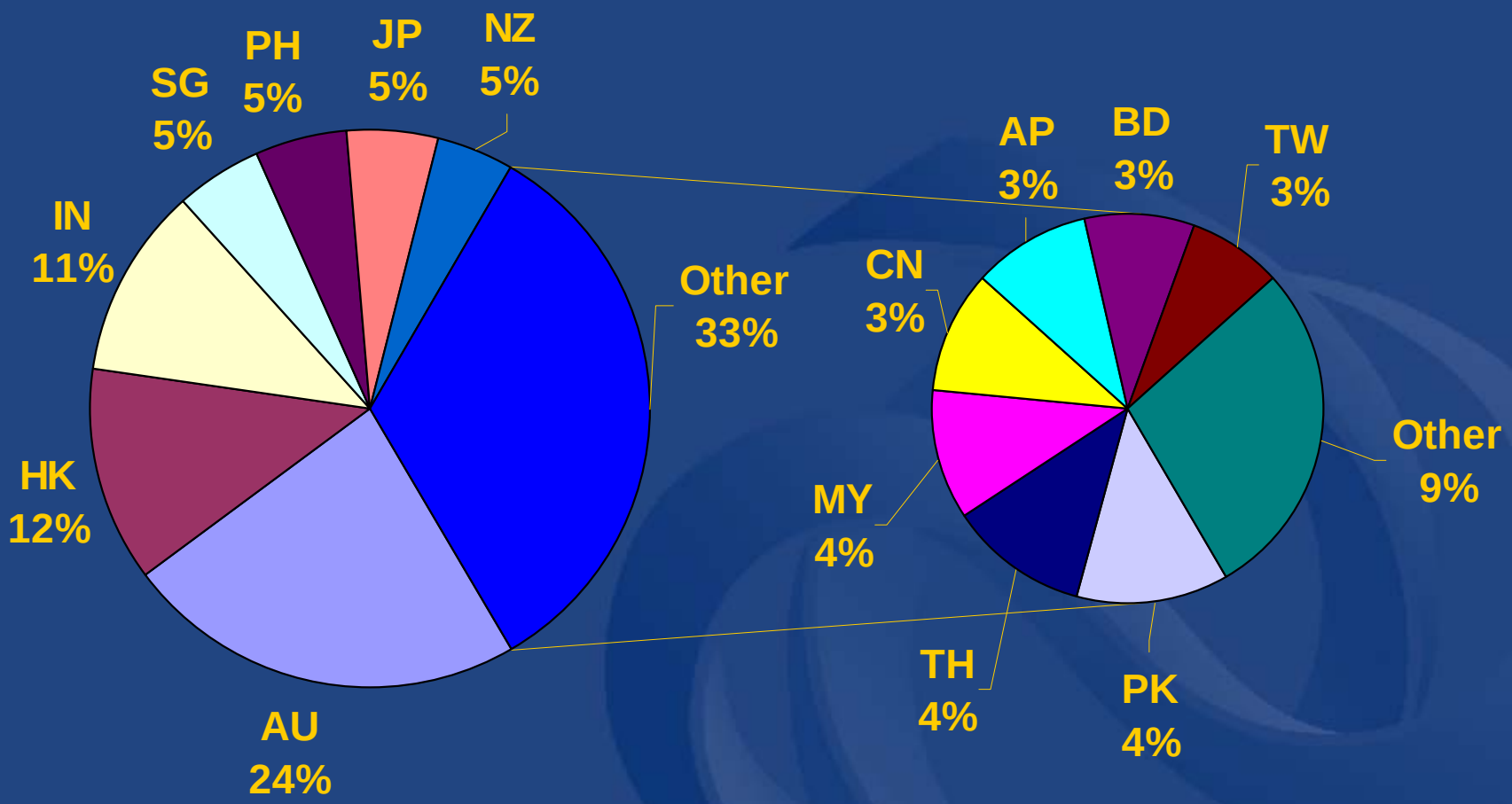
Internet Registry structure



APNIC structure

- Industry self-regulatory structure
  - Participation by those who use Internet resources
  - Consensus-based decision making
    - Eg. Policy changes, db requirements etc
  - Open and transparent
- Meetings and mailing lists
  - Open to anyone

APNIC membership



Source: APNIC statistic data - Last update June 2004

Questions?

Asia Pacific Network Information Centre

APNIC

Policy development in the Asia Pacific

The APNIC community

&

the policy development process

What is the APNIC community?

- Open forum in the Asia Pacific
  - Open to any interested parties
- Voluntary participation
- Decisions made by consensus
- Public meetings
- Mailing lists
  - web archived

- *A voice in regional Internet operations through participation in APNIC activities*

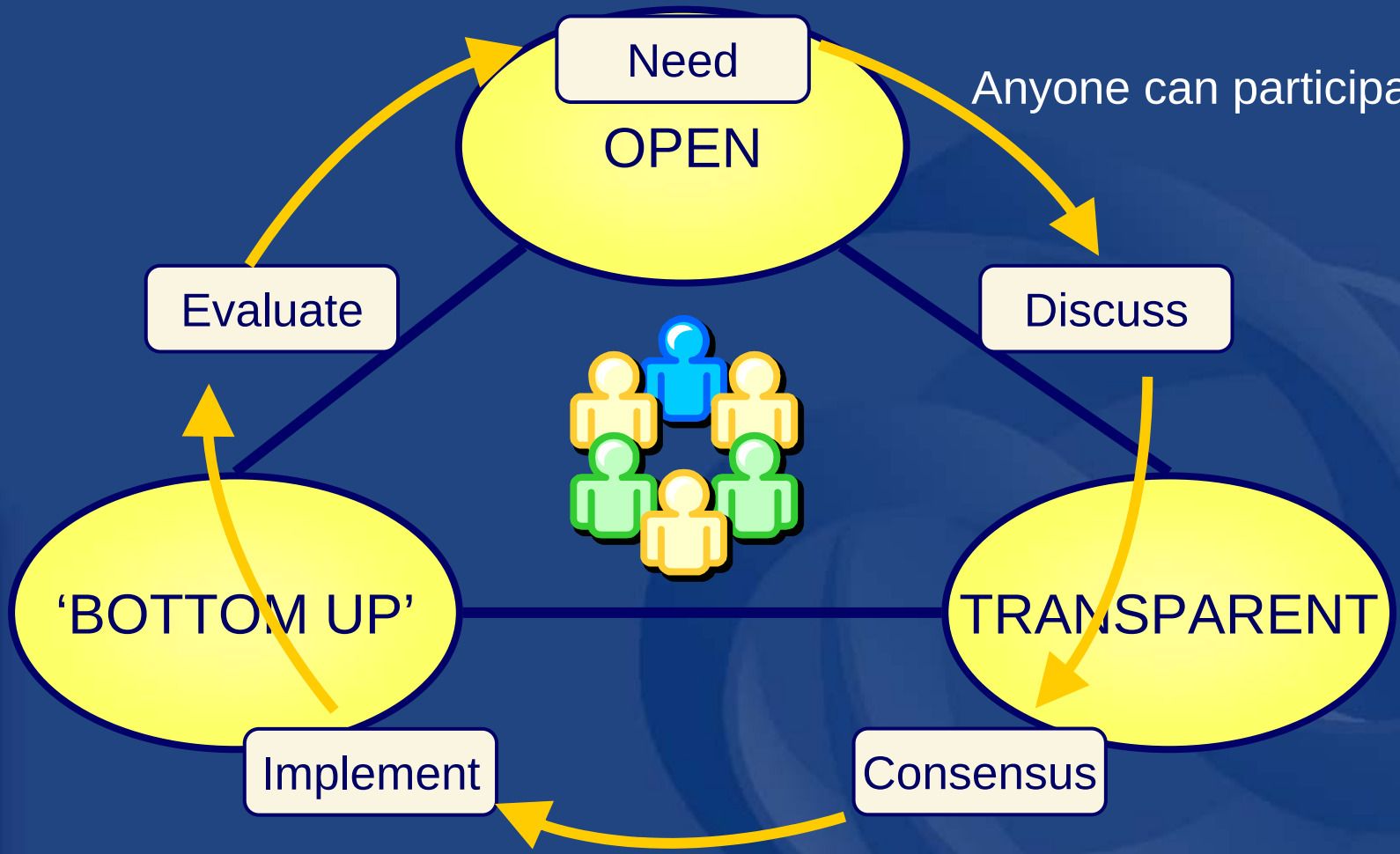
Policy development

- Industry self-regulatory processes
  - Open to all interested parties
  - Facilitated by RIR staff
- Policy implementation
  - RIR processes
  - ISPs and other affected parties

Participation in policy development

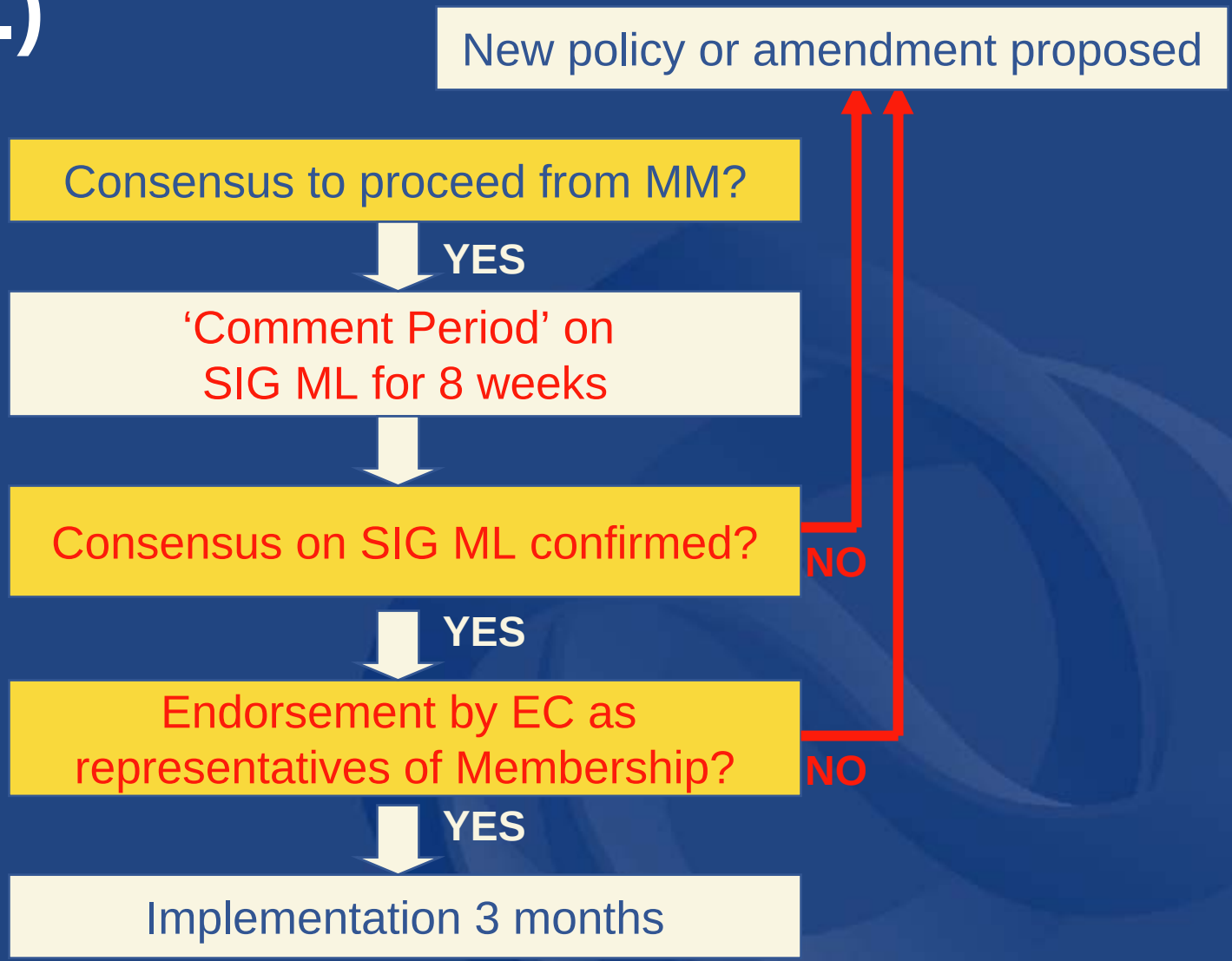
- Why should I bother?
  - Responsibility as an APNIC member
    - To be aware of the current policies for managing address space allocated to you
  - Business reasons
    - Policies affect your business operating environment and are constantly changing
    - Ensure your needs are met
  - Educational
    - Learn and share experiences
    - Stay abreast with “best practices” in the Internet

Policy development cycle



Policy development in practice

Policy development in practice (cont.)



How to make your voice heard

- Contribute on the public mailing lists
  - http://www.apnic.net/community/lists/index.html
- Attend meetings
  - Or send a representative
  - Gather input at forums
  - Via transcripts, web cast and Jabber chat
- Give feedback
  - Training or seminar events

Come to the APNIC meeting!

APNIC 18

Nadi, Fiji, 31 Aug- 3 Sep 2004


- Participate in policy development
- Attend workshops, tutorials & presentations
- Exchange knowledge and information with peers
- Stay abreast with developments in the Internet
- View multicast online
- Provide your input in matters important to you
- **Fellowships Available**

http://www.apnic.net/meetings/18

Questions?

- Policy making process description
  - http://www.apnic.net/docs/policy/dev/index.html

Internet Registry allocation and assignment

Policies

Overview of APNIC policies

- Definitions
- Background
- Objectives
- Environment
- IPv6 policies and procedures

Allocation and assignment

- Allocation
- *"A block of address space held by an IR (or downstream ISP) for subsequent allocation or assignment"*
  - Not yet used to address any networks

- Assignment
- *"A block of address space used to address an operational network"*
  - May be provided to LIR customers, or used for an LIR's infrastructure ("self-assignment")

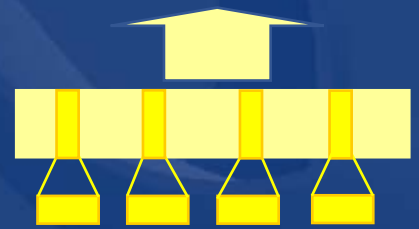
Portable & non-portable

Portable assignments

- Customer addresses independent from ISP
  - Keeps addresses when changing ISP
- Bad for size of routing tables ☹
- Bad for QoS: routes may be filtered, flap-dampened

Non-portable assignments

- Customer uses ISP's address space ☺
  - Must renumber if changing ISP
- Only way to effectively scale the Internet



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

APNIC policy environment

"*IP addresses not freehold property*"

- Assignments & allocations on license basis
  - Addresses *cannot* be bought or sold
  - Internet resources are public resources
  - "Ownership" is contrary to management goals

"Confidentiality & security"

- APNIC to observe and protect trust relationship
  - Non-disclosure agreement signed by staff

APNIC allocation policies

- Aggregation of allocation
  - Provider responsible for aggregation
  - Customer assignments & sub-allocations must be non-portable
- Allocations based on demonstrated need
  - Detailed documentation required
    - All address space held to be declared
  - Address space to be obtained from one source
    - routing considerations may apply
  - Stockpiling not permitted

Questions?

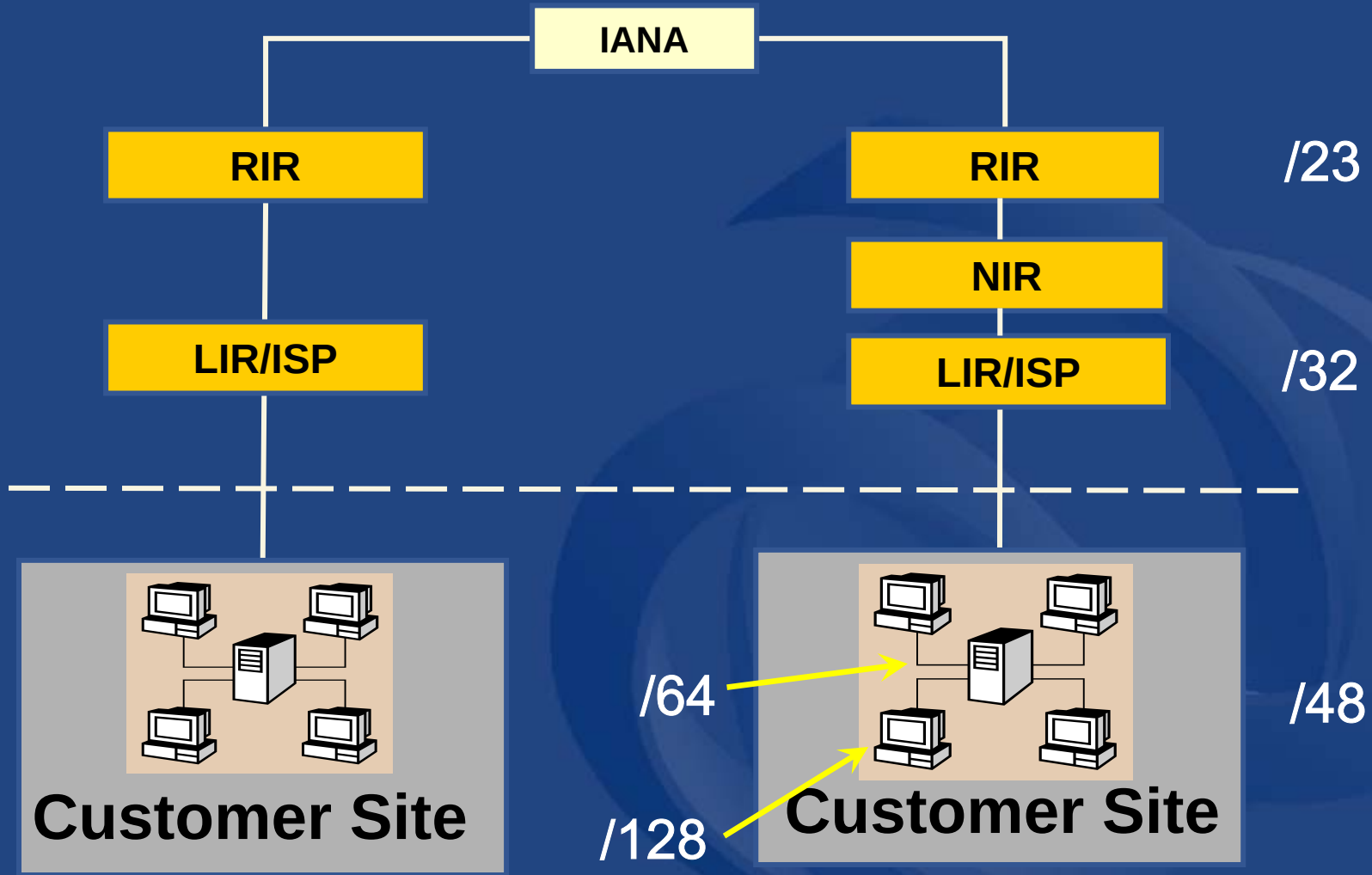
IPv6

Policies & procedures

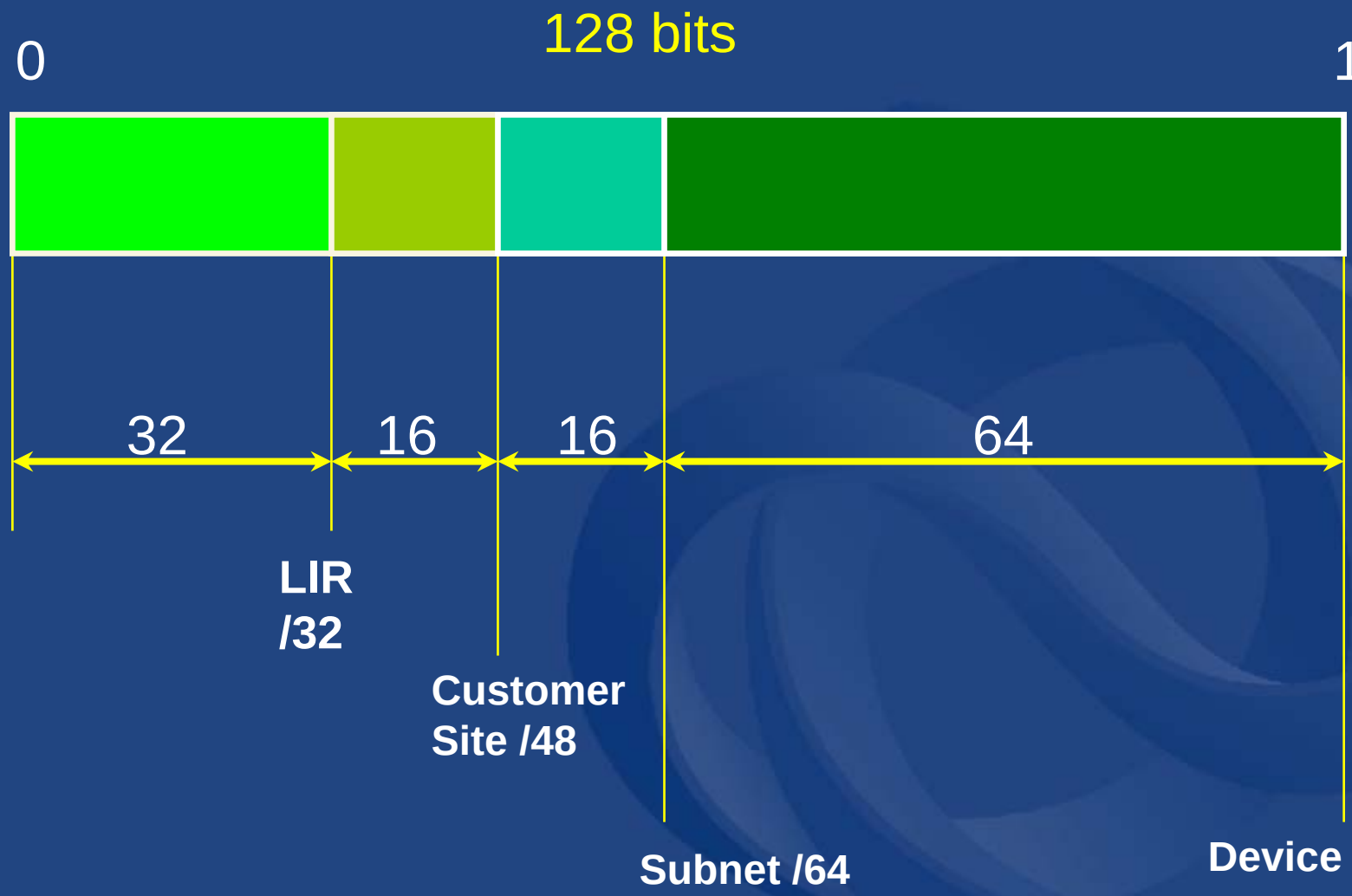
Overview

- IPv6 addressing structure
- IPv6 policy & procedures
- Current status and potential future
- Statistics

IPv6 address management hierarchy



IPv6 addressing structure



IPv6 initial allocation

- Initial allocation criteria
  - Plan to connect 200 end sites within 2 years
    - Default allocation (“slow start”)
- Initial allocation size is /32
  - Provides 16 bits of site address space

  - Larger initial allocations can be made if justified according to:
    - IPv6 network infrastructure plan
    - Existing IPv4 infrastructure and customer base

Example of a plan for 200 x /48

- APNIC guidelines for IPv6 allocation and assignment requests
  - Published on 2 July 2004
  - http://www.apnic.net/docs/policy/ipv6-guidelines.html

/44 sub-allocation to ISP:	16 /48s
Assignments to POPs:	20 /48s
Assignments to end sites:	170 /48s
Total number of /48s:	206 /48s

IPv6 sub-allocation policy

- LIR to ISP allocation
  - Policy determined by LIR
- DB registration
  - All /48 and shorter prefix allocations and assignments must be registered

IPv6 assignments

- Default assignment /48 for all end sites
  - PoP also defined as end site
  - Providing 16 bits of space for subnets

- Other assignment sizes
  - /64 only one subnet
  - /128 only one device connecting
- Larger assignments - Multiple /48s
  - Should be reviewed by RIR/NIR
    - Follow second opinion procedure

What is an end site?

- End site defined as an end user of an ISP where the ISP:
  - Assigns address space to the end user
  - Provides Internet transit service to the end user
  - Advertises an aggregate prefix route that contains the end user's assignment
- ISP PoP are also defied as end sites

RFC 3177

- Specific assignment guidelines
  - /48 in the general case, except for very large subscribers
  - /64 when it is known that one and only one subnet is needed by design
  - /128 when it is absolutely known that one and only one device is connecting.
- How to assess /48 requirements for /64 and /128 assignments?
  - Use HD ratio
  - i.e. /48 is utilised when 7,132 /64s are used

IPv6 utilisation

- Utilisation determined from end site assignments
  - LIR responsible for registration of all /48 assignments
  - Intermediate allocation hierarchy not considered
- Utilisation of IPv6 address space is measured differently from IPv4
- Subsequent allocation may be requested when IPv6 utilisation requirement is met

IPv6 utilisation requirement

- IPv6 utilisation measured according to HD-Ratio (RFC 3194):

$$\text{Utilisation}_{HD} = \frac{\log(\text{Assigned address space})}{\log(\text{Available address space})}$$

- IPv6 utilisation requirement is HD=0.80
  - Measured according to assignments only
    - E.g. ISP has assigned 10000 (/48s) addresses of /32

$$\frac{\log(\text{Assigned address space})}{\log(\text{Available address space})} = \frac{\log(10{,}000)}{\log(65{,}536)} = 0.83$$

IPv6 utilisation requirement (cont.)

- HD Ratio utilisation requirement of 0.80

IPv6 Prefix	Site Address Bits	Total site address in /48s	Threshold (HD ratio 0.8)	Utilisation %
42	6	64	28	43.5%
36	12	4096	776	18.9%
35	13	8192	1351	16.5%
32	16	65536	7132	10.9%
29	19	524288	37641	7.2%
24	24	16777216	602249	3.6%
16	32	4294967296	50859008	1.2%
8	40	1099511627776	4294967296	0.4%
3	45	35184372088832	68719476736	0.2%

- RFC 3194
- “In a hierarchical address plan, as the size of the allocation increases, the density of assignments will decrease.”

Subsequent allocation

- Must meet HD = 0.8 utilisation requirement of previous allocation
  - (7132 /48s assignments in a /32)
- Other criteria to be met
  - Correct registrations (all /48s registered)
  - Correct assignment practices etc
- Subsequent allocation size is at least double
  - Resulting IPv6 prefix is 1 bit shorter
  - Or sufficient for 2 years requirement

Other conditions

- License model of allocation
  - Allocations are not considered permanent, but always subject to review and reclamation
- Existing /35 allocations
  - A number of /35s have been assigned under interim IPv6 policy
  - Holders of /35s eligible to request /32

IXP IPv6 assignment policy

- Criteria
  - Demonstrate “open peering policy”
  - 3 or more peers
- Portable assignment size: /48
  - All other needs should be met through normal processes
  - /64 holders can “upgrade” to /48
    - Through NIRs or APNIC
    - Need to return /64

Other Ipv6 Policies

- Critical infrastructure
  - Root DNS, gTLD, ccTLD, RIR, NIR and IANA
  - Minimum allocation /32
- Documentation prefix
  - 2001:0DB8::/32
- Experimental allocation
  - Minimum allocation /32
  - Allocate for one year
  - http://www.apnic.net/docs/drafts/apnic-draft-experiment-v001.html

How to Obtain IPv6 Address

- Existing member of APNIC or NIRs
  - –APNIC member
    - http://ftp.apnic.net/apnic/docs/ipv6-alloc-request
  - –NIR member
    - Contact appropriate NIR
- Not a member
  - –Become member of APNIC or NIRs
    - APJII, CNNIC, JPNIC, KRNIC, TWNIC and VNNIC

IPv6 policy – have your say!

- Limited experience of policy in action
  - Your feedback very important
  - Policy always subject to change and refinement
- Open discussion list
  - global-v6@lists.apnic.net (all regions)
  - SIG Policy mailing list (APNIC region)
- Documentation
  - FAQ information and more!
    - http://www.apnic.net/services/ipv6_guide.html
  - Guidelines document published
    - To assist new requestors with policy
    - http://www.apnic.net/docs/policy/ipv6-guideliens.html

IPv6 regional variations

- In response to regional needs
  - Co-ordination efforts still continuing
- LACNIC
  - Amendment to “200 customer criteria”
- ARIN
  - Amendment 200 customers criteria waiver - early adopters (until 31 Dec ’04)
- APNIC
  - IPv6 allocations to ‘closed’ networks
  - IPv6 allocations to IPv4 networks

Policy update

consensus

APNIC17 IPv6 Policy Proposals

- Proposal: IPv6 allocations to closed networks
  - No alternative for large but private connected networks
  - Current APNIC practice as directed by EC
  - Requestors must meet criteria for initial allocation
- Reference
  - http://www.apnic.net/docs/policy/proposals/prop-015-v001
- Status
  - Consensus APNIC17
  - Endorsed by EC and implemented

APNIC17 IPv6 Policy Proposals

consensus

- Proposal: IPv6 allocations to IPv4 networks
  - Explicitly documents how to make IPv6 allocations based on IPv4 address holdings
  - Use of HD ratio in determining size of IPv6 allocation
  - Update sections 4.4 and 5.1.2 in policy
- Reference
  - http://www.apnic.net/docs/policy/proposals/prop-016-v002
- Status
  - Consensus APNIC17
  - Endorsed by EC
  - To be implemented August 2004

IPv6 allocation to IPv4 networks: examples

IPv4 application	IPv6 requirement (/48s)
Customer network (any size*)	One /48 per network
Dial up customer requiring subnets	One /48 per customer
ISP POP (any size)	One /48 per POP
Individual device requiring /32	(*) According to RFC 3177

IPv6 Global Allocations

- Proposal: Follow up to ripe-261. Requesting larger IPv6 allocations from IANA
  - Request for a /8 or a /12 from IANA
- Reference
  - http://www.apnic.net/docs/policy/proposals/prop-005-v001.html
- Status
  - Endorsed by EC 24 December 2003 (in principle)
  - Pending co-ordination with other regions

IPv6 implementation

Current status and potential future

Internet for everything?

- “Peer to peer” between any pair of devices, not just people on computers
  - Appliances, automobiles, buildings, cameras, control units, embedded systems, home networks, medical devices, mobile devices, monitors, output devices, phones, robots, sensors, switches, VPNs
- No more NAT (“fog on the Internet”)
- Eventually, every device will be connected to the Internet
  - Every device will need an address

IPv6 products and services

- Area of products and services
  - Personal VPN over IPv6
    - i.e. Control DVD recorder via mobile computer
  - Visual communication over IPv6
    - i.e. Exchange personal information via game machine and USB camera
  - Home security over IPv6
    - i.e. Monitor/control home security via surveillance camera and sensors from outside
  - Toy
    - IP thread phone over IPv6

Source: http://www.ipv6style.jp/en/apps/20040224/index.shtml

IPv6 in business

- Some interesting conferences targeting business communities
  - IPv6 Forum: IPv6 products and services
    - Held in Las Vegas sponsored by CEA (Consumer Electronics Association)
    - January 2004
      - http://www.usipv6.com/ces2004/ces2004c.html
  - North American IPv6 Summit
    - Held in Santa Monica sponsored by over 20 corporate sponsors
    - June 2004 – over 500 attendees
      - http://www.usipv6.com/

IPv6 in business (cont.)

- IPv6 Business Summit 2004
  - Open the door to ubiquitous society
    - Held in Tokyo sponsored by various electronics and telecommunication companies
    - February 2004
    - http://www.v6bizsummit.jp/
    - Actual products and services were exhibited

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IPv6 Statistics update

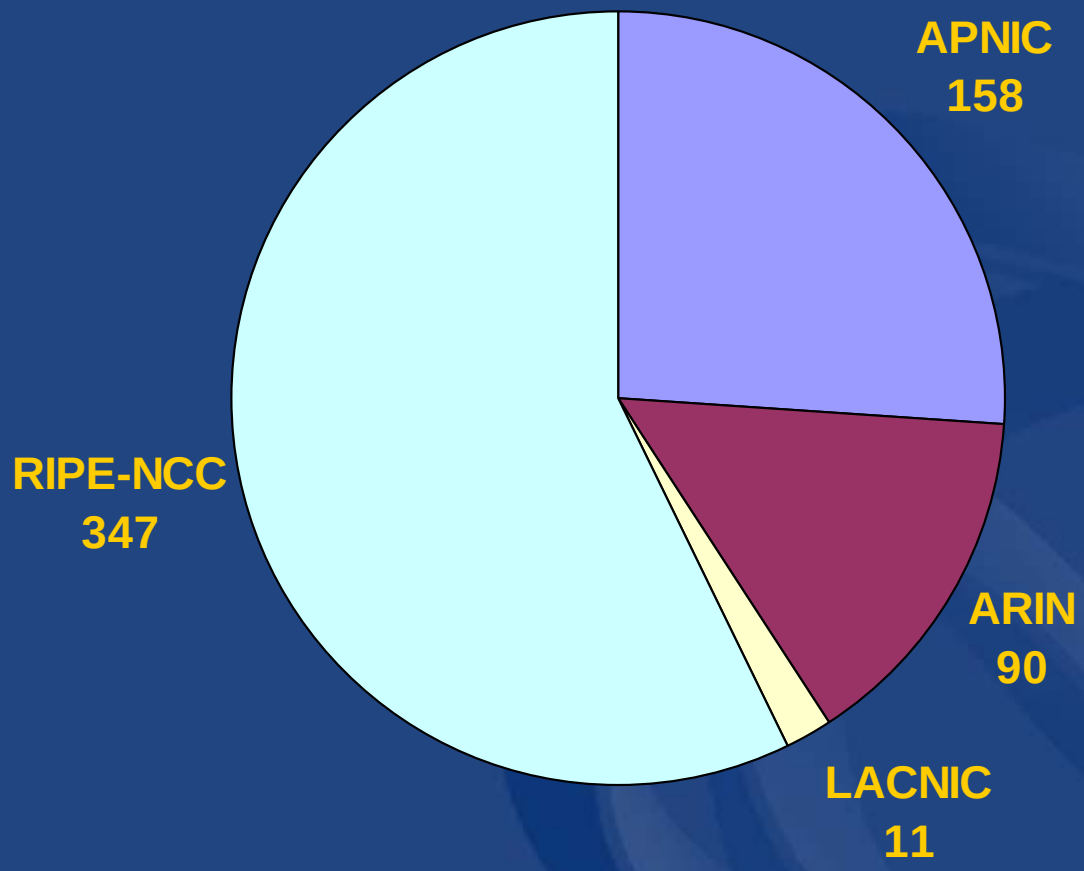
IPv6 Address Allocation Procedures

- IPv6 Allocations to RIRs from IANA

– APNIC	2001:0200::/23 2001:0C00::/23 2001:0E00::/23 2001:4400::/23	– LACNIC	2001:1200::/23
– ARIN	2001:0400::/23 2001:1800::/23 2001:4200::/23	– RIPE NCC	2001:0600::/23 2001:0800::/23 2001:0A00::/23 2001:1400::/23 2001:1600::/23 2001:1A00::/23 2001:4000::/23 and more

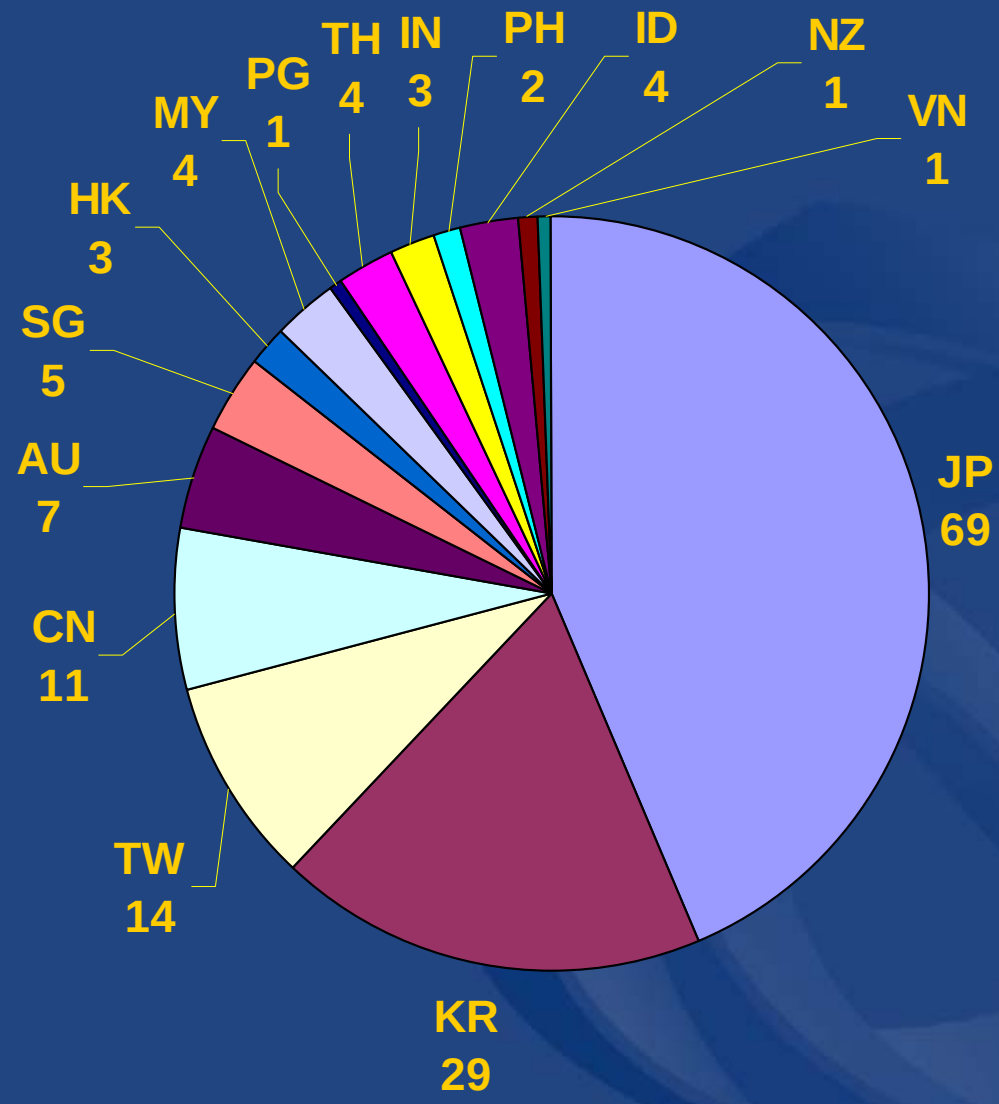
- IPv6 FAQ http://www.apnic.net/faq/IPv6-FAQ.html
- Joint press release – Cooperative support of Global IPv6 deployment (11/05/04)

IPv6 Allocations per RIR



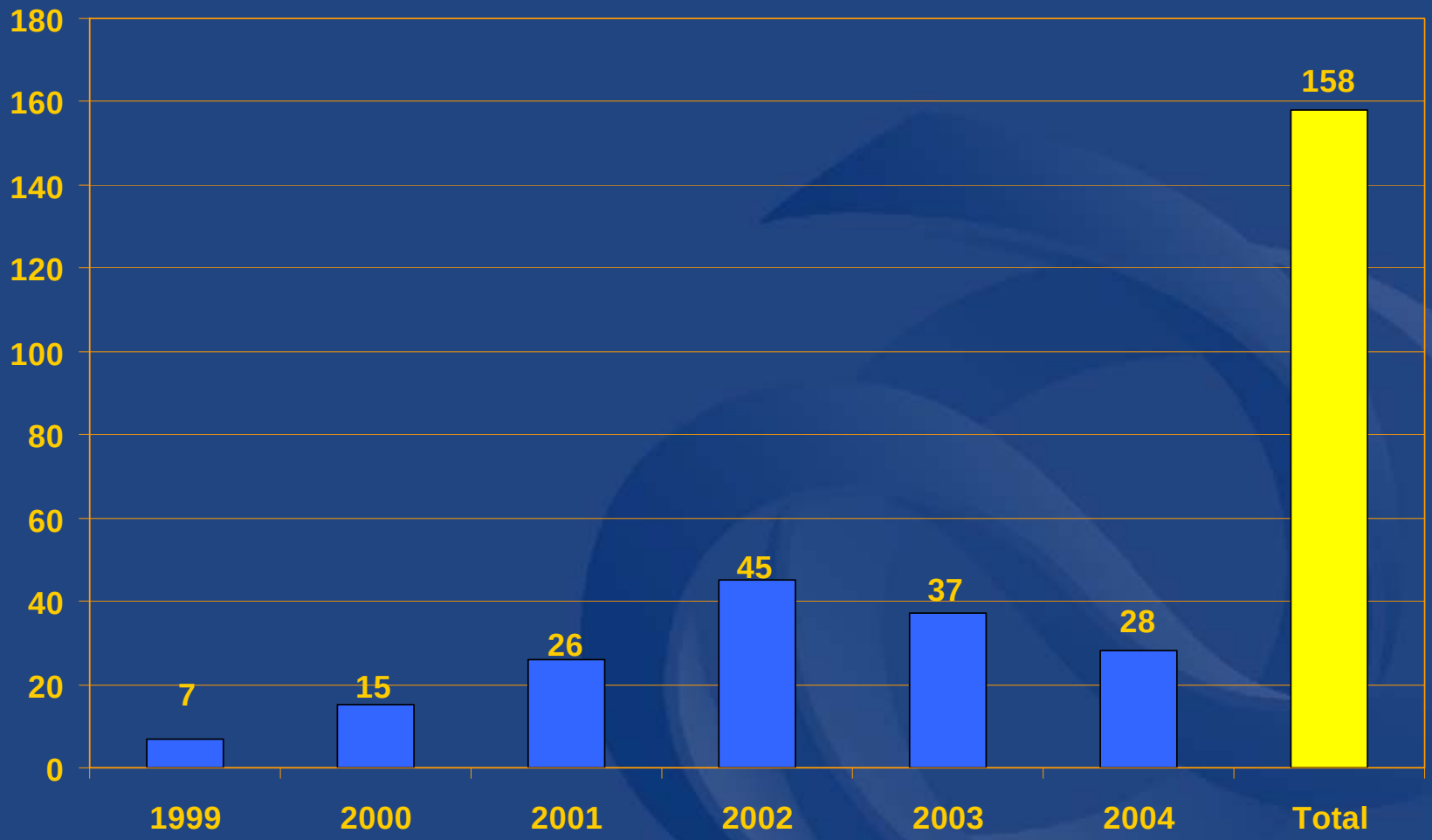
Source: APNIC statistic data - Last update June 2004

IPv6 allocations in Asia Pacific



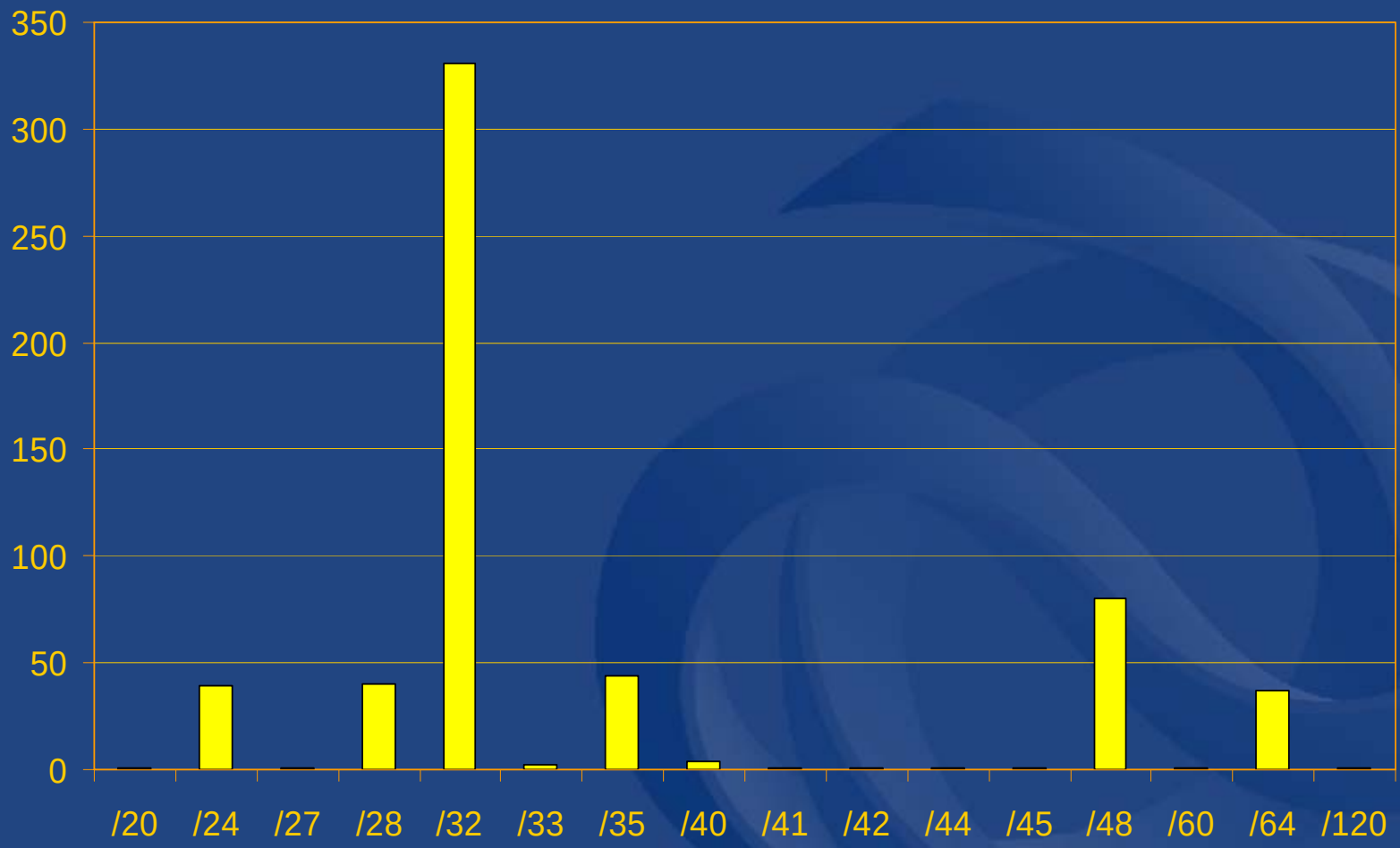
Source: APNIC statistic data - Last update June 2004

APNIC allocations by year



Source: APNIC statistic data - Last update June 2004

Global IPv6 routing table



Source: http://bgp.potaroo.net/v6/as1221/index.html - Last updated 17/06/2004

Questions?

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APNIC

Thank you!

Supplementary reading

Training material

- Today's training material will be made available at:

http://www.apnic.net/community/presentations/ipv6.html

Introduction

- Regional Internet Registry web sites
  - AfriNIC
    - http://www.afrinic.net
  - APNIC
    - http://www.apnic.net
  - ARIN
    - http://www.arin.net
  - LACNIC
    - www.lacnic.net
  - RIPE NCC
    - http://www.ripe.net
- APNIC past meetings
    - http://www.apnic.net/meetings

Introduction

- APNIC members
  - http://www.apnic.net/members.html
- Membership
  - Membership procedure
    - http://www.apnic.net/membersteps.html
  - Membership application form
    - http://www.apnic.net/apnic-bin/membership-application.pl
  - Membership fees
    - http://www.apnic.net/docs/corpdocs/FeeSchedule.htm

Member Services Helpdesk

- One point of contact for all member enquiries

Helpdesk hours

9:00 am - 7:00 pm (AU EST, UTC + 10 hrs)

ph: +61 7 3858 3188 fax: 61 7 3858 3199

- *More personalised service*
  - Range of languages:
    Cantonese, Filipino, Mandarin, Thai, Vietnamese etc.

- *Faster response and resolution of queries*
  - IP resource applications, status of requests, obtaining help in completing application forms, membership enquiries, billing issues & database enquiries

Private address space

- Private Address Space
  - Address Allocation for Private Internets
    - http://nori.apnic.net/ietf/rfc/rfc1918.txt
  - Counter argument: Unique addresses are good
    - http://nori.apnic.net/ietf/rfc/rfc1814.txt

Policies & policy environment

- Policy Documentation
  - Policies for address space management in the Asia Pacific region
    - http://www.apnic.net/docs/policy/add-manage-policy.html
  - Internet Registry IP allocation Guidelines
    - http://nori.apnic.net/ietf/rfc/rfc2050.txt

APNIC-17 policy update

- APNIC-17 meeting home page
  - http://www.apnic.net/meetings/index.html
- APNIC-17 report
  - http://www.apnic.net/meetings/17/report.html
- APNIC-17 policy decisions
  - http://www.apnic.net/meetings/17/report.html#2

Reports and statistics

- APNIC
  - http://www.apnic.net/info/reports/index.html
- Most recent RIR reports and joint statistics
  - http://www.apnic.net/meetings/17/docs/amm/amm-pres-tran-join-stats.pdf

IPv6 information

- IPv6 resource guide
  - http://www.apnic.net/services/ipv6_guide.html
- IPv6 address allocation and assignment policy
  - http://ftp.apnic.net/apnic/docs/ipv6-address-policy

IPv6 information (cont.)

- IPv6 Address request form
  - http://ftp.apnic.net/apnic/docs/ipv6-alloc-request
- FAQ
  - http://www.apnic.net/info/faq/IPv6-FAQ.html
- Need additional help?
  - Email helpdesk@apnic.net
  - Phone: 61-7-3858-3188
    - Operating hour Mon – Fri: 9:00 -19:00 AEST