



APNIC

ARIN
American Registry for Internet Numbers





The RIRs and IPv6

Prepared By
APNIC, ARIN, RIPE NCC

Overview



- RIR Overview
- RIR Coordination
- Policy Development Process
- IPv6 Policy History
- Current IPv6 Policies
- IPv6 Statistics
- Questions

History



- In the Beginning
 - Dr. Jon Postel maintained the list of assigned Internet numbers and laid the groundwork for the formation of the IANA
 - Initially US DoD provided registration and allocation of all domain names and IP address numbers
 - InterNIC established (1993)
- The Internet Community Made a Decision for Change
 - Consensus: Domain name and IP numbers registration should be separated to maintain stability of the IP numbers system
 - As a result the RIR system was born

RIRs - Origins



- **Proposed by IETF in early 1990's**
 - RFC 1174 (1990)
"IAB Recommended Policy on Distributing Internet Identifier Assignment..."
 - RFC1366 (1992) (Released with RFC 1367 (CIDR)
"Guidelines for Management of IP Address Space"
- **Documents provided rationale for IRs**
 - Criteria for establishment
 - Operating guidelines

Structure



- Bottom-Up Industry Self-Regulatory structure
 - Open and Transparent
 - Neutral and Impartial
- Not For Profit Membership Organization
 - Membership Open to All Interested Parties
 - Membership Elects Executive Board
 - Membership Approves Activities & Budget
- Policies Developed by Industry at Large Through Open Policy Processes
- Funding
 - Annual service fee
 - No charge per IP address
 - Open Financial Reporting

Regions



APNIC



- Asia-Pacific Network Information Centre
 - Founded in 1993 as independent organization
 - Membership Structure Established in 1996
 - 1,204 Members
- Service Region: Asia, Oceania and Western Pacific
 - 42 Economies
- Located in Brisbane, Australia

ARIN



- American Registry for Internet Numbers
 - Independent Association Since 1997
 - 1,701 Members
- Service Region: North & South America, the Caribbean, Africa South of Equator
 - 70 Countries
- Located in Chantilly, Virginia, US

RIPE NCC



- RIPE Network Coordination Centre
 - Founded in 1992, as part of TERENA
 - Independent Association since 1998
 - 3,124 Members
- Service Region: Europe, Middle East, Central Asia, Africa North of Equator
 - 109 Countries
- Located in Amsterdam, The Netherlands

Emerging RIRs



- LACNIC
 - Working with ARIN
 - www.lacnic.org
- AFRINIC
 - Working with RIPE NCC
 - www.afrinic.org

Address Space Management Historical Challenges



- Address Space Depletion
 - IPv4 Address Space is Finite
 - Pre RIR, Many Wasteful Allocations
- Routing Chaos
 - Legacy Routing Structure, Router Overload
 - CIDR & Aggregation are Vital
- The Internet Changes
- Inequitable Management
 - Unstructured and Wasteful Address Space Distribution

Address Space Management Objectives



- Conservation
 - Efficient Use of Resources
 - Allocation Based on Demonstrated Need
- Aggregation
 - Limiting Growth of Routing Table
 - Provider-Based Addressing Policies
- Registration
 - Ensuring Uniqueness
 - Troubleshooting
- Fairness and Consistency
 - Regional Communities
 - Global Communities

RIR Coordination



- IPv6 policy development (WG)
- RFC 2050 policy evaluation (WG)
- Pre-RIR address registration transfer
- Joint Presentations
 - ASO GA – March 2002
 - ICANN – March 2002
 - IETF(IEPG) – March 2002
 - ITU IPv6 Tutorial – May 2002
 - AfNOG & AfriNIC – May 2002
- Information Exchange

Policy Development Principles



- Open
- Transparent
- Documented
- Developed bottom-up

Principle One

OPEN



- Participation Open to Everyone
 - by those who need the resources
 - within industry self-regulatory framework
- Developed in open policy forums
 - Open Mailing Lists
 - Open Public Policy Meetings

Principle Two

TRANSPARENT



- Mailing list archives
- Public policy meeting archives
- Meeting minutes
 - APNIC Executive Council
 - ARIN
 - Board of Trustees
 - Advisory Council
 - RIPE NCC Executive Board

Principle Three

DOCUMENTED

- Policies documented
- Joint RIR policy documentation
 - RIR Policy comparison matrix
 - IPv6 allocation policy



Principle Four

Developed Bottom-Up

- Proposals Originate
 - Public
 - Other RIR communities
- Discussed in Public Fora
 - E-mail Lists
 - Public Policy Meetings
- Responsive policy development
 - fair to all
 - changing requirements of industry



Open Policy Meetings



- **APNIC (2 per year)**
 - 3 - 6 Sep - Kita-Kyushu, Fukuoka, JP
- **ARIN (2 per year)**
 - 30 Oct – 1 Nov – Eugene, Oregon
- **RIPE NCC (3 per year)**
 - 9 - 13 Sep - RIPE 43 - Rhodes, GR

Outreach



- Objectives
 - Raise awareness
 - Promote industry self-regulation
- Activities
 - Meetings with
 - Government representatives
 - Industry groups
 - Training Programs
 - Conferences

IPv6 Policy



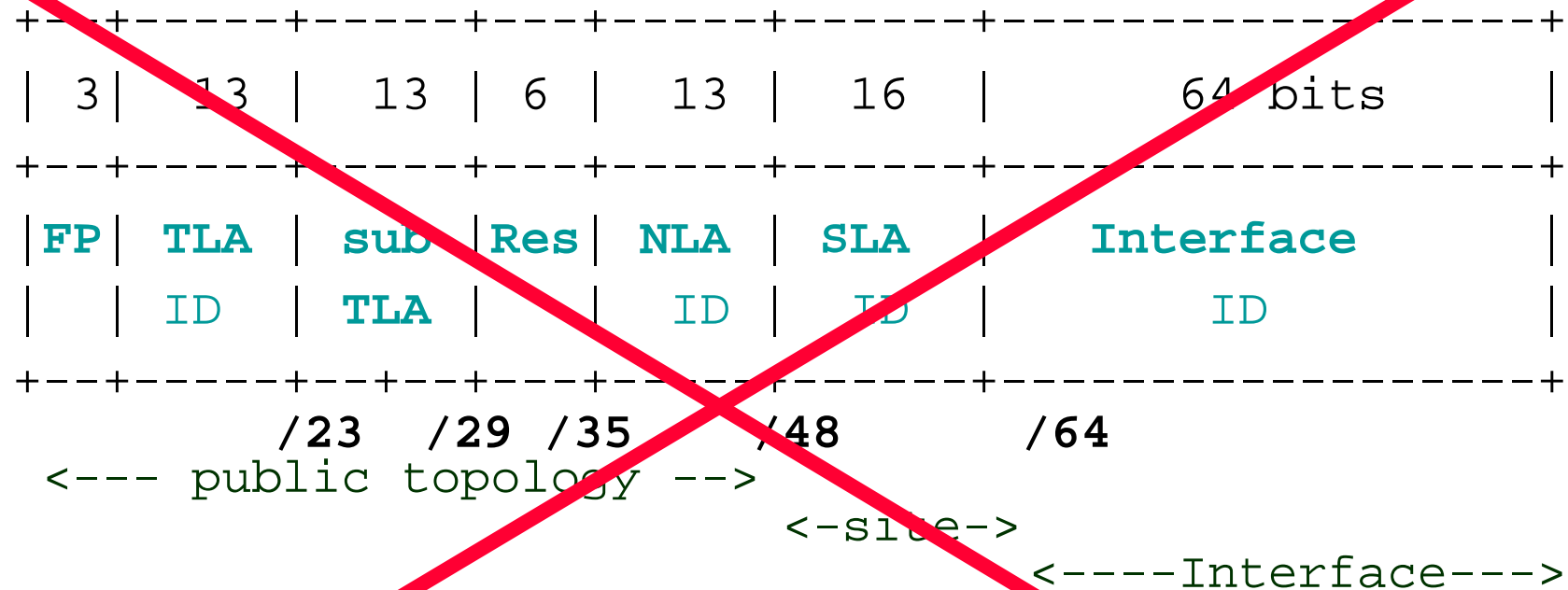
- History
- Key Issues Addressed
- FAQ

IPv6 Policy History



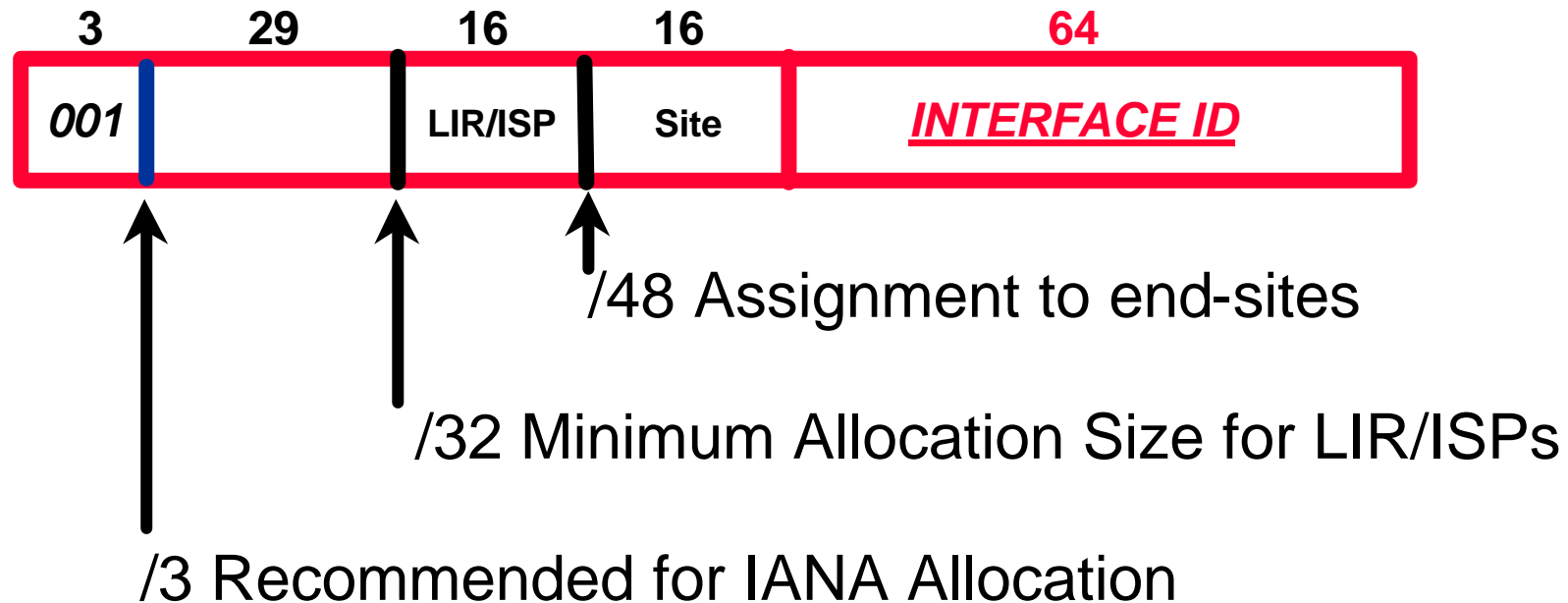
- Oct 1999-Dec 2001
 - Feedback from RIR communities, IETF
 - Major progress Aug 2001 (Taipei)
 - Global mailing list created Oct 2001
- Dec 2001
 - Initial interim draft policy document
- April 25
 - Revised interim draft
 - Modified initial criteria based on RIPE input
- Consensus in all regions

Old IPv6 Address Boundaries



(RFC 2374 - Mixes technology and policy)

New IPv6 Unicast Address: *Technology* and *Policy*



Technology is what can be Hard-Coded in Routers

Key Issues Addressed



- Provide a larger initial allocation
- Previous deployment experience for allocation size
- Provide convenient 'utilisation' method

FAQ – Allocation Size



- Is there a minimum allocation size?
 - Yes, a /32
 - It will be allocated if you meet the criteria
- Is there a maximum allocation size?
 - No
 - Your actual need, based on IPv4 and/or IPv6 assignment history, will be considered

FAQ – Allocation Criteria



- How do I get an IPv6 allocation?
 - Satisfy following criteria
 - Be an LIR and
 - Not be an end site and
 - Plan to provide IPv6 connectivity to organisations and to end sites and
 - Have a plan for making /48 assignments to other organisations within two years

FAQ – Allocation Criteria



- Can I get more than a /32?
 - Yes, enough to enable you to provide IPv6 service to all of your IPv4 customers
 - No more than initial /32 will be given to requestors who cannot demonstrate previous assignment history

FAQ – HD Ratio



- What is the 'Host Density (HD)' ratio?
 - In a hierarchical address plan, as the size of the allocation increases, the density of assignments will decrease
- Do I need to calculate HD ratio?
 - No, just use the table in the policy document
- Why do I need to know about it?
 - Defines the point at which you should come back to the RIR for more address space
 - Helps with measuring how much to allocate

Example: HD Ratio 0.8

IPv6 prefix	Site addr bits	Total site addrs in /48s	Threshold	Util%
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%

RFC3194 “The Host-Density Ratio for Address Assignment Efficiency”

Subsequent Allocations



- Registration necessary to determine 'usage'
 - Count /48s assigned
 - Meet utilisation threshold in HD ratio table for prefix
- Allocation size
 - Existing allocation doubled
 - e.g. /32 will be expanded to a /31
 - May be larger
 - Allocations based on two year plan

Other Issues



- LIR to ISP allocation
 - Policy determined by LIR
 - Must be able to meet HD ratio for subsequent allocations
 - LIR responsible for tracking all /48s
- DB registration
 - All /48 and shorter prefix allocations and assignments must be registered
- Existing /35 holders
 - Eligible to have /35 expanded to a single /32 prefix

Assignments

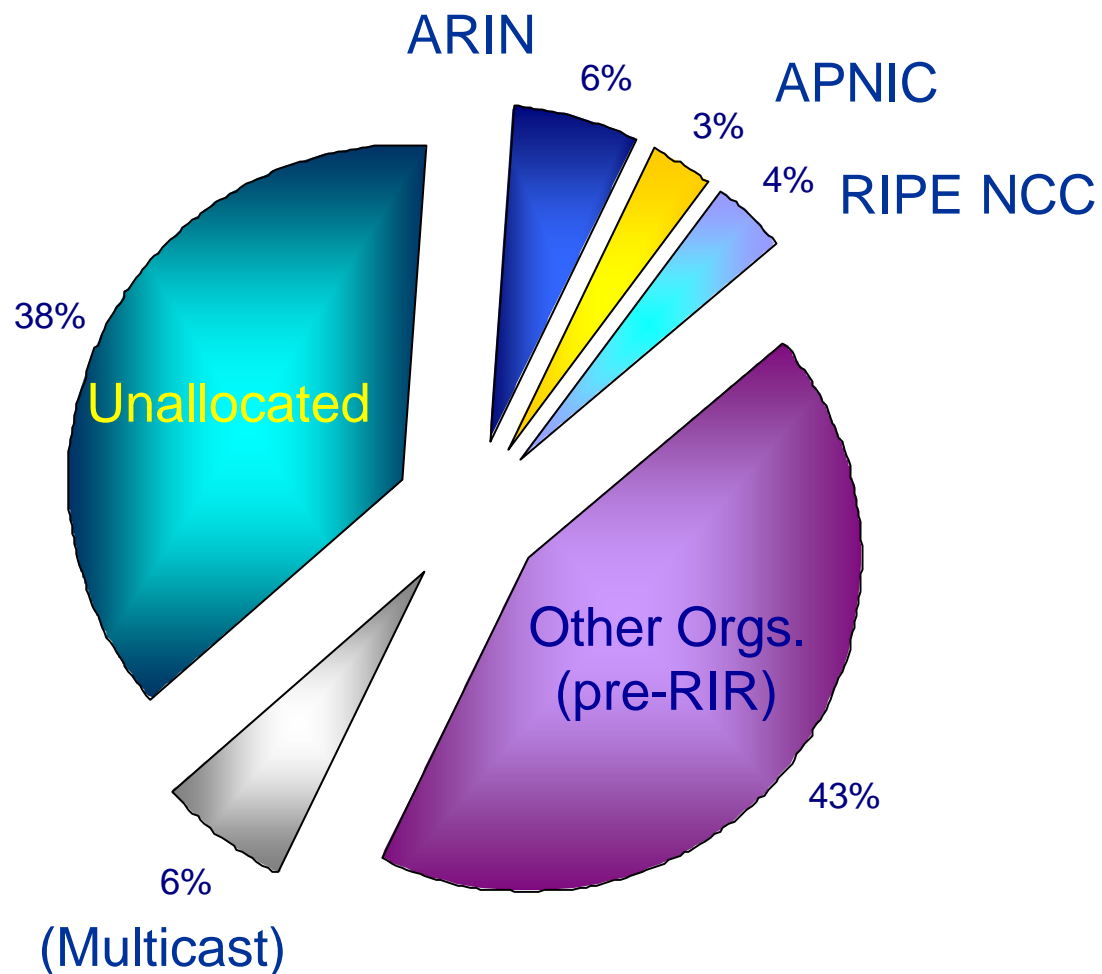


- Previous global consensus
 - /48 generally
 - /64 only one subnet
 - /128 only one device connecting
- Multiple /48s
 - Should be reviewed by RIR/NIR (until experience is gained)
- ISP infrastructure
 - /48 per POP



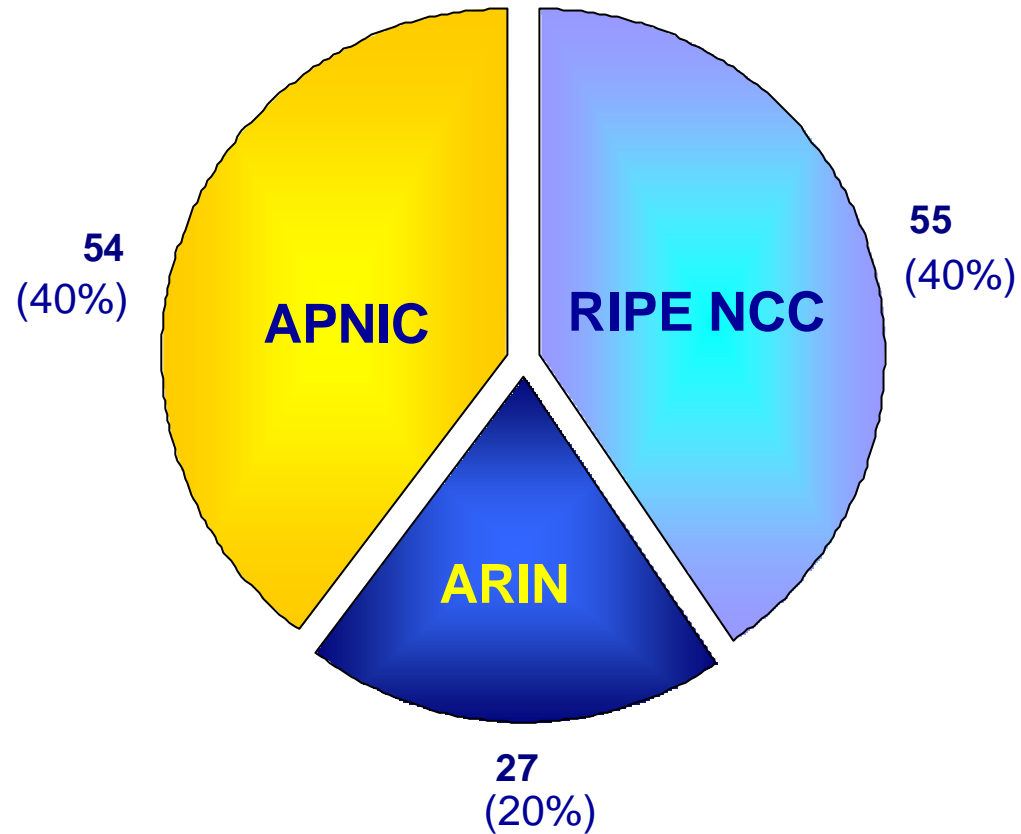
Statistics

IANA Delegations IPv4 Address Space



IPv6 Allocation

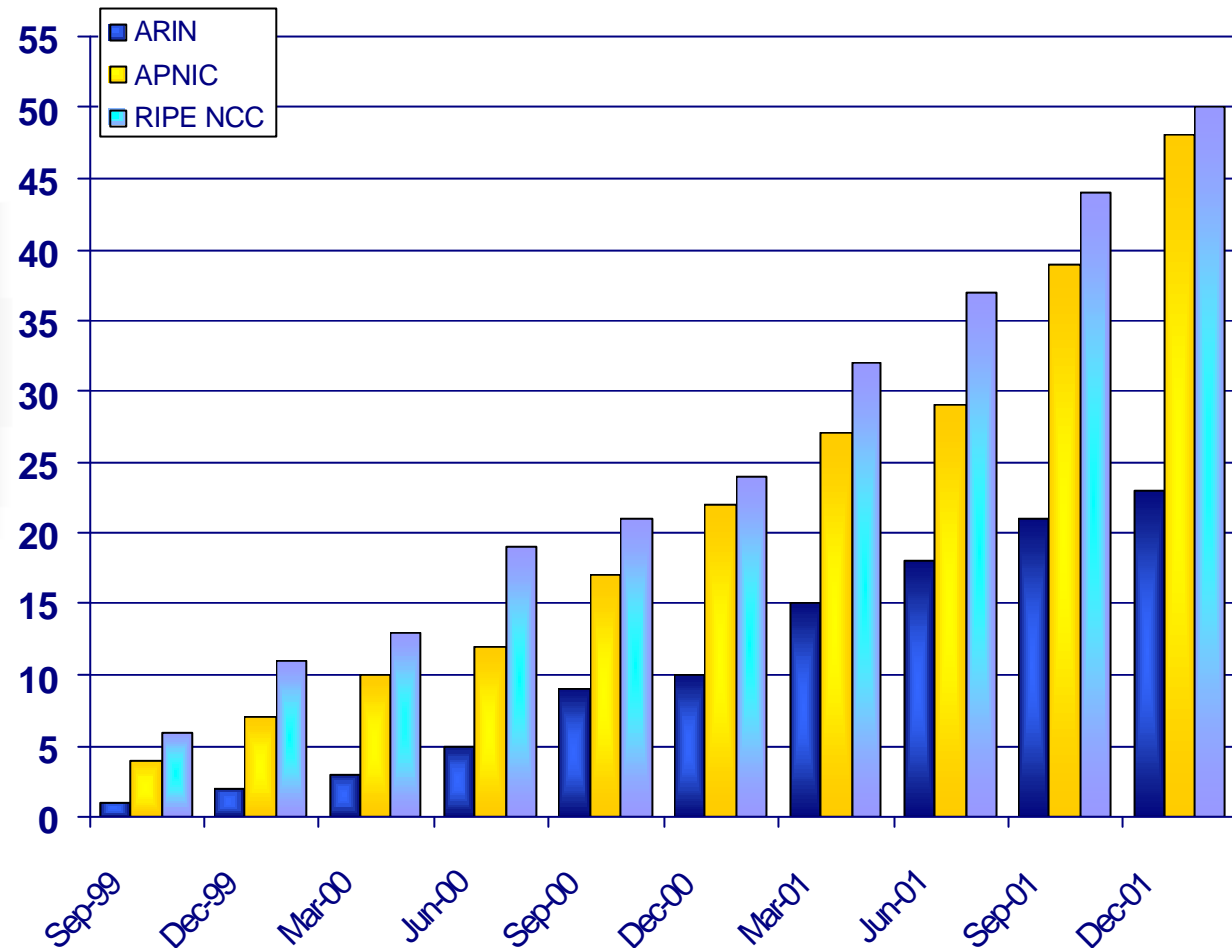
started April 1999



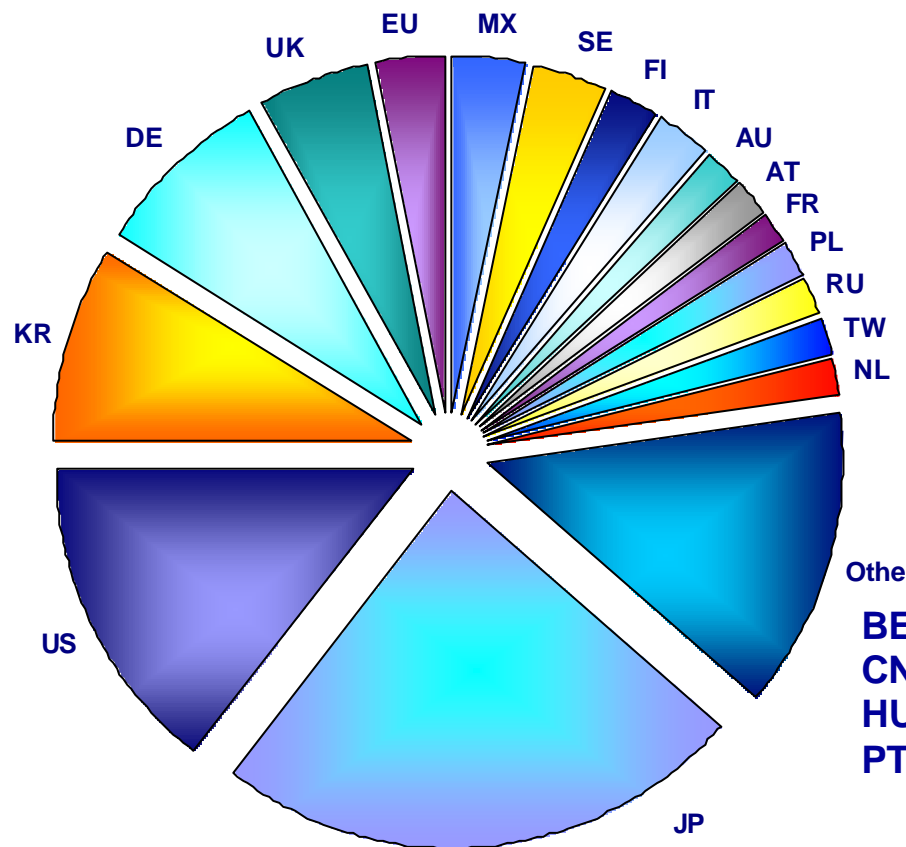
Total: 136

as of 3/29/02

IPv6 Allocations per RIR 1999-2001



IPv6 Distribution by Country 2001



JP – 30 (24%)

US – 18 (15%)

KR – 11 (9%)

DE – 10 (8%)

Other

BE, BR, CA, CH,
CN, CZ, DK, GR, HK
HU, IE, LT, MY, NO,
PT, SG, ES,

RIR Statistics



<http://www.apnic.net>



<http://www.arin.net>

<http://www.ripe.net>



<http://www.aso.icann.org/rirs/stats/index.html>



IPv6 Survey

IPv6 Survey

- Motivation
 - Track IPv6 development & allocation usage
 - Share experience among members
 - Highlight IPv6 issues and gather input
- Target Group
 - All members with IPv6 allocations contacted (52)
 - 29 replies (56%), all had held their allocation at least 3 months
 - Even split in commercial & research network (15-14)

Biggest Hurdles

- Lack of (stable) devices supporting IPv6
- Lack of incentive/no customer demand
- Multihoming
- Training staff to understand IPv6
 - at network management level
 - at helpdesk/end user support level
- Lack of security in current implementations
- 6bone interference

Biggest Hurdles

- *cont'd*

- Insufficient network management tools
- Don't yet feel the need (no IPv4 shortage yet)
 - for example, academic institutions with enough legacy space
- Root name servers not reachable through IPv6
- No commercial firewall
- Allocation Policy

More Hurdles

- HW/SW -

- Cisco
 - Not stable, need to improve IOS, not supported on all platforms
 - No upgrade path for older platforms, new routers required
- Microsoft
 - Need to provide fully functional IPv6 implementation
 - Currently includes IPv6, but it's somewhat hidden!
- Unreliable & not fully supported software for routers and servers
- Not sensible to run IPv4 and IPv6 on same equipment; too expensive to run two large networks simultaneously
- “Lack of support for IPv6 transport in 'large-scale' access technology products (ADSL, wireless LAN)

More Hurdles

- Demand -

- IPv6 does not solve anything yet
- End-users/customers don't see any advantages to IPv6 over IPv4, so no demand is created
- No killer application to 'tip the scales' and induce the mass-deployment needed to get out of the chicken & egg loop

Reactions to the Hurdles

- Postpone deployment
 - mostly in a wait and see mode
- Deploy open-source boxes with custom patches
 - PC based solutions and equipment with V6 support
 - IPv6 firewalls for UNIX, BSD systems are pretty good

How to Remove Hurdles

- GPRS/UMTS could be 'killer' product, might push vendors and developers to do more on IPv6
- When customers tell vendors that they purchase product from other vendor's because they support IPv6
- Information/education campaign for net/sysadmins & customers
- Sponsor workshops for local community
- If some services/products would *only* run IPv6, people would be forced to switch

Other Comments

- Detach 6bone from production networks
- Disappointed with the progress
- Connectivity not a problem but lack of services is
- Allocation guidelines need rethinking
- Hope that projects like 6Net have good results to spur on IPv6 deployment
- Don't want to carry over IPv4 routing problems
- I am really open to suggestions

Summary

- IPv6 deployment is taking shape cautiously and gradually
- Better hardware support needed
- Low customer demand
- No urgent need perceived yet



Questions?