國際IPv6網址發放原則介紹

2002網際網路趨勢研討會IPv6 Tutorial

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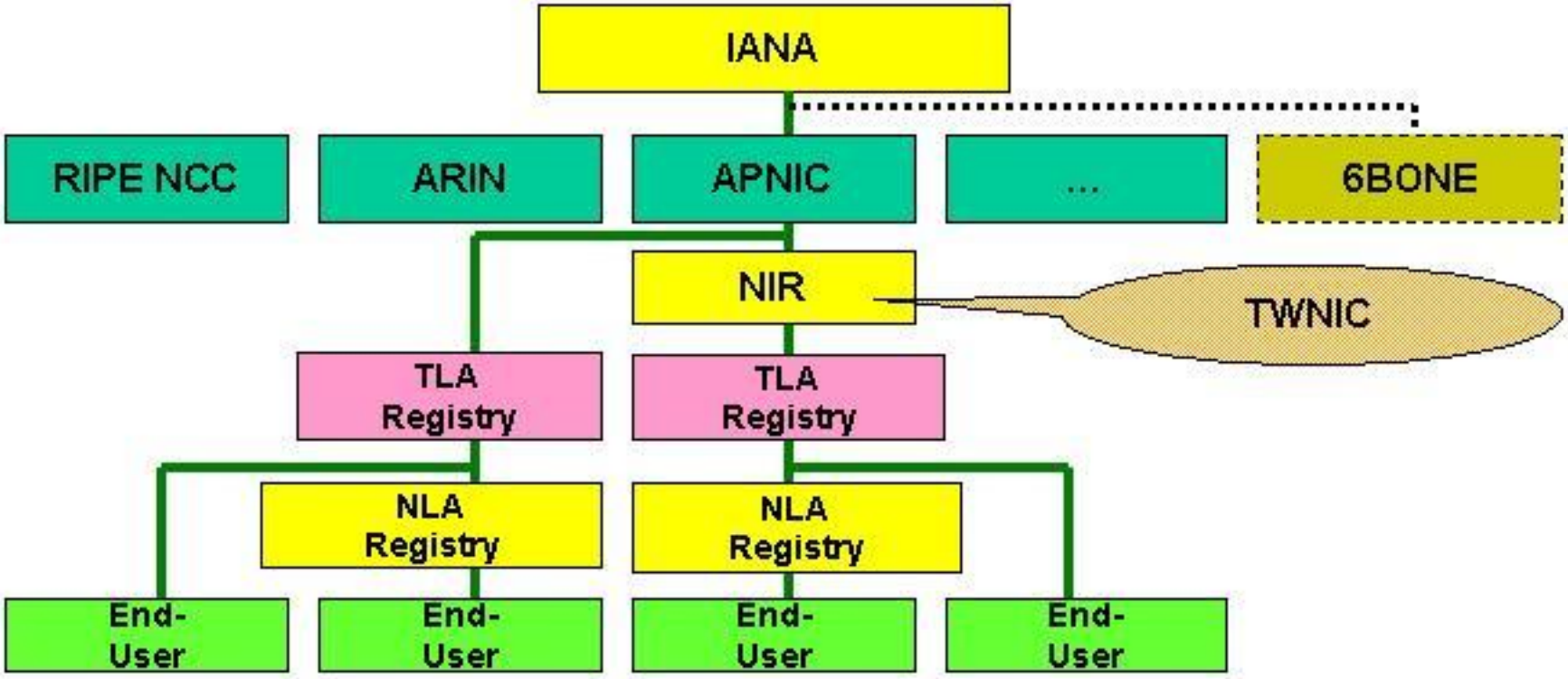
International IPv6 Address Management

Management Method – Hierarchical Management



International IPv6 Address Management (cont'd)

Initial IPv6 Sub-TLA Address Management in details

IPv6 Prefix Range	Assignment
2001:0000::/29-2001:01F8::/29	IANA
2001:0200::/29-2001:03F8::/29	APNIC
2001:0400::/29-2001:05F8::/29	ARIN

IPv6 Prefix Range	Assignment
2001:0600::/29-2001:07F8::/29	RIPE NCC
...	For future
2001:FE00::/29-2001:FFF8::/29	For future

International IPv6 Address Management (cont'd)

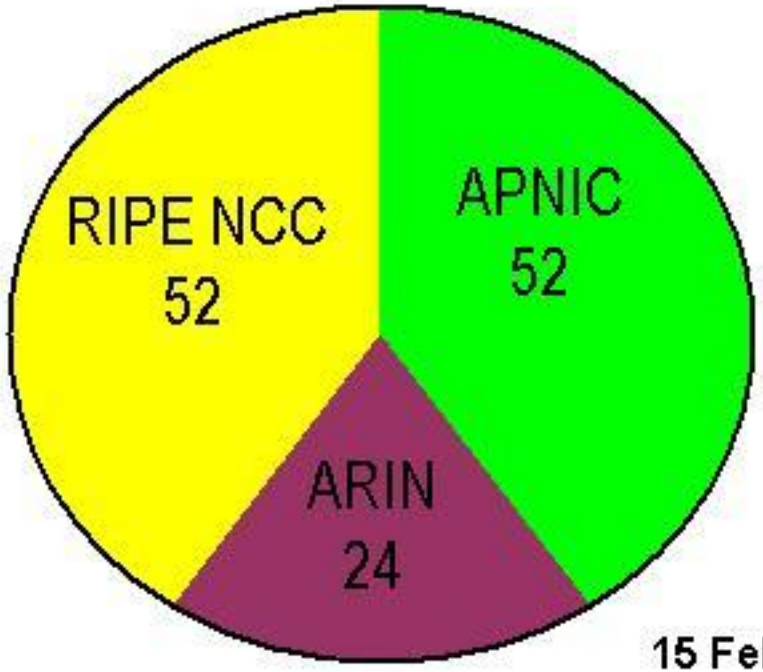
Initial IPv6 Sub-TLA Address Allocation

Before Initial Stage	→	At Initial Stage
1. Peering relationships ≥ 3 ASes AND 2. Clear intent to provide IPv6 service within 12 months AND either 3-1. ≥ 40 IPv4 customers OR 3-2. 6bone experience		1. Peering relationships ≥ 3 sub-TLAs AND either 2-1. 40 SLA customers OR 2-2. a clear intent to provide IPv6 service within 12 months

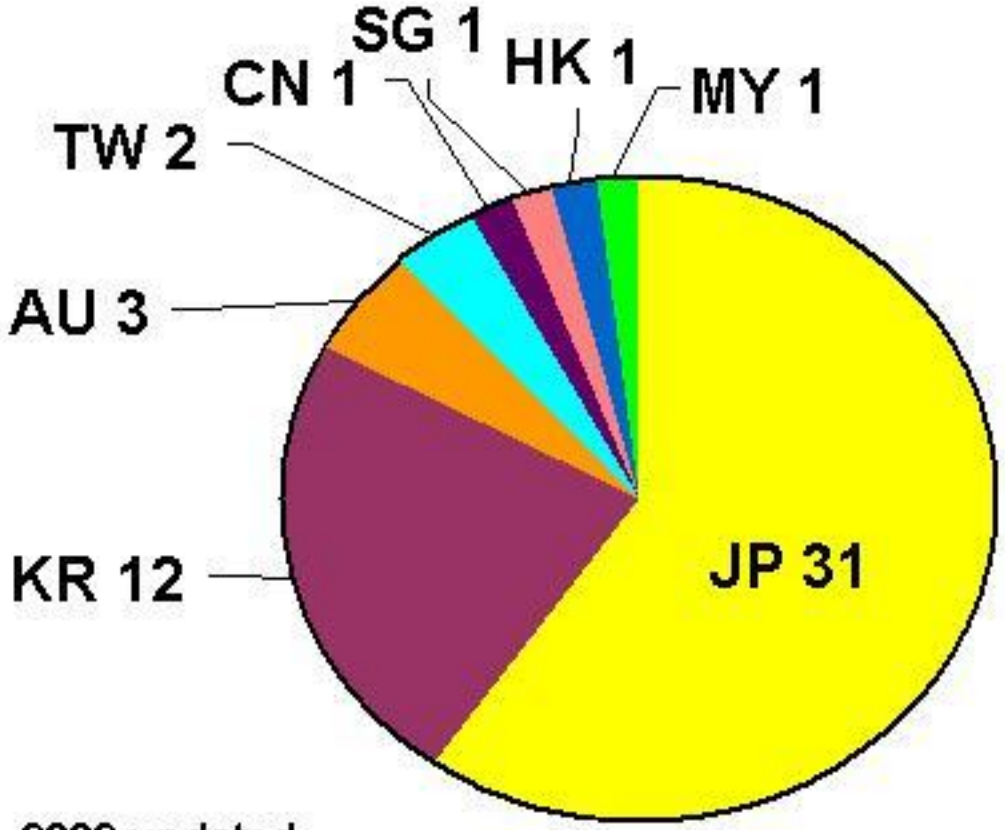
Reference

- RFC1881 IPv6 Address Allocation Management
- RFC2373 IPv6 Addressing Architecture
- RFC2450 TLA & NLA Assignment Rules
- RFC2471 IPv6 Testing Address Allocation
- RFC2921 6BONE pTLA and pTLA Formats
- RFC2928 Initial IPv6 Sub-TLA ID Assignments
- RFC2374 An IPv6 Aggregatable Global Unicast Address Format

IPv6 Address Allocation



RIR IPv6 Allocations



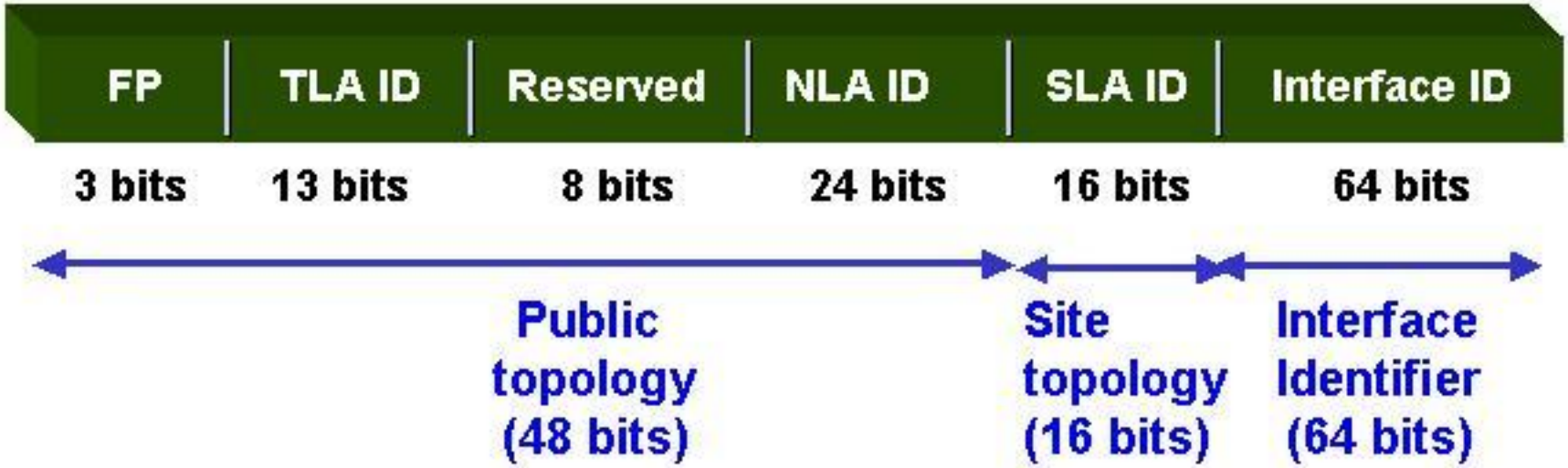
15 Feb., 2002 updated

APNIC IPv6 Allocations

IPv6 Addressing – RFC2374

Aggregatable Global Unicast Format

- RFC2374 (FP001)
- 128 bit addresses



IPv6 Address Allocation and Assignment Global Policy

Draft of December, 22 2001 Version 2001-12-22

Overview

- In particular, [RFC2373, RFC2373bis] designates 2000::/3 to be global unicast address space that IANA may allocate.
- IANA has assigned initial ranges of global unicast IPv6 address space from the 2001::/16 address block to the existing RIRs.
- This document concerns the initial and subsequent allocations of the 2000::/3 unicast address space, for which RIRs formulate allocation policies.
- This document updates and replaces all the guidelines and procedures of the existing Provisional IPv6 Policies [RIRv6-Policies] based on over two years of experience with the 1999 policy.
- Address policies should be globally uniform and formulated in a bottom-up manner through consensus processes at regional and global levels.

Definitions(1/7)

Autonomous System (AS)

- Autonomous Systems are the unit of routing policy in the world of exterior routing, and are specifically applicable to protocols like BGP [RFC1771].

Internet Registry (IR)

- An Internet Registry (IR) is an organization that is responsible for distributing IP address space to its members or customers and for registering those distributions.

Definitions (2/7)

Internet Assigned Numbers Authority (IANA)

- The Internet Assigned Numbers Authority (IANA) has responsibility for management of the entire IP address space used on the Internet.

Regional Internet Registry (RIR)

- Regional Internet Registries (RIRs) are established and authorized by respective regional communities, and recognized by the IANA to serve and represent large geographical regions.

Definitions (3/7)

- Currently, there are three RIRs: APNIC,RIPE NCC, and ARIN. Preparations are being made to establish LACNIC and AfriNIC.

National Internet Registry (NIR)

- A National Internet Registry (NIR) is an IR that primarily allocates address space to its members, which are Local Internet Registries (LIRs).

Definitions (4/7)

Local Internet Registry (LIR)

- A Local Internet Registry (LIR) is an IR that primarily assigns address space to the users of the network services that it provides.
- LIRs are generally ISPs, whose customers are primarily end users and possibly other ISPs.

Definitions (5/7)

Allocate

- To allocate means to distribute address space to IRs for the purpose of subsequent distribution by them.

Assign

- To assign means to designate address space that an IR distributes part or all of to an end user for the purpose of actual deployment in that end user's or ISP's own network.

Definitions (6/7)

Utilization

- Unlike IPv4, IPv6 generally assigns a /48 to each end site.
- Throughout this document, the term utilization refers to the allocation of /48s to end sites, and not the utilization of those /48s within those end sites.

Definitions (7/7)

Site

- A site is defined as an end user (subscriber) who has a business relationship with a provider that involves that provider carrying its traffic.

Goals of IPv6 address space management

Goals

- The goals of address space management described here reflect the mutual interest of all members of the Internet community and ensure that the Internet is able to function and grow to the maximum extent possible
- Attention must be paid to the fact that differences between IPv6 and IPv4 change the relative priority of elements that must be considered to attain these goals.

Goals of IPv6 address space management

- **Uniqueness**
  - Every assignment and/or allocation of address space must guarantee uniqueness worldwide.
- **Registration**
  - Every assignment and allocation of Internet address space must be registered in a public registry database accessible to all members of the Internet community.

Goals of IPv6 address space management

Aggregation

- Wherever possible, address space should be distributed in a hierarchical manner, according to the topology of network infrastructure.
- This is necessary to permit the aggregation of routing information and limit the expansion of Internet routing tables.

Goals of IPv6 address space management

- **Conservation (Stewardship)**
  - Maintaining unnecessary allocations and assignments or stockpiling address space with no aggregation merit should be avoided as a matter of course.
- **Fairness**
  - All policies and practices relating to the use of public address space should apply fairly and equitably to all existing and potential members of the Internet community, regardless of their location, nationality, size or any other factor.

Goals of IPv6 address space management

- Minimize Overhead
  - Overhead includes the need to go back to RIRs for additional space too frequently, the overhead associated with managing address space that grows through a number of small successive incremental expansions rather than through fewer, but larger, expansions, etc.

Goals of IPv6 address space management

Conflict of goals

- The goals of conservation, aggregation and minimization of administrative overhead often conflict with each other.
- IPv6 address management should give higher priority to aggregation and lower priority to address conservation, when compared with current IPv4 management practices.

IPv6 Policy Principles

- **Address space not to be considered property**
  - The global IPv6 policies in this document are based upon the understanding that address space is lease-licensed for use rather than owned.
  - with such lease-licenses to be of specific limited duration of normally one year.
  - Conditions of a lease-license have specific conditions applied at the start or renewal of the lease.

IPv6 Policy Principles

- Lease-licenses will typically be renewed automatically at the end of their duration when the following two conditions are met:
  - The original basis of the allocation remains valid.
  - Registration requirements relating to that allocation have been fulfilled at the time of renewal

IPv6 Policy Principles

- Routability not guaranteed
  - registries are not responsible for routability, which is affected by the technical implementation by LIRs/ISPs.
  - RIRs must take steps, however, to ensure that allocations they make will not result in excessively fragmented address space, as that may lead to loss of routability.

IPv6 Policy Principles

- Minimum Allocation
  - making minimum allocation size too small leads to address fragmentation, and making the size too large lowers the efficiency of address use.
  - The interim policies adopt the following concept:
    - a minimum address space (/32) will be provided by default by RIR/NIR to LIRs.

IPv6 Policy Principles

- providers requiring space larger than a /32 may request more address space, but must provide justification for such a request.

IPv6 Policy Principles

Consideration of IPv4 Infrastructure

- Where an existing IPv4 service provider requests IPv6 space for eventual transition of existing services to IPv6, the number of present IPv4 customers may be used as a reason for requesting more space in justifying IPv6 address space requests.
- This assumption should be evaluated and reviewed on the next occasion of revising the policies.

Policies for allocations and assignments

- Consistency of IR address space management policies
  - All Internet Registries shall adopt policies that are consistent with the policies formulated by the Internet community and described in this document.

Initial allocation

Initial allocation criteria

- A requesting organization can receive an initial allocation by demonstrating that it has an immediate (i.e., within next three months) requirement for at least a /36 prefix.
- Immediately after the allocation, the organization will have 776 or more sites in need of address assignments.

Initial allocation

- 776 is the number of /48 address blocks that can be assigned out of a /36 address block to achieve an HD-Ratio of 0.8.

Initial allocation size

- A requesting organization satisfying the initial allocation criteria can receive an initial allocation of the minimum /32 address block.
- necessary sizecan be represented by the following expression:

  S(0) = shorter(/32, eval(required prefix size))

  where (required prefix size) is the prefix size of applicant requesting allocation

Subsequent allocation

Subsequent allocation criteria

- Subsequent allocation will be provided when an organization (ISP/LIR) satisfies the evaluation threshold of past address utilization in terms of the number of sites in units of /48 assignments.
- The HD-Ratio is used to assess the utilization of the existing address block as described below.

Subsequent allocation

Utilization Metric

- In general, HD-Ratio [RFC3194] is expressed as follows:

$$HD = \frac{\text{Log(number of allocated objects)}}{\text{Log(maximum number of allocatable objects)}}$$

where the objects are IPv6 site addresses (/48s) assigned from an IPv6 prefix of length P.

Subsequent allocation

- The utilization threshold T, expressed as a number of individual /48 prefixes to be allocated from IPv6 prefix P, can be calculated as:

T=2

- It is an address allocation utilization ratio and not an address assignment utilization ratio.

((48-P)*HD)

Subsequent allocation

Applied HD-Ratio

- A desirable HD-Ratio for evaluation is thought to lie between 0.80 and 0.85, with the actual value needing to be determined as experience is gathered from implementation of this policy.

Subsequent allocation

Subsequent Allocation Size

- The size of an "n"-th time subsequent allocation S(n) is found as:

  S(n) = shorter(S(n-1)-1,eval(two_years_req))

  where S(n-1)-1 represents one bit shorter prefix address block size of the previous allocated address block size, and eval(two_years_req) represents the evaluation of two-year demands of the requesting organization.

LIR-to-ISP allocation

- There is no specific policy for an organization (ISP/LIR) to allocate address space to subordinate ISPs.
- LIR is required to keep track of all /48s assignments, including assignments made by its subordinate ISPs to end users, and report the assignment status to RIR/NIR so that the HD-Ratio can be evaluated when a subsequent allocation becomes necessary.

Assignment

Assignment address space size

- with IETF recommendations [RFC3177] and RIR agreement [RIRs-on-48] recommending the assignment of:
  - /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.

Assignment

- Assignment of multiple /48s to a single site
  - When a single site requires an additional /48 address block, it can request the assignment with documentation or materials that justify the request.
  - Requests for multiple or additional /48s will be processed and reviewed (i.e., evaluation of justification) at the RIR/NIR level.

Assignment

- Assignment to operator's infrastructure
  - An organization (ISP/LIR) may assign a /48 per PoP as the service infrastructure of an IPv6 service operator.
  - a separate assignment can be obtained for the in-house operations of the operator.

DB registration

- When an organization in reciept of an IPv6 address allocation makes IPv6 address assignments, it must register assignment information in a public database (initially a database maintained by an RIR/NIR, which may be replaced by a distributed database for registering address management information in future).
- Information is registered in units of assigned /48 networks.
- IR/NIRs will use registered data to calculate the HD-Ratio at the time of application for subsequent allocation and to check for changes in assignments over time.

Reverse lookup

- When an RIR/NIR delegates IPv6 address space to an organization, it also delegates the right to manage the reverse lookup zone that corresponds to the allocated IPv6 address space.
- Each organization should properly manage its reverse lookup zone.

Validity of allocations and assignments

- An allocation or assignment of address space is valid only so long as the original criteria on which the allocation or assignment was based continues to be valid.
- If an allocation or assignment is made for a specific purpose, but the original purpose or original justification no longer applies, the allocation or assignment shall become invalid.
- Invalid allocations shall be returned to the appropriate IR.

Existing IPv6 address space holders

- Once the policies described in this document have been adopted, an organization already receiving an allocation according to the "PROVISIONAL IPv6 ASSIGNMENT AND ALLOCATION POLICY DOCUMENT" [RIRv6-Polices] is immediately eligible to having its allocation expanded to a /32 address block.
- The /32 address block will contain the already allocated smaller address block (one or multiple /35 address blocks in many cases) that was already reserved by the RIR for a subsequent allocation to the organization.

Special case

- Special considerations will be given to the cases described below, with no regard to the provision of this document.
- Individual RIRs are currently discussing policies for these cases independent of this document.

Special case

IX (Internet Exchange)

- An IX is a point at which ISPs connect with one another. It requires ISP-independent addresses.

Early IPv6 address policy

- Bootstrap Phase
  - Transitional and temporary
  - Concludes
    - After first 100 sub-TLA IDs have been allocated worldwide, or
    - After a RIR has allocated 60 sub-TLA IDs in their region
- General Phase

Extension of the bootstrap period proposed in APNIC meeting in Taipei

- APNIC proposed to extend the bootstrap period until the RIRs have made a combined total of 200 IPv6 allocations. If 120 allocations are made in one RIR's region, then the bootstrap period will end in that region, but will continue in the other regions until the total reaches 200 globally.

- It is also proposed that as the end of the extended period approaches, this issue should be reviewed again with the possibility of further extension.

IPv6 Policy Development

- Oct 1998 — Initial discussions RIRs/IETF and RIR communities
- July 1999 — Provisional policy document released
- Aug 1999 — IPv6 allocation service began
- Oct 1999 — Review of policy document after early deployment experience
- 2001 — Revised policy document to be published following extensive IETF/community input
- 2002… — Policies *always* subject to change