

# ARIN Number Resource Policy Manual

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## Abstract

This is ARIN's Number Resource Policy Manual (NRPM). It is available at: <http://www.arin.net/policy/>. This version supersedes all previous versions.

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## 1. Introduction

Addressing policies in the ARIN region are created in accordance with the "Internet Resource Policy Evaluation Process" (<http://www.arin.net/policy/irpep.html>). The status of current and historical policy proposals can be found on the "Policy Proposal Archive" page ([http://www.arin.net/policy/proposals/proposal\\_archive.html](http://www.arin.net/policy/proposals/proposal_archive.html)).

Each policy consists of a number of component parts separated by dots. The first figure to the far left and preceding the first dot (.), refers to the chapter number. The figure following the first dot indicates a policy section. Any subsequent figures are for the purpose of identifying specific parts of a given policy.

## 2. Definitions

### 2.1. 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.

### 2.2. 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. The primary role of RIRs is to manage and distribute public Internet address space within their respective regions.

### 2.3. National Internet Registry (NIR)

A National Internet Registry (NIR) primarily allocates address space to its members or constituents, which are generally LIRs organized at a national level. NIRs exist mostly in the Asia Pacific region.

### 2.4. 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.

### 2.5. Allocate and Assign

A distinction is made between address allocation and address assignment, i.e., ISPs are "allocated" address space as described herein, while end-users are "assigned" address space.

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

**Assign** - To assign means to delegate address space to an ISP or end-user, for specific use within the Internet infrastructure they operate. Assignments must only be made for specific purposes documented by specific organizations and are not to be sub-assigned to other parties.

## 2.6. End-user

An end-user is an organization receiving assignments of IP addresses exclusively for use in its operational networks.

## 2.7. Multihomed

An organization is multihomed if it receives full-time connectivity from more than one ISP and has one or more routing prefixes announced by at least two of its upstream ISPs.

## 3. Directory Services

### 3.1. Bulk Copies of ARIN's WHOIS

ARIN will provide a bulk copy of WHOIS output, including point of contact information, on the ARIN site for download by any organization that wishes to obtain the data providing they agree to ARIN's acceptable use policy. This point of contact information will not include data marked as private.

[The Request Form for ARIN Bulk WHOIS Data, which contains the Acceptable Use Policy (AUP) for Bulk Copies of ARIN WHOIS Data, can be found at: <http://www.arin.net/registration/agreements/bulkwhois.pdf>]

### 3.2. Distributed Information Server Use Requirements

The minimal requirements for an organization to setup a distributed information service to advertise reassignment information are:

- ▶ The distributed information service must be operational 24 hours a day, 7 days a week to both the general public and ARIN staff. The service is allowed reasonable downtime for server maintenance according to generally accepted community standards.
- ▶ The distributed information service must allow public access to reassignment information. The service may restrict the number of queries allowed per time interval from a host or subnet to defend against DDOS attacks, remote mirroring attempts, and other nefarious acts.
- ▶ The distributed information service must return reassignment information for the IP address queried. The service may allow for privacy protections for customers. For residential users, the service may follow ARIN's residential privacy policy that includes displaying only the city, state, zip code, and country. For all other reassignments, the service shall follow ARIN's privacy policy for publishing data in a public forum.
- ▶ The distributed information service may return results for non-IP queries.
- ▶ The distributed information service must respond to a query with the minimal set of attributes per object as defined by ARIN staff.

- ▶ The distributed information service may include optional attributes per object that are defined locally.
- ▶ The distributed information service must return results that are up-to-date on reassignment information.

### 3.3. Privatizing POC Information

Organizations may designate certain points of contact as private from ARIN WHOIS, with the exception that, at the minimum, one point of contact must be viewable.

### 3.4. Routing Registry

#### 3.4.1. Acceptable use policy

- ▶ The ARIN Routing Registry data is for Internet operational purposes only. Mirroring is only allowed by other routing registries.
- ▶ The user may only distribute this data using a WHOIS service unless prior, written permission from ARIN has been obtained.
- ▶ To protect those registered in the ARIN routing registry, ARIN may need to specify additional conditions on access permissions for this data in the future. The permission to access the data is based on agreement to the conditions stipulated in this document in addition to any others that may be added in the future.
- ▶ Please see the <http://www.irr.net/docs/list.html> URL for information about the replicated Routing Registry data.

### 3.5. Autonomous System Originations

#### 3.5.1. Collection

ARIN will collect an optional field in all IPv4 and IPv6 address block transactions (allocation and assignment requests, reallocation and reassignment actions, transfer and experimental requests). This additional field will be used to record a list of the ASes that the user permits to originate address prefixes within the address block.

#### 3.5.2. Publication

##### 3.5.2.1. Description of data

ARIN will produce a collection of the mappings from address blocks to ASes permitted to originate that address block. The collection will consist of a list where each entry will consist, at a minimum, of an address block, a list of AS numbers, and a tag indicating the type of delegation of the address block. This collection will be produced at least daily.

##### 3.5.2.2. Bulk publication of data

ARIN will make the collected mappings from address blocks to AS numbers available for bulk transfer in one or more formats chosen at its own discretion, informed by the community's current needs. This data will not be subject to any redistribution restrictions—it may be republished or repackaged in any form. Should ARIN choose to use WHOIS bulk transfer as the bulk form of data access required by this paragraph, the address

block to AS mappings will not be subject to any redistribution restrictions, but the remainder of the WHOIS data will remain subject to the terms of the then-current AUP regarding bulk access to WHOIS data.

#### 3.5.2.3. Other formats

ARIN may also make the collected or individual mappings from address blocks to AS numbers available in other forms, possibly query services, chosen at its own discretion, informed by the community's current needs. ARIN may require agreement to an acceptable use policy for access to the data in these forms.

## 4. IPv4

### 4.1. General Principles

#### 4.1.1. Routability

Provider independent (portable) addresses issued directly from ARIN or other Regional Registries are not guaranteed to be globally routable. Therefore, ISPs should consider the following order of priority when requesting IP address space:

- ▶ Request IP address space from upstream provider
- ▶ Request IP address space from provider's provider
- ▶ Request IP address space from ARIN (not guaranteed to be globally routable)

#### 4.1.2. Validity

IP address allocations are valid as long as the utilization and other relevant criteria continue to be met, and the yearly fee is submitted.

#### 4.1.3. Invalidation

ARIN may invalidate any IP allocation if it determines that the requirement for the address space no longer exists.

#### 4.1.4. Recall

In the event of address space recall, ARIN will make every reasonable effort to inform the organization that the addresses are being returned to the free pool of IPv4 address space.

#### 4.1.5. Determination of IP address allocation size

Determination of IP address allocation size is the responsibility of ARIN.

#### 4.1.6. CIDR bit boundaries

In an effort to ensure that Classless Inter-Domain Routing (CIDR) is implemented and utilized as efficiently as possible, ARIN issues blocks of addresses on appropriate "CIDR-supported" bit boundaries.

#### 4.1.7. RFC 2050

ARIN takes guidance from allocation and assignment policies and procedures set forth in RFC 2050. These guidelines were developed to meet the needs of the larger Internet community in conserving scarce IPv4 address space and allowing continued use of existing Internet routing technologies.

## **4.2. Allocations to ISPs (Requirements for Requesting Initial Address Space)**

### **4.2.1. Principles**

#### **4.2.1.1. Purpose**

ARIN allocates blocks of IP addresses to Internet Service Providers (ISPs) for the purpose of reassigning that space to their customers.

#### **4.2.1.2. Annual Renewal**

An annual fee for registered space is due by the anniversary date of the ISP's first allocation from ARIN. ISPs should take care to ensure that their annual renewal payment is made by their anniversary due date in accordance with the Registration Services Agreement. If not paid by the anniversary date, the address space may be revoked. Please review the Annual Renewal/Maintenance Fees Page for more details.

#### **4.2.1.3. Utilization rate**

Utilization rate of address space is a key factor, among others, in determining address allocation.

#### **4.2.1.4. Slow start**

Because the number of available IP addresses on the Internet is limited, many factors must be considered in the determination of address space allocations. Therefore, IP address space is allocated to ISPs using a slow-start model. Allocations are based on justified need, not solely on a predicted customer base.

#### **4.2.1.5. Minimum allocation**

In general, ARIN allocates IP address prefixes no longer than /20 to ISPs. If allocations smaller than /20 are needed, ISPs should request address space from their upstream provider. For multihomed ISPs, ARIN allocates IP address prefixes no longer than /22. If allocations smaller than /22 are needed, multihomed ISPs should request address space from their upstream provider.

#### **4.2.1.6. Immediate need**

If an ISP has an immediate need for address space, and can provide justification to show that the address space will be utilized within 30 days of the request, ARIN may issue a block of address space, not larger than a /16 nor smaller than ARIN's customary minimum allocation, to that organization. These cases are exceptional.

### **4.2.2. Initial allocation to ISPs**

#### **4.2.2.1. Standard or non-multihomed**

Organizations that do not meet the requirements described in the multihomed section below (Section 4.2.2.2) must satisfy the following requirements:

##### **4.2.2.1.1. Use of /20**

The efficient utilization of an entire previously allocated /20 from their upstream ISP. This /20 allocation may have been provided by an ISP's upstream provider(s), and does not have to be contiguous address space. The organization must meet the requirement of efficient use of 16 /24s. For example, if an organization holds a

smaller allocation, such as 12 /24s, from its upstream provider, the organization would not meet the minimum utilization requirements of a /20.

##### **4.2.2.1.2. Efficient utilization**

Demonstrate efficient use of IP address space allocations by providing appropriate documentation, including assignment histories, showing their efficient use. ISPs must provide reassignment information on the entire previously allocated block(s) via SWIP or RWHOIS server for /29 or larger blocks. For blocks smaller than /29 and for internal space, ISPs should provide utilization data either via SWIP or RWHOIS server or by using the table format described in Section 4.2.3.7.5.

##### **4.2.2.1.3. Three months**

Provide detailed information showing specifically how a /20 will be utilized within three months.

##### **4.2.2.1.4. Renumber and return**

ISPs receiving a new /20 may wish to renumber out of their previously allocated space. In this case, an ISP must use the new /20 to renumber out of that previously allocated block of address space and must return the space to its upstream provider.

#### **4.2.2.2. Multihomed**

When prefixes are allocated which are longer than /20, they will be from a block reserved for that purpose. In order to receive an initial allocation from ARIN, organizations applying under the multihomed policy must:

- ▶ When requesting a /22, demonstrate the efficient utilization of a minimum contiguous or noncontiguous /23 (two /24s) from an upstream.
- ▶ When requesting a /21, demonstrate the efficient utilization of a minimum contiguous or noncontiguous /22 (four /24s) from an upstream.
- ▶ When requesting a /20, demonstrate the efficient utilization of a minimum contiguous or noncontiguous /21 (eight /24s) from an upstream.

##### **4.2.2.2.1. Efficient utilization**

Provide reassignment information for /29 and shorter prefix lengths using the Shared WHOIS Project (SWIP) or by providing the same information fields in an RWHOIS server. If additional address space is later requested, this information must be available at the time of the request. Utilization for blocks smaller than /29 can be documented via SWIP or RWHOIS server or by using the format described in Section 4.2.3.7.5.

##### **4.2.2.2.2. Three months**

Provide information showing that the requested IP address space will be utilized within three months and demonstrating an intent to announce the requested space in a multihomed fashion.

##### **4.2.2.2.3. Renumber and return**

Agree that the newly requested IP address space will be used to renumber out of the current addresses which will be returned to their upstream provider(s).



#### **4.2.2.2.4. Additional requests following the initial allocation**

To receive additional address space following the initial allocation, multihomed organizations must have returned the original IP address space to its provider in its entirety and must provide justification for a new allocation as described above in the section titled Requirements for Requesting Initial Address Space.

### **4.2.3. Reassigning Address Space to Customers**

#### **4.2.3.1. Efficient utilization**

ISPs are required to apply a utilization efficiency criterion in providing address space to their customers. To this end, ISPs should have documented justification available for each reassignment. ARIN may request this justification at any time. If justification is not provided, future receipt of allocations may be impacted. In extreme cases, existing allocations may be affected.

#### **4.2.3.2. VLSM**

To increase utilization efficiency of IPv4 address space, ISPs reassigning IP address space to their customers should require their customers to use variable length subnet mask (VLSM) and classless technologies (CIDR) within their networks. ISPs should issue prefix lengths longer than /24 wherever feasible.

#### **4.2.3.3. Contiguous blocks**

IP addresses are allocated to ISPs in contiguous blocks, which should remain intact. Fragmentation of blocks is discouraged. To avoid fragmentation, ISPs are encouraged to require their customers to return address space if they change ISPs. Therefore, if a customer moves to another service provider or otherwise terminates a contract with an ISP, it is recommended that the customer return the network addresses to the ISP and renumber into the new provider's address space. The original ISP should allow sufficient time for the renumbering process to be completed before requiring the address space to be returned.

#### **4.2.3.4. Downstream customer adherence**

ISPs must require their downstream customers to adhere to the following criteria:

##### **4.2.3.4.1. Utilization**

Reassignment information for prior allocations must show that each customer meets the 80% utilization criteria and must be available via SWIP/RWHOIS prior to your issuing them additional space.

##### **4.2.3.4.2. Downstream ISPs**

Customers must follow ARIN policy for ISPs.

#### **4.2.3.5. ARIN approval of reassignments/reallocations**

##### **4.2.3.5.1. /18**

All extra-large ISPs making reassignments of a /18 or greater to a customer must first have these reassignments reviewed and approved by ARIN.

##### **4.2.3.5.2. /19**

Small to large ISPs making customer reassignments of a /19 or greater must first seek ARIN's approval.

##### **4.2.3.5.3. Required documentation for pre-approval requests**

- ▶ Network engineering plans - Network engineering plans including subnets, host counts, and hosts per subnet, with projected utilization rates and associated confidence levels of those projections for one and two years,
- ▶ Deployment schedule - Deployment schedule for the network, including major milestones for each subnet,
- ▶ Network topology diagrams.

#### **4.2.3.6. Reassignments to multihomed downstream customers**

Under normal circumstances an ISP is required to determine the prefix size of their reassignment to a downstream customer according to the guidelines set forth in RFC 2050. Specifically, a downstream customer justifies their reassignment by demonstrating they have an immediate requirement for 25% of the IP addresses being assigned, and that they have a plan to utilize 50% of their assignment within one year of its receipt. This policy allows a downstream customer's multihoming requirement to serve as justification for a /24 reassignment from their upstream ISP, regardless of host requirements. Downstream customers must provide contact information for all of their upstream providers to the ISP from whom they are requesting a /24. The ISP will then verify the customer's multihoming requirement and may assign the customer a /24, based on this policy. Customers may receive a /24 from only one of their upstream providers under this policy without providing additional justification. ISPs may demonstrate they have made an assignment to a downstream customer under this policy by supplying ARIN with the information they collected from the customer, as described above, or by identifying the AS number of the customer. This information may be requested by ARIN staff when reviewing an ISP's utilization during their request for additional IP addresses space.

#### **4.2.3.7. Reassignment information**

##### **4.2.3.7.1. Customer organization information**

ISPs are required to demonstrate efficient use of IP address space allocations by providing appropriate documentation, including assignment histories, showing their efficient use. SWIP and RWHOIS reassignments should show each client's organizational information.

##### **4.2.3.7.2. /29s and larger nets**

*ISPs must provide reassignment information on the entire previously allocated block(s) via SWIP or RWHOIS server for /29 or larger blocks. For blocks smaller than /29 and for internal space, ISPs should provide utilization data via*

SWIP or RWHOIS server or by using the format described in Section 4.2.3.7.5.

#### 4.2.3.7.3. Submit within 7 days

Any time an ISP receives a new block of address space, reassignment information should be submitted within 7 days of issuance of the new space. This information is used to demonstrate that the address space received is being efficiently utilized. Also, it will be reviewed to determine an ISP's and its downstream customers' utilization effectiveness if and when additional space is requested in the future.

#### 4.2.3.7.4. Visible via WHOIS

This information must be visible via WHOIS prior to submitting a request for a new allocation. For further information on reassigning IP address space, please see RFC 2050.

#### 4.2.3.7.5. Accounting for additional utilization

The following format should be used to provide the required information for utilization of blocks smaller than /29 and for describing internal networks when either SWIP or RWHOIS server is not used:

|                             |                             |                          |                        |
|-----------------------------|-----------------------------|--------------------------|------------------------|
| City                        | Which IP Addresses Assigned | No. of Ports             | No. of Dial-up Clients |
| City                        | Which IP Addresses Assigned | No. of Internal Machines | Purpose                |
| Which IP Addresses Assigned |                             | List URLs for Websites   |                        |

#### 4.2.3.7.6. Residential Customer Privacy

To maintain the privacy of their residential customers, an organization with downstream residential customers may substitute that organization's name for the customer's name, e.g. 'Private Customer - XYZ Network', and the customer's street address may read 'Private Residence'. Each private downstream residential reassignment must have accurate upstream Abuse and Technical POCs visible on the WHOIS record for that block.

#### 4.2.4. ISP Additional Requests

ISPs requesting additional address space from ARIN beyond their initial allocation should follow the guidelines described in the ARIN ISP Guidelines for Requesting Additional IP Address Space.

##### 4.2.4.1. Utilization percentage (80%)

ISPs must have efficiently utilized all previous allocations and at least 80% of their most recent allocation in order to receive additional space. This includes all space reassigned to their customers. The reassignment information section of the ARIN ISP Network Request Template should be completed for all address blocks that have been allocated to your organization. In the template, line 1b. Assigned: information will be verified via SWIP/RWHOIS and 1c. Reserved: should be used to indicate internal network information. Please note that until your prior utilization is verified to meet the 80% requirement,

ARIN can neither process nor approve a request for additional addresses.

##### 4.2.4.2. Return address space as agreed

Return prior address space designated for return as agreed.

##### 4.2.4.3. Three months

Provide detailed information showing specifically that the address space will be utilized within three months.

##### 4.2.4.4. Twelve months

After an organization has been a subscriber member of ARIN for one year, they may choose to request up to a 12 month supply of IP addresses.

#### 4.2.5. Web Hosting Policy

When an ISP submits a request for IP address space to be used for IP-based web hosting, it will supply (for informational purposes only) its technical justification for this practice. ARIN will analyze this data continuously, evaluating the need for future policy change.

#### 4.2.6. Cable Address Space Policy

- ▶ In most cases, ISPs that have residential cable subscribers assign address space to their cable infrastructure to which their customers connect rather than to individual subscribers. This assignment information regarding each market area holding an address block should be entered via the SWIP template (or by using RWHOIS) with the network name used to identify each market area. Initial allocations are based on total number of homes that could purchase the service in a given market area.
- ▶ Using SWIP or RWHOIS, cable ISPs must show that they have reassigned at least 80% of their current address space, with a 50 to 80% utilization rate, in order to request additional addresses.
- ▶ Each assignment to a specific end-user (if holding /29 and larger blocks) requires the submission of a SWIP template or use of an RWHOIS server. Requesters will also be asked to provide detailed plans for use of the newly requested space.

#### 4.3. End-users - Assignments to end-users

##### 4.3.1. End-users

ARIN assigns blocks of IP addresses to end-users who request address space for their internal use in running their own networks, but not for sub-delegation of those addresses outside their organization. End-users must meet the requirements described in these guidelines for justifying the assignment of an address block.

##### 4.3.2. Minimum assignment

###### 4.3.2.1. Single Connection

The minimum block of IP address space assigned by ARIN to end-users is a /20. If assignments smaller than /20 are needed, end-users should contact their upstream provider.

#### 4.3.2.2. Multihomed Connection

For end-users who demonstrate an intent to announce the requested space in a multihomed fashion, the minimum block of IP address space assigned is a /22. If assignments smaller than a /22 are needed, multihomed end-users should contact their upstream providers. When prefixes are assigned which are longer than /20, they will be from a block reserved for that purpose.

#### 4.3.3. Utilization rate

Utilization rate of address space is a key factor in justifying a new assignment of IP address space. Requesters must show exactly how previous address assignments have been utilized and must provide appropriate details to verify their one-year growth projection. The basic criteria that must be met are:

- ▶ A 25% immediate utilization rate, and
- ▶ A 50% utilization rate within one year.

A greater utilization rate may be required based on individual network requirements. Please refer to RFC 2050 for more information on utilization guidelines.

#### 4.3.4. Additional considerations

End-users may qualify for address space under other policies such as Immediate need [4.2.1.6] or Micro-allocation [4.4].

#### 4.3.5. Non-connected Networks

End-users not currently connected to an ISP and/or not planning to be connected to the Internet are encouraged to use private IP address numbers reserved for non-connected networks (see RFC 1918). When private, non-connected networks require interconnectivity and the private IP address numbers are ineffective, globally unique addresses may be requested and used to provide this interconnectivity.

#### 4.3.6. Additional Assignments

In order to justify an additional assignment, end-users must have efficiently utilized at least 80% of all previous assignments, and must provide ARIN with utilization details. The prefix size for an additional assignment is determined by applying the policies found in Section 4.3 of the NRPM.

#### 4.4. Micro-allocation

ARIN will make micro-allocations to critical infrastructure providers of the Internet, including public exchange points, core DNS service providers (e.g. ICANN-sanctioned root, gTLD, and ccTLD operators) as well as the RIRs and IANA. These allocations will be no longer than a /24 using IPv4 or a /48 using IPv6. Multiple allocations may be granted in certain situations. - Exchange point allocations MUST be allocated from specific blocks reserved only for this purpose. All other micro-allocations WILL be allocated out of other blocks reserved for micro-allocation purposes. ARIN will make a list of these blocks publicly available. Exchange point operators must provide justification for the allocation, including: connection policy, location, other participants (minimum of two total),

ASN, and contact information. ISPs and other organizations receiving these micro-allocations will be charged under the ISP fee schedule, while end-users will be charged under the fee schedule for end-users. This policy does not preclude exchange point operators from requesting address space under other policies.

#### 4.5. Multiple Discrete Networks

Organizations with multiple discrete networks desiring to request new or additional address space under a single Organization ID must meet the following criteria:

1. The organization shall be a single entity and not a consortium of smaller independent entities.
2. The organization must have compelling criteria for creating discrete networks. Examples of a discrete network might include:
  1. Regulatory restrictions for data transmission,
  2. Geographic distance and diversity between networks,
  3. Autonomous multihomed discrete networks.
3. The organization must keep detailed records on how it has allocated space to each location, including the date of each allocation.
4. When applying for additional internet address registrations from ARIN, the organization must demonstrate utilization greater than 50% of both the last block allocated and the aggregate sum of all blocks allocated from ARIN to that organization. If an organization is unable to satisfy this 50% minimum utilization criteria, the organization may alternatively qualify for additional internet address registrations by having all unallocated blocks of addresses smaller than ARIN's current minimum allocation size.
5. The organization may not allocate additional address space to a location until each of that location's address blocks are 80% utilized.
6. The organization should notify ARIN at the time of the request their desire to apply this policy to their account.

#### 4.6. Amnesty and Aggregation Requests

##### 4.6.1 Intent of this policy

This policy is intended to allow the community and ARIN staff to work together with holders of address resources in the best interests of the community by facilitating the return of unused address space and the aggregation of existing space in a manner which is in the best interests of both parties.

All transactions under this policy must either create greater aggregation (a reduction in the number of prefixes) or the return of address space. Transactions should only be accepted under this policy if they are in the interests of the community (e.g. they improve aggregation or result in a net reclamation of space).



#### **4.6.2 No penalty for returning or aggregating**

ARIN shall seek to make the return of address space as convenient and risk-free to the returning organization as possible. An organization with several non-contiguous blocks seeking to aggregate and return space at the same time should be accommodated if possible. If it is possible to expand one block, for example, to facilitate the return of other blocks, ARIN should do that.

#### **4.6.3 Return should not force renumbering**

An organization shall be allowed to return a partial block of any size to ARIN. For any return greater than a /24, ARIN shall not require that the non-returned portion of the block be renumbered unless the returning organization wishes to do so.

#### **4.6.4 Timeframe for return**

Any organization which is returning addresses under this policy shall negotiate with ARIN an appropriate timeframe in which to return the addresses after any new resources are received under this policy. In the case of a simple return, the timeframe shall be immediate. In the case where renumbering into new addresses out of existing addresses to be returned is required, the returning organization shall sign a contract with ARIN which stipulates a final return date not less than 6 months nor more than 18 months after the receipt of new addresses. If an organization misses this return date, but, ARIN believes the organization is working in good faith to complete the renumbering, ARIN may grant a single extension of 6-12 months as staff deems appropriate to the situation. Such an extension must be requested in writing (email to [hostmaster@arin.net](mailto:hostmaster@arin.net)) by the organization at least 15 days prior to the original expiration date.

#### **4.6.5 RSA Required if new addresses received**

Any organization which receives any additional addresses under this policy shall be required to sign an ARIN RSA which will apply to all new addresses issued and to any retained blocks which are expanded under this policy.

#### **4.6.6 Annual contact required**

Any organization which participates in this policy shall be required to sign an agreement stipulating that ARIN will attempt contact at least once per year via the contact mechanisms registered for the organization in whois. Should ARIN fail to make contact, after reasonable effort the organization shall be flagged as "unreachable" in whois. After six months in "unreachable" status, the organization agrees that ARIN may consider all resources held by the organization to be abandoned and reclaim such resources. Should the organization make contact with ARIN prior to the end of the aforementioned six month period and update their contact information appropriately, ARIN shall remove the "unreachable" status and the annual contact cycle shall continue as normal. If the organization pays annual fees to ARIN, the payment of annual fees shall be considered sufficient contact.

#### **4.7. Aggregation Requests**

If an organization, whether a member or non-member, ISP or end-user, relinquishes a group of portable, non-aggregatable address blocks to ARIN, they shall be allowed to receive a block in exchange, /24 or shorter, but no more than the shortest block that could contain all of the returned blocks. Exchanged space shall be returned within 12 months. If the gain in the number of addresses is greater than 4096, the aggregation request must be evaluated by the ARIN in accordance with the current IPv4 allocation policy. If all of the previous address blocks were maintained in the ARIN database without maintenance fees, the replacement space shall be as well, but if any one of the returned blocks had associated maintenance fees, then the replacement block shall also be subject to maintenance fees.

#### **4.8. [section number retired]**

#### **4.9 Minimum Allocation for the Caribbean and North Atlantic Islands**

The minimum IPv4 allocation size for ISPs from the Caribbean and North Atlantic Islands sector of the ARIN region is /22.

##### **4.9.1. Allocation Criteria**

- ▶ The requesting organization must show the efficient utilization of an entire previously allocated /22 from their upstream ISP. This allocation (/22) may have been provided by an ISP's upstream provider(s), and does not have to be contiguous address space. The organization must meet the requirement of efficient use of 4 /24s.
- ▶ Utilization Reporting and Justification. All other ARIN policies regarding the reporting of justification information for the allocation of IPv4 and IPv6 address space will remain in effect.

## **5. AS Numbers**

There are a limited number of available Autonomous System Numbers (AS Numbers), therefore, it is important to determine which sites require unique AS Numbers and which do not. Sites that do not require a unique AS Number should use one or more of the AS Numbers reserved for private use. Those numbers are: 64512 through 65535.

In order to be assigned an AS Number, each requesting organization must provide ARIN with verification that it has one of the following:

1. A unique routing policy (its policy differs from its border gateway peers)
2. A multihomed site.

AS Numbers are issued based on current need. An organization should request an AS Number only when it is already multihomed or will immediately become multihomed. Details regarding requirements, fees, and applying for an AS Number can be found on the Guidelines for AS Numbers page.

## 5.1. 16-bit and 32-bit AS Numbers

- ▶ Commencing 1 January 2007, ARIN will process applications that specifically request 32-bit only AS Numbers and assign such AS numbers as requested by the applicant. In the absence of any specific request for a 32-bit only AS Number, a 16-bit only AS Number will be assigned.
- ▶ Commencing 1 January 2009, ARIN will process applications that specifically request 16-bit only AS Numbers and assign such AS Numbers as requested by the applicant. In the absence of any specific request for a 16-bit only AS Number, a 32-bit only AS Number will be assigned.
- ▶ Commencing 1 January 2010, ARIN will cease to make any distinction between 16-bit only AS Numbers and 32-bit only AS Numbers, and will operate AS number assignments from an undifferentiated 32-bit AS Number pool.

### Terminology

"16-bit only AS Numbers" refers to AS numbers in the range 0 - 65535

"32-bit only AS Numbers" refers to AS Numbers in the range 65,536 - 4,294,967,295

"32-bit AS Numbers" refers to AS Numbers in the range 0 - 4,294,967,295

### Expiration

Section 5.1 will be removed from the first version of this manual published after 1 January 2010.

## 6. IPv6

[Editor's note: The IPv6 assignment and allocation policy document was adopted by the ARIN Board of Trustees on July 9, 2002. As part of the ARIN policy cataloging project of 2004, the IPv6 policy document was inserted into the ARIN Number Resource Policy Manual; the fact that it was once a stand alone document explains why the phrase "this document" occurs in this section.]

### Status of this Memo

This document was developed through joint discussions among the APNIC, ARIN, and RIPE communities.

### Abstract

This document defines registry policies for the assignment and allocation of globally-unique IPv6 addresses to ISPs and other organizations. This document obsoletes the "Provisional IPv6 assignment and allocation policy document."

This document was developed jointly by the communities of APNIC, ARIN, and RIPE.

### 6.1. Introduction

#### 6.1.1. Overview

This document describes policies for the allocation and assignment of globally-unique Internet Protocol Version 6 (IPv6) address space. It updates and obsoletes the

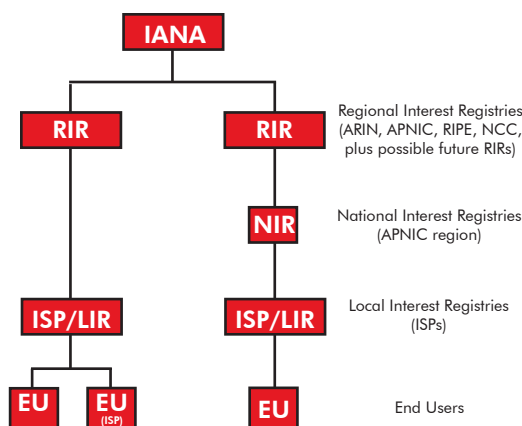
existing Provisional IPv6 Policies in effect since 1999 (RIRv6-Policies). Policies described in this document are intended to be adopted by each registry. However, adoption of this document does not preclude local variations in each region or area.

(RFC2373, RFC2373bis) designate 2000::/3 to be global unicast address space that IANA may allocate to the RIRs. In accordance with (RFC2928, RFC2373bis, IAB-Request), IANA has allocated 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 and assignment policies.

### 6.2. Definitions

The following terms and their definitions are of particular importance to the understanding of the goals, environment, and policies described in this document.

Responsibility for management of IPv6 address spaces is distributed globally in accordance with the hierarchical structure shown below.



#### 6.2.1. 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. IRs are classified according to their primary function and territorial scope within the hierarchical structure depicted in the figure above.

#### 6.2.2. 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. The primary role of RIRs is to manage and distribute public Internet address space within their respective regions.

#### 6.2.3. National Internet Registry (NIR)

A National Internet Registry (NIR) primarily allocates address space to its members or constituents, which are generally LIRs organized at a national level. NIRs exist mostly in the Asia Pacific region.

#### 6.2.4. 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.

#### 6.2.5. Allocate

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

#### 6.2.6. Assign

To assign means to delegate address space to an ISP or end-user, for specific use within the Internet infrastructure they operate. Assignments must only be made for specific purposes documented by specific organizations and are not to be sub-assigned to other parties.

#### 6.2.7. Utilization

In IPv6, "utilization" is only measured in terms of the bits to the left of the /56 boundary. In other words, utilization refers to the assignment of /56s to end sites, and not the number of addresses assigned within individual /56s at those end sites.

Throughout this document, the term utilization refers to the allocation of /56s to end sites, and not the number of addresses assigned within individual /56s within those end sites.

#### 6.2.8. HD-Ratio

The HD-Ratio is a way of measuring the efficiency of address assignment (RFC 3194). It is an adaptation of the H-Ratio originally defined in (RFC1715) and is expressed as follows:

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

where (in the case of this document) the objects are IPv6 site addresses (/56s) assigned from an IPv6 prefix of a given size.

#### 6.2.9. End site

An end site is defined as an end user (subscriber) who has a business relationship with a service provider that involves:

1. that service provider assigning address space to the end user
2. that service provider providing transit service for the end user to other sites
3. that service provider carrying the end user's traffic.
4. that service provider advertising an aggregate prefix route that contains the end user's assignment

### 6.3. Goals of IPv6 address space management

#### 6.3.1. Goals

IPv6 address space is a public resource that must be managed in a prudent manner with regards to the long-term interests of the internet. Responsible address space management involves balancing a set of sometimes competing goals. The following are the goals relevant to IPv6 address policy.

#### 6.3.2. Uniqueness

Every assignment and/or allocation of address space must guarantee uniqueness worldwide. This is an absolute requirement for ensuring that every public host on the Internet can be uniquely identified.

#### 6.3.3. Registration

Internet address space must be registered in a registry database accessible to appropriate members of the Internet community. This is necessary to ensure the uniqueness of each Internet address and to provide reference information for Internet troubleshooting at all levels, ranging from all RIRs and IRs to end users.

The goal of registration should be applied within the context of reasonable privacy considerations and applicable laws.

#### 6.3.4. 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 by ISPs, and to limit the expansion of Internet routing tables.

This goal is particularly important in IPv6 addressing, where the size of the total address pool creates significant implications for both internal and external routing.

IPv6 address policies should seek to avoid fragmentation of address ranges.

Further, RIRs should apply practices that maximize the potential for subsequent allocations to be made contiguous with past allocations currently held. However, there can be no guarantee of contiguous allocation.

#### 6.3.5. Conservation

Although IPv6 provides an extremely large pool of address space, address policies should avoid unnecessarily wasteful practices. Requests for address space should be supported by appropriate documentation and stockpiling of unused addresses should be avoided.

#### 6.3.6. 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.

#### 6.3.7. Minimized Overhead

It is desirable to minimize the overhead associated with obtaining address space. 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.

#### **6.3.8. Conflict of goals**

The goals described above will often conflict with each other, or with the needs of individual IRs or end users. All IRs evaluating requests for allocations and assignments must make judgments, seeking to balance the needs of the applicant with the needs of the Internet community as a whole.

In IPv6 address policy, the goal of aggregation is considered to be the most important.

### **6.4. IPv6 Policy Principles**

To address the goals described in the previous section, the policies in this document discuss and follow the basic principles described below.

#### **6.4.1. Address space not to be considered property**

It is contrary to the goals of this document and is not in the interests of the Internet community as a whole for address space to be considered freehold property.

The policies in this document are based upon the understanding that globally-unique IPv6 unicast address space is licensed for use rather than owned. Specifically, IP addresses will be allocated and assigned on a license basis, with licenses subject to renewal on a periodic basis. The granting of a license is subject to specific conditions applied at the start or renewal of the license.

RIRs will generally renew licenses automatically, provided requesting organizations are making a good-faith effort at meeting the criteria under which they qualified for or were granted an allocation or assignment. However, in those cases where a requesting organization is not using the address space as intended, or is showing bad faith in following through on the associated obligation, RIRs reserve the right to not renew the license.

Note that when a license is renewed, the new license will be evaluated under and governed by the applicable IPv6 address policies in place at the time of renewal, which may differ from the policy in place at the time of the original allocation or assignment.

#### **6.4.2. Routability not guaranteed**

There is no guarantee that any address allocation or assignment will be globally routable.

However, RIRs must apply procedures that reduce the possibility of fragmented address space which may lead to a loss of routability.

#### **6.4.3. Minimum Allocation**

RIRs will apply a minimum size for IPv6 allocations, to facilitate prefix-based filtering.

The minimum allocation size for IPv6 address space is /32.

#### **6.4.4. 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 to justify a larger request than would be justified if based solely on the IPv6 infrastructure.

### **6.5. Policies for allocations and assignments**

#### **6.5.1. Initial allocation**

##### **6.5.1.1. Initial allocation criteria**

To qualify for an initial allocation of IPv6 address space, an organization must:

- a. be an LIR;
- b. not be an end site;
- c. plan to provide IPv6 connectivity to organizations to which it will assign IPv6 address space, by advertising that connectivity through its single aggregated address allocation; and
- d. be an existing, known ISP in the ARIN region or have a plan for making at least 200 end-site assignments to other organizations within 5 years.

##### **6.5.1.2. Initial allocation size**

Organizations that meet the initial allocation criteria are eligible to receive a minimum allocation of /32.

Organizations may qualify for an initial allocation greater than /32 by submitting documentation that reasonably justifies the request. If so, the allocation size will be based on the number of existing users and the extent of the organization's infrastructure.

#### **6.5.2. Subsequent allocation**

Organizations that hold an existing IPv6 allocation may receive a subsequent allocation in accordance with the following policies.

##### **6.5.2.1. 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 /56 assignments. The HD-Ratio (RFC 3194) is used to determine the utilization thresholds that justify the allocation of additional address as described below.

##### **6.5.2.2. Applied HD-Ratio**

The HD-Ratio value of 0.94 is adopted as indicating an acceptable address utilization for justifying the allocation of additional address space. Appendix A provides a table showing the number of assignments that are necessary to achieve an acceptable utilization value for a given address block size.

##### **6.5.2.3. Subsequent Allocation Size**

When an organization has achieved an acceptable utilization for its allocated address space, it is immediately eligible to obtain an additional allocation that results in a doubling of the address space allocated to it. Where



possible, the allocation will be made from an adjacent address block, meaning that its existing allocation is extended by one bit to the left.

If an organization needs more address space, it must provide documentation justifying its requirements for a two-year period. The allocation made will be based on this requirement.

### **6.5.3. [section number retired]**

### **6.5.4. Assignments from LIRs/ISPs**

LIRs must make IPv6 assignments in accordance with the following provisions.

#### **6.5.4.1. Assignment address space size**

End-users are assigned an end site assignment from their LIR or ISP. The exact size of the assignment is a local decision for the LIR or ISP to make, using a minimum value of a /64 (when only one subnet is anticipated for the end site) up to the normal maximum of /48, except in cases of extra large end sites where a larger assignment can be justified.

The following guidelines may be useful (but they are only guidelines):

- ▶ /64 when it is known that one and only one subnet is needed
- ▶ /56 for small sites, those expected to need only a few subnets over the next 5 years.
- ▶ /48 for larger sites

For end sites to whom reverse DNS will be delegated, the LIR/ISP should consider making an assignment on a nibble (4-bit) boundary to simplify reverse lookup delegation.

RIRs/NIRs are not concerned about which address size an LIR/ISP actually assigns. Accordingly, RIRs/NIRs will not request the detailed information on IPv6 user networks as they did in IPv4, except for the cases described in Section 6.4.4 and for the purposes of measuring utilization as defined in this document.

#### **6.5.4.2. Assignment of multiple /48s to a single end site**

When a single end site requires an additional /48 address block, it must 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.

Note: There is no experience at the present time with the assignment of multiple /48s to the same end site. Having the RIR review all such assignments is intended to be a temporary measure until some experience has been gained and some common policies can be developed. In addition, additional work at defining policies in this space will likely be carried out in the near future.

#### **6.5.4.3. Assignment to operator's infrastructure**

An organization (ISP/LIR) may assign a /48 per PoP as the service infrastructure of an IPv6 service operator.

Each assignment to a PoP is regarded as one assignment regardless of the number of users using the PoP. A separate assignment can be obtained for the in-house operations of the operator.

### **6.5.4.4. Registration of Assignments**

All /56 and larger assignments to end sites are required to be registered either by the LIR or its subordinate ISPs in such a way that the RIR/NIR can properly evaluate the HD-Ratio when a subsequent allocation becomes necessary.

### **6.5.5. Registration**

When an organization holding an IPv6 address allocation makes IPv6 address assignments, it must register assignment information in a database, accessible by RIRs as appropriate (information registered by an RIR/NIR may be replaced by a distributed database for registering address management information in future). Information is registered in units of assigned /56 networks. When more than a /56 is assigned to an organization, the assigning organization is responsible for ensuring that the address space is registered in an RIR/NIR database.

RIR/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.

IRs shall maintain systems and practices that protect the security of personal and commercial information that is used in request evaluation, but which is not required for public registration.

### **6.5.5.1. Residential Customer Privacy (2003-3)**

To maintain the privacy of their residential customers, an organization with downstream residential customers may substitute that organization's name for the customer's name, e.g. 'Private Customer - XYZ Network', and the customer's street address may read 'Private Residence'. Each private downstream residential reassignment must have accurate upstream Abuse and Technical POCs visible on the WHOIS record for that block.

### **6.5.6. Reverse lookup**

When an RIR/NIR delegates IPv6 address space to an organization, it also delegates the responsibility to manage the reverse lookup zone that corresponds to the allocated IPv6 address space. Each organization should properly manage its reverse lookup zone. When making an address assignment, the organization must delegate to an assignee organization, upon request, the responsibility to manage the reverse lookup zone that corresponds to the assigned address.

### **6.5.7. Existing IPv6 address space holders**

Organizations that received /35 IPv6 allocations under the previous IPv6 address policy (RIRv6-Policies) are immediately entitled to have their allocation expanded to a /32 address block, without providing justification, so long as they satisfy the criteria in Section 6.5.1.1. 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. Requests for additional space beyond the minimum /32 size will be evaluated as discussed elsewhere in the document.

### 6.5.8. Direct assignments from ARIN to end-user organizations

#### 6.5.8.1. Criteria

To qualify for a direct assignment, an organization must:

- a. not be an IPv6 LIR; and
- b. qualify for an IPv4 assignment or allocation from ARIN under the IPv4 policy currently in effect, or demonstrate efficient utilization of all direct IPv4 assignments and allocations, each of which must be covered by any current ARIN RSA.

#### 6.5.8.2. Initial assignment size

Organizations that meet the direct assignment criteria are eligible to receive a direct assignment. The minimum size of the assignment is /48. Organizations requesting a larger assignment must provide documentation justifying the need for additional subnets. An HD-Ratio of .94 must be met for all assignments larger than a /48.

These assignments shall be made from a distinctly identified prefix and shall be made with a reservation for growth of at least a /44. This reservation may be assigned to other organizations later, at ARIN's discretion.

#### 6.5.8.3. Subsequent assignment size

Additional assignments may be made when the need for additional subnets is justified. Justification will be determined based on the .94 HD-Ratio metric. When possible, assignments will be made from an adjacent address block.

## 6.6. References

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(RFC2928) "Initial IPv6 Sub-TLA ID Assignments", R. Hinden, S. Deering, R. Fink, T. Hain. September 2000, RFC 2928.

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(RIRs-on-48) <http://www.arin.net/policy/archive/ipv6re-assign.html>.

(RIRv6-Policies) <http://www.afrinic.net/policy.htm>  
<http://www.arin.net/policy/nrpm.html#ipv6>  
<http://lacnic.net/en/politicas/index.html>  
<http://www.ripe.net/ripe/docs/ipv6policy.html>  
<http://www.apnic.net/docs/policy/ipv6-address-policy.html>

## 6.7. Appendix A: HD-Ratio

The HD-Ratio is not intended to replace the traditional utilization measurement that ISPs perform with IPv4 today. Indeed, the HD-Ratio still requires counting the number of assigned objects. The primary value of the HD-Ratio is its usefulness at determining reasonable target utilization threshold values for an address space of a given size. This document uses the HD-Ratio to determine the thresholds at which a given allocation has achieved an acceptable level of utilization and the assignment of additional address space becomes justified.

The utilization threshold T, expressed as a number of individual /56 prefixes to be allocated from IPv6 prefix P, can be calculated as:

$$T = 2^{((56-P)*HD)}$$

Thus, the utilization threshold for an organization requesting subsequent allocation of IPv6 address block is specified as a function of the prefix size and target HD ratio. This utilization refers to the allocation of /56s to end sites, and not the utilization of those /56s within those end sites. It is an address allocation utilization ratio and not an address assignment utilization ratio.

The following table provides equivalent absolute and percentage address utilization figures for IPv6 prefixes, corresponding to an HD-Ratio of 0.94.

## 6.8. Appendix B: Background information

### 6.8.1. Background

The impetus for revising the 1999 Provisional IPv6 policy started with the APNIC meeting held in Taiwan in August 2001. Follow-on discussions were held at the October, 2001 RIPE and ARIN meetings. During these meetings, the participants recognized an urgent need for more detailed, complete policies. One result of the meetings was the establishment of a single mailing list to discuss a revised policy together with a desire to develop a general policy that all RIRs could use. This document does not provide details of individual discussions that lead to policies described in this document; detailed information can be found in the individual meeting minutes at the [www.apnic.net](http://www.apnic.net), [www.arin.net](http://www.arin.net), and [www.ripe.net](http://www.ripe.net) web sites.

### 6.8.2. Why a joint policy

IPv6 addresses are a public resource that must be managed with consideration to the long-term interests of the internet community. Although regional registries adopt allocation policies according to their own internal processes, address policies should largely be uniform across registries. Having significantly varying policies in different regions is undesirable because it can lead to situations where "registry shopping" can occur as requesting organizations request addresses from the

registry that has the most favorable policy for their particular desires. This can lead to the policies in one region undermining the efforts of registries in other regions with regards to prudent stewardship of the address space. In cases where regional variations from the policy are deemed necessary, the preferred approach is to raise the issue in the other regional registries in order to develop a consensus approach that all registries can support.

### 6.8.3. The size of IPv6's address space

Compared to IPv4, IPv6 has a seemingly endless amount of address space. While superficially true, short-sighted and wasteful allocation policies could also result

in the adoption of practices that lead to premature exhaustion of the address space.

It should be noted that the 128-bit address space is divided into three logical parts, with the usage of each component managed differently. The rightmost 64 bits, the Interface Identifier (RFC2373), will often be a globally-unique IEEE identifier (e.g., mac address). Although an "inefficient" way to use the Interface Identifier field from the perspective of maximizing the number of addressable nodes, the numbering scheme was explicitly chosen to simplify Stateless Address Autoconfiguration (RFC2462). The middle bits of an address indicate the subnet ID.

| P  | 56 - P | Total /56s            | Threshold           | Util %  |
|----|--------|-----------------------|---------------------|---------|
| 56 | 0      | 1                     | 1                   | 100.00% |
| 55 | 1      | 2                     | 2                   | 95.90%  |
| 54 | 2      | 4                     | 4                   | 92.00%  |
| 53 | 3      | 8                     | 7                   | 88.30%  |
| 52 | 4      | 16                    | 14                  | 84.70%  |
| 51 | 5      | 32                    | 26                  | 81.20%  |
| 50 | 6      | 64                    | 50                  | 77.90%  |
| 49 | 7      | 128                   | 96                  | 74.70%  |
| 48 | 8      | 256                   | 184                 | 71.70%  |
| 47 | 9      | 512                   | 352                 | 68.80%  |
| 46 | 10     | 1,024                 | 676                 | 66.00%  |
| 45 | 11     | 2,048                 | 1,296               | 63.30%  |
| 44 | 12     | 4,096                 | 2,487               | 60.70%  |
| 43 | 13     | 8,192                 | 4,771               | 58.20%  |
| 42 | 14     | 16,384                | 9,153               | 55.90%  |
| 41 | 15     | 32,768                | 17,560              | 53.60%  |
| 40 | 16     | 65,536                | 33,689              | 51.40%  |
| 39 | 17     | 131,072               | 64,634              | 49.30%  |
| 38 | 18     | 262,144               | 124,002             | 47.30%  |
| 37 | 19     | 524,288               | 237,901             | 45.40%  |
| 36 | 20     | 1,048,576             | 456,419             | 43.50%  |
| 35 | 21     | 2,097,152             | 875,653             | 41.80%  |
| 34 | 22     | 4,194,304             | 1,679,965           | 40.10%  |
| 33 | 23     | 8,388,608             | 3,223,061           | 38.40%  |
| 32 | 24     | 16,777,216            | 6,183,533           | 36.90%  |
| 31 | 25     | 33,554,432            | 11,863,283          | 35.40%  |
| 30 | 26     | 67,108,864            | 22,760,044          | 33.90%  |
| 29 | 27     | 134,217,728           | 43,665,787          | 32.50%  |
| 28 | 28     | 268,435,456           | 83,774,045          | 31.20%  |
| 27 | 29     | 536,870,912           | 160,722,871         | 29.90%  |
| 26 | 30     | 1,073,741,824         | 308,351,367         | 28.70%  |
| 25 | 31     | 2,147,483,648         | 591,580,804         | 27.50%  |
| 24 | 32     | 4,294,967,296         | 1,134,964,479       | 26.40%  |
| 23 | 33     | 8,589,934,592         | 2,177,461,403       | 25.30%  |
| 22 | 34     | 17,179,869,184        | 4,177,521,189       | 24.30%  |
| 21 | 35     | 34,359,738,368        | 8,014,692,369       | 23.30%  |
| 20 | 36     | 68,719,476,736        | 15,376,413,635      | 22.40%  |
| 19 | 37     | 137,438,953,472       | 29,500,083,768      | 21.50%  |
| 18 | 38     | 274,877,906,944       | 56,596,743,751      | 20.60%  |
| 17 | 39     | 549,755,813,888       | 108,582,451,102     | 19.80%  |
| 16 | 40     | 1,099,511,627,776     | 208,318,498,661     | 18.90%  |
| 15 | 41     | 2,199,023,255,552     | 399,664,922,315     | 18.20%  |
| 14 | 42     | 4,398,046,511,104     | 766,768,439,460     | 17.40%  |
| 13 | 43     | 8,796,093,022,208     | 1,471,066,903,609   | 16.70%  |
| 12 | 44     | 17,592,186,044,416    | 2,822,283,395,519   | 16.00%  |
| 11 | 45     | 35,184,372,088,832    | 5,414,630,391,777   | 15.40%  |
| 10 | 46     | 70,368,744,177,664    | 10,388,121,308,479  | 14.80%  |
| 9  | 47     | 140,737,488,355,328   | 19,929,904,076,845  | 14.20%  |
| 8  | 48     | 281,474,976,710,656   | 38,236,083,765,023  | 13.60%  |
| 7  | 49     | 562,949,953,421,312   | 73,357,006,438,603  | 13.00%  |
| 6  | 50     | 1,125,899,906,842,620 | 140,737,488,355,328 | 12.50%  |
| 5  | 51     | 2,251,799,813,685,250 | 270,008,845,646,446 | 12.00%  |
| 4  | 52     | 4,503,599,627,370,500 | 518,019,595,058,136 | 11.50%  |

#### 6.8.4. Acknowledgment

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An editing team was then organized by representatives from each of the three RIRs (Takashi Arano, Chair of APNIC's Policy SIG, Thomas Narten, Chair of ARIN's IPv6 WG, and David Kessens, Chair of RIPE NCC's IPv6 WG).

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The final editing of this document was done by Thomas Narten.

#### 6.9. IPv6 Reassignments policy

The size of IPv6 address assignments to End Sites is to be determined by the ISP/LIR.

ISPs and LIRs may choose whether to make changes to their procedures for assigning address blocks to End Sites. The threshold End Site allocation efficiency level is between 20% to 50% for most ISPs and LIRs when based on a 0.94 HD Ratio. ISPs and LIRs will need to operate address plans according to this target level of End Site allocation efficiency.

#### 6.10. Micro-allocations

##### 6.10.1. Micro-allocations for Critical Infrastructure

ARIN will make micro-allocations to critical infrastructure providers of the Internet, including public exchange points, core DNS service providers (e.g. ICANN-sanctioned root, gTLD, and ccTLD operators) as well as the RIRs and IANA. These allocations will be no larger than a /24 using IPv4 or a /48 using IPv6. Multiple allocations may be granted in certain situations. - Exchange point allocations MUST be allocated from specific blocks reserved only for this purpose. All other micro-allocations WILL be allocated out of other blocks reserved for micro-allocation purposes. ARIN will make a list of these blocks publicly available. - Exchange point operators must provide justification for the allocation, including: connection policy, location, other participants (minimum of two total), ASN, and contact information. ISPs and other organizations receiving these micro-allocations will be charged under the ISP fee schedule, while end-users will be charged under the fee schedule for end-users. This policy does not preclude exchange point operators from requesting address space under other policies.

##### 6.10.2. Micro-allocations for Internal Infrastructure

Organizations that currently hold IPv6 allocations may apply for a micro-allocation for internal infrastructure. Applicant must provide technical justification indicating why a separate non-routed block is required. Justification must include why a sub-allocation of currently held IP space cannot be utilized. Internal infrastructure allocations must be allocated from specific blocks reserved only for this purpose.

### 7. Reverse Mapping

#### 7.1. Maintaining IN-ADDRs

All ISPs receiving one or more distinct /16 CIDR blocks of IP addresses from ARIN will be responsible for maintaining all IN-ADDR.ARPA domain records for their respective customers. For blocks smaller than /16, and for the segment of larger blocks which start or end with a CIDR prefix longer than /16, ARIN can maintain IN-ADDRs through the use of the SWIP (Reallocate and Reassign) templates or the Netmod template for /24 and shorter prefixes.

#### 7.2. Lame Delegations in IN-ADDR.ARPA

ARIN will actively identify lame DNS name server(s) for reverse address delegations associated with address blocks allocated, assigned or administered by ARIN. Upon identification of a lame delegation, ARIN shall attempt to contact the POC for that resource and resolve the issue. If, following due diligence, ARIN is unable to resolve the lame delegation, ARIN will update the WHOIS database records resulting in the removal of lame servers.

### 8. Transfers

#### 8.1. Transfers

Number resources are non-transferable and are not assignable to any other organization unless ARIN has expressly and in writing approved a request for transfer. ARIN is tasked with making prudent decisions on whether to approve the transfer of number resources.

It should be understood that number resources are not "sold" under ARIN administration. Rather, number resources are assigned to an organization for its exclusive use for the purpose stated in the request, provided the terms of the Registration Services Agreement continue to be met and the stated purpose for the number resources remains the same. Number resources are administered and assigned according to ARIN's published policies.

Number resources are issued, based on justified need, to organizations, not to individuals representing those organizations. Thus, if a company goes out of business, regardless of the reason, the point of contact (POC) listed for the number resource does not have the authority to sell, transfer, assign, or give the number resource to any other person or organization. The POC must

notify ARIN if a business fails so the assigned number resources can be returned to the available pool of number resources if a transfer is not requested and justified.

## 8.2. Transfer Requirements

ARIN will consider requests for the transfer of number resources only upon receipt of evidence that the new entity has acquired the assets which had, as of the date of the acquisition or proposed reorganization, justified the current entity's use of the number resource. Examples of assets that justify use of the number resource include, but are not limited to:

- ▶ Existing customer base
- ▶ Qualified hardware inventory
- ▶ Specific software requirements.

## 8.3. Documentation Requirements

In evaluating a request for transfer, ARIN may require the requesting organization to provide any of the following documents, as applicable, plus any other documents deemed appropriate:

- ▶ An authenticated copy of the instrument(s) effecting the transfer of assets, e.g., bill of sale, certificate of merger, contract, deed, or court decree
- ▶ A detailed inventory of all assets utilized by the requesting party in maintaining and using the number resource
- ▶ A list of the requesting party's customers using the number resources.

If further justification is required, the requesting party may be asked to provide any of the following, or other supporting documentation, as applicable:

- ▶ A general listing of the assets or components acquired
- ▶ A specific description of acquisitions, including:
  - ▶ Type and quantity of equipment
  - ▶ Customer base
- ▶ A description of how number resources are being utilized
- ▶ Network engineering plans, including:
  - ▶ Host counts
  - ▶ Subnet masking
  - ▶ Network diagrams
  - ▶ Reassignments to customers

## 9. [reserved]

## 10. Global Number Resource Policy

### 10.1. IANA to RIR Allocation of IPv4 Address Space

This document describes the policies governing the allocation of IPv4 address space from the IANA to the Regional Internet Registries (RIRs). This document does

not stipulate performance requirements in the provision of services by IANA to an RIR in accordance with these policies. Such requirements should be specified by appropriate agreements among the RIRs and ICANN.

#### 1. Allocation Principles

- ▶ The IANA will allocate IPv4 address space to the RIRs in /8 units.
- ▶ The IANA will allocate sufficient IPv4 address space to the RIRs to support their registration needs for at least an 18 month period.
- ▶ The IANA will allow for the RIRs to apply their own respective chosen allocation and reservation strategies in order to ensure the efficiency and efficacy of their work.

#### 2. Initial Allocations

Each new RIR shall, at the moment of recognition, be allocated a new /8 by the IANA. This allocation will be made regardless of the newly formed RIR's projected utilization figures and shall be independent of the IPv4 address space that may have been transferred to the new RIR by the already existing RIRs as part of the formal transition process.

#### 3. Additional Allocations

A RIR is eligible to receive additional IPv4 address space from the IANA when either of the following conditions are met.

- ▶ The RIR's AVAILABLE SPACE of IPv4 addresses is less than 50% of a /8 block.
- ▶ The RIR's AVAILABLE SPACE of IPv4 addresses is less than its established NECESSARY SPACE for the following 9 months.

In either case, IANA shall make a single allocation of a whole number of /8 blocks, sufficient to satisfy the established NECESSARY SPACE of the RIR for an 18 month period.

##### 3.1. Calculation of AVAILABLE SPACE

The AVAILABLE SPACE of IPv4 addresses of a RIR shall be determined as follows:

AVAILABLE SPACE = CURRENTLY FREE ADDRESSES + RESERVATIONS EXPIRING DURING THE FOLLOWING 3 MONTHS – FRAGMENTED SPACE

FRAGMENTED SPACE is determined as the total amount of available blocks smaller than the RIR's minimum allocation size within the RIR's currently available stock.

##### 3.2. Calculation of NECESSARY SPACE

If the applying Regional Internet Registry does not establish any special needs for the period concerned, NECESSARY SPACE shall be determined as follows:

NECESSARY SPACE = AVERAGE NUMBER OF ADDRESSES ALLOCATED MONTHLY DURING THE PAST 6 MONTHS \* LENGTH OF PERIOD IN MONTHS

If the applying RIR anticipates that due to certain special needs the rate of allocation for the period concerned



will be greater than the previous 6 months, it may determine its NECESSARY SPACE as follows:

- A) Calculate NECESSARY SPACE as its total needs for that period according to its projection and based on the special facts that justify these needs.
- B) Submit a clear and detailed justification of the above mentioned projection (Item A).

If the justification is based on the allocation tendency prepared by the Regional Internet Registry, data explaining said tendency must be enclosed.

If the justification is based on the application of one or more of the Regional Internet Registry's new allocation policies, an impact analysis of the new policy/policies must be enclosed.

If the justification is based on external factors such as new infrastructure, new services within the region, technological advances or legal issues, the corresponding analysis must be enclosed together with references to information sources that will allow verification of the data.

If IANA does not have elements that clearly question the Regional Internet Registry's projection, the special needs projected for the following 18 months, indicated in Item A above, shall be considered valid.

#### 4. Announcement of IANA Allocations

When address space is allocated to a RIR, the IANA will send a detailed announcement to the receiving RIR. The IANA will also make announcements to all other RIRs, informing them of the recent allocation. The RIRs will coordinate announcements to their respective membership lists and any other lists they deem necessary.

The IANA will make appropriate modifications to the "Internet Protocol V4 Address Space" page of the IANA website and may make announcements to its own appropriate announcement lists. The IANA announcements will be limited to which address ranges, the time of allocation and to which Registry they have been allocated.

### 10.2. Allocation of IPv6 Address Space by the Internet Assigned Numbers Authority (IANA) Policy to Regional Internet Registries

This document describes the policy governing the allocation of IPv6 address space from the IANA to the Regional Internet Registries (RIRs). This document does not stipulate performance requirements in the provision of services by IANA to an RIR in accordance with this policy. Such requirements will be specified by appropriate agreements between ICANN and the NRO.

#### 1. Allocation Principles

- ▶ The unit of IPv6 allocation (and therefore the minimum IPv6 allocation) from IANA to an RIR is a /12
- ▶ The IANA will allocate sufficient IPv6 address space to the RIRs to support their registration needs for at least an 18 month period.

- ▶ The IANA will allow for the RIRs to apply their own respective chosen allocation and reservation strategies in order to ensure the efficiency and efficacy of their work.

#### 2. Initial Allocations

- ▶ On inception of this policy, each current RIR with less than a /12 unallocated address space, shall receive an IPv6 allocation from IANA
- ▶ Any new RIR shall, on recognition by ICANN receive an IPv6 allocation from the IANA

#### 3. Additional Allocations

A RIR is eligible to receive additional IPv6 address space from the IANA when either of the following conditions are met.

- ▶ The RIR's AVAILABLE SPACE of IPv6 addresses is less than 50% of a /12.
- ▶ The RIR's AVAILABLE SPACE of IPv6 addresses is less than its established NECESSARY SPACE for the following 9 months.

In either case, IANA shall make a single IPv6 allocation, sufficient to satisfy the established NECESSARY SPACE of the RIR for an 18 month period.

##### 3.1. Calculation of AVAILABLE SPACE

The AVAILABLE SPACE of IPv6 addresses of a RIR shall be determined as follows:

AVAILABLE SPACE = CURRENTLY FREE ADDRESSES + RESERVATIONS EXPIRING DURING THE FOLLOWING 3 MONTHS – FRAGMENTED SPACE

FRAGMENTED SPACE is determined as the total amount of available blocks smaller than the RIR's minimum allocation size within the RIR's currently available stock.

##### 3.2. Calculation of NECESSARY SPACE

If the applying Regional Internet Registry does not establish any special needs for the period concerned, NECESSARY SPACE shall be determined as follows:

NECESSARY SPACE = AVERAGE NUMBER OF ADDRESSES ALLOCATED MONTHLY DURING THE PAST 6 MONTHS \* LENGTH OF PERIOD IN MONTHS

If the applying RIR anticipates that due to certain special needs the rate of allocation for the period concerned will be different from the previous 6 months, it may determine its NECESSARY SPACE as follows:

Calculate NECESSARY SPACE as its total needs for that period according to its projection and based on the special facts that justify these needs.

Submit a clear and detailed justification of the above mentioned projection (Item A).

If the justification is based on the allocation tendency prepared by the Regional Internet Registry, data explaining said tendency must be enclosed.

If the justification is based on the application of one or more of the Regional Internet Registry's new allocation policies, an impact analysis of the new policy/policies must be enclosed.

If the justification is based on external factors such as new infrastructure, new services within the region, technological advances or legal issues, the corresponding analysis must be enclosed together with references to information sources that will allow verification of the data.

If IANA does not have elements that clearly question the Regional Internet Registry's projection, the special needs projected for the following 18 months, indicated in Item A above, shall be considered valid.

#### 4. Announcement of IANA Allocations

The IANA, the NRO, and the RIRs will make announcements and update their respective web sites regarding an allocation made by the IANA to an RIR. ICANN and the NRO will establish administrative procedures to manage this process.

### 10.3 IANA Policy for Allocation of ASN Blocks to RIRs

#### Abstract

This document describes the policy governing the allocation of Autonomous System Numbers (ASNs) from the IANA to the Regional Internet Registries (RIRs).

This policy document does not stipulate performance requirements in the provision of services by the IANA to an RIR. Such requirements will be specified by appropriate agreements between ICANN and the Number Resource Organization (NRO).

#### 1. Allocation Principles

IANA allocates ASNs to RIRs in blocks of 1024 ASNs. In this document the term "ASN block" refers to a set of 1024 ASNs. Until 31 December 2009, allocations of 2-byte only and 4-byte only ASN blocks will be made separately and independent of each other.

This means until 31 December 2009, RIRs can receive two separate ASN blocks, one for 2-byte only ASNs and one for 4-byte only ASNs from the IANA under this policy. After this date, IANA and the RIRs will cease to make any distinction between 2-byte only and 4-byte only ASNs, and will operate ASN allocations from an undifferentiated 4-byte ASN allocation pool.

#### 2. Initial Allocations

Each new RIR will be allocated a new ASN block.

#### 3. Additional Allocations

An RIR is eligible to receive (an) additional ASN block(s) from the IANA if one of the following conditions is met:

1. The RIR has assigned/allocated 80% of the previously received ASN block, or
2. The number of free ASNs currently held by the RIR is less than two months need. This projection is based on the monthly average number of ASNs assigned/allocated by the RIR over the previous six months.

An RIR will be allocated as many ASN blocks as are needed to support their registration needs for the next 12 months, based on their average assignment/allocation

rate over the previous six months, unless the RIR specifically requests fewer blocks than it qualifies for.

#### 4. Announcement of IANA Allocations

The IANA, the NRO and the RIRs will make announcements and update their respective websites/databases when an allocation is made by the IANA to an RIR. ICANN and the NRO will establish administrative procedures to manage this process.

## 11. Experimental Internet Resource Allocations

ARIN will allocate Numbering Resources to entities requiring temporary Numbering Resources for a fixed period of time under the terms of recognized experimental activity.

"Numbering Resources" refers to unicast IPv4 or IPv6 address space and Autonomous System numbers.

The following are the criteria for this policy:

### 11.1. Documentation of recognized experimental activity

A Recognized Experimental Activity is one where the experiment's objectives and practices are described in a publicly accessible document. It is a normal requirement that a Recognized Experimental Activity also includes the undertaking that the experiment's outcomes be published in a publicly accessible document at the end of the experiment. The conditions for determining the end of the experiment are to be included in the document. Applicants for an experimental allocation are expected to demonstrate an understanding that when the experiment ends, the allocation will be returned; a successful experiment may need a new allocation under normal policies in order to continue in production or commercial use, but will not retain the experimental allocation.

A "publicly accessible document" is a document that is publicly and openly available free of charges and free of any constraints of disclosure.

ARIN will not recognize an experimental activity under this policy if the entire research experiment cannot be publicly disclosed.

ARIN has a strong preference for the recognition of experimental activity documentation in the form of a document which has been approved for publication by the IESG or by a similar mechanism as implemented by the IETF.

### 11.2. Technical Coordination

ARIN requires that a recognized experimental activity is able to demonstrate that the activity is technically coordinated.

Technical coordination specifically includes consideration of any potential negative impact of the proposed experiment on the operation of the Internet and its deployed services, and consideration of any related experimental activity.

ARIN will review planned experimental activities to ensure that they are technically coordinated. This review will be conducted with ARIN and/or third-party expertise and will include liaison with the IETF.

### **11.3. Coordination over Resource Use**

When the IETF's standards development process proposes a change in the use of Numbering Resources on an experimental basis the IETF should use a liaison mechanism with the Regional Internet Registries (RIRs) of this proposal. The RIRs will jointly or severally respond to the IETF using the same liaison mechanism.

### **11.4. Resource Allocation Term and Renewal**

The Numbering Resources are allocated on a lease/license basis for a period of one year. The allocation can be renewed on application to ARIN providing information as per Detail One. The identity and details of the applicant and the allocated Numbering Resources will be published under the conditions of ARIN's normal publication policy. At the end of the experiment, resources allocated under this policy will be returned to the available pool.

### **11.5. Single Resource Allocation per Experiment**

ARIN will make one-off allocations only, on an annual basis to any applicant. Additional allocations to an organization already holding experimental activity resources relating to the specified activity outside the annual cycle will not be made unless justified by a subsequent complete application.

It's important for the requesting organization to ensure they have sufficient resources requested as part of their initial application for the proposed experimental use.

### **11.6. Resource Allocation Fees**

ARIN may charge an administration fee to cover each allocation made of these experimental resources. This fee simply covers registration and maintenance, rather than the full allocation process for standard ARIN members. This administration fee should be as low as possible as these requests do not have to undergo the same evaluation process as those requested in the normal policy environment.

### **11.7. Resource Allocation Size**

The Numbering Resources requested come from the global Internet Resource space, and are not from private or other nonroutable Internet Resource space. The allocation size should be consistent with the existing ARIN minimum allocation sizes, unless small allocations are intended to be explicitly part of the experiment. If an organization requires more resource than stipulated by the minimum allocation sizes in force at the time of their request, their experimental documentation should have clearly described and justified why this is required.

### **11.8. Commercial Use Prohibited**

If there is any evidence that the temporary resource is being used for commercial purposes, or is being used for any activities not documented in the original experiment description provided to ARIN, ARIN reserves the right to immediately withdraw the resource and reassign it to the free pool.

### **11.9. Resource Request Appeal or Arbitration**

ARIN reserves the ability to assess and comment on the objectives of the experiment with regard to the requested amount of Numbering Resources and its technical coordination. ARIN reserves the ability to modify the requested allocation as appropriate, and in agreement with the proposer. In the event that the proposed modifications are not acceptable, the requesting organization may request an appeal or arbitration using the normal ARIN procedures. In this case, the original proposer of the experimental activity may be requested to provide additional information regarding the experiment, its objectives and the manner of technical coordination, to assist in the resolution of the appeal.

## **Online Resources**



### **Number Resource Policy Manual**

<http://www.arin.net/policy/nrpm.html>

### **Appendix A - Change Log**

**The Change Log can be found at:**

[http://www.arin.net/policy/nrpm\\_changelog.html](http://www.arin.net/policy/nrpm_changelog.html)