Network Working Group
Request for Comments: 1466
Obsoletes: 1366

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May 1993

Guidelines for Management of IP Address Space

Status of this Memo

This memo provides information for the Internet community. It does not specify an Internet standard. Distribution of this memo is unlimited.

Abstract

This document has been reviewed by the Federal Engineering Planning Group (FEPG) on behalf of the Federal Networking Council (FNC), the co-chairs of the Intercontinental Engineering Planning Group (IEPG), and the Reseaux IP Europeens (RIPE). There was general consensus by those groups to support the recommendations proposed in this document for management of the IP address space.

1.0 Introduction

With the growth of the Internet and its increasing globalization, much thought has been given to the evolution of the network number allocation and assignment process. RFC 1174, "Identifier Assignment and Connected Status", [1] dated August 1990 recommends that the Internet Registry (IR) continue as the principal registry for network numbers; however, the IR may allocate blocks of network numbers and the assignment of those numbers to qualified organizations. The IR will serve as the default registry in cases where no delegated registration authority has been identified.

The distribution of the registration function is desirable, and in keeping with that goal, it is necessary to develop a plan which manages the distribution of the network number space. The demand for network numbers has grown significantly within the last two years and as a result the allocation of network numbers must be approached in a more systematic fashion.

This document proposes a plan which will forward the implementation of RFC 1174 and which defines the allocation and assignment of the network number space. There are three major topics to be addressed:

1) Qualifications for Distributed Regional Registries

2) Allocation of the Network Number Space by the Internet Registry

3) Assignment of the Network Numbers

2.0 Qualifications for Distributed Regional Registries

The major reason to distribute the registration function is that the Internet serves a more diverse global population than it did at its inception. This means that registries which are located in distinct geographic areas may be better able to serve the local community in terms of language and local customs. While there appears to be wide support for the concept of distribution of the registration function, it is important to define how the candidate delegated registries will be chosen and from which geographic areas.

Based on the growth and the maturity of the Internet in Europe, North America, Central/South America and the Pacific Rim areas, it is desirable to consider delegating the registration function to an organization in each of those geographic areas. Until an organization is identified in those regions, the IR will continue to serve as the default registry. The IR remains the root registry and continues to provide the registration function to all those regions not covered by distributed regional registries. And as other regions of the world become more and more active in the Internet, the Internet Assigned Numbers Authority (IANA) and the IR may choose to look for candidate registries to serve the populations in those geographic regions.

It is important that the regional registry is unbiased and and widely recognized by network providers and subscribers within the geographic region. It is also important that there is just a single regional registry per geographical region at this level to provide for efficient and fair sub-allocation of the address space. To be selected as a distributed regional registry an organization should meet the following criteria:

a) networking authorities within the geographic area legitimize the organization,

b) the organization is well-established and has legitimacy outside of the registry function,

c) the organization will commit appropriate resources to provide stable, timely, and reliable service to the geographic region,

d) is committed to allocate IP numbers according to the guidelines established by the IANA and the IR, and

e) is committed to coordinate with the IR to establish qualifications and strategies for sub-allocations of the regional allocation.

The distributed regional registry is empowered by the IANA and the IR to provide the network number registration function to a geographic area. It is possible for network applicants to contact the IR directly. Depending on the circumstances the network subscriber may be referred to the regional registry, but the IR will be prepared to service any network subscriber if necessary.

3.0 Allocation of the Network Number Space by the Internet Registry

The Class A portion of the number space represents 50% of the total IP host addresses; Class B is 25% of the total; Class C is approximately 12% of the total. Table 1 shows the current allocation of the IP network numbers.

	Total	Allocated	Allocated (%)
Class A	126	49	38%
Class B	16383	7354	45%
Class C	2097151	44014	2%

Table 1: Network Number Statistics (May 1992) [2]

Class A and B network numbers are a limited resource and therefore allocations from this space will be restricted. The entire Class A number space will be retained by the IANA and the IR. No allocations from the Class A network numbers will be made to distributed regional registries at this time. (See section 4.1.)

Allocations from the Class B network number space will be restricted also. Small blocks of numbers may be allocated to regional registries, which will be required to ensure that the allocation guidelines are met. The IR will monitor those allocations. (See section 4.2.)

It is proposed that the IR, and any designated regional registries, allocate addresses in conformance with this overall scheme. Where there are qualifying regional registries established, primary responsibility for allocation within that block will be delegated to that registry. It should be noted that the Reseaux IP Europeens Network Coordination Center (RIPE NCC) had been allocated a block of Class C addresses (193.0.0 - 193.255.255) prior to the adoption of this proposal. The RIPE NCC has agreed to allocate the addresses

within that block according to the guidelines stated in this RFC.

The Class C network number space will be divided into allocatable blocks which will be reserved by the IANA and IR for allocation to distributed regional registries. In the absence of designated regional registries in geographic areas, the IR will assign addresses to networks within those geographic areas according to the Class C allocation divisions.

Inspection of the Class C IP network numbers shows that the number space with prefixes 192 and 193 are assigned. The remaining space from prefix 194 through 223 is mostly unassigned.

The IANA and the IR will reserve the upper half of this space which corresponds to the IP address range of 208.0.0.0 through 223.255.255.255. Network numbers from this portion of the Class C space will remain unallocated and unassigned until further notice.

The remaining Class C network number space will be allocated in a fashion which is compatible with potential address aggregation techniques. It is intended to divide this address range into eight equally sized address blocks.

```
192.0.0.0 - 193.255.255.255
194.0.0.0 - 195.255.255.255
196.0.0.0 - 197.255.255.255
198.0.0.0 - 199.255.255.255
200.0.0.0 - 201.255.255.255
202.0.0.0 - 203.255.255.255
204.0.0.0 - 205.255.255.255
206.0.0.0 - 207.255.255.255
```

Each block represents 131,072 addresses or approximately 6% of the total Class C address space.

It is proposed that a broad geographic allocation be used for these blocks. At present there are four major areas of address allocation: Europe, North America, Pacific Rim, and South & Central America.

In particular, the top level block allocation be designated as follows:

Multi-regional	192.0.0.0 - 193.255.255.255
Europe	194.0.0.0 - 195.255.255.255
Others	196.0.0.0 - 197.255.255.255
North America	198.0.0.0 - 199.255.255.255
Central/South America	200.0.0.0 - 201.255.255.255
Pacific Rim	202.0.0.0 - 203.255.255.255
Others	204.0.0.0 - 205.255.255.255
Others	206.0.0.0 - 207.255.255.255

It is proposed that the IR, and any designated regional registries, allocate addresses in conformance with this overall scheme. Where there are qualifying regional registries established, primary responsibility for allocation from within that block will be delegated to that registry.

The ranges designated as "Others" permit flexibility in network number assignments which are outside of the geographical regions already allocated. The range listed as multi-regional represents network numbers which have been assigned prior to the implementation of this plan. It is proposed that the IANA and the IR will adopt these divisions of the Class C network number space and will begin assigning network numbers accordingly.

4.0 Assignment of the Network Number Space

The exhaustion of the IP address space is a topic of concern for the entire Internet community. This plan for the assignment of Class A, B, or C IP numbers to network applicants has two major goals:

1) to reserve a portion of the IP number space so that it may be available to transition to a new numbering plan

2) to assign the Class C network number space in a fashion which is compatible with proposed address aggregation techniques

4.1 Class A

The Class A number space can support the largest number of unique host identifier addresses and is also the class of network numbers most sparsely populated. There are only approximately 11 Class A network numbers which are unassigned or unreserved, and these 11 network numbers represent about 9% of the total address space.

The IANA and the IR will retain sole responsibility for the assignment of Class A network numbers. The upper half of the Class A number space will be reserved indefinitely (IP network addresses 64.0.0.0 through 127.0.0.0). While it is expected that no new

assignments of Class A numbers will take place in the near future, any organization petitioning the IR for a Class A network number will be expected to provide a detailed technical justification documenting network size and structure. Class A assignments are at the IANA's discretion.

4.2 Class B

Previously, organizations were recommended to use a subnetted Class B network number rather than multiple Class C network numbers. Due to the scarcity of Class B network numbers and the underutilization of the Class B number space by most organizations, the recommendation is now to use multiple Class Cs where practical.

The restrictions in allocation of Class B network numbers may cause some organizations to expend additional resources to utilize multiple Class C numbers. This is unfortunate, but inevitable if we implement strategies to control the assignment of Class B addresses. The intent of these guidelines is to balance these costs for the greater good of the Internet.

4.2.1

Organizations applying for a Class B network number should fulfill the following criteria:

1) the organization presents a subnetting plan which documents more than 32 subnets within its organizational network

AND

2) the organization has more than 4096 hosts

Organizations applying for a Class B network number must submit an engineering plan that documents its need for a Class B network number. This document must demonstrate that it is unreasonable to engineer its network with a block of class C network numbers. The engineering plan must include how many hosts the network will have within the next 24 months and how many hosts per subnet within the next 24 months.

The submitted engineering plans will be held in strict confidence by the Internet registries and will only be used to judge whether an application is justified. If it is deemed that the applicant's engineering plan, including the number of hosts and subnets, does not warrant a Class B assignment, the applicant will be allocated a block of Class C addresses.

There may be some circumstances where the organization is unable to utilize a block of Class C network numbers and does not meet the suggested criteria. In such cases, the engineering plan should clearly demonstrate their inability to utilize a block of Class C network numbers.

4.2.2

The IR may allocate small blocks of Class B network numbers to regional registries if so doing will improve the service that is being provided to the community. The IR may issue more specific guidelines for the further assignment of the numbers which will be consistent with the stated guidelines. The IR may require accounting of the block assignment including receipt of the applicants' engineering plans. The IR may audit these engineering plans to confirm that the assignments are consistent with the guidelines.

4.3 Class C

Section 3 of this document recommends a division of the Class C number space. That division is primarily an administrative division which lays the groundwork for distributed network number registries. This section addresses assignment of network numbers from within regional block assignments. Sub-allocations of the block to sub-registries is beyond the scope of this paper.

By default, if an organization requires more than a single Class C, it will be assigned a bit-wise contiguous block from the Class C space allocated for its geographic region.

For instance, an European organization which requires fewer than 2048 unique IP addresses and more than 1024 would be assigned 8 contiguous class C network numbers from the number space reserved for European networks, 194.0.0.0 - 195.255.255.255. If an organization from Central America required fewer than 512 unique IP addresses and more than 256, it would receive 2 contiguous class C network numbers from the number space reserved for Central/South American networks, 200.0.0.0 - 201.255.255.255.

The IR or the registry to whom the IR has delegated the registration function will determine the number of Class C network numbers to assign to a network subscriber based on the subscriber's 24 month projection of required end system addresses according to the following criteria:

Organization	Assignment
1) requires fewer than 256 addresses	1 class C network
2) requires fewer than 512 addresses	2 contiguous class C networks
3) requires fewer than 1024 addresses	4 contiguous class C networks
4) requires fewer than 2048 addresses	8 contiguous class C networks
5) requires fewer than 4096 addresses	16 contiguous class C networks
6) requires fewer than 8192 addresses	32 contiguous class C networks
7) requires fewer than 16384 addresses	64 contiguous class C networks

If the subscriber's network is divided into logically distinct LANs across which it would be difficult to use the given number of Class C network numbers, the above criteria may apply on a per-LAN basis. For example, if a subscriber has 600 hosts equally divided across ten Ethernets, the allocation to that subscriber could be ten Class C network numbers; one for each Ethernet. The subscriber would have to support the request with to deviate from the stated criteria with an engineering plan.

These criteria are not intended to cause a subscriber to subnet Class C networks unneccessarily. Although, if a subscriber has a small number of hosts per subnet, the subscriber should investigate the feasibility of subnetting Class C network numbers rather than requesting one Class C network number for every subnet. In cases where the lack of Class C subnetting would result in an extravagant waste of address space, the registries may request an engineering plan detailing why subnetting is impossible.

If a subscriber has a requirement for more than 4096 unique IP addresses it could conceivably receive a Class B network number. However, there are cases where a subscriber may request a larger block of Class C network numbers. For instance, if an organization requires fewer than 8192 addresses and requests 32 Class C network addresses, the regional registry may honor this request. The maximal block of Class C network numbers that should be assigned to a subscriber consists of 64 contiguous Class C networks. This would correspond to a single IP prefix of 18 bits.

Exceptions from the above stated criteria will be determined on a case-by-case basis.

5.0 Conclusion

This proliferation of class C network numbers may aid in retarding the dispersion of class A and B numbers, but it is sure to accelerate the explosion of routing information carried by Internet routers. Inherent in these recommendations is the assumption that there will be modifications in the technology to support the larger number of

network address assignments due to the decrease in assignments of Class A and B numbers and the proliferation of Class C assignments.

Many proposals have been made to address the rapid growth of network assignments and a discussion of those proposals is beyond the scope and intent of this paper.

These recommendations for management of the current IP network number space only profess to delay depletion of the IP address space, not to postpone it indefinitely.

6.0 Acknowledgements

The author would like to acknowledge the substantial contributions made by the members of the following two groups, the Federal Engineering Planning Group (FEPG) and the Intercontinental Engineering Planning Group (IEPG). This document also reflects many concepts expressed at the IETF Addressing BOF which took place in Cambridge, MA in July 1992. In addition, Dan Long (BBN), Jon Postel (ISI), and Yakov Rekhter (T.J. Watson Research Center, IBM Corp.) reviewed this document and contributed to its content. The author thanks those groups and individuals who have been cited for their comments.

7.0 References

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8.0 Security Considerations

Security issues are not discussed in this memo.

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