      Centralized Address Space Management(CASM) Requirements and Framework
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Abstract

   The organizations use IP Address Space Management (IPAM) tools to
   manage their IP address space, often with proprietary database and
   interfaces. This document describes evolution of IPAM into a
   standardized interfaces for centralized management of IP addresses.

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1. Introduction

   The address space management is an intergral part of any network
   management solution. The network architectures are rapidally
   changing with the migration toward private and public clouds. At the
   same time, application architectures are also evolving with a shift
   toward micro-services and multi-tiered approach.

   There is a pressing need to define a new address management system
   which can meet these diverse set of requirements. Such a system must
   be built with well defined interfaces so users can easily migrate
   from one vendor to another without rewriting their network management
   systems.

   This document identifies a broad set of requirements and defins a
   architectural framework that should become the basis to develop a new
   address management system. We are calling this new system as
   Centralized Address Space Management (CSAM) system.

2. Requirements Language

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in RFC 2119 [RFC2119].

3. Terminology

    CASM: Centralized Address Space Management

    IPAM: IP Address Management

4. Requirements from CASM system

    In order to build CASM, there is a clear need to define a broad set
    of requirements that must be the basis for defining the architecture
    framework for CASM. The requirements should be able to meet the
    various use-cases identified in the draft.

    This sections identifies the major set of requirements for defining
    CASM system.

4.1. General operational requirements

   Some requirements are not specific to any particular functiolaity of
   CASM but applicable to all aspects of CASM system.

      Multi-tenancy: All interfaces exposed by CASM system must be
      multi-tenant capable. This is highly desirable for cloud based
      network management solutions. It may also be applicable for a
      service provider with different managed services use-case
      scenario.

      Autentication and Authorization: All interfaces exposed by CASM
      system must support an authentication scheme. It also highly
      desriable to support operational restrictions on certain resources
      based on identity for security reasons.

      Audit Logging: All CASM actvities must be logged for auditing or
      debugging purposes. The system must provide an interface to
      access these records.

      Error notification: All interfaces exposed by CASM system must
      support error handling and user-defined error notification
      mechanism suh as alert or email. There may also be need to take
      corrective action for autonomus operation.

4.2. Interafce modeling requirements

   The interface to external user must be meta-dat driven as much as
   possible to meet wider set of use-cases, e.g., instead of requesting
   an explicit IPv4 address, user should specify an adsress request
   based on its requirements.

The following requirements should be considered for pool management interface defintion. The attributes should be realted to the requestor which could a physical device, virtual machine, container or other entities present in a network.

Fucntional attributes such as switch, router, firewall, server, end-point

Form-factoral attributes such as physical, virtual

Opertional attributes such as management plane, control plane, data plane

Network segment identifier, such as VLAN, VxLAN or other user-defined value

Network segment type such as point-to-point, multi-point, loopback

Addressing scope attributes such as private, public, vpn, unicast, multicast

Extensible user-defined attributes

4.3. Functional requirements

The CASM should support following functionality for it to be adopted for wide varierty of use cases.

4.3.1. Address pools

A CASM system should allow ability to manage different kind of address pools. The following pools should be considered for implementation; this is not mandatory or exhaustive by any means but given here as most commonly used in networks. The CASM system should allow user-defined pools with any address objects.

Unicast address pool:

Private IPv4 addresses

Public IPv4 addresses

IPv6 addresses

MAC Addresses

Mulicast address pool:

IPv4 address

IPv6 address

4.3.2. Pool management

There should be a rich set of functionality as defined in this section for operation of a given pool.

Address management:

Address allocation either as single or block

Address reservation

Allocation logic such as mapping schemes or algorithm per pool

General management:

Pool initializing, resizing, threshold markings for resource monitoring

Pool attributes such as used to automatcally create DNS record

Pool priority for searching across different pools

Pool fragmenetation rules, such as how pool can be sub-divided

Pool lease rules for alloation requests

4.3.3. Integration with other address services

In order to build a complete address management system, it is important that CASM should be able to integrate with other address services. This will provide a complete solution to network operators without requiring any manual or proprietary workflows.

DHCP server:

Interface to initialize address pools on DHCP server

Notification interface whenever an address lease is modified

Interface to access address lease records from DHCP server

Ability to store lease records and play back to DHCP server on reboot

DNS server:

    Interface to create DNS records on DNS server based on DHCP
    server events

NAT device:

    Interface to initialize NAT pools

    Interface to access NAT records from NAT device

    Ability to store NAT records and play back to NAT device on
    reboot

5. Archiectural framework

    Based on the requirements specifed in this document, we propose the
    following high-level architecture for building CASM.

    There are three broad categories for CASM interface defintion:

        Pool management interface: Interface to external user or
        applications such as SDN controller to manage addresses

        Log interface: Interface to access log and records such as DHCP,
        DNS, NAT

        Integration interface: Interface to address services such as DHCP,
        DNS, NAT

    The propsed CASM framework is shown in Figure 1.

```
+----------------+ +------+ +----+ +-----+ +---------------------+
|Interface for   | |SDN/  | |OSS/| |ADMIN| |Interface for logs,  |
|managing address| |Legacy| |BSS | |     | |DHCP, DNS, NAT, Address|
|space and pools | |      | |    | |     | |allocation records   |
+--------+-------+ +--+---+ +-+--+ +--+--+ +----------+----------+
         |            |        |       |              ^
         |            |        |       |              |
         |            |        |       |              |
         |            |        |       |              |
         v            v        v       v              |
   +---+-----------+-------+-------+--------------+------+
   |       Address Space Management (IPAM) System       |
   |    +-----------+ +----------+ +--------+            |
   |    | Pool      | |Address   | |Database|            |
   |    | Management| |Management| |        |            |
   |    +-----------+ +----------+ +--------+            |
   |                                                     |
   +------------------------+----------------------------+
              |
   +-----------v-----------+
   |Address Helper Plug|ins |
   +----+--+------+-----+---+
        |  |      |     |------------------+
        |  +----+ |     |                  |
        |       | ------------+            |
        v       +----|        |            |
   +--------+ +-----+ +----------+ +--------+
   | DNS    | |NAT  | | Address  | | DHCP   |
   | Servers| |     | | Mapping  | | Servers|
   |        | |     | | Systems  | |        |
   +--------+ +-----+ +----------+ +--------+
```
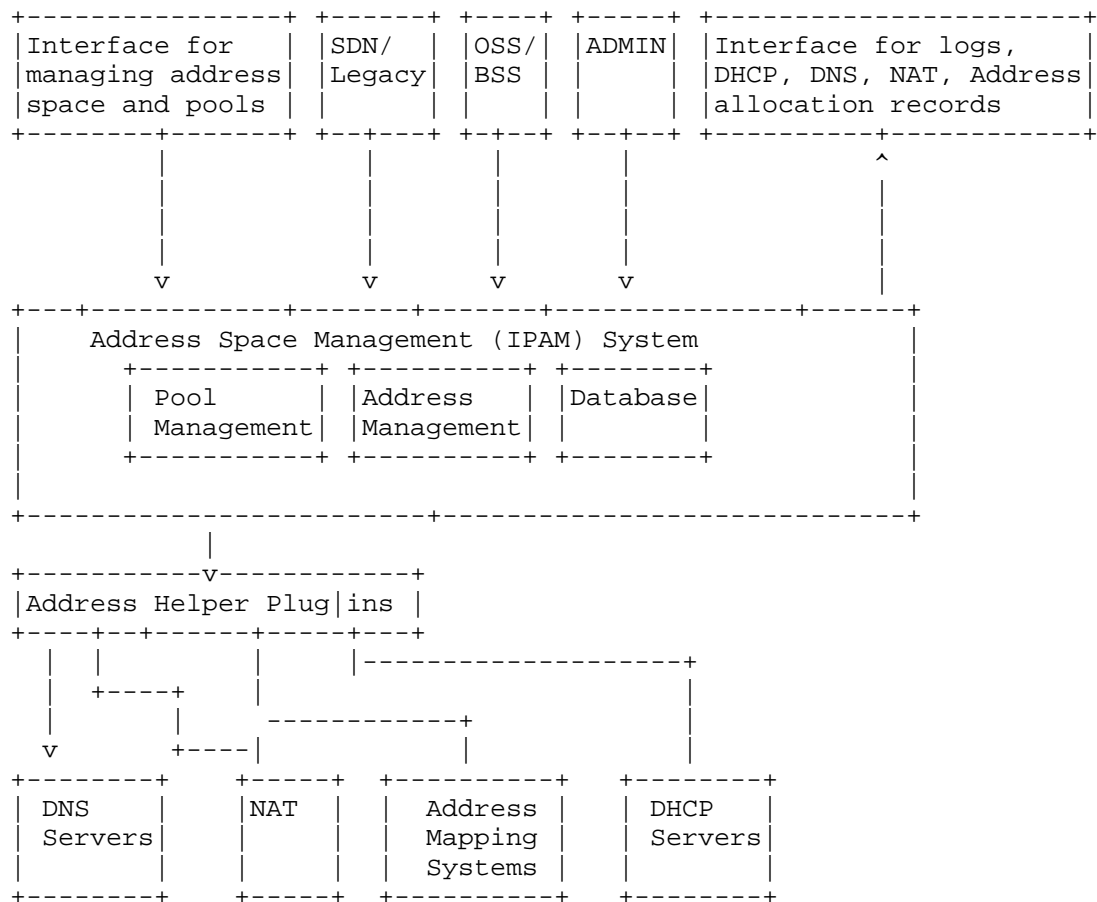
Figure 1: CASM Architecture

6. Acknowledgements

7. IANA Considerations

    This memo includes no request to IANA.

8. Security Considerations

    TBD

9. Informative References

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
              Requirement Levels", BCP 14, RFC 2119,
              DOI 10.17487/RFC2119, March 1997,
              <http://www.rfc-editor.org/info/rfc2119>.

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