

Univ of Pennsylvania IPv6 Addressing Plan

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2005-07-08 (with minor updates since then)

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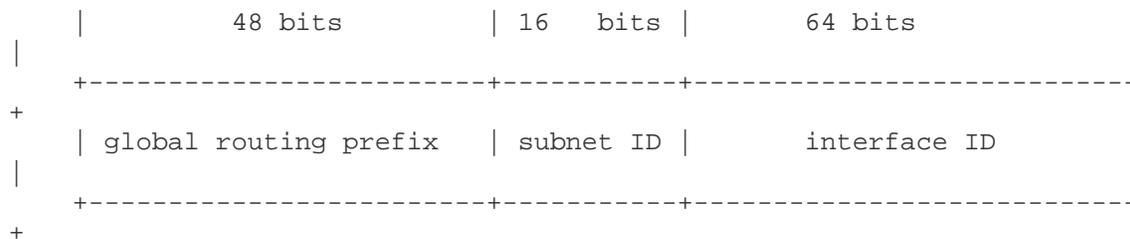
UPDATE: This document is historical. The University acquired a portable (Provider-Independent) IPv6 allocation from the regional registry, ARIN in 2008: **2607:f470::/32**, and has developed a new addressing plan, replacing the one described here.

Introduction

This document describes the preliminary IPv6 addressing plan for PennNet, the University of Pennsylvania's campus data network.

Penn's IPv6 address block is **2001:0468:1802::/48**, which is allocated by the MAGPI GigaPoP out of it's 2001:0468:1800::/40 space. The MAGPI allocation in turn was received from it's provider, Abilene, the Internet2 backbone network. The university is contemplating applying for a portable allocation from ARIN to aid in future multi-homing.

In Penn's case, the structure of an IPv6 address looks like the following (see RFC 3513):



where the global routing prefix is 2001:0468:1802::

General Scheme

The University's /48 allocation is sufficient to number 65,536 (2^{16}) /64 sized subnets. However, the first /64 prefix, 2001:0468:1802::/64 is treated specially.

Certain specialized subnets do not need to consume so much space, such as point to point links between routers, router only broadcast networks in the core of PennNet etc. For such networks, smaller subnet allocations of size /112 will be made from the first /64 prefix.

In addition, the first /112 sized prefix, 2001:0468:1802::/112, is reserved for router loopback addresses and other host routes. The remaining 65,535 /64 prefixes will be employed for general campus subnets.

Router Loopback Addresses

Router loopback addresses are /128 bit host routes allocated in the prefix 2001:0468:1802::/112. Some initial allocations are:

Address	Router
2001:0468:1802:0000:0000:0000:0000:0001/128	external1
2001:0468:1802:0000:0000:0000:0000:0002/128	external2
2001:0468:1802:0000:0000:0000:0000:0003/128	external3
2001:0468:1802:0000:0000:0000:0000:0004/128	vag2
2001:0468:1802:0000:0000:0000:0000:0005/128	modv2
2001:0468:1802:0000:0000:0000:0000:0006/128	huntzman2
2001:0468:1802:0000:0000:0000:0000:0007/128	nichols1
2001:0468:1802:0000:0000:0000:0000:0008/128	chnr4
2001:0468:1802:0000:0000:0000:0000:0009/128	chnr5
2001:0468:1802:0000:0000:0000:0000:000a/128	eisenschwein
2001:0468:1802:0000:0000:0000:0000:000b/128	
2001:0468:1802:0000:0000:0000:0000:000d/128	

Point-to-Points and other special networks

These networks typically comprise only router interfaces which do not use EUI-64 style auto-configuration. Hence subnets smaller than a /64 can be used. These networks are /112 sized allocations made in the prefix 2001:0468:1802::/96. Excluding the /112 allocation already reserved for router loopbacks, this provides the ability to number 65,535 such networks.

Address	Network
2001:0468:1802:0000:0000:0000:0001::/112	Core 1
2001:0468:1802:0000:0000:0000:0002::/112	Core 2
2001:0468:1802:0000:0000:0000:0003::/112	reserved
2001:0468:1802:0000:0000:0000:0004::/112	reserved
2001:0468:1802:0000:0000:0000:0005::/112	reserved
2001:0468:1802:0000:0000:0000:0006::/112	reserved
2001:0468:1802:0000:0000:0000:0007::/112	reserved
2001:0468:1802:0000:0000:0000:0008::/112	reserved
2001:0468:1802:0000:0000:0000:0009::/112	reserved

2001:0468:1802:0000:0000:0000:000a::/112	reserved
2001:0468:1802:0000:0000:0000:000b::/112	reserved
2001:0468:1802:0000:0000:0000:000c::/112	reserved
2001:0468:1802:0000:0000:0000:000d::/112	reserved
2001:0468:1802:0000:0000:0000:000e::/112	reserved
2001:0468:1802:0000:0000:0000:000f::/112	reserved

[p2p links:]

2001:0468:1802:0000:0000:0000:0010::/112	reserved
2001:0468:1802:0000:0000:0000:0011::/112	SEASNet link
2001:0468:1802:0000:0000:0000:0012::/112	
etc etc ..	

Reserved ranges

The remaining space in 2001:0468:1802::/64 is reserved for future use.

General campus subnets

General campus subnets are all /64 sized networks excluding the first /64 prefix, ie.

2001:0468:1802:0001::/64	ISC N&T Suite Network
2001:0468:1802:0002::/64	ISC N&T Engineering Lab
2001:0468:1802:0003::/64	Streaming Server Network
2001:0468:1802:0004::/64	ISC N&T Suite Wireless
Network	
2001:0468:1802:0005::/64	
2001:0468:1802:0006::/64	
2001:0468:1802:0007::/64	
2001:0468:1802:0008::/64	
2001:0468:1802:0009::/64	
2001:0468:1802:000a::/64	
2001:0468:1802:000b::/64	
2001:0468:1802:000c::/64	
2001:0468:1802:000d::/64	
2001:0468:1802:000e::/64	
2001:0468:1802:000f::/64	
2001:0468:1802:0010::/64	
2001:0468:1802:0011::/64	VoIP Servers 1
2001:0468:1802:0012::/64	VoIP Servers 2
[...]	
2001:0468:1802:0101::/64	NOC1 Network
2001:0468:1802:0102::/64	NOC2 Network
2001:0468:1802:0103::/64	NOC3 Network
[...]	
2001:0468:1802:ffff::/64	

There is currently no general strategy of where in the range a particular /64 subnet allocation will be made. Topological assignment may not provide much benefit in terms of it's route aggregation possibilities because end user subnets are increasingly multihomed to the PennNet core.

Delegations to other departments

Large schools, institutes or departments that need their own allocation will be provided a chunk of contiguous space from the allocation for general campus subnets. Examples include the Engineering school (SEASnet) and Resnet. Typically, an aggregate advertisement for these spaces will be made at their points of attachment to the campus routing core.

2001:0468:1802:1000::/54	Test Networks
2001:0468:1802:1400::/54	(unassigned)
2001:0468:1802:1800::/54	(unassigned)
2001:0468:1802:1c00::/54	(unassigned)
2001:0468:1802:d000::/54	ResNet
2001:0468:1802:d400::/54	(unassigned)
2001:0468:1802:d800::/54	(unassigned)
2001:0468:1802:dc00::/54	(unassigned)
2001:0468:1802:e000::/54	SEAS
2001:0468:1802:e400::/54	(unassigned)
2001:0468:1802:e800::/54	Wharton School
2001:0468:1802:ec00::/54	(unassigned)
2001:0468:1802:f000::/54	(unassigned)
2001:0468:1802:f400::/54	(unassigned)
2001:0468:1802:f800::/54	(unassigned)
2001:0468:1802:fc00::/54	(unassigned)

Routing Design

Integrated IS-IS is configured as the interior routing protocol for IPv6. It is configured to initially carry IPv6 routes only in order to separate it from the production IPv4 network which runs OSPF version 2. At some point in the future, IS-IS will likely be employed to route IPv4 also. A single flat level-2 IS-IS area is initially deployed. A multi area design will likely emerge with increased deployment of IPv6 on campus.

Multi-protocol BGP is used for inter-domain peering with external IPv6 networks. At the current time, Penn's sole IPv6 peer is the MAGPI GigaPoP. Additionally, an IPv6 Internal-BGP mesh is configured between all the IPv6 enabled Penn core and border routers.

Address configuration for endstations is performed via stateless address auto-configuration (RFC 2461). Stateful DHCPv6 service may be deployed at a future date to centrally manage host address assignments.

DNS Configuration

The Penn DNS servers support AAAA and IPv6 (long) PTR records. One of the authoritative servers (noc3.dccs.upenn.edu) currently supports DNS queries over IPv6 transport. An initial set of IPv6 ranges and their associated DNS domain names have been configured in the DNS management application (Assignments). A new third level domain, **v6.upenn.edu**, has been created, for use by hosts that want to maintain a separate domain name for their IPv6 addresses.

Future Work

- Integrated IS-IS for both IPv4 and IPv6 interior routing
- IPv6 Multicast routing
- Stateful auto-configuration using DHCPv6
- Testing of IPv6 Enabled Applications

References

- [Internet2 IPv6 Working Group](#)
- [RFC 4291: Internet Protocol Version 6 \(IPv6\) Addressing Architecture](#)
- [RFC 3587: IPv6 Global Unicast Address Format](#)
- [RFC 3177: IAB/IESG Recommendations on IPv6 Address Allocations to Sites](#)
- [RFC 3627: Use of /127 Prefix Length Between Routers Considered Harmful](#)
- [RFC 1195: Use of IS-IS for Routing TCP/IP and Dual Environments](#)
- [draft-ietf-isis-ipv6: Routing IPv6 with IS-IS](#)
- [RFC 2283: Multiprotocol Extensions for BGP-4](#)
- [RFC 2461: Neighbor Discovery for IP Version 6 \(IPv6\)](#)
- [RFC 2462: IPv6 Stateless Address Autoconfiguration](#)
- [RFC 2545: Use of BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain Routing](#)
- [RFC 2893: Transition Mechanisms for IPv6 Hosts and Routers](#)