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Running Multiple IPv6 Prefixes
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Abstract

This document introduces that multiple prefixes in one network/host might be common in IPv6, and describes several multiple prefixes use cases that might be beneficial to the network. Then some operational considerations and current gaps to support multiple prefixes operations are described.

Table of Contents

1.	Introduction	3
2.	Multiple Prefixes Use cases	3
2.1.	Multihoming	3
2.2.	ULA+PA	4
2.3.	Make-before-break renumbering	4
2.4.	Semantic Prefixes	4
3.	Basic operational considerations	5
3.1.	Multiple prefix provisioning	5
3.2.	Multiple addresses in one interface	5
3.3.	Address selection	5
3.4.	DNS relevant	6
4.	Current Gaps	6
5.	Security Considerations	7
6.	IANA Considerations	7
7.	Acknowledgments	7
8.	References	7
8.1.	Normative References	7
8.2.	Informative References	7

1. Introduction

IP protocols have been widely spread. More and more services are relying on IP technology. As the evolution of network application, the IP network architecture/functions are becoming more and more sophisticated.

One aspect is the requirement of multiple prefixes. There are several motivations as the following:

- Multiple network provisioning, including multihoming and semantic prefixes (as described in [section 2.4](#)) etc;
- Multiple logic planes, VPN/OAM .etc.

In IPv6, multiple prefixes feature is naturally well-supported. Standard IPv6 stack supports multiple-address-per-interface as default; there is a standard address selection algorithms [[RFC6724](#)] defined for multiple prefixes purpose. It is one of the most important difference and also an advantage comparing IPv4.

This document introduces several multiple prefixes use cases in IPv6 that might be beneficial to the network use. And some operational considerations are given, as while as some current gaps for supporting running multiple prefixes.

2. Multiple Prefixes Use cases

2.1. Multihoming

When a network is multihomed, the multiple upstream networks would assign prefixes respectively. If a network for some reason neither acquire a PI (Provider Independent) space nor deploys IPv6 NAT, then the multihoming would resulting in hosts with multiple PA (Provider Aggregated) IPv6 addresses with different prefixes.

This approach in IPv4 has rarely been used, since the IPv4 doesn't

support multiple addresses/prefixes well. But it is quite practical in IPv6. This approach allows the SMEs to do multihoming without burden from running PI address space or running IPv6 NAT. Furthermore, multiple PA spaces don't have the potential global routing system scalable issue as the PI does [[RFC4894](#)].

However, multihoming with multiple PA spaces has some operational issues which mainly include address selection, next-hop selection,

and exit-router selection. Especially for the exit-router selection, it seems there has not been any practical solution yet.

[2.2](#). ULA+PA

Unique Local Addresses (ULAs) are defined in [[RFC4193](#)] as provider-independent prefixes. Since there is a 40 bits pseudo random field in the ULA prefix, there is no practical risk of collision (please refer to [section 3.2.3 in \[RFC4193\]](#) for more detail).

For either home networks or enterprise networks, the main purpose of using ULA along with GUA is to provide a logically local routing plane separated from the globally routing plane. The benefit is to ensure stable and specific local communication regardless of the ISP uplink failure or change. This benefit is especially meaningful for the home network or private OAM function in an enterprise.

In some special cases such as renumbering, enterprise administrators may want to avoid the need to renumber their internal-only, private nodes when they have to renumber the PA addresses of the whole network because of changing ISPs, ISPs restructure their address allocations, or whatever reasons. In these situations, ULA is an effective tool for the internal-only nodes.

[2.3](#). Make-before-break renumbering

[[RFC4192](#)] describes a procedure that can be used to renumber a network from one prefix to another smoothly through a "make-before-break" transition.

In the transition period, both the old and new prefixes are available, it is a very good use of multiple prefixes that could avoid the session outage issue in most of the situations when renumbering a network.

[2.4.](#) Semantic Prefixes

[I-D.jiang-semantic-prefix] describes a framework to embed some parameters into the IPv6 prefix segment. The parameters might contain user types, service types, applications, security requirements, traffic identity types, quality requirements and other criteria may also be relevant parameters which a network operator may wish to use to treat packets differently and efficiently.

With this approach, for example, the ISPs could provision one subscriber multiple addresses/prefixes to access different services.

Liu & Jiang

Expires April 24, 2014

[Page 4]

Internet-Draft

Running Multiple Prefixes

October 2013

[3.](#) Basic operational considerations

There might be some argument/worry that in practice running multiple prefixes would make terrible operational complexity. It is apprehensible that most of the administrators are not accustomed to this model, since it is quite different with that in IPv4.

But considering running multiple prefixes in IPv6 might be very common, administrators need to adapt this new operational model regardless of personal preference.

Following sub-sections summarize several important operational considerations that try to eliminate the FUD of the administrators.

[3.1.](#) Multiple prefix provisioning

- Multiple provisioning domains: considering current DHCP architecture does not fit multiple provisioning domains well, the administrators should avoid that multiple provisioning domain all directly configuring the host through DHCP, since it might cause confusion for the host.
- Multiple provisioning mechanisms: if administrators applied DHCP/SLAAC co-exist in one network, and then they need to learn that there might be some issues, which are reported in [I-D.liu-bonica-dhcpv6-slaac-problems].

[3.2.](#) Multiple addresses in one interface

- Current implementations support this feature very well; normally this wouldn't be a problem
- But current IPAM/NMS applications might not be ready for this multiple mappings management

[3.3.](#) Address selection

This is probably the most error prone problematic issue in running multiple prefixes.

[RFC5220] reported various potential problems with address selection in deployment. Some of them have been handled in the updated standard address selection mechanism [[RFC6724](#)].

[3.4.](#) DNS relevant

Normally, one SP only allows only its users to look at DNS records of the service. So in multiple network provisioning scenarios, each DNS query from a host must be forwarded to a suitable DNS server. Hosts normally are not able to select a DNS server for each DNS query target.

[RFC6731] is developed for this purpose; it defined DHCPv4/v6 options to deliver the DNS selection policies for hosts.

[4.](#) Current Gaps

- o Not all IPAM/NMS tools are able to handle one interface and multiple addresses mappings.
- o ULA+IPv4 selection

There is a special case that needs to be noticed, which is described in [section 2.2.2 of \[RFC5220\]](#). When an enterprise has IPv4 Internet connectivity but does not yet have IPv6 Internet connectivity, and the enterprise wants to provide site-local IPv6 connectivity, a ULA is the best choice for site-local IPv6 connectivity. Each employee host will have both an IPv4 global or private address and a ULA. Here,

when this host tries to connect to an outside node that has registered both A and AAAA records in the DNS, the host will choose AAAA as the destination address and the ULA for the source address according to the IPv6 preference of the default address selection policy [[RFC3484](#)]. This will clearly result in a connection failure. Although the new address selection standard [[RFC6724](#)] has added ULA specific rules to prefer IPv4 over ULA, but the majority of current existing hosts might still under the old [[RFC3484](#)] specification.

o Multiple PA exit-router selection

In multiple PA multihoming networks, if the ISPs enable ingress filtering at the edge, then the administrators need to deal with the the exit router selection issues. Currently there is no well-used solution, so the administrator might need to communicate with the ISP for not filtering the prefixes.

If a site has multiple PA prefixes, complexities in routing configuration will appear. In particular, source-based routing rules might be needed to ensure that outgoing packets are routed to the appropriate border router and ISP link. Normally, a packet sourced from an address assigned by ISP X should not be sent via ISP Y, to

avoid ingress filtering by Y [[RFC2827](#)] [[RFC3704](#)]. Additional considerations may be found in [MULTIHOMING-WITHOUT-NAT].

[5](#). Security Considerations

TBD.

[6](#). IANA Considerations

This draft does not request any IANA actions.

[7](#). Acknowledgments

Useful comments were received from Victor Kuarsingh and Roberta Maglione.

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Liu & Jiang	Expires April 24, 2014	[Page 8]
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Internet-Draft	Running Multiple Prefixes	October 2013
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