Analysis of Semantic Embedded IPv6 Address Schemas

draft-jiang-v6ops-semantic-prefix

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Introduction

- **Semantic IPv6 address schema are existing**
  - Dividing a network into different subnets according to different semantics is already widely existing today
  - Some network operators have chosen to embed semantics into IPv6 prefixes
  - These semantic embedded IPv6 address schemas enable easier packet inspection and relevant operations with certain operational costs and even pitfalls
  - An ISP and an enterprise semantic prefix examples are introduced in appendixes
- **The document aims to**
  - understand the usage of semantic embedded IPv6 address schemas
  - neutrally analyze on the associated advantages, drawbacks and technical gaps for more complex address schemas

Understanding of Semantic Prefix

- **Network operators (both ISPs and enterprises) desire to be aware of more information about each packet**
  - Many information is not expressed explicitly. Hence, it is difficult for network operators to identify
- **IPv6, with a large address space, allows semantics to be embedded into addresses**
  - Routers can easily apply relevant operations accordingly
  - It allows enterprise semantics to be able to traverse ISP networks
- **Prefix is trusted with source address spoofing preventing mechanism deployed**
  - Untrusted choices: interface identifier, extension header, diffServ field, etc.

Understanding of Semantic Prefix(2)

- **Semantic Prefix Domain**
  - A domain in which a consistent set of semantic prefix policies are administered in a coordinated fashion
  - A Semantic Prefix Domain has a set of pre-defined semantic definitions, which is only meaningful **locally**
  - An enterprise Semantic Prefix Domain may span several physical networks, traversing ISP networks
- **The embedded semantics**
  - The prefix bits that can be used for embedded semantics are very limited. Only the selected, most useful semantics can be embedded in the prefix
  - The selection of semantics varies among different network operators
  - The selection criterion and the impact of each choice are out of scope

Understanding of Semantic Prefix(3)

- **Network Operations Based on Semantic Prefixes**
  - Network operations based on explicit semantics easier to realize and stable
  - Detailed operation vary depending on various embedded semantics
  - The network operations can be abstracted into following categories:
    - Statistic based on certain semantic
    - Differentiate packet processing
    - Security isolation
    - Access control
    - Resource allocation
    - Virtualization

Potential Benefits

Depending on embedded semantics, various beneficial scenarios can be expected

- Providing a directly and explicitly mechanism for packet inspection Easy measurement and statistic
- Simplified measurement and statistics gathering
- Better policy aggregation, service segregation
- Simplifying network management: easy dynamic reconfiguration of semantic oriented policy; easy security isolation; easy flow control; easy user behavior management; easy network resources access rights management; easy virtualization
- The listed are not all

Potential Drawbacks

Network operator should consider the drawbacks before deciding to deploy a semantic IPv6 address schema

- Address consumption caused by lower address utility rate. The wastage is mainly comes from aligning.
  - Network operators should be aware they may not get more addresses because they have allocated their assigned address block(s) for semantic
- Encoding too many semantics into prefixes can come at the expense, may also induce semantic overlap
- The risk of privacy/information leakage
- Burdening the host OS
- Source address spoofing preventing mechanism may be required

Gaps for Complex Semantic Prefix

- **The simplest model without any technical gaps: only embedded abstracted user type semantic into the prefix**
  - can be supported with the current network architecture

- **In order to fulfill more benefits of the complex semantic prefix design, additional functions are needed**
  - Semantic notification in the network
  - Semantic relevant interactions between hosts and the network
  - Additional Technical Extensions that may increase the usefulness and applicability : dynamic policy configuration, semantics announcements to peer networks, extension beyond the left-most 64 bits, organizing consumer/home networks according to semantics, etc.

- This document does NOT intend to suggest the standardization of any common global semantics
- This document does NOT intend to draw any conclusions, either recommending this kind of address schemas or not

This document aims to be
an Informational neutrally analyze document

Comments! Thanks!

Does v6ops want to adopt this draft?