Autoconf
Internet-Draft
Intended status: Informational
Expires: April 15, 2010

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October 12, 2009

IP Addressing Model in Ad Hoc Networks
draft-baccelli-autoconf-adhoc-addr-model-03

Abstract

This document describes a model for configuring IP addresses and subnet prefixes on the interfaces of routers which connect to links

with undetermined connectivity properties.

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1. Introduction

The appropriate configuration of IP addresses and subnet masks for router network interfaces is generally a prerequisite to the correct functioning of routing protocols. Consideration of various items, including underlying link capabilities and connectivity, geographical topology, available address blocks, assumed traffic patterns, etc. are used when determining the appropriate network topology and the associated IP interface configuration.

When the capabilities and connectivity of the links that connect routers are well-known and rather stable, logical network topology design and corresponding IP interface configuration are rather straightforward. Absent any assumption about link-level connectivity, there is no canonical method for determining a given IP interface configuration.

Ad hoc networks are typical examples of networks with undetermined link-level connectivity. MANET routing protocols have as purpose to detect and maintain network connectivity, assuming that routers' interfaces are configured with IP addresses. This document thus proposes a model for configuration of IP addresses and subnet prefixes on router interfaces to links with undetermined connectivity properties.

2. Terminology

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

3. Applicability Statement

The configuration proposed by this model is applicable to any router's IP interface. It specifies IP addresses and IP subnet prefixes to be configured on network interfaces.

When more specific assumptions can be made regarding the connectivity between interfaces, these SHOULD be considered when configuring subnet prefixes.

4. IP Subnet Prefix Configuration

If the link to which an interface connects enables no assumptions of

connectivity to other interfaces, the only addresses which can be assumed "on link", are the address(es) of that interface itself. Note that while link-local addresses are assumed to be "on link", the utility of link-local addresses is limited as described in Section 6.

Subnet prefix configuration on such interfaces must thus not make any promises in terms of direct (one hop) IP connectivity to IP addresses other than that of the interface itself. This suggests the following principle:

- no two such interfaces in the network should be configured with the same subnet prefix.

As direct communication is allowed between interfaces of different routers between which L2 communication is enabled, even if these interfaces are configured to appear within different subnets, IP packet exchange is still enabled in such cases.

If on the contrary, assumptions can be made regarding connectivity between interfaces, these SHOULD be considered when configuring IP subnet prefixes, and the corresponding interfaces MAY be configured with the same subnet prefix.

5. IP Address Configuration

Routing protocols running on a router may exhibit different requirements for uniqueness of interface addresses; some have no such requirements, others have requirements ranging from local uniqueness only, to uniqueness within, at least, the routing domain.

Configuring an IP address that is unique within the routing domain satisfies the less stringent uniqueness requirements of local uniqueness, while also enabling protocols which have the most stringent requirements of uniqueness within the routing domain. This suggests the following principle:

- an IP address assigned to an interface that connects to a link with undetermined connectivity properties should be unique at least within the routing domain.

6. Addressing Model

Section 4 and Section 5 describe principles for IP address and subnet prefix configuration on an interface of a router, when that interface connects to a link with undetermined connectivity properties. The following describes guidelines that follow from these principles,

respectively for IPv4 and IPv6.

6.1. IPv4 Model

For IPv4, the principles described in Section 4 and Section 5 suggest the following rules:

- An IP address configured on this interface should be unique, at least within the routing domain; and
- Any subnet prefix configured on this interface should be of length /32.

Note that the use of IPv4 link-local addresses [RFC3927] should be discouraged in this context, due to the limitations outlined in Section 6.2 for IPv6 link-local addresses, that also concern IPv4 link-local addresses.

6.2. IPv6 Model

For IPv6, the principles described in Section 4 and Section 5 suggest the following rules:

- An IP address configured on this interface should be unique, at least within the routing domain, and
- A subnet prefix configured on this interface should be of length /128.

Note that while an IPv6 link-local address is assigned to each interface as per [RFC4291], in general link-local addresses are of limited utility on links with undetermined connectivity, as connnectivity to neighbors may be constantly changing. The known limitations are:

- Even if tested for local uniqueness at one moment using Duplicate Address Detection [RFC4862], a duplicate link-local address might appear as a neighbor the next moment, without it being an explicit event that would trigger DAD again. Such duplication would thus go undetected.
- There is no mechanism to ensure that IPv6 link-local addresses are unique across multiple links, hence they can not be used to reliably identify routers.
- Routers cannot forward any packets with link-local source or destination addresses to other links (as per [RFC4291]) while most of the time, routers need to be able to forward packets to/from

different links.

Therefore MANET autoconfiguration solutions should be encouraged to primarily focus on configuring IP addresses that are not IPv6 link-local.

7. IANA Considerations

This document has no actions for IANA.

8. Security Considerations

This document does currently not describe any security considerations.

9. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC4291] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, 2006.

[RFC3927] Cheshire, S., Aboba, B., and E. Guttman, "Dynamic Configuration of IPv4 Link-Local Addresses", RFC 3927, 2005.

[RFC4862] Thomson, S., Narten, T., and T. Jinmei, "IPv6 Stateless Address Autoconfiguration", RFC 4862, 2007.

Appendix A. Open Issues

The following issues were extensively discussed among the design team, without reaching a conclusion.

MANET Link Model - no satisfying MANET link model was formulated to date. Lacking a better definition so far, a MANET link is: a link with undetermined connectivity properties.

Global Uniqueness Requirements - it remains to be determined whether or not the scope of AUTOCONF includes applications other than routing protocols running on the router, which may communicate with outside the routing domain and which for that, require globally unique addresses.

Appendix B. Contributors

This document reflects discussions and contributions from several individuals including (in alphabetical order):

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