Internet Draft
Document: draft-chelius-adhoc-ipv6-00.txt
Expires: March 2003

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September 2002

IPv6 Addressing Architecture Support for mobile ad hoc networks
<draft-chelius-adhoc-ipv6-00.txt>

Status of this Memo

Abstract

The concept of node identifier, in practical terms an IP address, is crucial in ad hoc networks. Its use allows the setup of IP routing for ad hoc connectivity and the identification of several wireless devices as part of a unique ad hoc node. In this document, a new addressable object is defined: the ad hoc connector. It virtualizes several ad hoc network interfaces into a single addressable object. To locally address ad hoc connectors, a third IPv6 local-use unicast address (adhoc-local address) and the correlated use of the subnet multicast scope are defined.

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1. Introduction

The notion of ad hoc network is something particular compared to classical network architectures. It is a logical view that unifies several physical networks in a single multigraph topology. As said in [rfc2501], the concept of a "node identifier", in practical terms an IP address, is crucial in ad hoc networks. Its use allows the setup of IP routing for ad hoc connectivity as well as the identification of several wireless devices as part of a unique ad hoc node.

To gather several ad hoc interfaces in a single entity, the notion of ad hoc connectors is introduced. The ad hoc connector is the basic element of ad hoc networks. It virtualizes several network interfaces into a single addressable object. A host may have several ad hoc connectors and an interface may be bound to several ad hoc connectors. The ad hoc connector defines a set of addresses which identify indistinctly all bounded interfaces.

IPv6 addressing architecture proposes two local unicast addresses and their equivalent multicast scope: link-local and site-local. The use of link-local unicast and multicast addresses is unsuitable to ad hoc networks. A link-Local unicast address refers to a single interface and its validity is limited to the interface link. Since an ad hoc network may be included in a larger site or spread over different sites, a specific ad hoc use of site-local addresses is also inappropriate. In addition, a site-local address identifies a single interface whereas an ad hoc address may identify several ones.

To locally address ad hoc connectors, we propose the definition of a third IPv6 local-use unicast address: adhoc-local addresses. Their validity is limited to an ad hoc network. They provide a basic identification support for ad hoc nodes that can be extended by other configuration mechanisms such as stateless global address attribution.

In the IPv6 architecture scheme, an ad hoc network may be at the same time, a multi-link subnet and a multi-link multi-subnet. Considering the whole ad hoc network as a multi-link subnet is achieved by matching a particular multicast scope, the subnet scope, with the ad hoc network. To support the multi-link multi-subnet vision, the notion of logical ad hoc sub-networks, also called channels, is introduced. A channel is a connex set of ad hoc

connectors sharing a common channel value. A specific range of multicast addresses is associated to each channel. It enables the restriction of multicast groups to a given channel.

2. Terminology

Ad hoc connector - the basic element of an ad hoc network. It virtualizes several network interfaces in a

single addressable object.

Ad hoc identifier - a 64bits value that pseudo-uniquely identifies an ad hoc connector.

Ad hoc channel - a non null 16bits value associated to an ad hoc connector. This value indicates the ad hoc sub-network the ad hoc connector is connected to.

Ad hoc interface - a network interface bound to an ad hoc connector.

Ad hoc host - a host with at least one ad hoc interface.

Ad hoc route - a network route that only transits through ad hoc interfaces.

Ad hoc network - a maximal and connex set of ad hoc connectors.

Ad hoc sub-network - a maximal and connex set of ad hoc connectors sharing a common channel value.

Ad hoc router - an ad hoc node which may route packets between ad hoc network(s) and non ad hoc network(s).

Ad hoc sub-router - an ad hoc node which may route packets between two or more ad hoc sub-networks.

All ad hoc nodes must be configured as IPv6 unicast and multicast routers.

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. Ad hoc connector

As defined in [rfc2501], a MANet is the *union* of physical-layer multihop topologies, i.e. a multigraph. In this multigraph, it is inappropriate to use the network interface as the basic addressable element; network interfaces only exist in one single physical layer topology. The ad hoc connector is defined as the basic element of ad hoc networks. It is a view of mind that virtualizes several network interfaces into a single addressable object.

3.1 Ad hoc connector management

In the network, an ad hoc connector is identified by a 64bits value, the ad hoc identifier. Another 16bits non null value is associated to the connector: its ad hoc channel value.

Ad hoc connectors are created and destroyed by user management. Ad hoc IDs and ad hoc channel values are provided by the user at the connector creation. The ad hoc channel may be changed during the ad hoc connector life. A host may have several ad hoc connectors. However, ad hoc connectors of a single host must have different identifiers and different channel values.

For the ad hoc network to correctly behave, it is preferred for ad hoc IDs to be unique. It is the user responsibility to ensure uniqueness of its IDs. To build pseudo-unique IDs, host interface MAC addresses or cryptographic mechanisms such as the one described in [SUCV] may be used.

3.2 Interface binding

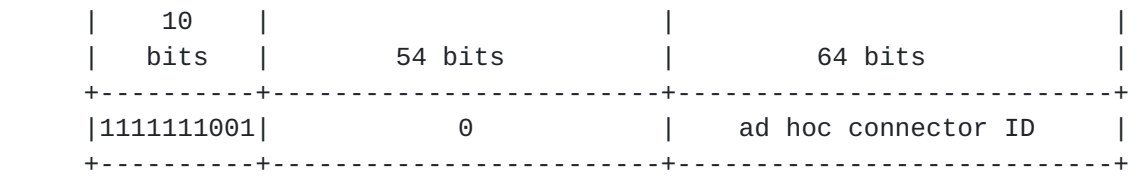
Network interfaces are manually bound to and unbound from ad hoc connectors by user management. A network interface may be bound to several ad hoc connectors and several network interfaces may be bound to a same ad hoc connector.

4. Addressing an ad hoc connector

An ad hoc connector is associated to a set of IPv6 addresses which identify all bounded addresses. These addresses are an adhoc-local address and eventually one or more global addresses. The local address ensures connectivity in the ad hoc network and the global ones enable Internet connectivity.

4.1 Local addressing

To address an ad hoc connector inside an ad hoc network, we define a third type of local-use unicast address: adhoc-local. The adhoc-local scope is for use in a single adhoc network. It is valid in all ad hoc sub-networks of the ad hoc network. Adhoc-Local addresses have the following format:



Each ad hoc connector is associated to a single adhoc-local address constructed using its identifier.

Ad Hoc nodes must not forward any packet with adhoc-local source or destination through a non ad hoc interface.

In addition to addresses given in [rfc2373], an ad hoc interface is required to recognize the following addresses as identifying itself:

- adhoc-local addresses of all ad hoc connectors it is bounded to.

An ad hoc interface is required to join the solicited-node multicast groups associated to the following unicast addresses:

- adhoc-local addresses of all ad hoc connectors it is bounded to.

4.2 Global addressing

Ad hoc connectors may be addressed using global addresses if global prefixes are available in the ad hoc network.

If a given global prefix P is delivered to an ad hoc connector with identifier Id, the global address constructed by concatenation of P and Id is associated to the ad hoc connector

An ad hoc interface is required to recognize the following addresses

as identifying itself:

- o all global addresses associated to all ad hoc connectors it is bounded to.

An ad hoc interface is required to join the solicited-node multicast groups associated to the following unicast addresses:

- o all global addresses associated to all ad hoc connectors it is bounded to.

5. Addressing multiple ad hoc connectors

To address multiple ad hoc connectors and to limit the scope of a multicast group to an ad hoc network, we use the subnet multicast scope as defined in [IPV6ADDR].

5.1 Predefined ad hoc multicast addresses

In addition to the ones given in [IPV6ADDR], the following well-known ad hoc multicast addresses are predefined:

"All ad hoc nodes" address:
FF03:0:0:0:0:0:0:1

The above multicast address identifies the group of all IPv6 ad hoc nodes within the ad hoc network.

"All ad hoc routers" address:
FF03:0:0:0:0:0:0:A

The above multicast address identifies the group of all IPv6 ad hoc routers within the ad hoc network.

"All ad hoc sub-routers" address:
FF03:0:0:0:0:0:0:B

The above multicast address identifies the group of all IPv6 ad hoc sub-routers within the ad hoc network.

Ad Hoc nodes must not forward any multicast packet with subnet scope through a non ad hoc interface.

5.2 Multicast and ad hoc sub-networks

To address multiple ad hoc connectors inside a single ad hoc sub-

network and to limit the scope of a multicast group to an ad hoc sub-network, we define a range of multicast addresses:

FF03:0:0:channel value:0:0:0:0

For a given channel value X, the following well-known ad hoc multicast addresses are predefined:

Reserved Multicast Address:

FF03:0:0:X:0:0:0:0

The above multicast address is reserved and shall never be assigned to any multicast group.

"All ad hoc nodes of a sub-network" address:

FF03:0:0:X:0:0:0:1

The above multicast address identifies the group of all IPv6 nodes within the ad hoc sub-network.

"All ad hoc routers of a sub-network" address:

FF03:0:0:X:0:0:0:A

The above multicast address identifies the group of all IPv6 ad hoc routers within the ad hoc sub-network.

"All ad hoc sub-routers of a sub-network" address:

FF03:0:0:X:0:0:0:B

The above multicast address identifies the group of all IPv6 ad hoc sub-routers within the ad hoc sub-network.

Ad Hoc nodes must not forward any multicast packet limited to an ad hoc sub-network with channel value X through an interface that is not connected to an ad hoc connector with channel value X.

5.3 Multicast membership

Ad hoc interfaces must join the following multicast groups:

- "All ad hoc nodes"
- "All ad hoc nodes of a sub-network" for the channel values of the ad hoc connectors they are bounded to.

In addition, ad hoc interfaces of ad hoc routers must join the following groups:

- o "All ad hoc routers"
- o "All ad hoc routers of a sub-network" for the channel values of the ad hoc connectors they are bounded to.

In addition, ad hoc interfaces of ad hoc sub-routers must join the following groups:

- o "All ad hoc sub-routers"
- o "All ad hoc sub-routers of a sub-network" for the channel values of the ad hoc connectors they are bounded to.

6. Duplicated ad hoc address detection

Ad hoc specific Duplicated Address Detection (DAD) may be performed once or several times, eventually periodically, on ad hoc addresses. Ad hoc specific DAD is not mandatory since it is not safe.

It is an ad hoc node responsibility to ensure uniqueness of its ad hoc addresses; either using an ad hoc specific DAD, either using unique or pseudo-unique ad hoc connector identifiers.

Classical DAD protocols are inappropriate in the ad hoc environment. Definition of an appropriate protocol is behind the scope of this document. An example is given in [AUTOCONF].

7. Global Prefix Discovery

Global prefixes may be manually or automatically delivered to ad hoc connectors. Definition of an ad hoc specific Prefix Discovery Protocol is behind the scope of this document. An example is given in [CONNECT].

8. Security Considerations

IPv6 addressing documents do not have any direct impact on Internet infrastructure security. Authentication of IPv6 packets is defined in [AUTH].

This document does not modify security issues related to ad hoc networks.

9. Notes

Values of the adhoc-local unicast prefix and predefined multicast addresses are given as examples and are not restrictive. Addresses and prefixes must be attributed by the IANA.

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