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Hierarchical Mobile Router Advertisement for nested mobile networks <draft-cho-nemo-hmra-00.txt>

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Abstract

This document describes needs for hierarchical mobile router advertisement for nested mobile networks. When ingress and egress interfaces of a Mobile Router are both wireless, the MR cannot distinguish the Router Advertisement of the parent MR from the RA of the child MR. To maintain hierarchical information of wireless nested mobile networks, RA message needs to be extended to deliver additional information for hierarchy.

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1. Introduction

This document proposes the Router Advertisement mechanism called Hierarchical Mobile Router Advertisement (HMRA) for nested mobile networks. Mobile network is a network that the entire network moves as a single unit and includes one or more mobile routers (MRs) that connect it to the global Internet [1]. Mobile routers use Mobile IPv6 protocol to broadcast Router Advertisement message. Mobile Network Nodes (MNNs) under an MR can configure their address and know the connectivity to the MR by listening the RA. Personal Area Network (PAN) and Vehicle Area Network (VAN) connected to the Internet are examples of mobile network. Furthermore, PANs in a vehicle are also possible and this situation is referred to as a nested mobile network.

Nested mobile networks contain MRs that are not directly attached to the Internet (i.e. connected to the Internet via another MR). In the case of nested mobile network, MRs also use Mobile IPv6 RA mechanism. MRs have ingress and egress interfaces, and each interface can be wired or wireless. If an MR uses wired ingress interface, the RA of the MR is delivered to only nodes connected by wire. But if an MR uses wireless ingress interfaces, all nodes in its coverage receive the RA of the MR. So when a parent MR has wireless egress interface and a child MR has wireless egress interface, the parent MR can listen to the RA of the child MR. This situation is called "RA Confliction".

2. Terms and Abbreviations

Age
: Age is defined as decreasing value by the distance from AR.

Visiting Mobile Node (VMN)
: A mobile node (MN), either a host or a router who can move topologically with respect to the MR and whose home link doesn't belong to the mobile network. A VMN that gets attached to a foreign link within the mobile network obtains an address on that link. [2]

3. Router Advertisement (RA) Confliction problem

When egress and ingress interfaces of an MR are both wireless, nested mobile networks have Router Advertisement (RA) confliction problem. When MRs form nested mobile networks, an MR receives RA of the child MR as well as the parent MR for the open characteristics of wireless interface. But the MR cannot distinguish which MR is its parent. Figure 1 shows the RA confliction problem. With existing RA scheme [3], MR2 receives both RAs of MR1 and MR3. So MR2 may think it is under MR3. And in this situation if MR2 wants to send data to the outside of mobile network, the packets cannot be routed correctly.

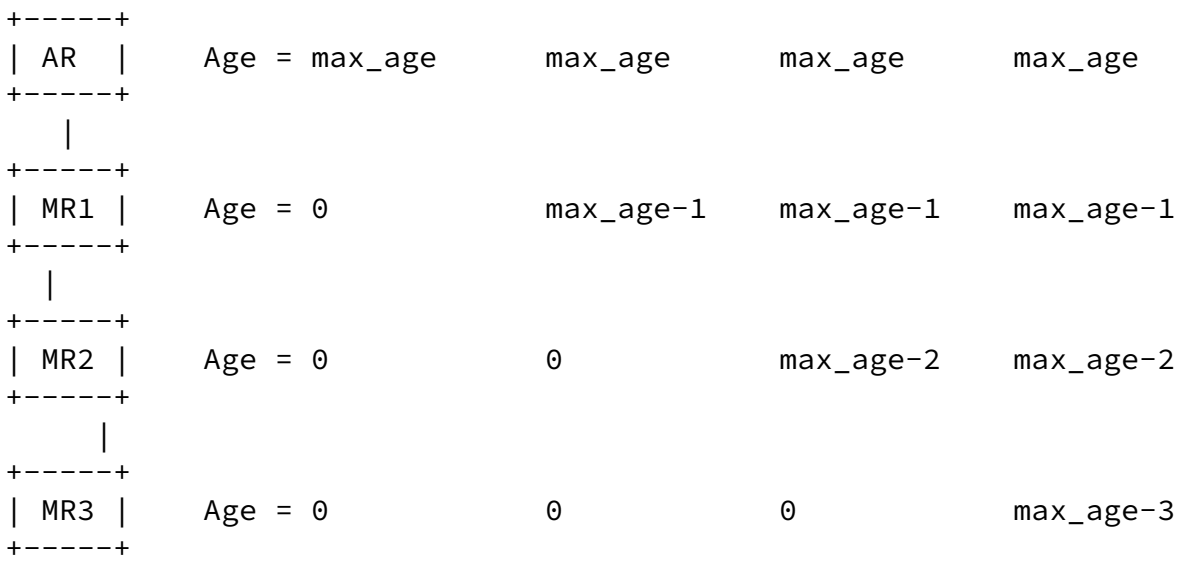

Figure 1. RA Confliction problem

RA confliction problem occurs since MRs and ARs broadcast RA messages simultaneously. Thus, additional information is needed in RA message for the management of hierarchy between MRs.

4. Hierarchical Mobile Router Advertisement (HMRA)

To solve the RA confliction problem of nested mobile networks this document proposes hierarchical architecture of RA, HMRA. HMRA is based on the information of hierarchy. For the purpose of hierarchical management, we employ a field for age in the RA message. Initially Access Router (AR) has age of maximum value and MRs have age of zero. The maximum value of age means the maximum depth of hierarchy.

When an MR receives an RA with an age value, the MR compares received age with its own age. So if the received age is less than or equal to its own age, the MR just ignores the RA. And if

received age is bigger than its own age, the MR sets its own age to smaller age than the received age by one. So each MR can construct the parent-child relationship by using this age information. When an MR moved to other network, we can know the movement by the change of Care-of Address (CoA). So whenever an MR changes its point of attachment, the MR re-initializes its age to zero and re-calculates its age again using new RA.

4.1. Router Advertisement Message Format

Figure 2 shows the RA message format with age field.

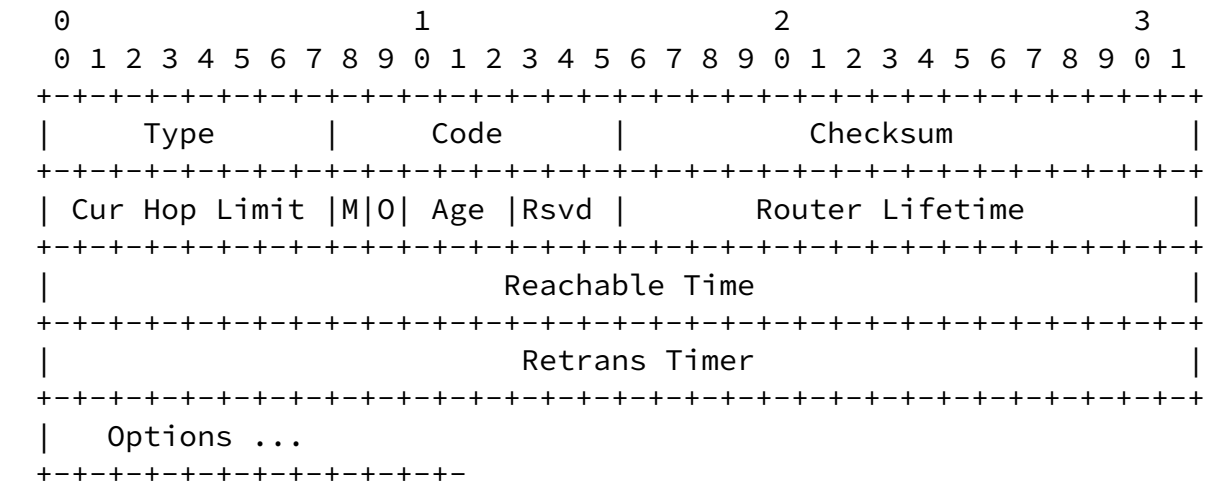

Figure 2. Router Advertisement message with "Age" field

ICMP Fields:

Type 134

Code 0

Checksum The ICMP checksum. See [4].

Cur Hop Limit 8-bit unsigned integer. The default value that should be placed in the Hop Count field of the IP

header for outgoing IP packets. A value of zero means unspecified (by this router).

M 1-bit "Managed address configuration" flag. When set, hosts use the administered (stateful) protocol for address autoconfiguration in addition to any addresses autoconfigured using stateless address autoconfiguration. The use of this flag is described in [5].

O 1-bit "Other stateful configuration" flag. When set, hosts use the administered (stateful) protocol for autoconfiguration of other (non-address) information. The use of this flag is described in [5].

Age 3-bit "Age" field for HMRA. Initially Access Router has age of maximum value and MRs have age of zero.

Rsvd A 3-bit unused field. It MUST be initialized to zero by the sender and MUST be ignored by the receiver.

Router Lifetime
16-bit unsigned integer. The lifetime associated with the default router in units of seconds. The maximum value corresponds to 18.2 hours. A Lifetime of 0 indicates that the router is not a default router and SHOULD NOT appear on the default router list.

Reachable Time 32-bit unsigned integer. The time, in milliseconds, that a node assumes a neighbor is reachable after having received a reachability confirmation. A value of zero means unspecified (by this router).

Retrans Timer 32-bit unsigned integer. The time, in milliseconds, between retransmitted Neighbor Solicitation messages. A value of zero means unspecified (by this router).

4.2. Hierarchy management

When an MR moves to the same level of other nested mobile network, the MR sets its age to zero and listens RA from neighbor MRs. If

the MR receives RA from the child MR before it receives from the parent MR, the MR thinks that the child MR is the parent. But after the MR receives RA of the parent MR, the MR corrects its age. When an N-level MR moves to an (N-1)-level mobile network, the MR receives bigger or the same age of RA from neighbor MRs. In this case re-initializing of age is not necessary. The MR just ignores the RA of the same age and accepts the RA of bigger age and set its age to smaller age than received age by one. When an N-level MR moves to an (N+1)-level mobile network, the MR sets its age to zero and listens to RA from the neighbor MRs. The next procedures are the same as the two cases above.

5. Security Considerations

When a malicious MR broadcast RA with the maximum age, hierarchy of nested mobile network can be confused.

6. Acknowledgements

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