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Network Mobility Support Terminology
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Abstract

This document defines a terminology for discussing network mobility problems and solution requirements. Network mobility arises when a router connecting an entire network to the Internet dynamically changes its point of attachment to the Internet therefrom causing the reachability of the entire network to be changed in the topology. Such kind of network is referred to as a mobile network. Without appropriate mechanisms, sessions established between nodes in the mobile network and the global Internet cannot be maintained while the mobile router changes its point of attachment.

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1. Introduction

Network mobility support is concerned with managing the mobility of an entire network which changes its point of attachment to the Internet and thus its reachability in the Internet topology. If network mobility is not explicitly supported by some mechanisms, existing sessions break and connectivity to the global Internet is lost.

This document defines the specific terminology needed to describe the problem space we face with network mobility and to edict the solutions and the requirements they must comply with. This terminology complies with the usual IPv6 terminology [7] and the generic mobility-related terms already defined in [2] and in the Mobile IPv6 [1] specifications. Some terms introduced in the present version of the draft may only be useful for the purpose of defining the problem scope and functional requirements of network mobility support and shall be removed or refined once we agree on the requirements.

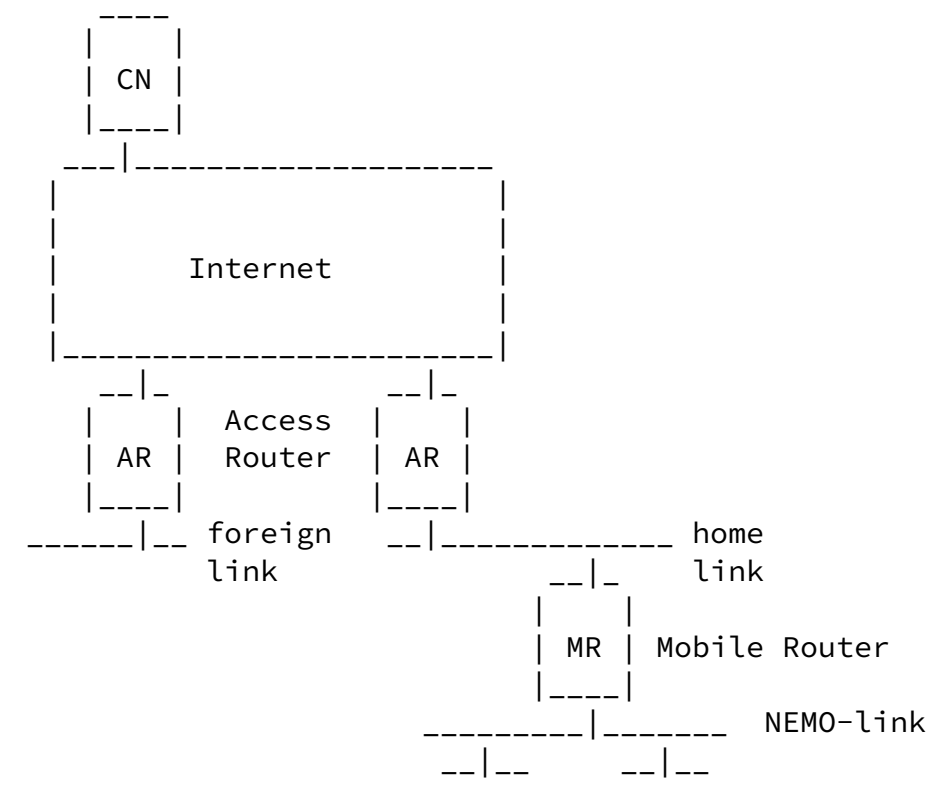
The first section introduces terms to define the architecture components; the second introduces terms to discuss the requirements, the third, terms to discuss nested mobility; the forth defines multihoming, and the last, miscellaneous terms which do not fit in either sections. The overall terminology is summarized in fig.1 to 5. Fig.1 shows a single mobile subnetwork. Fig.2. shows a larger mobile network comprising several subnetworks, attached on a foreign link. Fig.3 illustrates a node changing its point of attachment within the

mobile network. Fig.4 and 5 illustrate nested mobility whereas Fig.6 to Fig.8 illustrate multihoming.

2. Architecture Components

Fig.1 and 2 illustrate the architecture components involved in network mobility. The terms "Fixed Node (FN)", "Mobile Node (MN)", "Mobile Network", "Mobile Router (MR)", "Mobile Network Node (MNN)", "home link", "foreign link", "ingress interface", "egress interface", access router (AR), home link, foreign link are defined in [2].

A mobile network is composed by one or more IP-subnet and is viewed as a single unit. It is connected to the Internet by means of mobile routers (MRs). Nodes behind the MR primarily comprise fixed nodes (nodes unable to change their point of attachment while maintaining ongoing sessions), and additionally mobile nodes (nodes able to change their point of attachment while maintaining ongoing sessions). In most cases, the internal structure of the mobile network will in effect be relatively stable (no dynamic change of the topology), but this is not a general assumption.



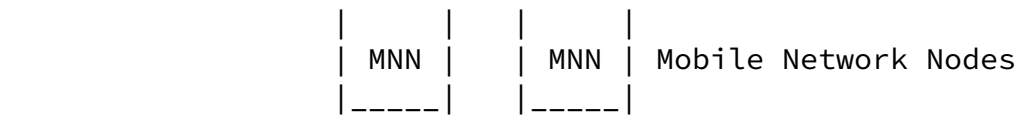
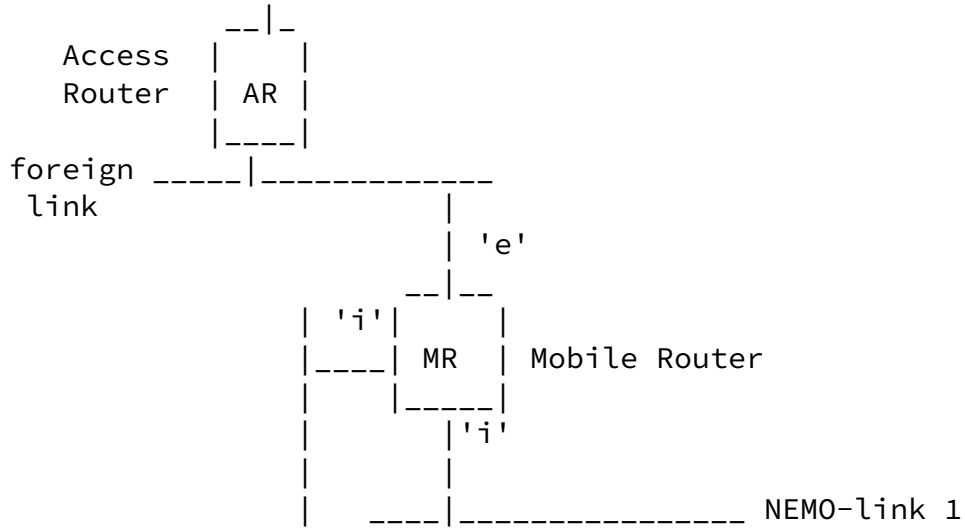


Fig.1: Architecture Components

At the network layer, MRs get access to the global Internet from the Access Routers (ARs) on the visited link. The MR maintains the Internet connectivity for the entire mobile network. It has one or more egress interface(s) and one or more ingress interface(s). When forwarding a packet to the Internet the packet is transmitted upstream through one of the MR's egress interfaces to the AR; when forwarding a packet from the AR down to the mobile network, the packet is transmitted downstream through one of the MR's ingress interfaces.

3. Functional Terms



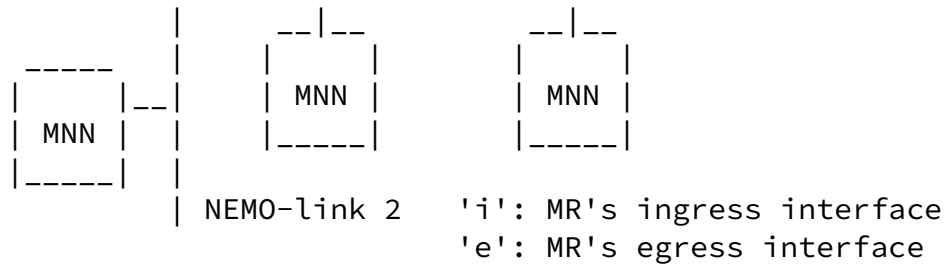


Fig.2: Larger Mobile Network with 2 subnets

Within the term Mobile Network Node (MNN), we can distinguish between LFN, VMN and LMN. The distinction is a property of how different types of nodes can move in the topology and is necessary to discuss issues related to mobility management and access control, but does not preclude that mobility should be handled differently. Nodes are classified according to their function and capabilities with the rationale that nodes with different properties (may) have different requirements.

3.1 Mobile Network

As defined in [2])

3.2 NEMO

An abbreviation either for "NEtwork MObility" or for " a NEtwork that is MObile". It the former, it refers to the concept of "network mobility" like in "NEMO Basic Support" and is also the working group's name. In the latter, it is used as a noun, e.g. "a NEMO" meaning "a mobile network".

3.3 MONET [DEPRECIATED]

An abbreviation for MObile NETwork. MONET can be used as a noun, e.g. a MONET" meaning "a mobile network". Not to be confused with MANET (Mobile Ad-hoc NETwork)

3.4 Mobile Router (MR)

As defined in [2])

3.5 Egress Interface (E-face)

As defined in [2])

3.6 Ingress Interface (I-face)

As defined in [2])

3.7 NEMO-prefix (MNP)

An acronym for Mobile Network Prefix (as defined in [2])

3.8 NEMO-link

A link (subnet) located within the mobile network.

3.9 Mobile Network Node (MNN)

As defined in [2]). May be either a LFN, LMN, or a VMN.

3.10 Node behind the MR

Any MNN located in a mobile network, beside the MRs connecting the mobile network to the Internet.

3.11 Local Fixed Node (LFN)

A fixed node (FN), either a host or a router, that belongs to the mobile network and which doesn't move topologically with respect to the MR. It's address is taken from a NEMO-prefix.

3.12 Local Mobile Node (LMN)

A mobile node (MN), either a host or a router which can move topologically with respect to the MR and whose home link belongs to the mobile network. It's address is taken from a NEMO-prefix.

3.13 Visiting Mobile Node (VMN)

A mobile node (MN), either a host or a router which can move

topologically with respect to the MR and whose home link doesn't belong to the mobile network. A VMN that gets temporarily attached to a NEMO-link (used as a foreign link) obtains an address on that link (i.e. taken from a NEMO-prefix).

3.14 NEMO-enabled (NEMO-node)

A node that has been extended with network mobility support capabilities and that may take special actions based on that (details of the capabilities are not known yet, but it may be implementing some sort of Route Optimization).

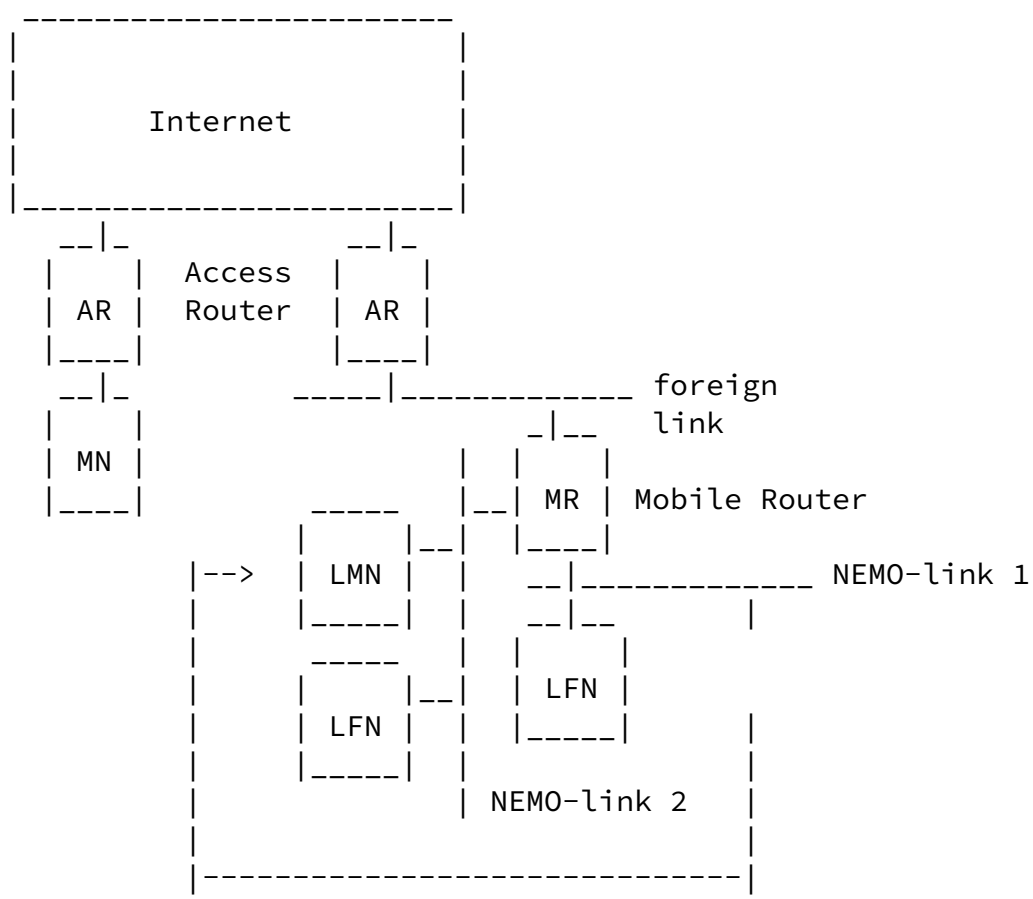


Fig.3: LFN and LMN: LMN changing from NEMO-link 1 to NEMO-link 2

3.15 NEMO-enabled MR

A mobile router that has been extended with network mobility support

capabilities and that may take special actions based on that (for instance as the ones defined in NEMO Basic Support [3]

3.16 MIPv6-enabled (MIPv6-node)

A node which has been extended with host mobility support capabilities as defined in [1] and that may take special actions based on that

3.17 Correspondent Node (CN)

Any node that is communicating with one or more MNNs. A CN could either be located in the fixed network or within the mobile network, and could be either fixed or mobile.

4. Nested Mobility Terms

Nested mobility occurs when there are more than one level of mobility. A MNN acts as an Access Router (AR) and allows visiting nodes to get attached to it. There are two cases of nested mobility:

- when the attaching node is a single node: VMN (see figure 4). For instance, when a passenger carrying a mobile phone gets Internet access from the public access network deployed into a bus.

- when the attaching node is a router with nodes behind it, i.e. a mobile network (see figure 5). For instance, when a passenger carrying a PAN gets Internet access from the public access network deployed in the bus.

For the second case, we introduce the following terms:

4.1 Nested Mobile Network

A mobile network is said to be nested when a mobile network is getting attached to a larger mobile network. The aggregated hierarchy of mobile networks becomes a single nested mobile network.

4.2 root-NEMO

The mobile network at the top of the hierarchy connecting the aggregated nested mobile network to the Internet.

4.3 parent-NEMO

The upstream mobile network providing Internet access to a mobile network down the hierarchy.

4.4 sub-NEMO

The downstream mobile network attached to a mobile network up the hierarchy. It becomes a subservient of the parent-NEMO. The sub-NEMO is getting Internet access through the parent-NEMO and does not provide Internet access to the parent-NEMO.

4.5 root-MR (or TLMR, but depreciated)

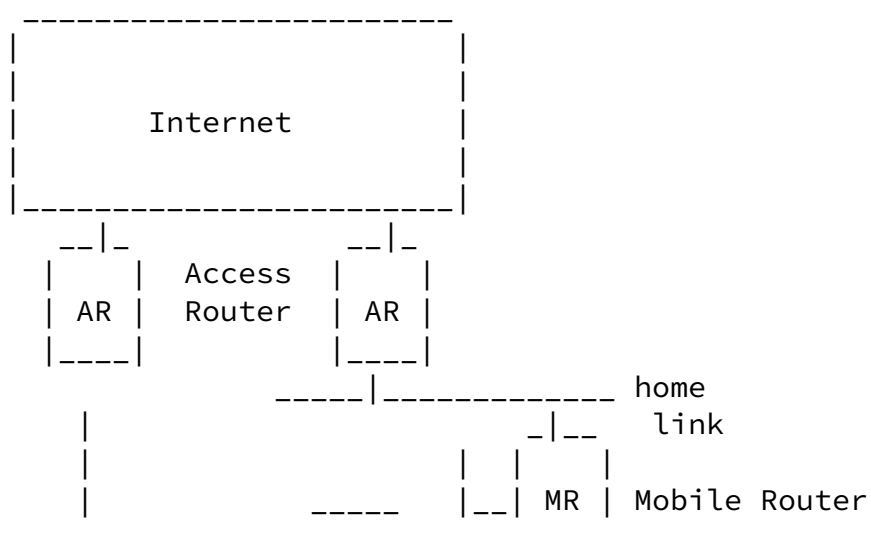
The MR(s) of the root-NEMO used to connect the nested mobile network to the fixed Internet. Was referred to as "TMLR" (Top-Level Mobile Router) in former versions of this document.

4.6 parent-MR

The MR(s) of the parent-NEMO.

4.7 sub-MR

The MR(s) of the sub-NEMO connected to a parent-NEMO



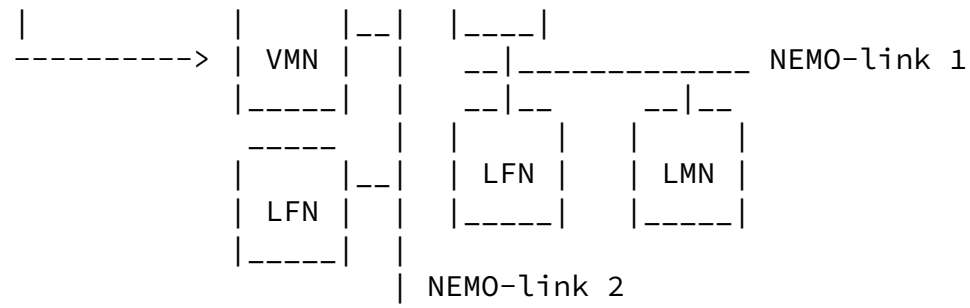


Fig.4: Nested Mobility: single VMN attached to a mobile network

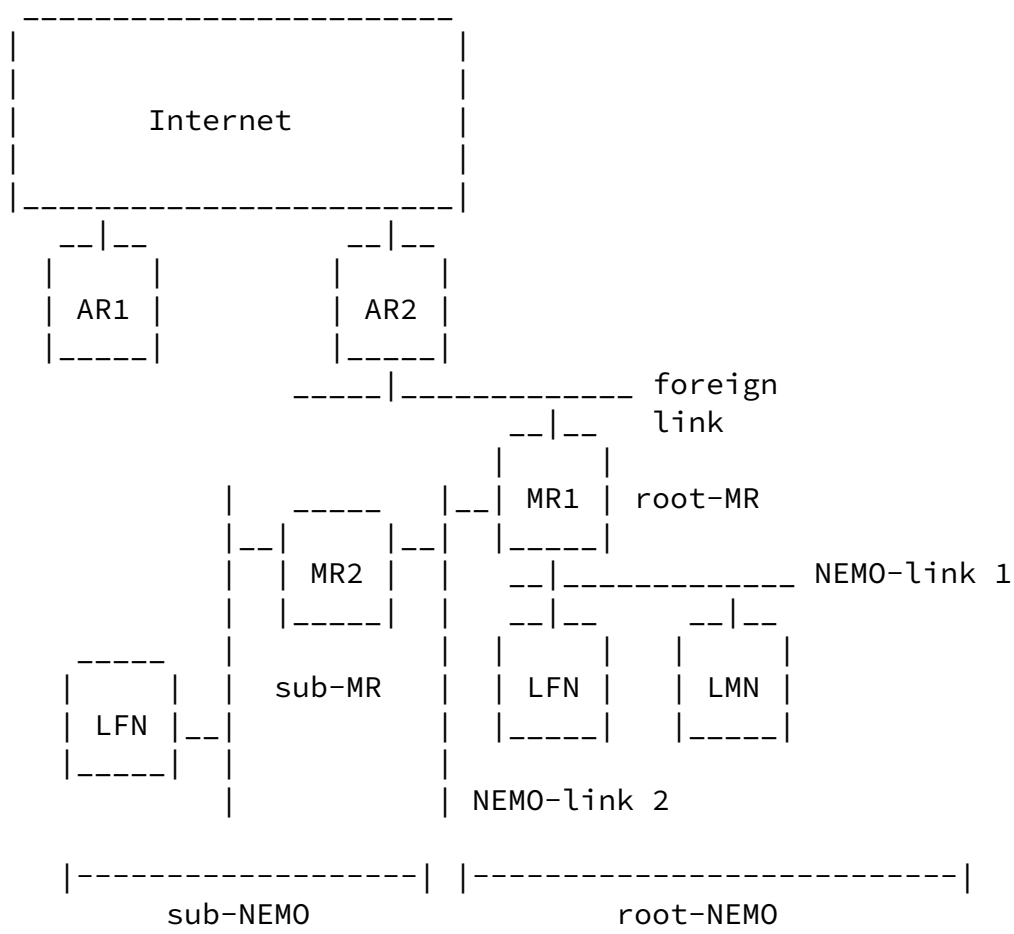


Fig.5: Nested Mobility: sub-NEMO attached to a larger mobile network

5. Multihoming Terms

Multihoming, as currently defined by the IETF, covers site-multihoming [8] and host multihoming.

5.1 Multihomed Host

Within host-multihoming, a host may either be:

- multi-addressed: multiple source addresses to choose between on a given interface; all IPv6 nodes are multi-addressed due to the presence of link-local addresses on all interfaces.
- multi-interfaced: multiple interfaces to choose between, on the same link or not.
- multi-linked: multiple links to choose between (just like multi-interfaced but all interfaces are NOT connected to the same

link)

- multi-sited: when using IPv6 site-local address and attached to different sites

5.2 Multihomed Mobile Router

A MR is multihomed when it has simultaneously more than one active connection to the Internet, that is when it is either:

- multi-egress-addressed MR: the MR has simultaneously multiple active addresses to choose between on a given egress interface
- multi-egress-interfaced MR: the MR has simultaneously multiple active egress interfaces on the same link or not
- multi-egress-linked MR: the MR has simultaneously multiple active egress interfaces on distinct links
- multi-egress-sited MR: the MR is simultaneously attached to different sites (possible distinct ISPs).

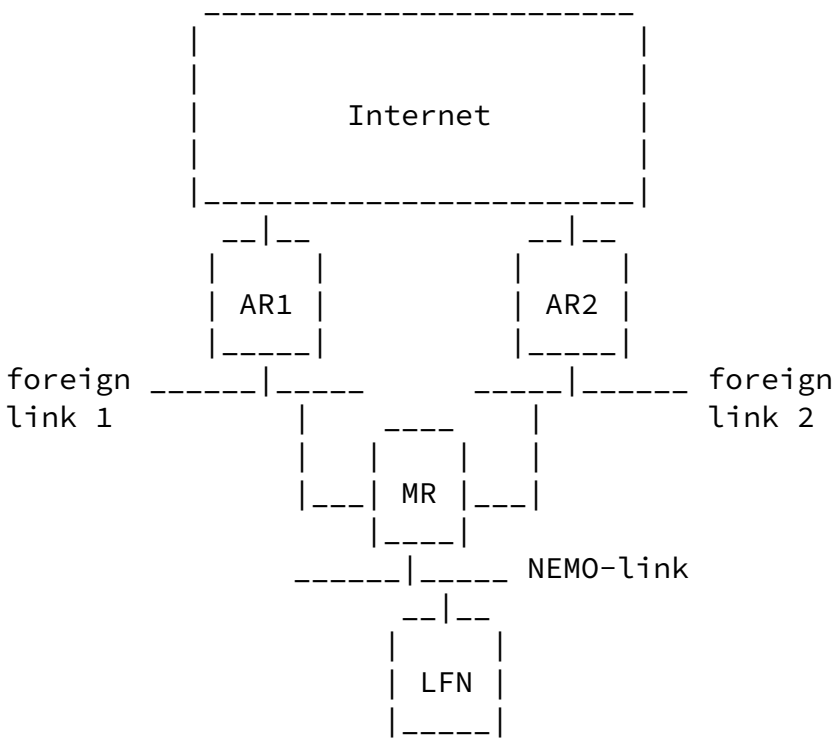
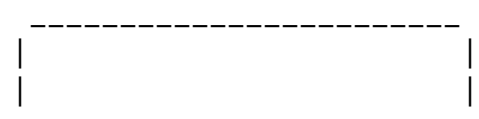


Fig.6: Multihomed Mobile Network: MR has multiple egress interfaces

5.3 Multihomed Mobile Network

A mobile network is multihomed when there more than one active egress interface connected to the global Internet, that is when either:

- a MR is multihomed, or
- multi-MR-NEMO: the mobile network has more than one MR to choose between



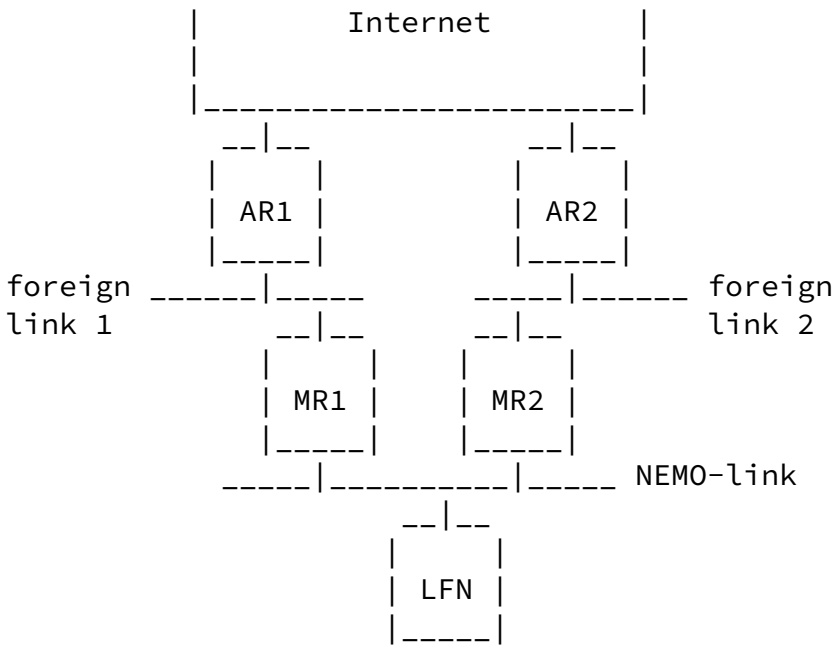


Fig.7: Multihomed Mobile Network: NEMO with multiple MRs

5.4 Multihomed and Nested Mobile Network

A nested mobile network is multihomed when there are more than one active interface connected to the global Internet, that is when either:

- a root-MR is multihomed, or
- multi-rooted-NEMO: there are more than one root-MR to choose between

5.5 Illustration

Fig.6 and 7 show two examples of multihomed mobile networks. Fig.8. shows two independent mobile networks. NEMO-1 is single-homed to the Internet through MR1. NEMO-2 is multihomed to the Internet through MR2a and MR2b. Both mobile networks offer access to visiting nodes and networks through an AR.

Let's consider the two following nested scenarios in Fig.8:

Scenario 1: what happens when MR2a's egress interfaced is attached to AR1 ?

* NEMO-2 becomes a subservient of NEMO-11
* NEMO-1 becomes the parent-NEMO for NEMO-2 and the root-NEMO for the aggregated nested mobile network
* NEMO-2 becomes the sub-NEMO
* MR1 is the root-MR for the aggregated nested mobile network
* MR2a is a sub-MR in the aggregated nested mobile network
* NEMO-2 is still multihomed to the Internet through AR1 and ARz
* The aggregated nested mobile network is not multihomed since NEMO-2 cannot be used as a transit network for NEMO-1

Scenario 2: what happens when MR1's egress interface is attached to AR2 ?

* NEMO-1 becomes a subservient of NEMO-2
* NEMO-1 becomes the sub-NEMO
* NEMO-2 becomes the parent_NEMO for NEMO-1 and also the root-NEMO for the aggregated nested mobile network)
* MR2a and MR2b are both root-MRs for the aggregated nested mobile network
* MR1 is a sub-MR in the aggregated nested mobile network

* NEMO-1 is not multihomed

* The aggregated nested mobile network is multihomed

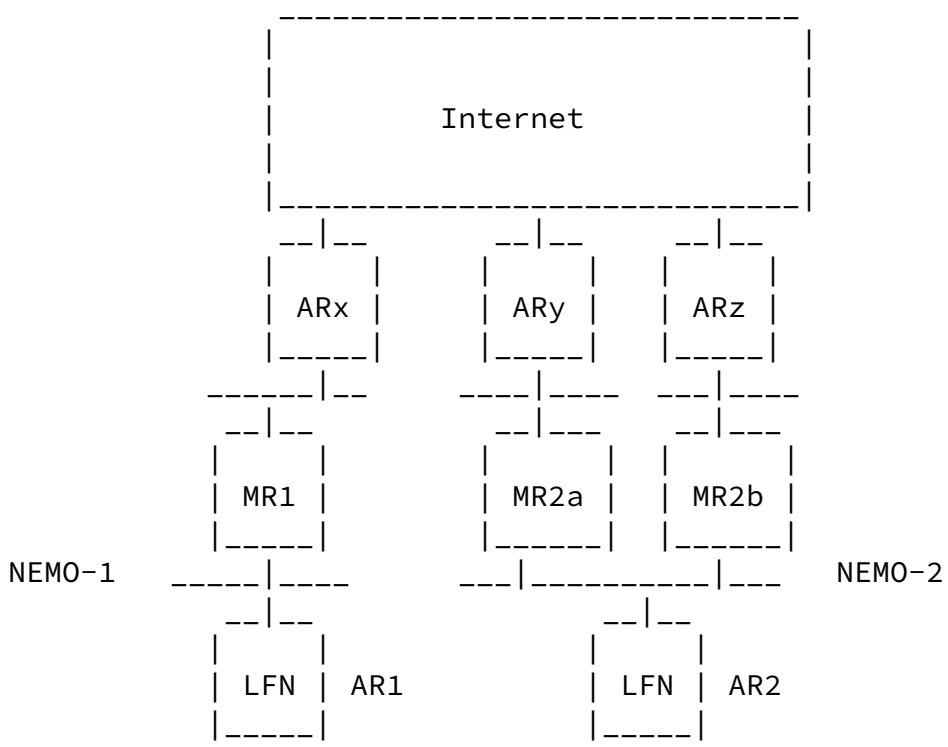


Fig.8: Multihomed Nested Mobile Network

6. Mobility Support Terms

6.1 Host mobility support

Host Mobility Support is a mechanism which maintains session continuity between mobile nodes and their correspondents upon the mobile host's change of point of attachment. It could be achieved by Mobile IPv6.

6.2 Network Mobility support (NEMO Support)

Network Mobility Support is a mechanism which maintains session continuity between mobile network nodes and their correspondent upon a mobile router's change of point of attachment. Solutions for this

problem are classified into NEMO Basic Support, and NEMO Extended Support.

6.3 NEMO Basic Support

NEMO Basic Support is a solution to preserve session continuity by means of bidirectional tunneling much like what is done using [1] for mobile nodes. The solution for doing this is solely specified in [3].

6.4 NEMO Extended Support

NEMO Extended support is to provide the necessary optimization, including routing optimization between arbitrary MNNs and CNs.

7. New Text From Usage Draft

The text in this section is taken from [5] and is subject to discussion on the mailing list.

7.1 Home Link

The link attached to the interface at the Home Agent on which the Home Prefix is configured. The interface can be a virtual interface, in which case the Home Link is a virtual Home Link.

7.2 Home Network

The Network formed by the application of the Home Prefix on the Home Link. With Nemo, the concept of Home Network is extended as explained below.

7.3 Home Address

With Mobile IPv6, a Home Address is derived from the Home Network prefix. This is generalized in Nemo, with some limitations: A Home Address can be either derived from the Home Network or from one of the Mobile Router's Mobile Network prefixes.

7.4 MRHA Tunnel

The bi-directional tunnel between a Mobile Router and its Home Agent

7.5 Mobile Aggregated Prefix

An aggregation of Mobile Network Prefixes.

7.6 Aggregated Home Network

The Home Network associated with a Mobile Aggregated Prefix. This Aggregation is advertised as a subnet on the Home Link, and thus used as Home Network for Nemo purposes.

7.7 Extended Home Network

The network associated with the aggregation of one or more Home Network(s) and Mobile Network(s). As opposed to the Mobile IPv6 Home Network that is a subnet, the extended Home Network is an aggregation and is further subnetted.

7.8 Virtual Home Network

The Home Network associated with a Virtual Network. The Extended Home Network and the Aggregated Home Network can be configured as Virtual Home Network.

8. Miscellaneous Terms

8.1 Idle MNN

A MNN that does not engage in any communication.

8.2 Idle Mobile Network

A mobile network that does not engage in any communication outside the network may be considered idle from the global Internet. This doesn't preclude that MNNs are themselves idle. Internal traffic between any two MNNs located in the same mobile network is not concerned by this statement.

9. Changes since draft-nemo-terminology-00.txt

- NEMO will be used either as the concept for NEtwork MObility and a noun meaning "NEtwork that is MObile"

- Added TMLR as depreciated term (everyone should use root-MR instead)

- Added NEMO-prefix

- Added NEMO-link

- Added NEMO-enabled MR

- Precision that IP address of LFN, LMN, or VMN is taken from a NEMO-prefix

- Added abbreviation E-face (Egress interface) and I-face (Ingress interface)

- Some re-ordering of terms, and a few typos.

- Added some text from the usage draft [5]

10. Acknowledgments

The material presented in this document takes most of the text from our former internet-drafts submitted to MobileIP WG and to the former MONET BOF. Authors would therefore like to thank both Motorola Labs Paris and INRIA (PLANETE team, Grenoble, France), for the opportunity to bring this terminology to the IETF, and particularly Claude Castelluccia (INRIA) for his advices, suggestions, and direction, Alexandru Petrescu (Motorola) and Christophe Janneteau (Motorola).

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