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An Analysis on Smooth Handoff Technique in NEMO Route Optimization Protocols

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ABSTRACT

With existing Network Mobility Basic Support (NEMO BS) protocol, entire transmissions are completely handled via Mobile Router (MR) to its home network on behalf of all Mobile Network nodes (MNNs) during movement among different networks. This concerns in enlarged length of route with higher delay and loss in best cases. Hence, in order to overcome these constraints, applying Smooth Handoff (SH) technique in Route Optimization (RO) for NEMO is an optimal solution. Consequently, the main aim of this paper is to offer a constructive analysis by doing analysis on some of the current approaches on soft handoff for RO in NEMO as well as discuss their strengths and weaknesses concerning delay and packet loss with some open issues.
Keywords : NEMO BS, soft handoff, RO, MR

I. INTRODUCTION

The group of entire network is considered as "Network Mobility (NEMO)". Generally NEMO is able to apply on public transport, for example bus, train, ship etc. The Internet Engineering Task Force (IETF) has proposed the NEMO Basic Support (NEMPO BS) protocol to handle the network mobility while it is moving by the NEMO working group. In [1], defined the basic methodology for providing network mobility called NEMO BS which is considered the most widespread network mobility protocol at the present time. NEMO BS operates in the IP layer and inherits the benefits of Mobile IPv6 [1-5] by extending the binding mechanism of the ancestor. Nonetheless, NEMO possess some limitations since it just extends the MIPv6 as of a node to a network. Principally, in the case of a RO, the transmission delay increases due to the bypass of packets and tunneling overheads increase every time packets pass through each HA. Various schemes have been proposed concerning soft handoff for the RO in the NEMO. As, the existing schemes have a long convergence time during RO after the soft handoff, hence, real-time applications are not sustained in these schemes due to higher handoff delay and its impact on packet loss . The rest of the paper is structured as follows. section 2 gives the brief overview on NEMO BSP architecture with its limitations, analysis on soft handoff technique for RO are discussed in section 3 followed by open issues in section 4. conclusion is given in section 5.

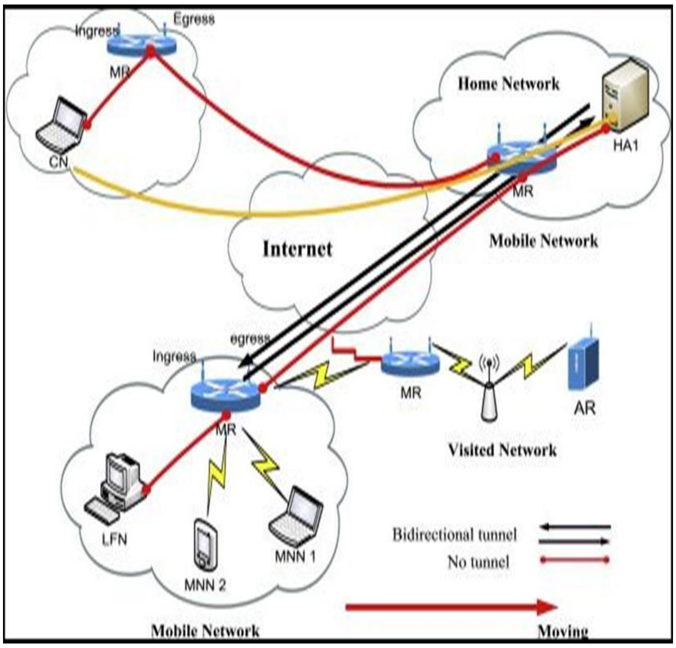

Figure 1. Basic architecture of NEMO BS [10]

II. METHODS AND MATERIAL

A. ARCHITECTURE OF NEMO BS

In NEMO architecture (as shown in Fig.1), it might have more than one routers, called Mobile Router (MR) work as a gateways in favor of the Mobile Network Nodes (MNNs) [1-5]. Even as the point of attachment of a mobile network alters because of mobility, MRs attain handoff so that the movement is transparent to MNNs. There are three types of MNNs mainly: Local Fixed Node (LFN) that do not move with respect to the mobile network, Local Mobile Node (LMN) usually reside in the mobile network but can move to other networks, Visiting Mobile Node (VMN) belong to another network but is currently attached to the mobile network, and MR. Sometimes Mobile Network Nodes can act as MR due to establish a nested mobile network. The network through which a mobile network is connected is called the home network. When MR is registered with a router in its own network, then is known as Home Agent (HA). A node which communicates with MNNs is called Correspondent Node (CN). Sometimes it can also considered as MNN. Hence, it can be mentioned that registration process is almost analogous to MIPv6 registration apart from setting of the MR flag and sending of prefix in the BU. Although NEMO BSP provides aggregate mobility management of a group of nodes resulting Power saving, Low complexity and few handoffs but still it has some limitation are mainly sub -optimal routing that increase delay and packet loss during handoff among multiple domains (as shown in Fig.2).

B. RELATED WORK

There are several extensions of NEMO BS protocol in order to allow soft handoff for the route optimization [6-14]. Researchers are focused to resolve many problems in NEMO BS protocols such as pinball routing and Binding Update (BU) signaling storm problems.

HCoP-B [6] is proposed to solve this problem in NEMO-BS as well as in MIPv6-based. HCoP-B makes consideration of scalability. This scheme is Tree based with Long handoff procedure and high probability of losing packets through handoff techniques. However, the scheme force bandwidth utilization and solve handoff latency and pinball problems due to signaling overhead in BUs messages.

Another new optimization scheme (i.e. OwR scheme) is proposed in paper [7]. The authors combines two existing schemes to introduce a new mechanism called Quota which is sessions optimized. The proposed scheme can handle nested NEMO, set up optimal routing for a certain number of sessions, and avoid blindness during RO simultaneously. The OwR scheme makes the combination of route optimization and reverse routing header (RRH) schemes using a quota algorithm for more effectiveness. OwR scheme reduces BUs messages. This scheme is suitable to act in scalable networks in some extends to provide soft handoff. However, in OwR, require extra signaling overhead in BUs messages. Due to the Optimization-Capable Local fixed Nodes (OLFN), causes bottleneck problem for MR in NEMO.

SeNERO in [8] proposes a certificate-based authentication mechanism with the correspondent router that makes use of a Public Key Infrastructure (PKI) to provide a higher level of security. A test-bed based evaluation provides the improvements in terms of better handover delay in comparison to the original correspondent router protocol. Analysis of signaling overhead is provided as a second evaluation of the two protocols. Furthermore, a comparison to related work shows SeNERO scheme’s advantages concerning signaling efficiency and security properties. SeNERO scheme is insecure manner, which is proposed to solve triangular routing problem and reduce signaling and handover overhead. However, providing RO when home networks are out of signal. SeNERO scheme is a bandwidth consuming protocol. Still need to focus on scalability issues. Moreover, several schemes have been proposed for the aeronautical network to support IP communications, including the Border Gateway Protocol (BGP) based, NEMO and the Host Identity Protocol (HIP) based NEMO. Yet, these schemes still possess end-to-end packet delay as well as loss due to the sub-optimal routing [3]. The idea of proposed soft handoff technique for RO in NEMO based aeronautical network, which aims to set up optimal routing and reduce the handoff delay. Existing soft handoff-based NEMO route optimization mechanisms are characterized in Table 1.

Table 1: Soft handoff-based NEMO RO Schemes

Scheme By citation No.	Higher handoff Delay	Signalling overhead	Packet loss	Scalability Considered?
2	No	No	No	No
3	No	No	No	No
4	No	No	No	No
5	No	No	No	Yes
6	No	No	Yes	Yes
7	No	No	No	Yes
8	Yes	Yes	Yes	No

9	No	Yes	Yes	Yes
10	No	Yes	Yes	Yes
11	No	No	No	Yes
12	No	No	No	Yes

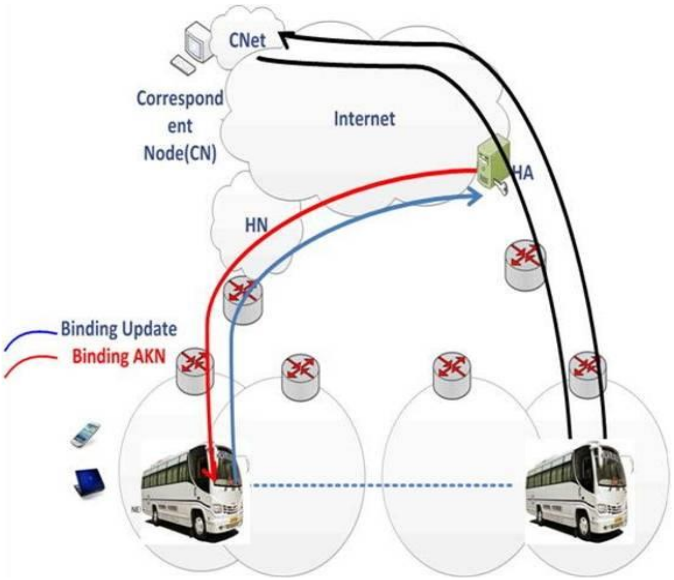

Figure 2. Triangular Problem in NEMO [10]

III. RESULTS AND DISCUSSION

Open Issues

Simplicity is the most important feature of the Network Mobility Basic Protocol since it's a logical extension of the MIPv6 operation at the MRs and their HA. Some issues related to soft handoff for RO in NEMO that may need further research are mainly:

- Sub optimal routing which include delay and loss due to increase in Packet Size as well as extra Signaling Overhead
- Transparency and Seamless Mobility

IV. CONCLUSION

In this paper, we have analyzed and evaluated some of the current approaches on soft handoff for RO in NEMO BS support. In addition with that, discusses their strengths and weaknesses based on packet loss and delay. Furthermore, the open issues are highlighted as well.

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