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Comparative Analysis of Handoff Management Protocols MIPV6 and HMIPV6 in Next Generation Wireless Systems

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***Abstract*-Recent research in wireless communications technologies has focused to the development of Next Generation wireless systems (NGWS) which integrate various existing wireless networks technologies, each of which is optimized for some specific services such as WLANs, WiMAX, General Packet Radio Service (GPRS) and Universal Mobile Telecommunications System (UMTS). The Most important and challenging issue is to realize seamless handoff with small handoff latency and packet loss to ensure Quality of service (QoS) in NGWS.**

Moblie IP is a solution for mobility support in the global Internet. The mobile node can experience disruptions or even intermittent disconnections of an ongoing real time session during handovers. This can heavily affect user satisfaction when traffic on the network is high. Therefore handoff delay needs to be minimized to provide good quality Mobile IP services. In this paper we discuss different type of protocols for NGWS and their comparative study and analysis.

***Keywords: NGWS, HMIPV6, MIPV6, Handoff Latency*.**

I. INTRODUCTION

Rapid progress in the research and development of wireless networking and communication technologies has created different types of wireless communication systems, such as Bluetooth for personal area, IEEE 802.11 WLANS for local area, Universal Mobile Telecommunications System (UMTS) for wide area, and Satellite networks for global networking.

These networks are complimentary to each other and, hence, their integration can realize unified NGWS that have best features of individual networks to provide ubiquitious "always best connected" to the mobile user.

The architecture of NGWS should have following characteristics:-

- *Economical*-The architecture should use as much of existing infrastructure as possible and minimize the use of new infrastructure.
- *Scalable*- The architecture should be able to integrate any number of wireless system both existing and future service provider.
- *Reliable*-The architecture should be robust enough to provide fault tolerance.
- *Secure*- The architecture should be secure and provide privacy equivalence.
- *Seamless mobility support*-The architecture should support seamless mobility management to eliminate connection interruption and QOS degradation

In the integrated NGWS, users are always connected to the best available network and switch between different networks based on their service needs. It is an important and challenging issue to support seamless mobility management in the NGWS.

Mobility management contains two components :

Location Management: It enables the system to track the locations of mobile user between consecutive communications.

Handoff management: It is the process by which user keep their connections active when they move from one base station (BS) to another.

There are efficient location management technique however, seamless support of Handoff management in NGWS is still an open research issue.

In the NGWS, two **types of handoff** scenarios may arise horizontal handoff and vertical handoff

Types of Handoff

Horizontal handoff: Handoff between two BS of the same system. Horizontal handoff can be further classified into:-

Link layer handoff: Handoff between two BS that are under the same foreign agent (FA).

Intrasystem handoff: Horizontal handoff between two BSs that belong to two different foreign agent (FASs) and both FA belong to the same system and hence, to same gateway foreign agent (GFA).

Vertical Handoff (Inter system handoff): Handoff between two BSs that belong to two different systems and, hence, two different GFAs.

For efficient Intra and intersystem handoff protocols should have the following characteristics to support seamless handoff in NGWS

- Minimum handoff latency: The handoff management protocols introduce only minimum handoff latency.
- Low packet loss: Packet loss during handoffs should be minimized

- Limited handoff failure: Handoff failure probability should be limited to desired value.

II. HANDOFF MANAGEMENT PROTOCOLS

Mobile IPV6

Mobile IPv6 is mainly proposed to keep any communication between a mobile node and a correspondent node (CN) while the mobile node moves from one IPv6-based sub-network to another one. In this design, each MN has a home address identifying its home network [12]. Within its home network, each MN uses the traditional routing functions to exchange IP datagram with its CN. Whenever an MN moves from its local network to a new network, its home address becomes invalid and then the MN can create a new address called care-of address (CoA) from a router advertisement message sent by the new visited network [12]. A binding between MN's CoA and its home address is updated to the MN's home agent to keep continuous communications between the MN and its correspondent(s). In this way, MN's home agent can always detect coming communication packets to MN with MN's home address, and locate the current position of MN with MN's CoA. At the beginning of the handover procedure, an MN can use "Neighbour Discovery" scheme, which is based on reception of Router Advertisement (RA) sent by current access router (AR), to detect its movement to a new subnet .After verifying the uniqueness of its link local address on the new link, the MN will create an IPv6 address called CoA from the corresponding prefix in RA [15]. After that, MN will exchange binding update information which include MN's CoA with its HA and its CN to allow all of them to maintain their connections. Mobile IPv6 can reasonably keep track of MN's new address by timely binding update between the MN and its home gent. However, before finishing binding update, data packet communications are interrupted. The MN needs to spend time discovering new subnet, establishing new care-of address, and exchanging information between MN and its home agent. For NGWS, all of them will create a lot of signalling traffic and latency, resulting in packet loss. It is even worse when an MN roams between two ARs several times. This frequent roaming will cause ping pong effects, which refer to the situation in which too frequent and unnecessary location updates and handoffs occur in a short time. In this case, MN cannot keep normal continuous communications with its CN(s). In the mean time, all packets destined for the old care-of address are dropped. Therefore, we need to improve binding update procedure of Mobile IPv6 handover schemes to reduce handoff latency and signalling traffic.

Hierarchical Mobile IPv6

Hierarchical Mobile IPv6 (HMIPv6) is developed to reduce the amount of signalling traffic required, which affects handoff latency of MN's communications. Unlike MIPv6, HMIPv6 addresses the issue of local mobility and global mobility separately, which means local handoffs are managed locally without notifying home agent, while global mobility is managed with the MIPv6 protocol. In HMIPv6, the global internet is divided into regions for local area mobility and each region is connected to the rest of IP network with a new node called Mobility Anchor Point (MAP), which is a kind of anchor point in charge of several ARs. In this scheme, each mobile node has two care-of addresses. One is a regional care-of address and the other is a local care-of address. The regional care-of address is local to the MAP's covered region. An MN communicates with its correspondent nodes via its regional care-of address. When an MN moves into a new region or domain, it will first get a regional care-of address from MAP advertisement information, and then the MN will inform its home agent and its correspondents about its "regional location" as its raw location information [15]. When the MN moves between two ARs in the same region covered by a same MAP, MN will update its localization into the domain and get a new local care of address by sending local registration to the MAP, instead of sending to its home agent. The MAP intercepts data packets designated to MN's regional care-of address and tunnels them to the corresponding MN's local care-of address. So in this way, handoff latency and signalling traffic are reduced because each MN hides its local movements in a region from its home agent and correspondents, and meanwhile MN can keep unbroken communications with its correspondent(s).

III. DISCUSSION AND ANALYSIS

Handover latency analysis The handoff latency at an MN side is defined as the time interval during which an MN cannot send or receive any packets during handoff and it is composed of L2 (link layer) and L3 (IP layer) handoff latencies [5]. The L3 handoff latency is the sum of delay due to movement detection, IP addresses configuration and binding update procedure. Following notations are considered for analysis from

L	Length of handoff latency
SC	Total Signalling cost for HO
T(L2)	Layer 2 HO latency/cost
T(M2)	Movement detection latency/Cost
T(DAD)	Duplicate address Detection latency/Cost
T(BU)	Binding update latency/Cost for HA/CN
T(BU-MAP)	Binding Update latency/Cost for MAP/NMAP
M	Latency or cost of packet delievery between MN and Access Router
A	Latency or cost of packet delievery between MN and HA
B	Latency or cost of packet delievery between HA and CN
C	Latency or cost of packet delievery between MN and CN

Let L(MIPv6) be handoff latency of MIPv6. Then it can be expressed as:

L(MIPv6) = T(L2) + T(MD) + T(DAD) + T(BU)

L(MIPv6) = T(L2) + (2M) + (2M) + (4A+ 2B + 4C) (1)

Where T (L2) is link layer latency, T(MD) is movement detection latency, T(DAD) is duplicate address detection latency, and T(BU) is binding update and return rout ability latency. Let L(HMIPv6-Intra) be handoff latency of HMIPv6 Intra-MAP Domain handoff. Then it can be expressed as:

L(HMIPv6-Intra domain) = T(L2) + T(MD) + T(DAD) + T(BU-MAP)
L(HMIPv6-Intradomain) = T(L2) + 2M + 2M + 2M (2)

Where T(L2) is link layer latency, T(MD) latency for movement detection, T(DAD) for duplicate address detection and T(BU-MAP) is latency for binding update between MN and MAP which is less than T(BU) of MIPv6 (i.e T(BU-MAP) < T(BU)). As MN moves within same MAP domain, binding update and return routability between MN and HA/CN is not required to be performed.
Let L (HMIPv6-Inter) be handoff latency of HMIPv6 Inter-MAP Domain handoff. Then it can be expressed as:

L (HMIPv6- Inter domain) = T(L2) + T(MD) + T(DAD) + T(BU-NMAP) + T(BU)
L (HMIPv6-Inter domain) = T(L2) + (2M) + (2M) + (2M) + (4A + 2B + 4C) (3)

Where, T (L2) is link layer latency, T(MD) latency for movement detection, T(DAD) for duplicate address detection and T(BU-NMAP) is latency for binding update between MN and NMAP. In this case, MN needs to update HA/CN about MN's new RCoA on new MAP. Hence T (BU) is also added.

Handoff Protocols in NGWS	**HO Latency**	
MIPV6	T(L2)+(2M)+(2M)+(4A+2B+4C)	
HMIPV6	Intra Domain	T(L2)+(2M)+(2M)+(2M)
	Inter Domain	T(L2)+(2M)+(2M)+(2M)+(4A+2B+4C)

IV. CONCLUSION

In this paper there has been overview of handoff management in NGWS, and comparison of current handoff techniques for IP-based NGWS. Specifically, we have described and analysed handoff protocol schemes in details, Mobile IPv6, Hierarchical Mobile IPv6. Mobile IPv6 protocols define a care-of address for MN in a new visited network. Among we analyze handoff latency of MIPv6 and HMIPV6 protocol schemes. Future work should be carried out in determining other new obstacles in handoff schemes and protocols needs to be improved.

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