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A Survey: MOBILE IPV4/IPV6 Fundamentals, Advantages and Disadvantages

Aymen Hasan Rashid Al Awadi
Information Technology Research Development Center, University of Kufa, Najaf, Iraq

Hakim Adil Kadhim
Faculty of Engineering, University of Kufa, Najaf, Iraq

Ismail
School of Computer Sciences University Sains, Malaysia 11800

Abstract— Mobile IP technology considers as one of the buzzwords in world of wireless technology. Nowadays, a lot of Internet applications depend on this technology to deploy their services like VOIP, VANET and so on. However, the main goal of this technology is to maintain high connectivity among the mobile nodes. The assumption here is that the Mobile Node (MN) should remain connected to its Home Agent (HA) during its mobility from one scope to another. The new scope is called Foreign Agent (FA) whereby the Mobile node can remain connected (routed) to the original scope (HA) by getting a new IP from FA which is called Care of Address (CoA). This paper will address the certain aspects belonging to the Mobile IP technology such as Mobile IPV4 and its relationship to Mobile IPV6 and some advantages and disadvantages of using Mobile IP. Vi-Fi (Vehicle Wi-Fi) descried as one of most advanced technology of Mobile IP.

Keywords— Mobile IPV6 Mobile IPV4, Home Agent, Foreign Agent, Wi-Fi Care of address

I. INTRODUCTION

Internet Protocol version 4 (IPv4) has been introduced in 1981. Owing to the dramatically growing of interconnected computers, this situation leads to depletion of IPv4 addresses. Consequently, a new version of addressing system called IPv6 was developed. The IPv6 recommendation for standard track specification has started since 1995. The main difference between IPv4 and IPv6 is the techniques of addressing formats. Furthermore, IPv4 uses 32 bits addresses, but in contrast, IPv6 uses 128-bits as the length of the IP address. Nowadays, wireless network access is increasingly popular; it allows freely mobility during communications and network access at a fair rate among nodes. Mobile IPv6 is designed to manage Mobile Nodes (MNs) movements among wireless IPv6 networks [1].

II. FUNDAMENTALS OF MOBILE IPV4/IPV6

Mobile IPV6 is based on Mobile IPV4 and developed as an integrated part of IPV6 protocol suite. Moreover, Mobile IPV6 enables its owned nodes to be connected to the networks by accessing to their home networks even though the nodes are away from home. Like Mobile IPV4, Mobile IPV6 is transparent during the nodes mobility (changing from node to node is unawareness to the users). Mobile IPV6 nodes conduct a full IPV6 infrastructure deployment to be worked only with IPV6 networks [2]. As for mobile IPV4, it requires three functional entities in the network: the Home Agent (HA), the Foreign Agent (FA), and Mobile Node (MN). On the other side, the functional entities which are formed the structure of Mobile IPV6 networks are: HA and MN [3]. In Mobile IPV4, the HA keeps track of all MNs in the network by their owned home addresses. On the other hand, the same MNs are kept track of their current temporary addresses by using special address coined as Care-of-Address (CoA). Once the MN has changed its position, an automatic connection has established between the MN and the HA to declare about the new location and to assign a new CoA address represents the current position. This process is performed by sending a binding update message via the Internet Control Message protocol (ICMP) to the HA [3]. In assumption that is one MN decide to establish a direct connection with another corresponding MN, it sends the connection packets via the home network address to set the communication channel and exchange the packets between each other. The HA then received the packets coming from the Correspondent Node (CN) and forwards them to the MN at its CoA through the current FA. All of these steps known as tunnelling. In Mobile IPV4, and all traffic that are destined among MNs has to be tunnelled via the HA [3]. Mobile IPV6 is the advanced version of IPV4. Furthermore, it is an integrated suite that is embedded into IPV6 and provides many new improvements. One of the most improvements in the Mobile IPV6 is the abandon the need of the FA entity within the IPV6 network [3].

Therefore, the two Mobile IPV6 addresses that are mentioned previously (HA and CoA) enable the MN to be moved freely among different IPV6 wireless networks transparently [1]. Generally, there is an unique HA uses to identify the MN to the Home Agent (HA); this address is fixed and permanent to the node unlike the CoA which is allocated differently to the MN at each time that the node visits a new network. Therefore, there is a new CoA will be assigned to the MN once it moves from its home network to a different foreign network [8]. Steps of discovering and registering new CoA depicted in Figure 1.

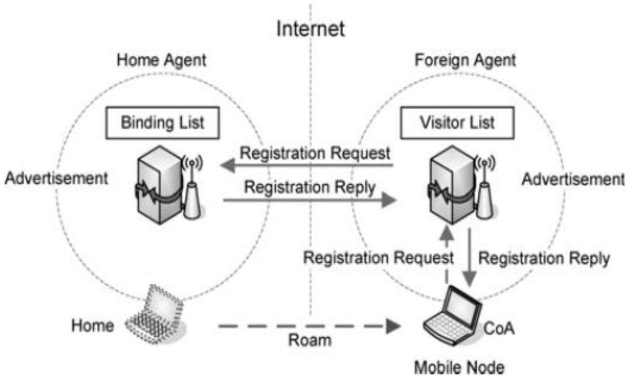

Figure 1 steps of handoff in mobile IP [5]

In Mobile IPV6, the correspondent Node (CN) maintains a binding cache by validating the routing optimization service and solves the triangular routing problem of Mobile IPV4. If CN does not contain active mapping for a mobile node in its binding cache, it will send packets directly to the MN home address [5]. Home address, in turn, receives all the packets sent to mobile node by any CN and tunnels them to the corresponding MNs CoA. When the MN receives tunnelled packets from the home agent, it sends a binding update message informing the CN about its current CoA. Upon receiving the binding update message, a CN creates or updates its binding cache and sends all future packets to MN's CoA.

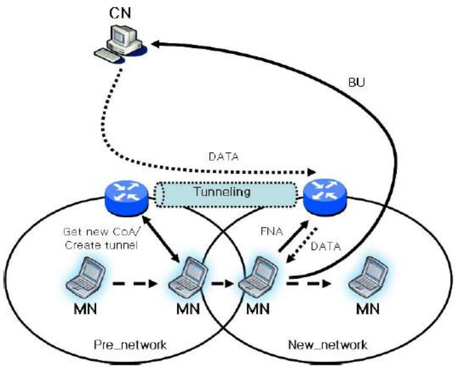

Figure 2 Handoff operation in Mobile IPv6 [7]

Whenever a MN changes its current location, it sends a binding update message to all active CNs to inform them about its new CoA [5]. Figure 2 shows the process of tunnelling and sending information between MN and CN which is determined as a result of handoff operation.

III. PROS AND CONS OF MOBILE IPV6

Mobile IP (MIP) can be interpreted as a mobility management protocol standardized by the IETF (Internet Engineering Task Force). Since mobile IP is considered as a layer 3 management protocol, it allows seamless roaming between different types of networks such as third-generation (3G) networks, Bluetooth or 802.11 WLAN [3]. Mobile IP, Cellular IP and HAWAII are the proposed paradigms of the IP mobility solutions that are designed to enable MNs to send and receive packets via the internet without restriction of their attachment points [8]. The mobility in the Mobile IP is required to provide two addresses for each, one is a permanent (HA) and is used by the higher level protocols and the other is temporary and is used to indicate the current location of the MN (CoA) [3]. Mobile IP is used to configure our network communication automatically and without any interaction when we move around and change our point of attachment to the network. The three basic components of Mobile IP (MN, HA, FA) as we discuss previously cooperate with each other to locate and register the current IP subnet. The main goal of Mobile IP is to develop a routing support schema to permit IP nodes using either IPV4 or IPV6 to seamlessly roam among IP sub networks and media types [7]. Mobile IP reactive mechanism for handoff is not suitable for rapid-mobility. In order to cope the handoff speed up challenge, we need to add two additional entities [9]. The additional entities increase the speed up of the handoff and improve the performance of the hierarchical and non-hierarchical implementations of mobile IP. These entities can be classified as following:

Ghost Mobile Node (g-MN) moves with the MN along the different cells and follows a determined trajectory. The g-MN is a "virtual" repeater capable of registering and allocating the resources in a predictive matter. The g-MN increases the handoff speed up and augments the performance of Mobile IP. The g-MN is capable of replicating the registration request, handling the creation of the tunnel, replacing the authentication and the authorization information from the MN and acting on behalf of the MN before being within a range of the new FA.

Ghost Foreign Agent (g-FA) is an entity that receives a delegation of authority from the FA. The g-FA is created in the neighbourhood of the FA. The main role of the g-FA is to advertise about a FA presence based on a neighbour FA. There are so many pros and cons regarding of Mobile IP have been discussed in this paper. Since the IP address is uniquely identified the device's point of attachment, so it is impossible for the mobile device to maintain the existing transports and higher layer connections easily and this is can be considered as a scaling problem [5]. MIPV6 has degraded performance if the mobile node device performs frequent handoffs in a local domain due to high signalling load, handoff latency, and packet loss. Thereby, the hierarchical schemes are used to reduce the handoff latency in local domains by employing a hierarchical structure to minimize the location update signalling with external networks [5]. Mobile IPV6 may have some problems to support real-time or loss-sensitive applications because of high signalling overhead and long signalling delay when a MN performs a binding update with its Home Agent or CN. Whenever MN moves from one access router to another, it should register (or binding update) a new CoA into its owned HA even though the distance between the HA and MN may be long. During the registration process, the MN may lose the connection with CN and it may induce packet loss and latency [8]. Mobile IP is not designed to handle high-speed gracefully. Such protocols produce considerable overhead and high forwarding delay. So, the protocols which are based on registration and unaware of packet re-routing are not appropriate for speeds higher than 20 m/s [9]. In the same context, every handoff is performed with some handoff latency, and during this latency the mobile node is not able to receive packets. Thereby, whenever the handoff rate is increased, the packet loss is also increased simultaneously. The handoff latency is varies according to use the different protocols suite [5]. For example, if we argue the micro-mobility protocols suite, within the local domain, the packet undergoes to the encapsulation and de-capsulation process before reaching a mobile node. The encapsulation and de-capsulation overhead minifies the available bandwidth in the wireless channel for HMIPv6 (Hierarchical Mobile IPv6) and RRMIPv6 (Mobile IPv6 Regional Registrations) when compared to MIPv6 [5]. Mobile IP local domain is more sensitive to the failure of MAPs (Mobility Anchor Point). MAP acts as the proxy home agent for mobile nodes within the local domain. The mobility inside the local domain (MAP domain) is handled by HMIPv6 (using MAP) and mobility among MAP domains is handled by MIPv6. The failure of MAP will prevent the packets to be routed to all the users in the local domain [8]. Another issue is that how many Access Routers (ARs) should be beneath a MAP within a regional network. The number of ARs is very critical for the system performance. A smaller number of ARs will lead to excessive location updates to the home network and consequently cannot provide the full benefit of local registration.

A large number of ARs will also degrade the overall performance by generating a high traffic load on MAPs which is, in turn, resulted a high cost of packet delivery [8].

IV. APPLICATION FOR VEHICULAR NETWORKS

The main goal of designing mobile IP technique is to maintain a continuous connection to the Internet. So, the changes in the IP address could cause a loss to the Internet connection and also some of network techniques like VPN, VoIP will be affected from this lack of connectivity [11]. Wi-Fi (IEEE 802.11) service could be the most widely technology used to making use of Internet service. However, Microsoft corporation has been developed Vi-Fi (Vehicle Wi-Fi) in 2008 whereby a moving terminal (a car for instance) can benefit from the cheapest access (Wi-Fi) to the Internet while the car is on moving [10]. Using such technology (Vi-Fi) would double the length of VOIP sessions and also double the number of successful TCP transfers [12]. The Wi-Fi clients' handoff with one base station leads to high distribution in connectivity. In contrast, the communicating clients to multiple base stations at the same time could reduce distribution and increase the connectivity between the applications (moving terminals) [12]. The developer of Vi-Fi aimed to make a type of coordination between the participating and lightweight base stations by making use of probabilistic algorithms [12]. The developed protocol Vi-Fi has deployed and evaluated by observing its performance of connectivity for two months by trace-driven simulations. The observation results have shown that the link layer connectivity close to the ideal state with continuous connectivity among the applications with handling the IP address changes [12]. Eventually, all the previous characteristics could help a lot on deploying and making use of Wi-Fi for long distances transparently and efficiently.

V. CONCLUSIONS

Nowadays, every new technology comes to solve issue(s) on the networking technology must contain some problems and drawbacks; "there is nothing ideal on the technology world". However, Mobile IP is one of those new technologies has a set of pros and cons have emerged when using it in the real applications. As for the pros, the Mobile IP technology is concentrated on maintaining the mobile connectivity (roaming) for moving devices as in 3G mobile network and other applications. In contrast, the same technology has some drawbacks on mobility handoff between HA and FA, where the Mobile IP handoff causes some loss in the transferred packets between MN and the other end points. However, the challenge of handoff and all its reflections on the network connectivity have been treated by proposing some techniques like g-MN and g-FA. Some features of the Mobile IPV6 such as tunneling, encapsulation and de-capsulation are integrated into the Mobile IPV4 to create a heterogeneous network environment. The integrated features of the Mobile IPV4 are caused, in turn, a lot of overhead and degrading to the performance of the moving terminals duo to the handoff. On the other side, the lack of the handoff latency on the mobile local network is overcome by minifying the location update with external network using hierarchal structure. Other concepts have been addressed like MAP, high speed mobility and the number of ARs that should be beneath the MAP regional network for efficient connectivity. Eventually, Mobile IP, especially IPV6, has many aspects need to be studied and evolved in the future, such as the high speed of mobile terminals, the performance limitations and growing the need to the mobile applications on moving terminals to provide a real time audio, video transferring. Therefore, at the recent days, Mobile IPV6 technology is considered as a vital field of research which attracts many of researchers that are interesting with developing and evolving the future of wireless networks.

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