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A Proxy Based Solution to Address the Unsuccessful Handover Occurrence in 6LoWPAN-WSN

Khan Riaz

Assistant Prof., Computer Science and Engineering, Islamic University of Science and Technology, Awantipora, Kashmir (India)

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***Corresponding Author**
Email: riazk3[at]gmail.com

ABSTRACT

The handover (HO) process in mobile networks mainly comprises layer 2 (L2) disconnection of the mobile node (MN) at previous link, registration with new network and delivery of packets in the new domain. In order to reduce the registration time, several solutions based on *pre-registration* have been proposed where the MN can initiate and complete the registration process well before the L2 handover. However, in some mobility scenarios with high mobility speed (e.g. vehicular mobility models), the *pre-registration* is not always possible to achieve the successful HO process, thus the result is failed or unsuccessful-HO. Therefore, in this paper we first articulate the problem by analyzing the issues responsible for the unsuccessful-HO followed by its theoretical analysis. On the basis of observations, we propose a mobility scheme that utilizes the link quality and mobility speed to trigger the HO process earlier for high mobility speed and vice versa. Due to the speed estimation we are able to categorize the HO into successful or unsuccessful one at the initial stage of HO process, thus reducing the delay operations to some extent. Furthermore, the gateway routers assisting mobility maintain a list of neighboring ANs which helps in HO triggering and establishing a bidirectional tunnel between Previous Gateway Router (PGR) and New Gateway Router (NGR) if the unsuccessful-HO occurs. To test the effectiveness, the proposed scheme is analyzed and evaluated by using the Network Simulator-2 (NS2). The handover performance is observed in two phases with respect to the variations in Wireless Link Delay (WLD) and Data Rate at different values of MN speed (v). The performance parameters namely HO delay, packet loss and signaling cost were observed. The data result shows that the proposed scheme improves the handover performance by reducing the HO-delay and packet loss to 15.1ms and 4% respectively. The proposed scheme also outperforms some of the highly cited solution in the field.

1. Introduction

With the emergence of technologies like Internet of Things (IoT) and Machine to Machine (M2M) communication, Wireless Sensor Networks (WSNs) have gained a considerable importance in the Next Generation Networks (NGNs). Recently 6LoWPAN has enabled the interconnection of WSN with internet of things (IOT) which extends their scope to new paradigm [1, 2]. A LoWPAN is composed of numerous sensor nodes which are characterized by small size, low energy consumption, limited processing, limited computing powers, small storage capacity and are in compliant to link protocol IEEE 802.15.4 [3]. Communication in such networks can be achieved via light weight routing protocols [5, 6]. 6LoWPAN supports mobility and efficient mobility support can intensify many application areas such as Hospital Wireless Sensor Network (HWSN), Intelligent Transport System (ITS), industrial automation and smart cities [4]. Currently the standard mobility protocols are categorized into two categories namely host based and network based protocols which are not considered suitable for constrained networks [7]. Although, network-based protocols relieve the MN from heavy mobility signaling but Connection termination and complex mobility operations in PMIPv6 lead to extra HO delay and packet loss [8]. Furthermore, high mobility speed and frequent HOs also lead to unsuccessful HO. On the other hand, mobility in sensor networks is often intended for critical applications such as HWSN where packet loss and high HO latency is not acceptable [13]. Therefore, network-based mobility protocols need further improvements in constrained IP-networks. Moreover 6LoWPAN architecture differs from IPv6 and current mobility standards pose obstacles to carry out mobility operations seamlessly [9]. Some of the leading solutions proposed in [10-12, 28] are PMIPv6 based which emphasize on HO latency and pay less attention towards packet loss. This packet loss occurs due to connection termination, complex mobility operations and unsuccessful HO occurrences in traditional schemes. Therefore to address these issues we propose a mobility scheme with the following novelties:

i. A 6LoWPAN architecture with hierarchical address scheme is presented.
ii. Based on this architecture a mobility algorithm is proposed to address unsuccessful HO occurrence.
iii. L3 HO is performed before L2 HO due to prior mobility registration without need of CoA configuration.

The remainder of this paper is organized as follows. In section 2, related work on mobility management in 6LoWPAN-WSN is discussed. Section 3 describes 6LoWPAN architecture with address structure and section 4 presents mobility scenario along with random way point (RWP) model. The proposed