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Handoff Schemes in Mobile Environments
A Comparative Study

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ABSTRACT

Vehicular ad-hoc networks are one of the most popular applications of Ad-hoc networks, where networks are formed without any sort of physical connecting medium and can be formed whenever required. It is an area in networks that has enjoyed a considerable amount of attention for quite some time. Due to the highly mobile environment where these networks find their usability, it can be understood that there are a lot of problems with respect to maintaining the communication links between the moving vehicular nodes and the static infrastructures which act as the access points (AP) for these moving vehicular mobile nodes (MN). The coverage area of each AP is limited and as such, the connections need to be re-established time and again between the MNs and the closest accessible AP. Handoff is the process involved here, which deals with selecting the optimal APs as well as the best network available for data transmission. In this article, the authors compare various handoff methods and categorize them based on the different approaches they follow.

KEYWORDS

Access Points, Ad-Hoc Networks, Cost Based Methods, Cross Layer, Handoff, Horizontal Handoff, Routing, Seamless, Switching, Vanets, Vertical Handoff, Wireless Communications

1. INTRODUCTION

Ad-hoc networks are formed by the collaboration of one or more communicating nodes. These networks do not have any predetermined architecture. It is applicable for a scenario that requires particular operations and after its scope, it simply cannot be adopted for any other purpose. In Wireless ad-hoc networks, the decisions are made dynamically. Each node is responsible for information routing and storage. They are the best examples for infrastructure-less architecture (Chowdhuri et al., 2014). These decisions are based on the network it is connected to and the routing protocol it makes use of, to select the node that would store and further forward a packet. As the ad-hoc networks do not have base stations, packets are transmitted through a multi-hop system (Chowdhuri et al., 2014). There are many applications that are based on ad-hoc networks. Nodes that are in a mobile environment

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make use of the ad-hoc networking concept to be interconnected on the move at all times. One of the best examples of networks that provide communication support in a continually changing or moving environment are Vehicular Ad-hoc Networks or VANETs and these kinds of networks are used in inter-vehicular communications. VANETs can have communication nodes which can be Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) (Sharma & Malhotra, 2014). Intelligent VANETs have already made an impact with their ability to make decisions in case of emergencies. VANETs are said to be made up of three attributes (Raw et al., 2013). The first attribute are the vehicles themselves and they are considered to be the nodes in the network. Secondly, base stations along the roadside make up the infrastructure, thus giving a definite backbone to the network. The third set of components are radio waves which act as the communication channels for transferring data.

VANETs help mobile vehicles that move at great speeds to communicate effectively due to their ability to form intelligent networks that cater to the various needs of applications. A major aspect about these networks to be noted is the fact that these vehicles are highly mobile and are moving at great speeds. When there are mobile nodes that are travelling very high speeds, it may prove challenging to provide connectivity without distortions or network breakages. Due to the unpredictability of the nodes and the direction they might take without any warning, it becomes difficult to route the packets (Chowdhuri et al., 2014). In scenarios such as these, the importance of handoff comes the fore. Handoff is the process by which a link that was previously established between a node and an Access Point (AP) is switched to another point, in the direction in which the node is travelling in or is the closest to. The delay caused by handoff dictates the Quality of Service (QoS) in VANETs (Roy et al., 2016).

In this manner, a vehicle, which can be said to be a mobile node, can exchange information easily without getting disconnected from the APs. Re-routing is the most widely accepted and implemented method for handoff (Wang et al., 2015). In re-routing, a new path is identified and selected to be the route which the node must take in order to get connected to the next optimal AP, without much delay, therefore ensuring that there is no breakage in the communication link. Handoff is one of the most important processes within a mobile environment and it helps in maintaining the QoS of the network. QoS is a measurement of the efficiency of service that is provided by the network in terms of various attributes such as packet delivery, overall delay etc., It estimates how well a system's performance fares against its expected outcome. Certain requirements are expected to be fulfilled by the network that is providing the service to clients and these requirements are known as the QoS of the network (Gupta & Garg, 2015).

Handoff can be broadly categorized into two types based on the network being made use of. The two types are horizontal handoff and vertical handoff. Horizontal handoff is the process of 'handing over' taking place within a particular network itself. In this process, the APs are switched within the same network. In vertical handoff, node switching takes place between APs of different enabling technologies like LTE, WiMAX etc. This process not only focuses on the network allocation, but also used as a decisive agent to select the optimal channel through which data packets can be exchanged. Handoff is also differentiated based on the number of APs a mobile node is connected to at a particular instance of time (Roy et al., 2016). The first type, known as the hard handoff (break before make). In this approach, handover takes place after the mobile node has been disconnected from the current AP. The second type of handoff is called the soft handoff (make before break) where the handover process takes place much before the connection between the current AP and the mobile node is terminated. In such a handoff process, it is necessary to identify the target AP beforehand.

This paper is a survey about different handoff methods that have been proposed by various researchers. The methods that have been proposed follow different approaches to performing an handover and these approaches are compared, which is the novel contribution of this paper. It has been categorized into four sections. Section 2 explains how the problem was formulated. Section 3 gives an overview of the various methods proposed for optimal handoff in mobile environments. Section 4 gives comprehensive summary about the various handoff methods discussed and the different aspects covered by each method. Section 5 provides conclusive findings and the future scope for the work.