



Group mobility support in mobile WiMAX networks

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ABSTRACT

Group mobility refers to the scenarios that multiple mobile stations (MSs) move in a group at the same time, generally in the same direction with a short distance of separation. In the normal operation, when the group of MSs moves out of the coverage of the current serving BS and into that of another BS, multiple handovers processes should be performed at almost the same time. Large latency will be incurred due to the collisions of the ranging requests from the MSs in the group and the extra time for the corresponding backoff. Especially, when the number of MSs in the group is larger, the handover latency becomes much more significant and it would affect transmissions seriously. In this paper, we propose a group handover scheme to design an efficient and effective handover process with low latency for the group mobility scenarios in the mobile WiMAX networks. The Bridge MS is introduced to integrate several handover processes for the group of MSs into only one, which could eliminate the collision of the ranging requests and shorten the latency incurred. The results of the evaluation show that much lower handover latency for the group of MSs during the handover could be obtained by the proposed scheme and the improvement becomes significant as the number of MSs is increased in the group.

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1. Introduction

Mobile WiMAX communication system becomes more and more popular in the recent years. It is specified to provide the broadband wireless access for the wide coverage with high bandwidth for data transmission. The physical (PHY) and the media access control (MAC) layer are detailed in the IEEE 802.16 standard (IEEE Std 802.16-2008, 2008). The mobile devices and the mobility are supported with the specific handover process. With those features, the WiMAX network is suitable to be employed as a communication platform for the military usage and emergency operations. In these situations, the group mobility issues are very important to support the military and emergency applications, in which multiple mobile stations (MSs) could move in the same direction with short separations as a group.

Previous works on the group mobility have been carried out by many researchers. Some works have focused on the setting of a group mobility model, such as the group partitioning and the group representing, in Yan and Jim Mee (2008), Enkhbold et al. (2008), Yan et al. (2009), Gunasekaran and Nagarajan (2009) and Ning et al. (2008). Solutions to provide better routing schemes to enhance the network performance have been proposed in In-Ho et al. (2009), Mingyang and Peter (2009), Seong-Yee et al. (2008) and Sahibzada et al. (2006). Solutions on the fast authentication for

the group of MSs have also been investigated in David et al. (2007) and Tat Kin and Azman (2007). Many other issues related to the group mobility, such as bandwidth management, scheduling and location service have been studied in Eranga et al. (2006), Arul et al. (2008), Teck Meng et al. (2007) and Hui et al. (2008). Besides these, the handover for a group of MSs is a very important topic to be investigated, especially for some specific environments like the military and emergency scenarios.

The handover is a process to maintain the communication connectivity when a MS moves from the air interface of one base station (BS) to that of another BS. The mandatory handover mode in IEEE 802.16 system is the hard handover (HHO), which includes the scanning to select the suitable target BS and the network re-entry to establish a new connection with the selected target BS. However, latency will be incurred during the handover process. This latency could temporarily stop the data transmission and it may cause packet delay for data transmissions. If the delay is large and it exceeds the time constraint for real-time applications, this delay would cause packet drop. This problem becomes much serious when multiple MSs request to perform handovers at almost the same time, which is commonly encountered in the group mobility scenarios. When several MSs move as a group, they may need to start handovers concurrently. The ranging requests will contend to perform ranging at the start of the ranging. The collisions will be produced and much longer delay will be introduced to the group handover processes.

Some research works have been conducted to improve the performance of the group mobility when the corresponding

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