An Intelligent WiMAX Mobile Network Handoff Mechanism with GPS Consideration

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ABSTRACT
Presently, the emerging of WiMax wireless broadband wide-area network technology is very important. Because of transmission distance and faster transmission, more and more researches have been devoted into this field. We hope to apply the technology into our daily life sooner the better. The M-Taiwan plans have been related to the infrastructure of the wireless environment in major cities. This paper is focused on using a set of GPS technology and integrated with 802.16e-Smart cars to provide a handoff mechanism, called the Intelligent Mobile Network Handoff Mechanism. An ASN-establishment of a DataBase Server, is the most important hope that through this DataBase to store information related to GPS, and through this Server to calculate the base station line, handoff. By using our proposed mechanism, a base station can be planned in advance on the path of choice. To reduce the number of possible handoff, scanning the channels and by the waste channel scanning the time it takes, hoping to provide a more stable WiMax services.

Keywords
WiMax, 802.16e, MIPv6, ITS, GPS

1. INTRODUCTION
Recently, Internet network tend to develop in wireless network by using wireless antenna. Users can save the cost through building infrastructure by using wireless transmit. It has to use Mobile IP to provide uninterrupted service when you move between different wireless networks. Nowadays, WiMAX (Worldwide Interoperability for Microwave Access) is the best choice to replace the wired networks. However, it still needs Mobile IP to present handoff, so that make an uninterrupted network, and to improve QoS to take the place of wired networks. The handoff of MIPv6 (Mobile IPv6) and FMIPv6 (Fast Mobile IPv6) are the popular issue for research, it may be the wireless backbone structure in new generation. Users demand for more various service at present, not only connect to Internet, but also the real-time application service and mobility are the tendency of the wireless network development.

There may very likely to be a limitation due to Handoff technology, thus how to predict user path has become an important research. Current research for the mobile users has provided significant results, the user arrived at an unfamiliar region, the accuracy still need to upgrade. Our proposed system consider that most of current ITS have installed GPS, it can directly provide path planning information. Combining handoff functions of 802.16e, it is a practical research topic to provide compatibility of systems handoff without modifying the IEEE 802.16e standard.

The outline of this paper is as follows. In Section 2, the handoff procedures of 802.16e and forecast the path of developed are introduced. Section 3 describes the mechanism of Intelligent Mobile Network Handoff Mechanism. Finally, the conclusion and the future works are discussed in Section 4.

2. RELATED WORK
In this section, we will introduce the following types of technology: ITS, GPS, the overall process of handoff mechanism, IEEE Std 802.16e (referred to 802.16e) of network architecture and mobility support.

2.1. ITS (Intelligent Transportation System)
Telematics is called ITS for short. Transport use the Internet is the trend of development of mobility communication in the future. The current development of ITS main objective is to combine the communications technology provided by industry. It has become the country's main transport system in the development of logistics. Car connected to internet to construct the Ubiquitous computing will be most popular of information communication and business in the future.

2.2. GPS (Global Positioning System)
GPS is the most popular positioning system technology, developed by the U.S. Department of Defense. In the past, GPS only was used in some high-tech areas, for example: for military, aviation or maritime, it's for public usage now. The "car navigation systems" now is an example of practical application. GPS is constructed from 24 satellites, including three preparatory satellites. The overall operation of the satellite positioning system can be divided into three parts: Space Segment, Control Segment and User Segment. It uses the simultaneous signal with the satellite and its relationship between relative positions to detect the exact location.

In fact, there has been a combination of GPS and handoff of wireless networks design proposed in the literature [9], it mainly integrates 802.11 wireless network, Mobile IP and GPS systems constitute the entire structure of the environment, but simply
through the GPS to locate the current location of MS, to choose an AP database from all APs around current position. Then, by telling MN of Mobile IP that it can use the database as a handoff list, but it does not have the designated base stations to process the handoff. Overall, this is a network environment architecture which is decided by end users to make handoff.

Figure 1. GPS combine with 802.11

2.3. Handoff Procedure

Handoff is disconnected from the connection to stop receiving the packet from Correspond Node, until MN move to a new subnet and received the packet from Corresponding Node again. For Wireless internet handoff, its main purpose is providing the handoff of Layer 3, IP layer, but besides the Layer 3, the Layer 2 is also included in the overall handoff of total time. When MN (Mobile User) left the scope of Serving BS (Serving Base Station), in order to avoid any disruption in service, it would search the available Target BS (Target Base Station) which can handoff. MN will set a Neighbor BS Scanning RSSI value (Here’s a example by 802.16e’s MS), once Serving BS signal strength below this value, it will start this process to find the base station, MN according to the channel from backbone or it own allow list to scan and measure the signal strength, once the Serving BS value lower than the Handover RSS Target value, it will start handoff procedures, disconnect the original connection, and connect to the base station it scanned.

Figure 2. Handoff architecture

2.4. Handoff Process of 802.16e

There are procedures in handoff process of 802.16e, which include Cell Reselection, Handoff Decision and Initiation, BS Synchronization to Target BS Downlink, Termination of MS Context respectively.

Before handoff procedure, we must realize the topology near by, which may be part of Serving BS or MS informed that their scanners Channel, Serving BS will be cyclical sending MOB_NBR-ADV to the MS, message contained in the surrounding BS DCD UCD, and so on and access information.

After creating network structure, Serving BS or MS will use the success of handoff to set up a policy algorithm to select one or more handoff for choosing Target BSs for handoff of MS, after getting threshold of handoff, HO can be launched by MOB_MSHO-REQ of MS and then launched a series of messages exchanged necessary. When MS sent MOB_MSHO_REQ, the Serving BS which received message must confirm the possible moving to its network through internet with Target BSs, after Target BSs receiving notification return a response to Serving BS, Serving BS will return a MOB_BSHO_RSP which including all Target BSs state to MS.

MS of 802.16e must synchronize the Downlink of Target BS like 802.16d, and get parameters, such as DCD, UCD, DL-MAP, UL-MAP etc. If MS has been get BSID, carrier frequency, DCD/UCD, and other parameter from MOB_NBR-ADV and Scanning, it can shorten the process.

Final step of handoff procedure is that MS must remove the information of link to Serving BS. Figure 3 is Message Flow for 802.16e.

Figure 3. Message Flow for 802.16e(BS) Handoff
The network architecture of 802.16e is shown in Figure 4. Network Reference Model (NRM) is introduced by following:

- **Base Station (BS):** to provide wireless signals to the Mobile Station (MS).
- **Mobile Station (MS):** generally call Mobile communication device.
- **CSN:** CSN back-end link to the Internet or Application Service Provider (ASP) network.
- **ASN:** components include base stations and ASN Gateway, ASN provide users wireless signals to access, including WiMax Layer 2 link, transfer WiMax AAA message, establishment of Layer 3 link and the tunnel with CSN.

![Figure 4. Architecture of 802.16e Network](image)

### 3. INTELLIGENT MOBILE NETWORK HANDOFF MECHANISM

In this section, we will explain our system and how to provide services, 3.1 explains how Telematics indicative handoff without modifying the 802.16e standard through MOB_NBR-ADV.

#### 3.1. Through MOB_NBR-ADV control

**Telematics handoff**

L2 handoff mechanism includes three steps:

1. Discovery
2. Re-association
3. Re-authentication

Whether a handoff decision will be made is based on the Discovery, and Discovery is used for scanning BS for handoff. The convention handoff mechanism is based on the strength of signal which is getting high enough to threshold for determining to begin handoff. The protocol of WiMAX add a mechanism that back-end network provides BS information around itself (MOB_NBR-ADV includes BS information which can be linked) coordinate scanning, search base station. MOB NBR-ADV is sent by our system which one includes only one indicative BS to handoff.

MS is moving between two BS, it will be affect by them. However, when the signal strength fluctuates within the default level value of handover, it would create the mechanism for starting handoff, resulting in constant change Hand, this situation known as the Ping-Pong-Effect. How to choose BS is the question we want to explain here.

![Figure 5. flowchart of WiMAX combine GPS](image)

First GPS will use Triangulation Method to find the current location and label the values of longitude and latitude. After user deciding the destination, user should point the destination clearly in GPS. Map software using own algorithms calculate the path between source and destination. Map Software will deliver path information to Serving BS through network and deliver to Handoff Management Server which in ASN. According to this information, HMS will calculate the amount of BS which affected the coordinative value respectively.

In Figure 6, After HMS has calculated completely, it will deliver BS-indication message to Serving BS through ASN, and forward the user using GPS. Next step, user wills handoff BS chosen which is indicated. Once user arrived at the location which need handoff, user will scan and process handoff according to the indicated BS frequency. Finally, we can find that the method we introduced does not modify the standard.