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Handoff with MIMO for High-Speed Trains Using Heterogeneous Mobile Communication

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Abstract*: In Communication Based Train control handoff latency is a challenging factor in wireless technology. In this paper handoff latency is reduced by make before break scheme. By this scheme signal detected without multiple radio transceiver at Mobile Station instead two antennas are used one at front end and other at back end which connects with new and old access point respectively. Information about train is sent in Space Time Block Code through which interference is cancelled. With Multiple Input Multiple Output Maximum Ratio Combining (MIMO-MRC) Signal to Noise Ratio is increased. The channel is estimated using Mean Square Error and Bit Error Rate and distance between two APs are calculated. The information about train is encrypted to protect from hackers using Advanced Encryption Standard algorithm. The result shows that using MIMO can significantly reduce handoff latency for CBTC services.*

Keywords *–MIMO,MRC,STBC,CBTC*

I. Introduction

Communication based train control handoff latency is reduced by make before break scheme. By this scheme signal detected without multiple radio transceiver at Mobile Station instead two antennas are used one at front end and other at back end which connects with new and old access point respectively. Information about train is sent in Space Time Block Code through which interference is cancelled. With Multiple Input Multiple Output Maximum Ratio Combining Signal to Noise Ratio is increased. The channel is estimated using Mean Square Error and Bit Error Rate and distance between two APs are calculated.

Handoff signaling is lower than traditional schemes when the data rates are not more than 13Mbps.The required intersite distance, are analyzed and compared with traditional break-before-make schemes .In this paper we propose a MIMO assisted handoff (MAHO) scheme for CBTC WLAN system with two antennas or more antennas configured on train and each AP. WLAN technologies are widely used in communication based train control systems, where handoff latency is the key factor affecting the transmission performance. A MIMO- assisted handoff scheme for Communication based train control systems is reduce handoff latency by using Context aware Handover algorithm and maximum ratio combining.

II.Communication Based Train Control (CBTC)

Communication based train control (CBTC) systems are advanced train control systems utilizing continuous, high capacity, bidirectional wireless communications. CBTC systems are used to exchange control, location and other data between the train and the wayside control center.

A. Multiple Input Multiple-Output (MIMO)

In frequency-selective channels, the use of multiple input multiple-output (MIMO) systems in combination with cyclic-prefixed orthogonal frequency-division multiplexing (OFDM) is an efficient approach to support reliable transmission at high data rates.

B. Wireless Local Area Network (WLAN)

The basic handoff in WLAN is described in the IEEE 802.11. This process performed by 1) Discovery: The discovery process can either be active or passive.

Re-authentication: MS authenticates with the best suitable AP found in the first phase.

Association: Once the MS is authenticated with the new AP, it sends a Re-association Request to the new AP. In response, the new AP sends a Reassociation

C. HANDOFF :

It is a process which maintains continuity of a call or a session of a mobile station (MS) while moving in and out of the coverage area of different cells by changing the current channel in the current cell into a new channel when the MS moves into a new cell.

D. MIMO Assisted Handoff (MAHO)

MIMO signal detection and interference cancellation algorithms can be reliably applied and the "make-with break" scheme is realized without multiple radio transceivers.

E. Make before break

Where the station needs to dissociate with the old AP before it find a new AP and associate with it. In this procedure, the data transmissions will avoided to interrupt, and the transmitted data will avoid to lost.

F. Break before make

Where the station needs to dissociate with the old AP first and then find a new AP and associate with it. In this procedure, the data transmissions will be interrupted, and the transmitted data will be lost. In CBTC systems are Improved and over Performance, Reduce Handoff Delay, Reduce Bandwidth Delay.

G. MIMO-MRC

It is a process which maintains continuity of a call or a session of a mobile station (MS) while moving in and out of the coverage area of different cells by changing the current channel in the current cell into a new channel when the MS moves into a new cell. Multiple radio transceivers are used to eliminate the handoff latency completely. However, these schemes are required to use two or more radio units to scan and preassociate with new APs, which will increase the cost and complexity of the communication system.

Multiple-input–multiple-output (MIMO) systems have been the key technologies in mainstream wireless communication technical standards such as the Third-Generation Partnership Project Long-Term Evolution and IEEE 802.11 Some handoff schemes applying MIMO technologies are proposed in the handover decision method based on the detecting number of antennas is proposed.

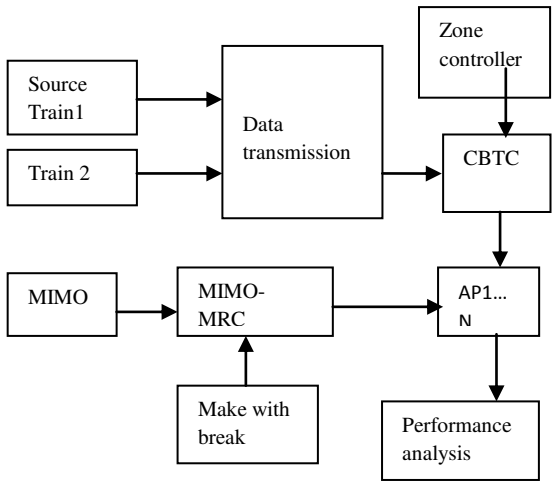

Fig 1. communication based train control systems

III.Overview of Communication Based Train Control Sytem and Reduced Handoff Latency

A CBTC system with WLAN-based train–ground communication system is given in Fig. 1. In this system, continuous bidirectional wireless communications between each MS on the train and the wayside AP are used to transmit train-control related information. MIMO signal detection and Time Block Code through which interference is cancelled. With Multiple Input Multiple Output Maximum Ratio Combining (MIMO-MRC) can be reliably applied and the "make with-break" can be realized without multiple radio transceivers at the MS. When the train move along the rail its mobile station would need to switch from one AP to another AP. The coverage of each AP is quite limited In general, during the handoff procedure, data packets will be lost .When a train moves away from the coverage of an AP and enters the coverage of another AP along the railway, the train will need to switch from one AP to the other to provide continuous data transmission between the train and wayside devices. The handoff procedure will result in communication interruption and loss of train control information. There are no more than 200 APs in the train–ground communication system; therefore, all APs beside the rails are in the same sub network, and only layer 2 handoff issues need to be considered.

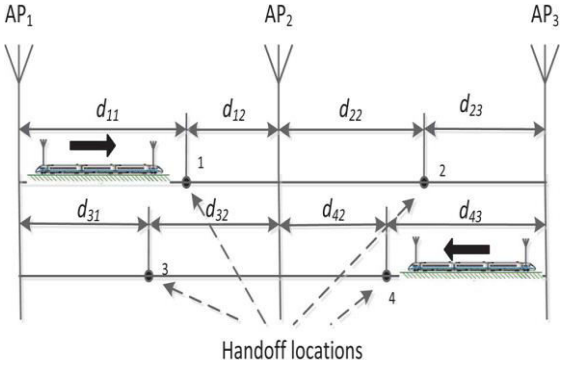

Fig 3. Delay difference between adjacent APs.

MS continuously tracks nearby APs by synchronizing short listening periods with periodic transmissions from each base station. In this way, the station can preassociate with new APs to reduce the handoff latency . In Communication Based Train control handoff latency is a challenging factor in wireless technology. In this paper handoff latency is reduced by make before break scheme. By this scheme signal detected without multiple radio transceiver at Mobile Station instead two antennas are used one at front end and other at back end which connects with new and old access point respectively.

When the train move along the rail its mobile station would need to switch from one AP to another AP the Handoff is produced . Main station is searching the nearest access point . When train reach the end of access point would needs to be switched to the another access point. The process is introduced the handoff latency. Handoff latency is reduced by using the Context aware Handover algorithm .

IV. Conclusion

The purpose of this paper is to present a reduced the handoff latency and frame error rate using the Context aware Handover algorithm and maximum ratio combining. In this paper, we present a WLAN MAHO scheme in a CBTC communication system to reduced the handoff latency and improve the transmission performance. In future work enhanced a heuristic based vertical handover prediction and MIH (Media Independent Handover) based handover algorithm for individual user. By using this algorithm, can reduce handover preparation delay and prevent unnecessary handovers.

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