DESIGN AND PERFORMANCE ANALYSIS OF TRAIN CONTROL SYSTEM WITH AND WITHOUT CO-OPERATIVE RELAYING USING LINK BREAKAGE

D.K.Harish[1], Dr.M.Arun[2]

[1]Student, M.TECH Communication Engineering,
Vellore Institute of Technology (VIT) University, (India)
[2]Professor, Networking Department, Vellore Institute of Technology (VIT) University, (India)

ABSTRACT

A Control system used in this paper is Train Control System (TCS) which performs safety communication operations to the Rail vehicles. These Train Control systems are severely affected by communication latency. Usually these Train Control Systems are in Infrastructure mode, so we need to create a wireless communications between trains.These Train Control systems are very popular in Wireless local area networks (WLAN). Now-a-days due to increase in mobile units, providing the channels for communication in mobile environment is one of the challenging issues. Here in this paper we are going to generate and simulate various scenarios by with and without Co-operative relaying using link breakages between Mobility nodes(Trains) and Access pointby providing mobility to mobile unit as random, fixed pattern and finding the performance parameters like delay, throughput, Jitter, Average Transmission Delay, Average Path Loss, Average Signal Power, Utilization, Energy consumed in Transmit Receive and Idle mode, Percentage of Time in Transmit Receive and Idle mode etc., using Qualnet 7.0 software for network simulation.

Keywords: Co-operative Relaying,Train Control System (TCS), Wireless Local Area Network (WLAN).

I. INTRODUCTION

Now-a-days safety has become a crucial role to prevent accidents between trains. The collision between trains can be controlled by controlling speed allocating a perfect route map to the trains in order to avoid collision. For this we need to design a Train Control System (TCS). We require a safety communication not only in a closed transmission manner but also in a free space and the communication is through wireless medium [1]. The Train Control System (TCS) has a strong requirement in communication availability and latency due to this handoff occurs frequently. Most of this wireless communication occurs in WLAN and the Train Control System uses the technology of IEEE 802.11 standard for communication [2].

In this Train Control System we are going to introduce a concept of co-operative relaying. Normally we use relays in between mobile nodes and access points here the train itself will act as a relay node. The train to train communication is done in order to prevent from regular handoffs. If there is any link breakage between the mobile node and the access point in a WLAN the communication cuts and accidents may occur [3]. That is why here comes a concept of co-operative relaying, if there are any link breakages between mobility nodes and

access points we need to achieve certain challenging parameters like throughput, delay, jitter, path loss etc. Here in this paper we are going to create two scenarios with and without co-operative relaying by link breakage and going to analyse the performance parameters like throughput, delay etc. [4].

The process we performed in simulating the network is as follows: we considered an area of dimension500 X 500, in which mobile nodes, access points and a controller was considered. We gave a path that a mobile unit may travel and observed communication process while the mobile unit is moving along a path. The link between mobile unit and access point is through the wireless network. The data type we considered in communication between mobile unit and the controller is of constant bit rate. A fixed simulation time was set and the graphs of different parameters were observed.

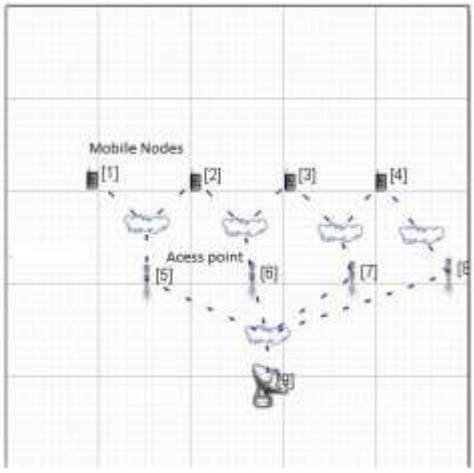

Fig.1 Network Model

II.FIGURES AND TABLES

2.1 Design and Architecture of Simulated Scenario Without Co-Operative Relaying and With Link Breakage

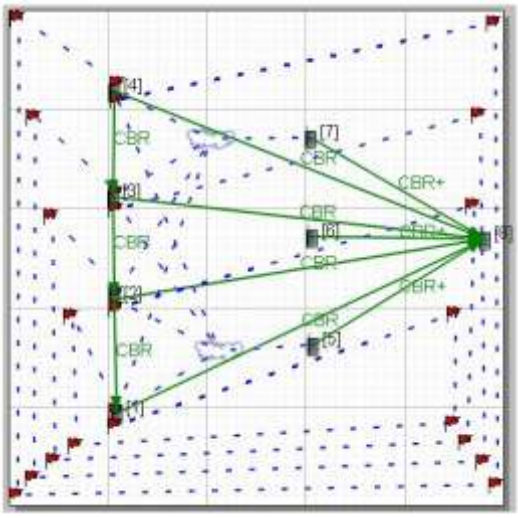

Fig.2 without Co-Operative Relaying and Link Breakage

Here in the above scenario we are going to take 4 mobile nodes, 3 access points and 1 server. If we observe at the 6th node there is a breakage of link and constant bit rate is considered between all nodes.Here we use AODV (Ad hoc on demand Distance Vector) routing protocol.

2.1.1 System Performance of Throughput

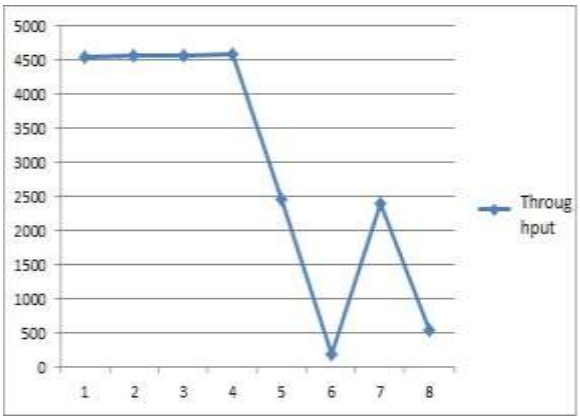

Fig.3 Performance of Throughput

2.1.2 System Performance of Delay and Jitter

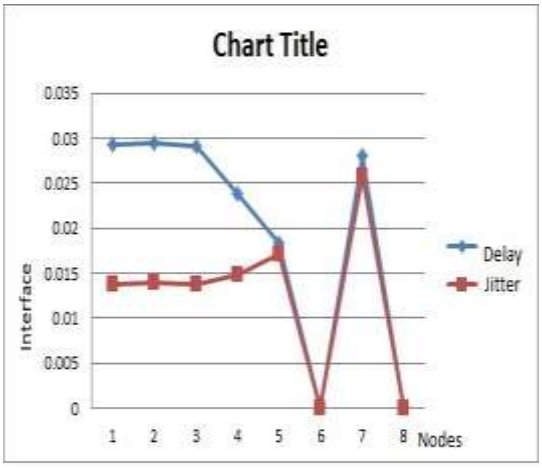

Fig.4 Performance of Delay and Jitter

In the above graphs if we see there will be no throughput, Delay and jitter near 6thnode. This is due to the breakage of communication between mobile node and the access point.

2.2 Design and Architecture of Simulated Scenario with Co-Operative Relaying and with Link Breakage

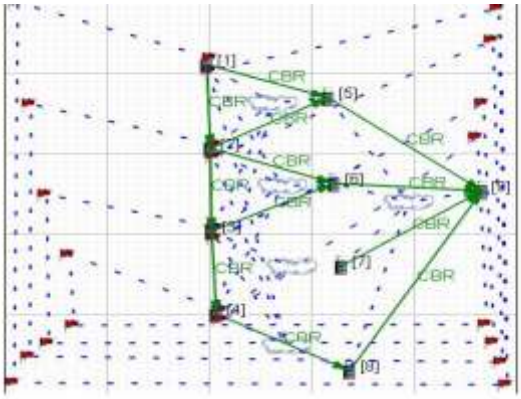

Fig.5 with Co-Operative Relaying and Link Breakage

Here in the above scenario the mobility nodes (1, 2, 3, and 4) are created as the relay nodes by giving a transmission power of 30dbm and CBR is considered between the mobile nodes. For access points nodes (5, 6,

7, 8) the transmission power is given more than the mobile nodes such as 42dbm and CBR is considered between the mobility nodes and the access points. We are using AODV routing protocol. If we observe at the 7th node the wireless communication is broken and co-operative relaying technique is used to fulfil the complete performance of the system.

2.2.1 System Performance of Throughput

Fig.6 Throughput Performance Graph

In the above graph throughput is achieved at the 7th node by the performance of co-operative relaying

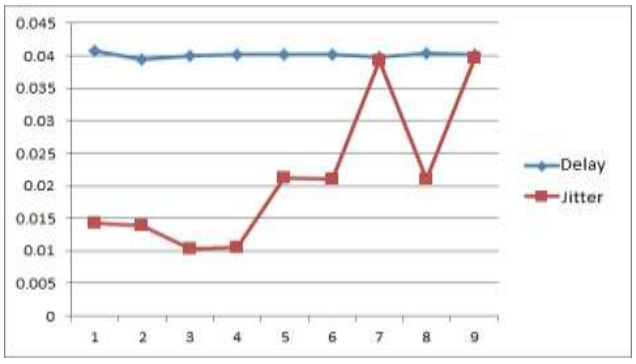

Fig.7 Performance of Delay and Jitter

In the above graph delay and jitter is achieved at the 7th node by the performance of co-operative relaying.

2.2.2 Tabular Column

Performance Method	Transmission power		Data rate (Mbps)	Routing Protocol
	Mobile nodes	Access point		
With Co-operative Relaying	30dbm	42dbm	2mbps	AODV
Without Co-operative Relaying	15dbm	42dbm	1mbps	AODV

III. CONCLUSION

Train Control Systems has requirements in communication delay. Due to frequent Handoffs communication latency occurs. To overcome these problems we have generated various scenarios of network with and without co-operative relaying in Qual Net software by different means of communication architectures by considering relays as mobility nodes with constant bit rate. By these we are going to reduce multiple Handoffs and reducing

communication latency. The advantage of this paper is to achieve various performance parameters like Throughput, Delay and Jitter when there is a communication failure between mobile nodes and access points by means of co-operative Relaying. The future work is done on co-operative relaying with multi-link breakagesand multi hopping.

REFERENCES

[1] Li-jie Chen *, Zhen-yu Shan, Tao Tang, Hong-jie Liu,Performance analysis and verification of safety communication protocol in train control system, Computer Standards & Interfaces 33 (2011) 505-518.

[2] Li Zhu, F. Richard Yu,Handoff Performance Improvements in MIMO-Enabled Communication-Based Train Control Systems, IEEE Transactions on Intelligent Transportation Systems, vol. 13, no. 2, June 2012.

[3] Li Zhu, F. Richard Yu, Communication-Based Train Control (CBTC)Systems With Cooperative Relaying: Design and Performance Analysis,IEEE Transactions on vehicular Technology, vol. 63, no. 5, June 2014.

[4] R. D. Pascoe and T. N. Eichorn, "What is communication-based traincontrol," IEEE Veh. Tech. Mag., vol. 4, no. 4, pp. 16–21, Dec. 2009.