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Communication Based Train Control System

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ABSTRACT

Railway telemetric applications are presently attracting interest and are under intense study. Suitable railway telemetric applications increasingly set to require a subsidiary means to help existent control system make train operation safe and better. Since 2006, train-to-train communication has been studied to respond to such necessity. A main characteristic of train-to-train communication is that operation control to stop possible accidents is conducted among trains without help of a base station. This paper suggests a train-to-train communication in a physical layer depending on multihop and cooperation, taking a high-speed railway propagation channel into credit. The mechanism of this model lie in the idea that a source train use trains on another tracks as relays to transmit signals to destination train on the same track.

Keywords: *Communication; Railway; Control System.*

1.0 Introduction

Railways are most powerful transportation systems which exert significant effect in supporting growth of economies. Safety concerns in railways are attracting a growing amount of attention at present, because the railways have considered an increased responsibility for safeguarding the personal and property safety. Railway accidents generally result to serious dignity loss of life and property.

These phenomena directly encourage the researchers to focus more on different systems for railway safety. The mainstream technique of railway safety in China is the Chinese Train Control System Level 3 (CTCS-3) depends on the Global System for Mobile Communication for Railways (GSM-R) which behaves as a radio interface to link trains with control center to exchange security messages; this system assure that trains are monitored by a real-time device and that they operate at a certain safe distance between each other.

It cannot be refused that the CTCS-3 system has proved to be an exact technique for positioning and also provides a fast exchange of motion state and control messages. However, according to statistics given by the American Federal Railroad Administration (FRA) in the United States, about 8221 accidents threaten the passengers' personal security in the last four years.

This is because a train driver could only be instructed about potential collisions by an operation center. If the operation center fails to send control messages in an emergency, an accident will not occur.

Therefore, it is essential to develop a novel technique to contribute existing system to make control of train operation safer and more accurate. This technique allows the train conductors to keep updated with correct information of traffic conditions in their neighborhood.

Depending on inter-train multihop communication, the train-to-train communication aims at finding a potential collision and then broadcast pre-warning messages to another trains on the same and side tracks.

When a control center system finds potential accidents, the train-to-train communication acts in an assisting role to quickly send messages to other trains and provide potential solutions to the driver to ignore danger. Furthermore, its application also minimizes outlays on infrastructure management for base stations.

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2.0 Literature Survey

In last few years, research on train-to-train communication has been conducted by several organizations, including the German Aerospace Center (DLR). Communications-based train control (CBTC) is a railway signaling system that makes use of the telecommunications in the train and track equipment for the traffic management and infrastructure control. Because of the CBTC systems, the exact position of a train is known more correctly than with the traditional signaling systems. This results in a more capable and safe way to manage the railway traffic. Metros (and other railway systems) are capable to improvise the headways while maintaining or improving safety [4].

A CBTC system is a continuous, automatic train control system exertion high-resolution train location tracking, independent from track circuits; continuous, high-capacity, bidirectional train-to-wayside data communications; and train borne and wayside processors have ability of executing Automatic Train Protection (ATP) functions, as well as optional Automatic Train Operation (ATO) and Automatic Train Supervision (ATS) functions[3].

3.0 World Survey

CBTC technology has been (and is being) successfully executed for different applications. They range from some implementations with short track, finite numbers of vehicles and less operating modes (such as the airport APMs in San Francisco or Washington), to mixed overlays on existing railway networks carrying more than a million passengers each day and with more than 100 trains (like the lines 1 and 6 in Metro de Madrid, line 3 in Shenzhen Metro, some lines in Paris Metro, New York City Subway and Beijing Subway[2].

After all the difficulty, the table below tries to summarize and reference the main radio-based CBTC systems exerted around the world as well as those current projects being developed. Apart from, the table distinguishes between the implementations performed over available and operative systems and those undertaken on completely new lines

Fig 1: CBTC Railway System

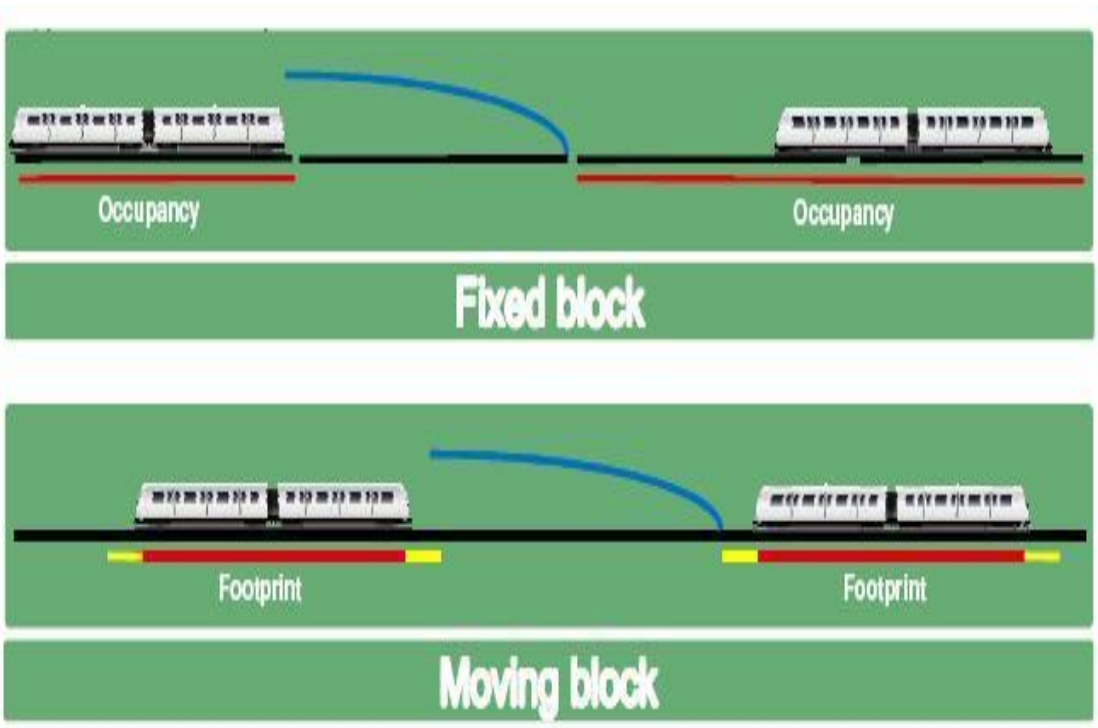

Table 1: Rail Distribution System

Location/System	Times	Supplier	Solution	Commissioning	Km	No. of trains
Las Vegas	Monorail	Thales	Seltrac	2004	6	36
Seattle-Tacoma Airport	Satellite Transit System	Bombardier	CITYFLO 650	2003	3	22
Singapore MRT	North East Line	Alstom	Urbalis	2003	20	40
San Francisco Airport	Air Train	Bombardier	CITYFLO 650	2003	5	38
Hong Kong MTR	West Rail Line	Thales	Seltrac	2003	35.4	29
Lausanne Metro	M2	Alstom	Urbalis	2008	6	17
New York City Subway	BMT Canarsie	Siemens	Traingaurd MT CBTC	2009	17	69
Taipel	Neihu Mucha	Bombardier	CITYFLO650	2009	26	76

4.0 Indian Survey

Chennai: As Indian Railways is planning to bring semi-high speed trains, Southern Railway is gearing up to equip its signaling and communication system in such a way that there will not be human errors when trains are runs at 160 kmph. A railway company belonging China conducted a study recently to find out if semi-high speed trains can be conducted on Chennai-Bengaluru/Mysuru route. Company is yet to give its report.

Railways is planning to bring Communication Based Train Control System, (CBTS), widely used in metro rail networks, to assure that more trains could be operated on the same railway line without compromising on security by improving the signaling and anti-collision safety features. This technology is necessary for running high speed trains.

Speaking at a seminar on "Capacity and Safety Enhancement with Modern Signaling System" consolidated by Institute of Railway Signal and Telecommunication Engineers (IRSTE) railway board extra member S Manohar said importance would be given to CBTC on the mainline and on suburban routes where the number of trains operated was high.

A study in Delhi metro rail showed that CBTC could originate headway of 120 seconds. Hyderabad metro is also planning to bring the system. The system will also display signal status on the dashboard of the train.

TVM Signaling and Transportation Systems Ltd managing director Gopalakrishnan P said, "When speed of the trains is increased, we have to depend more on technology to assure safety. Technology should control on the loco pilot who drives the train. This will reduce human error. CBTC is one such technology. In semi-speed and high speed trains, the role of loco pilot will be supervisory. The control will be with an automated system with a choose number of people monitoring movement of trains."

Research Design and Standards Organization (RDSO) director general P K Srivastava said, "Anti-collision system like Train Collision Avoidance System (TCAS), which has feature of an local technology called Train Protection and Warning System (TPWS), is being developed because safety is critical as speed of trains go up. This will be the future.

TPWS has been under trial in between Moore Market Complex suburban station and Gummidipoondi since 2008. Manohar said the victory rate of the system was 99% [5].

In a paper Ravi Prakash Karcherla from Thales India said, "Radio-based train control technologies is a state-of-the-art and proven signaling system for growing density of trains on a route by minimizing headway and increase in asset utilization ability [3]. Execution of such system in metro rail network should give the chance for railways to explore the technology for mainline networks."

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