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**APT REPORT ON**

**RAILWAY RADIOCOMMUNICATION APPLICATIONS USING POSITIONING AND TIMING INFORMATION PROVIDED BY SATELLITE SYSTEMS IN SOME APT COUNTRIES**

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1. Scope

This APT report provides information on operational scenarios of railway radiocommunication applications that uses positioning and timing information provided by satellite systems and their relevant technical information, field test studies and deployment experiences in some APT countries.

1. Train approach warning system introduced in Japan

2.1 Introduction

When working or conducting inspections on railway lines, train approach watchers are deployed to visually check the approach of trains and notify maintenance workers by voice or sound when a train is approaching to ensure safety by forcing them to move off the tracks. To back up the work of train approach watchers and maintenance workers (hereinafter, referred to as "maintenance workers") which rely on human attention to detect approaching trains, a train approach warning system has been developed that uses positional information calculated from satellites to detect and warn against approaching trains.

2.2 Relevant technical information

The train approach warning system mainly consists of a center server and worker terminals. There are two methods for judging the approach of trains: by the center server and by the worker terminals.

(1) Center Server judgement Method

The maintenance workers positional information is obtained by GPS positional information from the worker terminals such as smart phones carried by maintenance workers and transmitted to the center server on the ground through mobile network operators' (MNOs) services. And the trains positional information, determined from track circuit and railway signal information, are transmitted to the center server from traffic information display (TID) server in centralized traffic control (CTC) section. The collected information is processed at constant intervals, and it is judged in the server whether trains are approaching to the maintenance workers or not. If a train is judged to be approaching, Alerts are transmitted to the mobile terminals held by the maintenance workers to inform them the approach of train using MNOs services and the maintenance workers are notified by a voice and/or a sound alarm.

(2) Worker terminal judgment method

The procedure for collecting maintenance workers and trains positional information to the center server is the same as method (1). On some railway sections, the trains positional information is also transmitted to the central server by MNOs service using on-board GPS unit mounted on the train. The center server picks out trains around each worker terminal and transmits the trains positional information to the worker terminals using telecommunication service by MNO. The worker terminals calculate the distance from the train position and its own position and alerts the maintenance workers by display, voice and vibration.



Fig.1 Configuration of Train approach warning system

2.3 Field test studies or deployment experiences

In Japan, it has already been introduced in several railway companies and lines.

1. **Brief introductions of applications using satellite systems in some other APT countries** 
   1. Australia [1][2]

In Australia, the next-generation train control system, the Advanced Train Management System (ATMS), is being deployed to modernize the rail network. Utilizing GPS and mobile technology (Telstra 4G network), ATMS enables real-time monitoring of trains, leading to significant improvements in safety, capacity, and reliability. As of September 2022, the system is operational on the ARTC network between Port Augusta and Whyalla in South Australia, with plans for further deployment across the Nullarbor region.

* 1. China [3]

China has been utilizing the BeiDou Navigation Satellite System (BDS) for various railway applications, particularly for safety protection. One notable application is "Train Approaching Warning Protection System." The high-precision positioning information from BDS is collected at Train Approaching Warning Protection Centre via railway radiocommunication network, and this information is used to track the positions of both trains and workers. To enhance safety on the tracks, early warnings are issued when a train is approaching workers.

* 1. India [4]

Indian Railways has initiated the Real Time Train Information System (RTIS) Project in collaboration with the Indian Space Research Organization (ISRO), utilizing satellite-based technology. The system employs ISRO’s satellite-based GPS technology, known as the Indian Regional Navigation Satellite System (IRNSS), to provide accurate and real-time information on train movements. This information is collected at the Central Location Server via the Mobile Service Provider Network, allowing Train Control to track the location and speed of all trains. In this way, the system can help to reduce delays and improve scheduling. Additionally, passengers will be able to access real-time information on train locations through their smartphones.

* 1. Korea [5]

The Korean railway system employs various train positioning technologies, including track circuits, axle counters, and doppler radar, etc. Among these, satellite-based positioning systems are also utilized. KORAIL integrates GPS with tachometers to ensure continuous monitoring of train movements. Additionally, Busan Metro Line 1, which includes both above-ground and underground sections, utilizes GPS in conjunction with Wi-Fi and LTE-R to assist drivers.

1. Summary

The systems introduced in this report are typical cases of using positional information provided by GNSS. Such technology is widely used beyond railway radiocommunication applications, so studying them may also be useful for implementing satellite systems. It is expected that this report will be helpful for APT countries in introducing systems using satellite systems within their railway radiocommunication applications.

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