

Annex-3.3.3 Traffic Management and Communication Systems

1 Introduction

Railway signalling systems have been developed and have started to be used in order to ensure the safety of train traffic on railway lines and efficient utilization of railway lines. Progress has been made in signalling systems along with technological developments and today signalling systems capable of controlling a whole train are produced.

Overhead line and analogue carrier systems were used as transmission systems in communication systems before, but then communication ensured through cable type analogue carriers using copper wires as transmission medium. SDH (*Synchronous Digital Hierarchy*) systems with various capacities, access elements and devices providing data transmission have been used as transmission systems with the coming into use of fiber optic cables.

Data transmission and voice communication of signalling and electrification systems (SCADA); constitution of transmission infrastructure of GSMR system; data transmission for computer systems through which several services of our Enterprise, paging systems, informing passengers, communication of multi functional trackside telecommunication system and connections of telephone switchboards are conducted through transmission systems.

Radio systems are used as an auxiliary service to train traffic for providing communication of moving trains with stations, control centres and each other, and conducting services for worksite, port, safety, train formation and et cetera. All radio communication through traffic management or shunting channels are recorded.

2 Signalling Systems

Signalling is defined as an electric and mechanical system regulating railway traffic in railways, highways and ports.

Railway signalling systems aim at ensuring safe railway traffic and controlling of it.

2.1 Mechanical Signal

In mechanical signalling systems, switches within the station area and mechanical signs (semaphores) installed for entry and departure to the station are controlled by levers and transmission wires within the control desk inside the station building.

2.2 Electric Signal

These are electrical systems established for performing regulation and management of railway traffic. It is available with these systems to reach the data acquired by field systems from the centre, monitor the movement of railway vehicles with this information, remotely control compatible field equipment and manage railway traffic.

Electric signalling systems enable centralized control of facilities such as signalling, switches, etc. and centralized monitoring of train movements and they are referred to as TMS.

3 Traffic Control Systems

3.1 Traffic Management with Signals (TMS)

Train traffic is managed from centres via electric signals. Fast and smooth train traffic is ensured in line sections, to which the system is applied, through automatic or operated signals installed on entry and exit of stations and sidings and blocks between them. In this system, adjacent trains run with a block distance between them.

3.2 Management of Traffic from Central with Communication Tools (MTCCT)

Train traffic is managed through instructions given by a telephone fixed in centre in this system. In line sections with this system, some stations were made safe with mechanical signals installed on entries and exits. Whereas, in some stations there is no safety installations.

In MTCCT system, adjacent trains run with a station distance between them. Unless the leading train arrives to the next station, the following train is not dispatched to the same direction.

3.3 Two-Way Communication Based Traffic Control (Broad Coverage Digital Radio System “CBTC”)

Train traffic is ensured by radio link with uninterrupted communication through trackside and on-board equipment. MARMARAY train operation is performed using this system.

4 Communication Systems

4.1 Telephone

It is the corporate telephone system used for traffic management. They are found in traffic control centres, local control desks and near control panels, crossings and signal posts. Conversations made with these telephones are recorded. Using them out of purpose is forbidden. Telephone plugs are located near signal posts and, at certain intervals, communication posts to enable the staff on running trains, locomotives and track vehicles to communicate with traffic controller from trackside. Train staff communicate with traffic controller connecting portable telephones they have to the plugs or unlocking the telephone.

4.2 GSM-R Communication System

GSM-R has been developed embedding additional features for railways to GSM technology in order to resolve the differences between countries in railway operation and provide a unified system to create a standardized application. This system enables uninterrupted communication up to 500 km/h train speed.

4.3 GSM

In the areas where there is not a fixed communication network or operation of it, communication between Traffic Control Centres, stations and trains is ensured via mobile phones with this system and conversations are recorded.

4.4 Radio

During the performance of the services, fixed and portable radio systems, which are not directly related with the train traffic but are supplementary to the traffic, are used for communication between command centres and train staff for increasing the safety level and providing services rapidly. Conversations made with radios are recorded as well.

5 Train Protection and Control Systems

5.1 Automatic Train Stop System (ATS)

This is a system consisting of ATS coil device that is equipped to tractive units through coil circuits placed along trackside. ATS warns the driver to decrease the running speed or stop the train controlling the running speed according to the displayed signal and automatically stops the train if the warning is ignored.

This system automatically stops the train and controls running speed for the safety of the traffic in the case that a red signal in the line sections managed with electric signals is violated due to various reasons. It warns the driver to slow down or stop according to yellow or red signals. Automatic brake become active and stops the train as soon as possible if a red signal is violated.

5.2 Automatic Train Protection System (ATP)

It is an automatic protection system.

It controls the running speed and compares it with the safe speed the train should be running at and calculates the distance between the train and the red signal, status of the line (values such as gradient, speed limit, curve etc.) in designating the safe speed. If this calculated speed exceeds the designated one the system decreases the running speed accordingly or stops the train.

As long as the driver follows the commands given by the signalling system in the line, speed limitation is not directly effective on the driver. ATP only interferes for making an adjustment to prevent exceeding of maximum speed limit or danger points when the driving patterns of the driver is not proper.

5.3 European Train Control System (ETCS)

A different signalling system has been established because of different signalling systems and onboard equipment used in European countries.

Existing locomotives could not be used in the regions and border crossings with different signalling systems, and therefore, separately installing onboard equipment, compatible with the signalling system of the line that will be used, on locomotives became necessary. In order to prevent this, a standard traffic management system has been designed.

ETCS Level-I: Information that can limit the running speed such as colours of the signals being approached by the train in its direction, maximum speed limit in the line section where the train runs, the distance to the stop and curve and tunnels in the direction is conveyed by the equipment installed on trackside to the onboard equipment on the train.

Information received from trackside are evaluated by onboard equipment and the driver is informed vocally and visually through a display in the driver cab. Onboard equipment automatically slows down or stops the train according to the information in case the driver ignores the warnings.

ETCS Level-II: It is a radio based control system. GSM-R is used as the connection of radio. It includes every feature and function ERTMS/ETCS Level 1 provides. As a difference from ERTMS/ETCS 1, train movement authority given by trackside signalling systems is conveyed to the onboard equipment via GSM-R. As there is a continuous communication between trackside and onboard equipment, changes in the signalling information can be instantly delivered to the train.