Study on Automatic Train Supervision of the Korean Radio-based Train Control System

MIN-SOO KIM, YONG-KI YOON, SEH-CHAN OH and YONG-KYU KIM
Radio-based Train Control Research Team,
Korea Railroad Research Institute
360-1 Woram-dong, Uiwang-si, Gyeonggi-do,
437-757, KOREA
ms_kim@krri.re.kr http://www.krri.re.kr

Abstract: - The Communication Based Train Control (CBTC) system reports the real-time train location from an onboard system to a wayside systems and transmits the movement authority through radio communication from the wayside system to the onboard system, and it shall increase railway capacity by allowing the high-density train control through high information transmission amount between the wayside ATP/ATO and the onboard ATP/ATO. This paper deals with the Automatic Train Supervision (ATS) which is the subsystem of the Korean Radio-based Train Control System (KRTCS) which is developing for the purpose of the driverless operation. The difference between the ATS system of KRTCS and the conventional ATS of the existing Fixed Block System (FBS) is receiving the train location information through the ATP, receives detailed train operation status, and can control individual train remotely.


1 Introduction

Railways perform their each function as multiple systems such as vehicles, tracks and signals etc. Therefore, co-operative operations between each subsystem are essential. Railroad signal (or the train control system) is in charge of ensuring safe railroad operation and improving efficiency of railroad operations by maintaining a safe separation of a preceding train and a following train [1].

Signal system which is installed in Korea are Automatic Train Stop (ATS), Automatic Train Control (ATC), balise (or transponders) and Automatic Train Protection (ATP) using the track circuit.

Communications Based Train Control (CBTC) system which is introduced in Korea recently is a railroad signal system based on communications and information technology. Also, CBTC is consists of subsystems such as Automatic Train Supervision (ATS), Automatic Train Protection (ATP), Automatic Train Operation (ATO), Electronic Interlocking (EI) and Radio Communication Network (RCN).

ATS provides system status information and supervision methods, and it performs automatic controls about various system functions.

This paper deals with ATS as a subsystem of KRTCS (Korean Radio based Train Control System) that driverless operation is possible. Also, it described ATS design for KRTCS under development with an aim of driverless operation.

2 Automatic train supervision system of KRTCS

![Fig.1 KRTCS onboard and wayside system diagram](image-url)
ATS of KRTCS is test equipment for standard system specification and performance evaluation of ATP/ATP which is core sub-system of radio-based train control system.

It is built with minimal modifications based on equipment reliability and safety is verified through commercial performance of Korea train control system field. In other words, existing ATS traced the train identification and train location based on track circuit information detected by EI device, ATS of KRTCS transmits location from on-board information in more details to wayside by using radio communication through interface with ATP.

Figure 2 shows a detailed screen about train location information.

![Fig.2 Detailed information about the status of the train via the wireless communication](image)

Also, KRTCS is possible supervision and remote control of train operation status in more details at the central control center on behalf of a train crew if necessary, since KRTCS is based on driverless operation.

In other words, all train operation control commands remote control of the train (manual and automatic control of train speed, lock and release control of block, suppression of train departure, station skip/stop, train emergency stop/release, temporary speed restriction/release, work area set/release, remote inching control and so on) through ATP.

ATP is responsible for the ultimate protection for the safety of the train.

Figure 3 shows all KRTCS wayside system (wayside ATP, RCN, CCTV) including ATS and EI, and Figure 4 describes train operation situation displayed on large display panel of ATS.

KRTCS ATS consists of traffic control computer, MSC, various console, network systems and large display panel, and it interfaces with on-board, wayside ATP/ATO equipment, EI and radio network to implement basic function of KRTCS.

Also, KRTCS ATS is configured to be able to perform these functions such as train operation control, train operation, supervision and treatment, train operation data management and add spare train in case of degraded situation in cooperation with CCTV.

ATS major equipment of KRTCS is as follows.

### 2.1 TCC (Traffic Control Computer)
ATS of KRTCS is a system that enables driverless operation and it is installed as the most reliable system.

As the main processor of the central control room, it transmits to each unit of the central control room by processing the data in the field.

Therefore, traffic control computer must possible uninterrupted operation and its overall system shall not be affected by abnormality that occurred in peripheral device.

### 2.2 MSC (Management Support Computer)
MSC is equipment that performs train operation and various reports, statistics data management. The main computer is connected to traffic control computer and receives train operation performance in real time, and MSC is configured to output data to screen or printer from the request the user's PC when the user requests it.
Also, it is configured to be able to back up the computer functions in case of emergency such as failure of the host computer.

2.3 Operator Console
Operator Console is an equipment that allow local control of operator by displaying to the operator about field status on screen. It performs all displays and control function of the train operation and movement.

2.4 Train Monitor Console
It allows the function that monitoring in front cabin of the train is also possible in control center to the crew understanding operation status in details when driverless operation.

2.5 Programmer Console
Programmer console is equipment that preparation, modification and management of train operation planning, and adjustment of each system major variable or parameters.

2.6 Maintenance Console
Maintenance console shall provide center ATS status and field states to the operator in real time to enable maintenance.

2.7 Large Display Panel
Large display panel displays various field signal information on the screen which is received from main computer and it shall guarantee continuity and stability to allow uninterrupted operation is possible.

Table 1 shows differences between existing ATS and KRTCS ATS.

<table>
<thead>
<tr>
<th>Division</th>
<th>The existing system</th>
<th>The distributed system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify train location informa tion</td>
<td>- Receiving occupancy information detected from track circuits detection device (AF, PF etc.) via electronic interlocking.</td>
<td>- Identify current situation and display by receiving information such as train location, direction and movement authority from ATP.</td>
</tr>
<tr>
<td></td>
<td>- Train location tracking by software algorithms based</td>
<td>-- Identify detailed unit location</td>
</tr>
</tbody>
</table>

3 Conclusion
This paper deals with ATS design which is subsystem of communications based train control system for urban railroad that driverless operation is possible.
Unlike existing ATS, it has differences that receiving train location information through ATP, supervision train operation status and remote control is possible.
ATS system was designed with minimal modifications for apply to KRTCS.

References:


