III INTERNATIONAL CONFERENCE
TRANSPORT SYSTEMS TELEMATICS TST'03

ZESZYTY NAUKOWE
POLITECHNIKI ŚLĄSKIEJ 2003
TRANSPORT z.51, nr kol. 1608

railway interlocking systems,
traffic control and information systems,
railway transport quality

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CONTRIBUTION OF MODERN CONTROL AND INFORMATION SYSTEMS TO QUALITY IMPROVEMENT OF RAILWAY TRANSPORT

Modern railway control systems based on remote control can be applied to increase traffic management efficiency, to centralise traffic control and also to reduce costs. Related information systems, which automatically take information from interlocking equipment, may than contribute to additional increase of traffic management efficiency and improve clients' information.

WPŁYW NOWOCZESNEGO SYSTEMU ZARZĄDZANIA RUCHEM ORAZ SYSTEMU INFORMACYJNEGO NA POPRAWĘ JAKOŚCI TRANSPORTU KOLEJOWEGO

Nowoczesne systemy sterowania koleją oparte na zdalnym sterowaniu mogą być stosowane do podwyższania sprawności zarządzania ruchem, do centralizacji sterowania ruchu a także do obniżania kosztów. Systemy związane z informatyką, które automatycznie pobierają informację z wyposażenia blokady, mogą wpłynąć na dodatkowe powiększenie efektywności zarządzania ruchem oraz udoskonalenie informacji klienta.

1. INTRODUCTION

One of principal standards of quality of transport is its speed. Its improvement can be achieved in different ways, at first by modernizing of infrastructure, than by modernizing of rolling stock and at not least by improvement of traffic management organization. Especially on railway there is possibility of improvement of quality of transport processes by change of interlocking concept.

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2. REMOTELY CONTROLLED INTERLOCKING SYSTEMS

One of possible modifications is creation of centralized control and interlocking system. In period of development of remotely controlled systems (RCS) we should have in mind distinctions, which result from different situation at main and branch lines. It is clear that there is not necessity to equip all lines with the same equipment. So it is necessary to build interlocking system with acceptable risk level (e.g. traffic disturbance in case of system failure, security risk level etc.) and acceptable costs in view of importance of line and character of traffic.

2.1 BRANCH LINES

The primary reason for implementation of RCS on branch lines is reduction of staff, which capacity is obviously not utilized, but it is not only benefit of these systems on branch lines. Other benefits, which can be fully used on main lines, are written in section 2.2.

The next possibility of quality improvement and efficiency of traffic management is system of radioblock. Its realization involves secured master computer in centre and secured terminal in vehicle with function of simple automatic train control, both connected to data channel of radio link. The line has to be equipped with passive balises. Coverage of line by radio signal is necessary only in places of transmission, i.e. especially near stations. It is expected that in view of highly differentiated conditions on lines system could be applied in various levels, which can be increased without difficulties and which are compatible. At the highest level this system should be compatible with ETCS on main lines. The meaning of this system is to allow movement of train at line speed with acceptable security risk level and minimum lossages.

2.2 MAIN LINES

The primary reason for implementation of RCS on main lines is impossibility of effective managing of traffic from separate interlocks in stations, because in particular stations are not available direct information about traffic in distant locations of railway line and mediated information do not allow correct deciding, because they are not punctual enough. This situation is getting worse with increasing number of trains and with their increasing speed. RCS allow higher traffic management effectiveness and minimization of traffic disturbances impacts. In regard of necessity of high operability under all circumstances (e.g. failure state of system) there is not possible to realize so extensive staff reductions as on branch lines. It is necessary to establish the most optimal conditions for traffic and its quality.

3. SUPERSTRUCTURES OF INTERLOCKING SYSTEMS

Superstructure, which provides transmission of information about train movement from interlocking system to railway information systems, can be established. This information can conduce to additional improvement of traffic management effectiveness and they can also conduce to clients of railway, whether in passenger transport (train location) or in freight transportation (monitoring of consignment). One of these systems is GTN, which will be described in section 3.1. Interconnection of interlocking and information systems has some problems, which result from principles of interlocking.

The main problem of this connection is that between interlocks and RCS devices are transferred safety-relevant information and for their simplification is necessary to have closed network by standard EN 50159-1 in whole area. It means that, aside from another technical details, there is requirement that device, which is operated in transition network, cannot generate information that appear as RCS information and they cannot create access for trespassers.

Closed network and no generating of reserved information cannot be proved or it would be difficult to keep closed network after longer running period.

Because there is no existing interlocking system prepared for alternative solution by open network in sense of standard EN 50159-2, there is no possibility to establish open interconnection between interlocking system and any superior control system. In this stage is possible only restricted interconnection, when data are sent from interlocking system and access to this system is disabled in sense of requirements of interlocking equipment. Available technical solution is unidirectional connection of fail-safe network and network of other information systems (OIS), which allows OIS to obtain actual and relevant information about traffic through interlocking system, but on the other side it inhibits access from OIS network to RCS network (OIS network means e.g. GTN network and linked system CEVIS, MIS etc.) In no case is possible to control interlocking equipment directly from OIS network.

In their consequences cannot be utilized all possibilities of these systems, e.g. if there is train route to right section of station, etc. If we want to execute these supervisions we have only one possibility now – implement it directly into RCS.

3.1 GRAPHICAL AND TECHNOLOGICAL SUPERSTRUCTURE (GTN)

Graphical and Technological Superstructure is computer application designed as a support for traffic management on determinate sector of railway network. It is characterized as a superstructure of interlocking system with transfer of train numbers. Application is preferred on lines with RCS, but it could be applied in isolated stations too.

With regard to connection of interlocking and information functions, GTN is instrument for effective traffic management. This application allows:

- to monitor activity of interlocking system and, on basis of train numbers transfer, collects required information about current state of traffic in controlled area, both in real time,
- to display and documents real realization of traffic on line sections and in particular stations – train log, train diagram of executed traffic, operation log,
- to do traffic statistics for assigned area,

- to use immediately information about current state of traffic for generation of prognostic model – updating of train route in train diagram allows instant evaluation of transport processes,
- to change organization and planning of traffic for next period,
- to connect to Information System of Operative Management (ISOR), so it is gateway between interlocking system and information and management systems of railway traffic (CEVIS, MIS, CDS),
- to be source of information about optimum form of train movement, which will be conveyed to locomotive driver and they will directly affect driving dynamics of train.

3.2 CONCLUSIONS

It is obvious that interlocking and information systems contribute to quality of railway transport. Remotely controlled interlocking systems and their connection with information system for managing of traffic and for customers are the right way to improvement of quality. In period of development and implementation of these systems we must accept different conditions of individual line and the solution must be adapted to these conditions.

4. AUTOMATIC DISTRIBUTION SYSTEMS OF INFORMATION FOR PASSENGERS

Information systems for passengers can be divided in principle to acoustic and visual systems. Both of these systems should deliver integrated information about movement of trains relative to railway station or stop. Part of this information, which is distributed manually now, is possible to be generated automatically by system GTN. In that case is necessary to tell apart about situation in stations and stops.

4.1 RAILWAY STATIONS

Nowadays most of important stations in Czech Republic are equipped with visual and acoustic system for informing of passengers. Minor stations are mostly equipped with acoustic system or there is not system for informing of passengers. Information for these systems is generated manually, although with some computer assistance (e.g. selection of type of announcement).

For fully automatic distribution of information is necessary the system connected to interlocking system. This requirement is fulfilled by system GTN connected to interlocking system with transfer of train numbers.

Visual information

The first visual information about train is displayed on information panel as soon as there is free place. This place can appear in time of departure (or in specific time after arrival) of some train, which listed on this panel. This information contains on departure (arrival) panel (and so on platforms and on ways to platforms) type and number of train, direction of train and scheduled departure time and can be taken from train diagram.

The specification of platform or track is suitable after departure of previous train from this track to prevent accession of passengers to wrong train. Information about track is also in GTN. The problem of this solution, especially in main stations with long access way to platforms, is occupation of track just after departure of previous train, when there is need to ensure as little time of stop in station as possible. In this case is suitable to specify the track sooner in connection to expected departure time of previous train.

GTN system also transmits information about delay of trains, which is possible to be displayed before time of scheduled arrival (it is not usual these days).

Approximately 5 minutes before expected departure or arrival time (this information is in GTN system) is also suitable to display this fact on information panel, e.g. by bulb blinking.

After actual departure of train (it is information from interlocking system transmitted by GTN) will be the information about this train deleted from panel. In case of arrival is suitable to display information about train certain time after.

Acoustic information

The first acoustic information comes approximately 5 minutes before expected arrival time. This information could be taken from GTN system, because it provides current information about train movement and automatically corrects expected train diagram. In this time there is announcement about train type and number, the direction of train, times of arrival and departure, the platform and eventually the train setting.

The next information is arrival of train. This information is available in GTN system as information from interlocking system about occupation of track. The correction of this time (difference between time of occupation of track and its arrival) is also possible in GTN system.

The last information about train is call to ending of accession, which is provided in designated time before departure. This time depends on local conditions.

The important information is also the delay of train. It is suitable to inform about it at least 5 minutes before scheduled arrival and then in regular intervals and in case of change of delay. Similar times should be applied in case of departure. If the change of expected departure is known later, then is suitable to announce it immediately.

4.2 RAILWAY STOPS

Railway stops are important part of railway system and there is very insufficient standard of information for passengers. There is mostly only one source of information – the table of arrivals and departures. This fact has a great impact on interest of passengers, because there is not way to announce them any disturbances.

Visual information

At stops is sufficient to install panels for visual information about two next trains (it is possible to display it apart by relevant track). This information should contain especially direction of train, scheduled departure and delay of train. Track number should be also displayed, especially in case of traffic closure of one of tracks. Information from GTN would be: scheduled departure, direction of train, delay of train and used track. In short time before expected arrival of train is possible to use stronger visual signalization (bulb blinking etc.).

Acoustic information

Approximately 5 minutes before scheduled arrival of train (this time could be different in view of local conditions) could be announced information, which contains at least direction of train and scheduled departure, and also delay of train – when it comes, there should be another announcement 5 minutes before expected arrival of train. In case of bigger delay is reasonable to repeat this information in appropriate intervals. When the train is not going, there is necessary to inform passengers about alternative connection – this information cannot be announce automatically from GTN system.

Next announcement, which contains information about direction of train and used track should come before expected arrival of train.

4.3 CONCLUSIONS

Connection between GTN system and information systems for passengers is missing link especially in case of railway stops or stations without personnel, which can be count as stops in view of distributing information for passengers. There are passengers without any information about disturbances directly at stops now in Czech Republic and they have to only wait when the train arrive in case of delay or cancellation of train. This situation does not contribute to attract passengers to railway transport. With regard to this situation is necessary to mention that this information is also missing in bus transport and improvement of way of information passengers in railway transport could be competitive advantage.

On the other hand there are bigger station, where is necessary big number of announcements, including announcement about connected trains. When we use automatic announcing, there could be situation that the information is distributed with delay, so they are useless, and this delay is transferred to next announcements. So I think that there is suitable to have operator of acoustic information system in these stations. Visual information could be in view of their character displayed automatically in connection with GTN system.

ABBREVIATIONS

CDS	Central Dispatching System (on the Czech Railways)
CEVIS	Central Information System of Rolling Stock (on the Czech Railways)
ETCS	European Train Control System
GSM-R	Global System for Mobile Communication – Rail
GTN	Graphical and Technological Superstructure of interlocking system
ISOR	Information System of Operational Management (on the Czech Railways)
MIS	Local Information System (on the Czech Railways)
OIS	Other information systems
RCS	Remotely controlled systems

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