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traffic management and control,
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REGIONAL CENTERS OF RAILWAY TRAFFIC MANAGEMENT

The paper presents a general approach to the issue of centralization of railway traffic control and management in the multi-post marshalling areas and on selected examples of installations operating within PKP. Various variants of equipment and systems of traffic management-control (ksr) for these areas have been considered. The summary presents conclusions resulting from site inspections and operating experiences of presented solutions.

OBSZAROWE CENTRA STEROWANIA RUCHEM KOLEJOWYM

W referacie przedstawiono w sposób ogólny problematykę centralizacji sterowania i zarządzania ruchem kolejowym w wieloposterunkowych obszarach nastawczych oraz na wybranych przykładach instalacji działających na PKP scharakteryzowano różne warianty wyposażenia tych obszarów w urządzenia i systemy kierowania-sterowania ruchem (ksr). W podsumowaniu przedstawiono wnioski wynikające z badań terenowych oraz doświadczeń eksploatacyjnych prezentowanych rozwiązań.

1. INTRODUCTION

Polish State Railways (PKP) using experiences gained in European Union countries adapt their structure to the new environment conditions. The company realizes its objectives in the process of restructuring. These goals may be formulated as:

a) adaptation of PKP company to the requirements of market economy,
b) approaching PKP to the standards and solutions assumed for railways in the EU countries,
c) internal rationalization of PKP company economy.

Realization of these established goals is not possible without change and adaptation of services offered by PKP in the area of accessibility of railway infrastructure and its changes. The progressing process of Poland's integration with the European Union was one of the factors conditioning a dynamical progress of works aimed at implementation of revision of solving the traffic control issues in multi-post control regions.

These works have resulted in preparation and approval by PKP a concept to equip the railway trunk lines E-30 and E-65 with the traffic control equipment, as these trunk lines will be modernized as first. These concepts expressly provide for requirement concerning establishing large-area control centers in Wrocław (for line E-30 it will be section Zgorzelec-Wrocław-Opole) and Kraków (for line E-65, section of CMK).

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And simultaneous carrying out and implementation of new control techniques on the test sections (smaller than the target centralized control areas). Practically, work with implementation of this type of systems in PKP started at the beginning of nineties and resulted among others from appearance of computerized supervisory systems for the management and control of traffic.

At the beginning they were remote setting systems (such as computerized panel of SABEL type), later on they were remote control systems (such as OSA – ZS) and the requirements for the integrated ksr systems were formulated not earlier than after gaining certain experience.

In practice, PKP has three rather highly advanced ksr systems, namely: the WSKR-2 system, developed by Technical University of Warsaw that is the longest used in PKP, then Ebiscreen 3,0 (Adtranz) and ILTIS (Siemens) systems being on the testing stage.

As systems ILTIS and Ebiscreen 3,0 are quite similar in assumed philosophy of task realization, we may assume that they belong to the same class of ksr systems. This paper discusses instances of systems WSKR-2 and ILTIS.

2. TRAFFIC MANAGEMENT AND CONTROL SYSTEM (KSR) – GENERAL INFORMATION

A KSR system should feature modular design, enabling dynamical change of its configuration in the case of changed number of objects to be governed. It may be built in various functional and hardware configurations. It consists of three components: dispatcher's control, remote control and train information transfer. Depending on needs, the KSR systems may appear single-handed or in combination of two or create an integrated whole containing all the elements named above. A general structure of the KSR system is shown on Fig.1.

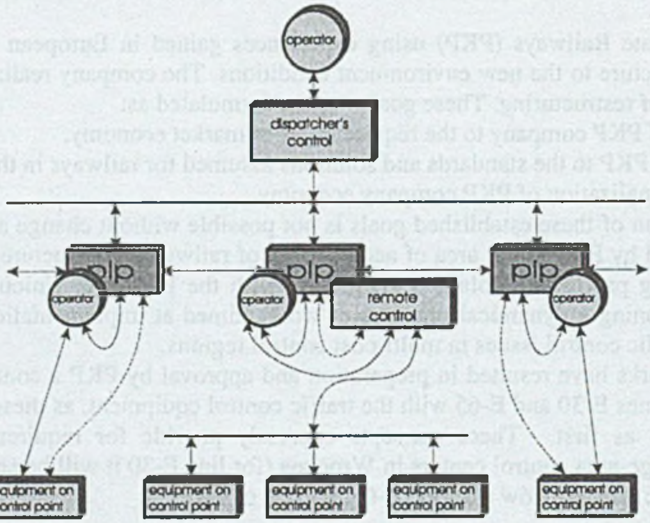

Fig.1. A general structure of KSR system

The structure of dispatcher's control system assumes existence of one control center provided with all technical means for this purpose and adequate number of posts for section dispatchers' work. The structure of traffic control system consists of two levels:

Local level includes traffic control from a work-stand located on this control point. At this level, control seldom takes place, only when particular need arises. Control points on this control level will not be manned permanently with train dispatchers. Larger control points may have installed a fully equipped train dispatcher's work-stand, whereas smaller ones basically do not provide for the local control. The above principles do not apply to the stations, where control centers will be located. As a rule, these stations will be controlled locally.

Level – local control center includes control of the point where it is installed, either as a local or remote control of subordinate control points.

Due to the tasks performed, the local control center will be provided with the full operating work-stand both for local control on its own, and work-stand for remote control of the subordinate control posts as well as permanent dispatching staff (train dispatchers).

Theoretically there are three variants possible for a solution of the train traffic management and control system:

1. centralized management and dispatching of train traffic from one or several remote traffic management and control centers;
2. decentralized traffic management by the train dispatchers on the stations and branch posts and centralized traffic management from one or several dispatcher's supervision centers (dispatcher's control);
3. an intermediate solution consisting in managing the traffic by sectional train dispatchers within the small areas including either several small intermediate stations or a single large one with adjacent branch posts and centralized train traffic control from one or several dispatcher's supervision centers.

Both centralized traffic management from one remote traffic control center as well as remote traffic control in small areas does not cover maneuvering control on hump yards, maneuvering yards and maneuvering tracks separated of other stations. The selection of an appropriate concept of management and control of train traffic requires that certain factors are taken into account, such as:

- linking with other PKP lines,
- structure and type of operational tasks on each traffic control post,
- traffic reliability understood as minimization of impact of malfunctions occurring in operation of the technical line equipment operation (SRK equipment, traction lines, subsoil, etc) on the timeliness of the train traffic.

3. CHARACTERISTICS OF SELECTED KSR SYSTEMS

3.1. WSKR-3 SYSTEM

The WSKR-2 system was implemented in PKP in a step-by-step way, installed on the line Kraków - Medyka as WSKR-1, then, in later version of WSKR-2 on the Reda – Hel line, and in both cases it was cooperating basically with relay-based equipment of E type. This cooperation takes place through a relay interface. It constitutes a separate device connected with the OZS/OS controller (station Reda-Hel). The last installation of the system took place on the section E-20 on the LCS Błonie area including the following stations: Gołąbki, Ożarów, Płochocin, Błonie, Teresin-Niepokalanów, Sochaczew. The above mentioned control posts are provided with the SRK interlocking systems of type Ebilock 850. This resulted in a necessity to implement a link (interface) between the Ebilock 850-type system and LCS equipment of WSKR-2 type. In the presented case, the role of interface between these systems is performed by the OZS/OS controller with a software interface. Due to this fact, it may functions related with the cooperation of WSKR-2 system with the interlocking computer APN585 of Ebilock 850 system, while still performing its hitherto functions.

For the purposes of WSKR-2, the physical transmission of data to/from Ebilock 850 takes place using 2 pairs of RS232 lines, i.e. in a standard way of linking this system with the supervisory system (computer panel of a local or remote control). Supervisory systems hitherto used with Ebilock 850 are MAN900 and Ebiscreen. In the case of WSKR-2 the aforesaid RS232 lines are to be routed the OZS/OS controllers where they are connected to the standard I/O cards.

The LCS Błonie is provided with a computer supervisory remote control system WSKR-2/ZS (computers NZS, monitors, digitizers) enabling the sectional dispatcher to control the SRK equipment (APN 586 computers) at the posts controlled, i.e. realization of train traffic control process in a multi-post region of remote control. The system WSKR-2/ZS configuration for the LCS Błonie is shown on Fig.2.

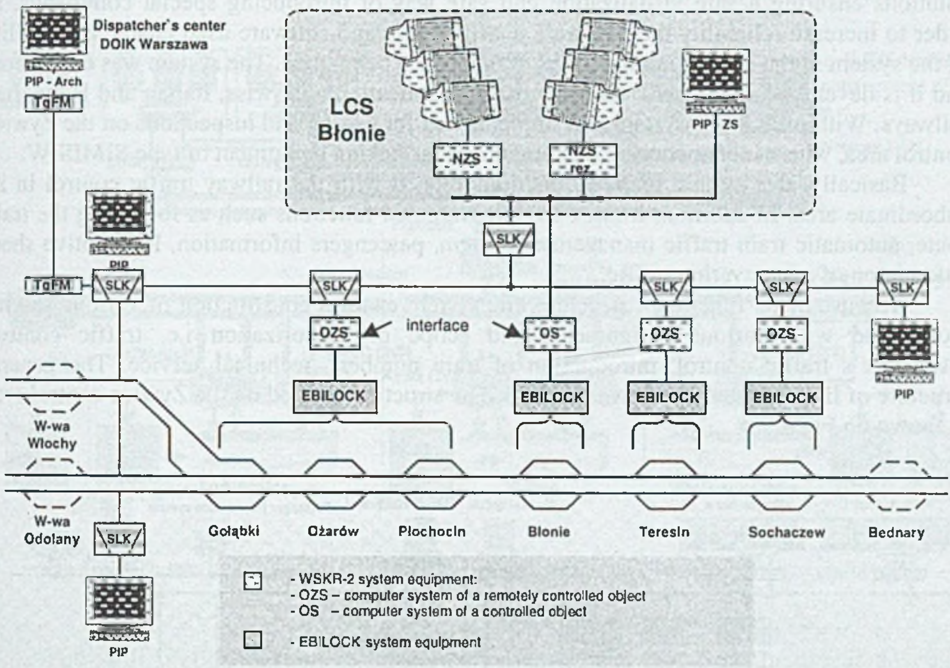

Fig.2. WSKR-2/ZS configuration for LCS Błonie

Computer remotely controlled object controllers (OZS of WSKR-2 system) at the Błonie station and controlled object controller (OS of WSKR-2 system) are installed on the following posts: Ożarów, Teresin-Niepokalanów and Sochaczew, enabling controlling of interlocking computers APN 586 installed at these stations. The a/m controlled posts are then provided with the mentioned above software interface.

The RS232 connections between the WSKR-2/NZS controller located at the Błonie station and WSKR-2/OZS at the station of Ożarów, Teresin and Sochaczew are realized using railway communication system SLK of the Bydgoszcz manufacturing PZŁ. They are based upon optical wire connections. The SLK system is a transparent one from the point of view of WSKR-2, because it does not interfere with the contents and format of telegrams being sent.

Thus configured, the WSKR-2 system serves the area covering: 107 centralized points and trippers, cooperates with the Eac line block in 3- and 4-position versions, pbl Eap and has 7 A category level crossings interlocked in the routes.

3.2. ILTIS SYSTEM

The ILTIS system is designed for handling the railway traffic and automation of interlocking frame service operation with use of a graphical user interface. It is designed for remote control of one or more stations and controlling areas. It enables construction of many train control and dispatcher's work-stands as well as those of technical services. It was adapted for controlling of computer- and relay based on the SRK systems. The system uses solutions ensuring a safe visualization and safe way of introducing special commands. In order to increase reliability the hardware configuration and software used enable availability of the system in the case of malfunctions of one of the computers. The system was engineered and it is developed since 1990. Its main area of application are Swiss, Italian and Hungarian railways. Within PKP this system was implemented for testing and inspections on the Żywiec control area, where it cooperates with computer interlocking equipment of type SIMIS-W.

Basically, this system realizes functions related with the railway traffic control in its subordinate area. In addition, it has other programmed functions such as following the train route, automatic train traffic management system, passengers information, locomotive shed, automation of maneuvering traffic.

Because of its functional structure, the system enables construction of various service work-stand with various assignments and scope of authorization i.e. traffic control, dispatcher's traffic control, introduction of train numbers, technical service. The general structure of ILTIS system is shown on Fig.3. The structure applied on the Żywiec control area is shown on Fig.4.

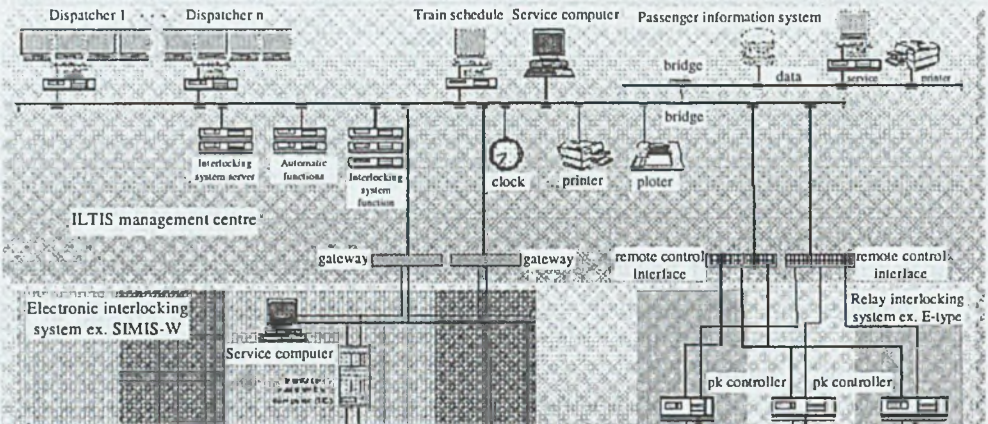

Fig.3. Instance of system ILTIS configuration

The configuration presented above shows possibilities of cooperation with the on station traffic control systems, both relay- and computer based ones and with passenger information systems. The similar principle renders feasible also cooperation with the heating control systems rolling stock diagnostics, fire protection etc. All computers are linked with a computer network that constitutes a very important element of the system.

The ILTIS system network is separated i.e. no connection of other computer systems is foreseen for the same network segment where ILTIS system is connected.

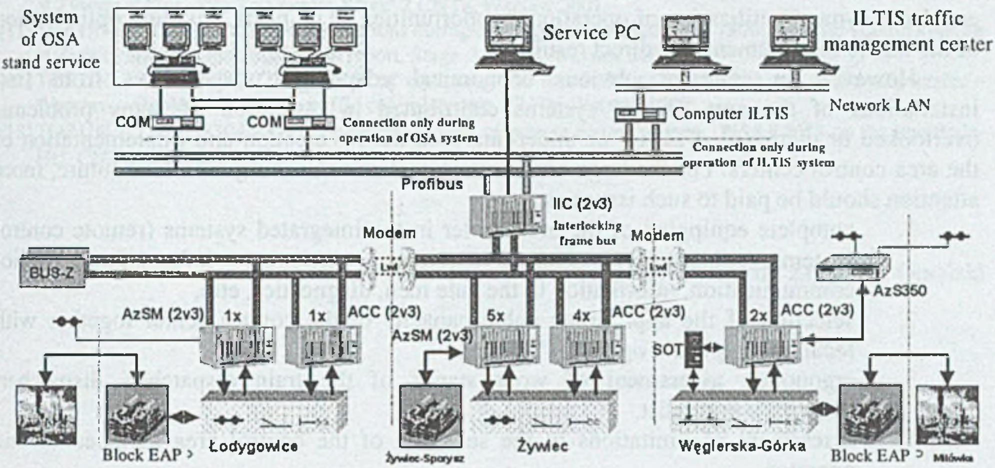

Fig.4. Structure of ILTIS and SIMIS-W systems in their version applied in the Żywiec control area

The configuration and concept applied in order to achieve high availability do not cause the requirement of using special or industrial versions of software, as system's availability it is ensured by redundancy of devices and well constructed structure of software. The ILTIS system is built in such a way that at least three computers – CUPU's operate in team at the same time.

An appropriate configuration of software on these computers ensures that in case of hardware failure or necessity to switch out one of the computers, the system remains operational and lack of one computer does not impair its functionality and availability of the entire system. Disconnection and re-connection of one computer does not result in disturbed operation of the entire system, thus does not require interruption of traffic or system restart.

Thus configured, the ILTIS system serves the area provided with: 45 centralized switch-points and trippers, 62 signals cooperate with Eap line block, key lock, SOT track circuits, axle counters, and has one level of the railway crossing of A category interlocked in the routes.

4. CONCLUSIONS RESULTING FROM OPERATION OF AREA CONTROL SYSTEMS

The experience acquired during operation of the KRS systems have confirmed the justified implementation of these type of systems in PKP on one hand, and have shown, how many problems are to be dealt with during preparation of specific proposals of line modernization on the other.

The advantages, undoubtedly, include reduction of employment and more effective use of human resources (in case of the Żywiec control area modernization allowed transfer of 10 train dispatchers and 10 signalmen to other posts) as well as improvement of work conditions and increase of the railway traffic management safety. Efficient train traffic management resulted in ca. 30% reduction of time necessary for preparation and setting of routes and enabled a dynamic utilization of operational opportunities on all posts, entailing optimization of the traffic management as a direct result.

However, in spite of obvious economical advantages, experiences from first installations of the area control systems contributed in revelation of many problems, overlooked or disregarded earlier or under-analyzed during creation and implementation of the area control centers. For the large-area control centers to be designed in the future, more attention should be paid to such issues as:

1. complete equipping of the area center in the integrated systems (remote control systems, dispatcher's control systems, passenger information, radio-communication, information to the gate men, diagnostics, etc),
2. selection of the appropriate cubic capacity of the control center together with location of specific operators' stands,
3. ergonomic assessment of work stands of the train dispatcher, dispatcher, diagnostic specialist,
4. assessment of limitations in the selection of the control area assigned to one operator,
5. solution of A category level of the railway crossing control with interlocked routes.

We have to hope that the experience gained during realization of the specific area control systems already implemented in PKP will be used for solving the issues arising during realization of really large line modernization projects, that constitute a measure allowing PKP to achieve goals mentioned at the beginning of this paper.

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