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MODERN STRUCTURES OF RAILWAY TRAFFIC CONTROL

New electronic and data transmissions open new possibilities of railway traffic management and control. Today, we have really safe computer solutions, we can observe very fast development of this technology. Management centralisation gives many advantages as well for railway operators and railway customers. Hardware concentrations allow for better technical development. A data transmission is nerve system of this structure. Even transmission has no safety meaning, we should remember to have possibility for temporary system decentralization for local operated.

NOWOCZESNE STRUKTURY STEROWANIA RUCHEM KOLEJOWYM

W referacie opisana została struktura sterowania i zarządzania ruchem kolejowym w oparciu o nowoczesne urządzenia srk oraz techniki transmisji danych. Przykładowa organizacja oparta została na rozwiązaniu wdrażanym przez kolej niemiecką DB. Struktura ta składa się z Centrum Zarządzania Ruchem we Frankfurcie pełniącym nadrzędną funkcję dyspozytorską wobec siedmiu Obszarowych Centrów Sterowania Ruchem, na które została podzielona sieć kolei niemieckich. Podstawą systemu są nowoczesne urządzenia komputerowe oraz Lokalne Centra Sterowania rozmieszczone na sieci DB.

1. INTRODUCTION

New technologies we can meet in our day to day life and modern science are more and more used in rail traffic solutions. As new technology was easy accepted in information and commercial systems, its implementation in traffic control proceeds quite cautiously. Functional abilities of modern systems are enormous but because of their safety responsibility traditional systems are considered as more safe sometimes.

Computerization of this part of technology seams to be unavoidable anyway. There are some solution already designed which are guaranteed to be safe at the level no lower then traditional systems.

Experience of European railways proofs great possibilities due to using computerized control systems and sets direction for their further development.

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2. MODERN TRFFIC CONTROL SYSTEMS STRUCTURES

The german railway example will be used as a most advanced modern control technology.

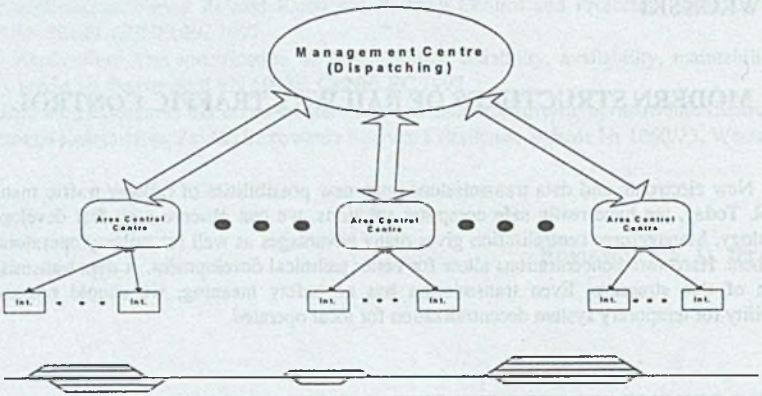

Fig.1. Block diagram of control system structure

This concept is based on modular structure divided into several levels. The base level consists of existing interlockings as well as local remote control centres. Generally they are computerised interlocking, however it is possible to use interfaces to relay interlockings.

Upper level consists of Area Control Centres. German railways DB are divided into seven such centres. In the future, all local operators will be moved to that centres. Supervisory rule in this structure belongs to Network Management Centre (NMC), controlling whole national railway network.

The idea of Network Management Centre (called Dispatching Centre as well) is based on concentrating all dispatching, maintenance, information functions in one place and integration of all functions required for network management by one system.

Functions integrated in Network Management Centre are dedicated mainly for train traffic monitoring and supervision.

Sufficient operation of railway network depends on proper operation of signalling equipment like signals, point machines, ATP systems as well as systems improving customer service like passenger information, lifts, ticket machines. This is the reason how important integration of supervisory and maintenance functions in one place is. Additionally in this solutions information systems may use real time data directly from traffic situation

Network Management Centre, together with Are Control Centres makes up coherent traffic management and control system. Individual tasks are realised by different servers using the same database. Fig. 2 presents block diagram of traffic management system. Its main assumption is to connect all spread operators terminals with one network. Inside the centre this is the role of LAN (*Local Area Network*). The design of the network dues to it certain requirements. All control elements allocated on the network are connected by special, safe

interfaces with WAN network (*Wide Area Network*). Local Control Centres as Alcatel's system ESTW L90, others electronic interlockings or other relay systems are fully controlled by multifunctional Man Machine Interfaces (MMI) located in Centres.

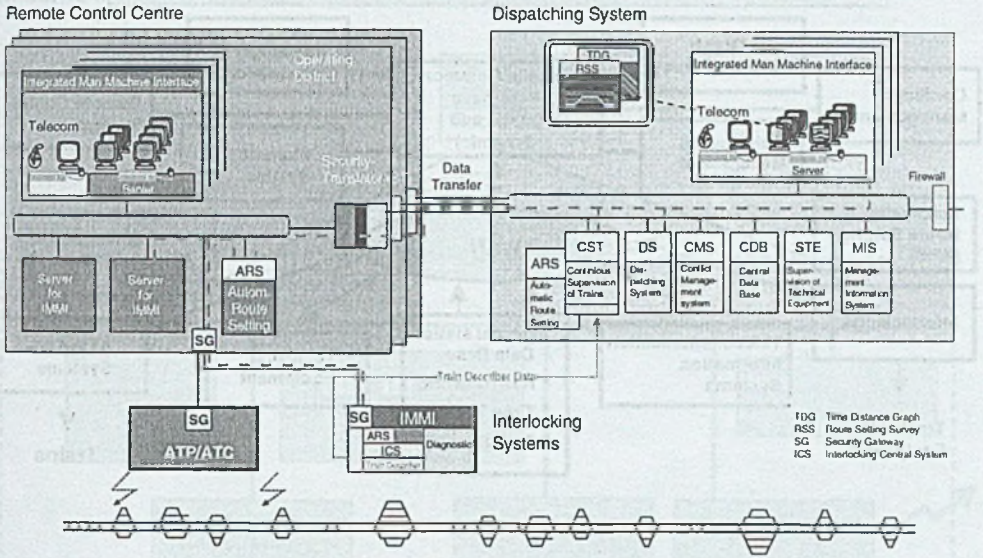

Fig.2. Management system block diagram

At engineering phase modular structure of the system was arranged. For redundancy realisation and new functions extension possibilities, modules are divided according to their tasks. Fig.3 shows general centre structure. Main part of the system consists of database including for example timetable or element status expectations. At the real time, system receives dynamic informations from interlockings, ATP systems and other elements. All informations are available for all subsystems. In this way it is possible to define when system should support the operator for example with traffic conflict solutions. Operator interfaces (MMI) have an access to all servers, so operators can monitor actual situation at many views and displaying methods.

It is important to point out that orders given by Network Management Centre to Area Control Centres do not include control orders, so fail-safe transmission is not required. The fail-safe transmission is required between Area Control Centres and interlockings but even in this case disturbed order would be blocked by trackside interlocking.

Concentration of all systems in one place causes that people work all together. It is much easier to coordinate operational tasks with maintenance, lets to plan time slots according to actual traffic situation. Easier staff management is possible as well operational and technical, especially when unexpected traffic situations or system problems occur.

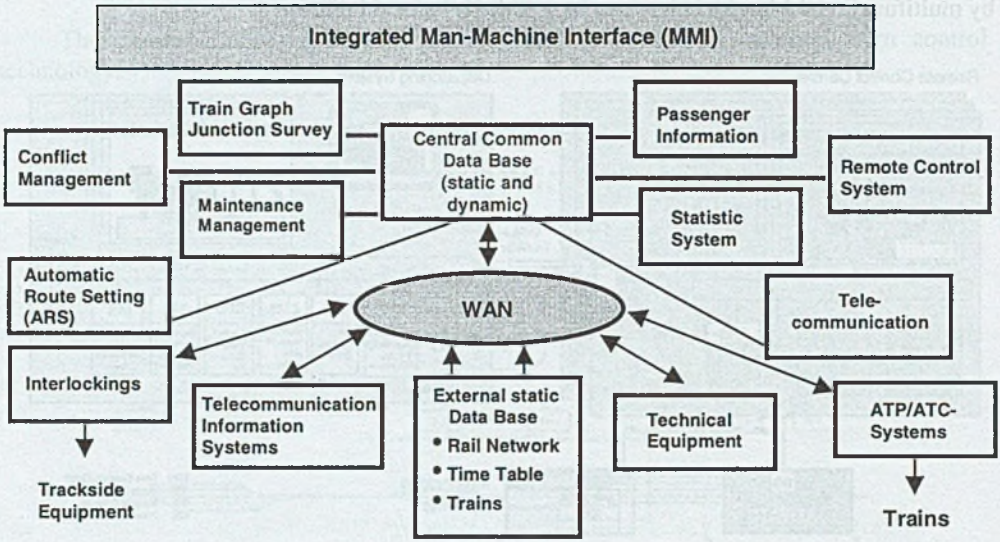

Fig.3. WAN network in management system

Gathering management personnel in one place reduces exploitation costs. This way of management allows for better staff accommodation according to planned traffic situation for example in rush hours. It is possible to give to one operator more then one station to operate. Direct advantage is employment limitation, mostly in operational staff which may reach 80%

Another advantage of centralization is availability of real-time data about all kind of elements what makes their diagnostic much easier. It is possible to inform lower level workers about malfunctions together with more actual information. Due to that services optimization is possible.

Integration of functions and hardware facilitates to use highest level of computer equipment. Newest technology usage makes data access easy and fast, lets for system extensions. System flexibility and reacting for dynamically changing traffic conditions requires additional functions using microcomputerised technology. One of most important function is conflict management. Those conflicts may be caused by train delays, elements failures, etc.

Different, important tool is automatic route setting. Route for each train identified by its number is set automatically when the train approach the station.

System integration simplifies statistic functions. Fast and deep analyses are possible to improve customer service or employment optimisation.

The bases of remote control are local control centres, supervised by Management System. For their communication special gateways are required. Local control centres are

treated as single interlocking, operating sometimes several stations, together with line trackside elements. I new structure, for example, operator from one of polish local centre (Opalenica) would be moved to area control centre to operate „his" are from there. Depending on traffic density another stations could be operated by him.

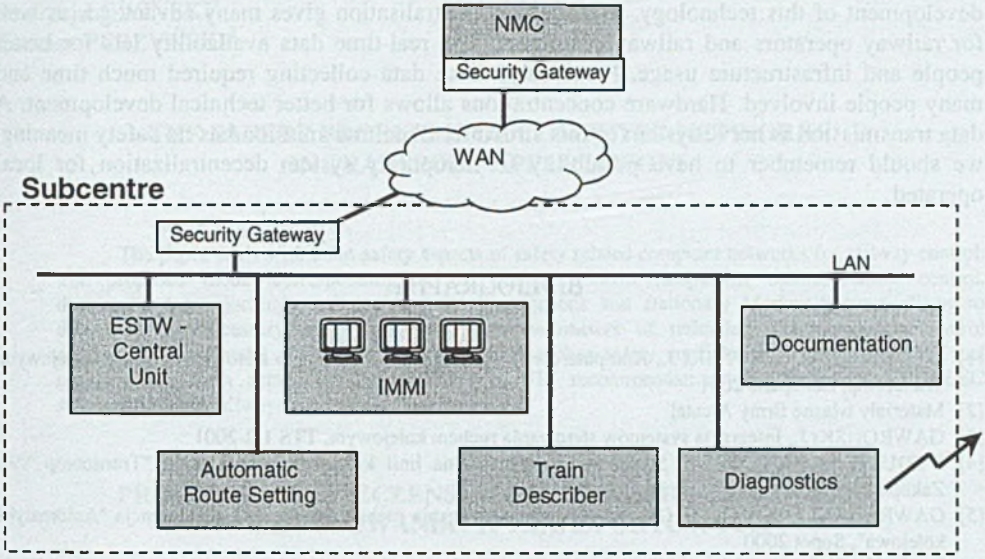

Fig.4. Data transmission between area and local centre

The main advantages for network solutions against direct connections are cabling savings (access, connection costs) and transmissions reliability due to many alternative connections via many network junctions.

Actually in Poland no WAN network is used for railway traffic control. However there is no technology requiring such solutions yet. Despite of it, being step before traffic management centralisation and new transmission technology implementation, the way of data exchange should be discussed and chosen

It seems that WAN network is the best solution. Such connections are worldwide used to communicate in cities, regions, countries and continents.

3. CONCLUSIONS

New electronic and data transmissions open new possibilities of railway traffic management and control. Whole organisation and control concept can and should be changed. Today, when we have worked out really safe computer solutions, we can observe very fast development of this technology. Management centralisation gives many advantages as well for railway operators and railway customers. The real-time data availability lets for better people and infrastructure usage. Previously, those data collecting required much time and many people involved. Hardware concentrations allows for better technical development. A data transmission is nerve system of this structure. Even transmission has no safety meaning, we should remember to have possibility for temporary system decentralization for local operated.

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Reviewer: Prof. Zbigniew Ginalski