

ON – LINE IS OPERATIONAL TRACKING AND MANAGEMENT OF RAILWAY TRAFFIC

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Abstract: Project solution of software tools presents an interface between graphical and numerical representation of data concerning navigation of trains in space and time. It is possible to apply software tools for constructing and creation of railway time-table in traditional technology, as well as for dynamic variant of development of railway time-table. Software tool of this type is indispensable for simulation model of train management in cases of offset from determinate time-table.

I. INTRODUCTION

Operational monitoring and management of trains in move with a classical methodology based on continuous telephone collecting data on the movement of trains (time of arrival, departure time, deviations from the projected schedule ...). These data are manually registered, and then presented in graphical form on a printed chart in advance, adapted to a particular part of railway (the actual chart of train traffic).

Plotting the actual route of movement of trains is carried out manually by different color pen with great care and a lot of time. Certain time intervals (work situations) are performed by cumulative and individual processing of data on the movement and work of trains (labor effect) for each Area of operational department. This processed data is forwarded to the Central operating department, where the data is processed and systematize the level of the entire territory of joint stock company "Serbian Railways".

All these activities are done manually and take so much of the time for dispatchers. This has the consequence that dispatchers are often not in a position to do their primary job (train traffic management, optimization of train transport, the optimization of material use and human resources, operational planning...)

We came to the idea, with full participation and suggestions of **DIZS (Society of Engineers of RAILWAY TRANSPORT)** that this job should be transferred to the informational system.

II. GENERAL INFORMATION SYSTEM FEATURES

Information subsystem is based on continuous and uninterrupted data collection and processing (24 hours, 365 days a year) about the origin of the train, train composition, movement of the train, graphical representation train in movement (real - the dynamic traffic chart of trains), the simulation of further movement of trains (including logical controls that can detect the conflict situation), change of the train status, telegrams and dispatching orders relating to the relevant train, the end of the train drive (train dissolution), as well as insight into the archival data.

At any time system provides information on current location and status of all trains on all parts of the track covered by the informational system. The train formation and creation of the route becomes visible to all official locations that are on the driving course.

At each change of data on train movement correction is performed on the full route of the train route, and prediction of deviations from the planned timetable.

- subsystem for real-time
- data is collected at source and stored in local and central tandem server with data replication
- data are available at any time to authorized administrative authorities (management company), dispatch centers (operational departments), the staff members who is directly involved in regulation and execution of railway transport, as well as users of railway services (in the form adapted to their authorities and needs)
- subsystem is directly linked to and coordinated with other informational subsystems on the railway (schedules, tracking of wagons) which function as an integrated informational system for monitoring and management of traffic.

Subsystem is directly connected to the Internet application to track information about current location and the delay of trains, wagons location, schedule and WAP service via mobile phone for information about the timetable and location of wagons.

III. TECHNICAL – TECHNOLOGICAL TERMS

Informational system covers about 1,500 kilometers of track (including a complete "Corridor X" and "Bar line"). The informational subsystem includes the following lines: Belgrade - Novi Sad - Subotica (01/03/06), Belgrade - Ruma - Sid (19/04/06), Belgrade - Pozega - Vrbnica (12/07/06), Belgrade - M. Krishna - Lapovo (12/07/06), Belgrade - Lion - Lapovo (12/07/06), Pozega - Kraljevo - Lapovo (12/07/06), Nis - Lapovo (01/10/06), Niš - Dimitrovgrad (01/10/06), Nis - Presevo (01/10/06), Nis - Zaječar (01/10/06), Ruma - Sabac - Brasina (2009) Belgrade - Pancevo - Vrsac (2009).

For the purposes of the Informational System was installed and configured the appropriate computer and communication equipment (connected to a single intranet joint stock company "Serbian Railways") at over 140 locations, of which: 55 in the offices of train dispatcher, 30 in Head of sections and Head of stations, 20 in Dispatching centers (including Tele command centers: Belgrade Marshalling, Pozega, Nis (the Department Lapovo).

It has been trained over 500 users, who directly participate in work or use the services of informational system (TK dispatchers, senior dispatchers, train dispatchers, the authorized station workers).

COMPUTER AND COMMUNICATION EQUIPMENT

Specifications of equipment of INTRANET network of Serbian Railway

Computer and communication equipment	The level of communication nodes					Total
	1 a	1	2			
Database server	5	3				8
Intranet access server	1					1
Router to connect to a companion Intranet nodes	1	3	2 5			29
Router to connect to the Internet	1					1
Central switch	1	3				4
Firewall	1					1
Switch for the local network	2 2	2 2	1 0	2		54
Surveillance equipment and network management	1					1
Domain controllers	2	3	2 0			25

3. The level of communication nodes

Level 1:	Belgrade
Level 1a:	Novi Sad, Niš, Požega ili Kraljevo
Level 2:	Subotica, Belgrade shunting, Belgrade centre, Užice, Lapovo, Lapovo shunting, Zaječar, Bor luggage engine, Požarevac, Pančevo, Ruma and Zrenjanin

Servers in the hall Nemanjina 6

Local servers

No.	Location	Purpose
1	Makiš	Domain Controller
2	Zdravka Čelara	Domain Controller
3	Novi Sad	Domain Controller
4	Novi Sad	SQL
5	Subotica	Domain Controller
6	Subotica	SQL
7	Ruma	Domain Controller
8	Šid	Domain Controller
9	Lapovo	Domain Controller

No.	Purpose of server
1	Domain Controller
2	CISCO Management
3	Antivirus – slave server
4	ORACLE
5	File and print server
6	SQL
Blade servers	
1	SQL 1
2	E-mail
3	DNS, mail relay
4	ORACLE 1
5	Proxy
6	External web, Cristal report
7	Antivirus – master server
8	SQL 2
9	ORACLE 2
10	Linux – internal mail
11	The primary domain controller
12	MQ
Dell server	
1	ORACLE, DELL
IBM Mainframe	
1	DB2, application and file servers, ftp

3.2 APPLICATION SOFTWARE

3.2.1. Application software has entirely done and the developed **Project team for the IT Department of Informational Systems and Informational Technology JSC "Serbian Railways"** in cooperation with experts from the Department of the timetable and Operative Division of Department for Transport jobs.

3.2.2 Application software has been done in two layer client - server architecture, designed for **On - Line work** to the central database,

10	Niš	Domain Controller
11	Niš	SQL
12	Kraljevo	Domain Controller
13	Kraljevo	File server
14	Dimitrovgrad	Domain Controller
15	Prijepolje	Domain Controller
16	Požega	Domain Controller
17	Ristovac	Domain Controller
18	Zrenjanin	Domain Controller
19	Zaječar	Domain Controller
20	Požarevac	Domain Controller
21	Kikinda	Domain Controller
22	Vršac	Domain Controller
23	Sombor	Domain Controller
24	Pančevo	Domain Controller

3.2.3 Software package as the base uses software tools for graphic interpretation of space-time data on the movement of trains "**ŽELMET**"

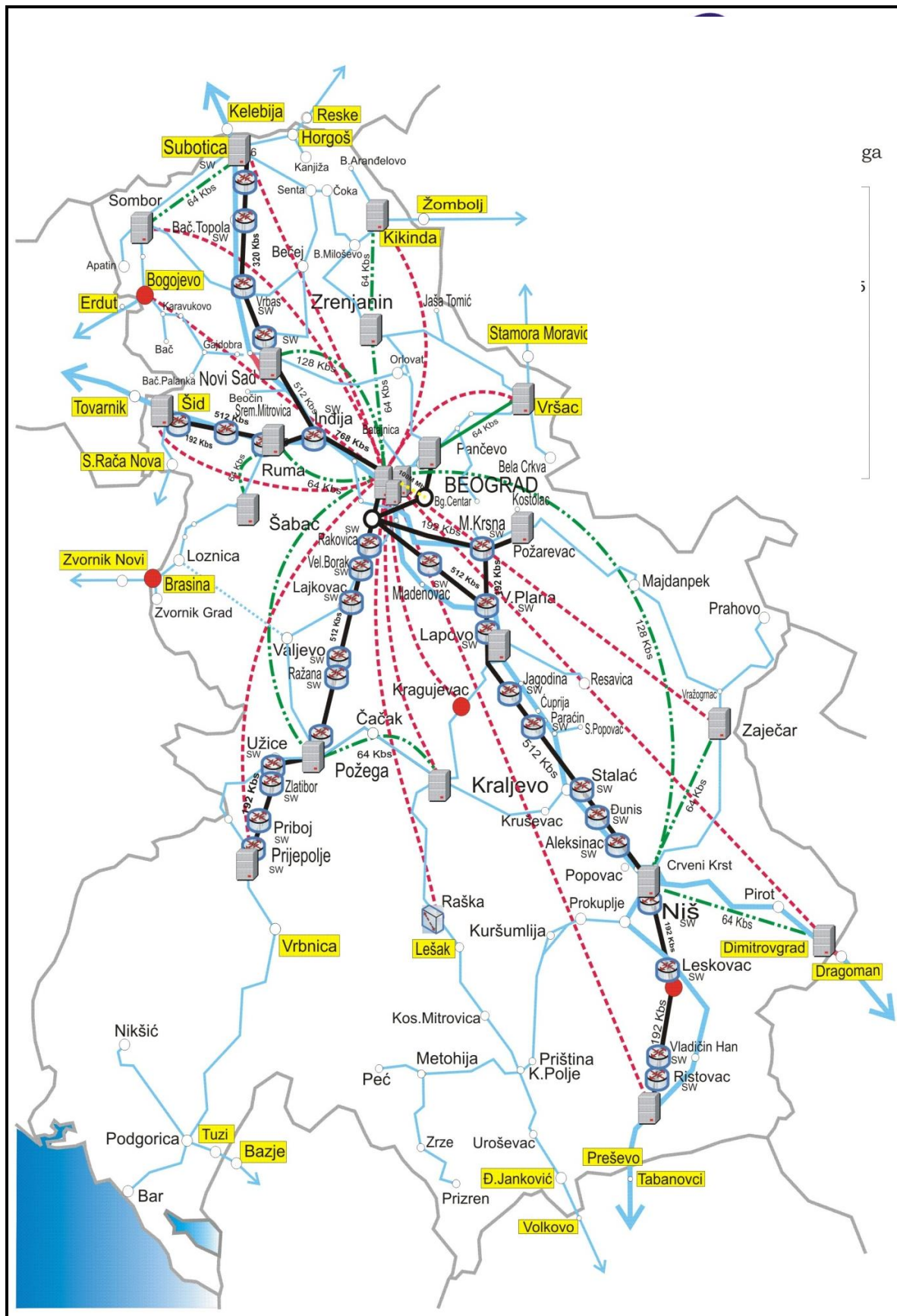
(Decision of the Commission for findings and technical improvements of Public Institution "Serbian Railways" No. 5442/04-59 from 20/07/04 was recognized as a Technical promotion)

3.2.4 The database has been created in **SQL - Server 2000**, as part of an integrated **database for monitoring traffic joint stock company** Serbian Railway "**Ž IIS**"

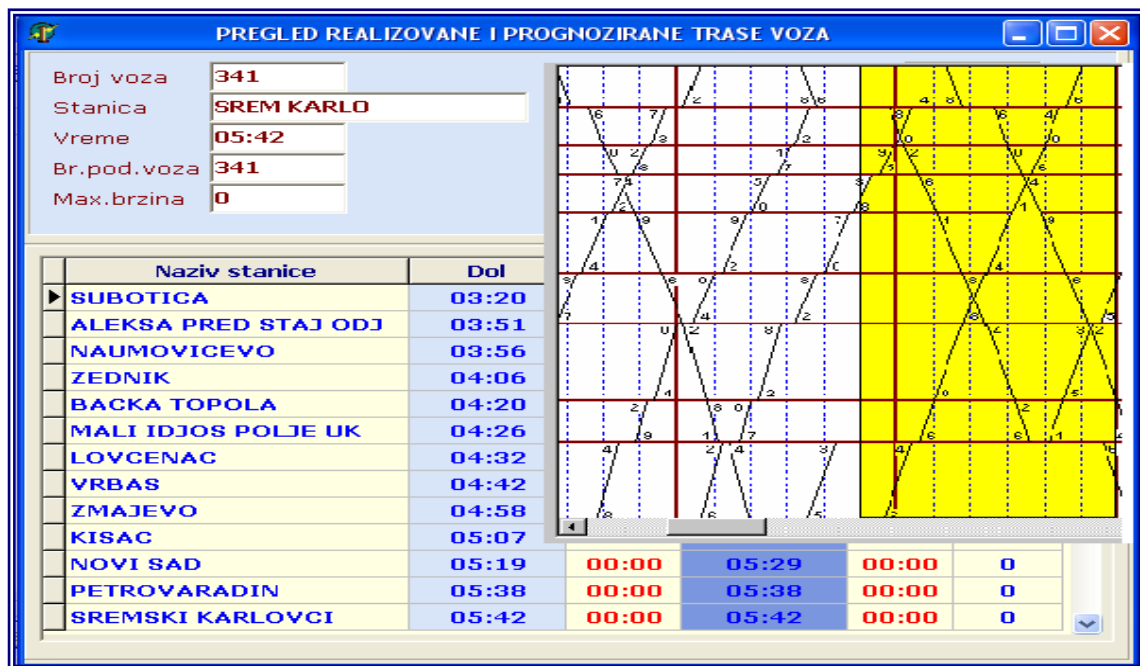
3.2.5 The user interface is organized into four complex and functional units as it follows:

- **Software package for Chargé trains**
- **Software package for Transportation Dispatcher**
- **Software package for TK - Dispatcher**
- **Software package designed for Management**

Intranet network with the network of railway lines of joint stock company "Serbian Railways"



Picture of menu to display charts Real traffic trains



3. CONCLUSION

In the opinion of the expert team **DISZ (Society engineers of RAILWAY TRANSPORT)**, this information system is fully possible to apply to smaller systems such as urban and suburban railways, subway, operators (lessees of railways) in cargo and passenger traffic.

The implementation of informational system **ŽIIS** achieved the following effects:

- Modernization and humanization work of operational service with the full support of computer science and technology
- Monitoring the traffic of trains in real time
- Simulation of the traffic situation for a certain period of time
- Avoiding and overcoming conflicting traffic situations
- Minimize the deviation of the projected timetable that arising from traffic reason
- Realistic and operational planning of train working appliances and the operation of train and train staff
- Making operational decisions based on real data
- Elimination of multiple recording and processing of data relating to the same phenomenon
- The ability to access and exchange data with other information systems within the joint stock company "Serbian Railways", as well as with neighboring railway administrations

- Significant financial savings resulting from reducing train delays and reduce the cost of consumable materials (charts, forms, pencils ...)

5. REFERENCES

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- [4] Kent Reispdoph "Delphi 5" Mikroknjiga, Belgrade, 2001