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URBAN TRANSPORT MANAGEMENT BY INTEGRATED, TELEMATICS SYSTEM

Abstract

The increasing demands in cities on mobility require the more efficient utilization of the transport network, the capacities. The serving of increasing claims is realizable by joint of the conventional traffic-control system into a *urban transport management system*. The execution of the functions belonging to this concept demands the development of an integrated, telematics system. Many elements of this new system are even today available. The use of the integrated system makes the increase of the efficiency of the establishments in transport in many respects possible.

1. Introduction

In present period of development of the transport the cities are to face up to new types of problems. The use of cars increases and the quality and proportion of the public transport decreases, simultaneously. In consequence of a new tendency, namely the removal of urban inhabitants into the suburban area or the outskirts of the city and connecting with it, the increase of the demands of daily change of place, the previous crowded state in cities was even getting worse and the damaging effects to the environment were on the increase. The serving of the increasing demands cannot be improved to significant degree by building of new elements in the transport network, the built-up areas mean physical bounds. The urban transport management system to be made known gives an opportunity for solving of the mentioned problems.

In this paper, the description of the functions, the logical structure, the conditions for operation and the effects of the integrated, telematics system for urban transport management was set as an aim. At preparing of the paper the applied, exemplary international experiences and solutions were overviewed.

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2. The concept and aims of the urban transport management

As a first step of statement of the system we define the concept of the urban transport management, it's aims and the tasks connected with it [1],[2],[3],[4],[5]. The concept of the urban transport management is defined in the international scientific literature in various manner. Two, in essence near definitions of these are the followings:

1. According to the definition of Wacker and Flasche, the urban transport management is a complex entirety of the means and measures of the transport system, that makes the integrated operation of the transport system possible. This system comprises several kinds of transport modes and transport sectors [4].
2. In accordance with the definition of the Norwegian "Nordisk Vegteknisk Forbund" transport association, the urban transport management is the control of the transport flows (vehicles, passengers, goods) by spatial and time influencing of the transport demands, the customs and the means-choice, by announce of the actual and forecasted traffic conditions, by supply of the value-added information and by support of other means. These solutions make the preservation of the unbroken, safe and undisturbed permeability of the transport network, the efficient transport, the increase of travel comfort and the reduced environmental burdening (pollution, noise) possible [1].

Basically, the urban transport management comprehends the following areas:

- the public transport management (supply of dynamic information for the passengers),
- the road transport management (supply of dynamic information for the individual drivers).

The road transport management includes the control of both passenger and goods transport.
As **overall aims** of the urban transport management the following ones should be stressed:

- the serving of the increasing demands towards mobility by increase of permeability of the transport network,
- the organizing of more efficient use of the resources (means, energy, workforce), the increase of the economic effectiveness,
- the reduction to minimum level of the whole use of time being necessary for change of place,
- the increase of the transport safety,
- the reduction of the damaging effects to environment,
- the improvement of the life-quality.

For the sake of achievement of the mentioned aims, the main works below should be accomplished **for create of the integrated, telematics system**:

- the integration of the systems executing the supervision and control of the transport processes, the systems gathering, storing and retrieving data and the systems supplying information,
- the joining of already working and additional new - carrying new tasks out - systems to the integrated system,
- the improvement of cooperation of the centres controlling the individual and public transport,
- the forming of harmonized, coordinated collaboration of the systems and organizations participating in the transport management; the make of use of the information originating from the certain subsystems possible at operation of the other subsystems,
- the promote of efforts for common optimum operation of the subsystems instead of it's own optimum operation,

- the forming of hierarchic rule-system (meta rules) at coordinating of operation of the subsystems, and by support of it the conflicts between the aims of operation of the subsystems can be managed or terminated,
- the influence and control of the traffic increasingly automatically; the reduction of the human operations and interventions.

In summary, the present role of the road traffic-control is gradually to be extended to cover also the urban transport management tasks. In the course of it, it is needed to accomplish a three-direction integration, the integration of the passenger information systems of the public transport, the information supplying systems of the individual transport and the transport control systems (of companies).

3. The telematics systems used in field of the urban transport management [6],[7],[8]

The subsystems belonging to the certain functions can be classified among three groups, accordingly which transport mode they execute the tasks of. These groups and the subsystems belonging to them are the followings:

a., Telematics systems used generally

These subsystems are used for the management of both the public and the individual transport.

1. systems supervising the network continuously or measuring the volume of the traffic,
2. traffic-depended control system for traffic lights considering the lead of the public transport means,
3. general systems serving information of both the public and the individual transport (Internet, PC-s with CD, Info terminals, personal traveller assistance (handys), television, radio),
4. systems for identifying and positioning of the vehicles,
5. systems supplying information regarding the weather and the road surface conditions,
6. systems supplying information about the environmental burdening (pollution, noise),
7. supervising systems for special constructive works (e.g. tunnels, bridges),
8. system supplying information regarding the planned restrictions of the transport network (e.g. road works),
9. information systems of P+R car parks,
10. data processing and control system of the transport management centre,
11. system to support the decision making and planning processes of the urban transport authorities.

The first two systems together form the conventional traffic-control system.

b., Telematics systems used in public transport

1. control systems of public transport,
2. passenger information and information supplying systems (systems used before, during and after the journey),
3. dynamic itinerary planning systems.

c., Telematics systems used in individual transport

The individual transport includes both the passenger transport and the goods transport.

1. roadside, collective information systems for drivers (variable message signs),
2. on-board, collective information systems for drivers,

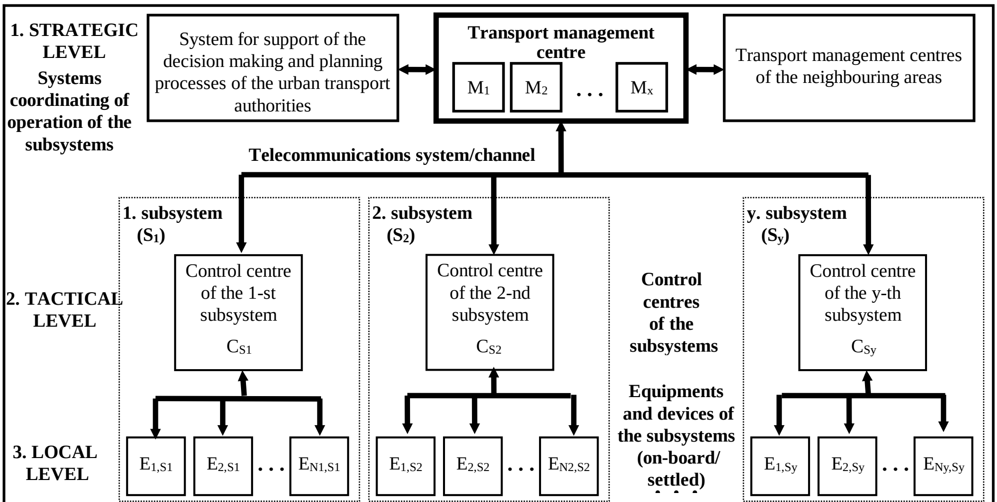
3. dynamic system for control of target-guidance,
4. speed influencing system,
5. system for control of the driving in a certain area, the road and parking fees,
6. assist systems for managing of unforeseen occurrences in transport,
7. control system of the urban freight transport,
8. information system of the bicycle traffic,
9. supervising and control systems of traffic of the urban freeways,
10. information systems for disabled persons.

4. The comprehensive model of the integrated, telematics system for urban transport management and it's components

At the overview of the integrated system we make a that kind of logic structure known, which is independent from the later, concrete hardware and software solutions, namely the physical construction; and in consequence with it, it is more permanent in time.

a., The skeleton model

The subsystems join to each other and to the transport management center through telecommunications system. Similar connections are between the centers of the subsystems and the devices, equipments being on the local (area) level, too. For data transmission can be used the conventional telecommunications networks and the newest Advanced Communications Service (ACS). The general skeleton model can be seen in the Figure 1.



Key:

$M_1 \ldots M_x$	- the modules executing the control tasks of the transport management centre
x	- the number of the modules executing the control tasks of the transport management centre
$S_1 \ldots S_y$	- the subsystems
y	- the number of the subsystems
$C_{S1} \ldots C_{Sy}$	- the control centres of the subsystems
$E_{1,S1} \ldots E_{N1,S1}$	- the equipments and devices belonging to the subsystems (S_1 subsystem)
. . .	
$E_{1,Sy} \ldots E_{Ny,Sy}$	- the equipments and devices belonging to the subsystems (S_y subsystem)
$N_1 \ldots N_y$	- the number of the equipments and devices belonging to the certain subsystems

Fig. 1. The general skeleton model of the integrated, telematics system

Three levels can be distinguished by the functions. These are the followings:

1, **Strategic level** - the urban transport management center and the joining system for support of the decision making and planning processes of the urban transport authorities. The center is a modular construction, the modules execute the certain data processing and control tasks.

2, **Tactical level** - the control centres of the subsystems, which - following the control strategy determined by the transport management centre - execute the appropriate control of the subsystems.

3, **Local (area) level** - the equipments and devices of the subsystems, which operate in the way that determined by the own control center.

An urban transport management system covering a given area - because of the being contiguous of the transport network - are contact also with the systems executing similar task and covering the neighbouring areas, geographical units.

b., The connection model

The Figure 2. gives a summary of the information connections between the subsystems executing the certain functions. In the figure can be seen the direction of the connections, the modules carrying the data processing and control tasks of the transport management centre out, and the functional connections of these modules. The centre keeps contacts - in addition to the mentioned subsystems - with the partners performing the operation of the whole system, the service companies, the organizations maintaining the transport network and it's establishments (road work companies, public-service companies, local governments), the police, the fire brigades, the ambulance, the troubleaverting organizations, the bigger taxi companies and the persons giving direct notices. These connections mean mostly talk-based communication, which are signed in the figure by broken lines.

c., The structure of the database [9]

The subsystems have own databases containing transport data for own operation. The basic aim at integration is that the subsystems make open, common that part of data used by them that the other subsystems can use up for the operation. Important point of view is that the databases of the subsystems - because of the common use - should have common data-structure, the data should be stored in the same format and the content of the data should have appropriate authenticity level. The biggest database of the integrated, telematics system is established in the transport management centre. Those data of the other subsystems is stored in this database which is needed for the executing of the strategic control tasks, for the making of newer, more valuable, overall information. Hereby the repetitions can be reduced, the consistence of data can be improved. The data of the common database can be classed among the following groups:

- database for data of archives: technical, operational, control, traffic data,
- database for data of occurrences planned in advance (e.g. road works),
- database for data of actual network-conditions,
- database for predicted traffic data.

It is not essential, that the common database should be stored in one computer. If this data is stored in more computer, the telecommunications network makes the accessibility of data possible.

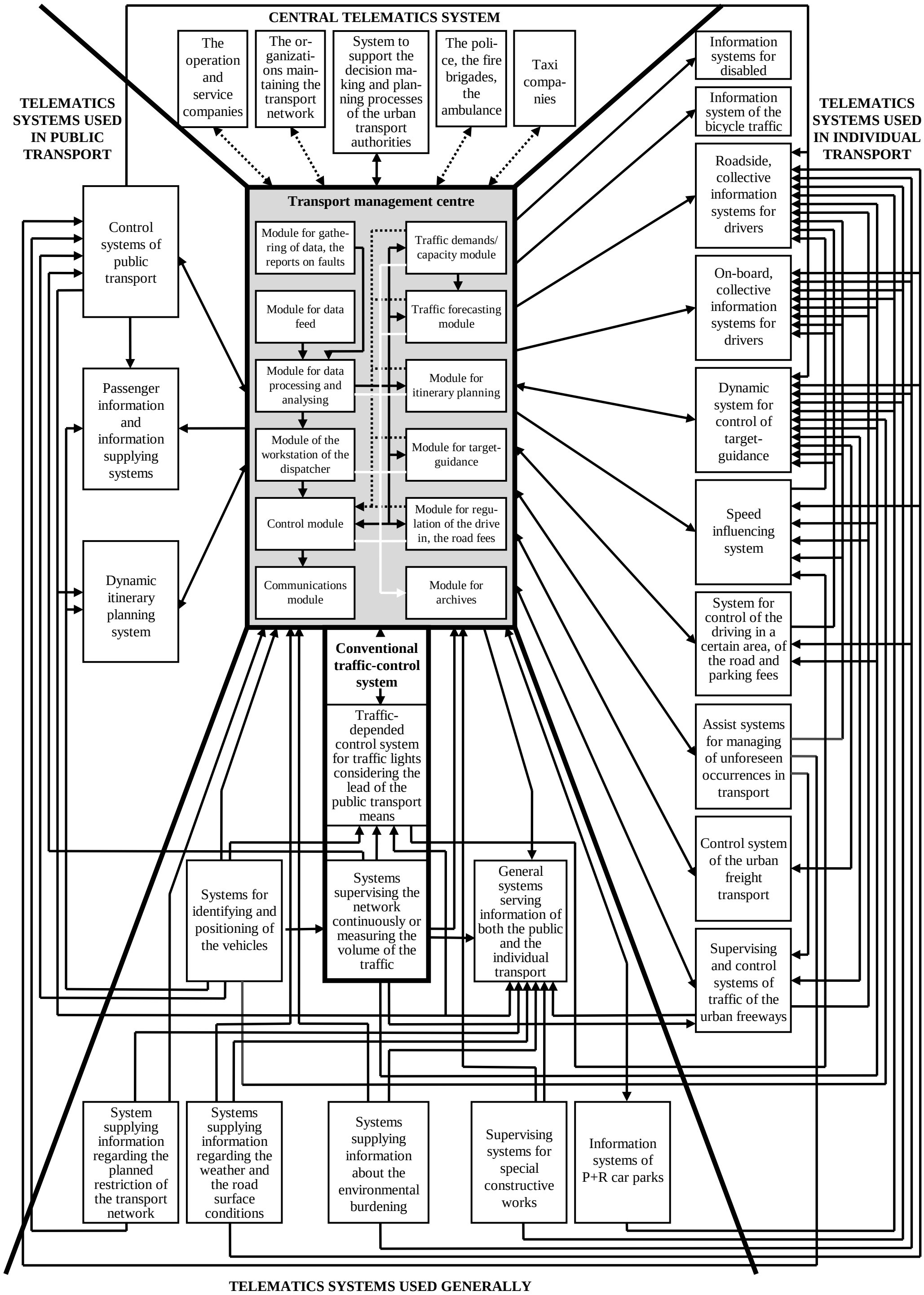


Fig. 2. The information connections between the subsystems

5. The building up, the operation and the effects of the integrated, telematics system

The system for urban transport management can be realized by the cooperation of the public transport companies, the organizations for road operation and maintenance, the data providers and the private organizations [10]. The coordination is the task of the public sector. Such a system joins closely to the conception of the urban transport associations. At the common use of data, the following points of view are to be took into consideration:

- the proprietary rights of the data,
- the issues stated in the agreements for cooperation, e.g. the quality and the authenticity of the data,
- the issues of trade, including the value, the type of the data,
- the institutional and operational issues.

At decision making in the transport control the conditions of the actual traffic situation and the traffic situation of the earlier period are considered. In accordance with it, the general form of model of the decision is:

$$\textbf{\textit{IF}}\ <condition_{A1}>AND\ldots AND<condition_{Al}>AND<condition_{E1}>AND\ldots AND<condition_{Em}>$$
$$\textbf{\textit{THEN}}\ <task_1>\ AND\ <task_2>\ AND\ \ldots\ AND\ <task_n>. \quad (1)$$

The following designation is used:

$condition_{A1}...condition_{Al}$ - the conditions of the decision making regarding the actual traffic situation,

$condition_{E1}...condition_{Em}$ - the conditions of the decision making regarding the traffic situation of the earlier period,

$task_1...task_n$ - the control tasks following the decision making considering the certain conditions,

l - the number of the conditions of the decision making regarding the actual traffic situation ,

m - the number of the conditions of the decision making regarding the traffic situation of the earlier period,

n - the number of the control tasks.

In the model, between the factors the OR logical connection also can be used instead of the AND logical connection.

The development of this kind of system results in economic, environmental and social benefits. The following advantages can be realized for the more important participants in the transport [2]:

1. for passengers
   - accessibility of value-added information in wider range covering the whole process of the travelling (particularly important in case of passengers travelling rarely),
   - the improve of the reliability and the scheduled runs of public transport means,
   - the increase of the travel comfort and the safety,
   - less traffic congestions, more constant carrying away of the traffic,
   - shorter reaching time, (fuel savings).
2. for public transport companies
   - the increase of attractiveness of the public transport,
   - the increase of number of the carried passengers,
   - lower operational and maintenance costs regarding same performance,
   - business potentials by serving of data of the available transport databases, the traffic-control in wide range.

3. for traffic-control of roads

- control of transport demands on higher level by means of several kinds of information equipments.

4. for companies operating P+R car parks

- higher utilization of capacity of the car parks, hereby achievement of higher benefit.

The benefits for society:

- the increase of proportion of the public transport contrary to the individual transport,
- the reduce of the damaging effects to the environment,
- the support of increasing demands on mobility on high level, by decreasing fuel consumption,
- cost savings (the invested capital gets quickly back, the system has external effects),
- planning and decision making in transport relying on more information.

Summary

The integrated, telematics system for urban transport management as an advanced telematics solution in transport contributes to the formation of the "information society". The system makes the accessibility to the most recent information related to the transport for the passengers, the individual drivers, the maintaining, operating organizations of the transport network and the transport companies possible. Hereby the uncertainty in the transport can be reduced, decisions before and during the journey can be made in possession of more information. As the effect of operation of the system, the proportion of use of the public transport, the permeability of the whole network are increasing, the life quality is changing for the better in the operation area of the integrated system.

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