Development of integrated, intelligent passenger information supplying system beyond 2000

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Abstract. The increasing demands in the public transport, in field of passenger information supplying service are aimed at up-to-date, being in keeping with the actual traffic conditions, reliable information supply, in sum increase of level of passenger information service. In accordance with it, the continuous data supply of passenger transport process requires the high standard developing, making intelligent, and after it the integrated building together of telecommunications and informatics systems of passenger information service. The creation of the stated integrated, intelligent passenger information supplying system is a great leap forward the realization of this aim at the begining of 2000.

Keywords: Alphanumeric model, Integrated data base, Integrated intelligent system, Passenger information system, Public transport, Transport informatics

1. Introduction

In this paper, basically I try to advance in that direction, how the integrated transport systems can be developed in the begining of the new millennium. Two main tendecies can be distinguished. Either the inter-subsectorial, territorial integration of basic systems performing the certain functions is the standpoint of development or strive for integration of control of these basic systems. Having hope, that many people will deal with inter-subsectorial, territorial integration of basic systems, I - relying on the researches lasting for more decades in the Faculty of Transport Engineering of Technical University of Budapest - focus my attention on the integration of control of transport basic sytems.

For the integration, the knowing of components to be integrated is required. The outlining of the development is needed to be begun by the overview of systems applied in the field of transport control, and transport informatics, after it can dwell on the content of the integration. The two main components of the transport informatics systems aiding the control of transport are the good transport and the passenger transport informatics. Considering that, the given range is rather limited for the treatment of a theme specializing on the integration, I will state only tasks of integration which are connected with passenger transport informatics. I mention however, that we have experiences also in that regard, how the control, informatics components are needed in the good transport can be intagrated in the next decades.

Dealing with the integration of passenger transport informatics, I will touch upon the next topics: object of the up-to-date passenger information service, overview of informatics systems applied in the passenger information supplying service, phases of the connecting, integration of the subsystems into unified system, statement of alphanumeric models expressing phases of the integration, questions of development of the integrated data base. The entire passenger transport informatics includes the planning systems of passenger transport process, and after completing the accounting systems as well. I will disregard including of these subsystems – expecting the timetable planing system - in the integration, because these subsystems are not connected directly with the process of passenger information supplying.

For creating of the integrated, intelligent passenger information supplying system the necessary technical background is available, but the knowledge connecting with integration is still imperfect. With my paper I try to contribute to progress and widening of knowledge in this field.

2. Goals and objects of the up-to-date passenger information service

In recent period of transport development new opportunities present itselves to increase the efficiency in several viewpoints of transport establishments by using *intelligent transport systems.* The promoting of as big share as possible of public transport means and making it competitive contrary to individual transport get important role at the satisfaction of total mobility demand. To achieve the mentioned aim the intelligent, integrated passenger information supplying system covers the whole passenger transport (travelling) process in space and time. For realization of it, real-time, place-independent, individual, spreading from house to house, taking the intramodal, and the intermodal changing possibilities also into consideration, multimodal information service has to be at passengers' disposal.

The developing factual knowledge of various disciplines and the technological development make achiving this aim possible. At taking into consideration of disciplines, the factual material of the system interdiscipline, and the transport discipline have to be used in the course of integration. With regard to technological means, the resulted significant development in field of transport automatons, telecommunication technology, and computers contributes to formation of the integrated system. At review of technical means, the achieved significant development, and results in the following fields have to be stressed and used: (Hidas 1998).

- the increase of performance of computers, possibility of parallel and distributed data processing,
- availability of advanced systems for data base management,
- existence of small, portable "telematics" appliance,
- the computer controlled, advanced communication networks,
- unwired communication opportunity with the running vehicle (two-way analogue and digital radio connection, telecommunications satellites),
- availability of Global Positioning System (GPS),
- development of advanced vehicle identifying and vehicle tracking systems.

3. Informatics systems applied in the passenger information supplying service

The classification of informatics systems applied in the passenger information supplying service is possible by the features of the realized hardware solutions, the used softwares, the data bases, and in the sequence of process of change of place (travelling) as well. We act most properly, if consider the process of change of place (travelling) as a main principle at putting the systems in order, seeing that the basic process, say the elements, logic of process of change of place between the origin and destination points is steady, while the hardware, the software, and the data base components go through unbroken change, and technological development.

Consequently, the analysis of field of use of telematics in integrated passenger information tasks begins with dividing the process of change of place (travelling) into part processes, then the part processes into further components. For fulfilling of passenger information functions in the various phases of the travelling process had already previously came into being the computer aided systems, that can be joined to the integrated, intelligent passenger information supplying system in processlogical order at creating of it.

Following the process-oriented principle, the passenger information systems can be classed among three groups. To mark the certain groups and the systems within the groups the initial letters of words of the systems' name are used. The three groups are the nexts: (Csiszár and Westsik 1999).

1. Computer Aided Passenger Transport Preparing systems: CAPTP,
2. Computer Aided Passenger Transport Control, Management systems: CAPTCM,
3. Computer Aided Passenger or Luggage Retrieving systems: CAPLR.

The inner parts of the main groups in the appropriate logical order are:

1. Computer aided passenger travel preparing systems:

- Timetable Information System: TIS,
    - Timetable Extract Preparing System: TEPS,
    - Itinerary Planning System: IPS,
    - Information Supplying System on Stand Alone Computer or via Internet: ISSSACI,
    - Tourist Information Supplying System: TISS,
- Seat Reservation System: SRS,
    - Seat Reservation by Separated Network: SRSN,
    - Seat Reservation by Multi-Function Network: SRMFN,
- Ticketing System: TS,
    - Ticketing by Stand Alone System: TSAS,
    - Ticketing by Separated Network: TSN,
    - Ticketing by Multi-Function Network: TMFN,
    - On Board Ticketing: OBT.

2. Computer aided passenger transport control, management systems:

- Lead TO Vehicle Information System: LTOVIS,
    - Visual Information Supplying System of Service Departure: VISSSD,
    - Auditiv Information Supplying System of Service Departure: AISSSD,
- On Board Information System: OBIS,
    - Information Supplying System regarding Travelling: ISST,
    - Passenger Comfort Information Supplying System: PCISS,
    - Marketing Information Supplying System: MISS,

- Tourist Information Supplying System: TISS,
- Lead OFF Vehicle Information System: LOFFVIS,
  - Visual Information Supplying System of Service Arrival: VISSSA,
  - Auditiv Information Supplying System of Service Arrival: AISSSA,
  - Passenger Information System aiding Travelling Further: PISTF.

3. Computer aided passenger or luggage retrieving systems:

- Lagguage Retrieving System: LRS,
- Passenger Retrieving System: PRS.

All of the enumerated systems are in use for shorter or longer period of time, therefore I disregard description of them, I presume the knowing of them. (Kramer 1997), (Schar 1997), (Soriano et al. 1997), (Westsik 1997).

4. Phases of the connecting, integration of the subsystems into unified system

The previously created, computer aided systems for fulfilling the listed passenger information supplying functions work mainly isolated, communicate with difficulties, use substantially different hardware and software components. Creating of a unified passenger information system has a primary importance for that reason, because in consequence of the spatial and time extension of transport processes the unified information network is at least as important as the transport network itself, and many same information are included in the different subsystems. The standardization of subsystems to be integrated, the unification of information spectrum, the use of common code systems and connectable hardware, software components are the substantial prerequisite for creating of the integrated, intelligent passenger information supplying system.

An integrated, intelligent passenger information system covering a wide transport network can be brought into existence by the integration of the present passenger information systems in five phases. These phases are the follows:

1. integration of informatics systems fulfilling passenger information functions, within one company,
2. integration of integrated, intelligent passenger information systems of companies, within the subsectors,
3. integration of integrated, intelligent passenger information systems of subsectors, among the subsectors,
4. spatial integration of multimodal integrated, intelligent passenger information systems (country-wide, international, continental, intercontinental, global integration),
5. total integration of the integrated in space systems.

The phases of integration and the being based on each other of the informatics systems fulfilling the passenger information functions can be seen on the Fig. 1. To mark the Integrated, Intelligent Passenger Information Supplying System the initial letters of words are used: IIPISS. Next to the symbols used to mark the systems are the characters in the right lower index to indicate the subsector or the transport company. *R, RW, WW, A, C* mark in order the certain subsectors (road, railway, waterway, air, city transport). In case of a company, these characters are supplemented by further numeric value for further differentiation. The numbers of distinguished companies within the certain subsectors are marked in order by *m, n, o, p, r*.

5. Alphanumeric models expressing phases of the integration

In **first phase** of the integration, the equation below expresses the integration of the passenger information systems working being isolated of the certain transport companies into a *unified, company passenger information system*. Let's see, for example, the *i.* road transport company. In this case the form of the model equation is the following:

$$TIS_{Ri}+SRS_{Ri}+TS_{Ri}+LTOVIS_{Ri}+OBIS_{Ri}+LOFFVIS_{Ri}+LRS_{Ri}+PRS_{Ri}=IIPISS_{Ri}, \quad (1)$$

where the *R*, by the symbols indicating the functional systems, refers to the road transport company, and the *i* shows, that the equation written down concerns the *i.* road transport company. The relation above can be written down in the same way in case of all companies of all subsectors.

In **second phase** of the integration, the equation below expresses the integration of the integrated passenger information systems developed at the transport companies of the subsectors into a *unified, subsector passenger information system.* This model equation of integration concerns the road subsector:

$$\sum_{j=1}^{n} IIPISS_{Rj}=IIPISS_{R1}+IIPISS_{R2}+...+IIPISS_{Rn}=IIPISS_{R}, \quad (2)$$

where the already described notation is used. The relation above can be written down in the same way in case of all subsectors.

In **third phase** of the integration, the equation below expresses the integration of the integrated passenger information systems developed at the certain subsectors into a *unified, multimodal passenger information system.*:

$$IIPISS_{R}+IIPISS_{RW}+IIPISS_{WW}+IIPISS_{A}+IIPISS_{C}=IIPISS, \quad (3)$$

where on the right side of the model equation can be found the designation of the unified, multimodal passenger information system.

The relations written down up to this point concern transport network, or rather passenger information supplying systems of a smaller area (location, region, country, ...), therefore I have disregarded territorial differentiation as far as here. The characters indicating the certain area can be given next to abbreviation of the systems' name in the right upper index. In case of wide public transport network of a geographical unit is needed to connect integrated passenger information systems of the certain areas within the geographical unit. In **fourth phase** of the integration, the model equation below expresses the *connection of integrated, multimodal passenger information systems developed on the certain areas*, that is to say spatial integration:

$$\sum_{s=1}^{Z_k} IIPISS^{ks}=IIPISS^{k1}+IIPISS^{k2}+...+IIPISS^{kZ_k}=IIPISS^{k}. \quad (4)$$

The equation written down models the integration of passenger information supplying systems being on the certain areas of the *k.* geographical unit, where next to the main symbols the first part of the right upper index shows the geographical unit, and the second part of the index shows the areas involved in the integration. The number of areas - in case of *k.* geographical unit - is: Z_k.

In **fifth phase** of the integration, the model equation below expresses the *total* *integration* of integrated, intelligent, passenger information systems of the certain geographical units:

$$\sum_{l=1}^{y} \text{IIPISS}^{l}=\text{IIPISS}^{T}. \tag{5}$$

The upper limit of the summarizing is *y,* that can be determined with knowledge of number of the geographical units. The *T* index on the right side of the equation marks the integrated, intelligent passenger information supplying system after the total integration. The model equations written down point out, what kind of tasks regarding the integration have to solve from the begining of the next millennium.

6. Development of the integrated data base

At creating of the integrated, intelligent passenger information system is needed to produce a network, central data base by using appropriate informatics, telematics tools. In this data base all the data flows logically assemble together, and the data coming from many and different sources is handled in appropriate structure. At executing of the passenger information supplying functions, from this data base is needed and possible to obtain data. Data sets handled by data base management system in the common data base can be stored decentralized, distributed. These data sets can be grouped by the place of storing and the time permanent feature of the data. Connecting of the data sets into a unified system has to be done considering these two points of view. Creating of the common data base includes the following main tasks: (Kramer 1997).

1. Standardization, creating of uniform code and data system in place of many and considerably divergent code and data systems of the subsystems working being isolated so far.
2. Conversion of the data stored until now in text form regarding the routes, lines, services into geo-information data base.
3. Exploring, stopping of the data errors, screening of the contradictory, incomplete, repeated data, correction of the errors in the available data bases.
4. Bypass of data recurrences, construction of logical structure of the common data base by representation of the data needed for operation of systems involved in the integration in coincidence chart.

7. Conclusions

The stated integrated, intelligent system has an important role in passenger information service of “integrated public transport areas” (e.g. big cities and its’ surroundings) including more subsectors. This system regarding the public transport can constitute the part of an overall passenger transport information system, that integrates real-time information systems of the individual transport and the dynamic parking control systems as well. This overall transport information system is particularly important in case of combined (individual+public) transport forms. In accordance with it, this paper summarizes the main directions of development in field of passenger information service, including the goals and objects of the up-to-date service, then the overwiev of already applied informatics systems in processlogical order, the phases of the connecting, integration of subsystems into unified system, the alphanumeric models expressing these phases. Finally the directions of development of the integrated data base, the hardware and software solutions are mentioned. The stated development in the passenger transport is one of those tasks that should be solved by us in begining of the new millennium.

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DEVELOPMENT OF INTEGRATED, INTELLIGENT PASSENGER INFORMATION SUPPLYING SYSTEM

During the passenger information process, regular and many-way connections are among the seven main participants.

1. passengers,
2. intelligent vehicles equipped with vehicle identifying and vehicle tracking system,
3. information centre, that can be established decentralized,
4. integrated data base,
5. terminals for passenger information supplying service,
6. on board passenger information equipment,
7. telecommunications system, network, satellites.

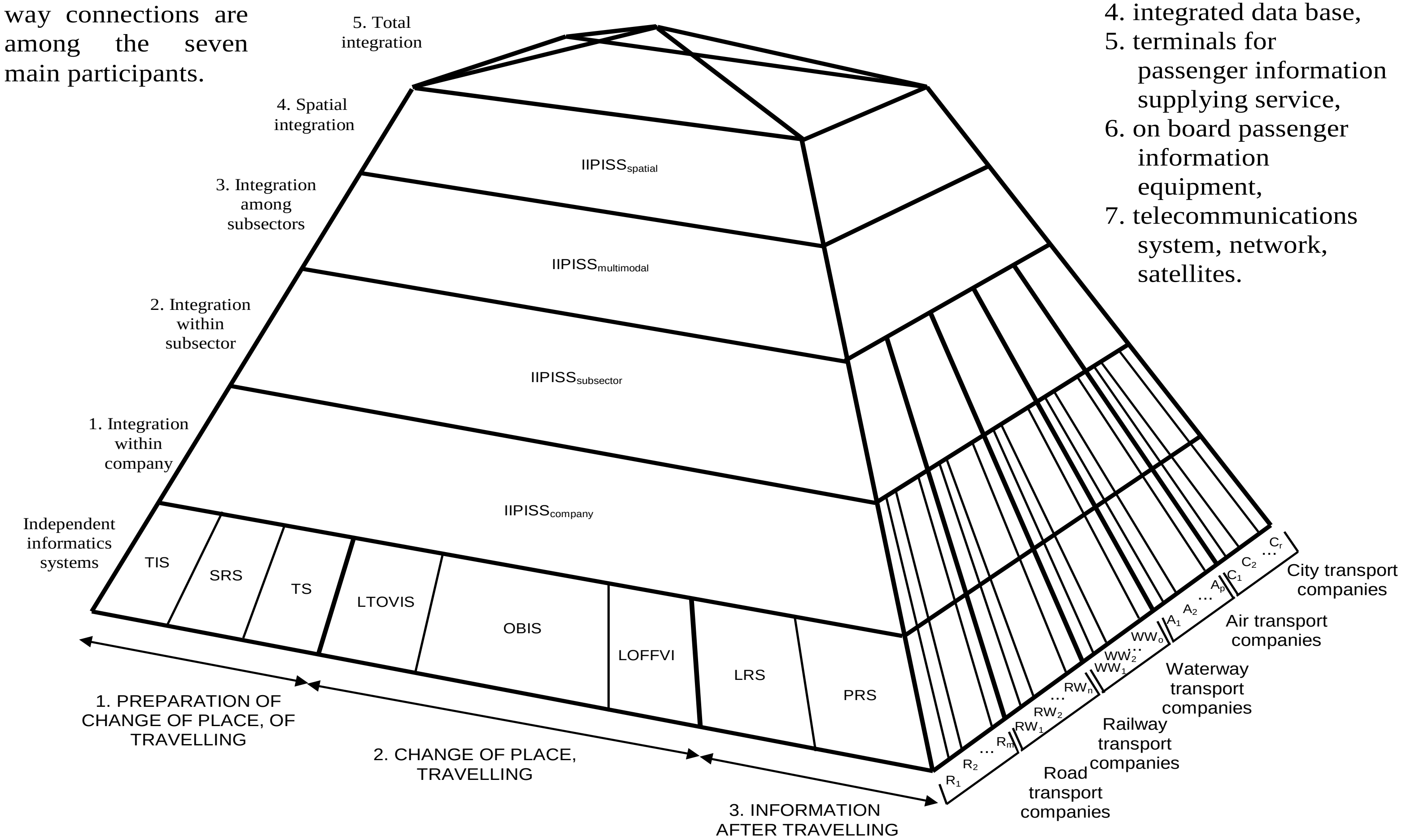

Fig 1.: *Phases of the integration of informatics systems executing passenger information*

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