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COMPUTERISED ROUTE CHOICE PLANNING ON PUBLIC TRANSPORT NETWORK

Abstract

In an advanced public transpot system is required to provide passengers with accurate information on a high standard. The itinerary planning computer system helps the passengers before beginning of the journey. This system makes the route and mean choice easier considering the main service-choosing point of views. The computer program is able to handle static timetable datas and dynamic datas of current traffic situation, the current datas of vehicles' position. Different information technology solutions exist for itinerary planning.

1. Introduction

Before beginning of a travel the passengers are often helpless. It is particularly true if intends to make use of public transport means. Does not know which stops (stations) are found in surroundings of his or her origin and destination point, on which route, by which mean can get the destination, where is needed changing, how long is needed to wait, what does the journey cost, and even we can continue the similar questions arising in the passenger. Make the task more difficult that at present the timetable booklets are accessible with difficulty and expensive. Its handling is difficult for an unpractised passenger and it takes up a great deal of time to arrange means on different services in proper order. The itinerary planning computer system to be made known gives answers for these questions using the offered advantages of informatics and telematics. The increasing of computer use makes possibly for us by short distance travel also the computerised preparing of itinerary.

2. Problem of the route choice

The public transport network is a system of routes serviced by public transport means of a definite area. The elements of this network can be modeled by node models. In

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case of public transport network the nodes are the stops (stations) and the lines are the services. We can consider the sections connecting the single stops (stations) with the concrete origin and destination points as the lines of the model as well. In this way the enlarged network node model is called as extended network node model.

The aim of route searching is to determine the resistances of routes in accordance with passengers' real route choices [1]. The resistances of lines of a node model following the real circumstances are linear functions of different paramethers (time, length, cost, comfort, safety,...), or in more complicated case they are non-linear functions of these paramethers. At creating this function the paramethers influence the resistance according to passengers' route choice custom features. Make it more difficult determination of resistance that the single paramethers are not permanent in time but alternate dynamically. Consider for example that public transport network is various on different days and on different part of the day as well as the timetables of vehicles running of different lines are also various. In the case of a certain passenger, in a certain situation some paramethers are more important or less important than the average value. Thus in this case the use of resistance formula created on the basis of average route choice custom features does not give the desired result. After this short statement that can be seen that detrmination of resistance values on single lines is a complex task. Thus the problem of the route choice is needed to be approached in another way.

3. The itinerary planning system

The itinerary planning system provides the passenger information before beginning of journey. Make it easier the route and mean choice. The passengers asking for information can make use of service of this system directly and indirectly. Directly at information boards of stops (stations) or on Internet can be to ask for route offer. By appearance on Internet many inquirers can make use of this service sitting at home. The indirect use of route planning system can be realized in many ways. On the one hand it can help the work of information service staff on bigger stations. Hereby the answer giving time for passengers is decreasing and the human inaccurancy can be eliminated. On the other hand the tourist information centres and tourist offices also can use this service. In this way the passenger gets in touch with computer not directly but through a terminal operator person.

This kind of computer route planning program can be made use of also as the part of the dynamic transport-influence system. Namely in this way we offer public transport alternative for individual drivers. If for example somebody approaches the city by car and would like to reach a well-defined purpose but it meets some difficulties, then he or she can ask for this service's help. If so the optimum manner of reaching the purpose is to guide the arrival to an advantageous-situated P+R parking place from where can continue journey by public transport. Being in possession of infornation which has been given in the itinerary there the journey can be continued without loss of time [2].

If we consider the origin in time of datas used at route offer planning there are two possible solutions. In case of one of them the itinerary is based only on static data that is previously planned timetable data. The another possibility is to use the data of current traffic situation, the current data of vehicles' position. In this latter case we speak about itinerary made on the basis of dynamic data. If so it can be given information for the passengers on substantially higher level, more exactly, connected to the real position.

4. The itinerary planning program

The prepared itinerary planning procedure and computer program take all sectors in public transport into consideration. The itinerary is completed in four steps. The sequence of these steps is the following:
a., Choice of stops (stations) situated in surroundings of passenger's origin and destination points.
b., Key in of input data that are necessary for planning of displacement by public transport means.
c., Seeking process of services[2] on the basis of input data.
d., Choice of appropriate services, summarizing of part-data, sorting of itineraries into proper order.

a., Choice of stops (stations) situated in surroundings of passenger's origin and destination points

Computer program helps the choice of stops (stations) in two ways. If we know the post address of origin or destination point (city, zip code, street, street-number) then it produces the list of recommended stops (stations) for this address and the reaching times as well. If the post addresses are unknown and we can only approximately designate the origin and destination points on the digital map then the program appoints the nearest stops or staions. In this case the computer gives the direction, distance and reaching time too.

b., Key in of input data that are necessary for planning of displacement by public transport means.

To key in of input data by the passenger is possible on the input screen. The person asking for information has to give the origin point, and the destination point, the date of intended journey, the point of time and the being utilized rate of price reduction. It is needed to determine that how many changes will be contained in the itinerary. And it can be decided that which main service-choosing point of views will have been taken into consideration by computer at sorting of itineraries into proper order. The main service-choosing point of views are:
- itinerary containing the nearest departure point of time,
- itinerary with shortest reaching time,
- itinerary with lowest cost,
- itinerary giving preference to some means of public transport.

c., Seeking process of services on the basis of input data.

Seeking means the determination of services on the lines of node model. For this the computer program uses the datatable called "Basis". In a record of the datatable are the code of a node of the node model, the code of a service touching this node and some further data of the node and the service. The alternatives of searching process are:

In case of *itinerary without change* searching means the determination of services touching the origin and as well as destination point.

In case of *itinerary with one change* the itinerary is made up of two sections. In the searching process the computer does the determination of change points and the searching of

[2] On concept of service I mean giving of transport means (bus, train, suburban train, etc.) by identify mark (service number, train number, etc.) and time data.

service data belonging to certain sections. The common part of set of points are accessible directly from origin point and set of points are accessible directly from destination point is taken into consideration as changing point. In case of one changing point the itineraries can be made as a combination of services belonging to first section and services belonging to second section.

In case of *itinerary with two changes* the itinerary is made up of three sections. In the searching process two part-steps are realized at the same time. The one of part-steps is determination of first and second changing points. The other part-step is searching of service data belonging to certain sections. The points are accessible directly from origin point are taken into consideration as first and the points are accessible directly from destination point are taken into consideration as second changing point. Further criteria is that between the first and second changing point is needed to be direct reaching possibility. At fixed changing points the itineraries can be made as a combination of services belonging to first, second and third section.

In similar way itineraries also can be created with more than two changes. There is not obstacle of principle to increase the number of changes. But in practice on the one hand the searching process slows down in case of large-size database, on the other hand over a definite number of changes the passenger probably chooses the not public transport.

d., Choice of appropriate services, summarizing of part-data, sorting of itineraries into proper order.

Not each service that had been got at seeking can be taken into consideration at itinerary planing. At queries the application of a filter on appropriate services happens on the basis of the following point of views:

- The time value has to be higher at the end point than at the beginning point of a section. So can be selected the services running towards the end point of the section.
- The services departuring later than the time had been given at key in or the arrival time of the previous section are appropriate as the services of a section.
- Only the services running on the determined day can be used, therefore only these services are needed to be choosed in the itinerary.
- Maximum 30 minutes waiting time can be even considered as acceptable at changing points.
- In itineraries with change “loop” journeys are not allowed; that is the origin or destination point of itinerary can not function as changing point.

Data regarding the certain sections (running-time, covered distance, fare being paid, kind of means, restricting mark regarding the service running) can be determined by data being in one record of the “Basis” datatable. The summarized data regarding the whole itinerary (“tightened” reaching time, running-time, waiting time, covered distance, fare being paid) can be calculated by part-data of sections.

Computer program arranges the ready itineraries first of all according to main service-choosing point of views had been given at key in, then according to order of point of views had been stored on the basis of route choice costum statistics of passengers in advance. This order of point of views is the following:

1. nearest departure point of time,
2. shortest reaching time,
3. lowest cost.

The passenger gets the data of itineraries sorted into proper order on the output screen. In addition printed itinerary can also be asked for that helps the orientation during the journey [3]. The printed itinerary can be seen on the Figure 1.

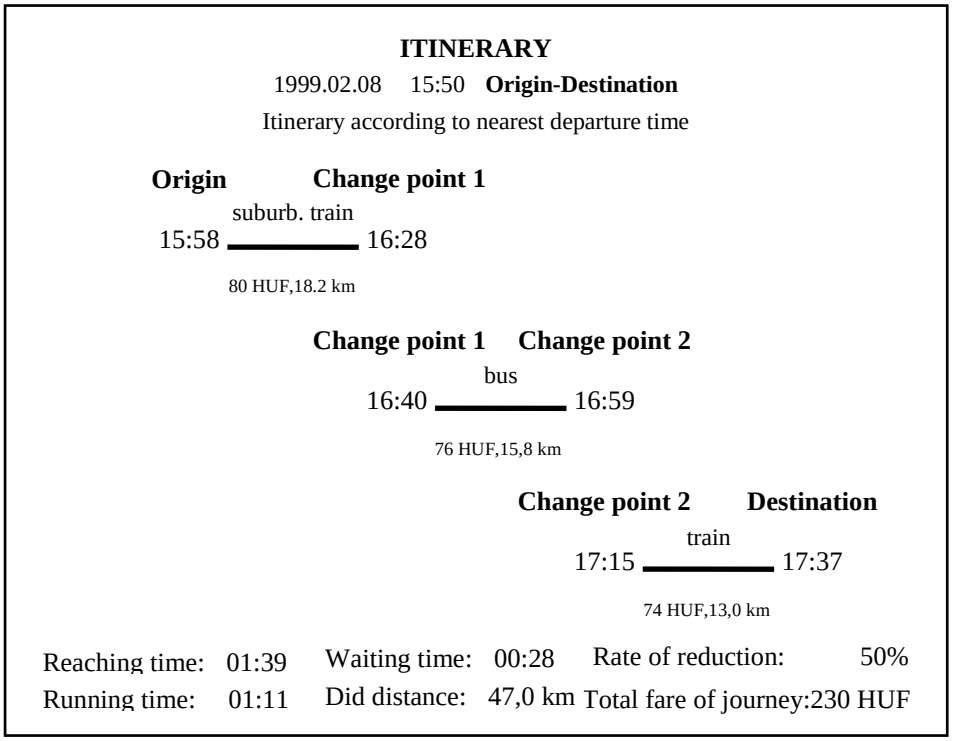

Fig. 1. Printed itinerary

5. Structure of the database

The program handles the following datatables:
- basic datatable of stops and stations,
- datatable called “Basis” of queries,
- datatables of local public transport facilities,
- datatables of tariffs.

The data of mentioned four datatables can be added at first data addition. The computer produces the itineraries on the basis of data given by the passenger at query and with using of data of these datatables. The structure of the datatable called “Basis” can be seen in Table 1. Auxiliary datatables can be used at adding of earlier datatable. For addition of data of a timetable field is expedient to take down a route and a service datatable belonging to this timetable field.The computer program is in operation by static data but the developed structure gives possibility to make use of dinamic data partly at itinerary planning. Addition of dinamically changing data is possible on a form that is presented on a screen.

Tab. 1. Structure of the datatable called “Basis”

Field name	Data type	Field size	Example	Note
ID	Text	3 character	007	point (stop, station) identification character
Rose	Text	7 character	2603003	route and service number of service
Time	Date/time	Short time	9:51	time of departure (arrival) of service at this point
Limit	Text	1 character	I	sign determining the days of service
Km	Numeral	Double (1 decimal)	35.1	distance of point from the start point on route of the service

6. Hardware solutions for itinerary planning

a., Stand alone solution in case of static system

At this development level the computer accomplishes the itinerary planning task on the spot by own program on the basis of static timetable data added in advance. The data addition, the data modification needs a short time on occasion of timetable and tariff changing. It is disadvantegous that in such a case at all settlings is needed to do these operations which are clumsy in case of many apparatus that are settled in spreaded-in-space points.

b., Central solution in case of static system

The itineraty planning terminals can be joined to central computer by advanced communication service (ACS). The placed out sets forward the data given by passenger for itinerary planning to the central computer. Then this computer does the searching, applying a filter, summarizing, sorting in proper order tasks by central program on the basis of central database. After this, the data of ready itineraries are forwarded to the terminals, where the ready itinerary is presented and printed out. Does not run program at terminals. If it is necessary more than one itinerary planning computer at some settling, then those ones join the communication network through a terminal control device. The great advantage of the centralised system is that in the central database the data modification can be done easily and quickly. Signal comes from the settled terminals to the centre that signals whether the terminals are out of order and the consumption of paper needed for printing can be followed as well. This solution is indispensable for construction of the dynamical system.

c., Central solution in case of dynamic system

In case of this solution the inter-sectoral dispatcher keys in the datas regarding the current traffic situation and the differences from the planned timetable in the database of central computer. The dispatcher keeps the contact with the organizations providing dynamic data or gets direct data regarding vehicles’ position by vehicle-following satellite system (e.g. in case of road vehicle). Over a certain traffic intensity computer helps the dispatcher at ascertaining of occurrence of difference from the planned timetable which are being taken into consideration. The informatics figure of central solution relied on advanced communication service, in case of dynamic system can be seen on the Figure 2. The sectoral dispatchers forward the dynamic data to the inter-sectoral dispatcher by wired (telephone,

fax,...) or unwired (radio) datatransfer way. The inter-sectoral dispatcher keys these datas in the database of central computer by his own workstation. Or the terminal control devices, or directly the terminals join the central computer by advanced communication service.

Summary

The unbroken expansion of traffic on the road network makes the limit of the permeability of routes within a reasonable time. The instruments of telematics also can be used to manage the problems caused by the traffic expansion or problems connecting to it. The public transport means can become more attractive contrary to individual transport by giving accurate information on a high standard containing the details as well (e.g. advanced information service at P+R parking places). Employment of competitive public transport is advantegous for passengers and for people living in the city or in it's surroundings in many respects. In addition nowadays the intensive information providing for passengers using the public transport is an indispensable condition in modern transport. The realization of a common passenger information, itinerary planning system is favourable for all public transport companies and mainly for passengers because during a change of place the passengers often use more than one kind of transport means.

References

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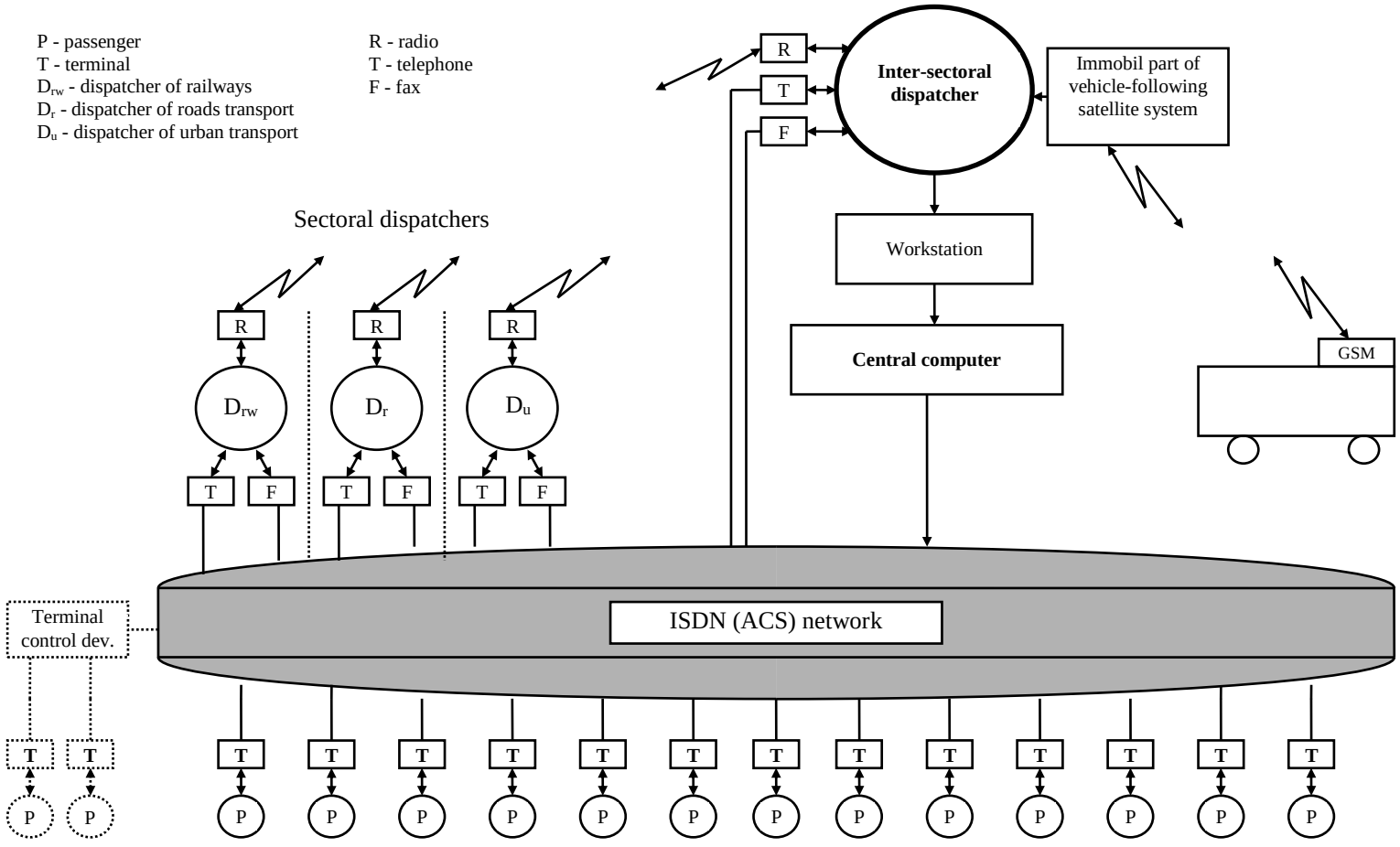

Fig. 2. The informatics figure of central solution relied on advanced communication service, in case of dynamic system