

# Solutions for Finding the Optimum Route between Two Urban Locations Using Public or Private Transport or Pedestrian Movement

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**Abstract:** TRANSASIST is an intelligent system for the management of circulations in urban environment, based on modern information and communication technologies at European standards level. The system manages different types of information regarding the urban transport and integrates GIS environment for work with vectorial digital maps, multimedia techniques, solutions for complex data acquisition and wireless communication technologies. TRANSASIST is a dynamic system that allows on-line information and management of complex data structures regarding the urban road transport infrastructure and characteristics. In the TRANSASIST system development, a modern approach based on UML technology has been used. TRANSASIST helps citizens to travel across urban areas by finding the best route between two points offering solutions for public transport, private transport and pedestrian movement.

**Keywords:** Intelligent management system, urban transport, wireless communication technologies

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## 1. Target Area

TRANSASIST is an intelligent system for the management of circulations in urban environment [1], based on modern information and communication technologies at European standards level. The system manages different types of information regarding the urban transport and integrates GIS (Geographical Information System) environment for work with vectorial digital maps, multimedia techniques, solutions for complex data acquisition and wireless communication technologies.

The area addressed by TRANSASIST system is surface and underground urban public transport, urban private transport and circulation in a city as a pedestrian. In the TRANSASIST system development, a modern approach based on UML technology has been used [2].

## 2. General Characteristics

TRANSASIST is a dynamic system that allows on-line information and management of complex data structures regarding the urban road transport infrastructure and characteristics.

TRANSASIST supports citizens in their travel into an urban locality to find the best route between two points offering solutions for public transport, private transport and pedestrian movement. Travellers have the possibility to obtain on-line information regarding the means of transport to be used and the duration of a travel, in the whole transport network of a locality.

The system allows determination of possible route(s) to a certain destination indicated through station name, street name (address, postal code), name of economic, social, touristic, artistic objective or a combination of these.

The system offers information, both in graphical form (routes on which circulation is performed) and in table form (streets from the route, streets on which circulation is performed, progression intervals on hourly schedules of a day, the first and last drive hour etc.), regarding the urban transport with public means of transport.

A journey may be planned by indicating the date when the travel will be performed and the hour of departure or arrival at a certain place or address.

The environment of representation of the route(s) offered by the system contains two types of graphical maps: raster maps and vectorial maps.

When vectorial maps are used, the system allows their personalization by choosing the colours for display background, map background or text displayed on map.

The system allows finding possible routes between two points from the urban transport network by using some predefined criteria:

- Travel only with a certain vehicle type;
- Circulation only with surface transport;
- Circulation only with underground transport;
- Multimodal circulation with different means of transport;
- Number of transfers between urban transport routes on the covered route;
- Degree of detail for the offered information.

The determined route transport segments are displayed in a window that allows visualization of the necessary data for a travel: departure station, recommended means of transport, necessary transfers, arrival station, number of stations to be covered, departure hour, arrival hour, estimated travel duration.

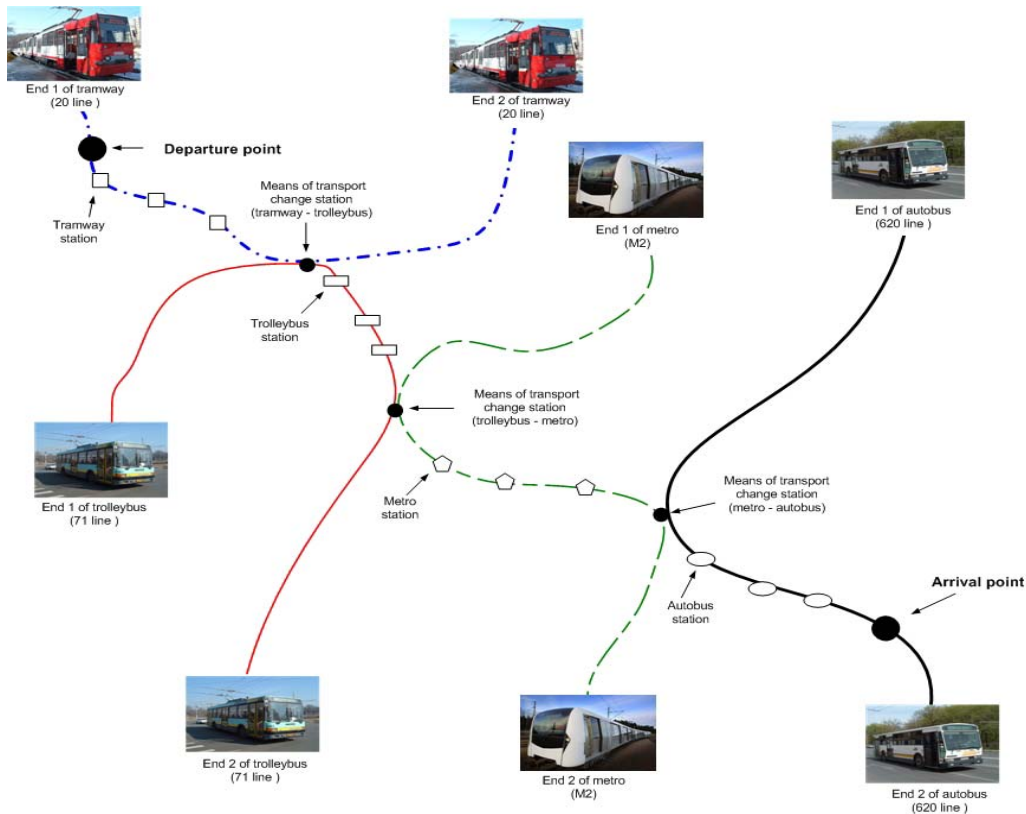
For circulation optimization there are suggested routes in which the connection between different transport segments is carried out through pedestrian movement.

TRANSASIST system offers information regarding circulation on the streets of a city between two points and by persons who ride private means of transport (car, motorcycle, bicycle etc.).

In figure 1, it is underlined the mode of creating an urban public transport route between two points (departure point and arrival point) from public transport segments specific to different transport lines.

The route chosen for exemplification is formed by four transport segments pertaining to different surface and underground public transport lines.

The first segment includes a section from a tramway transport line, segment 2 is performed by trolleybus, segment 3 is covered by the metro and on the last segment to destination the circulation is carried out by bus.



**Figure 1.** Public transport area covered by TRANSASIST system.

### 3. System Structure

The TRANSASIST system functions [3] are structured on two levels. Level 1 refers the system function categories and level 2 underlines the component functions for each function category.

TRANSASIST system contains the following function categories:

- Information;
- Route determination in urban transport with public means of transport;
- Route determination in urban transport with private means of transport;
- Route determination for pedestrians;
- Information search and visualisation through the system - user interface;
- Management of means of transport and transport lines;

- Information search and printing;
- Help.

The functions referring to urban public transport require the involvement of transport operators in providing updated data regarding the transport lines under their management.

#### 4. System Functions

The departure and arrival points may be of the following types:

- Public transport point;
- Street;
- Objective (economic, touristic, social, artistic).

The system functions for each category are presented in table 1.

**Table 1.** Public transport area supported by TRANSASIST system.

<b>Function category</b>	<b>Function</b>
Information	<ul style="list-style-type: none"> <li>• Specification of departure and destination points for which information is required;</li> <li>• Visualisation of the route specific to each urban public transport line by information provision in text form and by representation on a digital map.</li> </ul>
Route determination in urban transport with public means of transport	<ul style="list-style-type: none"> <li>• Specification of departure and destination points;</li> <li>• Determination of route to be covered with public means of urban transport between the specified departure point and destination point;</li> <li>• Specification of segments to be covered on foot in the case in which there exist not 2 public means of urban transport which can be chained;</li> <li>• Visualisation of the route that must be covered with public means of urban transport by information provision in text form and by representation on a digital map.</li> </ul>
Route determination in urban transport with private means of transport	<ul style="list-style-type: none"> <li>• Specification of departure point and destination point;</li> <li>• Determination of optimum route to be covered by private means of urban transport between the specified departure point and destination point;</li> <li>• Visualisation of the route which must be covered by private means of urban transport by information provision in text form and by representation on a digital map.</li> </ul>
Route determination for pedestrians	<ul style="list-style-type: none"> <li>• Specification of departure point and destination point;</li> <li>• Determination of optimum route to be covered by pedestrian transit between the specified departure and destination points;</li> <li>• Visualisation of the route that must be pedestrian covered by information provision in text form and by representation on a digital map.</li> </ul>
Information search and visualisation through the system - user interface	<ul style="list-style-type: none"> <li>• Visualization of information offered by the system at global level and detail level;</li> <li>• Personalization of the language of dialogue between user and system, the display background colour, the text colour, the</li> </ul>

Function category	Function
	background map colour; <ul style="list-style-type: none"> <li>• Modification of map visualization scale (zoom).</li> </ul>
Management of means of transport and transport lines	<ul style="list-style-type: none"> <li>• Management of types of public means of urban transport;</li> <li>• Management of urban public transport lines.</li> </ul>
Information search and printing	<ul style="list-style-type: none"> <li>• Obtaining, on paper, of information regarding the urban transport.</li> </ul>
Help	<ul style="list-style-type: none"> <li>• User assistance by providing information for guidance in TRANSASIST system usage.</li> </ul>

## 5. Selection Criteria

The principal selection criteria considered by the TRANSASIST system for information searching are the following:

- Type of the means of transport;
- Type of the desired transport:
  - surface (road);
  - underground (metro).
- Number of transfers between routes to perform;
- Degree of detail of the information offered to the user.

## 6. Managed Data Structures

The conceptual model of data structures underlines the principal data managed by the system and the logical connections between them.

The data collections that have been identified based on requirements submitted by users and on system functions, related with their role within TRANSASIST system, have been structured in six data categories. Each data category contains a series of data entities which underlines the types of homogeneous data structures.

### 6.1. Data categories

The data categories managed by the TRANSASIST system regarding urban public transport are:

- Information regarding means of transport;
- Information regarding routes of transport lines;
- Information regarding transport schedules;
- Information regarding transport payment;
- Information regarding transport usage;
- Information regarding transport infrastructure and localization points.

### 6.2. Data entities

The principal data entities managed by the TRANSASIST system are the following:

- Types of means of transport;

- Lines of urban public transport with tramway;
- Lines of urban public transport with trolleybus;
- Lines of urban public transport with bus;
- Lines of urban public transport with microbus;
- Lines of urban public transport with metro;
- Station of boarding / un-boarding at transport line level;
- Transport schedules;
- Public transport operators;
- Private transport operators;
- Modes of payment;
- Tariff areas;
- Tariffs;
- Centres for travel document procurement;
- Documentation information regarding the travel document validity;
- Documentation information regarding the travel document usage mode;
- Fines;
- Centres for fine payment;
- Documentation information regarding the litigation performance mode;
- Streets included in urban area map;
- Economic, social, touristic, artistic objectives.

The conceptual model of TRANSASIST system data collections is presented in figure 2.

Some entities, considered relatively independent, have been grouped due to their homogeneous data structures. The respective groups of entities are:

- Transport lines;
- Transport operators;
- Digital map of the locality.

## **7. Technical architecture**

The principal technical components of TRANSASIST system are:

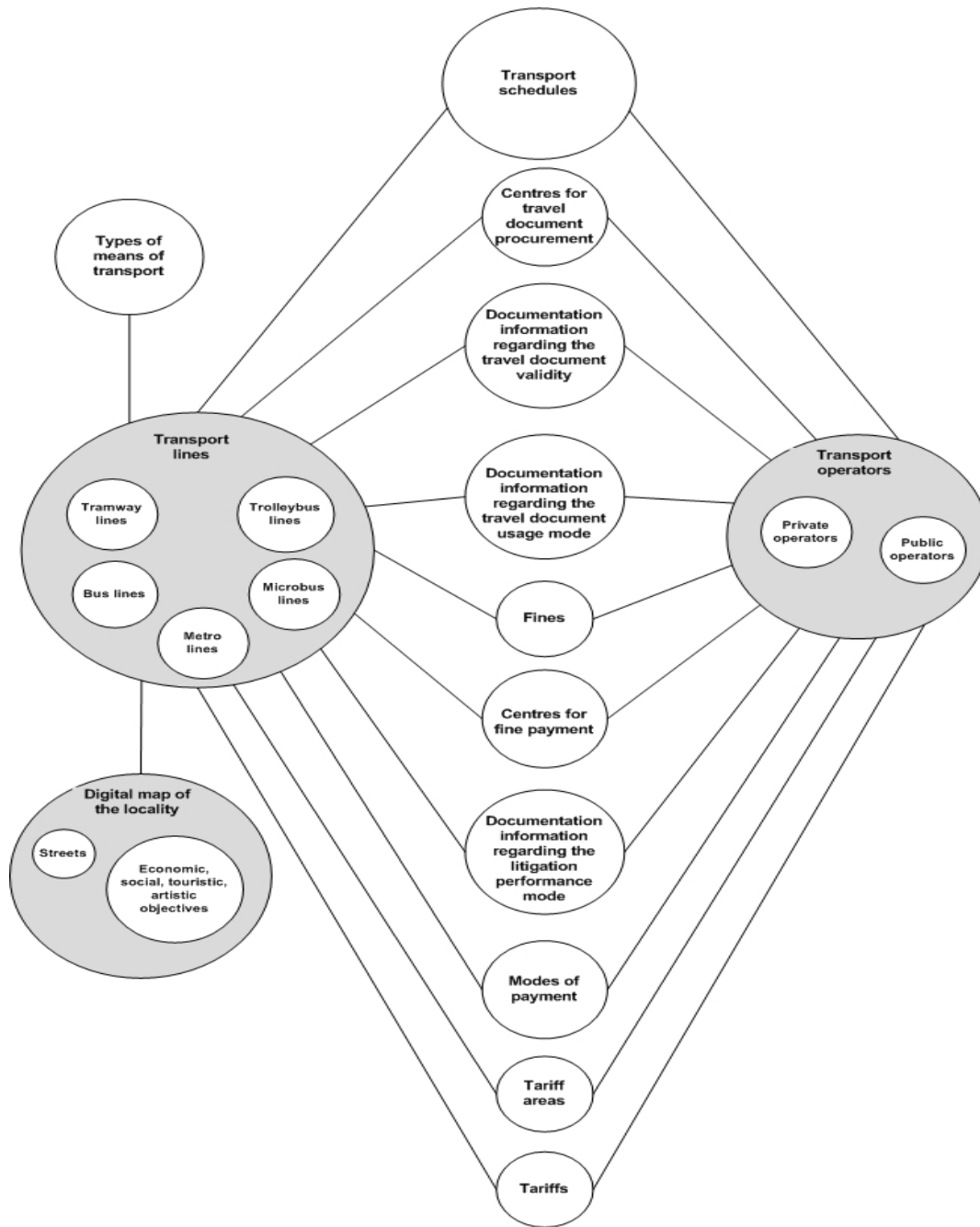
- Database;
- Administration server that manages the global data structures and the software components and assures the data updating;
- Mobile devices that select the data necessary for users' orientation and assist them in the circulation on public transport lines, with private means of transport or on foot.

The group of users involved in system usage are:

- TRANSASIST system monitoring centre;

- Persons or groups of persons moving in urban environment.

The TRANSASIST system technical architecture is presented in figure 3.



**Figure 2.** Conceptual model of data structures.

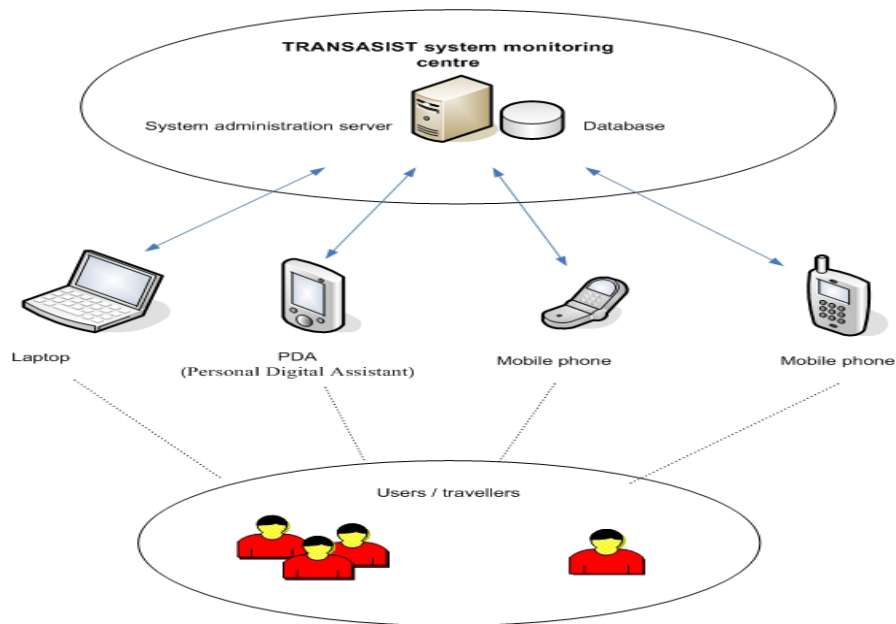


Figure 3. TRANSASIST system technical architecture.

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