NEWSLETTER

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Integrated intermodal traveller services

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International Trip Planning and support based on the needs of travellers

The ENHANCED WISETRIP Approach!

EUROPEAN UNION

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International Journey Planning Needs and Functions

International Journey Planning Needs and Functions

It is widely argued that providing travelers with door-to-door international multimodal journey planning services with real time alerting and on-trip re-planning capabilities constitutes a major need in the international travelers' community. Table 1 below presents the major journey planning needs not fully covered by the existing journey planning services.

Existing Services	Journey Planning Needs
▪ Existing JPs are designed to provide data that can assist local, regional and national travelers.	▪ Integrated itinerary planning taking into account international, national, and urban transport services ▪ Planning international trips with return ▪ Planning international trips with mandatory intermediate stops
▪ Accessibility information of facilities in specific stations/terminals provided for special groups (e.g. disabled people).	▪ Planning Itineraries customized to the international traveler profile (elderly, disabled, tourist, and business)
▪ Real-time information and alerting services: only limited modes and in a very local area are covered with real-time data.	▪ Be prepared for potential trip disruptions at the pre-trip phase of a journey ▪ Deal with trip disruption at the en-route phase of a journey by getting re-planning options

Table 1. Journey planning needs and relevant existing services

The WISETRIP project aimed at designing and implementing an international door-to-door journey planner. The Enhanced WISETRIP (E-WISETRIP) system aims to cover the above journey planning needs through enhancing the WISETRIP system functionalities in terms of: i) extending the modal and geographical coverage of the journey planning services, ii) providing information services customized to the travelers special travel needs (e.g., elderly), and iii) introducing dynamic trip re-planning and real-time alerting information services.

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International Journey Planning Problems (1)

International Journey Planning Models

Based on the journey planning needs identified in the project work plan, the following trip planning models were identified:

i) The elementary International Itinerary Planning Model, which aims to determine alternative itineraries between an origin and a destination for a given earliest departure time and/or a latest arrival time.

ii) The Round-Trip International Itinerary Planning Model, aiming to specify alternative itineraries for an international trip with return given an earliest departure time from the origin, a latest arrival time at the destination, an earliest departure time from the destination back to the origin, and a latest arrival time at the origin.

iii) The International Multiple-Trip Itinerary Planning Model aiming to determine alternative itineraries from an origin to a destination passing through a sequence of mandatory intermediate stops each one constrained by a latest arrival time and an earliest departure time

iv) The International Trip Contingency Planning Model, which emerges from the need to work out disruption scenarios at the pre-trip phase of a journey. Given a disruption scenario out of a relevant predefined list of potential incidents (e.g., service cancellation, k minutes delay of departure/arrival, terminal closed), alternative itineraries that resolve the relevant travel disruption are seek. The solutions identified are meant to be used as back-up solutions for the execution of the journey. The solution of the emerging trip re-planning problem should take into account constraints inherited from the initial trip itinerary e.g., tickets for transport services already booked.

v) The International Dynamic Itinerary Re-Planning Model which aims to determine an alternative sub-itinerary from the traveler's current (actual) location in the executed itinerary to the destination, taking into account that a transport service initially included in his/her trip itinerary is not in use anymore (due to cancellation of increased delay). The alternative itinerary is calculated while the traveler is en-route taking into account the updated schedules of the underlying transport services.

All models are defined on an international multimodal scheduled transportation network (Figure1). Models (i)-(iii) pertain to static pre-trip international journey planning aiming to determine alternative international multimodal itineraries taking into account the following criteria: travel time, number of transfers, cost, transfer time, and CO2 emissions which will be calculated on a per passenger basis by the E-WISETRIP CO2 calculator (Task WP4.1). Models (i)-(iii) are modeled as mutli-criteria time-dependent shortest paths problems on multimodal scheduled transportation networks.

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International Journey Planning Problems (2)

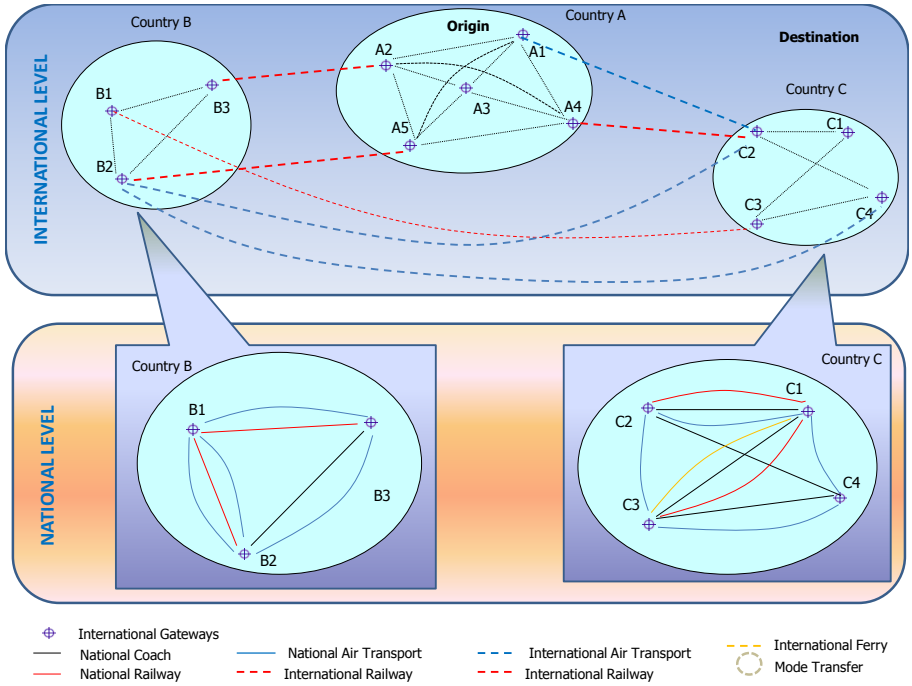

Figure 1. International and national layers of the transportation network under study

On the other hand, models (iv)-(v) deal with the trip re-planning problem addressing a potential transport disruption affecting the initial plan of a trip. In particular, the international itinerary contingency planning model aims to create a back-up itinerary from the node where the potential disruption is associated with, up to the destination of trip. This type of problem is based on static information. The international dynamic itinerary re-planning model aims to fix the disrupted trip in real time by determining an alternative itinerary from the node where the traveler is currently standing or heading to, up to the destination of the trip. This type of problem uses updated transport information (schedules) based on real-time data. Both re-planning problems are modeled as time-dependent shortest path problems in a multimodal scheduled transportation network.

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Modelling Issues

Network Model

Any International itinerary involves a sequence of International, National/interurban and urban/local transport service segments (including walking). The underlying transportation network for any International itinerary planning problem, involves the International, interurban, and urban public transport networks operating within the area of coverage of the system. Solving any itinerary planning problem on the above network is an unmanageable task. However, the relevant transportation network has a hierarchical structure: the interurban and/or urban transport service segments included in an itinerary play the role of transfer links between International transport segments (Figure 2).

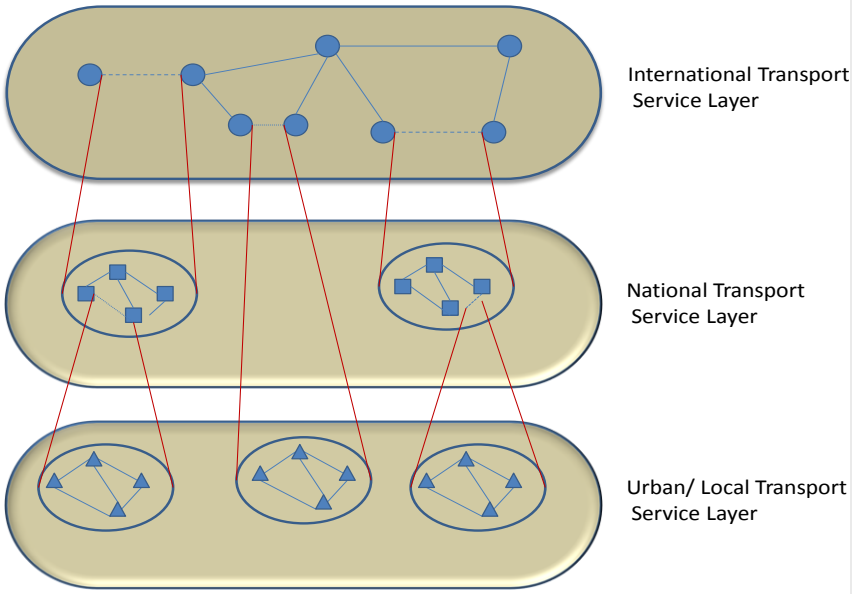

Figure 2. Hierarchical structure of the international transportation network under study

Thus, the problem may be solved in two stages: i) at the first stage alternative partial itineraries are determined including only international transport service segments, and ii) at the second stage, each of the partial itineraries determined in the first stage is enhanced with the interurban and urban/local sub-itineraries resulting to complete itineraries.

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Modelling Issues (2)

The emerging complete itineraries are further assessed in terms of the travel time, cost, the number of transfers and transfer time and any dominated solutions are disregarded.

The network used in order to determine the partial international itineraries consists of nodes and links defined as follows:

- The set of nodes represent all the international gateways (terminals facilitating at least one international transport service) of any transportation mode, the point of origin and the point of destination.
- The links represent the transportation links (i, j, s, t_d, t_a) where i and j are nodes, $s \in S$ where S is the set of transportation services operated within nodes i and j, t_d and t_a denote the departure time from node i and the arrival time at node j respectively. In addition to the international transportation links, transfer links are also included representing interurban/urban sub-itineraries connecting pair of nodes of the network.

In particular, three types of transfers links can be identified:

- *Walking transfer links* where the transfer between two nodes may be performed by walking (e.g., transferring from an international airport terminal to an international rail station within the same neighbourhood with international connections.
- *Local/Urban Transfer links* where the transfer is performed by using the local public transport system (metro, tram, bus) or taxi. Note that walking will also be included for performing part of the local transfer.
- *Interurban Transfer links,* which imply that a transfer may be performed through an interurban trip (e.g., by train, coach, ferry). Note that this type of transfer will possibly include local transfers as part of the overall interurban trip.

Customised Network

For any international trip request, only a sub-network of the entire international network may be applicable. The remaining links would not be used in any of the alternative trip itineraries. Thus, any international itinerary planning problem may be solved on a sub-network customised for the specific origin-destination nodes.

This feature is incorporated in the Enhanced WISETRIP Journey Planning functionality by determining and storing customised sub-networks for any pair of origin –destination countries. This process is performed offline and includes the steps described in Figure 3.

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Modelling Issues (3)

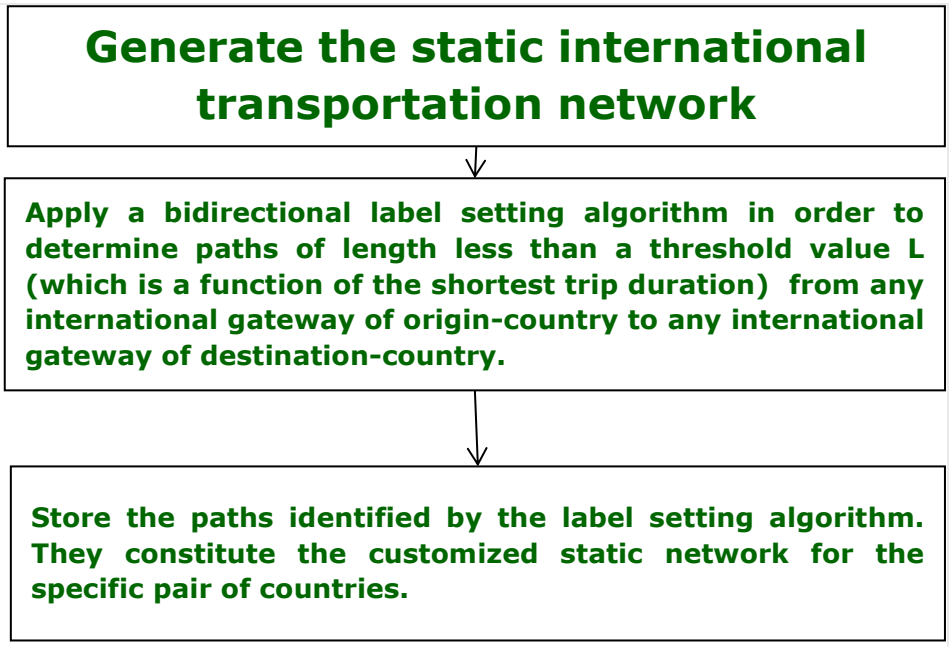

Figure 3. Steps of the pre-processing stage

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Solution Algorithm

Solution Algorithm

The international itinerary planning problems addressed within the Enhanced WISETRIP system are solved through the solution approach illustrated in Figure 4.

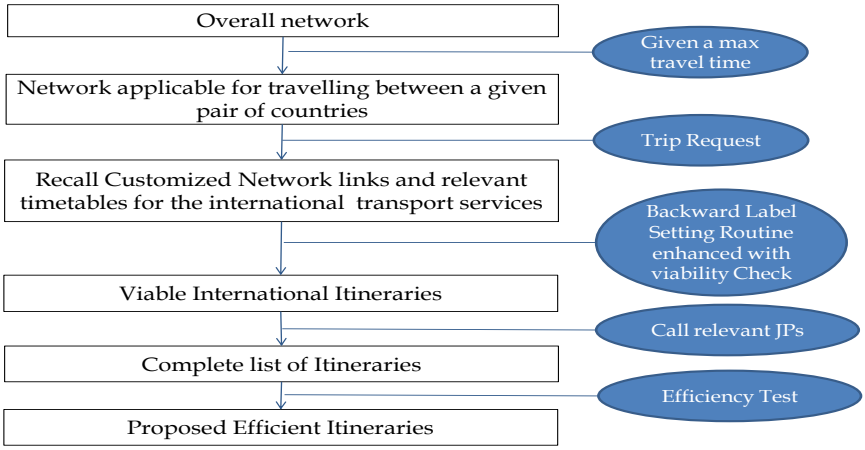

Figure 4. Overall solution approach

A backward label setting algorithm is proposed for solving the multi-criteria time-dependent shortest path problem in a multimodal network. The multi-criteria algorithm for multimodal networks proposed in (Androutsopoulos and Zografos, 2009) will be adapted to deal with viability issues arising in the international itinerary planning problem.

A backward label setting algorithm is proposed for solving the lexicographical time-dependent shortest path problem in a multimodal network. The Chrono-SPT paradigm (Pallottino & Scutella, 1997) will be adapted to solve this problem taking into account the relevant viability issues.

Androutsopoulos, K.N., K.G. Zografos (2009). Solving the multi-criteria time-dependent routing and scheduling problem in a multimodal fixed scheduled network. European Journal of Operational Research 192 (1), pp. 18-28.

Pallottino S, M. Scutella (1997). Shortest Path Algorithms in Transportation Models: classical and innovative aspects. Technical Report TR-97-06, Universita di Pisa.

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Enhanced WISETRIP Website

The Enhanced-WISETRIP Website is now on line

The Website is designed to be the reference point to access information about the Project, the Enhanced-WISETRIP Website, accessible at: http://www.wisetrip-eu.org is targeting Actors, Experts, Stakeholders, Service Providers, User Groups and Individuals interested and involved in advanced, real-time multimodal Journey Planning Services and Solutions.

The Website's structure is organised to promote the general Project objectives and results. The general project information and outlook can be found into the 'Project' section, while the achieved results and developments can be monitored by looking into the 'Results' pages. Project Documentation (including Deliverables and Newsletters), Consortium Information and a News & Events section are also offered to keep visitors up-to-date with the project progress.

In the short-medium term, the launch of the Website will also benefit from the exchange of references and resources with other experts and relevant projects, so please check regularly http://www.wisetrip-eu.org to be kept up to date with the progress of the project !

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We Need Your Support

Enhanced WISETRIP partners would like to thank the User Group members that took part in the WISETRIP project. We have recognised your comments in the design of Enhanced WISETRIP and hope you will continue to support the development and evaluation of the system. If you have any comments regarding any aspect of our work or content of this newsletter, please contact Prof. J.D. Nelson at University of Aberdeen (j.d.nelson@abdn.ac.uk).

WISETRIP in operation

The focus of the project in the past five months has been on developing, refining, and implementing the itinerary planning models and algorithms that will be integrated in system. Project has also concentrated on designing the interface of the system and integrating new co-operating journey planning systems (9292, EMT, and In-Time).

WISETRIP news & events

1. Presentation of the itinerary planning models and algorithms in the 1st European Symposium on Quantitative Methods in Transportation Systems (September 4-7 2012, Lausanne, Switzerland)
2. Annual Meeting of the Transportation Research Board, Washington D.C., USA, January 13-17, 2013 (TNO).

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