

VIENNA-SPIRIT: SMART TRAVELLING BY USING INTEGRATED AND INTERMODAL TRAVELLER INFORMATION

Stefan Bruntsch¹, Karl Rehr²

¹*ARC Seibersdorf research GmbH,
Division Intelligent Infrastructures and Space Applications, 2444 Seibersdorf,
Tel: +43 (0) 50550 2021, Fax: +43 (0) 50550 2031
E-mail: stefan.bruntsch@arcs.ac.at*

²*Salzburg Research Forschungsgesellschaft mbH,
Jakob-Haringer-Straße 5/III, 5020 Salzburg,
Tel: +43 (0) 662 2288 416, Fax: +43 (0) 662 2288 299
E-mail: karl.rehrl@salzburgresearch.at*

SUMMARY

This paper introduces conceptual and implementation approaches for an integrated, intermodal traveller information system in the Vienna region. Studies forecast high potentials of travellers willing to use alternative means of transport if provided with intermodal traveller information and having travel time advantages. Furthermore it is expected, that intermodal traveller information can contribute to the increase of public transport use and road network efficiency. A model for context-based traveller information support is the basis for the conceptual design of the integrated, intermodal traveller information system developed in the Austrian research project Vienna-SPIRIT. Moreover, a pilot traveller information system was implemented and tested in this project. The focus was on the integration of existing route planning and information services in one system providing integrated, context-based and intermodal traveller information support. The user can access this intermodal travel information from car navigation systems as well as from mobile devices such as handhelds and smart phones. After the successful tests transfer to operation and further developments are planned in several respects.

INTRODUCTION

In order to manage the continuously increasing amount of road traffic alternative measures apart from building new infrastructure are necessary. Among other policies, experts and decision makers claim a modal shift from road to public transport. Traffic and traveller information systems are regarded as one instrument to bring travellers to use public transport more frequently. Nevertheless, networking and interoperability of these systems is missing to achieve this objective.

In the past, two separated domains existed in the sector of traffic and traveller information, on the one hand public transport information systems and on the other hand car driver route guidance systems. Public transport timetable information systems have evolved to intermodal

door-to-door route planning services, for instance in the Vienna region. However, these systems provide only pre-trip planning services and passengers are not supported with on-trip guidance and orientation. On the other side, route guidance and navigation systems, in-vehicle as well as on mobile devices, are optimised to car driver needs and do not consider other means of transport or intermodal information. For this purpose, the integration of network data for transport modes in one multimodal reference network and the definition of intermodal transfer points would be necessary. That means, integrated and continuous travel information support for intermodal journeys¹ has not been available so far.

BARRIERS AND OBJECTIVES

Travellers on intermodal journeys are confronted with complex situations, e.g. finding a parking place, finding the right platform, orientating in a metro station etc. This additional complexity leads to barriers, which distract travellers from changing from car to public transport.

The following issues are regarded as such barriers:

- Once travelling by car the transfer to public transport is not sufficiently supported. Car drivers have no access to public transport timetable information via in-vehicle navigation systems. So, they cannot know that changing public transport would be worthwhile in some cases.
- Familiar navigation applications cannot be used while travelling with public transport or walking. If existing at all, travellers have to get used with other information systems and have to care themselves about information integration.
- Existing intermodal traveller information systems only provide pre-trip route planning features. Pre-planned journeys cannot be accessed by mobile devices or adapted to the current situation while travelling. Especially in complex transfer situations, where travellers have to find the right platform or exit, orientation support is missing so far.
- Geographic information is optimised for navigation on road network and contains rare information about park & ride facilities and transfer points to public transport. However, pedestrian, bicycle and public transport navigation requires additional network information.

The Austrian research project Vienna-SPIRIT, which was initiated by Verkehrsverbund Ost-Region (VOR) and partly funded by the Austrian Ministry for Transport, Innovation and Technology aimed at reducing these barriers by providing seamless intermodal traveller information on mobile devices and in-vehicle navigation systems. Thus, it is expected to contribute to an increase of public transport use and an increase of road network efficiency.

The intermodal traveller information system developed in Vienna-SPIRIT addresses, on the one hand, commuters and business travellers in urban areas who need intermodal alternatives in case of traffic congestion on their route and, on the other hand, tourists which could leave their car at the city borders and are then more flexible travelling by public transport.

¹ Intermodal in terms of transport means 'travelling with or using more than one mode of transport during a single journey'.

To achieve above mentioned objectives Vienna-SPIRIT:

- integrates information of all means of transport in one traveller information system (**intermodality**),
- provides seamless and continuous access to traveller information on mobile devices (**mobility**) and
- links existing (monomodal) traveller information and navigation systems and uses their “intelligence” for navigation, timetable information and parking information (**interoperability**).

CONTEXT PARAMETERS AND TRAVEL SITUATIONS

The Vienna-SPIRIT system should be designed for context-based and integrated information provision. Different information needs at different phases of a journey (pre-trip planning, on-trip information, on-trip orientation and navigation) require adaptations of the information system. The appropriate parameters could either be recognised according to the travel progress or have to be explicitly announced by the traveller. Context parameters which are relevant in the particular travel situation are shown in Figure 1.

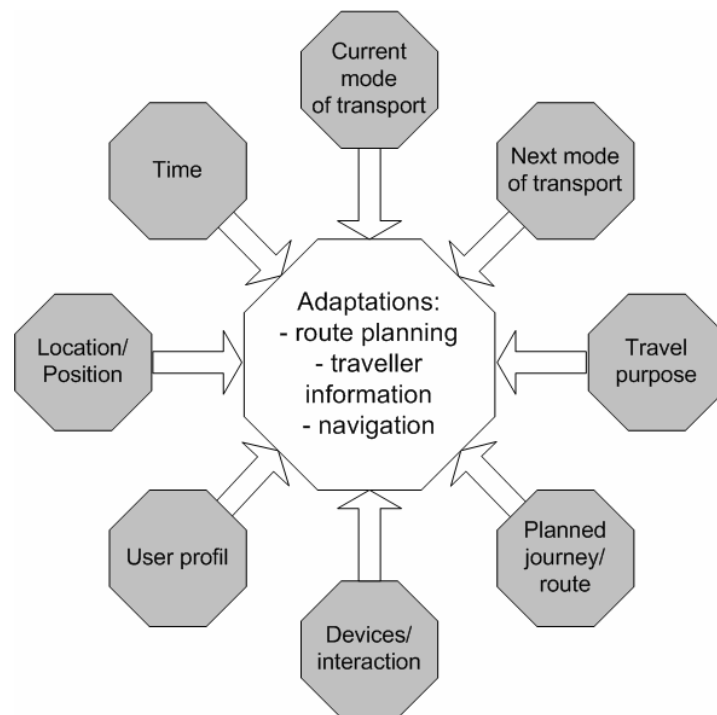


Figure 1: Context parameters for an integrated traveller information system [1]

The modelling of travel situations basically differentiates between a pre-trip phase and one or more on-trip phases. The pre-trip phase consists of route planning before the departure. In Vienna-SPIRIT the on-trip phase always refers to the pre-trip phase, which means on-trip information and navigation support is based on a planned route. A typical character of intermodal journeys is that travellers use more than one means of transport during the on-trip phase (travel situations and possible links see in Figure 2). Every means of transport requires

other information contents and level of detail as well as different kind of navigation support. For example, pedestrians orientate themselves in another way than car drivers. For pedestrians distance information are less useful. They need other landmarks such as outstanding objects or buildings, signposts etc. [2]. The public transport system is again based on timetables. Thus, route planning has to consider fix intervals in addition to distance and speed.

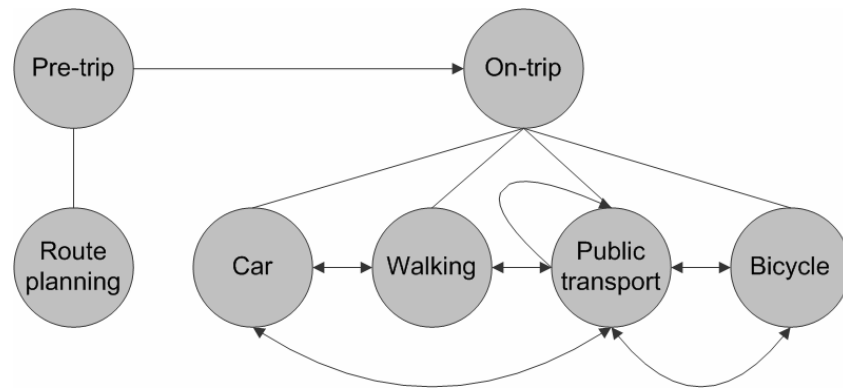


Figure 2: Travel situations pre-trip and on-trip

THE ARCHITECTURE

The Vienna-SPIRIT system architecture was designed considering the following requirements:

- Management of the heterogeneity of different devices and interaction modes,
- Integration of existing information systems and use of local “intelligence”,
- Integration and optimisation of traveller information from different sources,
- Continuity and adaptation of traveller support.

Hence, the system architecture is based on a hierarchic layer model. It consists of 4 logical layers which fulfil specific system tasks, which are the:

- Device Layer,
- Adaptation Layer,
- Middleware Services Layer,
- Legacy Systems/ Data Layer.

By means of open and standard interfaces between the Middleware Services Layer and the Legacy Systems Layer the Vienna-SPIRIT system achieves the requirement of integrating existing traveller information systems and heterogeneous data. The Middleware Services Layer consists of independent service modules. These services shall collect route and traffic information from different legacy information systems, but also manage user profiles and preferences. Personalised traveller information is especially important to facilitate the access of once planned route information with more than one device. Thus, permanent and continuous availability is guaranteed. The Adaptation Layer copes with the heterogeneity of devices and was designed to adapt or harmonise data exchange and interaction between the different clients and the middleware services. It contains gateways which provide system access for one or more device classes. The Device Layer is characterised by classes which result from different purposes, functionalities and interaction modes. The classes can be

divided in Car-Embedded Telematics Platform (In-car navigation systems), Active Client (PDA or smartphones), Web-Client, Mobile Messaging Client (SMS and MMS) and the Voice Client (Server-based voice recognition). This shaping facilitates that client “intelligence” (e.g. for navigation) can be used, e.g. in the classes of Car-embedded Telematics Platform and Active Client, and clients with low “intelligence” are fully supported by the server system.

The system architecture shown in Figure 3 was designed as a conceptual architecture for integrated and intermodal traveller information systems. Within the project Vienna-SPIRIT, this architectural design was only partly implemented in the pilot system.

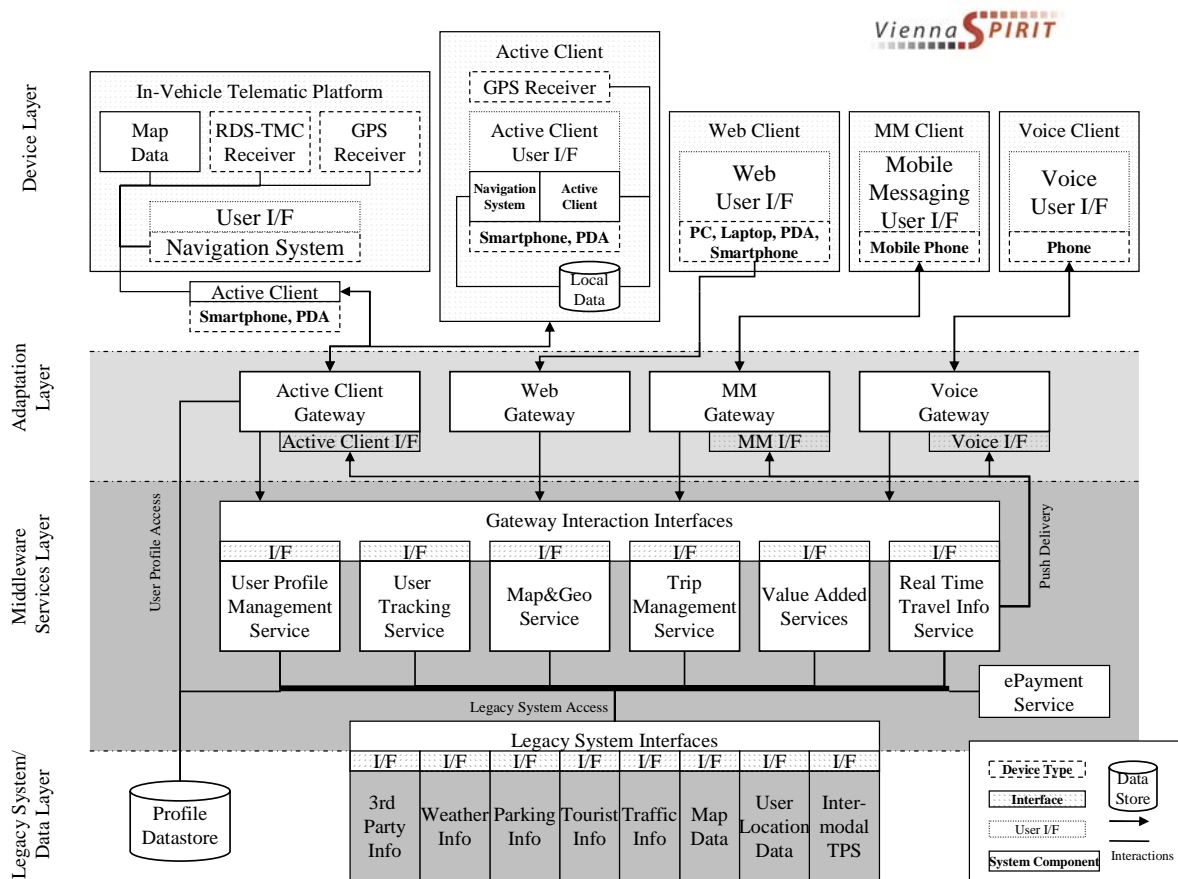


Figure 3: Conceptual Architecture of the Vienna-SPIRIT system [3]

THE PILOT SYSTEM

The pilot system of Vienna-SPIRIT was implemented in order to test and evaluate the usability, performance, acceptance and impacts of integrated and intermodal traveller information services. A previous user survey [4] showed that 20 percent of travellers would use alternative means of transport if they could access intermodal traveller information. The most important decision factor for travellers is the travel time. The pilot system was implemented by the Vienna-SPIRIT partners Verkehrsverbund Ost-Region, ARC Seibersdorf research, Salzburg Research, MATERNA and Sonorys. It was tested and demonstrated in the ARC Infotainment Concepts Car, which is equipped with most modern ITS facilities.

Clients

Vienna-SPIRIT used a Siemens VDO device as in-vehicle navigation system which provides a serial interface for data exchange and remote access. This opened the possibility to integrate additional features (within a Vienna-SPIRIT menu) and to handle data exchange (position information) by a proxy. This proxy is realised as an active Java Midlet installed on a Symbian phone. The smartphone is connected via Bluetooth to the navigation system and communicates with the Vienna-SPIRIT server via GPRS. In case of congestion or other reasons the user can start from the navigation system planning of intermodal route alternatives (considering current context parameters such as position, means of transport, desired transfer point etc.), This means, that the server seeks for park & ride facilities and requests public transport timetable or real-time information, if available (Figure 4). Moreover, it is possible to receive details about parking space availability or to request an active route from the server which has been planned with another client before. After the user has selected his favourite route, the position of the respective park & ride facility is transferred to the navigation system and navigation destination is changed respectively.



*Figure 4: Additional Vienna-SPIRIT features on the navigation system
[Source: Siemens VDO, Vienna-SPIRIT]*

Active clients were implemented based on Java for Symbian phones and on .NET for Pocket PC. Both clients use Bluetooth-GPS-receivers for automatic positioning. The .NET-client has an additional interface to the navigation software TomTom Navigator (see Figure 5). Thus, the user can activate intermodal route planning with this navigation software. Similarly to the in-vehicle navigation system, navigation is continued to the park & ride facility after selecting an alternative intermodal route. Furthermore, trips can be requested from and stored on the central server. The Smartphone client is intended to accessing trip information after leaving the car with its navigation system. The user can read up on route details and maps of route parts anytime and anywhere.

The voice client facilitates intermodal route planning with automatic speech recognition. The user dials a phone number and announces route planning input data in a short and user-friendly dialogue. After calculating the route alternatives Vienna-SPIRIT delivers the results via SMS or MMS. If the user is registered, the selected route can also be stored on the Vienna-SPIRIT server and can later be requested from another device. In doing so, the user is able to access Vienna-SPIRIT services with every common mobile phone.



Figure 5: Vienna-SPIRIT PDA Client and Vienna-SPIRIT Icon in TomTom Navigator
 [Source: Toshiba, TomTom, Vienna-SPIRIT]

Middleware

The middleware services were realised as web services². The services are modularly configured, which means that independent functions are contained in different services. The data exchange between middleware services and other layers happens with data packages defined in XML³. In the gateways these data packages are transformed into according output formats and delivered to the clients. Standards defined by OGC and W3C guarantee open interfaces and interoperability with other systems. A core service is the user management which enables the storage of user preferences and, in particular, of calculated trips.

Legacy Systems

As described before Vienna-SPIRIT utilises route planning and traffic information services of existing systems. Intermodal route planning requires inquiries to the Map24 service for seeking the optimal park & ride facilities. Furthermore, inquiries are made to the public transport timetable information system EFA for calculating the public transport part of the route. If available, dynamic parking information is requested from the parking information server of Skidata.

² <http://www.w3.org/2002/ws>

³ <http://www.w3.org/XML/Schema>

CONCLUSIONS AND OUTLOOK

Within the project Vienna-SPIRIT the technical feasibility of an integrated and intermodal traveller information system was proved. The demonstration has triggered considerations for a stepwise transfer into operation and further research. Verkehrsverbund Ost-Region plans to extend its intermodal route planning services with a voice-based service module. Furthermore, the module “Intermodal route planning / timetable information” shall be integrated in the newest generation of Siemens VDO navigation systems (module of the Java-based Top Level Architecture).

User surveys showed that about 20 % of travellers would be willing to change to alternative means of transport if intermodal traveller information were available as a standard service on mobile devices. In a few years, most of the people will be equipped with a smartphone. Thus, traveller information services have to be optimised to the specific requirements of these devices, which are for example, restricted user interface and display size, less memory and processor performance, restricted battery capacity. Moreover, the intermodal traveller expects navigation support in all phases of a trip, especially for orientation in complex transfer buildings (indoor navigation), and the integration of traveller information and e-ticketing services. The development of such a personal travel companion for smartphones has started in the project Open-SPIRIT.

ACKNOWLEDGEMENTS

The authors would like to thank all the members of the Vienna-SPIRIT consortium and other involved participants, which contributed to the success of the project, especially the colleagues of Verkehrsverbund Ost-Region, ARC Seibersdorf research, Salzburg Research, MATERNA and Sonorys.

Moreover, the Vienna-SPIRIT consortium would like to thank the Austrian Ministry for Transport, Innovation and Technology which co-funded and supported the project Vienna-SPIRIT within the national research programme I2 – Intelligent Infrastructure.

REFERENCES

- [1] Karl Rehr, Harald Rieser, Stefan Bruntsch: “Vienna-SPIRIT: Situationsbezogene, integrierte Reiseunterstützung für intermodale Reisen“, in *IfGI prints, Muensteraner GI-Tage*, vol. 22, Muenster, 2004, pp. 83-96 (in German)
- [2] A.J. May et al.: Pedestrian navigation aids: information requirements and design implications, in *Personal Ubiquitous Computing*, vol. 7, Springer, London, 2003, pp. 331-338
- [3] Vienna-SPIRIT: Work Package 4 Architecture – Final Report, 2004
- [4] VOR (Verkehrsverbund Ost-Region): User survey about intermodal travel information systems, Vienna, December 2002