**Current Trends of Real-Time Multimodal Urban Mobility Information Services (RTMMIS)**

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**ABSTRACT**

This paper describes a study of current trends in urban mobility real-time multimodal information systems (RTMMIS) conducted in the first phase of TicTac, a research project aimed at improving real-time public transport information of commuters of the Sophia-Antipolis agglomeration in France.

After citing our main information sources, a short state of the art is proposed, where 5 types of information are distinguished. We then focus on 4 issues: perturbations, ease of use, user participation and open data, multimodal vision. Finally, we conclude by insisting on the role of the transport authorities in setting up a RTMMIS in line with a mobility management policy, and summarise the key issues for an urban mobility real-time multimodal information service.
1. CONTEXT: THE TICTAC PROJECT

TICTAC (1), a 2 year project funded by ADEME (the French energy agency) in the realm of the PREDIT (2) transport research programme, started in 2010. Partners are Vulog, Inria, MHC Consultants, the Sophia-Antipolis Agglomeration and CETE Mediterranee. The goal is to design, develop and evaluate a real time information service for commuters to the Sophia Antipolis business area in the French Riviera, in order to improve the public transport level of service and modal share. Coming to Sophia Antipolis in other modes than private car is awkward and the area is suffering from recurring congestion; taking public transport often implies transfers and getting proper information is not easy. TICTAC aims at improving the situation in terms of provided information. The project will deliver:

- a prototype service co-designed and evaluated by a user panel;
- enhancement propositions of the existing travel information service in the area;
- design recommendations for an improved information service;
- lessons learnt and transferability of results.

The TICTAC prototype service was tested in Early 2011, and a new version will be tested in Fall 2011. As an interesting by-product of the developments, an evaluation methodology will be available (in French).

This paper presents the state of the art report (3) on current trends of (urban mobility) real-time multimodal information service (RTMMIS) which was produced as first deliverable of the TICTAC project, with the goal of taking it into account in the design of the service to be prototyped in TICTAC.

The work relies on the technical watch done by CETE Méditerranée since about 10 years (4) via the Predim web site (5) and the publication of several studies related to multimodal information systems and services.

The document first lists a source of useful sources, and analyses more deeply four issues which appeared essential for designing an RTMMIS:

- real time and perturbation information delivery
- man machine interface of personalised, mobile and location-based services
- providing the user with a global view of the current transport offer
- user participation

The report concludes with general recommendations.

The report has first been published (in French) in June 2010. As early 2011, the TICTAC service is starting to be tested. In June 2011, the presentation will be updated, notably with in French cities such as Lyon, Paris, Grenoble, Toulouse or Montpellier, some achievements of selected European projects (such as EBSF, In-Time, SIRI), and will give first results from the TICTAC project.
2. CURRENT TRENDS

2.1 Information Sources

The report lists several sources that we used for this review:

- in France: PREDIM, ATEC conference, blogs such as transports du futur, Chronos, Transid, MobiPhone...
- in Europe: ETC proceedings, TRKC, ITS conference, Interreg or Research Framework Programme projects.
- for other countries (mostly USA), sites such as TransitWire, TCRP...

We will cite here only a few references we’ve found. Moreover, this state of the art was published in mid-2010: a way of updating it is to check from the various sources what has happened since then.

In France

In France, not so many reports on real time multimodal information have been published, however a few seminars on this topic have been organised in the last years, for instance supported by the PREDIM programme. The recent creation of the French Multimodal Information and Ticketing Agency (AFIMB) in 2010 could foster some advances in the coming years.

In Europe

Cities like Stockholm (14) or Vienna (13) have launched multimodal real-time journey planners. Among the numerous European projects, it is worth mentioning:

- I-TRAVEL with an interesting state-of-the-art although not focused on real-time;
- E-MOTION (FP6) : state of the art of real time travel information systems, with a quite detailed annex listing the systems and services deployed in Europe
- IN-TIME (FP7) currently on-going, with new results still being published. (7)

The "Strategic Review of Travel Information Research" published in 2007 by Bristol University for UK DfT is an interesting report focused on travel information usage, based on a quite exhaustive bibliographic study.

Overseas

At the global level we may cite the PTA project of the Cisco ‘connected urban development initiative’ and the MIT (9), with in Seoul, Amsterdam and Singapore. A interesting report has been published in 2010 by the US DoT, entitled ‘Real-Time Traveler Information Market Assessment White Paper’ (6). This report describes the current deployment of travel information, mode by mode (car, PT, parking), gives some costs estimation, states a diagnostic and proposes some recommendations (including in the standardisation field). Multimodal information is gaining momentum in the US, so are new channels such as RSS feeds and social networks; the issues of open data and data standards is seen as important as a means to enable new applications and new usage of transport data.
2.2. **State Of The Art**

As a very rough state of the art, we can say that the following information is available today:

- reference (static) information for several PT networks over a mobility area or a region;
- real time traffic (travel times, perturbations, images) covering the motorways and major urban roads via the web, on mobiles, and via traditional media (radio etc.);
- real time perturbation and delays for the major PT lines provided on the web, on-board, at stops;
- real-time car park availability;
- recurring congestion (travel times) based on historical data and statistics on motorways.

Depending on the countries and agglomerations, this state of the art is attained or still a goal.

Some possible improvements are

- improve the tools for comparing modes (including walk and bicycle) and their combination, for the general public and for professionals, in real time or based on historical data, for planning the next trip door-to-door or for longer term question such as choosing based on travel constraints and budget, etc.

- detect gridlocks: it is not so useful to know that there will be some delays at evening rush hour, or even to know that we will lose 5 minutes on a particular trip. Information becomes crucial in case of hard perturbations, occurring typically a few times a month on a particular area, situations where it is faster to walk than ride or drive, where the road network are blocked though not necessarily closed (e.g. because of a severe accident). Nowadays, those situations are not always well detected and information may not be adequately broadcast via all media (radio, TV, navigators and phones, e-mails, public displays, etc.) so as to avoid any new vehicles in the blocked sector. Users may be a source of information to consider in that respect.

- a cross-cutting issue is information accessibility: this includes awareness (a lot of users do not know where to find proper information e.g. when they are on the move), or in a suitable format (multi-lingual, accessible to the handicapped, transport data for professionals).

2.3. **Several Types of Information**

A key issue is to make the distinction between different types of information. We propose here 5 types of information:

**Advises**

Advice are part of the ‘User Manuel’ of the transport network, they are quite useless for the daily commuter travels. However, even a daily commuter who changes his/her mode or usual route for home-work journey is like a newcomer and may need a ‘tutorial’ and advice. Advice like safety, fare and ticketing, rules, are general published. Practical advice (‘tips and tricks’) are much more difficult to find (where to park for taking PT, how much time margin take for the transfer, which bike route is recommended depending of the time of the day, which neighbouthood to avoid at certain times – e.g. during local market)
Reference information
The reference information (or ‘static’, ‘theoretical’) is necessary for using Public Transport (PT), so it is always provided by the PT networks (paper schedules, information at stops, web site) and also in ‘regional’ information portals generally funded by transport authorities. For road networks, the reference information is in general not provided either by the road operators nor by the authorities, but by third parties (digital map providers, traffic information service providers – which currently have no equivalent in the PT world). However the public authorities could have interest to maintain its own road travel time reference data, complemented with recurring congestion travel times, as an evaluation tool and a ways to make the journey planners use realistic data.

Time stamped event
As a rule of thumb, we can state that 80% of urban congestion is recurring congestion, which can be forecast and known by daily commuters. This seems a very important point for car and bus information. It seems that recurring congestion is poorly measured and thus poorly brought to the public, at least outside of the motorways. Along with cost, the ‘real’ travel time is a key criterion for route planning decisions, be it for drivers, PT users or cyclists. Planned event information (works, strikes, public events...) is different from recurring congestion but has been including in this third category, as it can only be provided by the network operators.

Real time data
‘Stricto sensu’ real-time information includes delays on PT lines, car park availability, road travel times which are measured by road operators. Real time data collection and monitoring still needs to be deployed on many networks, taking into consideration cost issues, but are already operational in many cities; for road traffic, third parties also collect real-time data.

Perturbations
Managing perturbations is a key role of the network operators; providing information on the perturbations and actions taken is sometimes not a priority for the operator compared to dealing with urgent operating issues.

We represent the way the 5 types of information are currently handled in the following table

<table>
<thead>
<tr>
<th>information type</th>
<th>data available ?</th>
<th>provided on-the-field ?</th>
<th>provided on the web ?</th>
<th>provided on mobiles ?</th>
<th>multimodal view</th>
</tr>
</thead>
<tbody>
<tr>
<td>advice / tips</td>
<td>not always</td>
<td>fares, safety</td>
<td>yes</td>
<td>no</td>
<td>variable</td>
</tr>
<tr>
<td>reference</td>
<td>yes</td>
<td>PT</td>
<td>PT</td>
<td>PT</td>
<td>PT+car</td>
</tr>
<tr>
<td>recurring / planned</td>
<td>variable</td>
<td>no</td>
<td>variable</td>
<td>more and more</td>
<td>rare</td>
</tr>
<tr>
<td>delays</td>
<td>TC, car, P separately</td>
<td>yes</td>
<td>not always</td>
<td>more and more</td>
<td>no</td>
</tr>
<tr>
<td>perturbations</td>
<td>often</td>
<td>by mode</td>
<td>more and more</td>
<td>more and more</td>
<td>partial</td>
</tr>
</tbody>
</table>

Table 1 : Information currently handled
3. A FOCUS 4 KEY ISSUES

3.1. Information on perturbations

A same perturbation can impact users in several ways, depending on its importance and information has been to be provided accordingly. We propose the 4 following levels:

1. **at the line or road level**: the information is in general controlled by the operators, who know what it is happening on “their” lines or roads. Information can be broadcast on-board or at stop, and via the (mobile) web. The state of the art can do it since many years, but cost issues still prevent a generalised deployment of; another issue is to improve information accessibility.

2. **at the exchange or corridor level**: a second level is to provide at a multimodal hub such as a railways station, airport, major road node, or when relevant (depending on the geography of the network) for a particular corridor. This implies a particular organisation, at least for exchanging and providing information from multiple sources. This can also include preparation work such as traffic management plans that define coordinated actions in case of major perturbations.

3. **at the urban area or regional level**: the truly global and multimodal information is broadcast on broader channels for a whole mobility area; it is geared towards all users who can if needed ask for more personalised information for a sector of interest. Therefore at this level, the information has to be selective and include only the more relevant events and advice. A dedicated structure has to be set up for doing the job.

4. **during a major event / crisis**: beyond a certain level of severity, event management becomes crisis management, and gets under the authority of higher authorities (the ‘Préfet’, in France). This is not any more in our present scope, only the interface with these higher authorities has to be examined, from the traveler information point of view.

3.2. Ease of use (personalised mobile location-based services)

*Personalisation and ergonomics*

Since more than 10 years, several R&D projects have designed, developed and tested prototype mobile real-time traveller information services, such as MIT’s PTA project or German projects of the Motiv-MIB programme and similar initiatives in Japan or even France (Mobiville for instance). Processes and functional requirements have been well described, with a frequent distinction between trip preparation and execution (on trip), the ergonomy of the service has been analysed and improved. Some recent developments of the operational context (large market penetration of location-aware smartphones; data availability; stronger political will to make the urban mobility actors work together, although this is still an obstacle to real deployment) make possible that the prototypes of multimodal navigators succeed and get out of the labs.


**Location-based services**

Marketing of mobility management are quite related to the provision of adequate RTMMIS. Two major trends are to notice in the last few years:

- the generalization of customer relation management tools in the transport sector (parking, tolling, ticketing, renting, traffic info services) brings, along with GPS and wireless communications, possibilities of tracking transactions and people mobility;
- the ease for the users to express themselves on a feedback channel (via official web sites, or unofficial blogs and fora) even when on the move.

In practice, the privacy issue is important, so the location based services may not be easily used jointly as a means to track users, except in experimentations aimed at measure transfer and dwell times, door-to-door travel times, mobility surveys, etc.

**Availability of real-time information**

Deployment of Real-time PT, Parking and Traffic management systems comes with data that can be used for traveler information. Availability of real-time data exchange standards (Datex2 for and SIRI for PT) is also a favourable factor.

Tools are getting mature, the major obstacle may still be access to data for third parties (i.e. for actors non operators the newtorks).

**Comparing between modes**

Comparing car and bus is still ‘taboo’, in France and in many countries, as the comparisons in terms of travel-time is perceived to be too favourable to car, in part because data which would be balance more in favour of alternative modes are not easily available. In practice users are doing the comparison themselves anyway, at the ‘strategic’ (transport budget) level, or ‘tactical’ trip level (for planning a particular journey), although with incomplete data.

In France, some experiments have been done of comparing real-time trips in the 90’s, but interestingly not any more in the recent years. As better data is getting available, this is going to change and real-time journey planners emerge in Europe, with pioneer cities such as Vienna or Stockholm, for instance.

**3.3. User participation and open data**

These two topics emerged as evolutions of the world wide web (so-called ‘web 2.0’).

**User can participate and contribute to information**

Participation includes:

- user involvement in designing information services is a very active area, comprising open innovation ideas and the concept of living labs, funded at the European level (see the EnOLL network http://www.openlivinglabs.eu);
- in the mobility management domain, some results are available on how to make the users participate to improving the transport system, such as the NICHERES project.

The recent « web 2.0 » development also concerns the mobility information domain. Beyond the hype, transport authorities and operators can benefit from this trend as a way to improve traveler information and quality of service in general. Users can contribute at three levels: giving feedback on the service, providing information or data, or even by creating themselves
new services:
• user feedback is precious for designing and improving information services and is increasing used in practice;
• users (at least a small but very active minority among them) can create and manage reference data and have done it in a very impressive job by setting up the OpenStreetMap database, however this may not be directly useful to the transport authorities and operators. Users can also be a source of information or data about real-time perturbations, especially for lines or roads where no adequate data collection is deployed or available. Many US PT networks have created twitter sites; similar sites exist for instance in France, many of them non official, such as quoimaligne.fr (11).
• independent developers can produce useful applications and services, as long as data is made available to them in a way as easy as possible; this is the goal of the open data initiatives going on especially in the US and in the UK, and are appearing in France and elsewhere.

Open data platforms
A key idea of the ‘Web 2.0’ is that the provision of open data or web services will enable the development of new applications or services based on several information sources. It is certainly true, although several points are worth to be noted:
• this is still an emerging trend: for instance, there are many ways of providing open data and web services from publishing raw data to more restrictive web services with fee required depend on usage, that may all conform to rules such as the Public Information Reuse European Directive;
• the technical standards for providing the information are not all existing (this is one of reason of the recent ITS European Directive);
• the provision of an open data / web service is a project in itself, for which resource have to be secured; the sole publication of free data won’t produce instantly useful and sustainable information services;
• the project must be supported by the highest level of local decision makers (e.g. elected personalities of the urban area, such as the Mayor) and associate properly the stakeholders (including of course the transport and road operators).

3.4. Global vision of the multimodal transport offer
Despite a strong policies in favor of PT in most agglomerations, recurring congestion of roads and railways is still a problem, which calls for a better coordination in mobility and traffic management, transport networks operations and traveller information.
RTMMIS can also be provided by each transport operator and by third-parties, but as fas as public authorities are concerned, RTMMIS have to be considered more broadly as a mobility management tool. Information has to be wider than car and PT, and should also include walk, bicycle and innovative modes such as ridesharing, on-demande transport, carsharing, and so on.
Providing proper multimodal information is about more than providing side-by-side information about each existing network. A multimodal traffic coordination organisation seems necessary so as to qualify data and made it available.
In France, pioneer cities such as Toulouse and Grenoble. Others such as Lyon, Nice, Montpellier or Nantes have on-going projects.
Local coordination of urban mobility

Most local authorities are aware of this situation and look for concrete solutions adapted to their local context. Transport authorities (or actors playing a similar role) are well placed for this coordination and associate all local decision levels (in France: the state, Région, Département, agglomérations and communes) and all the transport operators (public and private) as well such as police or emergency services.

Actions are taken at several level:
- technical groups meeting at regular intervals that enable to share information between all actors and monitor current actions
- share data (see next section)
- shared tools
- off-line studies (traffic and mobility observatory, GIS, traffic and mobility models...)
- traffic management (coordination traffic operation such as PT priority at intersection or access management, traffic management plans; dynamic simulations and prevision)
- user information
- shared organization: mobility agency which may include a team dedicated to improving daily mobility in corridors or neighborhoods thanks to a concrete coordination with local operators and stakeholders.

The importance of open data for a wide dissemination of qualified data

Information services are not only local: if a local transport authority manages to coordinate mobility action plan, but the traveler information is only provided via the local public website, the target may not be attained: several media (web portals, mobile operators, press, radio, TV, social networks, etc.), some of them with larger perimeter, should also be reached. The ‘information chain’ is complex: every operator and public authority could in his own interest benefit from third parties delivering information to their targeted users.

Agreement on sharing data information between stakeholders seems a pre-requisite before building common tools.

Stakeholders are getting increasingly aware that information on the multimodal transport offer can be a mobility management tool, not only in real time, just before or during a trip: multimodal transport information can also be used to provide advice or routes taking into account recurring congestion and possibly parking constraints, or to provide off-line tools for the users and for the professionals.

In summary, we believe that key success factors for a coordinated multimodal approach are:
- sharing data;
- common tools for coordinated mobility management and user information (data provision platform, off-line observatory, traffic management tools, web portals)
- user participation.
RECOMMENDATIONS AND PERSPECTIVES

An urban mobility RTMMIS uses data from several network operators, and is not easily operated by one of them, but more likely by a more ‘neutral’ actor. A scenario where every public actor and transport operator would make its data freely available still is very unlikely for a lot of reasons that are out of our scope to discuss here. Therefore the urban mobility RTMMIS has to stem from a public initiative. For the urban or regional, this information service should be designed as a tool for mobility management, not “only” traveler information.

A global RTMISS initiative from the local public transport authority should include:
• a strong link with the network operators and coordinated traffic management projects;
• utilization of data for off-line studies and models;
• an open data / web service access platform (might be more or less open depending on the data and intended use) so as to enable many other services (including long-distance travel) and applications on various channels;
• and of course an easy-to-use user web/mobile portal with direct access to schedules, maps, journey planner, real time feeds and alerts.

Important issues to be taken into account are:
• data access and accessibility policy
• invest on historical data: measure recurring congestion, frequent perturbation, advice...
• invest on data standards and data quality
• improve comparison between modes and mode combinations
• user participation (at least strong feedback and if possible contribution).

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