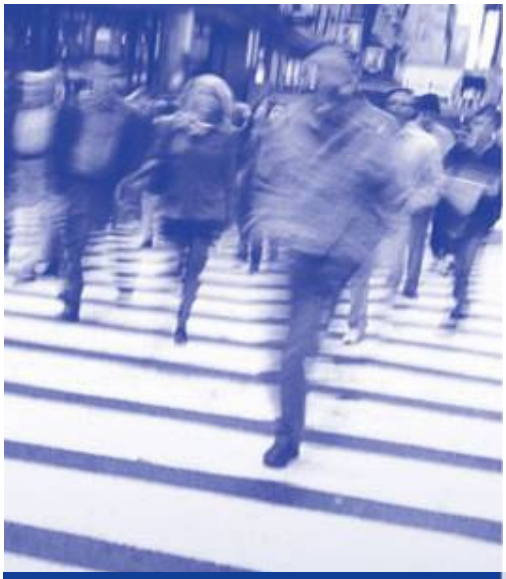

CiViTAS
Cleaner and better transport in cities

ARCHIMEDES
AALBORG • BRIGHTON & HOVE • DONOSTIA - SAN SEBASTIÁN • IAŞI • MONZA • ÚSTÍ NAD LABEM

Monza

R78.1 - Bus Management System in Monza: Interface with AVL/AVM System

City of Monza

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Contents

1. Introduction

1.1 Background CIVITAS

CIVITAS - cleaner and better transport in cities - stands for CIty-VITAlity-Sustainability. With the CIVITAS Initiative, the EC aims to generate a decisive breakthrough by supporting and evaluating the implementation of ambitious integrated sustainable urban transport strategies that should make a real difference for the welfare of the European citizen.

CIVITAS I started in early 2002 (within the 5th Framework Research Programme);
CIVITAS II started in early 2005 (within the 6th Framework Research Programme) and
CIVITAS PLUS started in late 2008 (within the 7th Framework Research Programme).

The objective of CIVITAS-Plus is to test and increase the understanding of the frameworks, processes and packaging required to successfully introduce bold, integrated and innovative strategies for clean and sustainable urban transport that address concerns related to energy-efficiency, transport policy and road safety, alternative fuels and the environment.

Within CIVITAS I (2002-2006) there were 19 cities clustered in 4 demonstration projects, within CIVITAS II (2005-2009) 17 cities in 4 demonstration projects, whilst within CIVITAS PLUS (2008-2012) 25 cities in 5 demonstration projects are taking part. These demonstration cities all over Europe are funded by the European Commission.

Objectives:

- to promote and implement sustainable, clean and (energy) efficient urban transport measures
- to implement integrated packages of technology and policy measures in the field of energy and transport in 8 categories of measures
- to build up critical mass and markets for innovation

Horizontal projects support the CIVITAS demonstration projects & cities by :

- Cross-site evaluation and Europe wide dissemination in co-operation with the demonstration projects
- The organisation of the annual meeting of CIVITAS Forum members
- Providing the Secretariat for the Political Advisory Committee (PAC)
- Development of policy recommendations for a long-term multiplier effect of CIVITAS

Key elements of CIVITAS

- CIVITAS is co-ordinated by cities: it is a programme “of cities for cities”
- Cities are in the heart of local public private partnerships
- Political commitment is a basic requirement
- Cities are living ‘Laboratories' for learning and evaluating

1.2 Background ARCHIMEDES

ARCHIMEDES is an integrating project, bringing together 6 European cities to address problems and opportunities for creating environmentally sustainable, safe and energy efficient transport systems in medium sized urban areas.

The objective of ARCHIMEDES is to introduce innovative, integrated and ambitious strategies for clean, energy-efficient, sustainable urban transport to achieve significant impacts in the policy fields of energy, transport, and environmental sustainability. An ambitious blend of policy tools and measures will increase energy-efficiency in transport, provide safer and more convenient travel for all, using a higher share of clean engine technology and fuels, resulting in an enhanced urban environment (including reduced noise and air pollution). Visible and measurable impacts will result from significantly sized measures in specific innovation areas. Demonstrations of innovative transport technologies, policy measures and partnership working, combined with targeted research, will verify the best frameworks, processes and packaging required to successfully transfer the strategies to other cities.

1.3 Participant Cities

The ARCHIMEDES project focuses on activities in specific innovation areas of each city, known as the ARCHIMEDES corridor or zone (depending on shape and geography). These innovation areas extend to the peri-urban fringe and the administrative boundaries of regional authorities and neighbouring administrations.

The two Learning cities, to which experience and best-practice will be transferred, are Monza (Italy) and Ústí nad Labem (Czech Republic). The strategy for the project is to ensure that the tools and measures developed have the widest application throughout Europe, tested via the Learning Cities' activities and interaction with the Lead City partners.

1.3.1 Leading City Innovation Areas

The four Leading cities in the ARCHIMEDES project are:

- Aalborg (Denmark);
- Brighton & Hove (UK);
- Donostia-San Sebastián (Spain); and
- Iasi (Romania).

Together the Lead Cities in ARCHIMEDES cover different geographic parts of Europe. They have the full support of the relevant political representatives for the project, and are well able to implement the innovative range of demonstration activities.

The Lead Cities are joined in their local projects by a small number of key partners that show a high level of commitment to the project objectives of energy-efficient urban transportation. In all cases the public transport company features as a partner in the proposed project.

2. Monza

Monza is a city on the river Lambro, a tributary of the Po, in the Lombardy region of Italy, some 15km north-northeast of Milan. It is the third-largest city of Lombardy and the most important economic, industrial and administrative centre of the Brianza area, supporting a textile industry and a publishing trade. It is best known for its Grand Prix.

The City of Monza, with approximately 121,000 inhabitants, is located 15 km north of Milan, which is the centre of the Lombardia area. This area is one of the engines of the Italian economy; the number of companies is 58,500, i.e. a company for every 13 inhabitants.

Monza is affected by a huge amount of traffic that crosses the city to reach Milan and the highways nodes located between Monza and Milan. It is also an important node in the Railways network, crossed by routes connecting Milan with Como and Switzerland, Lecco and Sondrio, Bergamo and Brianza. "Regione Lombardia", which in the new devolution framework started in 1998, has full responsibility for establishing the Local Public Transportation System (trains, coaches and buses) and has created a new approach for urban rail routes using an approach similar to the German S-Line or Paris RER.

Monza has recently become the head of the new "Monza and Brianza" province, with approximately 750,000 inhabitants, so will gain the full range of administration functions by 2009. Plan-making responsibilities and an influence over peri-urban areas will require the city to develop new competencies.

In this context, the objective of the City of Monza in participating in CIVITAS as a Learning City is to set up an Urban Mobility System where the impact of private traffic can be reduced, creating a new mobility offer, where alternative modes become increasingly significant, leading to improvements to the urban environment and a reduction in energy consumption (and concurrent pollution).

3. Background to the Deliverable

The use of real time location information gathered by the AVL/AVM system is fundamental to increasing the Service Level provided by the Urban Public Transport which is an objective of the ARCHIMEDES project.

Therefore measure 78, which covers the AVL/AVM system, is heavily interlinked to the other measures, as it will provide information necessary to implement measures 79 (Improved Traveller Information), 81 (Urban Traffic Control Activities) and 82 (Public Transport Priority System).

Measure 78 covers 2 tasks:

Task 11.8.4 Interface with the AVL/AVM System
Project Automation (PA) in corporation with TPM (the local public transport provider) will carry out a study to define the requirements for interfacing the AVL/AVM System already implemented by TPM for its subsequent use for Bus Traveller Information and for Public Transport Priority at Traffic Lights

Task 8.13 Bus Management System
Implementation by PA and TPM of the interface with the Automatic Vehicle Location/Automatic Vehicle Monitoring System (AVL/AVM) covering the entire bus fleet of TPM to make available the position of each bus in Real Time for the subsequent applications to be developed within the ARCHIMEDES project.

3.1 Summary Description of the Task

The technical research element is defined within Task 11.8.4 and is reported in the rest of this deliverable.

3.1.1 Task 11.8.4 Interface with the AVL/AVM System

Since November 1st, 2007, the Urban Public Transport Service in Monza has been defining the tender requirements for various system upgrades in preparation for the ARCHIMEDES project. One such set of requirements concerns the technical requirement for the interface between the AVL/AVM system (which will be used to monitor the service accomplished by public transport fleet) and the other elements of the public transport / wider traffic management systems in Monza.

4. Bus Management System in Monza: Interface with AVL/AVM System

4.1 Description of the Work Done

Among other issues, the ARCHIMEDES project relating to Public Transport in Monza, addresses the following issues:

- the capability to show through Variable Message Signs (VMS) installed at several important bus stops in the city the expected schedule for each monitored TPM bus (measure no. 79);

- the capability to announce the arrival of a bus at an intersection managed by an Urban Traffic Control (UTC) system for the coordinated control of traffic light controlled intersections (measure no. 81). The announcement also needs to include information about the status of the bus (i.e. on-time, delayed or ahead of schedule) so that the appropriate level of priority can be assigned to each bus as it approaches the intersection (measure no. 82).

In the approach proposed, the AVL/AVM, UTC and VMS systems keep their own independency, which means that each of them has its own functionality, architecture, technology for sensors and devices.

Therefore a common conceptual model to define which information needs to flow between these systems to achieve interrelated functions is required. The specific requirements for integration, as far as the AVL/AVM system is concerned, are presented in section 4.3, both in natural language and through a formal definition of the Web

Services software interface; These requirements express which information needs to be made available by the AVL/AVM system.

4.2 Summary of the Activities Undertaken

AVL/AVM systems have been designed to ensure complete control of the bus fleet.

The AVL function allows monitoring of the position and other relevant information relating to the status of each bus at given time intervals (typically every 30 sec). In order to do this, every bus is equipped with an on-board unit ("OBU"), consisting of an industrial PC with an internal GPS module to monitor and relay the position of the bus and the facility to communicate with other diagnostic devices on the bus such as the odometer, door controller (to know door opening times) etc to help monitor the status of the bus.

The AVM function maps the location information to the timetable assigned to the buses moving on their routes. This allows the system to know the following basic information:

- if the bus is on-time, delayed, or in advance: this information may influence taking specific actions to improve bus behaviour: as an example, if the bus is running in advance with respect to its timetable, the driver takes into account of this; in addition, in such circumstances it is not necessary to require priority for the bus at traffic light intersections where the option of bus priority exists;
- forecasts of bus arrival times at bus stops: such forecasts can be shown on the intelligent bus-stops ("info-bus"), as expected in Monza through measure no. 79;
- forecasts of bus arrival times at intersections: if the intersection is properly equipped, if the bus is delayed and if the overall traffic conditions allow it, a priority action on the traffic lights phasing can be issued to prioritise the passage of the bus, as expected in Monza through measure no. 82.

The use of the AVL/AVM system involves three basic processes:

- firstly, and typically carried out off-line, is related to a set of activities that need to be carried out well before the actual bus service becomes active. This is part of the service specification and concerns the configuration of the system, including the route of every line, timetable details, set-up procedures (all that happens before the bus can start with the service) and

- secondly, and strictly carried out on-line, concerns the use of the system during the execution of the service; as buses perform the assigned runs, the system gathers all the positions of the buses at predefined time intervals (AVL), enriches such information with the predefined schedules to achieve Monitoring capabilities (AVM).

- Finally, completion procedures. These are conducted after the last run is performed each day, and on entering the depot the OBU downloads all relevant information concerning the services performed (e.g. diagnostic information) to the central AVL/AVM computer.

4.3 Main Outcomes

This section presents the main functional and non-functional requirements that have been identified:

Requirement 1: the information should be available from the AVL/AVM system to the final ARCHIMEDES application (UTC, VMS) in “real-time”: i.e the information must be available at the receiving application within a few seconds of when the position of a bus is gathered;

Requirement 2: in order to provide the appropriate information as required by the final applications in the ARCHIMEDES project (UTC, VMS), the AVL/AVM system should be configured in relation to specific, selected sites relevant to the locations of the VMS displays and intersections where the UTC is active;

Requirement 3: Data received from the bus by the AVL/AVM system should contain at least the following information:

< Id_bus, Id_site, Forecast_Timestamp, Status, Id_Line, Direction >

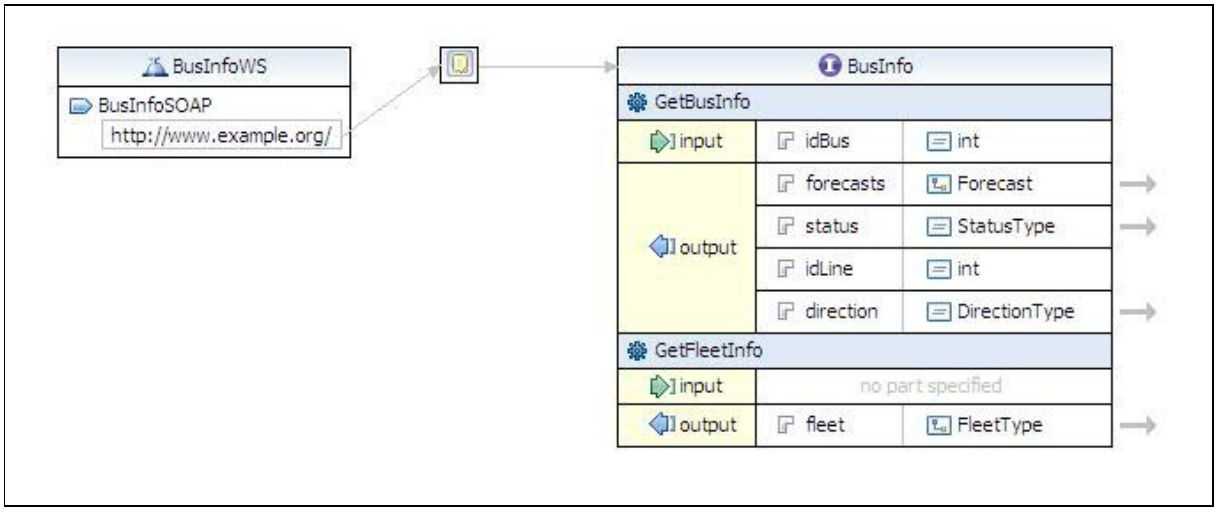
where:

- Id_line: unique identifier of the line
- Direction: direction of the line indicated by Id_line
- Id_bus: unique identifier of the bus
- Id_site: unique identifier of the site the forecast is referred to
- Forecast_Timestamp: yyyymmdd hh:mm:ss.[msec] of the forecast
- Status: <On_time, Delayed, Ahead of its time, Not_Avail>

Should other information be available, it would be helpful to know it (in a format that matches the relevant fields in the other systems).

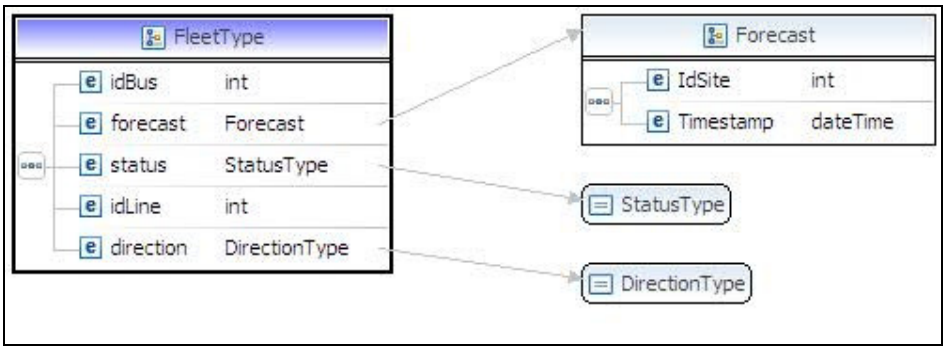
Requirement 4: the protocol that is to be used by the AVL/AVM system to update the forecasts has to be specified. This is important for the final consumer application to know how it will get such information and keep it updated. (For example, forecasts may be automatically passed through on a regular basis, or forecast updates may only be notified through specific protocols and/or messages if there is a significant change from the previous situation.)

Picture 1 depicts the general scheme of the Web Service used to get information by AVL/AVM system.



Picture 1 - Web Service definition

Picture 2 presents a detail of the Web Service specification.



Picture 2 - Web Service detail for fleet information

4.4 Problems Identified

No functional issues have as yet been identified. However, there is uncertainty as to the actual systems that will be in place, given that the branch of TPM that deals with Public Transport is being merged with another company.

4.5 Mitigating Activities

It is not known at the moment which is the AVL/AVM system to be interfaced: the first scenario is that the TPM fleet will keep the current AVL/AVM system; the second scenario is that the TPM fleet will switch to using the AVL/AVM used by the Company TPM is merging with. Once this decision is taken, the software implementation will start.

4.6 Future Plans

The future plans will need to be confirmed once the status of TPM has been clarified. However, the content of this deliverable confirms that all actions that are possible until this point have been considered. In practice this means that:

- The supplier of the AVL/AVM system will develop on its side the server part of a Web Service to the specification depicted in section 4.3.

- PA will then implement the software interface to access the AVL/AVM system, to use them in measures 79, 81 and 82.