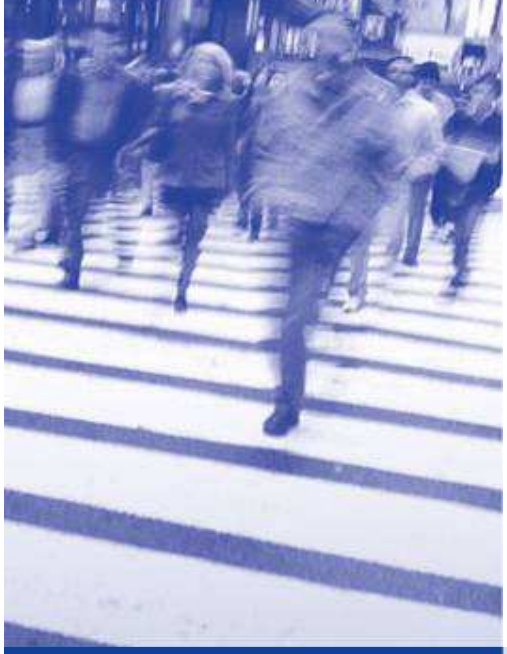

CiViTAS
Cleaner and better transport in cities

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

Monza

T78.1 – Bus Management System in Monza

City of Monza

August 2010

THE CIVITAS INITIATIVE
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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 are 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 will be 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 CIVITAS 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 proposed 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 proposed.

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

In the context of Sustainable Mobility, the use of Public Transport in the City of Monza needs to be increased. There are several aspects to face this issue, but in the ARCHIMEDES framework a precise choice has been undertaken, with the full support of the government of the Municipality: this choice consists of implementing technological measures to make Public Transport more attractive to citizens.

Two measures, no. 79 “(Improved Traveller Information in Monza”) and no. 82 (“Public Transport Priority System in Monza”) have therefore been identified, but both of these measures require a fundamental prerequisite, made available by Measure 78, whose results are reported here.

The context in which the activities reported in this deliverable have been carried out is depicted in the two paragraphs this chapter is composed of.

RTD Task: AVL/AVM System Interface Design and Implementation (11.8.4):

Project Automation S.P.A. (PA)), which has the role of technological partner of Comune di Monza, carried out a study to define the requirements for interfacing the AVL/AVM System implemented on the Public Transport fleet of the urban service in Monza. Such requirements are described in deliverable R78.1 and are independent from the current provider of the AVL/AVM service. In fact, when the activities of Monza were written in the technical description of ARCHIMEDES, the fleet of the urban service of the city of Monza used to be managed by Trasporti Pubblici Monzesi (TPM); however, since June 2009 the service has been managed by the Public Company, NET (“Nord-Est Trasporti”), which is jointly owned by ATM, the company which manages the Public Transport of

the city of Milan and TPM. Nevertheless, the same requirements coded in the above-mentioned deliverable R78.1 apply.

DEMO Task : Bus Management System in Monza (8.13):
NET has begun managing the Public Transport fleet of the urban service of the city of Monza and decided to replace the AVL/AVM system inherited by TPM with the system already in use on its fleet. NET was immediately informed about the ARCHIMEDES requirements concerning AVL/AVL. In response NET set up a joint working group involving the supplier of the new AVL/AVM system together with Project Automation to define an agreed framework covering both the original NET and the ARCHIMEDES system requirements .

The original NET requirements concerned the capability to track the service on its entire fleet (not only the ones operating in the city of Monza) to prove to effectiveness as well the responsiveness of the service, committed by a Public Body which pays such service. Such requirements are weaker than the ARCHIMEDES ones (e.g. the position reporting of each bus is currently taken every 3 minutes, but the ARCHIMEDES requirement is to gather the position much more frequently); it has been checked that the entire technological chain can fulfil both original NET requirements and the ARCHIMEDES ones.

3.1 Summary Description of the Task

Within this demonstration task the focus is on the results achieved so far, both from a methodological and a practical point of view. In terms of methodology, the chosen approach is presented in the paragraph 4.1. As far as the second issue is concerned, an appendix has been included specifically to show a significant subset of data that has been collected from July 2010 onwards.

4 Bus Management Service in Monza

4.1 Description of the Work Done

The work done is described in section 4.1.1.

4.1.1 Bus Localization and Monitoring

Each vehicle of the Public Transport Fleet has been equipped with an On-Board Unit (OBU); it consists of an Industrial PC with specific devices and sensors:

- a GPS device to determine the vehicle position, coded with Lat-Long coordinate system (WGS 84);
- a GPRS communication system to send the information to a Control Centre;

Data concerning vehicle positions are produced at a given frequency (sampling interval) and sent to the Control Centre at another given frequency (transmission interval). In the current context, the sampling interval is 5 seconds and the transmission interval is 3 minutes. For use in Measure 82 (public transport priority) the transmission interval will depend on the position of the bus on its route: when the bus is approaching the CIVITAS corridor equipped with centralized intersections, the transmission interval is 30 seconds; elsewhere, the transmission interval is 60 seconds. Both the sampling interval and the transmission interval can be dynamically adjusted.

In the ARCHIMEDES context, since the sampling interval is shorter than the transmission interval, more that one record can be sent when the transmission is established.

Once the Control Centre receives records sent by the buses of the fleet, such records are stored in a database table, for subsequent uses. In the ARCHIMEDES context, the immediate use provides information to Measure 79 (InfoBus) and to Measure 82 (Priority to intersections on the corridor identified). In addition, data is available for every type of statistical analysis.

As far as the operational issues are concerned, as the driver begins his shift, he identifies himself to the system, typing his personal code on a dedicated keyboard.

4.2 The Architecture

In the following picture the general system architecture is shown; the cyan boxes represent legacy software applications dedicated to specific roles.

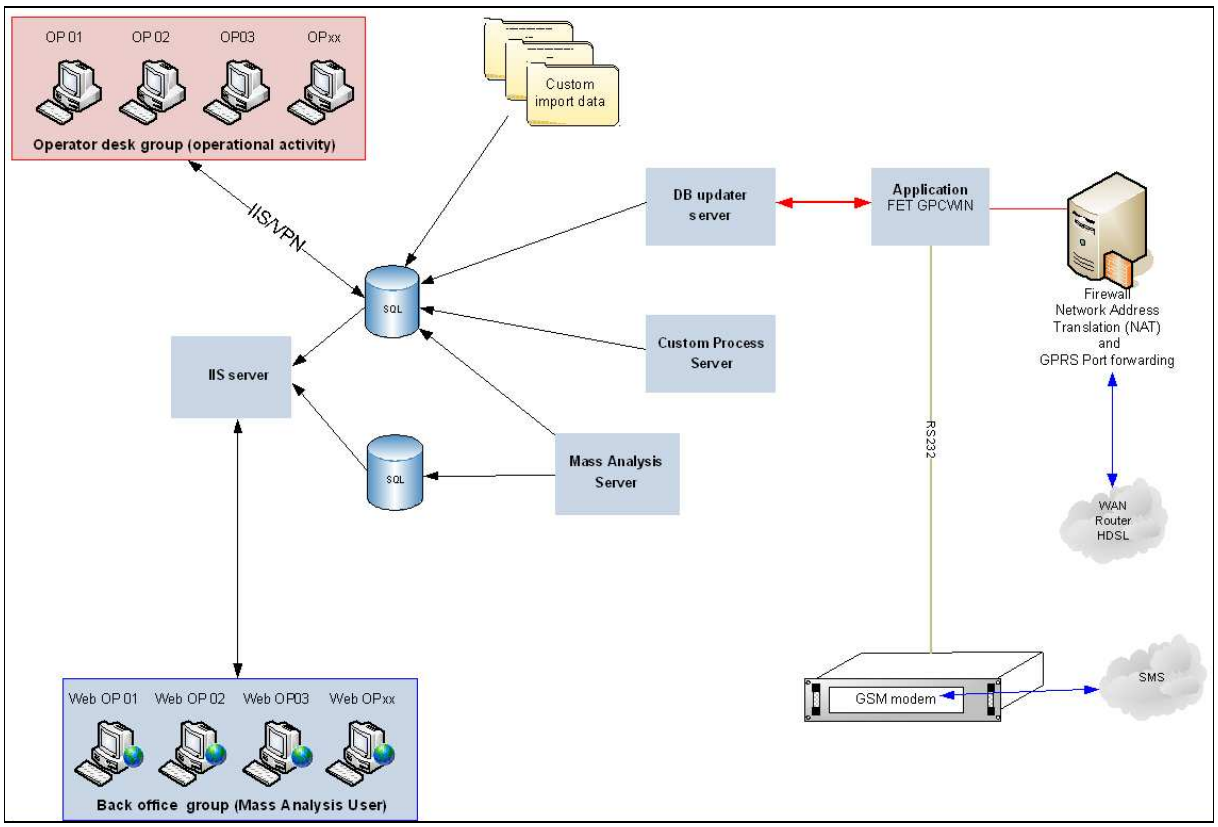


Figure 1 - The Reference Architecture

As mentioned before, the OBU communicates with the Control Centre through a GPRS connection; The Front-End application named **FET GPCWIN** processes data received and sends them to the database loader application, named **DB Updater**.

The component called *Custom Process Server* is an application activated at a given frequency that writes in the database table information concerning service monitoring, i.e. whether the bus is running on-time, in advance or in delay with respect to the scheduled service. Service Monitoring is performed with respect to relevant points of the line that are configured in the systems; they typically refer to bus stops or to intersections whose crossing could be preferred.

Data concerning the scheduled service are imported as (**Custom Import Data**) through a .csv file.

The database can be queried by operators through different software applications and can be made available to third-parties applications through specific application program interfaces, such as Web Services or store procedures.

4.3 The Algorithm to Compute Delays

The aim of this algorithm, implemented in a specific software module, allows comparison of actual service data gathered by the buses of the fleet with the schedule data, in order to provide the measure of eventual discrepancies.

To implement this algorithm, the concept of Mission has been introduced: a mission is a planned task that a bus must accomplish. This task consists of:

- a route to be performed in a give time
- a set of intermediate stops to be served at given time
- a timestamp for the beginning of the service
- a timestamp for the completion of the service

As the driver takes control of the bus, he identifies himself and selects the mission code. After the completion of this procedure, the OBU sends a message to the Control Centre informing that the driver has been associated with the mission.

From this moment on, all data received by that OBU belongs to that mission, which has defined a set of relevant points (bus stops, intersections); as these points are reached by the bus and a message is sent by the OBU to the Control Centre, the comparison between the expected time and the actual time is performed and the offset is generated.

All this information is stored in the database to continuously monitor the service as well as to analyze in subsequent stages the behavior of the service.

A tool provided with the system to monitor the service displaying the status of the bus (in advance, on-time, delay) is called “Mission Report”. It is a software application aimed at showing the status on the entire fleet. In the upper part of the screen the updated situation of each bus is presented, showing the last position gathered and the current deviation. In the lower part of the screen the mission details are reported, showing the situation at every relevant point already visited.

As date and bus to be monitored are selected, a coloured chart shows the mission behaviour; each colour has a different meaning; threshold can be customized; typical values are:

blue: the bus is in advance (more than 1 minute)
green: the bus in on-time, i.e. inside a predefined tolerance range (-1 to +1 min);
yellow: slight delay (+1 to +5 min)
orange: delay (+5 to + 10 min)
red: heavy delay (more than 10 minutes)

Thresholds can be customized by authorized users.

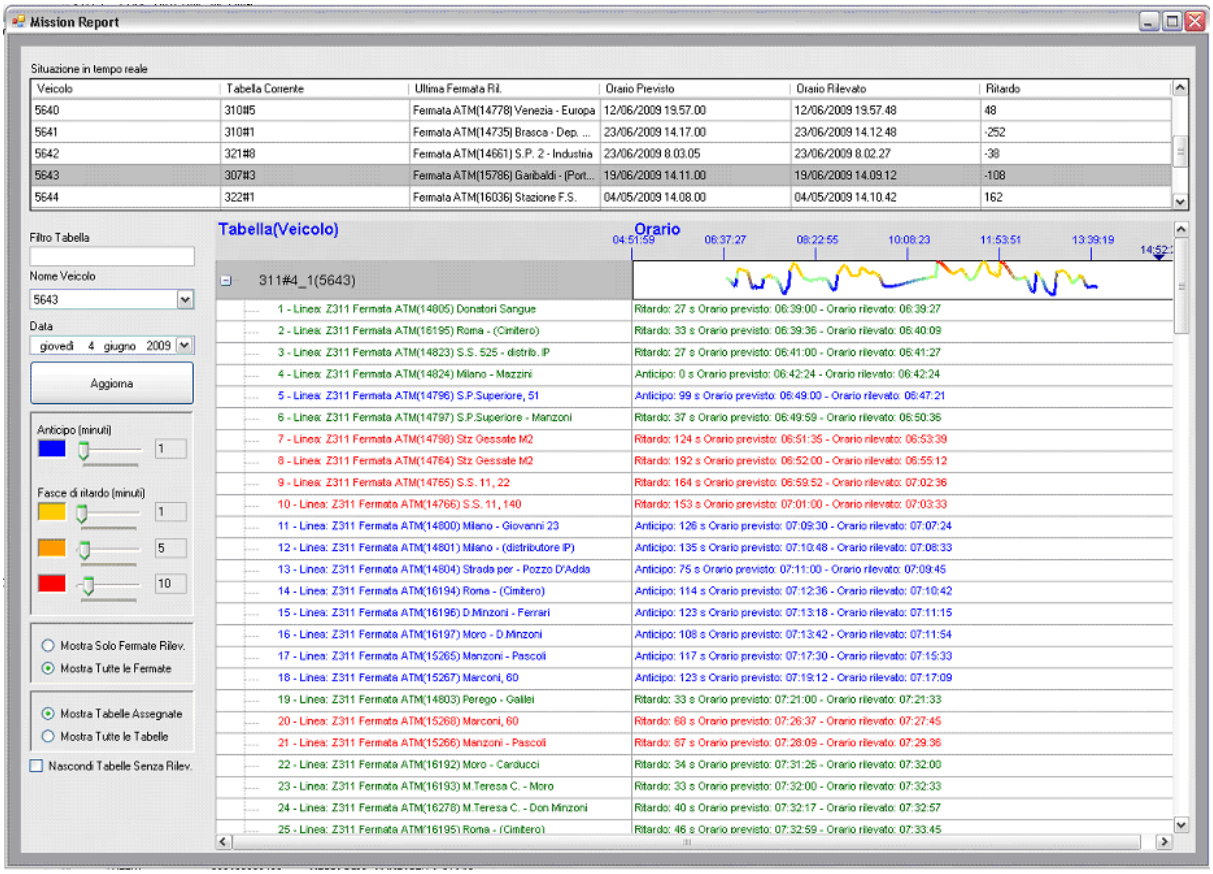


Figure 2 - Mission report screenshot

4.4 Enhanced Forecast Module

As described above, the control system relies on actual data to generate forecasts concerning bus stops approach. Each forecast related to a relevant point defined through geo-referenced coordinates depends on the status of the bus with respect to its schedule. Such forecast depends as well on:

- distance from the target point
- speed of the bus in the last timeframe and discrepancy with the expected speed in such stretch.

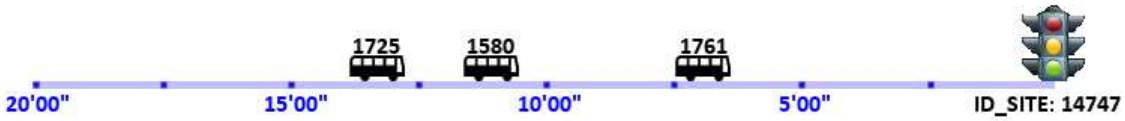
Such information will be used by the previously-mentioned measures no. 79 and no. 82.

The following table depicts a typical information concerning the actual arrivals at some bus stops, each one of them described by an Identification number (Id_Site, first column), a description (second column) and by the actual time difference from the schedule for one or more subsequent buses.

ID_SITE	DESCRIPTION	FLEET/ID_BUS – FORECAST_TIMESTAMP		
14724	Castello-Foscolo	NET2/1761 - 5’30”	NET2/1829 - 17’20”	
14747	Prampolini-Messa	NET2/1761 - 7’25”	NET2/1580 - 20’00”	NET2/1725 – 21’20”
14758	Adda-Sicilia	NET2/1829 - 9’00”		
15819	Foscolo-Cimitero	NET2/1920 - 13’10”	NET2/1829 – 27’10”	
16021	Cederna-Morelli	NET2/1920 - 18’30”		

The colours represent the status of the bus with respect to its schedule, as described above.

The same approach will be used to generate forecasts concerning the arrival time to intersections, to apply priority strategies. Such strategies, within ARCHIMEDES, will be faced in Measure no. 82; the picture below show this context.



ID_SITE	DESCRIPTION	FLEET/ID_BUS – FORECAST_TIMESTAMP		
14747	Prampolini-Messa	NET2/1761 - 7’25”	NET2/1580 - 11’00”	NET2/1725 – 16’20”

In both the contexts depicted, the accuracy of the forecasts depends on the number of relevant points defined. Is it up to the user to create such points where needed. The following picture shows the tracking of a bus in the Google Earth context. Each blue point is the position of the bus generated every 5 seconds; where the points are far from one to the next, the bus was moving. On the contrary, a cluster of points close to one another means that bus was stationary.

Figure 3 - Tracking example

4.5 Main Outcomes

The outcome expected, concerning in the effective collection of data related to the movement of the buses of the fleet across the city, has been fully accomplished; in the appendix a significant example is presented.

4.6 Problems Identified

No functional issues have as yet been identified as problems. (This is good news as GPS blackspots or lack of GPRS availability in some locations might have been expected.)

4.7 Mitigating Activities

Not applicable.

4.8 Future Plans

The implementation of the Measure will enable the development of measures no. 79 and no. 82, according to the updated project workplan.

Appendix: Sample Datasets Collected in Monza

This paragraph shows through a table a dataset collected in Monza concerning real data of the line z206 that will likely be used also in Measure 82, since it relates to intersections on the CIVITAS corridors.

Mission_name	*Sched.*	*Actual*	*Delay*	*Advance*	*Veh_ID*	*Stop_ID*	*Stop_Description*
20100726_206#1_1	5.50.01	5.50.57	0.00.56	0.00.00	1503	ATM329	Poliziano - Nievo
20100726_206#1_1	5.51.26	5.52.51	0.01.25	0.00.00	1503	ATM18	S.Caterina - Tintoretto
20100726_206#1_1	5.53.00	5.54.03	0.01.03	0.00.00	1503	ATM133	Borsa - Cederna
20100726_206#1_1	5.53.58	5.54.54	0.00.56	0.00.00	1503	ATM135	Borsa - Deledda
20100726_206#1_1	5.54.55	5.56.09	0.01.14	0.00.00	1503	ATM487	Borsa - Ferrari
20100726_206#1_1	5.56.00	5.57.30	0.01.30	0.00.00	1503	ATM422	Borsa - Pindemonte
20100726_206#1_1	5.56.58	5.57.48	0.00.50	0.00.00	1503	ATM423	Borsa - Buonarroti
20100726_206#1_1	5.57.34	5.58.18	0.00.44	0.00.00	1503	ATM144	Buonarroti - Mentana
20100726_206#1_1	5.58.46	5.59.09	0.00.23	0.00.00	1503	ATM302	Mentana - Aspromonte
20100726_206#1_1	6.00.05	6.00.09	0.00.04	0.00.00	1503	ATM387	Castello - Turati
20100726_206#1_1	6.02.00	6.01.30	0.00.00	0.00.30	1503	ATM283	Manzoni - Osio
20100726_206#1_1	6.03.00	6.03.06	0.00.06	0.00.00	1503	ATM408	Zavattari - Trento e Trieste
20100726_206#1_1	6.04.06	6.03.45	0.00.00	0.00.21	1503	ATM10	Carducci
20100726_206#1_1	6.05.12	6.05.27	0.00.15	0.00.00	1503	ATM201	Dei Mille - Appiani
20100726_206#1_1	6.05.52	6.05.57	0.00.05	0.00.00	1503	ATM105	Appiani - Zucchi
20100726_206#1_1	6.06.51	6.08.18	0.01.27	0.00.00	1503	ATM168	Prina - Borghetto
20100726_206#1_1	6.08.17	6.09.12	0.00.55	0.00.00	1503	ATM315	Monti e Tognetti - Sirtori
20100726_206#1_1	6.09.03	6.10.24	0.01.21	0.00.00	1503	ATM121	Boito - Battisti
20100726_206#1_1	6.09.43	6.11.03	0.01.20	0.00.00	1503	ATM122	Boito - Monteverdi
20100726_206#1_1	6.10.22	6.11.27	0.01.05	0.00.00	1503	ATM119	Boito - Beethoven
20100726_206#1_1	6.11.15	6.12.09	0.00.54	0.00.00	1503	ATM115	Boito - Paganini
20100726_206#1_1	6.12.21	6.13.00	0.00.39	0.00.00	1503	ATM335	Pergolesi - Boito
20100726_206#1_1	6.13.14	6.13.45	0.00.31	0.00.00	1503	ATM333	Pergolesi - (Ospedale)
20100726_206#1_1	6.14.00	6.14.09	0.00.09	0.00.00	1503	ATM410	Pergolesi - Donizetti
20100726_206#1_1	6.20.01	6.20.45	0.00.44	0.00.00	1503	ATM410	Pergolesi - Donizetti
20100726_206#1_1	6.20.53	6.21.51	0.00.58	0.00.00	1503	ATM483	Pergolesi - (Ospedale)
20100726_206#1_1	6.22.05	6.22.42	0.00.37	0.00.00	1503	ATM332	Pergolesi - Boito
20100726_206#1_1	6.23.18	6.24.21	0.01.03	0.00.00	1503	ATM120	Boito - Pero
20100726_206#1_1	6.24.11	6.24.57	0.00.46	0.00.00	1503	ATM118	Boito - Beethoven
20100726_206#1_1	6.24.50	6.25.36	0.00.46	0.00.00	1503	ATM116	Boito - Monteverdi
20100726_206#1_1	6.25.23	6.25.51	0.00.28	0.00.00	1503	ATM117	Boito - Battisti
20100726_206#1_1	6.26.10	6.26.57	0.00.47	0.00.00	1503	ATM480	Monti e Tognetti - Sirtori
20100726_206#1_1	6.27.42	6.27.45	0.00.03	0.00.00	1503	ATM153	Prina - Villoresi
20100726_206#1_1	6.28.48	6.28.36	0.00.00	0.00.12	1503	ATM409	Zucchi - Appiani
20100726_206#1_1	6.29.28	6.29.33	0.00.05	0.00.00	1503	ATM16	Grandi, 1
20100726_206#1_1	6.31.00	6.30.21	0.00.00	0.00.39	1503	ATM414	Zavattari - Trento e

Mission_name	*Sched.*	*Actual*	*Delay*	*Advance*	*Veh_ID*	*Stop_ID*	*Stop_Description*
							Trieste
20100726_206#1_1	6.32.00	6.31.57	0.00.00	0.00.03	1503	ATM284	Manzoni - Osio
20100726_206#1_1	6.33.21	6.36.03	0.02.42	0.00.00	1503	ATM388	Castello - Turati
20100726_206#1_1	6.34.20	6.36.39	0.02.19	0.00.00	1503	ATM301	Mentana - Beccaria
20100726_206#1_1	6.35.14	6.37.54	0.02.40	0.00.00	1503	ATM145	Buonarroti - Mentana
20100726_206#1_1	6.35.47	6.38.36	0.02.49	0.00.00	1503	ATM420	Borsa - Buonarroti
20100726_206#1_1	6.36.19	6.38.54	0.02.35	0.00.00	1503	ATM421	Borsa - Pindemonte
20100726_206#1_1	6.37.02	6.39.51	0.02.49	0.00.00	1503	ATM134	Borsa - Ferrari
20100726_206#1_1	6.37.40	6.40.36	0.02.56	0.00.00	1503	ATM136	Borsa - Deledda
20100726_206#1_1	6.38.34	6.41.15	0.02.41	0.00.00	1503	ATM175	Cederna - Borsa
20100726_206#1_1	6.39.12	6.43.51	0.04.39	0.00.00	1503	ATM381	Muratori - Tiepolo
20100726_206#1_1	6.39.50	6.44.00	0.04.10	0.00.00	1503	ATM380	Tiepolo - Borsa
20100726_206#1_1	6.41.00	6.45.27	0.04.27	0.00.00	1503	ATM329	Poliziano - Nievo
20100726_206#1_1	6.50.01	6.50.36	0.00.35	0.00.00	1503	ATM329	Poliziano - Nievo
20100726_206#1_1	6.51.26	6.52.21	0.00.55	0.00.00	1503	ATM18	S.Caterina - Tintoretto
20100726_206#1_1	6.53.00	6.53.27	0.00.27	0.00.00	1503	ATM133	Borsa - Cederna
20100726_206#1_1	6.53.58	6.54.18	0.00.20	0.00.00	1503	ATM135	Borsa - Deledda
20100726_206#1_1	6.54.55	6.55.42	0.00.47	0.00.00	1503	ATM487	Borsa - Ferrari
20100726_206#1_1	6.56.00	6.56.12	0.00.12	0.00.00	1503	ATM422	Borsa - Pindemonte
20100726_206#1_1	6.56.58	6.56.48	0.00.00	0.00.10	1503	ATM423	Borsa - Buonarroti
20100726_206#1_1	6.57.34	6.57.54	0.00.20	0.00.00	1503	ATM144	Buonarroti - Mentana
20100726_206#1_1	6.58.46	6.59.09	0.00.23	0.00.00	1503	ATM302	Mentana - Aspromonte
20100726_206#1_1	7.00.05	6.59.54	0.00.00	0.00.11	1503	ATM387	Castello - Turati
20100726_206#1_1	7.02.00	7.03.36	0.01.36	0.00.00	1503	ATM283	Manzoni - Osio
20100726_206#1_1	7.03.00	7.05.18	0.02.18	0.00.00	1503	ATM408	Zavattari - Trento e Trieste
20100726_206#1_1	7.04.06	7.05.54	0.01.48	0.00.00	1503	ATM10	Carducci
20100726_206#1_1	7.05.12	7.07.33	0.02.21	0.00.00	1503	ATM201	Dei Mille - Appiani
20100726_206#1_1	7.05.52	7.08.24	0.02.32	0.00.00	1503	ATM105	Appiani - Zucchi
20100726_206#1_1	7.06.51	7.11.00	0.04.09	0.00.00	1503	ATM168	Prina - Borghetto
20100726_206#1_1	7.08.17	7.11.54	0.03.37	0.00.00	1503	ATM315	Monti e Tognetti - Sirtori
20100726_206#1_1	7.09.03	7.13.21	0.04.18	0.00.00	1503	ATM121	Boito - Battisti
20100726_206#1_1	7.09.43	7.14.06	0.04.23	0.00.00	1503	ATM122	Boito - Monteverdi
20100726_206#1_1	7.10.22	7.14.42	0.04.20	0.00.00	1503	ATM119	Boito - Beethoven
20100726_206#1_1	7.11.15	7.16.36	0.05.21	0.00.00	1503	ATM115	Boito - Paganini
20100726_206#1_1	7.12.21	7.17.27	0.05.06	0.00.00	1503	ATM335	Pergolesi - Boito
20100726_206#1_1	7.13.14	7.18.18	0.05.04	0.00.00	1503	ATM333	Pergolesi - (Ospedale)
20100726_206#1_1	7.14.00	7.19.03	0.05.03	0.00.00	1503	ATM410	Pergolesi - Donizetti

Another dataset is the following:

This table again concerns some missions carried out on July 26th, 2010, this time by Vehicle_ID no. 256.

Mission_name	*Sched.*	*Actual*	*Delay*	*Advance*	*Veh_ID*	*Stop_ID*	*Stop_Description*
20100727_206#4_1	7.20.01	7.23.15	0.03.14	0.00.00	256	ATM410	Pergolesi - Donizetti
20100727_206#4_1	7.21.17	7.24.09	0.02.52	0.00.00	256	ATM483	Pergolesi - (Ospedale)
20100727_206#4_1	7.23.02	7.25.06	0.02.04	0.00.00	256	ATM332	Pergolesi - Boito
20100727_206#4_1	7.24.48	7.27.21	0.02.33	0.00.00	256	ATM120	Boito - Pero
20100727_206#4_1	7.26.05	7.28.15	0.02.10	0.00.00	256	ATM118	Boito - Beethoven
20100727_206#4_1	7.27.02	7.28.57	0.01.55	0.00.00	256	ATM116	Boito - Monteverdi
20100727_206#4_1	7.27.50	7.29.27	0.01.37	0.00.00	256	ATM117	Boito - Battisti
20100727_206#4_1	7.28.58	7.30.06	0.01.08	0.00.00	256	ATM480	Monti e Tognetti - Sirtori
20100727_206#4_1	7.31.12	7.33.03	0.01.51	0.00.00	256	ATM153	Prina - Villoresi
20100727_206#4_1	7.32.48	7.35.48	0.03.00	0.00.00	256	ATM409	Zucchi - Appiani
20100727_206#4_1	7.33.46	7.36.39	0.02.53	0.00.00	256	ATM16	Grandi, 1
20100727_206#4_1	7.36.00	7.37.27	0.01.27	0.00.00	256	ATM414	Zavattari - Trento e Trieste
20100727_206#4_1	7.38.00	7.38.30	0.00.30	0.00.00	256	ATM284	Manzoni - Osio
20100727_206#4_1	7.39.39	7.43.30	0.03.51	0.00.00	256	ATM388	Castello - Turati
20100727_206#4_1	7.40.52	7.44.00	0.03.08	0.00.00	256	ATM301	Mentana - Beccaria
20100727_206#4_1	7.41.58	7.45.30	0.03.32	0.00.00	256	ATM145	Buonarroti - Mentana
20100727_206#4_1	7.42.37	7.45.54	0.03.17	0.00.00	256	ATM420	Borsa - Buonarroti
20100727_206#4_1	7.43.17	7.46.09	0.02.52	0.00.00	256	ATM421	Borsa - Pindemonte
20100727_206#4_1	7.44.10	7.47.09	0.02.59	0.00.00	256	ATM134	Borsa - Ferrari
20100727_206#4_1	7.44.56	7.47.54	0.02.58	0.00.00	256	ATM136	Borsa - Deledda
20100727_206#4_1	7.46.02	7.48.30	0.02.28	0.00.00	256	ATM175	Cederna - Borsa
20100727_206#4_1	7.46.48	7.49.06	0.02.18	0.00.00	256	ATM381	Muratori - Tiepolo
20100727_206#4_1	7.47.34	7.49.51	0.02.17	0.00.00	256	ATM380	Tiepolo - Borsa
20100727_206#4_1	7.49.00	7.50.45	0.01.45	0.00.00	256	ATM329	Poliziano - Nievo
20100727_206#4_1	8.10.01	8.11.03	0.01.02	0.00.00	256	ATM329	Poliziano - Nievo
20100727_206#4_1	8.11.55	8.11.57	0.00.02	0.00.00	256	ATM18	S.Caterina - Tintoretto
20100727_206#4_1	8.14.00	8.13.09	0.00.00	0.00.51	256	ATM133	Borsa - Cederna
20100727_206#4_1	8.15.17	8.14.09	0.00.00	0.01.08	256	ATM135	Borsa - Deledda
20100727_206#4_1	8.16.34	8.14.54	0.00.00	0.01.40	256	ATM487	Borsa - Ferrari
20100727_206#4_1	8.18.00	8.15.48	0.00.00	0.02.12	256	ATM422	Borsa - Pindemonte
20100727_206#4_1	8.19.17	8.16.12	0.00.00	0.03.05	256	ATM423	Borsa - Buonarroti
20100727_206#4_1	8.20.05	8.16.57	0.00.00	0.03.08	256	ATM144	Buonarroti - Mentana
20100727_206#4_1	8.21.41	8.18.03	0.00.00	0.03.38	256	ATM302	Mentana - Aspromonte
20100727_206#4_1	8.23.26	8.19.00	0.00.00	0.04.26	256	ATM387	Castello - Turati
20100727_206#4_1	8.26.00	8.24.42	0.00.00	0.01.18	256	ATM283	Manzoni - Osio
20100727_206#4_1	8.28.00	8.25.42	0.00.00	0.02.18	256	ATM408	Zavattari - Trento e Trieste
20100727_206#4_1	8.29.42	8.26.33	0.00.00	0.03.09	256	ATM10	Carducci
20100727_206#4_1	8.31.24	8.28.00	0.00.00	0.03.24	256	ATM201	Dei Mille - Appiani
20100727_206#4_1	8.32.25	8.29.39	0.00.00	0.02.46	256	ATM105	Appiani - Zucchi
20100727_206#4_1	8.33.57	8.31.30	0.00.00	0.02.27	256	ATM168	Prina - Borghetto

Mission_name	*Sched.*	*Actual*	*Delay*	*Advance*	*Veh_ID*	*Stop_ID*	*Stop_Description*
20100727_206#4_1	8.36.10	8.32.06	0.00.00	0.04.04	256	ATM315	Monti e Tognetti - Sirtori
20100727_206#4_1	8.37.21	8.32.57	0.00.00	0.04.24	256	ATM121	Boito - Battisti
20100727_206#4_1	8.38.22	8.33.36	0.00.00	0.04.46	256	ATM122	Boito - Monteverdi
20100727_206#4_1	8.39.23	8.34.15	0.00.00	0.05.08	256	ATM119	Boito - Beethoven
20100727_206#4_1	8.40.45	8.35.06	0.00.00	0.05.39	256	ATM115	Boito - Paganini
20100727_206#4_1	8.42.27	8.36.42	0.00.00	0.05.45	256	ATM335	Pergolesi - Boito
20100727_206#4_1	8.43.49	8.37.42	0.00.00	0.06.07	256	ATM333	Pergolesi - (Ospedale)
20100727_206#4_1	8.45.00	8.38.06	0.00.00	0.06.54	256	ATM410	Pergolesi - Donizetti
20100727_206#4_1	9.00.01	9.02.21	0.02.20	0.00.00	256	ATM410	Pergolesi - Donizetti
20100727_206#4_1	9.01.31	9.03.39	0.02.08	0.00.00	256	ATM483	Pergolesi - (Ospedale)
20100727_206#4_1	9.03.37	9.05.06	0.01.29	0.00.00	256	ATM332	Pergolesi - Boito
20100727_206#4_1	9.05.42	9.06.45	0.01.03	0.00.00	256	ATM120	Boito - Pero
20100727_206#4_1	9.07.13	9.07.45	0.00.32	0.00.00	256	ATM118	Boito - Beethoven
20100727_206#4_1	9.08.22	9.12.06	0.03.44	0.00.00	256	ATM116	Boito - Monteverdi
20100727_206#4_1	9.09.19	9.13.42	0.04.23	0.00.00	256	ATM117	Boito - Battisti
20100727_206#4_1	9.10.38	9.15.18	0.04.40	0.00.00	256	ATM480	Monti e Tognetti - Sirtori
20100727_206#4_1	9.13.18	9.19.27	0.06.09	0.00.00	256	ATM153	Prina - Villoresi
20100727_206#4_1	9.15.12	9.26.00	0.10.48	0.00.00	256	ATM409	Zucchi - Appiani
20100727_206#4_1	9.16.20	9.27.03	0.10.43	0.00.00	256	ATM16	Grandi, 1
20100727_206#4_1	9.19.00	9.28.12	0.09.12	0.00.00	256	ATM414	Zavattari - Trento e Trieste
20100727_206#4_1	9.20.00	9.30.57	0.10.57	0.00.00	256	ATM284	Manzoni - Osio
20100727_206#4_1	9.21.48	9.33.00	0.11.12	0.00.00	256	ATM388	Castello - Turati
20100727_206#4_1	9.23.07	9.33.57	0.10.50	0.00.00	256	ATM301	Mentana - Beccaria
20100727_206#4_1	9.24.19	9.35.00	0.10.41	0.00.00	256	ATM145	Buonarroti - Mentana
20100727_206#4_1	9.25.02	9.36.06	0.11.04	0.00.00	256	ATM420	Borsa - Buonarroti
20100727_206#4_1	9.25.46	9.36.21	0.10.35	0.00.00	256	ATM421	Borsa - Pindemonte
20100727_206#4_1	9.26.43	9.37.06	0.10.23	0.00.00	256	ATM134	Borsa - Ferrari
20100727_206#4_1	9.27.34	9.38.15	0.10.41	0.00.00	256	ATM136	Borsa - Deledda
20100727_206#4_1	9.28.46	9.39.00	0.10.14	0.00.00	256	ATM175	Cederna - Borsa
20100727_206#4_1	9.29.36	9.39.57	0.10.21	0.00.00	256	ATM381	Muratori - Tiepolo
20100727_206#4_1	9.30.26	9.41.12	0.10.46	0.00.00	256	ATM380	Tiepolo - Borsa
20100727_206#4_1	9.32.00	9.42.06	0.10.06	0.00.00	256	ATM329	Poliziano - Nievo
20100727_206#4_1	9.50.01	9.51.54	0.01.53	0.00.00	256	ATM329	Poliziano - Nievo
20100727_206#4_1	9.51.55	9.52.39	0.00.44	0.00.00	256	ATM18	S.Caterina - Tintoretto
20100727_206#4_1	9.54.00	9.55.24	0.01.24	0.00.00	256	ATM133	Borsa - Cederna
20100727_206#4_1	9.55.17	9.55.54	0.00.37	0.00.00	256	ATM135	Borsa - Deledda
20100727_206#4_1	9.56.34	9.57.24	0.00.50	0.00.00	256	ATM487	Borsa - Ferrari
20100727_206#4_1	9.58.00	9.58.30	0.00.30	0.00.00	256	ATM422	Borsa - Pindemonte
20100727_206#4_1	9.59.17	9.59.45	0.00.28	0.00.00	256	ATM423	Borsa - Buonarroti
20100727_206#4_1	10.00.05	10.00.54	0.00.49	0.00.00	256	ATM144	Buonarroti - Mentana
20100727_206#4_1	10.01.41	10.02.06	0.00.25	0.00.00	256	ATM302	Mentana -

Mission_name	*Sched.*	*Actual*	*Delay*	*Advance*	*Veh_ID*	*Stop_ID*	*Stop_Description*
							Aspromonte
20100727_206#4_1	10.03.26	10.02.54	0.00.00	0.00.32	256	ATM387	Castello - Turati
20100727_206#4_1	10.06.00	10.06.00	0.00.00	0.00.00	256	ATM283	Manzoni - Osio
20100727_206#4_1	10.08.00	10.07.00	0.00.00	0.01.00	256	ATM408	Zavattari - Trento e Trieste
20100727_206#4_1	10.09.42	10.08.57	0.00.00	0.00.45	256	ATM10	Carducci
20100727_206#4_1	10.11.24		0.00.00	10.11.24	256	ATM201	Dei Mille - Appiani
20100727_206#4_1	10.12.25	10.11.57	0.00.00	0.00.28	256	ATM105	Appiani - Zucchi
20100727_206#4_1	10.13.57	10.13.57	0.00.00	0.00.00	256	ATM168	Prina - Borghetto
20100727_206#4_1	10.16.10	10.15.33	0.00.00	0.00.37	256	ATM315	Monti e Tognetti - Sirtori
20100727_206#4_1	10.17.21	10.16.57	0.00.00	0.00.24	256	ATM121	Boito - Battisti
20100727_206#4_1	10.18.22	10.17.18	0.00.00	0.01.04	256	ATM122	Boito - Monteverdi
20100727_206#4_1	10.19.23	10.17.39	0.00.00	0.01.44	256	ATM119	Boito - Beethoven
20100727_206#4_1	10.20.45	10.19.15	0.00.00	0.01.30	256	ATM115	Boito - Paganini
20100727_206#4_1	10.22.27	10.20.00	0.00.00	0.02.27	256	ATM335	Pergolesi - Boito
20100727_206#4_1	10.23.49	10.21.00	0.00.00	0.02.49	256	ATM333	Pergolesi - (Ospedale)
20100727_206#4_1	10.25.00	10.21.39	0.00.00	0.03.21	256	ATM410	Pergolesi - Donizetti