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Monza

R79.1 – Study of Bus Traveller Information

City of Monza

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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 encouraging sustainable mobility, the use of Public Transport in the City of Monza needs to be increased. In order to achieve this objective, within the ARCHIMEDES framework a clear decision has been made, which has the full support of the government of the Municipality. This is based on the implementation of technological measures to make Public Transport more attractive to citizens.

Within measure number 79 ("Improved Traveller Information in Monza"), an Advanced Traveller Information Service for Urban Public Transport is being set up to provide real time information at the most important bus stops of the city and at Porta Castello interchange node.

The implementation of the measure has been made possible by the activation of measure number 78 (Bus Management System in Monza) which has allowed bus location and monitoring, a fundamental prerequisite to define the kind of information to be provided to Public Transport users.

The measure covers 2 tasks.

Research Stage: Task 11.8.7 Bus Traveller Information Study

A study will be undertaken by Comune of Monza, with the technological support of PA and the operational support of NET to define the requirements of the kind of information to be provided to passengers at key interchanges and key bus stops in Monza.

Demonstration Stage: Task 8.14 Improved Traveller Information

Real time passenger information provided by the Bus Management System will be provided by NET to passengers at 10 key stops and at "Porta Castello" interchange node.

3.1 Summary Description of the Task

Within this research task, the work has focused on the study of the Public Transport service in Monza with the following activities:

1. analyse the current regulatory framework that is an important prerequisite to perform the measure (section 4.1.1);
2. analysis of the new Urban Public Transport network that will be activated in Spring 2011 (section 4.1.2), in order to identify the most suitable locations where to install Passenger Information Display Systems (PIDS). The attention has been primarily focused on most frequented lines, which cover the CIVITAS corridor for public transport.
3. Identification of the software and the technological framework to implement the measure (section **Error! Reference source not found.**), consisting of:
 - a. the Electronic Display to be installed at the bus stops identified,
 - b. an interactive totem to be installed at Porta Castello interchange node to provide complete information on the PT service to passengers (timetables, routes)

4 Study of Bus Traveller Information

4.1 Description of the Work Done

4.1.1 Regulatory framework of Public Transport

According to Italian law, the responsibility for Public Transport buses rests on the Provincial authority, which issues tenders and manages contracts with PT companies. Municipalities can only issue tenders for the urban service.

The actual contract running PT Services in Monza was issued by the Province of Milan in 2007, following an agreement between the Comune of Monza and Province of Milan. The aim was to have a unique contract for PT services for both the urban and suburban area of Monza, which includes many surrounding cities like Veduggio, Cinisello, Muggiò, Brughiero: as a matter of fact, historically, the PT service for the city of Monza has always extended to the city surroundings, and there was a strong input to maintain this approach.

Since Monza became capital of the new Province of Monza and Brianza, in June 2009, administrative offices of the new public body have started to become operational and at the beginning of 2011 the current contract for PT bus service, previously managed by Province of Milan will pass into the hands of Province of Monza, until its scheduled expiry date in 2014.

Management of railway transport is the responsibility of the Regione Lombardia which has structured the railway network following the example of German S-Bahn and Paris RER systems: there are 10 suburban lines, eight of which are already active, and Monza is crossed by the S9 Line, which connects Seregno (situated 10 km north from Monza) to the metro station of Sesto San Giovanni (terminus of line 1 of Milan Metro) and to several railway stations in Milan, also stopping at the most important Universities of Milan (see figure 2). At the moment the line Monza – Milan is served daily by 170 pairs of trains in both directions with an average frequency of 5 minutes in peak hours and 10 minutes in off-peak hours. In order to improve railway links, there are contacts with railway boards to start up planning stages to open new stations.

4.1.2 The new network of PT lines in Monza

4.1.2.1 Public Transport Offer in Monza

As described in Chapter 2, the city of Monza is affected daily by a huge amount of traffic crossing the city to reach Milan and the important street nodes surrounding the municipal territory. Moreover, due to its location Monza is the inevitable route for people travelling from Milan to Lecco, Sondrio and Valtellina (an important tourist area, due to its skiing resorts, to its beautiful mountains and lakes), also during weekends the city suffers from traffic congestion because of the influx of tourists.



Figure 1 – Territory of Monza and Brianza

Monza Railway Network

Monza is also an important railway node, crossed by routes connecting Milan with Como and Switzerland, Lecco and Sondrio, Bergamo and Brianza.

Relying on an agreement involving the Municipality of Monza, Rete Ferroviaria Italiana (Owner of the Italian Rail Network) and Regione Lombardia Land, the central railway station has been recently revamped and a new subway has been opened in order to facilitate the access from the eastern area of the town. Most of suburban lines have their terminus here, thus guaranteeing a real modal interchange.

In September 2006, the Public Transport Interchange Node of Monza, named “Porta Castello” was set in operation. It is one of the most important interchange nodes in the entire Lombardia area. As far as train departures are concerned, the InfoMobility service is active, so people accessing the Railway Station find real-time information relating to train services.

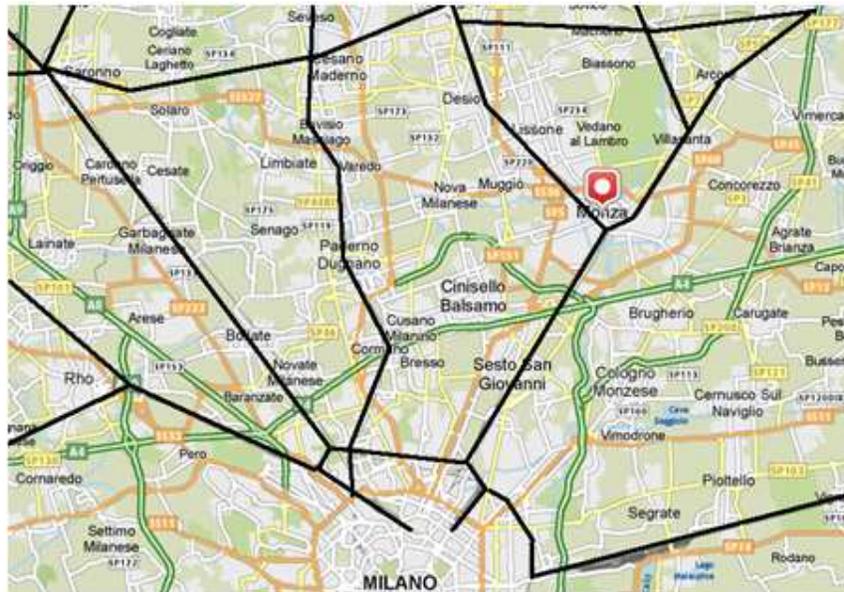


Figure 2 - Monza railway network

Monza Bus Network

What has been missing until now is a similar information system relating to the Public Transport bus services: PT users and commuters would expect to find an updated and reliable source of information concerning the arrival and departure of buses. This would allow them to take some time if the arrival is expected in a few minutes or to take the bus of another line whose route may be a second choice but convenient nevertheless.

As far as Public Transport by buses is concerned, the coverage of the city territory is constant with 66 km of bus routes, even though there has been a decrease in the number of users (4,260,270 travellers in 2007 compared with the 4,387,234 in 2006). Also commercial speed is decreasing due to the high volume of traffic.

In the Monza territory, there are six urban lines which were previously managed by Trasporti Pubblici Monzesi (TPM), a company 100% controlled by the Municipality of Monza, and several other lines managed by other transportation companies which connect different cities of Brianza to Monza railway station or to MM1 terminus in Sesto San Giovanni.

In September 2009, TPM merged with NET, a PT company in which ATM (the company which runs the bus and the metro service in Milan) has a stake, so the urban lines are now managed by NET.

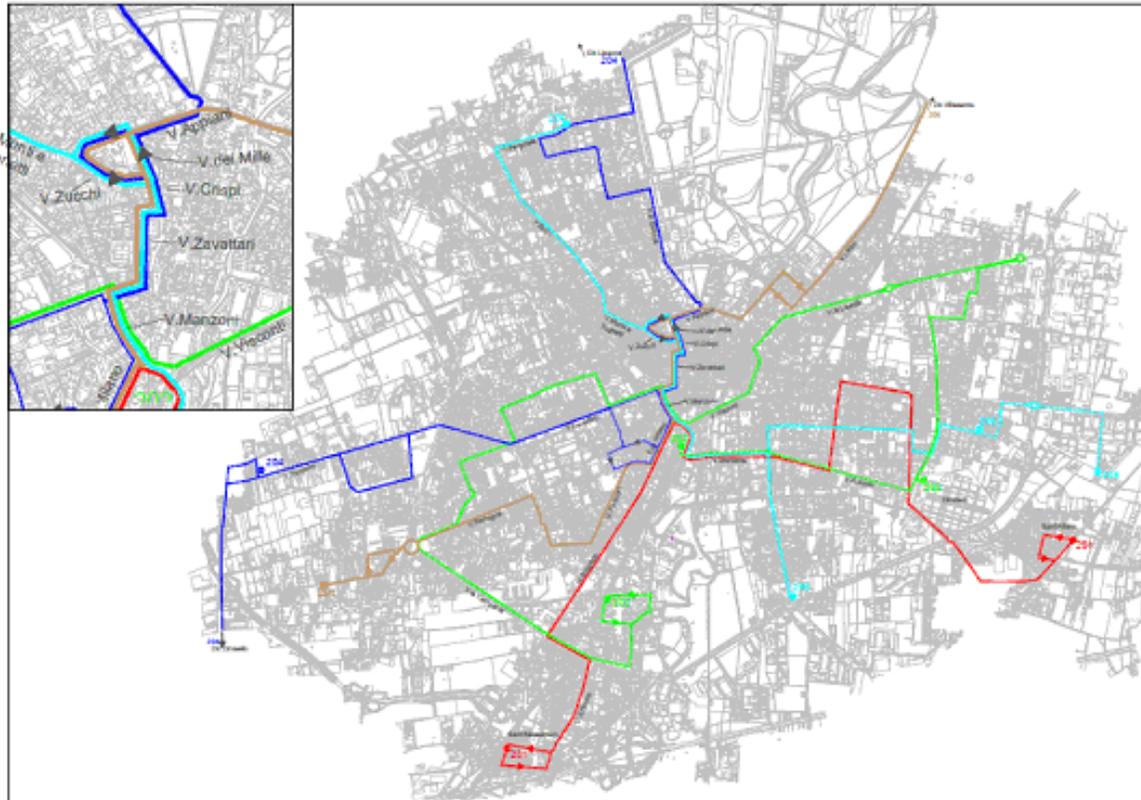


Figure 3 - Monza urban PT network as it was organised in 2010

This measure aims at making operational a real time passenger information system provided by the Bus Management System at 10 key stops and at "Porta Castello" interchange node.

4.1.2.2 Prerequisite of AVL/AVM system

Before merging with NET, TPM had already installed on its fleet an automatic vehicle location / monitoring (AVL/AVM) system, but that system would need to have been heavily upgraded to fulfil the ARCHIMEDES requirements.

The new management of the service, exploiting experience of ATM, decided to extend on the fleet inherited by TPM an existing AVL/AVM system, already active on ATM fleet operating in Milan; the extensions required have been accomplished with success in a short time, due to the internal design of this new AVM/AVM system. Since July 2010, each vehicle of NET fleet has been equipped with an On-Board Unit (OBU) consisting 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;

As the driver begins their shift, they identify themselves to the system, typing their personal code on a dedicated keyboard.

Data concerning vehicle positions are produced at a given frequency (sampling interval) and sent to the Control Centre at another given frequency (transmission interval). Once records are received by the Control Centre they are stored in a database table, for subsequent uses. In the ARCHIMEDES context, the immediate use provides information which will be used for Measure 79 (InfoBus) and for Measure 82 (Priority to intersections on the corridor identified). In addition, data is available for every type of statistical analysis.

As referred to earlier, at the beginning of 2011 responsibility for the contract for PT bus service, previously managed by Province of Milan will pass into the hands of Province of Monza. Within this framework, the Province of Monza, before starting the management of the contract, has decided to revise the network of PT services, taking into account problems and suggestions collated during the last three years.

The aim of this revision is to implement PT service in the urban area of Monza, connecting important transport nodes and interchanges to less well served areas, optimising costs and resources and improving timetables in order to offer best service frequencies.

The new network, which is only partially different from the previous one, will be operational from February 2011, but the most important bus stops have already been identified in order to define where bus shelters with electronic displays are going to be installed.

The choice of the bus stops has been shared with PT companies and with the Province of Monza and Brianza with the aim of installing thirty electronic bus shelters, ten of which will be located on one of the two CIVITAS corridors which have been identified at the beginning of ARCHIMEDES project, and more specifically on the corridor mainly dedicated to Public Transport routes, which end at Porta Castello interchange node, located at the bottom of the orange line close to the central Railway Station of Monza. In figure 4, the corridor for Public Transport is highlighted in blue, whilst the Corridor for private traffic is highlighted in red.

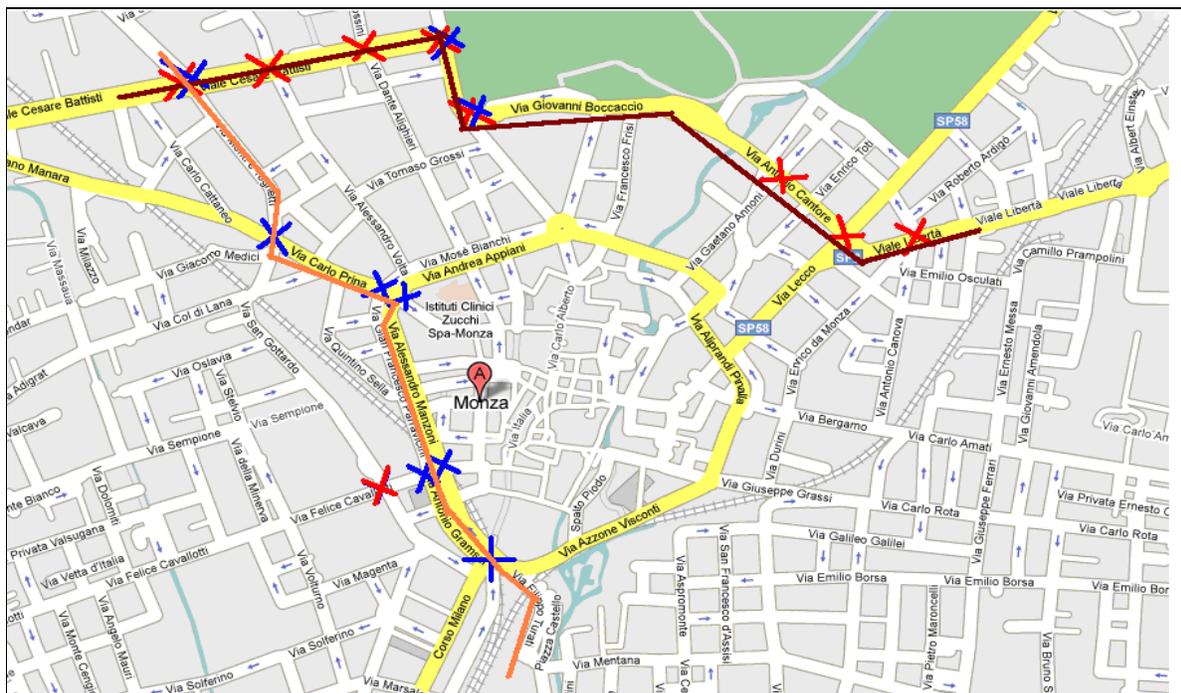


Figure 4 - Monza CIVITAS Corridors

Moreover, it has been considered to install electronic bus shelters in locations where the largest number of lines stop, so the information to PT users can be more complete and can also assist in the integration between different lines.

From this approach, NET has proposed its list of thirty bus stops where new shelters are being installed since the beginning of 2011. In figure 5, the new network of bus services is depicted, with the indications of the location of electronic bus shelters to be installed.

A red star indicates those bus stops situated on the CIVITAS Corridor; those with the yellow star are the other ones outside the CIVITAS Corridor.

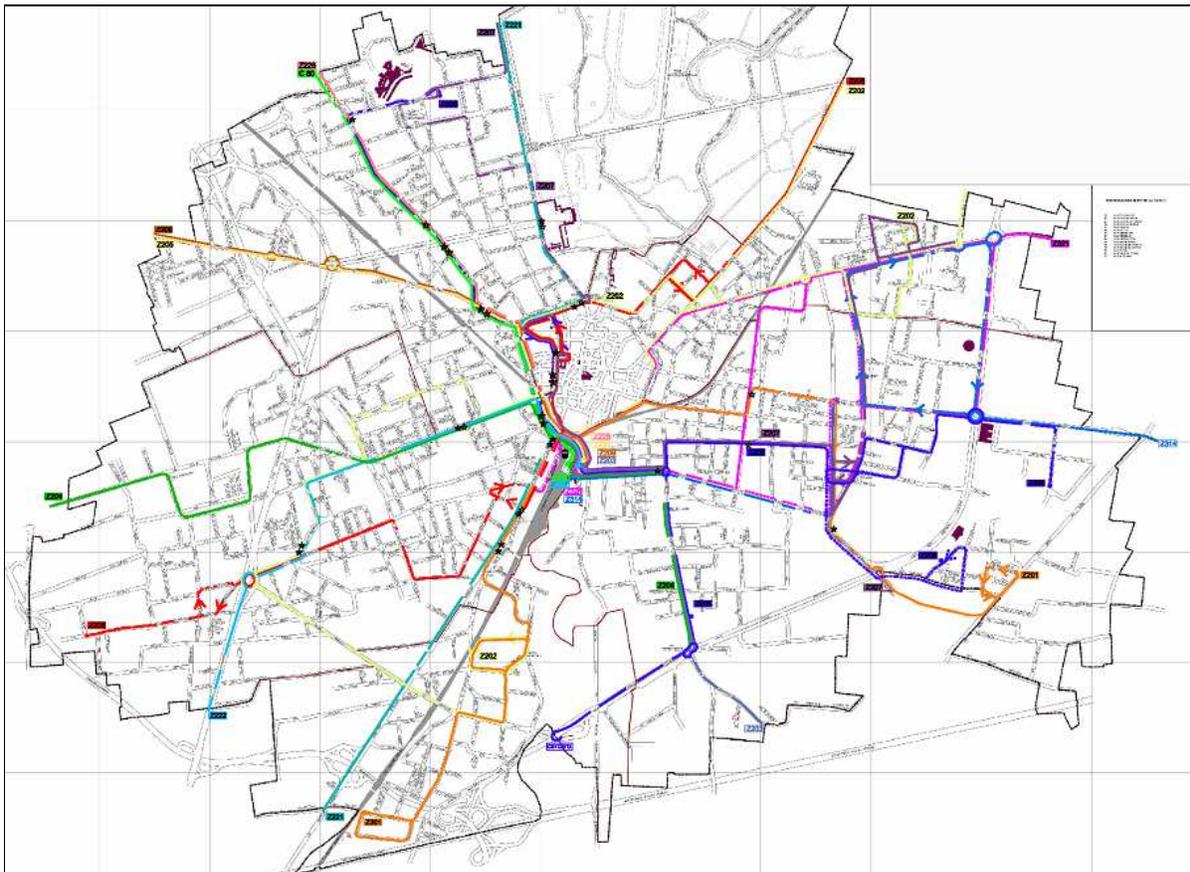


Figure 5 - Monza urban PT network after 2011 revision

As far as the railway station is concerned, discussions have taken place with Rete Ferroviaria Italiana (Owner of the Italian Rail Network), in order to define the best location for the screen to be installed in Porta Castello. The aim is to provide information to PT users and commuters on bus timetables.

4.1.3 Technological framework to implement the measure

The technological framework needed to provide end-user information concerning the actual arrival time of buses relies on the software system used also for Measure no. 78 (Bus localization system). This system has been extended through two new modules presented as pink boxes in Figure 6.

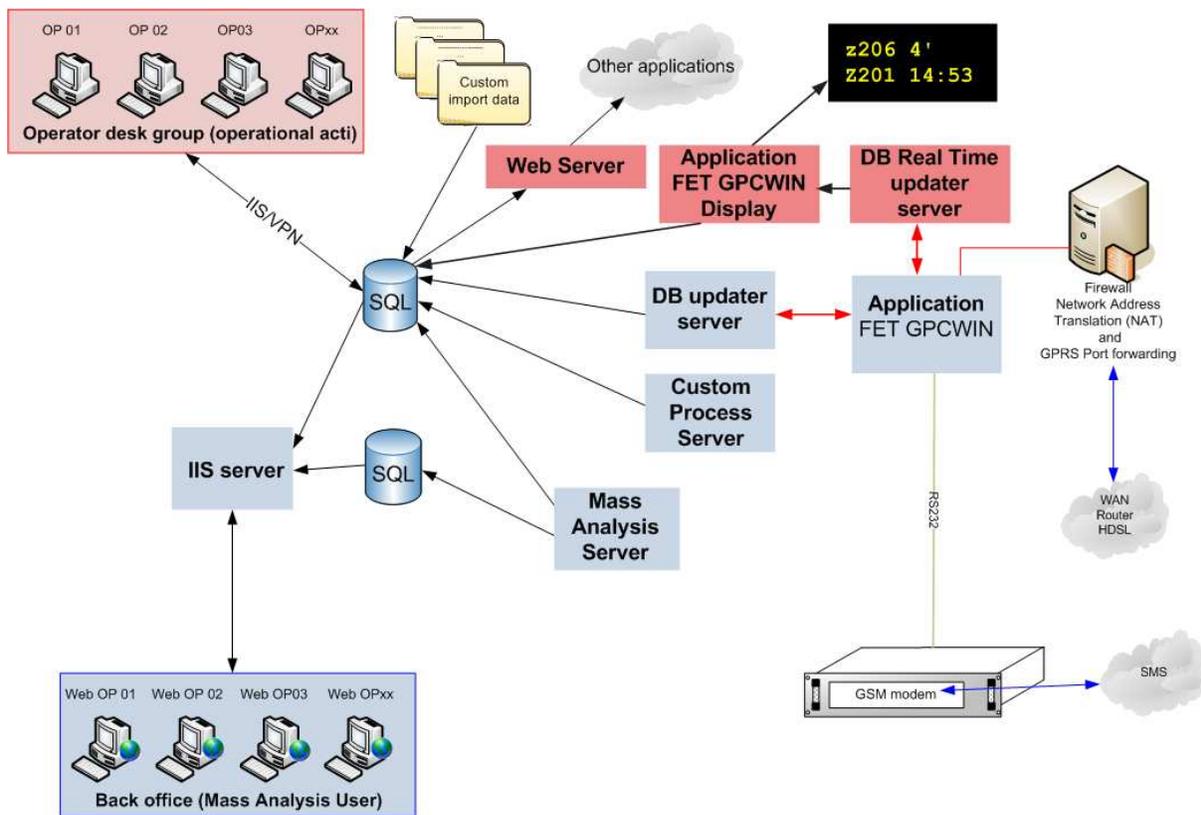


Figure 6 - Architecture of the system

In more detail, localization data collected by the buses of the Public Transport Fleet are now available as Real Time data, as they are received by the Central system, through the specific software module “DB Real Time Updater Server”.

Such data are transferred to another software module running in the Central System (“Electronic Display Server”) which is aimed at preparing data for every Electronic Display board installed across the city, depicted in Figure 6 by the black symbol with yellow characters.

Such Real Time data are available also for other future applications, as depicted by the grey cloud in the upper right position of Figure 6.

4.1.3.1 Electronic Display at relevant bus stops

An example of the electronic displays that will be installed at relevant bus stops is shown in Figure 7.

The display can be both connected to a power supply line and fed by solar power. In the city of Monza both these situations will probably be present. The functions are the same: the only difference is that with a power supply connection the display can always be active, whereas when the electronic display is fed by solar power the display shows the contents for some seconds every minute, in order to reduce energy consumption.



Figure 7 - AESYS electronic display

The control of the opto-electronic components is semi-static (AlInGaP LED Technology); this technology allows an optimal trade off between efficiency and reliability on one side and low consumption (max 10W).

The high-definition graphical matrix proposed (5mm step) ensures the maximum flexibility at showing different types of contents. More precisely, it allows adaptation of fonts and dimensions to text and graphics that can be clearly displayed. The readability of information presented is optimised, so the contents can be read also at 10 metres or more. The enclosure has been designed to resist at thefts.

Other relevant information are:

- continuous current control on LEDs;
- MTBF of LEDs: 1.500.000 operating hours;
- Amber colour LEDs at very high brightness (1.6Cd @ 20mA);
- 3000Cd/mq Brightness;
- Visibility angle: 120°Horizontal, 60°Vertical;
- Fanless Display for reduced maintenance tasks (no filter substitution);
- Operating Temperature: -20°C, +60°C;
- Operating Humidity: 5% to 90% (without condensation at +60°C);
- Automatic brightness control with 128 levels through specific sensor;

- IP54 protection

As far as the control unit is concerned, the main features are:

- microprocessor unit at 60 MHz and FPGA (Field Programmable Gate Array);
- 2 Mbit Flash Memory, 1Mbyte RAM;
- Internal temperature detection;
- Operating Range: -20° to +85°
- MTBF: 20,000 hours

Displays consists of three lines; each of them can show up to 20 characters with proportional font or 16 characters with a fixed font. If the content to be displayed consists of more than three lines, the display can alternatively show batches of three lines, restarting when all the messages have been displayed.

Characters that can be shown are:

- numbers, lowercase and uppercase letters

The attributes are:

- proportional font 7x5
- fixed font 7x5
- uppercase letters with subscript for the 8th row to show the descending component of letters p, q and g that use the 8th pixel;
- semi-expanded font 8x6 to highlight particular information

Messages can blink and message scroll is allowed on the third line (the lowest one).

The communication with the displays is accomplished through GPRS lines; the same front-end used for the GPRS communication with the On Board Units (OBU) installed on the buses of the fleet is used also for GPRS connection with the displays.

As far as information to be displayed, the choice is to represent for each bus line the following information:

- below 5 minutes to arrival, the number of minutes;
- above 5 minutes to arrival, the expected time of arrival in hour and minute format (e.g. 15:35); if the expected arrival is far away in time (e.g. 2 hours or more), the value is not shown and a courtesy message is presented, if configured.

In Figure 8 a screen captured from the software application controlling the system is shown: it is possible to have a glance of a typical configuration of the electronic Display spread across the city.

9105 Z208 San C 16.54	9107 Z206 Pergo 16.53	9108 Z266 Buona 16.56
9109 Z206 Pergo 16.55	9110 Z266 Buona 16.54 Z206 Poliz 16.58	9111 Z266 Buonarro 2' Z206 Polizian 4'
9125 Z206 Pergoles 2' Z208 San C 16.55	9126 Z208 San Carl 3'	9127 Z202 Cimit 16.56 Z201 S.Alessa 4'
9128 Z266 Buonarro 4' Z206 Poliz 16.57	9129 Z201 S.Ale 16.57	9889 Z208 San Carl 4'

Figure 8 - Example of a set of Display

Each one of the twelve parts of the picture in Figure 8 represents a display related to a bus stop, whose number is written on top (e.g. “9105”, “9107” and so on).

“Z208”, “Z206” and so on are the line numbers; the string following the line indicates the direction of the line; then the number of minutes before the arrival or the timestamp of the arrival are shown.

As far as the way to pursue communication between the central system and the Electronic Displays, once the GPRS link is established, the protocol relies on the following assumptions:

- each Display has an image into the central system, provided by the “Electronic Display Server” software module (see Figure 6);
- as the image of each Display changes, a new stream is sent to the Display;
- the Display applies its feature to manage the content received (multiple pages, scroll and blink management);
- if the Display doesn’t receive a new message within a given time, a watchdog mechanism sets a courtesy message on the Display, until a new valid message is received;
- if the messages are correctly sent to Display but problems arise in the progress of the bus (e.g. bus halted for a traffic jam, disruption in the service, and so on) the central system which generates the messages proposes a courtesy message;

4.1.3.2 Interactive Totem at Porta Castello interchange node

As far as a more complete communication system to be located at Porta Castello is concerned, a vertical interactive totem produced by Samsung will be installed; its functions allow a strong interactivity with users, thanks to touch screen function and built-in speakers.

More specifically, the chosen device is an outdoor solution LCD 46" all in one, catalogued as exclusive DID (Digital Information Display). It is equipped with a PC and network connectivity in order to be remotely controlled via LAN/WAN, and with a high brightness panel.

A conditioning system is included and the totem is provided with a protective glass against vandalism. As an outdoor device, it has been designed to endure rain, snow, heat, dust and difficult environmental conditions in general.



Figure 9 - SAMSUNG Totem 460 DRn -A

The precise location within Porta Castello node is under definition with Rete Ferroviaria Italiana (Owner of the Italian Rail Network).

Through the interactive totem, the following functions will be made available:

1. map of the Urban Public Transport Network, to allow travellers not knowing the city of Monza to understand the Public Transport Service;
2. Travel Planner application, involving the Urban Network of the city of Monza;
3. real time situation at Milan airports;
4. weather forecasts;

Other functions will be evaluated, such as daily news to be acquired by journalistic specialised providers, events planned in Monza or in the Province and so on.

4.2 Main Outcomes

The effective collection of data related to the movement of the buses of the fleet across the city of Monza has been fully accomplished through measure 78; these data will represent the starting point for the implementation stage of the measure. Devices to be installed (electronic displays and interactive totems) have been selected by NET and the Comune of Monza and their functions will be tested during the demonstration activities.

4.3 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.)

4.4 Mitigating Activities

Not applicable.

4.5 Future Plans

According to the updated project work plan, NET has already started inspections on the locations of the 30 bus shelters to be installed. The first ones will be installed along CIVITAS corridor and at the most important bus stops in the city by March 2011. In the same period the wide screen in Porta Castello will be installed.

The proposed technological framework is designed to host other functions that could be implemented in the future, such as:

- software applications to provide information through SMS service;
- software applications to provide information through a Web site;
- installation on buses of screens to provide passengers on-trip information.

Another important possible extension is the management of data related to other Public Transport fleets; in the city of Monza other PT operators are active, as explained in section 4.1.1 where the Regulatory framework has been presented. For these purposes, the DB Realtime Updater server should be fed by data originated by such fleets through specific software interfaces (e.g. Webservices).