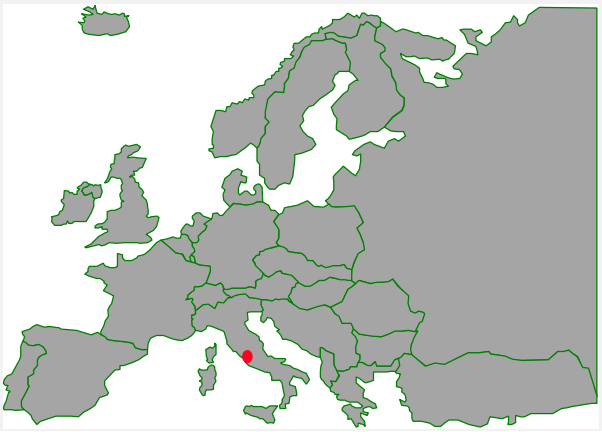
DEMONSTRATION SITE:	ROME/ITALY 
NAME OF THE DEMONSTRATION PROJECT (CASE STUDY):	TRAFFIC DEMAND MANAGEMENT: ACCESS CONTROL AND PARKING MANAGEMENT
DURATION OF THE PROJECT:	24 MONTHS
NAME OF THE TAP PROJECT:	CAPITALS / CAPITALS PLUS

URBAN PROFILE

The region Lazio is located on the West coast of centre Italy. The region, which is dominated by Rome, is the third most populous region (over 5 million inhabitants) and the third industrial pole in Italy. The City of Rome has a population of approximately 2.8 million.

Rome's economy is mainly based on services, including transport, tourism and public administration, which are mainly located in the City centre. The urban structure and the functional distribution of Rome is based on a mono-centric, radial development which reflects the concentration of activities in the geometric centre of the city. This concentration has resulted in the development of a radial system of transport connection, services being attracted towards the historical centre. Because of a lack of adequate ring roads, through traffic requires transit across the centre.

Private motorised vehicles dominate the modal split of the City of Rome: 60% of the daily trips are made via private transport, and only 40% of the daily trips are made with public transport means.

ABSTRACT

The dominance of the private car, the urban structure of the City Centre with mainly narrow and uneven streets as well as the absence of adequate ring roads have led to high levels of congestion and pollution, damaging both the health of the citizens and the cultural heritage of the city.

The City of Rome is aiming to reduce congestion and the impact of air pollution through the development of sustainable mobility policies. Key elements of this policy of sustainable mobility are:

- To improve the offered Public Transport facilities
- To manage private transport demand
- To keep citizens informed on transportation options

In order to achieve a more sustainable transport system, the City of Rome decided to use Intelligent Transport Systems (ITS) as a tool for mobility management and resource optimisation. These applications have been co-funded by the DGXIII of the European Commission in the CAPITALS and CAPITALS PLUS projects.

The first ITS measures that have been implemented were centred on traffic demand management and traffic information services. Demand management is being realised through different but co-ordinated means, from classical traffic control to automatic restriction of access to the historical centre in junction with paid parking.

The key objective of the Access Control System in Rome is the elimination of through traffic in the city centre and limiting access to residents in the so called "Limited Traffic Zone" in the City Centre. Access control in Rome was first realised in 1989 when restrictions were placed on vehicle entrances for the historical centre and was extended to a systematic manually controlled system. The first phase of 25 automatic access control entrance gates will be installed by the end of 1999. This phase will provide the possibility to manage a road pricing policy based upon once a year payment for authorised users. The second phase of all the exit gates will be installed by the middle of 2001 providing the possibility to differentiate between user types and length of stay within the restricted area (road pricing policy). The entire system will eventually handle at least 250.000 trips a day, and a concentration of at least 20.000 of these trips during the peak period. Furthermore, the system is likely to have to handle thousands of violations a day.

Data collected shows that the new automated system is less expensive (-35,5%) than the control performed by the municipal policemen.

The most critical factor of success prove to be the acceptance by the citizenship. Introducing the access control zone in steps, first by closing the centre manually and then by telematic means has been proven a success.

BACKGROUND AND OBJECTIVES

Considering the urban structure of Rome it is clear that the city was not designed for the use of cars. Narrow and uneven roads that do not form a grid pattern make the high level of private car use very difficult to manage. In addition, the city of Rome is lacking adequate ring roads so that even transiting across town often requires trips through the centre. The high level of economic activity in the Centre and at the same time the unfavourable conditions of car traffic has led to high levels of congestion and pollution, consequently damaging both the health of the general public and the cultural heritage of the city. These problems of urban transport were the impetus for Rome's current transportation policy, which aims to avoid, whenever possible, the use of private motorised vehicles.

The key elements of Rome's current policy of sustainable mobility, which aims to reduce congestion, the impact of air pollution, long trip times and high transportation costs, are the following:

- **To improve the supply of Public Transport**: The goal is to strengthen Public Transport so that it is both economically advantageous and competitive with private transport, in order to reverse the current modal split in favour of public transport bringing its share at 60% (with private transport at 40%). It also aims to provide ample public parking facilities, in particular park and ride areas.
- **To manage private transport demand**: The city of Rome has put much effort into the development of demand management techniques, in particular the introduction of an access control area in the historical centre and the introduction of pay parking.
- **To keep citizens informed on transportation options**: Rome's administration has also been developing various means of providing more complete mobility information, both pre-

trip and on-trip for system users, so as to allow each user to make a rational choice regarding the best mode for arriving at his destination.

In order to achieve these objectives the city of Rome has opted for the use of Intelligent Transport Systems (ITS[1]). The focus on ITS was explained with a need to support key mobility management applications, such as the ability to evaluate traffic conditions, to diversify supply so as to meet the varying needs of the users, and to facilitate the use of alternative transportation modes.

The realisation of ITS has been put forward through the development of an ITS Master Plan for Rome, which has been completed in 1998. The Master Plan provides the framework for the implementation of ITS tools from 1999 to 2005.

The Master Plan calls for a realisation in steps. In the first phase, the one being implemented before the year 2000, demand management and mobility information are the main issues addressed.

Demand management is made through different but co-ordinated means:

- Traffic control and traffic monitoring
- Restriction of access in the historical centre
- On-street paid parking (a novelty for Rome)
- Park & ride facilities

Traffic information is provided through:

- Variable message signs
- Traffic information centre (connected to media distributors)

These applications have been co-funded by the DGXIII of the European Commission in the CAPITALS and CAPITALS PLUS projects.

Access control

The key objective of the Access Control System in Rome is the elimination of through traffic in the city centre and limiting access to residents in the so called "Limited Traffic Zone" in the City Centre (ZTL area). The institution of this ZTL area was accompanied by a number of other demand management strategies, such as parking payment.

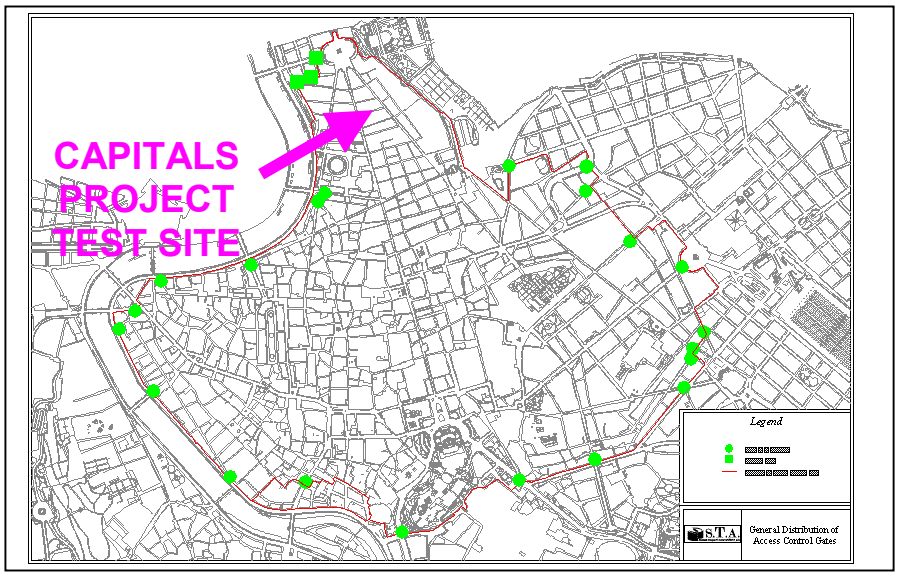
Access control in Rome was first realised in 1989 when restrictions were placed on vehicle entrances for the historical centre. These restrictions were not enforced in a systematic way until 1994 when municipal police were used to block the entrances into the area, entrance being allowed at defined gates. Permission to enter is given free of charge to the residents within the ZTL. Other users may obtain permission to circulate and park in the ZTL area if they fall into certain categories, such as doctors, artisans, etc.

In 1998, this authorisation became more complicated since authorised non-residents are now required to pay yearly the equivalent of 12 monthly public transport passes in order to obtain a permit for the access control area. Furthermore, parking is free for residents (near their home or within their designated neighbourhood) but destination parking is burdensome for both residents and authorised non-residents.

Because of the difficulty in enforcing this restriction of vehicles by the municipal police, Rome, after the test of a prototype, is in the process of implementing an electronic automatic access control system able to:

[1] Synonym: Transport Telematics Applications

- Recognise the vehicle both in entrance and in exit gates,
- Accept the most evolved electronic payment system,
- Manage the authorisation list in an extremely timely fashion (in order to respond to special access needs strongly tied to the cultural and social activities of the historical centre), and
- Initiate the process of violation enforcement, connected in real time to the control centre



Access Limited Area (ZTL)

Paid parking

The introduction of a pay parking system—in particularly valuable historical and cultural areas of the city which suffer from heavy traffic and congestion—is viewed as a primary mechanism for the control of private transport demand. For a long time, Rome's drivers were allowed to park everywhere and at any time. The ensuing congestion problems were correctly assigned to a lack of policy in this area. At the same time, the capacity improvement due to better traffic control and paid parking should not provide incentive to an increase of private traffic demand. The municipality of Rome has introduced on-street paid parking (outside the ZTL) wherever unregulated parking was either obstructing public transport or causing traffic problems and park & ride facilities in correspondence with underground lines peripheral stations or bus terminals.

PRESENT STAGE OF IMPLEMENTATION

Access control

The first step in the realisation of this system was taken during the CAPITALS project, a research and demonstration project supported by the European Union, during which a smaller version of the access control area was equipped with the entire automated system. The area was completely closed by 10 gates, a combination of entrance and exit gates, and five hundred residents were given on-board units with smart card to test the functioning of the system.

In the CAPITALS PLUS project, another demonstration project supported by the European Union, the system is extended to the entire restricted traffic area (ZTL). The complete area consists of 5 km² and will require at least 50 gates in total. This project will bring the development of the on-board unit to industrial production standard (35000 units as a first batch), fully satisfying the access control system's requirements and compatible with the national system of electronic toll collection. The same unit in combination with a pre-paid disposable card will be used to pay for on-street parking. The gate system will be implemented in two phases:

- The first phase of 25 entrance gates will be installed by the end of 1999. This phase will provide the possibility to manage a road pricing policy based upon once a year payment for authorised users.
- The second phase of all the exit gates will be installed by the middle of 2001. This phase will provide the possibility to differentiate between user types and length of stay within the restricted area (road pricing policy).

This division into phases allows for a base access road pricing program until the second phase can be completed in year 2001.

The entire system will eventually handle at least 250.000 trips a day, divided between entrances and exits from the area; and, it will handle a concentration of at least 20.000 of these trips during the peak period. Furthermore, the system is likely to have to handle thousands of violations a day.

Paid parking

The realisation of on-street paid parking is a running programme. With this view, the on-street paid parking has been progressively introduced for a total of 40.000 parking places. Payment is made through different means: tickets bought at parking-meters, pre-paid cards bought in shops and in-car cards. The use of the same on-board unit used for access control (with a smart card, rechargeable or disposable) will be tested in 1999.

As for park & ride facilities, approximately 9500 parking places have been constructed at modal interchange parking areas with an additional 15.000 parking places foreseen in the near future.

Financing and Resources used

Thanks to the Jubilee event, the local government has been allocated 20 million ECU for local transportation planning. This money is being invested into the implementation of different elements, including the realisation of the Urban Traffic Control Centre (i.e. the traffic control system, traffic monitoring system, variable message signs system and CCTV system) and of the Urban Traffic Control Centre, the completion of the access control for the ZTL (approximately 55 gates), and the development of the mobility centre. In co-ordination with ANAS (the national road agency), the completion of the variable message signs and the traffic sensors on the ring road is also planned for the year 2000.

Currently, the completion of the access control system (the entrance gates only) for the historical centre is being funded by national Jubilee funds while the research related issues to the demonstration is being co-funded in the CAPITALS PLUS project by DGXIII.

Cost of Access Control System

1996: Realisation of the system prototype, 10 gates (entrance &exit), control centre (basic functions), technological demonstration & s.w. development (400 equipped cars).	2,5 Meur (750k from CAPITALS Project)
1999: Design and procurement of the full system (phase 1), 29 gates (only entrance), 35.000 on board unit and smart card, control centre upgrading.	4.8 Meur
2001: Design and procurement of the full system (phase 2), 26 gates (exit), control centre upgrading.	3.5 Meur

TECHNICAL PROFILE OF PROJECT

The access control system consists of four parts:

- Local gates sub-systems
- On board unit and smart card
- Communication subsystem
- Control Centre

The *access gates* work together with the *control centre*, to monitor and control access to the historical centre:

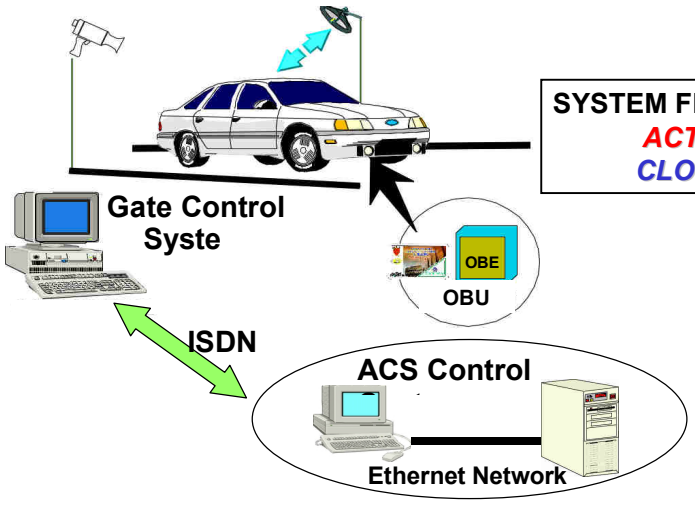
The *On Board Unit* (OBU) initiates the process by transferring vehicle data and assuring all the transaction elements. The unit, composed of a communication unit and a smart card, allows users to access the automatic services and to identify themselves. It informs the driver (visually, graphically, and acoustically) that he is activating an operation about the state of the device. The OBUs house an interface with a card reader, which contains user data and an electronic purse for payment of transactions. The user data resides on a micro-processor smart card, subdivided in pre-registered (fixed) and variable data.

A computer handles communications between the vehicle *(the On Board Unit)* and the *control centre*, containing all the relevant information on user types and the different access schedules; authorised vehicles are checked against the list of permits and if valid the transaction is closed. Otherwise a violation is detected.

The *vision unit/television camera* is a communication sub-system, which acquires vehicle images in the case of violation.

In Rome, the CAPITALS demonstration consisted of the installation of 3 entrance gates near Piazza del Popolo. The CAPITALS PLUS completion consists of a further 22 entrance gates all around the ZTL.

The exact positioning of the gates was based on the minimisation of the environmental and aesthetic impacts of the gates themselves in compliance with legal regulations. This evaluation was conducted by computer simulations and eventually led to the exclusion of several sites which, based on traffic figures alone, would have otherwise been included.The minimisation of aesthetic effects was a critical issue for Rome, requiring the gates to be in relative harmony with the urban context. In Rome, this fact required the selection of the gates to occur in close collaboration with a number of supervisory agencies in order to identify gates which would least impact the artistic heritage of the city.



System Architecture

RESULTS AND IMPACTS

The complete system will result in the largest urban access control system in operation world-wide.

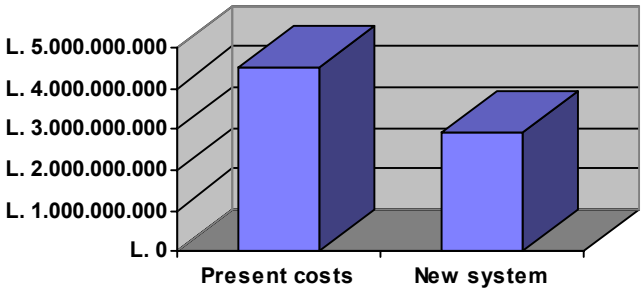
While it is too early for CAPITALS PLUS results, in CAPITALS validation activities, the technical performance of the system has been satisfactorily assessed, in spite of a limited user volunteer response.

Since the CAPITALS application covered just a portion of the historical centre (too small to induce a real modal shift from private car to other transport modes), the impacts on the transport system have been investigated by means of simulation, extending the ACS to the whole historical centre. A simulation model has been prepared to assess the effects of the extension of the ACS to different categories of users: authorised and unauthorised private car users, residents (using the car), PT users, motorcycle users.

Seven scenarios have been investigated according to different pricing policies. The assumption is that the residents and the (currently) authorised car users will be charged every time they cross the area border (leaving the area for the residents, entering for the authorised car users), while an hourly charge will be applied to the remaining car users.

The safety increase is higher with low fares, since in this case the reduction of motorcycle use (much more dangerous than other transport means) is higher.

As regards emissions, CO, VOC and on the other hand NO_x, TPM and FC show different trends, since the first depends essentially on motorcycle emissions (better results can be achieved through low fares), the second on car emissions (and then better results can be achieved through high fares). Besides, low fares would induce an increase of fuel consumption, while a fuel saving can be achieved with high fares.The overall effect on PT use and traffic flow obviously depends on the level of fares.



Cost comparison

Another important result regards the cost reduction for the authorities. Data collected shows that the new automated system is less expensive (-35,5%) than the control performed by the municipal policemen.

BARRIERS AND CONFLICTS

The ability to manage effectively the enforcement of violations is a critical factor in the system's success. Only with this ability guaranteed will the system be considered trustworthy and reliable to the users, eventually developing into user acceptance of the regulation of mobility demand in congested and highly valued areas.

A strong political will is necessary for starting this type of application. Opposition from commercial organisations residing within the access zone was strong in the beginning.

A special problem was caused by legislation requiring the physical presence of a policeman in order to fine the violators. The technology used, being completely automatic, had to be proved as reliable and error-free (rate of error less than human error) in order to make the technologies legally acceptable. On the basis of results of this type, a modification to the Italian Road Code was made allowing such technology to be admissible from the legislative point of view.

TRANSFERABILITY

Access control is under scrutiny from several cities as an efficient tool to overcome congestion and environmental problems. The experience of Rome, as a large city, can be profitable either to cities of the same dimension or to smaller cities. STA as the Mobility Agency of the Municipality

of Rome is co-operating in various European projects aimed at the issue. Results of the Rome application in access control will be available shortly (completion of installation foreseen before the end of 1999) and will be available through CAPITALS PLUS. Results of the CAPITALS demonstration are available through the deliverables of that project. Documents can be requested to the European Commission services.

As for transferability, while in principle there are no obstacles, it is clear that the burden of such systems is on the shoulders of local municipal authorities: financial and political constraints are distinctive for each city and no general rule can be defined. The main thrust is through example and success.

LESSONS LEARNED

The most critical factor of success was surely the acceptance by the citizenship. The fact of introducing the access control zone in steps, first by closing the centre manually and then by telematic means has been proven a success. The residents and those accessing the centre in Rome have long been accustomed to such measures: they had time to appreciate the resulting benefits: less pollution, less noise, parking place availability and increased (and more qualified) commercial interest.

Secondly, it is quite obvious that the technology itself had to be proven, not on an experimental basis but on a large scale demonstration.

The path followed by Rome in introducing the ZTL is then an example for other cities also. The time to arrive at the final system can obviously be shorter and peculiarities of each city could make it different in some aspects. Nevertheless the lessons learned are very valuable.

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Traffic Technology International - June-July 199