



## Technological and Operational Support for Car sharing

Deliverable 2.1 – TOSCA Car sharing System

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## 0 Summary

The hardware and software elements of the Car sharing organisation and the communication system (COCOS), provided by INVERS, are used for the operation of a car sharing system starting with 9 vehicles placed at three car sharing locations in the city centre area of Bologna involving about 100 customers.

In the Bologna pilot application, COCOS will help to provide a reliable, user-friendly and efficient car sharing management by setting up an electronic car sharing booking and accounting system, transferring trip data from car sharing vehicles to the booking centre (for accounting and fleet management purposes), using contactless smart cards to control user's access to vehicles and integrating car sharing and public transport information.

Within the last months of the TOSCA project the following COCOS system elements were implemented:

COCOS 2000 Software for administration, booking and accounting (The billing system set at ATC is also characterised by an OCR system. Vehicles are, in fact, equipped with a specific logbook containing specific forms that will have to be filled out by each car-sharing customer before starting his trip in order to record mileage, time and possible anomalies of the vehicle).

communication system between cars and operative centre including GSM-based onboard computers (Standalone System) for highly flexible car sharing location for each car sharing vehicle;

contactless smartcards for customer identification and keyless entry;

CocoWeb web server software for reservation via Internet.

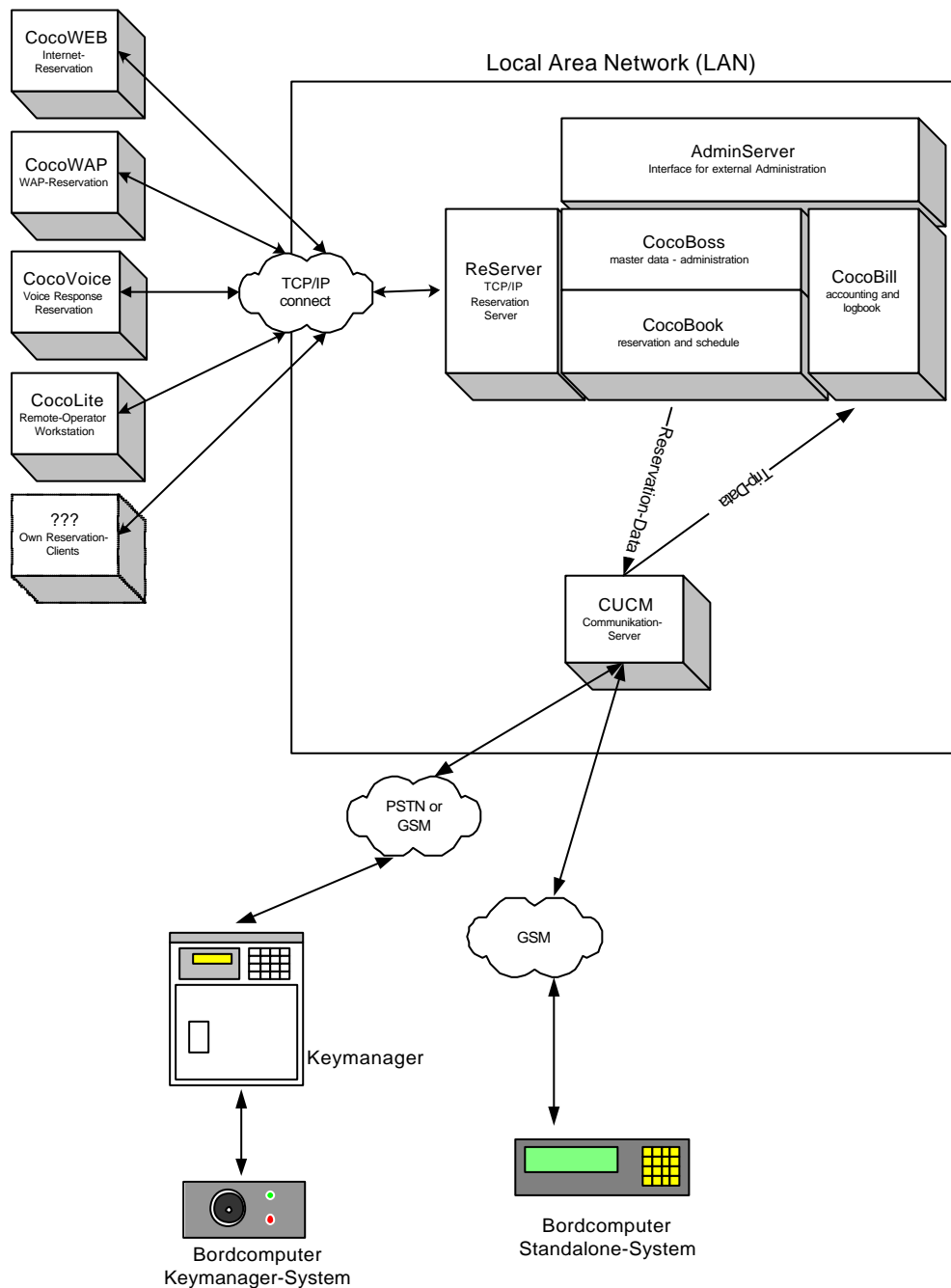
- Final tuning and overall system verification enabled the successful starting of Bologna car sharing real life operation.

# 1 System Overview

An overview of the system conception is given in the following diagram.

The key manager system, which is designed for large centralized locations with more than 3 cars is not yet implemented in the TOSCA car-sharing scheme, but it might be added if required.

## COCOS System overall view



The Standalone System requires no technical ground infrastructure at the location of the cars and also allows flexible, economical set-up of small car sites with only a few cars per site. Typical applications are company carpools branched at various locations and widely distributed de-centralised car sharing locations.

Following the systems characteristics ATC decided to adapt it for the pilot Tosca project.

The COCOS Standalone System gives direct keyless entry to the car with the COCOS contactless smart card. Customers just need to approach their smart card in front of the windshield card reader (Fig.1). The doors are unlocked only for a customer who has made a reservation for this car. The exchange of reservation data between COCOS reservation centre and the onboard computer is performed by a cost efficient GSM Short Message Service. As additional security feature, the immobiliser is released only if the customer enters the correct PIN on the keyboard of the onboard computer.(Fig.2-3)

FIG.1



FIG.2

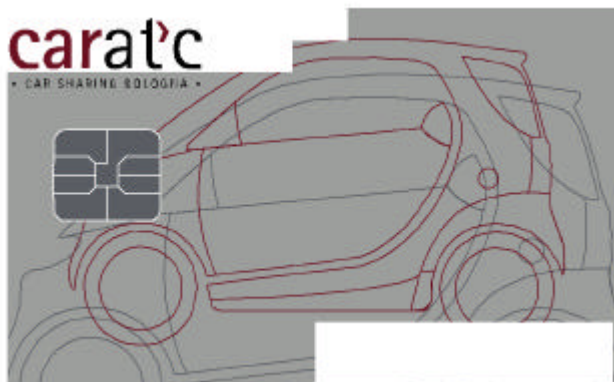


FIG.3



During the trip, the onboard computer records automatically distance and time. At the end of the trip, the onboard computer transmits the recorded trip data via GSM Short Message Service to the billing office. Based on these data, the car sharing accounting software (CocoBill) calculates a detailed invoice for each trip.

ATC vehicles are equipped with a logbook that each user is asked to fill in before starting his trip. All details are entered into a database through an optical reader automatic system and compared to the data provided from the OBC. This is an important device that allows crosschecks in case of discrepancies between data provided by car sharing customers and the accounting system.



ATC provided his customers with personalised cards that carry user personal details such as name, surname plus company, service, Bologna Municipality logos and the EC flag.

## **2 System Installation**

The implementation of the system was performed in 2 major steps. In the first step, the Backoffice System COCOS 2000 was installed on a single PC for test operation. In the second one, the onboard computers were definitely installed into each car.

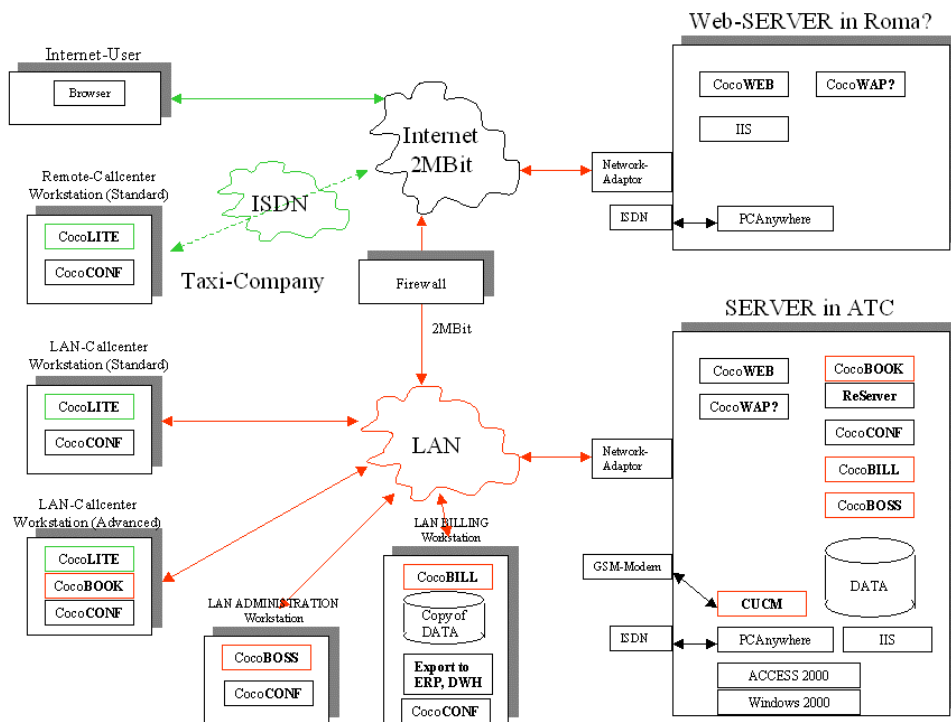
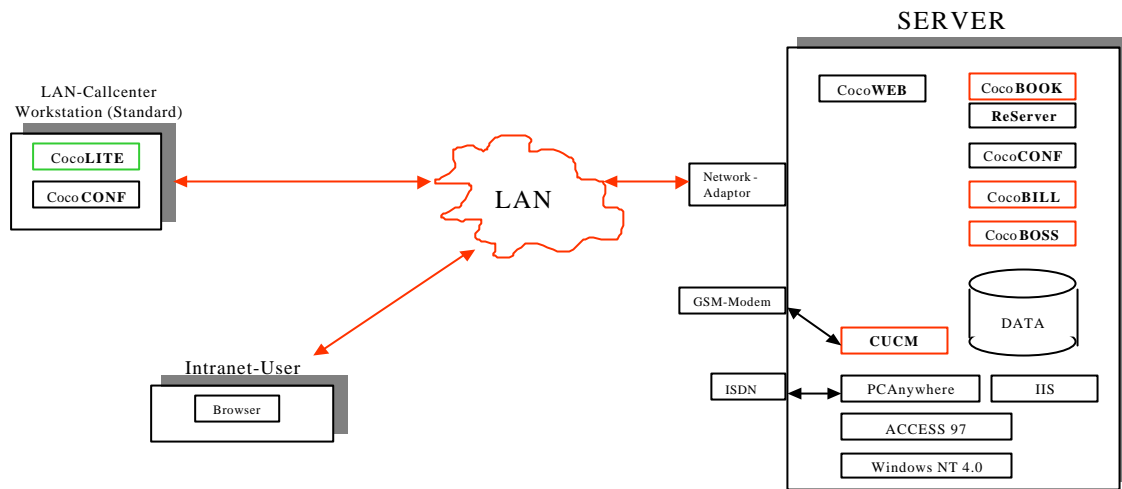
### 2.1 Installation of Backoffice Software:

The installation was made according to the implementation planning. Installation of call centre and administration centre, COCOS 2000 software for administration, booking and accounting and CocoWeb Webserver software for reservation via Internet was installed as well.

ATC sent a PC with Italian Windows NT4.0 and the required components to INVERS. The COCOS'2000 Software Package was installed on this PC and some training and INVERS engineers loaded sample data into the databases. The PC was tested for some days with an automatic reservation load generator before it was sent back to Bologna, meanwhile ATC built up necessary infrastructures (GSM SIMs, telephone lines, permanent power supply etc.).

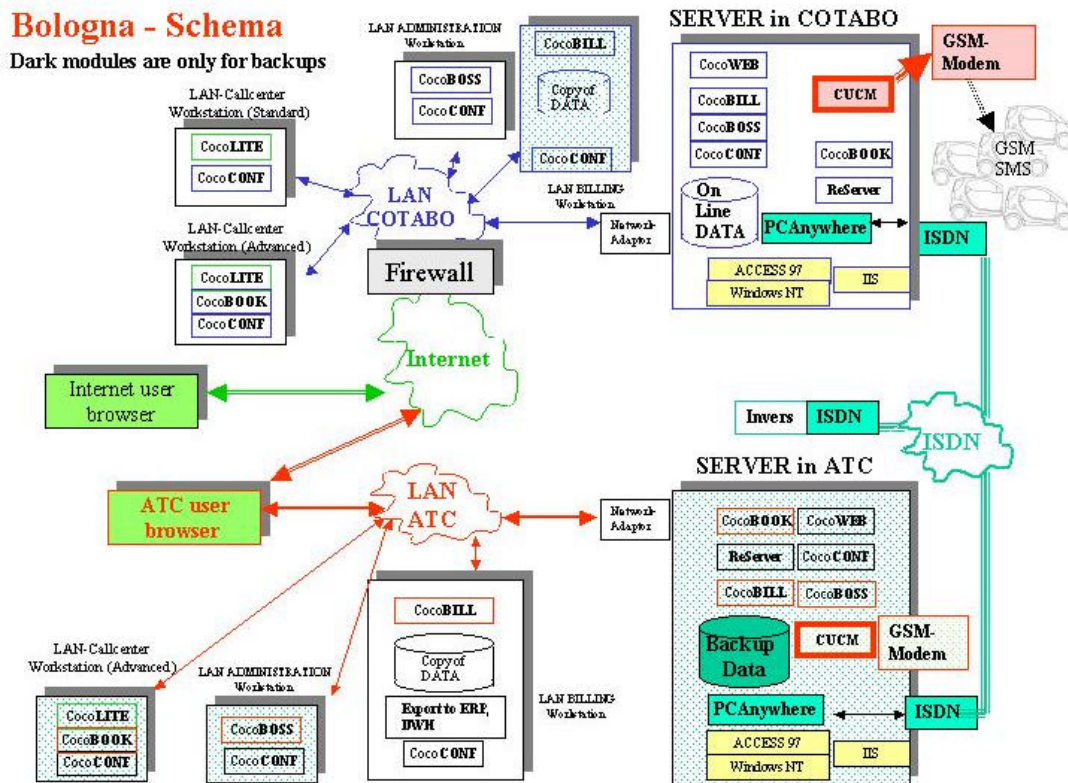
INVERS set up the computer together with the ATC network administrators into the ATC network. First tests and basic training were performed and training data were adapted to the local requirements. Special problems were caused by slightly different handling of short messages in the Italian GSM network.

The first picture represents the starting project plan without adaptation to the one of Bologna.



The above scheme is the first draft of Bologna: a web server at a remote server farm and a spare web server at ATC with the possibility to book from there in case of web server unavailability. As a 24/24-hrs call centre was not possible, it was considered to manage the servers directly on field.

It was then decided to adopt the below scheme with the main server at the taxi operator where the call centre is operative 24/24-hrs instead.



The booking software is located at COTABO (taxi operator) in order to guarantee 24 hrs service a day while at ATC is responsible for the billing activities.

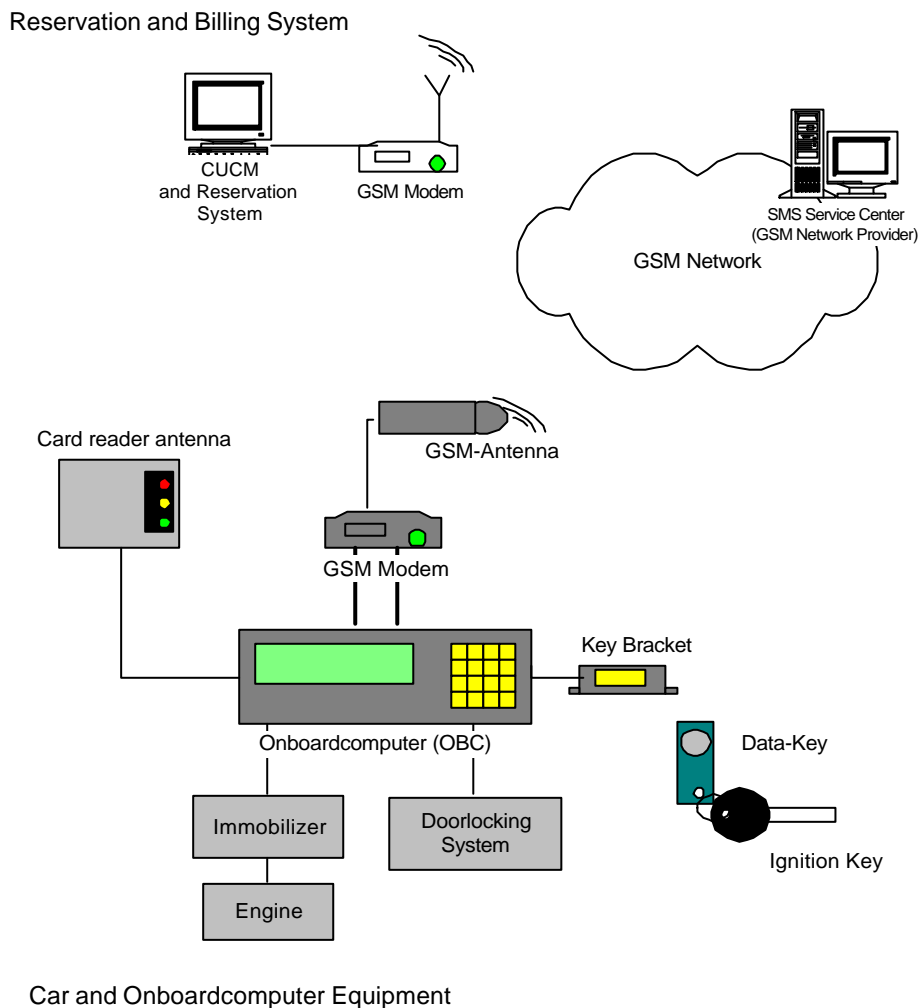
## 2.2 Installation of car-related hardware:

The COCOS Standalone System with GSM onboard computer and smart card readers were installed in nine car sharing vehicles.

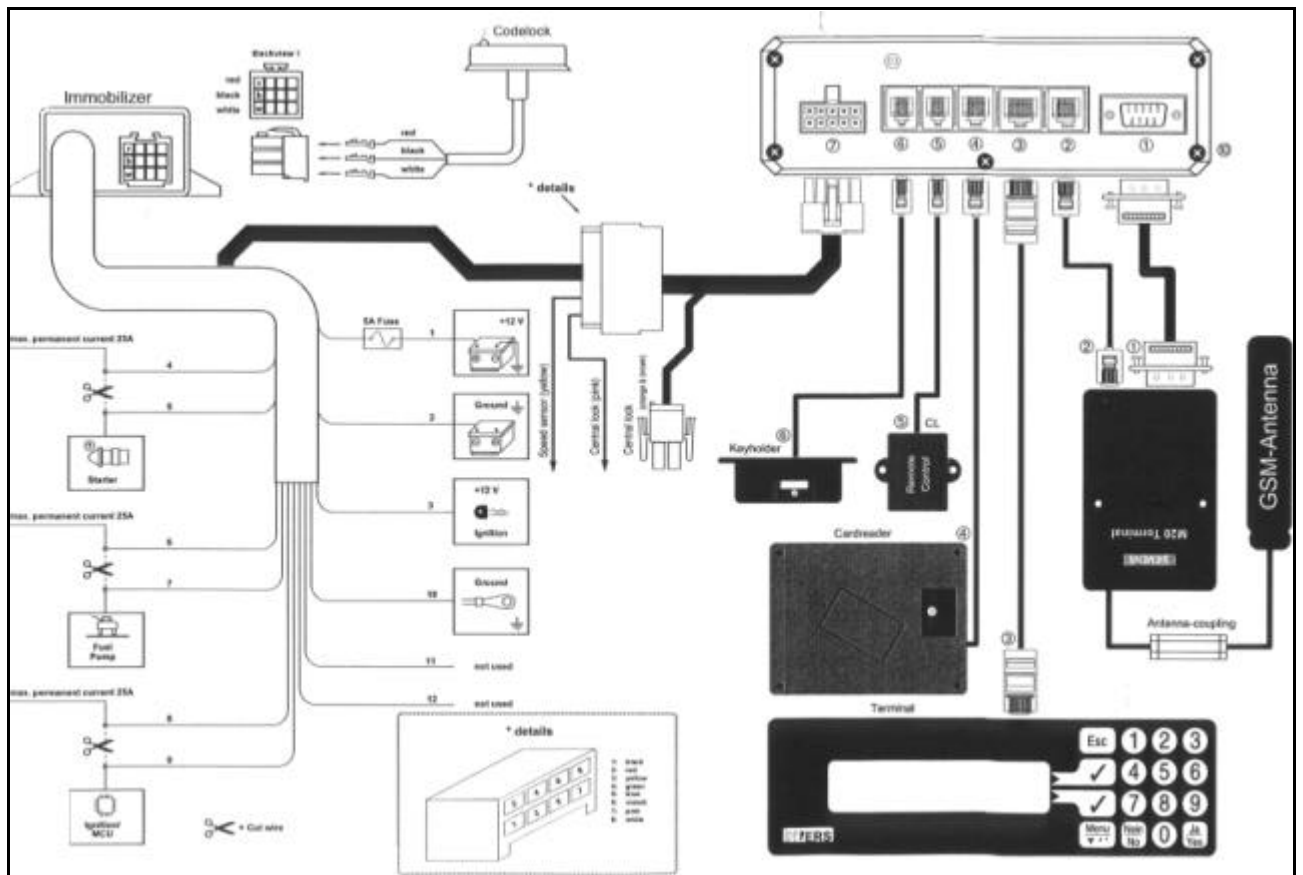
Below it is showed in detail, the components of the Standalone System installed into the cars and the related electric scheme.

The on board system operates with a 12 voltages and it is composed by:

- 1 Onboard computer main unit
- 1 Terminal (with display and keyboard)
- 1 Immobilizer FinTronic
- 1 Card reader antenna
- 1 Keyholder with datakey and fixing device
- 1 Siemens M20 GSM radio module with antenna
- 1 Odometer Kienzle



## Electric scheme



To operate the cars with the standalone system the following requirements are given:

- Cars with central door locking system,
- GSM contract for each car. Tariff "Data and SMS", rechargeable cards of an Italian provider.
- Sufficient GSM field strength at the location

These requirements were fulfilled in the TOSCA experiment.

Detailed installation documentation was produced in order to give general instructions as well as check lists and form sheets to organize and control the installation itself.

On board components installations were conducted from Bologna SMART dealer together with ATC.

During the first installation, INVERS showed and explained to the staff involved in the activity the onboard computer components and their functions. Together they installed the first OBC into the car. Basic settings and functions were also explained.

The first tests were made in combination with the INVERS Reservation Center in Germany. At this time, the ATC Reservation system was not yet needed.

After installing and setting up the first onboard computer instructions on how enter the car-related data into the databases of CocoBoss were given. A test-reservation from the ATC Reservation System was in fact sent to the car. The process of reservation transmission was explained and all functions were tested.

The installation of the second car was carried out by ATC. INVERS checked the quality of installation and explained all error diagnostics. The ATC administrator under INVERS engineer supervision did the set-up in the databases.

The workshop staff and ATC administrator set up the remaining cars. Some initial problems occurred because of wrong parameter settings in the onboard computers and central databases but correct settings were determined with the remote assistance of INVERS.

The installation time of the onboard computer system was about 3-4 hours per car.

Several internal tests were experienced through bookings and simulations of possible inconveniences that could occur to pilot users during Tosca real life operation.

Tests were made among a restricted number of ATC employees. Important and significant information has been collected from their experience and the results gained have been exploited for tuning-up both the car and the OBC (on board computer). These information have then been transferred to the "real car-sharing users" in order to prevent problems from arising during Tosca real operational lifetime.

Here follows the 9 working and operational SMART cars list:

Car Number	Plate number	Status
1	BR 242 HN	OK
2	BR 599 HR	OK
3	BR 600 HR	OK
4	BR 598 HR	OK
5	BR 595 HR	OK
6	BR 597 HR	OK
7	BR 601 HR	OK
8	BR 243 HN	OK
9	BR 596 HR	OK

The cars have therefore been sideways silk-screened with typical project and ATC' s logos while in front of the car a number, which identifies the car itself, has been placed. (See picture below).



The picture below shows a real car sharing location equipped with road markings and road signs.



The three parking locations (Via Zanolini, P.zza Roosevelt, P.zza VII Novembre) have been realised on public ground in accordance to Bologna's Mayor ordinances (see enclosed Annex) which moreover allow "Caratc" vehicles to access to the historical centre. Since 1<sup>st</sup> June 2001 the service is fully operative

### **3 Operator Training**

As the software is friendly and easy to use, a very brief training was enough to allow operators to handle booking successfully.

### **4 System Verification**

#### 4.1 Internal test

ATC checked the system operation in internal use for 5 weeks. INVERS assisted via telephone and e-mail hotline during this time. No system adaptations were made by INVERS, only the tariff model was adapted according to the requirements of ATC.

During the first phase, once the cars were all available with license and insurance, GSM was tested, some problems were encountered because the SIM cards could not work.

The second phase concerned the creation of a user group of about 20 people among ATC staff, and the translation of the interface from German to English and then into Italian.

#### 4.2 First user test

During the tests period only ATC members tested the system and the cars and no serious failures were reported. A first user sample was involved to test the service for 2-4 weeks. Their experience was evaluated and used as feedback for the last adaptations before starting the operational phase. During this phase, also the call centres staff benefited of this experience for real life operation.

In reality, due to the systems easiness, operators' training was conducted on a reduced basis.

To sum up Smart cars have been tested for a total period of 5 weeks before the piloting started. More than 200 trips have been made, about 20 sample users from ATC staff have experienced the system as well as the vehicles refuelling has been carried out with the original prepaid cards.

Both the communication software CUCM 32 and the hardware highlighted no particular problem.

At this stage we can state that there were only minor problems with the kind of car used (SMART) that is highly enhanced with electronic devices integrated in the car structure.

Sometimes there are problems with users forgetting about the sequential gear rules or some details about how to open or close the car.

Some difficulties arose because at the beginning there was only a server for tests and development.

After the installation of a backup server for booking, with backup GSM modem, and a test server the "confusion" about true and false bookings decreased.

The test server is also used for testing the billing procedure in the standard version, that will be integrated with ad hoc procedure at ATC for managing out of standard events and reading with OCR device the on board journal signed by users.

# **ANNEX**

## **Ordinances**

- **Authorisation to traffic limited zones access**
- **Parking area reservation for location "Via Zanolini"**
- **Parking area reservation for location " Piazza VII Novembre"**
- **Parking area reservation for location "Piazza Roosevelt"**