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1 Executive summary

This document will try to briefly show the system proposed for the Citymobil Demonstrator in Castellón, focussing in the vehicles used for the demonstrator and the adaptations made to them. The vehicles chosen for the demonstrator are the Civis-Cristalis of IRISBUS and the Elettrico Panteo U620E from TECNOBUS. One of the main reasons for choosing these two types of vehicles is their technical and environmental features that make them optimal for the test.

The vehicles and the equipment installed at the demonstrator are described throughout the document. The optical guidance of the vehicles and the electrical performance are some of the features that have been developed and adapted for Castellón demonstrator. Also the vehicles lifelong, their capacity, their manoeuvrability, as well as the capacity of integration of the vehicle within the area, have been considered and are described in the present document.

This document also describes other vehicle systems, such as ticketing, EAS and passenger information service. The ticketing system is necessary to implement a way of payment as the vehicle is thought to be driven with the minimum performance of the driver. Therefore, also EAS is described, as a system that helps in the operation, gathering and managing information in order to provide the operator with data that would help him/her make important decisions. Finally the passenger information system provides passengers with a reliable service, providing accurate estimations times.

2 Selected vehicles for the test

The vehicles selected for the Castellón demonstrator are Civis new-generation trolleybuses manufactured by Irisbus Iveco and the Elettrico Panteo U620E from TECNOBUS.

2.1 Civis-Cristalis

The Civis-Cristalis from IRISBUS is a dual-mode system vehicle. This dual-mode system allows the vehicle to run through electric air power supply or autonomous diesel mode. These vehicles have electric wheel-motors housed in the rear wheels: this eliminates bulky components such as the gearbox and driveshaft, thus creating a low, flat floor right along the bus. Castellón's Civis buses have full air-conditioning and Iveco medium-power diesel engines, which provide the necessary power when their trolley poles are not connected to the overhead power lines. The Civis accommodates 22 seats, including two wider seats for reduced mobility people, and a space for a wheelchair passenger, these vehicles are capable to transport up to 78 passengers.



Figure 1. CIVIS bus

Safety has been and is subject of research and development, including electric control equipment that guarantees a safe process of connecting and disconnecting from the aerial power supply. The braking system relies on both electric and mechanical brakes, which allow smooth and safe braking. An optical guidance system allows the vehicle to be automatically driven and achieves ideal performance, reducing times, improving the docking and improving notably the commercial speed. Civis-Cristalis' equipment & materials fulfil the requirements of the European

standard 95/28/CE, being electrically tri-state isolated. The emissions of the thermal engine included in the generator group also fulfil the European safety standards.

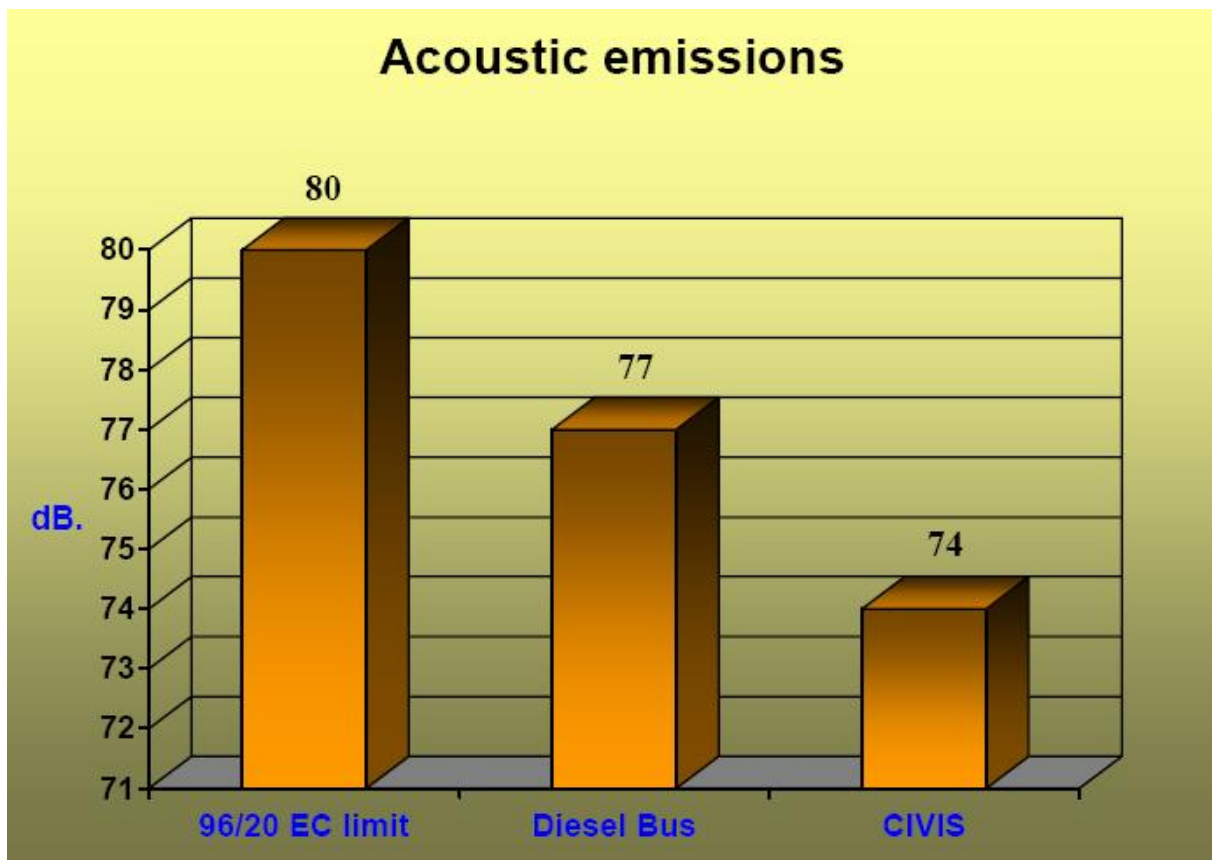


Figure 2. Acoustic emissions. Comparative

Useful Life

Civis-Cristalis is designed to have a useful life **longer than 20 years & 70,000 km/year**.

Capacity

The capacity of the *Civis-Cristalis* vehicles is around:

- 74-78 passengers, including 2 seats for low mobility people and space for a wheelchair

According to different distribution plans, it has been considered from 18 to 23 sittings.

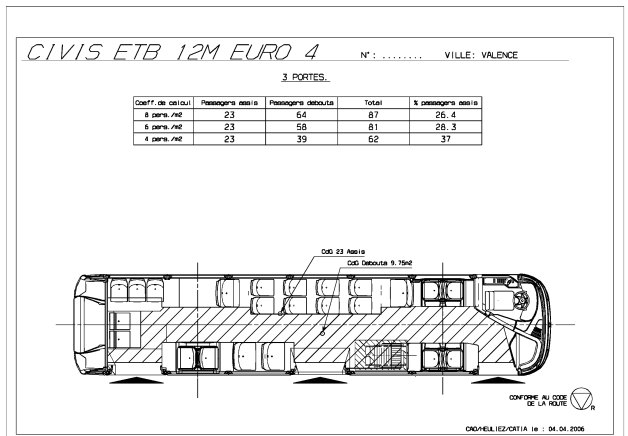
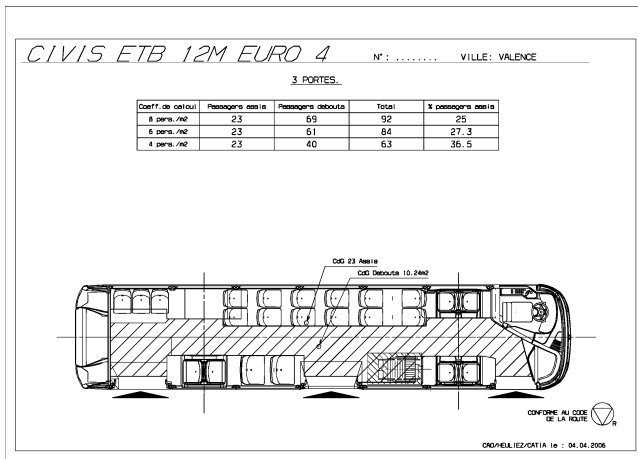
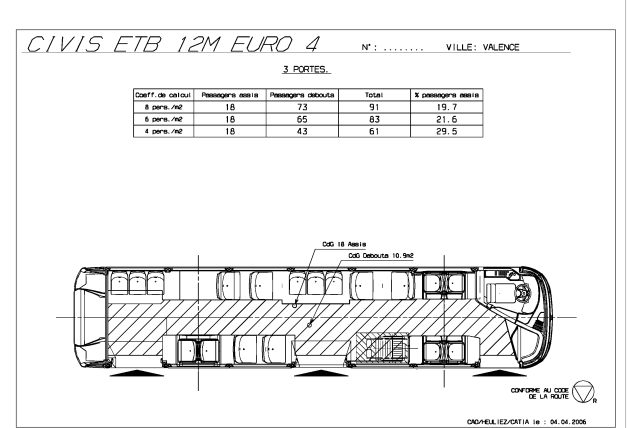
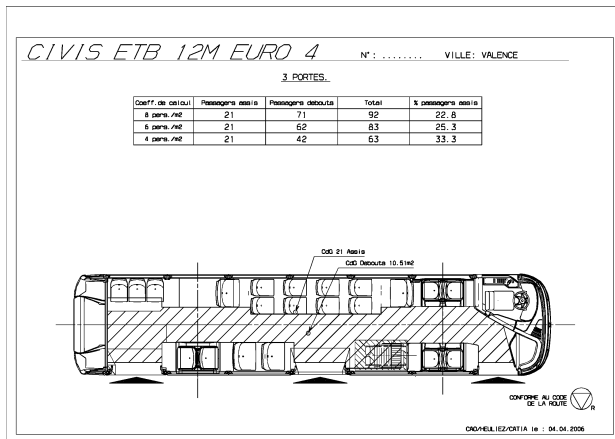


Figure 3. Vehicle Civis-Cristalis

Technical Characteristics

Civis-Cristalis floor is completely flat and low enough to make it easy to move inside the vehicle and to allow the access to and from the bus easily and without unnecessary obstacles such as ramps or steps.

2.2 Elettrico Panteo U620E

This vehicle is used in the city centre of Castellón.

This is an electric battery engine vehicle. Its maximum speed in urban route is 30 km/h. The vehicle is 6.2 meters long and has a capacity of up to 24 passengers including one seat for reduced mobility people.

Fortified by the excellent driving range results already obtained by the vehicles in the base version equipped with acid lead batteries, TECNOBUS has further differentiated its bus models so as to offer its clients quite a number of alternatives. Actually, such fundamental parameter can be considered as almost unlimited, even in practical terms, during the bus daily service, thanks to the exclusive battery pack replacement system which makes that one operator can very easily replace the empty batteries in a matter of just a few minutes and without any special tool other than a pallet truck, even the manual type.



Figure 4. Pantheon in Castellón Demonstration

2.3 Vehicles at the in/out-lane route

The vehicle Civis-Cristalis of IRISBUS introduces three driving ways in the line. The starting is carried out by a three positions switch: (O) Stop, Auxiliary (A) & departure (M). The vehicle also contains a safety system built-up in the driver's door to inhibit traction.

Normal Driving

The driving position is on the left hand side of the vehicle. Two pedals are used for traction/braking actions. The steering is controlled with the steering-wheel. The drive-line is achieved through the acceleration pedal. If the pressure against the pedal is released, the vehicle brakes electrically saving energy to the network. A simple lean against the pedal cuts the traction, activating immediately the electric brake power is directly proportional to the pressure done against the pedal.

Driving in manoeuvre

Forward: a switch in the driver's panel limits the speed. This limitation can vary depending on different parameters.

Backwards: The maximum speed can be fixed electronically.

Autonomous driving

Civis-Cristalis is equipped with a generator group fulfilling Euro 4, that allows 3,5 autonomy hours at maximum power in normal running. One of the main characteristics and advantages of Civis-Cristalis is its connection process to the poles, as the driver does not need to leave his position to perform the operation saving time and risks. The way to perform is as follow: the driver lines up the vehicle in the station according to marks that will indicate poles position where the taper can be found in power supply wires; he pushes a button to raise the poles, and from the drivers screen at the cabin he sees the manoeuvre thanks to the camera situated on pole's base; the taper guides the poles' head movements to contact the wires; a device indicates the power supply and the driver stops the generator group and starts the electrical mode.

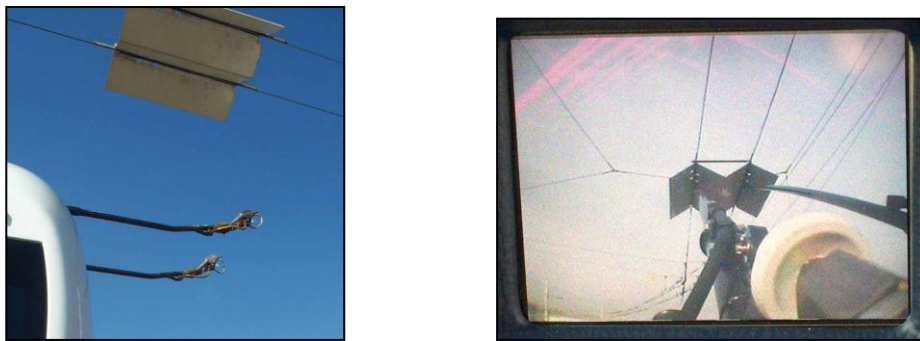


Figure 5. Catenary Connection

3 Vehicles enhancements

3.1 Integration with urban environment

3.1.1 Optical Guidance

CIVIS guided system is an optical guidance that allows following the path automatically by detecting and identifying a white mark on the track and managing and controlling the vehicle's direction, while the driver is only supervising the path and the surroundings for safety reasons. The optical guidance is performed with a camera located on the front-top side of the vehicle. Once the image is received it is analysed with software specially designed to identify the white line on the track. A servo-control device includes an engine that controls the steering wheel with the aim to cancel the difference between the actual trajectory and the ideal trajectory – signalled with the white line-.

To set out the optical guidance, several requirements must be taking into account and defined, since it affects urban environment integration. The comfort performance optimization and safety fulfilment must be analysed as follows: Geometry of vehicles and gates; vehicles' dynamics characteristics Platform height and platform edge profile; line's geometry; stations' geometry; alignment in approximation to the station, etc.



Figure 6. White line for the optical guidance

3.2 Energy

Civis-Cristalis vehicles work with two kinds of energy supply systems, Diesel and electrical power. The electrical power supply is the main supply system, and Diesel is used occasionally for little stretches where it's not possible to use the electrical power supply i.e. To drive the vehicle to the depot and at the end of the dedicated lane where the vehicle has to turn around.

The electrical engine is inside each wheel rim (wider than a normal one). Each engine activates the wheel where it's located giving an optimal drive in an urban environment.

The following figure shows where the group generator installed in the vehicle:



Figure 7. Group generator compartment

Being an electrical vehicle in most of the route, the Civis-Cristalis is a very clean and low emission vehicle. The following diagram shows the level of emissions of the vehicles used in Castellón.

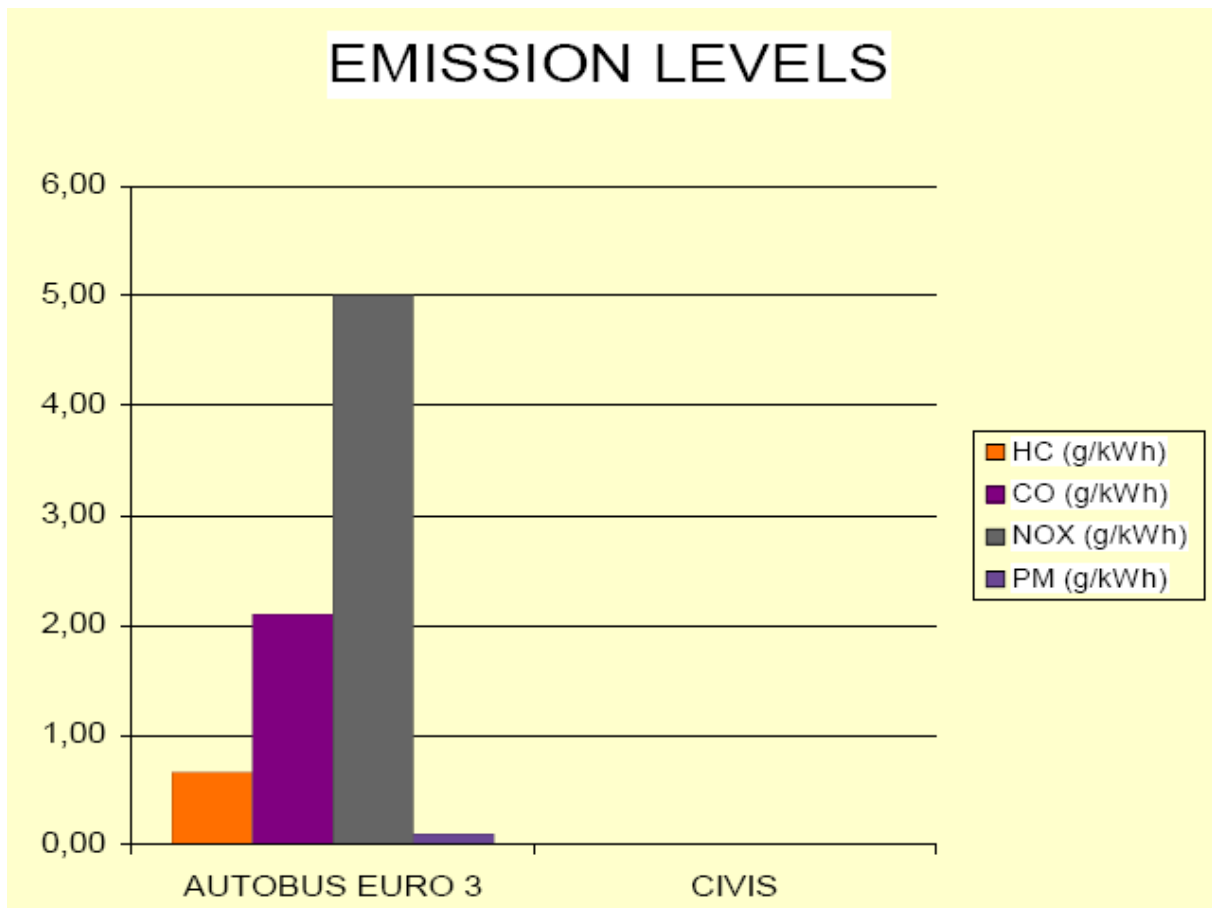


Figure 8. Toxic gases emission levels. Comparative between conventional bus and CIVIS

Safety

IRISBUS vehicle integrates a safe electric architecture. A high voltage transformer is located on the roofline close to the pole's base. This transformer ensures conversion from 750 V cc to 350 V cc, providing at the same time galvanic isolation. This conversion ensures that the whole vehicle is supplied with the correct electric power (pull chain, on-board networks 24 V cc and 230 V ac) and creates a "floating" current, eliminating risk.

The next figure shows how the vehicle's electric safety works.

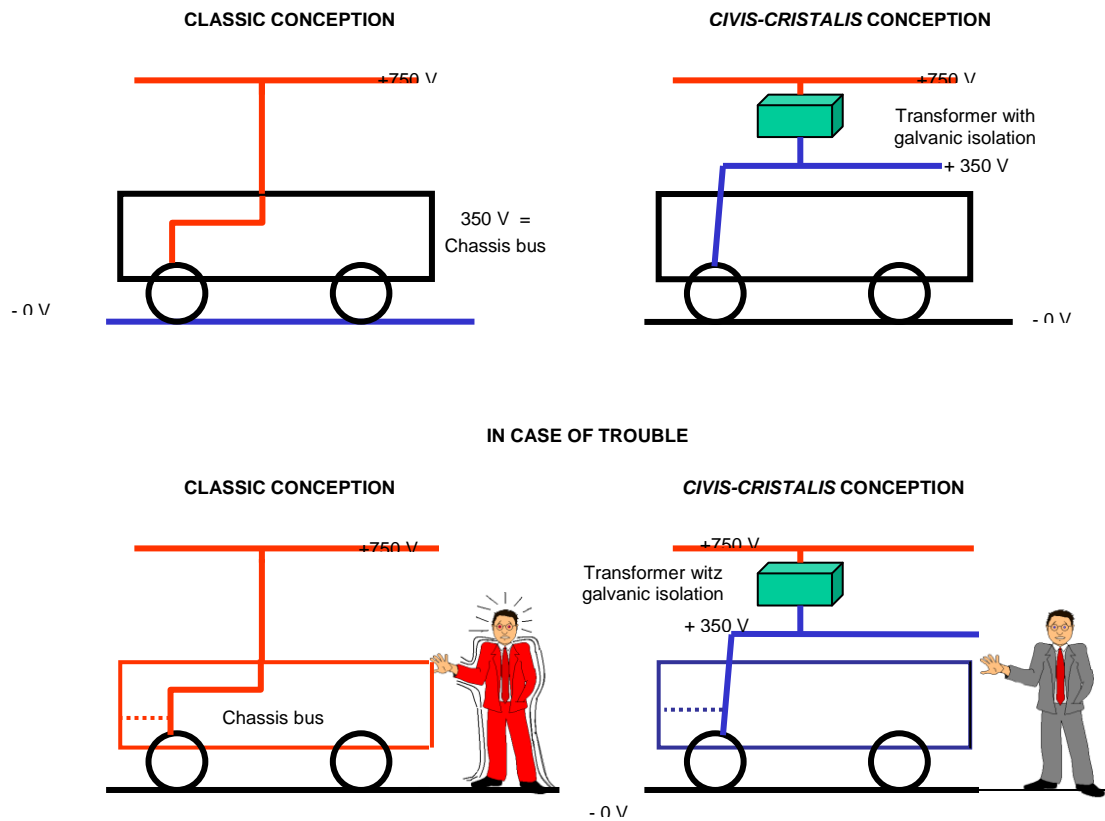


Figure 9. Vehicle's electric safety

The Civis-Cristalis vehicle implements three levels of isolation.

- 750 V cc, aerial bipolar power supply.
- 350 V cc ground
- Ground Bus (MB)

The electrical architecture of the Civis-Cristalis is depicted in the following image.

Cristalis / Civis: Arquitectura eléctrica

Versión Trolebus Articulado

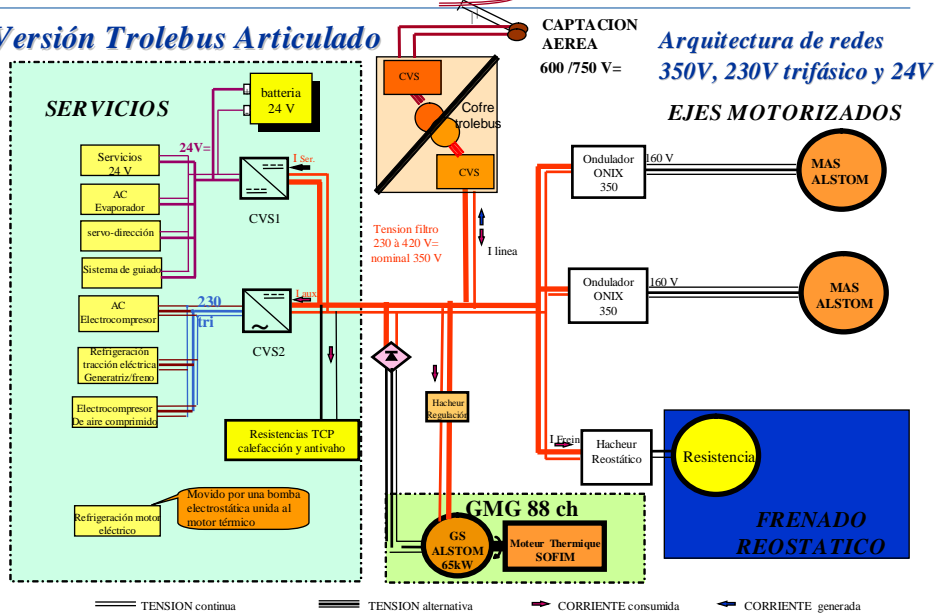


Figure 10. Electric Architecture diagram

The poles of the vehicle have double isolation which is implemented as follows:

Both poles are installed on a specific chassis with a first level of electric isolation between them. Besides, the chassis is connected to the ground, which is isolated from the ground bus (MB).

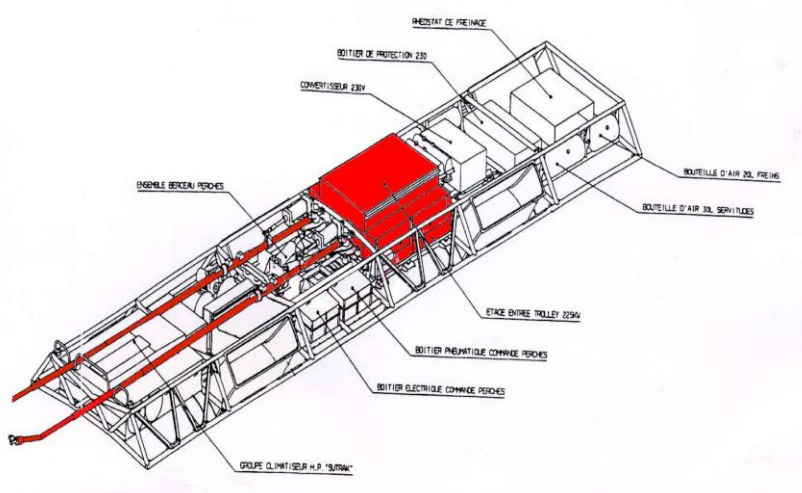


Figure 11. Assembly of poles and transformer with galvanic isolation on vehicle's roof.

Together with the architecture, the vehicle builds a complete electric network surveillance system that works on a preventive way to ensure passengers safety.

Cristalis / Civis: Sist. de vigilancia de la red eléctrica

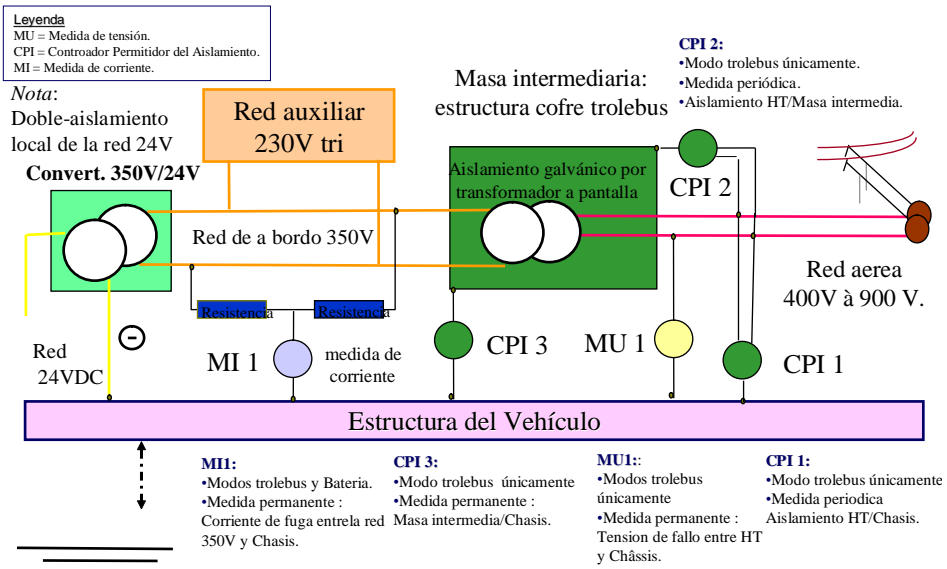


Figure 12. Electric network surveillance system

3.3 Exploitation Aid System

3.3.1 Introduction and goals

The Exploitation Aid System (EAS) is an integral control system applied to the public transport network buses. It provides the resources to know, and manage in real time the status and the available resources of the system. It provides the operators with the appropriate information and executes (or proposes) the necessary actions to optimise the service in short and medium term as well as long term planning. In the same way, it provides the necessary data for maintenance programs, according to the travel conditions and mileage and other statistics reports.

The technical objectives of the Exploitation Aid System are as follows:

- **Management control.** Management is the productive process of the transport companies. In the same way, taking into account the importance of the manufacturing costs in such companies, it is easy to understand the importance of a good Management from the managerial point of view especially since the EAS has already a huge experience working in collaboration with the managerial areas.
- **Resources optimisation.** The appropriate real time management of the resources and the co-ordination with the rest of the management systems of the road network makes it possible to increase the benefit. The consequence will be an improvement of the productivity and a lower cost per kilometre covered.
- **Improvement of Work conditions.** The EAS is an important element to improve the working conditions of the drivers and supervisors. In that way, it provides communication, information, safety and distribution advantages in relation with the exploitation of the lane.
- **Service information.** The data generated by the EAS can be incorporated in the computer system, obtaining therefore a huge quantity of data, either for statistic studies or for staff and fleet management. These data have a very high level of desegregation and reliability.
- **Service planning.** The information generated by the EAS will be used to improve the planning process in a very significant way. The exploitation working parameters (route time schedule, waiting time etc) and the demand behaviour (travellers rising/decrease) knowledge is basic for planning. In that way, the EAS provides the information in a continuous and reliable way.
- **Service quality.** A basic goal of the EAS is to improve the service quality that is both the internal management and the offer to the user. The quality improvement is a mandatory goal inside the maintenance management and the increment of public transport.

The fact that the **EAS** is a modular system makes it possible to adapt the system to the client's needs and makes it a scalable system, allowing to add new components and modules in the future. In the same way, it is possible adapt the system to work with different communications infrastructures either voice or data.

The main operative characteristics of the EAS are:

- **Continuous** real time information of the real exploitation status.
- **Automatic and reliable communication** of different messages types between the control centre and the rest of the elements of the system.
- **Voice communication** between the Control centre and the buses.
- **Reliable location**
- Follow-up of the real time deviations regarding the planning, or the regularity of the service
- Parametrical and **advanced algorithms** and actions.
- **Passengers information** on the real status of the service regarding the aspects affecting them
- Storage and capture of the **automatic statistics**. The statistic data stored can be configured.
- **Complete integration** of the rest of the systems related to public transport fleet exploitation.
- **Damage management** and continuous supervision of all resources and equipments
- **Graphic interface** completely interactive and easy to handle
- **Integrated management** of the structural data
- **Auxiliary exploitation** mediums co-ordination: cars/shop, auxiliary vehicles, inspection staff.
- **Resistance to Failures** by working in degraded mode at different levels.

3.3.2 General architecture of the EAS system

As shown in the following figure, the EAS has a modular architecture that can be seen as a system of the following sub-systems:

- SMC (System Management Centre)
- Communication network
- On Board equipment
- Information software at the stops

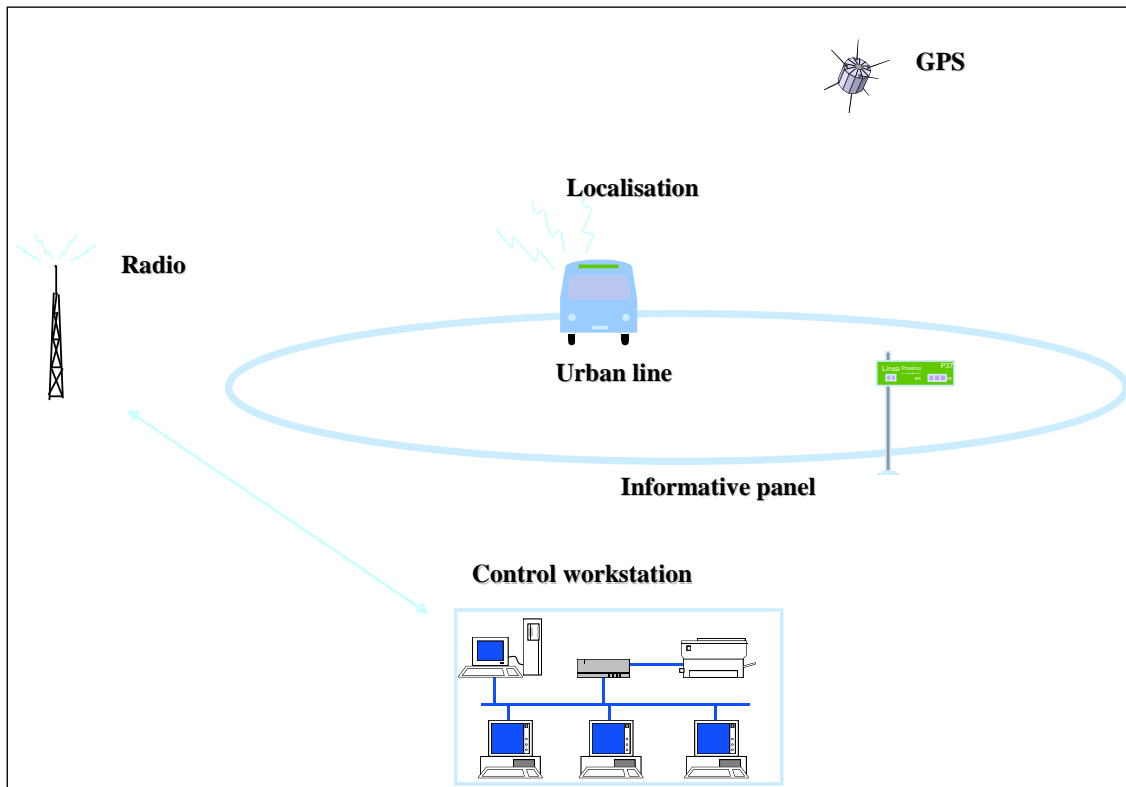


Figure 13. EAS general Diagram

- System Management Centre (SMC):** coordinates the operation of all on board equipment; receives information on the situation of the exploitation, holds information on the programme and takes decisions based on the deviation between the two. It captures and stores data for later statistical analysis. , Mainly, the equipment consists of a network of computers for control, statistics and user interaction, and a high performance storage system.
- Communications Network:** enables transfer information between all components that makes up the EAS. It is mainly made up of the radio and front-end communications infrastructure.
- On-board Equipment:** registers and processes the information of the vehicles, specially their location and mechanical warnings which may occur. Also enables communication between the vehicle and the SMC whether by instructions and coded messages via the driver's console or verbally via the audio radio channels.

3.4 Optical Guidance

3.4.1 Guidance's Principle

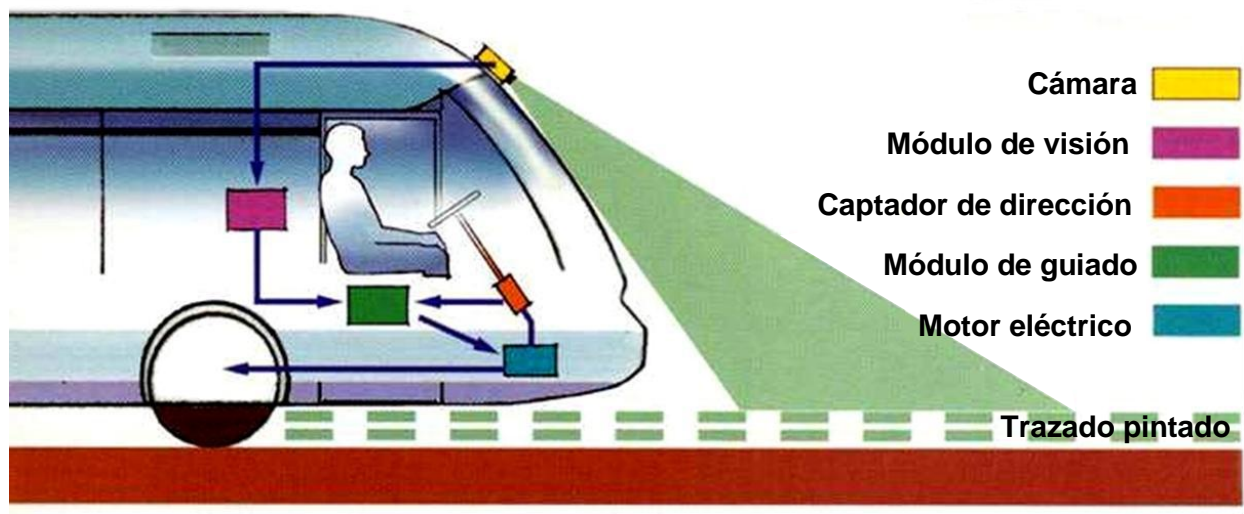


Figure 14. Optical Guidance Principle

CIVIS guidance system is an optical guidance that allows the vehicle to follow automatically an identified path signalled with ground marks, acting against vehicle's direction, while the driver is controlling the vehicle and keeping the itinerary watched.

The reading of the marks is done by a camera located on the front-top side of the vehicle, and is analysed instantly with the aim to set the difference between the real trajectory and the reference one. A servo-control device includes a motor that acts against the steering with the aim to cancel this difference.

3.4.2 Guidance's function

The optical guidance improves the driving operation and therefore the customer services and contributes to offer a high global quality transport system and to make it more attractive and easy to use.

The optical guidance contributes to improve accessibility, comfort, service quality and safety.

- a) Advantages: Passengers accessibility, including disabled people thanks to:
 - Precise docking, close to the platform with small horizontal gaps.
 - High platforms (27 to 30 cm) like the tram, with small vertical gaps.
- b) Offers high quality service thanks to its comfort and the easy access on board. The ground-level transfer between platform and vehicle meets everyone's accessibility needs, especially those of persons with reduced mobility



Figure 15. Access

- c) Offers a smooth and seamless accessibility solution with regards to disabled people. All passengers access the same way.
- d) Offers a reliable access solution no depending on mechanical devices reliability.
- e) Increases commercial speed thanks to rapidity during interchanges and the suppression of mechanical devices manoeuvre times set asides for the access of disabled people.
- f) Increases comfort in curve thanks to an optimized layout through the selection of rail trajectory



Figure 16. Curved Trajectory

- g) Increases safety

- Carries out a system that takes into account the maximum height signals.
- Releases driver responsibilities, reducing their stress and improving working conditions. Besides, its innovative design contributes to identify transport system as a modern way, safe and highly qualify.

Finally, the guided marks and the maximum height sign contributes to the visual line identification, therefore reinforcing its attractive as tram lines, inciting car drivers and motorist to respect the line.



Figure 17. Driver sight (left hand side case)



Figure 18. reserved lane

3.4.3 Guidance Operation Easiness

The guidance specifications consist of its guided system characteristics that allows to carry out most frequent configurations found in the station entrances & exits, offering a transition without rupture between guided and no guided modes, that is, without operation interruption or reduction in benefits.

The optical guidance has been conceived according to ergonomic principles providing him with an easy use and operation flexibility.

This flexibility adjustment occurs mainly to non existing movable devices and its qualities.

- The entrances and exits of the guided areas (with marks) are carrying out fluently without operation interruption or reduction of benefits: From the recorded image, the guidance optical system detects the ground marks and analyses the trajectory. The image processing link to a vehicle behaviour model, allowing the guidance system decides automatically to change the mode manual to a guided mode (and vice versa). Therefore, is the guidance system that informs the driver to control the steering?
- On guided area, the driver has always the possibility of taking over the vehicle's control (i.e. to avoid obstacles, a car or a pedestrian). Going back to the automatic guidance mode is an automatic process that takes place with no interruption, from the moment the driver rerun the vehicle to the signalled path and the driver releases the steering wheel. The optical guidance calculates permanently vehicles' attitude concerning the layout. (The lateral gap and the topple angle).

3.4.4 Guidance system and operation modes.

With the aim to accomplish commitment between:

- Safety demands
- System availability and robustness.
- Simplifying operation process and the interface man/machine.

The different operation modes are based on the following principles:

Operation modes definition:

On route, there are different ways of guidance system operation:

- Automatic guided mode, nominal way, where the transversal vehicle position is controlled by the optical guidance device. The automatic guidance mode is disconnected and the standard manual way is activated each time that driving conditions imposes or in case of mark detection loss, or in areas where a guided operation is no foresee.
- Manual ways linked to: Driver participation (driver control)

- Optical guidance safety function activation that separates the vehicle from its nominal trajectory and entails: A permanent exit from the guided way taking up again manual driving.
- A return to the guided way after a manual transition, limited on length and/or distance, from a request by the driver to the guided return and are accomplished all conditions to allow the use of the optical guidance again.

Guidance states definition:

On duty, the guidance system can be in the following states:

- Out of voltage: the driver has not connected the voltage system.
- Standby: The system is in standby awaiting a guidance authorisation.
- Authorised: This authorisation is eventually automatic when the auto test ends. The guidance system will automatically be activated from the conditions of coming into service (system mark).
- Active: the system guides the vehicle.
- Safety: in safety or in brake-down. The guidance is disconnected.
- Maintenance: The guidance system has detected a maintenance connection.

Guidance system operation:

Functions:

- Generate modes operation and stages with regards to the layout, vehicle's position and driver participation.
- To inform the driver of the consecutives stages and incidental anomalies of the guidance system. The vehicle carries out the information samples.
- Control vehicle's steering to follow the trajectory.
- Check its operation and its interfaces with the vehicle and establish diagnosis that facilitates the operation and the maintenance.

Finally, the operative ways are governed by the following principles:

- The step to activate guidance is automatic, in other words, an initiative of the guidance optical system. After check in the requirements: speed and vehicle's position with regards to the layout, correct reading of ground marks, optical guidance operative and authorise.
- In case of mark loss (end of guided area or anomaly in the mark reader), the optical guidance indicates to the driver the anomaly and the driver takes the control. After a loss, the guidance is in an authorise mode, in this case can return automatically to guidance when all the requirements are accomplished.
- To take up again control (REMC) is always possible and has priority. Is detected by the guidance that cancels its action in the steering column. After a

REMC and to avoid an obstacle, for example, the active guidance return happens after the driver has taken the vehicle to a nominal trajectory that has reauthorized the guidance, and the vehicle has taken up again the trajectory.

If the Guidance Safety System detects an anomaly or a breaking down of the electric power supply, an alarm sign (acoustic or visual) warns the driver. The guidance is isolated and any action is suspended to avoid any undesirable change.

In all cases, the driver keeps the control in coherence with the surroundings:

- Fixed surrounding: turns, crossings, bad visibility, an apparent mark ground degradation a cause of an act of vandalism.
- Variable surroundings: meteorological (rain, fog, frost, snow, side gust) affecting visibility, ground adherence, vehicle stability.
- Vehicle behaviour (wheel deflation, optical guidance breaking down, noise or vibrations indicating a break down, etc.).
- Imminent risk, fixed/movables obstacles on place, including other transport vehicles that uses in common the reserved space and pedestrian passengers too close to the edges of the platform.

Besides the acceleration and brake commands, the driver can, at any time, take up again the driving in manual way and therefore, can leave the nominal trajectory to avoid an accident. So, the intervention of the driver is always a priority.

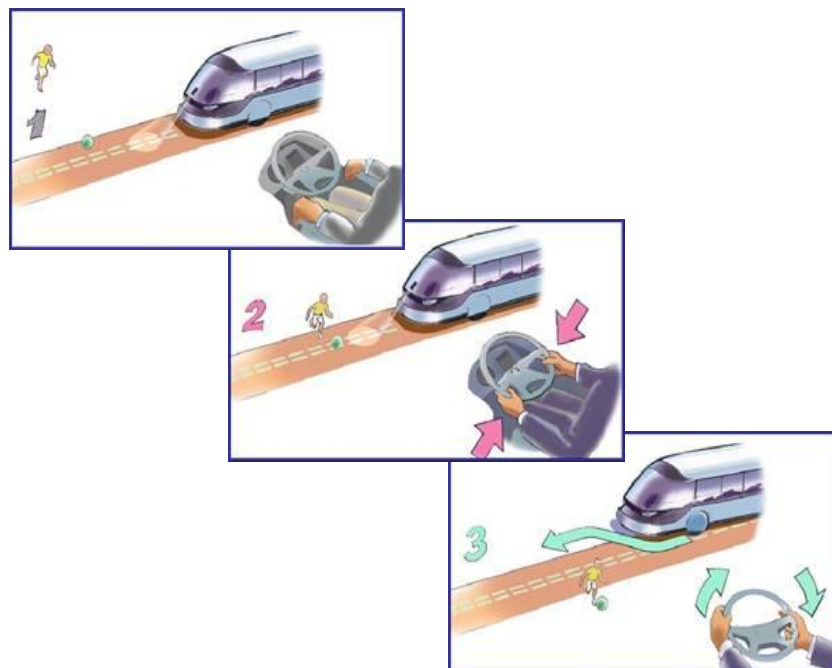


Figure 19. Detour to avoid obstacles in the presence of collision risk.

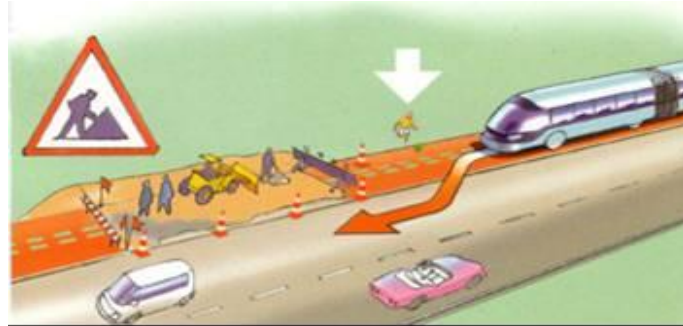


Figure 20. Detour to avoid road works

Interface man/machine

This section refers to interchanged information between the optical guidance and the driver and defines signalling and action ways.

Ways of signalling:

- Signal lamps.
- An acoustic warning (buzzer).
- An acoustic warning (buzzer) and a signal lamp for the alarms that indicates safety mode.

Momentary vibrations on the steering wheel, controlled by the guidance system, confirm at guidance active mode the steering control for the optical guidance.

The location of signal lamps and buttons, the colours and buzzer length where studied to not distract the driver for the primordial mission of on board passenger safety and the surrounding close to the vehicle, in particular in stations access.

3.4.5 Guidance features

a) Precision

The average precision of the optical guidance in straight line, without external disruptions is better than 50 mm.

For a standard platform that fulfils infrastructures specifications, the berthing precision allows horizontal gaps on vehicle 2 door of $40 \text{ mm} \pm 25 \text{ mm}$ to 99% of the berthing.

Regarding with platform configuration, the insertion studies allows defining the best trajectory with regards to the precision of the berthing.



Figure 21. Platform configuration

- b) Robustness Mark detection and guidance algorithms allow ensuring the optical guidance operation in unfavourable conditions.
- At night.
 - Following other vehicle.
 - In case of mark degradation or partially hidden.



Figure 22. Unfavourable driving cases.

The vehicle's guidance is guaranteed to a speed equal or lower to 70 km/h. The step between a manual or guided mode can be carried out to a speed up to 50 km/h. Therefore, the use of the guidance does not affect in any case vehicle's speed.

c) Reliability, availability, maintenance

As it has been shown above, the optical guidance safety is based on the detection of guidance device failures or the interfaces. According to TEOR's figures, the anomalies (failure of a function linked to the guidance or untimely activation of the safety device) are approximately of 1 to 10000 berthing. With a fleet of 38 guided vehicles in operation 4 years ago, only 8 manual intervention for vehicle trajectory control has been carried out in 2005. Besides, the failure of an equipment of the guidance does not stop a manual mode. The availability and reliability of the guidance system are very high.

Siemens provides all resources (training, tools) needed to ensure the maintenance of the optical guidance on site.

3.4.6 Guidance function safety principle.

The paramount in this kind of guidance system is that the driver is always responsible of safety. In particular, he must adapt its speed to adherence and traffic flow conditions.

Constructive measurements are taken into account with the aim to avoid a susceptible behaviour from an optical guidance device to stop the driver controlling the trajectory.

- When the driver takes up the control again (REMC) is detected by the optical guidance device that then interrupts any action in the steering column and advises the driver to carry out a REMC.
- When the optical guidance device is not controlling the steering and/or to follow the trajectory, cuts the guidance engine effort against the steering column and then informs the driver to carry out a manual control.

The driving system is, therefore, equipped with a device that:

- Detects operation anomalies
- In case of anomaly, release the steering (cutting the power supply) and advise the driver.

The detection of anomalies is carried out following two principles:

- Control of entry data validity by comparison between several information sources, being carried out in the safety controller.
- Control of probability and data coherence ensuring the guidance by the secondary controller (safety controller). The control module compares controlled processing data with data processed differently with the same magnitude. If data is very different, a functional anomaly has occurred.

Definition of the safety lane

The safe lane is the lane's width necessary for a vehicle to operate in safe conditions (the rear-view mirrors are within the safe lane, there is no extra room added).

The safe lane is defined during the insertion studies in parallel with the decision of the layout. The surroundings are taken into account when choosing the safe lane.

These surroundings depend on the following (no exhaustive list)

- Vehicle's characteristics: dynamic maximum height sign, manufacturing tolerance.
- Guidance's benefits.
- Wind influence.
- Guidance's anomalies.
- The braking down of the vehicle having an impact against the maximum height sign (blowout, deflate or tire cushion suspension).

The GLO, Maximum Height Sign, corresponds to the safe band shell. It must be materialized to allow the driver to detect an obstacle within this safe band shell.

The Maximum Height Sign reduce also risk of intrusion in place (Bus Line) contributing to:

- Commercial speed quality and frequency awareness.
- Driver's stress reduction.
- Accident risk reduction, improving vehicle's availability and reducing repair costs.

Largeurs de voie double sans poteau

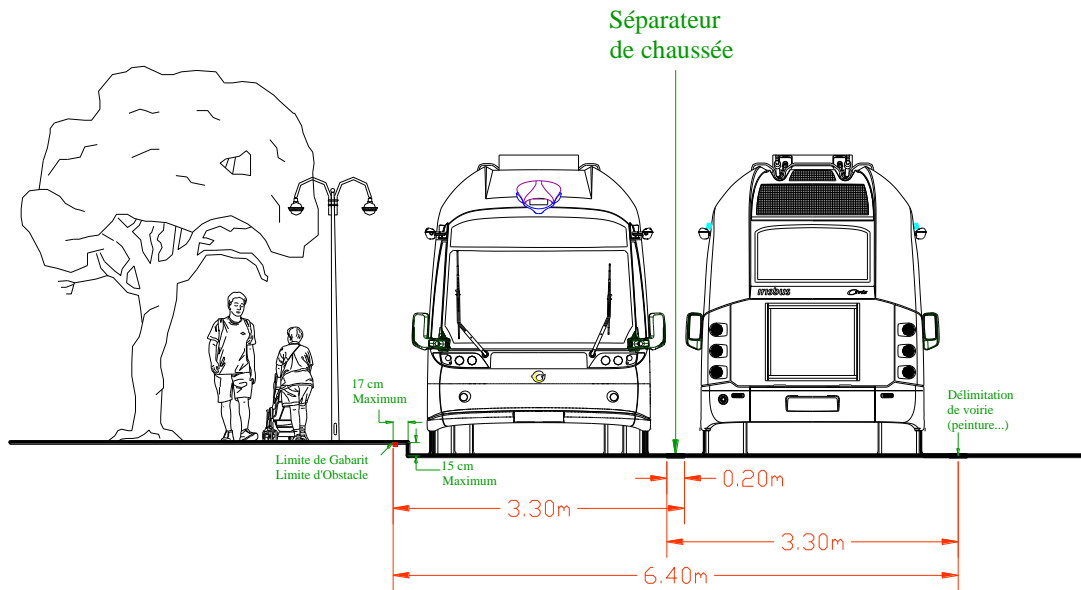


Figure 23. GLO right alignment in urban centre (area of 30 km/h)

3.4.7 Authorisation for the exploitation of the system in automatic guidance system

The authorisation for the exploitation of automatically guided vehicles is similar to the authorisation for the exploitation of a tramline system. The process goes through a safety evaluation of an independent committee, together with a homologation of the vehicle for use in public road, taking into account the automated guidance system features.

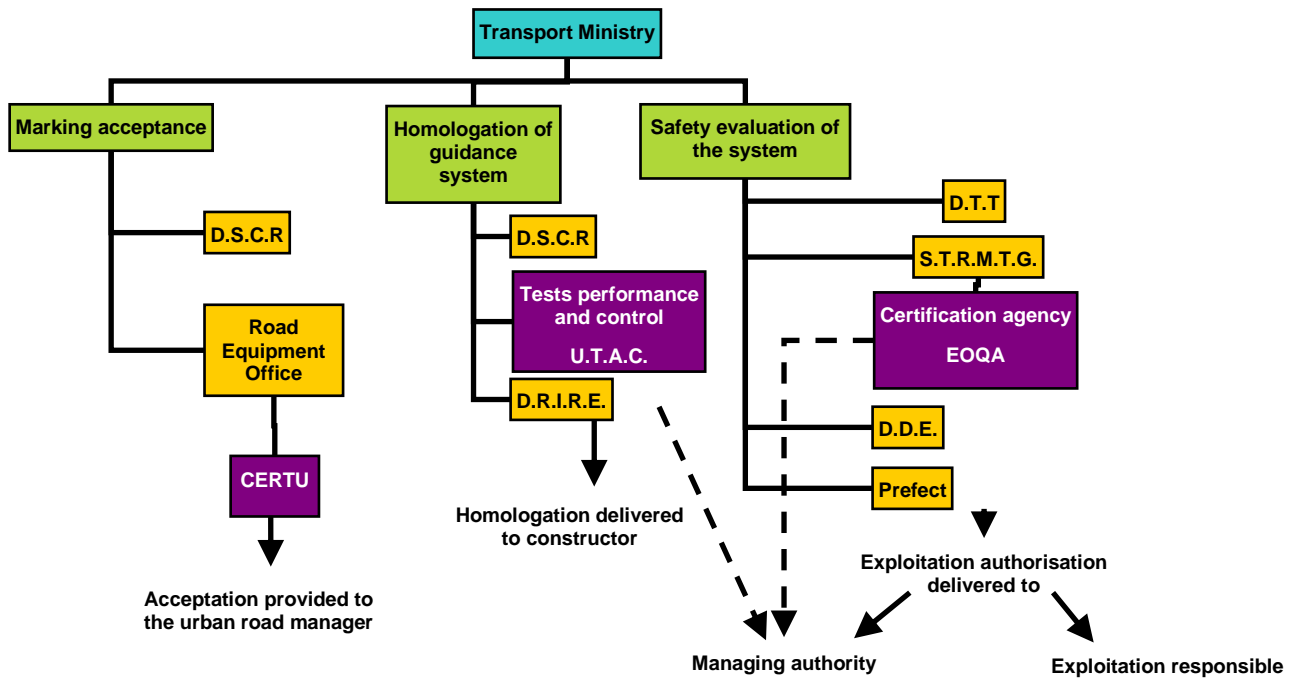


Figure 24. Authorisation process for exploitation of the system

3.5 Ticketing

3.5.1 Management of the ticketing system

Operational Status

The validating software comprehends a series of operational modes which correspond with those of the ticketing machine. This means that, except if there is an incident, the ticketing machine and the validating software are in the same mode.

The change from one mode to another is carried out depending on the entries or system events, as shown below.

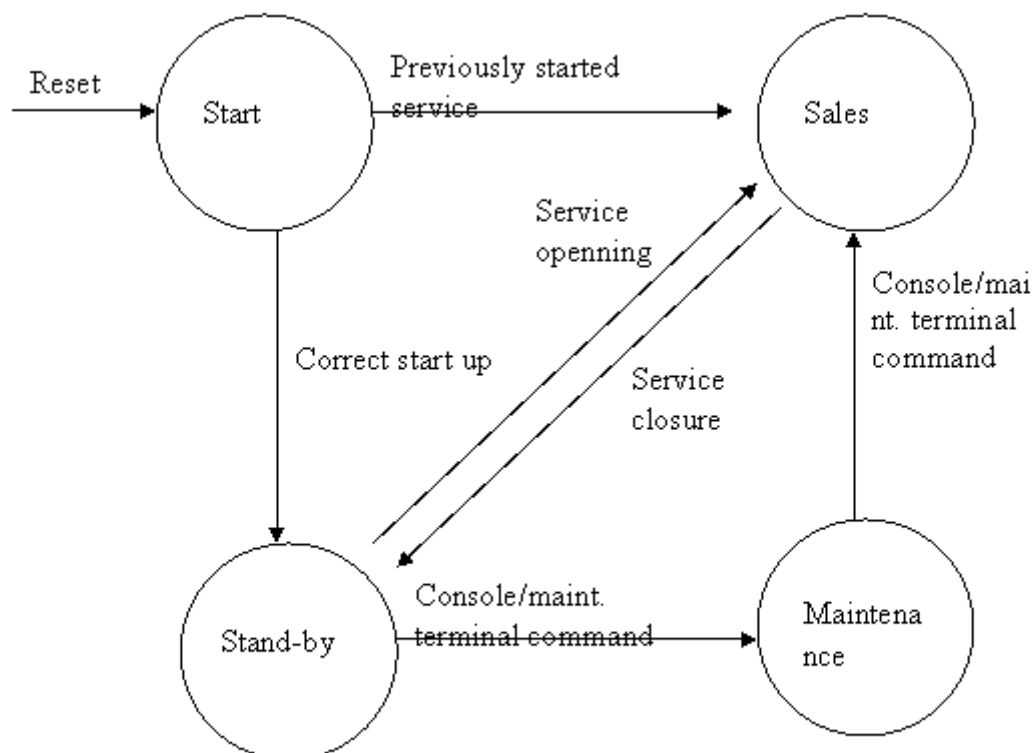


Figure 25. Diagram of functioning of the Ticketing System

This management includes the maintenance of all the primary and auxiliary entities of service, required to complete the process within the DEPOT (Subsystem of the Control Centre). The functions are the following:

- **Configuration of the DEPOT.** It includes the parameters that allow the DEPOT to perform.
- **Description of the equipment.** It allows adapting the name of the equipment to the uses of the customer.
- **Data from the company.** It contains identification data of the company for personalized documents.

- **General Parameters.** Maintenance of the parameters sent by the on board equipment.
- **Master Reports:** It includes the reports of the elements and services of the DEPOT.

Management of fares and transport tickets

It includes the maintenance of the primary entities of fares and transport tickets.

- **Fares.** It keeps the valid prices for the fares and defined types of fares.
- **Transport Tickets:** it includes the configuration of the tickets parameters
- **Zones:** the lines are divided in different zones for statistical reports, obtained from DEPOT and AVMS

3.5.2 Terminal Standardization for Valencia's ETM

In Castellón fee integration is taking place across different modes of transport, involving urban and interurban bus transport operators, metro operators, RENFE tram systems plus local train networks.

The aim for the Entity *Dirección General de Transportes de Valencia* is to achieve a transport ticket (trip ticket, season ticket, etc.) integrated in a contactless chip card that operates across all public transport networks within a specified geographic area, regardless of the transport operator.

To achieve this fee integration, eTM has outlined the technologic specifications that must be accomplished for any company that wishes to supply ticketing equipment.

The on board ticketing systems and vending machines must be able to support the following functions:

1. Contactless card recognition.
2. Internal data update.
3. Information gathering and storage.

The system has to be able to deal with various eTM transport tickets: 30 trips ticket, monthly transport ticket, 1, 2 or 3 day tickets, employee ticket, pensioner ticket....., and has to recognize the various transport operators involved so as to ensure accurate payment for the service they provide.

Besides, it has been necessary to standardize the hardware and software in order to ensure the reliability of fee integration and user acceptance of the system.

4 Conclusions

Through the present document the system proposed for the Citymobil project in Castellón has been briefly described. It has been proven the good criteria used in choosing the vehicle and the system proposed, due to its optimal performance in the required features of the Citymobil project. Aspects as environmental pollution reduction have also been considered to select the systems and equipment described in the document. The system chosen deploys the most advanced technologies in automatic vehicle guidance and regulation systems.