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Scenarios for automated road transport

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1 Abstract

CityMobil is an integrated project in the 6th Framework Programme of the European Union. The objective of the CityMobil project is to achieve a more effective organisation of urban transport, resulting in a more rational use of motorised traffic with less congestion and pollution, safer driving, a higher quality of living and an enhanced integration with spatial development

In the CityMobil project a wide range of terms and definitions is used, based mainly on the project partners' experience in other projects. In order to guarantee consistency throughout the project and to avoid confusion a number of items are redefined.

The same goes for the scenarios that were selected for the different CityMobil sub-projects. During the first year of the project a wider range of applications and interpretations emerged that led to a diversity of approaches. This deliverable serves to ensure consistency of treatment in the commonly applied scenarios, and to explain the differences in application of scenarios which are necessitated by the different sub projects.

2 Introduction

This deliverable's main aim is to define the common scenarios that are used in the CityMobil project, to define the specific scenarios to be considered within each sub-project, and to justify the differences between sub-projects.

Furthermore the advanced technologies that CityMobil focuses on are redefined, the strategic passenger movements in cities to which these technologies might be applied are identified, and the specific road types which need to be considered within each of these technologies are specified.

The reason for adding this deliverable to the list of CityMobil results is that during the first year of the project a wider range of applications and interpretations emerged that led to a diversity of approaches. This deliverable serves to ensure consistency of treatment in the commonly applied scenarios, and to explain the differences in application of scenarios which are necessitated by the different sub projects.

Technology definitions

The original CityMobil description of work uses the following five technology definitions:

- **Cybercars:** small autonomous vehicles for individual or collective transportation of people and goods, for specific areas such as city centres with little or no interaction with other (manual) vehicles.
- **High-Tech Buses:** buses on rubber wheels, operating like a tram on lanes with a light infrastructure using electronic guidance either for automation or for driver assistance.
- **Personal Rapid Transit (PRT):** small fully automatic vehicles operating on guideways to segregate them from pedestrians and other traffic.
- **Advanced City Cars (ACC):** new city vehicles integrating zero or ultra-low pollution mode and driver assistance such as ISA (Intelligent Speed Adaptation), parking assistance, collision avoidance, stop&go, etc. These vehicles should also incorporate access control coupled with advanced communications in order to integrate them easily into car-sharing services.
- **Dual-mode vehicles:** developed from traditional cars but able to support both fully automatic and manual driving. The first applications of automatic driving will be for relocation of shared cars using platooning techniques but these vehicles could become full cybercars in specific areas or infrastructures. Dual-mode vehicles represent the migration path from traditional cars to automatic driving.

The last two definitions in particular gave rise to confusion. This document will redefine the technologies in order to avoid further confusion. It must be stated however, that the definitions are meant to support clear and concrete discussions within the CityMobil project. They are not meant to put all possible advanced transport systems into exclusive categories with boundaries that may not be crossed. In fact many mixes between technologies are possible and the purpose of the new definitions is certainly not to exclude systems from consideration that do not fit into one of the defined categories.

Common scenarios

It appeared very soon after the start of the project that the different objectives and characters of the sub-projects required more detailed scenarios that were not always 100% common between sub-projects. These differences between the scenarios that the sub-projects used were noted by the project partners and the formal project reviewers and stimulated a discussion about the coherence of the definitions used in the project. This deliverable aims to present the different scenarios, explain the differences and show how they all fit together in a logical and coherent way.

3 Definitions of the five technologies

In this section the technologies, as included in the CityMobil Description of Work are redefined in order to create more clarity about the differences between the systems and their boundaries. As stated before, the definitions are only to help the discussion, they are not meant to exclude systems that do not fit in.

1. Cybercars

Cybercars are small automated vehicles for individual or collective transportation of people or goods. Cybercars have the following main characteristics:

- Cybercars offer a fully automated on demand transport system, meaning that under normal operating conditions no human interaction is needed
- Cybercars can either be fully autonomous, or make use of information from a traffic control centre, information from the infrastructure or information from other road users.
- Cybercars are small vehicles, either for individual transport (1-4 people) or for transport of small groups (up to 20 people).
- Cybercars can either use a separated infrastructure or a shared space. In theory there can be interaction with other road users, but the present state of the art limits their use to specific areas such as city centres with little or no interaction with other road users.

2. High-Tech Buses

High Tech Buses are buses on rubber wheels, operating more like trams than like traditional buses.

High Tech Buses have the following main characteristics:

- High Tech Buses are vehicles for mass transport (>20 persons)
- High Tech Buses use an infrastructure, which can be either exclusive for the buses or shared with other road users
- High Tech Buses can use various types of automated systems, either for guidance or for driver assistance or for other purposes
- High Tech Buses always have a driver, who can take over control of the vehicle at any time, allowing the vehicles to use the public road.

3. Personal Rapid Transit (PRT)

Personal Rapid Transit (PRT) is a transport system featuring small fully automatic vehicles for the transport of people.

PRT has the following main characteristics:

- PRT operates on its own exclusive infrastructure. There is no interaction with other traffic.

- PRT is fully automated, meaning that under normal operating conditions no human interaction is needed
- PRT vehicles are small with a capacity usually limited to 4 to 6 persons per vehicle
- PRT offers an on-demand service, where people are transported directly from the origin station to the destination station without stopping at intermediate stations, without changing vehicles and ideally without waiting time.

4. Advanced City Vehicles

Advanced City Vehicles are new city vehicles integrating zero or ultra-low pollution mode and driver assistance such as ISA (Intelligent Speed Adaptation), parking assistance, collision avoidance, stop&go, etc. These vehicles could also incorporate access control coupled with advanced communications in order to integrate them easily into car-sharing services.

Advanced City Vehicles have the following main characteristics:

- Advanced City Vehicles are small vehicles, developed for use in urban areas
- Advanced City Vehicles are equipped with advanced electronic systems for driver assistance or for fully automatic operation

Advanced City Vehicles can have the following characteristics in any possible combination:

- Zero or ultra-low pollution mode.
- Driver assistance such as ISA (Intelligent Speed Adaptation), parking assistance, collision avoidance, stop&go, etc.
- Access control coupled with advanced communications in order to integrate them easily into car-sharing services.
- Advanced City Vehicles can be either part of the public transport system or private vehicles.

5. Dual Mode Vehicles

Dual Mode vehicles are developed from traditional cars but are able to support both fully automatic and manual driving. The first applications of automatic driving will be for relocation of shared cars using platooning techniques but these vehicles could become full cybercars in specific areas or infrastructures. Dual-mode vehicles represent the migration path from traditional cars to automatic driving.

Dual Mode vehicles have the following main characteristics:

- Dual Mode vehicles are standard vehicles, suited to drive on public roads.
- Technology to enable both fully automatic and manual driving (Dual Mode Vehicles). In fully automatic mode Advanced City Vehicles operate as Cybercars.

4 The strategic passenger movements

The passenger application scenarios were developed from the viewpoint of passengers in CityMobil deliverable D2.2.3. In that perspective, technological details of vehicles do not matter, only the passenger functional aspects involving the interaction between the passengers and the vehicle are of relevance. With a systematic approach, so-called mobility concepts are derived, as is shown in the figure below. The three main determinants are:

- The availability of transport: private or public
- The use of vehicles: individual or collective
- Whether a vehicle is driven in automated mode or not.

The resulting mobility concepts are linked to the five technologies in Section 3.

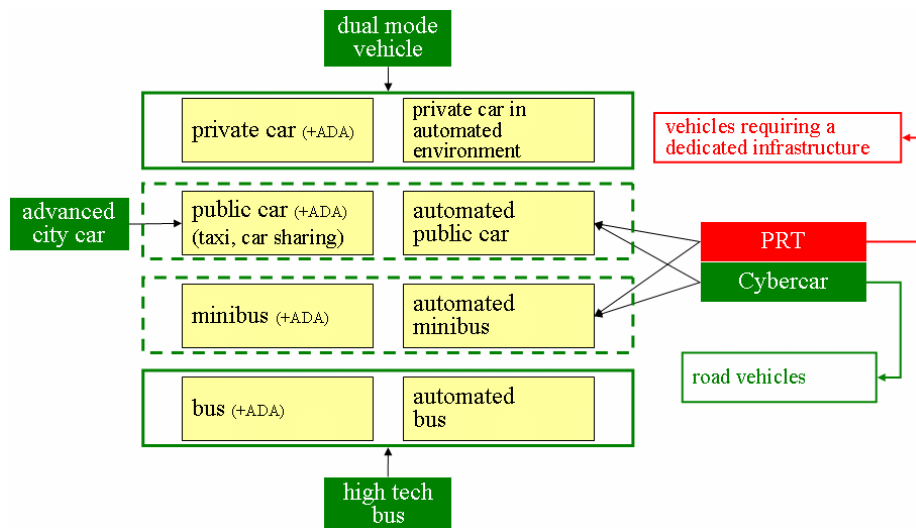


Figure 4.1: linkage of mobility concepts with the five advanced vehicle technologies

When placing a mobility concept in a type of service, and a specific urban area, the passenger application scenarios arise. The application scenarios in the table below were identified in CityMobil deliverable D2.2.3 as the most promising applications for each technology.

Table 4.1 Passengers application scenarios

Mobility concept	Passengers application scenario
Advanced city car	Car sharing outside the city centre in dispersed crowded environments
Cybercar	New form of urban public transport in crowded city centres
	Feeder for high quality public transport in low density suburbs
	Shuttle between parking or major transport node and major facility (e.g. shopping centre)
PRT	Inner city transport system where building underground is not an option
	Shuttle system between parking and airport terminal or event hall
	Inside major transport node connecting the different transport systems
High-tech bus	Connection between city centre and suburbs or major facility in adaptive city growing rapidly
Dual mode vehicle	Dedicated highway for automated vehicles in order to access the city more rapidly
	Sharing the track of cybercar systems in crowded city centres

5 Road Classification

The various application scenarios identified in each SP refer to many urban environments, which are not usually uniquely defined. The EC has adopted different classifications of roads, leading to different road categories.

Therefore it is not possible to make reference to unique road categories. However, for the purpose of CityMobil project, a common understanding of the scenarios is desirable; so the following common definitions of road categories are proposed.

The following classification is based on technical and functional characteristics, rather than for administrative purposes or for navigation purposes.

Motorways (freeways, highways)

At the top of the hierarchy are limited access roads freeways or motorways, including most toll roads (sections passing through or close to major towns and cities are usually free).

These roads have grade separated junctions to provide largely uninterrupted travel, often using partial or full access control, and are designed for high speeds, typically up to 120 kph . Two carriageways, each with 2 or more lanes,, are separated by a median fitted with crash barriers; there is an often slightly narrower lane next to lane 1, which is usually only to be used in cases of an emergency. Cyclists, pedestrians, mopeds, very slow vehicles and certain other traffic are banned.

Main roads

(e.g.: A road or Primary Routes in UK, *Routes Nationales* in France, *Strade Statali* and main extra-urban roads in Italy)

Extra-urban roads were the highest hierarchy level connecting the major and minor cities in countries, before the building of motorways. They are usually dual carriageway, with at least two lanes for each carriageway, but the junctions are not all grade-separated and there may not be a central reservation with a crash barrier. They may also be available to cyclists, pedestrians and mopeds etc., though like motorways, some Main roads may be equipped with service areas, including stopping places, and may be connected with deceleration and acceleration lanes. Speed limits vary but can be up to 120 kph.

Secondary extra-urban roads

These are generally single carriageway roads, with at least one lane for each direction. They usually connect minor towns and villages. Speed limits are typically up to 90 kph.

Urban arterials

These are usually dual carriageway roads; the carriageways are separated, often with traffic islands or medians, and have at least two lanes each, with a possible further lane for public transport (eg bus or tram). Speed limits are typically up to 70 kph.

Urban arterials are generally provided with pavements for pedestrians. Level intersections are usually controlled with traffic lights.

District roads

These serve as collectors in residential areas; they are usually single carriageway roads with one lane in each direction, and provided with pavements for pedestrians.

Local streets

This category includes most minor collectors, roads in areas with few outlets, low-speed neighbourhood streets, most indirect routes, alleys, dead-ends and side streets.

A local street is a street that intersects a district road and ends there. It is generally of little importance to through traffic. Being 'the last mile' of the road system, it generally carries little traffic. Common characteristics of a local street include low speed limits (usually not more than 40 km/h), kerbside parking, and few or no painted line markings to display lanes.

Most local streets are lined with residential development. Occasionally, a place of worship or a school may be located on a local street, but in a residential area, it is rare to find any commercial development (this is often prohibited by local zoning laws, unless directly adjacent to a major street).

Local streets are mostly intended only for the traffic of their residents and visitors. However, local streets that are not dead-ends may be used for rat running by motorists in congested areas.

Special lanes

E-lane

In general, a lane equipped with specific means or specially designated for automatic driving. The means of equipping can be optical or magnetic markings, RF beacons for communication, portals for access control, etc. Alternatively, the lane may simply be identified in terms of co-ordinates that can be followed by an in-vehicle navigation system and designated on the ground using only road signs and markings.

Vehicles operate in automatic mode with control systems for lateral and longitudinal control, according to strategies that assure constant speed and safe headways in platoon operation, and may follow directives received from the roadside eg speed limits from roadside beacons or guidance transmitted from a traffic control centre.

Closed or dedicated E-lane

A dedicated E-lane is a lane reserved for authorised vehicles, e.g. fully automatic cybercars, PRT vehicles or dual-mode vehicles in automatic mode, which in general are equipped with interoperable systems, in order to perform common driving strategies.

Open E-lane

An open E-lane is an e-lane that can be used by conventional, non equipped vehicles as well as automatic vehicles. This form of operation is proposed as an introductory phase to introducing dedicated E-lanes, and could be useful if road operators need to increase the use of the available road capacity. Probably, a means of access control, such as tolling, would be required to manage the use of the open e-Lanes by conventional vehicles.

Note

- a) Regarding road classification, only urban arterials, district roads and local streets, are of strict interest for CityMobil, although the main roads and motorways entering urban areas will be considered for the purposes of investigating the open E-lane concept.
- b) Some less relevant (with respect to CityMobil purposes) roads are not considered, e.g. service roads, rural roads, bicycle and pedestrian roads.
- c) The lanes dedicated to cybercars can be considered as e-lanes also.

6 Common application scenarios

During the first 12 months of the project various scenarios were investigated, based on the expectations for the best chances for success and the highest expected contribution to solving the urban mobility problems. Those discussions led to a number of common scenarios that either were deemed to have the best chance for implementation in the short or medium term or that were interesting for the longer term. These common scenarios were the basis of discussions in the sub-projects and led to a number of specific scenarios. In most sub projects the common scenarios were modified and changed to fit the needs of the particular sub-projects best. Where the specific topic of the sub projects demanded this, scenarios were selected that had no direct matches in other sub projects.

The common scenarios are the following.

S1. Cybercars in city centres

Small fully automated vehicles for people and goods transport in inner cities

S2. Cybercars as feeder in low density areas

Fully automated vehicles for transport of people to high density transport hubs

S3. High Tech buses on dedicated lanes in radial corridors

Partly automated buses to improve/replace present bus and tram lines

S4. PRT in inner city networks

PRT as a replacement for an inner city bus or taxi system

S5. Advanced city vehicles in cities

Advanced city vehicles with technology to help drivers carry out functions in a more effective and safer manner

S6. Dual mode vehicles in e-lanes

Automated vehicles that can be driven manually outside dedicated e-lanes

S7. Dual mode vehicles in mixed traffic

Automated vehicles that can mix with traditional traffic

For an overview of all of the various common and specific scenarios see the table in chapter 10.

7 Specific application scenarios in SP2

CityMobil Sub Project 2 is using common application scenarios, with a strategic sketch planning model, in four cities to assess the potential of new technologies if applied on a wide scale across cities. The detail of the scenarios to be tested in SP2 has yet to be finalised. This will be done following consultation with the cities to be modelled in MARS. However, the broad coverage has been agreed. Each tested scenario is a combination of a context scenario, an application scenario and a scenario reflecting complementary measures. A total of 22 combinations will be modelled over a 30 year period with 2005 as the base year as illustrated in the following table:

Table 6.1: specific application scenarios

Context Scenarios	Medium growth		High growth	
Do nothing	M0		H0	
Passenger application scenarios	With complementary measures	Without complementary measures	With complementary measures	Without complementary measures
Cybercar (inner city)	MW1	M1	HW1	H1
Cybercar (PT feeder)	MW2	M2	HW2	H2
PRT	MW3	M3	HW3	H3
High tech bus	MW4	M4	HW4	H4
DMV (city wide)	MW5	M5	HW5	H5

Context Scenarios

The context scenarios include medium and high growth scenarios for the following factors:

- Population ageing
- Fuel price increases
- Urbanisation
- Revitalisation of inner cities

Passenger Application Scenarios

The passenger application scenarios are:

S2.1 Cybercars

Operating in an inner city network (covering at least four inner city zones, including the city centre). The inner city network should link key facilities across the city such as rail or bus stations, business or shopping districts, universities and hospitals. The cybercars to be modelled in MARS will have a capacity of 20 passengers. The hours of operation, fares, etc. will be determined following consultation with the cities to be modelled.

S2.2 Cybercars

Operating as a feeder for high quality public transport in low density suburbs (to be included in at least four suburban zones). As in (1), the cybercars to be modelled in MARS will have a capacity of 20 passengers. The hours of operation, fares, etc. will be determined following consultation with the cities to be modelled.

S 2.3 PRT

Operating in an inner city network to include at least four zones (with track length and number of stops to be determined following consultation with cities – these are likely to vary between cities due to the differences in their sizes)

S2.4 High-tech bus

For each city, this mode will be included on some major routes from the suburbs into the city centre, and on at least one route connecting a major facility to the city centre.

S2.5 Dual mode vehicle

Dual mode operation will be modelled for an increasing proportion of the network and an increasing penetration rate over time. These proportions and rates will be agreed by the partners.

Application Scenarios S2.1-S2.5 are equivalent to Common scenarios S1, S2, S4, S3 and S7, as described in Section 6, respectively. Other passenger applications in Chapter 4 have been omitted because they are typically ones which a city-wide strategic model is less capable of representing.

The complementary measures will be selected from the following:

- City centre development 20% greater than that currently in city plans
- Priority for new modes at all traffic signals (area-wide)
- Re-distribution of existing road space to new vehicles on all new mode routes
- City centre road pricing cordon, am peak only, €5 charge per day
- Public Transport fare reductions of 20% over the 30 year period
- Parking fee increase of 50% over the 30 year period

8 Specific application scenarios in SP3

The objective of SP3 in defining the scenarios has been to identify some reference applications with specific and clearly distinct characteristics, ideally covering the widest range of applications in urban areas, in order to consider the technology requirements for each scenario. Therefore the focus has been especially on technical aspects, rather than on investigating in a comprehensive way where the different mobility concepts can be exploited. Furthermore, since the design of new advanced road vehicles and the definition of the related technologies are the final objective of SP3, PRT has been intentionally ignored, without limiting the validity and the extension of the results to PRT, which operates in a more controlled environment with less stringent requirements than the key technologies explored in SP3 are concerned.

The following scenarios have been preliminarily identified:

S3.1 Dual Mode Vehicles in town and city centres

This scenario considers an historical area, inside the city structure but often not well connected to the surrounding districts, and characterised by a complex and intricate network of local streets. This situation can be found in a large number of Mediterranean towns in Europe.

Dual Mode Vehicles can provide assistance to drivers in difficult manoeuvres and parking, also limiting speed according to the regulations. Dual Mode vehicles are manually driven outside the dedicated areas.

The expected benefit is better mobility in these areas, by reducing the number of private cars, enabling the introduction of car sharing, and catering for reduced mobility.

The traffic includes pedestrians, bicycles, mopeds, small delivery vehicles and possibly private vehicles.

S3.2 Dual Mode Vehicles in e-lanes

Dedicated e-lanes (see definition in Chapter 5) on urban arterials and ring roads can permit automatic driving of Dual Mode Vehicles and traffic control via a control centre. Drivers should supervise car operation in the lane and take the control at intersections with ordinary traffic. An open question is whether to allow conventional vehicles to share the lane. This is reasonable, during the introduction phase of Dual Mode Vehicles.

The expected benefit is an increase in road capacity, depending on the introduction level, thanks to better traffic fluidity and reduced inter-vehicle headways. Furthermore, safety would be improved, due to fewer lane changes, reduced relative speed, automatic control and the use of anti-collision systems; pollution and energy would be reduced, due to more constant speed.

S 3.3 Cybercars in inner city

The “Inner city centre” scenario involves an automated transportation system where the use of cybercars is made in a taxi-type application (individuals or small groups of four or five persons, on demand and point to point). The user can enter the vehicle at defined access points and has the possibility to choose the destination on pre-defined tracks.

The environment considered in this scenario is a specific urban area dedicated to pedestrian or semi-pedestrian and cybercar circulation. This specific urban area is a delimited area, which can receive a high density of persons who need to travel relatively short distances.

Semi-pedestrian means that only bicycles or very low speed vehicles (like garbage collection vehicles or cleaning machines) will interact with people or cybercars.

S 3.4 Dedicated lanes shared by automated vehicles

This scenario is an extension of the high-tech bus system with dedicated lanes, which in the recent past a growing number of cities have already successfully introduced.

In order to increase the road saturation of the dedicated bus lanes for the automated high-tech buses system in the future, the scenario “Dedicated lanes shared by automated vehicles” consists not only of automated buses on the lanes, but also dual mode vehicles (and eventually cybercars), which travel on the same driving lanes by means of automated guidance.

The traffic considered in the scenario includes high-tech buses, dual-mode vehicles, cybercars and frequent pedestrians and bicycles on the dedicated lanes and public traffic at intersections.

The driving is autonomous or assisted, up to a maximum speed of (about 80 km/h).

S3.5 Advanced city vehicles in cities

In previous definitions of scenarios, Advanced city vehicles were not included, because these vehicles were considered as conventional with some ADAS functions. Therefore, they were outside the scope of the CityMobil project. Now the definition of Advanced city vehicles has been extended with Dual Mode Vehicles. Since the characteristics of non fully automated Advanced city vehicles are of great interest for urban mobility, due to their low environmental impact and wide market potential, they have been included, on condition that the ADAS functions considered include at least ISA (Intelligent Speed Adaptation) and Dynamic Route Guidance

Application Scenarios S3.1-S3.5 are equivalent to Common scenarios S7, S6, S1, S3 and S5, as described in Section 6, respectively.

9 Specific application scenarios in SP4

Methods and tools from infrastructure planning to real time fleet management are all involved in the operational management of the new transport systems proposed by CityMobil. Clear application scenarios are required in order to study these operational issues. The specific scenarios defined within SP4 try to show the different situations in which organisational arrangements play a major role in Advanced Urban Transport Systems. These scenarios are as follows:

S4.1 Town Centre with Advanced city vehicles

S1 can be described as a situation in which roads, demand and traffic rules, are more or less the same as today, but there are a number of vehicles that have some ADAS functions such as Intelligent speed adaptation, parking assistance, collision avoidance, stop&go, guidance etc.. These vehicles are used by normal drivers who behave, from the travelling point of view, in the same way as the conventional car drivers. The idea is to set a scenario of “boundary conditions” where for example, there are well deployed conventional ITS systems. In this scenario:

- Traffic monitoring is a function that covers the whole city for all types of road including motorways (TD, AID, UTC and FCD system are widely available);
- It is possible to forecast traffic situations;
- Traffic management strategies are managed by some kind of “supervisor” able to define an “optimal” dynamic configuration of traffic flows over the whole network; this, in turn, allows the provision of suitable information that can influence the behaviour of users (UTC, VMS, DRG) in order to achieve a traffic distribution as close as possible to that defined as “optimal” by the supervisor;
- Speed and lane control through LCS are available for motorways.

S4.2 Urban arterials with an e-lane

Urban arterials are used by all types of travellers including cycles and pedestrians. With increasing congestion at peak hours and a significant proportion of traffic being dual-mode vehicles, it is proposed for the future that an ‘e-lane’ for dual-mode vehicles is established on urban arterials, main roads and motorways in urban areas.

Compared with traditional urban road operation, dual-mode vehicles will have the option to use either the e-lane or a traditional lane. As the capacity of a single e-lane could be much higher than that of a traditional lane, the overall capacity of urban arterials can be increased significantly and congestion can be effectively relieved.

The ultimate goal is for a **Dedicated E-lane** that can be used only by vehicles that are specially equipped to use it, running in an automatic mode ie dual mode vehicles. This will enable the formation and running of ‘road trains’ where vehicles are run in platoons at high speed to achieve maximum throughput. The interactions with conventional traffic will be limited to special interchanges sited at the entrances and exits of the e-lanes

However, while the potential benefits seem clear, considerable difficulties can be expected in introducing such a scheme which requires both a significant proportion of vehicles to be equipped and a dedicated infrastructure to be made available before the benefits can be realised.

An intermediate **Open E-lane** scenario will therefore also be investigated in which an existing lane can be equipped or certified for use by dual mode vehicles, but which will also be available to normal ie driver controlled vehicles (including ACCs).

In this Open E-lane scenario, dual mode vehicles can run in automatic mode, but other (ie driver controlled) vehicles are also allowed. This will limit the possible benefits of traffic operation that can be realised by driving automation.

The objective of this scenario is to provide an incremental path from ADAS to automation on a dedicated e-Lane via an open e-Lane scenario. Interim benefits should be obtained from the potential for forming platoons as more and more vehicles become suitably equipped, and some potential from the more productive use of time that would otherwise be spent driving..

In the open e-Lane scenario drivers must merge manually into and subsequently out of the e-Lane traffic stream and then manually switch their vehicle into and out of automatic mode as required.

This interface concept is new and represents a transition between manual and automated operations.

S4.3 Inner City Centre with cybercars

The reference demonstrator site will be Rome. But this scenario will not only focus on the parking application described, but also analyse the use of cybercars in a city centre, in a pedestrian or semi-pedestrian area. Another reference application is the Rivium ParkShuttle application, where guidance is performed by a computer system based on odometric measures and references to little magnets in the road. No physical guidance is used in either case.

The concept of cybercars is to provide fully automated vehicles. In current discussions within CityMobil the following applications were recognised:

- Taxi-equivalent;
- Public transport feeder;
- Mixed traffic scenario within conventional roads.

The common property of cybercars in all application scenarios is the full automation of the vehicles. Furthermore, Cybercars will be following routing instructions from a management centre.

S4.4 Shared Traffic Space with automated buses

A high-tech bus system is a public transport system, which connects various districts of a city and allows people to travel from their homes to work or to the city centre on a given timetable without being influenced by traffic jams or road congestion and independent of their own vehicle.

These high-tech buses systems offer a large number of advantages such as environmental friendliness, independence from personal vehicles, fixed schedules, smoother traffic flow, etc. The systems are operated on dedicated bus lanes. These are often separated from the normal roads by shoulders, typically covered by grass or trees. High-tech bus systems should have the capability of automatic guidance and automatic stopping at the bus stops, intersections, and pedestrian crossings. They are, however, also capable of being driven on regular public roads, with manual control and sharing the space with other road users.

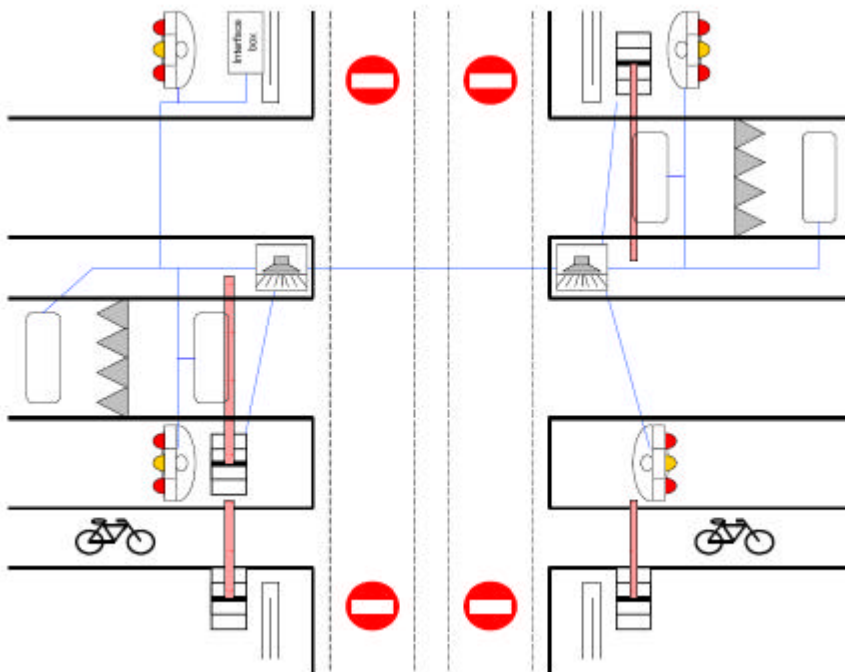


Figure 6.1: Example for cybercars crossing roads (from CyberMove D2.2 conceptual design report, Rivium Site)

S4.5 PRT

The Heathrow airport demonstration is a personal rapid transit system which takes passengers non-stop between their origin and destination. The system provides immediate response to each passenger's trip demand using small automated vehicles running on a dedicated track that links a passenger car park and the new Terminal 5.

The scenario for operational issues is based on the Heathrow Airport demonstration where automated PRT vehicles travel on a simple segregated track. The vehicles are controlled by a supervisory computer system which provides an on-demand service. Stations are offline and vehicles go directly to their destination. The network to be investigated will be expanded to cover the proposed extension of the system to serve terminals 1, 2 and 3 and the associated car parks.

Application Scenarios S4.1-S4.5 are equivalent to Common scenarios S5, S6, S7/1, S3 and S4, as described in Section 6, respectively.

10 Overview of scenarios

Technology	Scenarios	SP2 specific scenarios	SP3 specific scenarios	SP4 specific scenarios	CityMobil demonstrations	CityMobil showcases
Cybercars						
	S1 Cybercars in city centres	S2.1 Cybercars in city centres	S3.3 Cybercars in inner city	S4.3 Inner city with Cybercars		Daventry; Trondheim; Hyvinkää
	S2 Cybercars as feeder in low density areas	S2.2 Feeder in low density areas				
	Shuttle from parking to facility				Rome Cybercar system	
High Tech Buses						
	S3 High tech buses on dedicated lanes	S2.4 Suburbs to city centre	S3.4 Automated vehicles on dedicated lanes	S4.4 Shared traffic space with automated buses	Castellón bus system	
PRT						
	S4 PRT in inner city networks	S2.3 PRT in inner city networks		S4.5 PRT, expanded system at Heathrow	Heathrow PRT system	
Advanced City Vehicles						
	S5 Advanced City Vehicles in cities		S3.5 Advanced City Vehicles in cities	S4.1 Town centre with advanced City Vehicles		Genoa; La Rochelle
Dual mode vehicles						
	S6 Dual mode vehicles in e-lanes		S3.2 Dual mode vehicles in e-lanes	S4.2 Urban arterials with dedicated e-lanes		
	S7 Dual mode vehicles in mixed traffic	S2.5 Dual mode vehicles in mixed traffic	S3.1 Dual mode vehicles in mixed traffic	S4.3 Urban arterials with open e-lane		Genoa; La Rochelle