



CityMobil: Les Cybercars comme systèmes de transport connectés et la demande dans les villes durable

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Overview

- Automated vehicles and the benefits
- CyberCars and the applications
- Needs for connectivity
 - Connectivity for safety, efficiency, and users' comfort
 - Connectivity to be a part of a smart city
- Research activities at RITS, Inria for connected automated vehicles

Mobility today in our cities

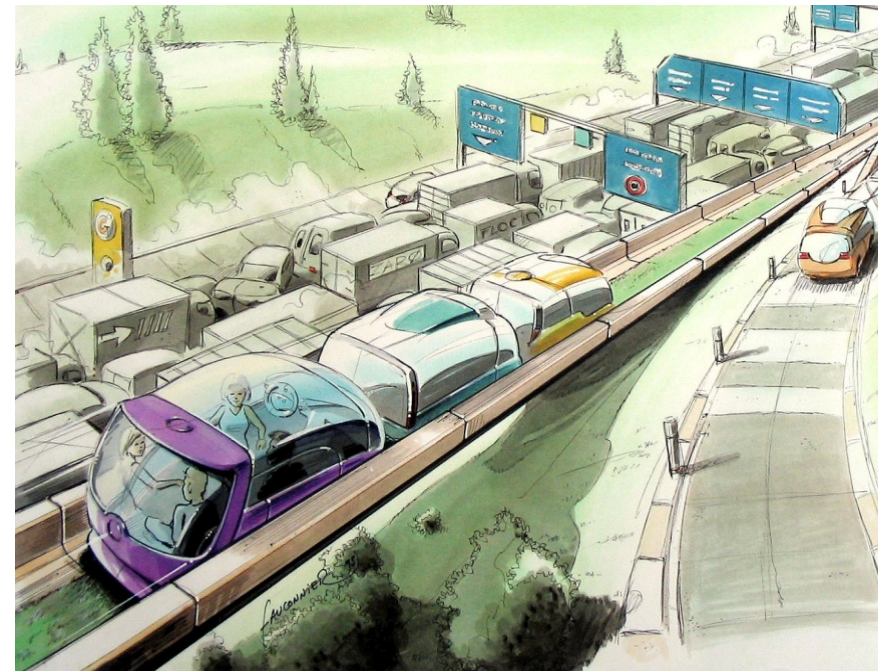


- Congestion
- Pollution
- Traffic accidents

Resulting in a decreasing quality of life

Automated vehicles

- Why remove driver?
 - Better safety
 - Better mobility
 - Better efficiency
 - Better nuisances



Market segments of automated vehicles

- Factory logistics
- Military vehicles
- Trucks/buses
- People movers
- Private vehicles



Cybercars

- Individual road vehicles with full automatic capability
- Part of an optimized **transportation system**
- Application scenarios
 - Crowded **city centers** with a parking problem; Old city centers where building an underground network is not a possibility
 - Outer **suburb areas** where conventional public transport is not viable
 - A shuttle **between a parking a lot or major facilities** (university/a shopping center)
 - A main or the only transport system of a **gated or protected area** (university campus, a hospital complex, industrial complex)
 - Transport system integrated within a major transport hub; **provide connections to other transport modes**

European projects

- CyberMove (2001—2004)
- CyberCars (2001—2004)
- NetMobil (2003—2005)
- MobiVIP (2002—2007)
- CyberC3 (2004—2006)
- CyberCars2 (2006—2009)
- CityMobil (2006—2011)
- CityNetMobil (2008—2011)
- **CityMobil2 (2012—2016)**



Cybercar: as automated transport

CityMobil

La Rochelle Juin-juillet 2011

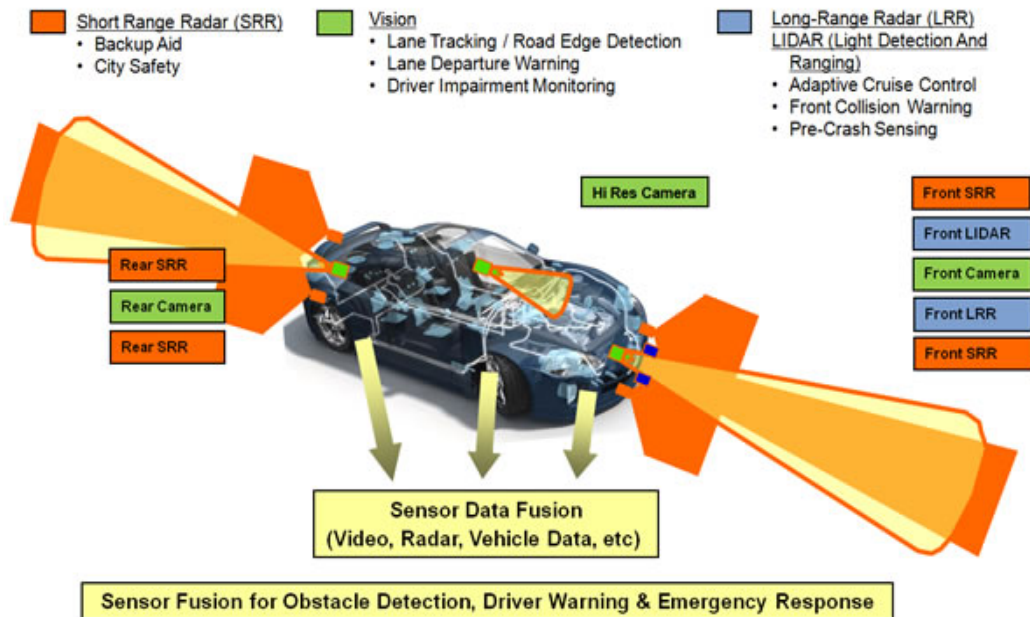
Première expérimentation de Cybercars
en environnement urbain non protégé

Successes of previous projects and challenges for CityMobil2

- Working demonstrations
- A thorough evaluation of application scenarios
- A large group of interested cities
- Open challenges
 - No clear legal framework
 - Stronger connectivity

Cooperative Cybercars: Need for strong connectivity

Autonomous vehicle “Sense → Plan → Act”



• Difficulties

- Sensing capability: dependency on the environmental condition (weather, time), reflectivity, field of view, distance
- Perception: Extremely challenging and difficult task!

Communication Needs

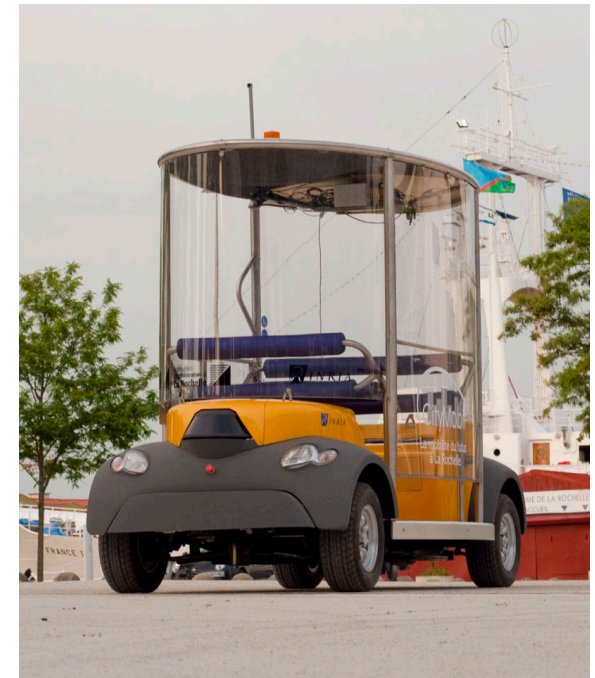
-safe, efficient, and comfort driving-

- Simplified “perception”
 - The environment tells “what” it is (where/how it is)
 - Environment: road, buildings, trees, vehicles, pedestrians, ...
 - V2V, V2I, V2P communications, Internet of Things, Cloud, LDM
- Cooperative driving
 - Platooning, lane changing, merging, intersection management
 - Remote driving
- Infotainment
 - Entertainment of the users/passengers

Communication Needs

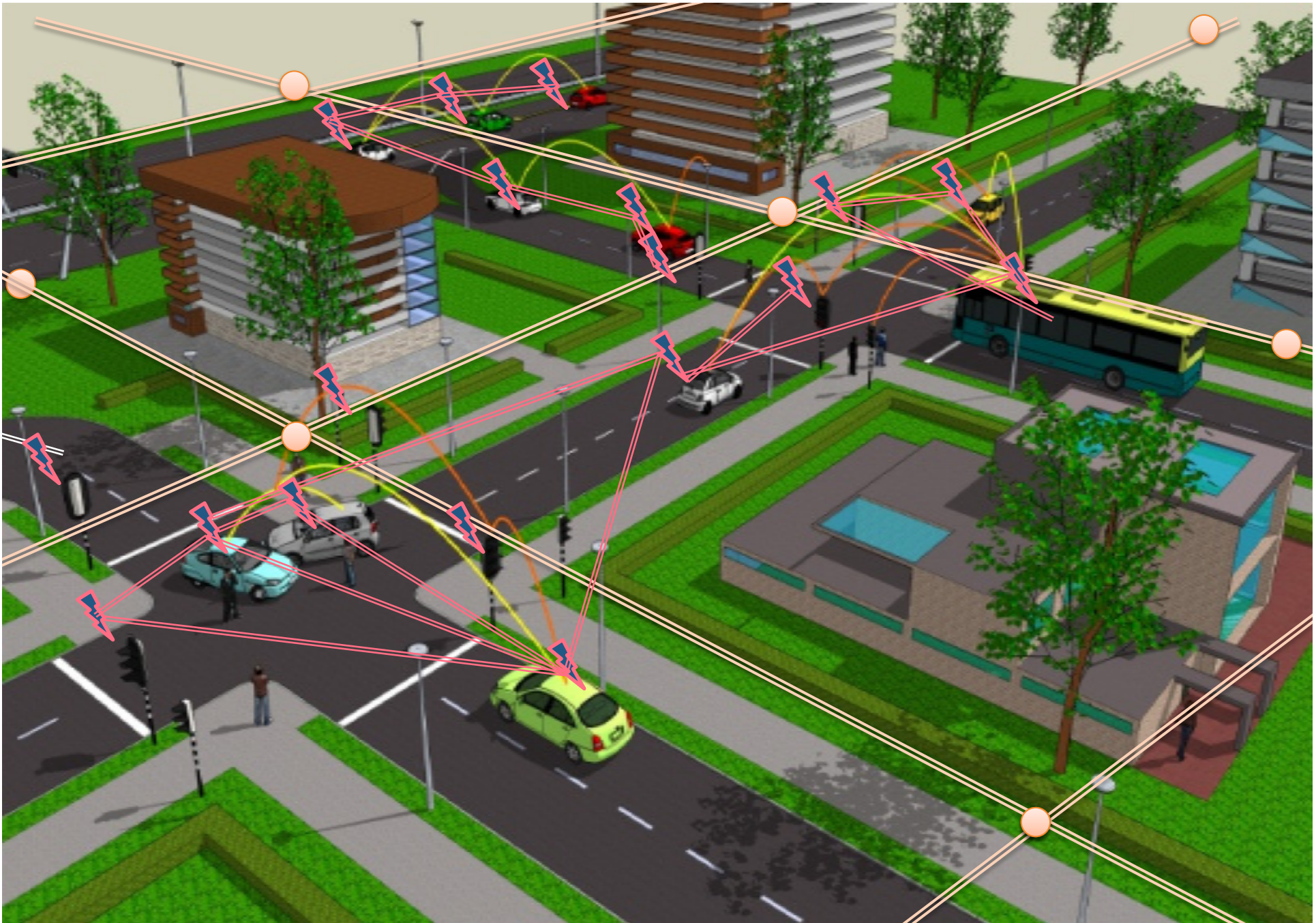
-Automated vehicles as a part of a smart city-

- Optimized travel
 - Minimum passenger waiting time for vehicle
 - Minimum passenger in-vehicle travel time
- Links to other modes of transport
- Payment possibilities (cash, bank card)



RITS:
Robotics and Intelligent
Transport System
Ex-IMARA



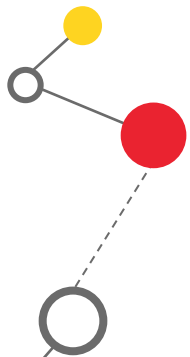
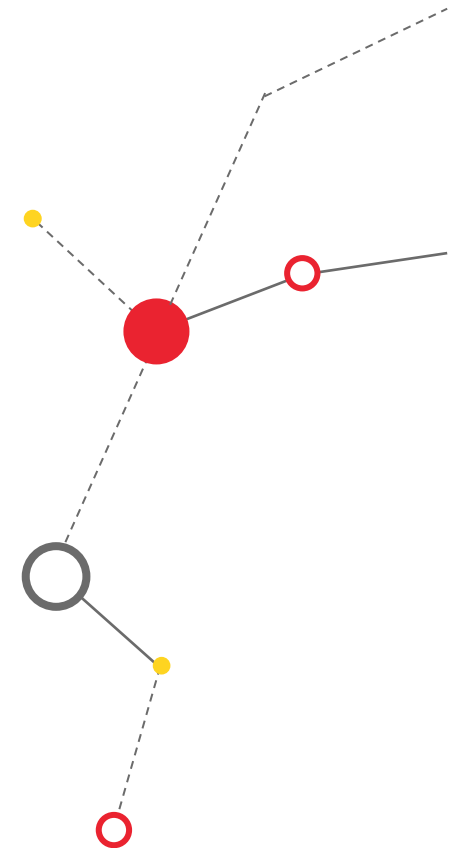
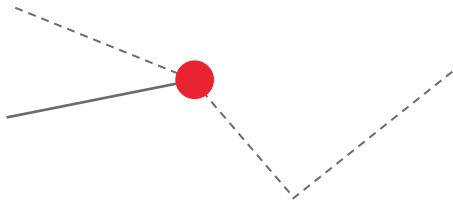


3 Main research topics

1 Robotics & ITS
Intelligent Transportation Systems

2 Modeling of large systems

3 Telecommunications & Networks



Communication Needs

-Cybercars-

- Communications for transportation service

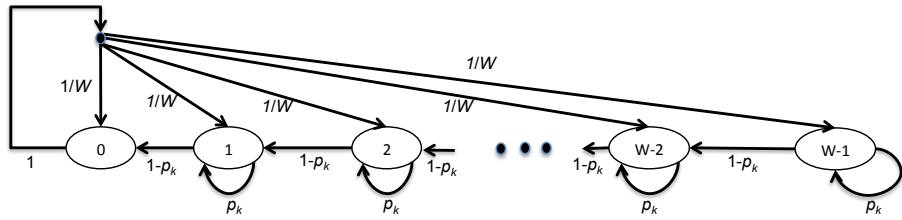


Cooperative Communication and Perception -for Protection of Vulnerable Road Users-

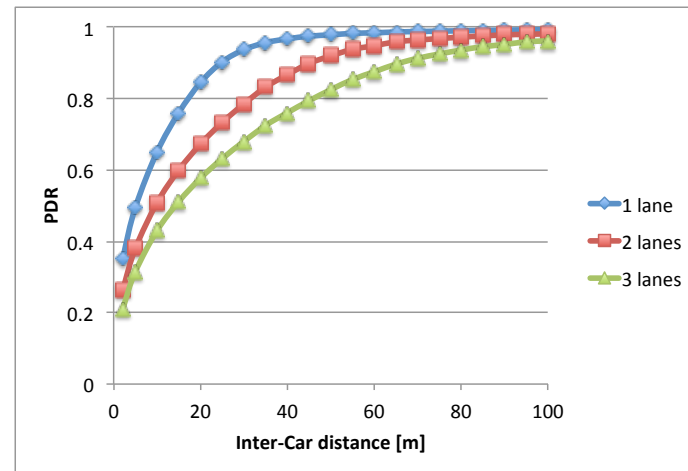


Communications using multiple-medias for platooning control (VLC & ITS-G5)

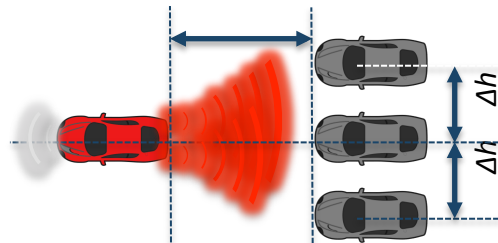
- ITS-G5 (IEEE 802.11p) for platooning



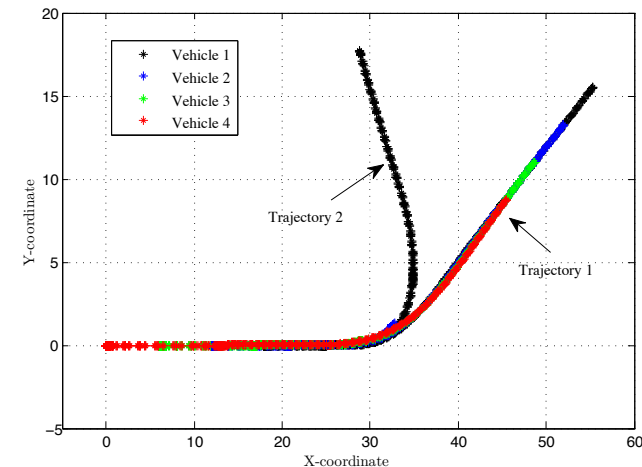
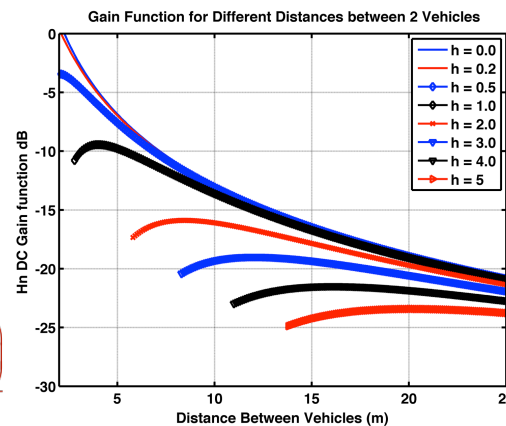
$$\tau_s = b(0) = \left[1 + \frac{W-1}{2(1-p_k)} \right]^{-1}$$



- VLC for platooning



$$H_n(\phi, \theta, x, h) = \frac{m+1}{2\pi} \frac{\cos^m \left(\frac{\pi}{2} - \tan^{-1} \left(\frac{x}{h} \right) - \phi \right) \cos \left(\tan^{-1} \left(\frac{x}{h} \right) - \theta \right)}{h^2 + x^2}$$



Both the ITS-G5 and VLC are to be used to ensure safe platooning

Summary

- Connectivity is one of the open issue for cybercars
- Connectivity to
 - Vehicles
 - Pedestrians
 - Infrastructure
 - Road
 - Trees
 - ...
 - ...
- City

Thank you!

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