



Embedded Systems for ITS



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MASTER INTERNATIONAL TRANSPORT ET ENERGIE

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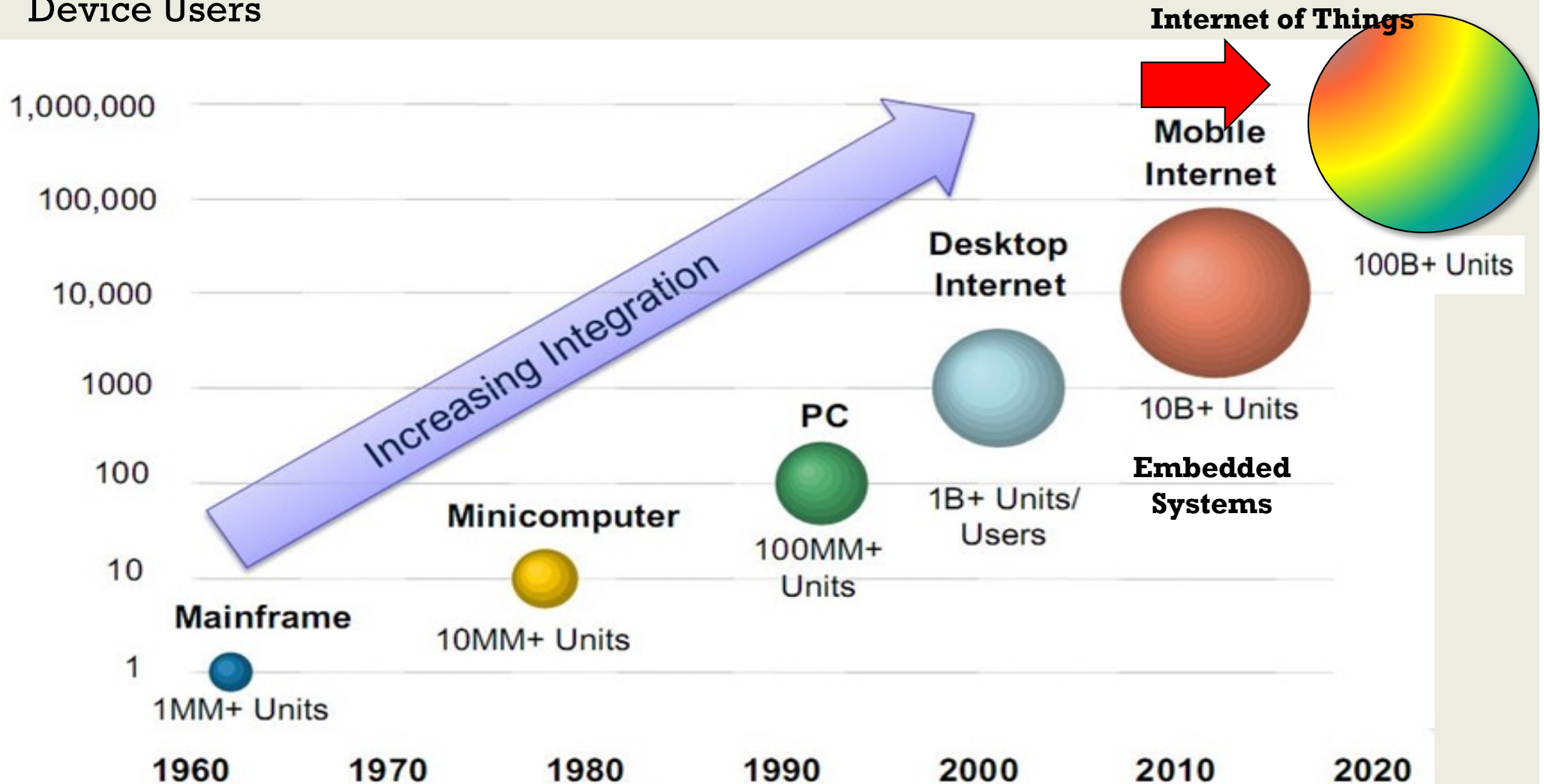
+ Plan



- Introduction to Embedded Systems
- Embedded Systems in ITS
 - Why Embedded Systems
 - Driver Assistant Systems
- Embedded Systems in ITS at University of Valenciennes

Computing growth orders over time 1960-2020

Device Users



Source: Adapted from ITU, Mark Lipacis, Morgan Stanley Research

+ What's an Embedded System?

- An **embedded system**: a computer system designed to perform **one or a few dedicated functions** under **application-specific constraints** (real time, power, energy)
- **Safety, reliability** and **usability**
 - The reliability : probability of **accomplishment of a function** under specified environmental conditions and over a **specified time**.
 - 1+1 Must be always gives 2
 - Safety: probability, that no catastrophic accidents will occur during system operation, no harm on the used



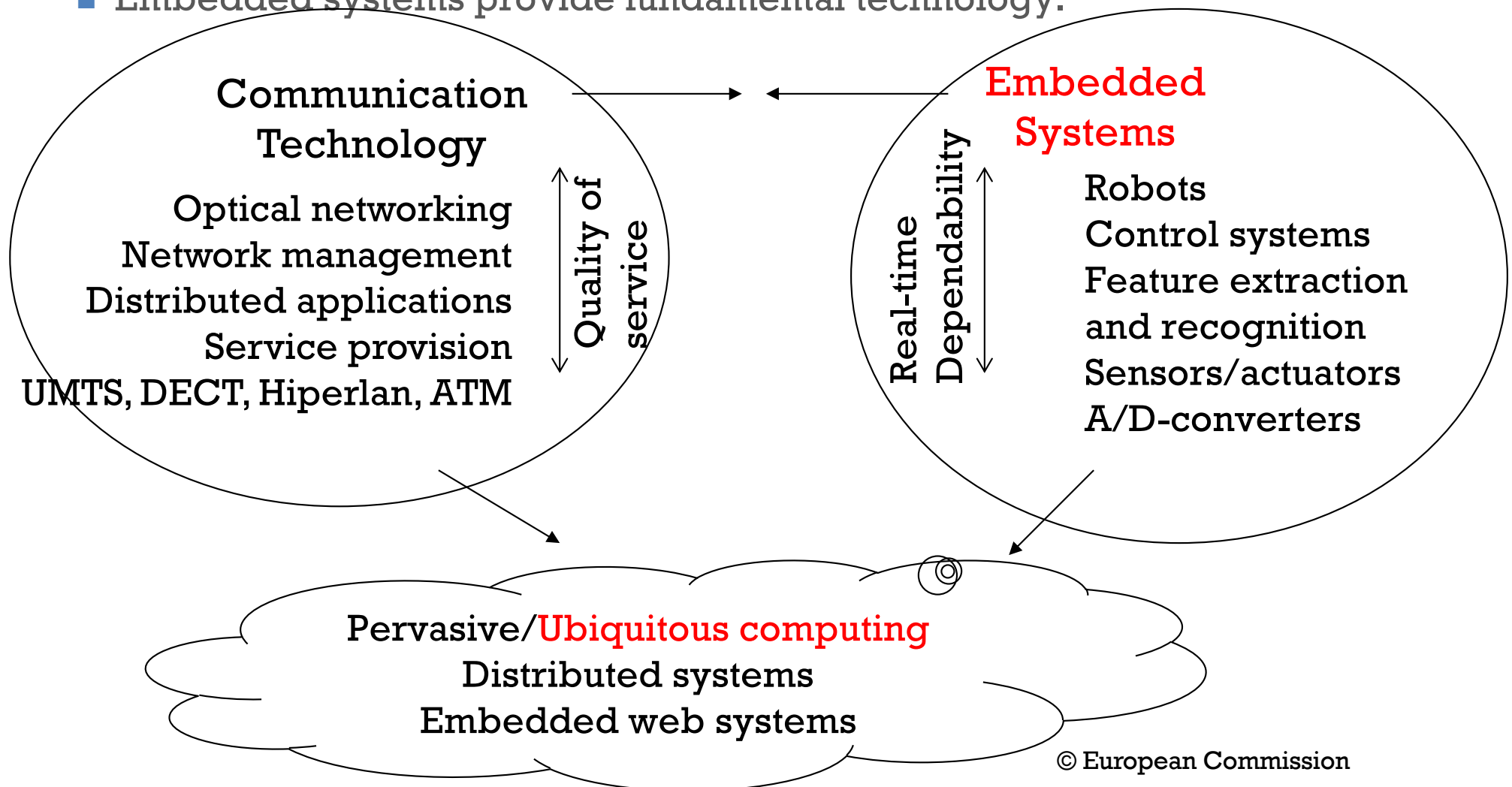
+ Cyber Physical Systems (CPS)



- Traditional embedded systems: dedicated to a specific task (1 application).
- CPS: communicating and collaborating # embedded systems, massively deployed, perform universal tasks across several domains

+ Extending the motivation: Embedded systems and ubiquitous computing

- Ubiquitous computing: Information anytime, anywhere.
- Embedded systems provide fundamental technology.



+ Mobile & Embedded Systems (MES) in ITS

- Next decade: new societal challenges in transportation and mobility
- Innovations in MES can help to manage these needs and challenges
- **MES must be smarter and more powerful.**
- New approaches in the design of applications, protocols and hardware platforms for ITS
 - Answer mobile applications & users needs:
 - More features & more services
 - Higher level of adaptability and reliability



+ Driver Assistance Systems (DAS's)

1.3 million people are killed on world roads every year (+3,500/day, 90% in developing countries)

Driver Assistance Systems (DAS): help drivers to make quick and correct decisions in critical situations



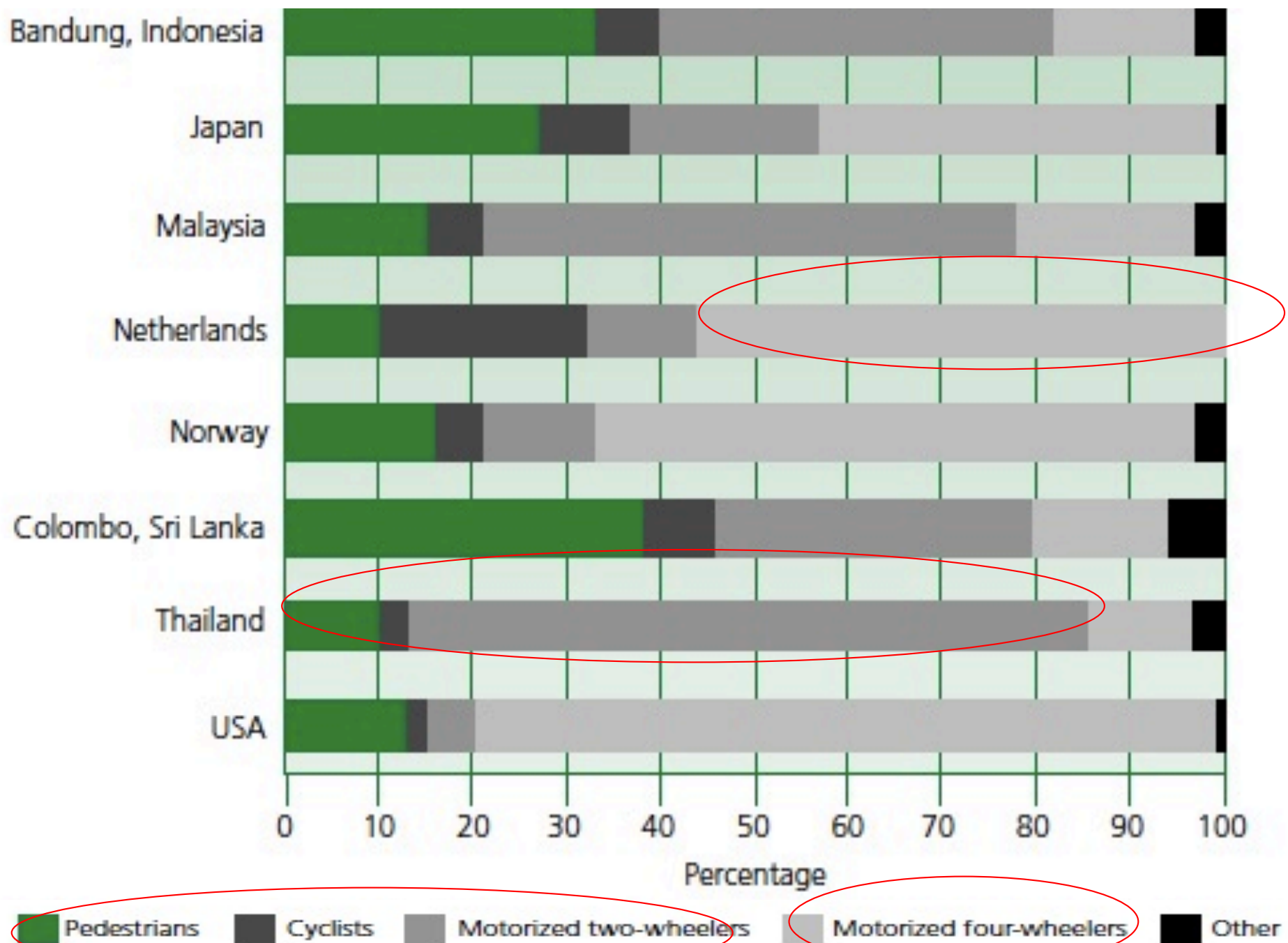
+ L'informatique embarquée et l'automobile

- *The automotive sector ... ensures the employment of more than 4 million people in Europe. Altogether, some **8 million jobs** in total depend on the fortunes of the transport industry and related sectors - representing around 7 per cent of the European Union's Gross National Product (GNP) [OMI bulletin]*

- Example d'applications:

- ABS: Anti-lock braking systems
- ESP: Electronic stability control
- Airbags
- Efficient automatic gearboxes
- Theft prevention with smart keys
- Blind-angle alert systems
- ... etc ...





Source: reference 44.

+ Embedded Systems in Automotive

Electronics in modern cars correspond to 50% total cost

3 raisons

- Economic / Policy: Reduce fuel consumption.
- Ecological: Minimizing pollution.
- Social: Securing means of transport in general and in the car in particular.



Columbia Omnibus

+ Hauts de France Region and Transportations Systems

KEY FIGURES

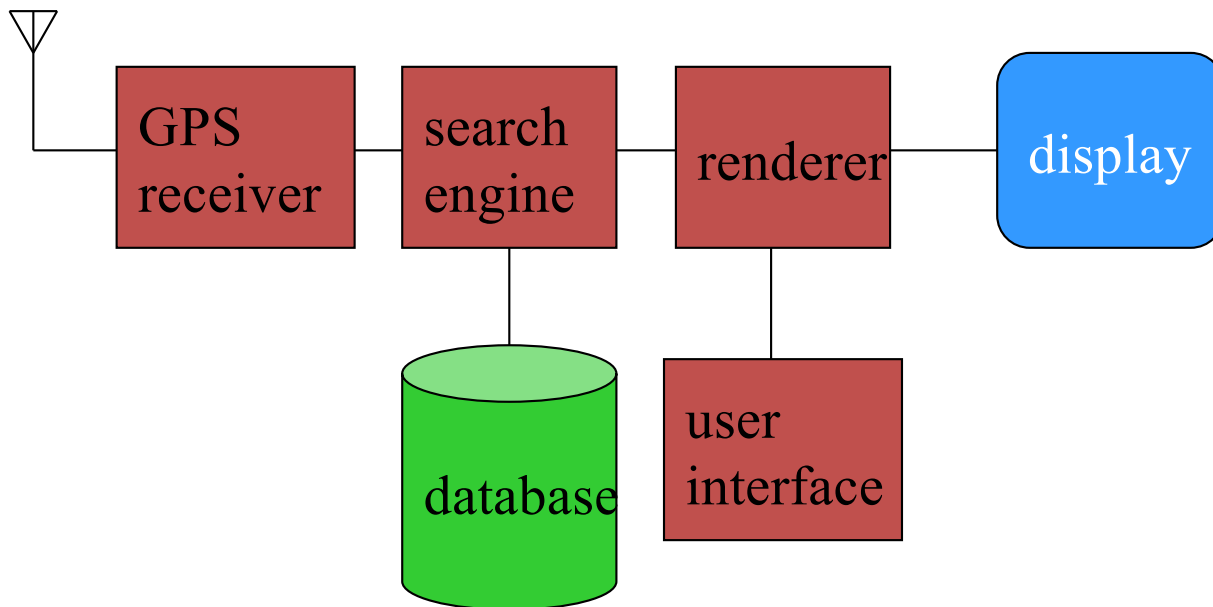
- 3 interna car manufacturers on 7 different sites.
- More than 200 automotive suppliers (Valeo, Faurecia, ..)
- More than 60 000 employees in the sector
- 30% of the domestic production of vehicles
- 40% of the national production of engines and gearboxes
- Nearly 2/3 of European manufacturers within 500 km

7 SITES

- **Toyota** : Yaris
- **Renault Douai** : Scenic, Grand Scenic et Mégane Coupé-cabriolet
- **Sevelnord** (PSA Peugeot/Citroën/Fiat): C8, 807, Phedra, Ulysse, Jumpy, Expert, Scudo
- **MCA** (Renault Maubeuge) : Kangoo VP et VU, Nissan Kubistar
- **PSA Valenciennes** : Boîtes de vitesses
- ...

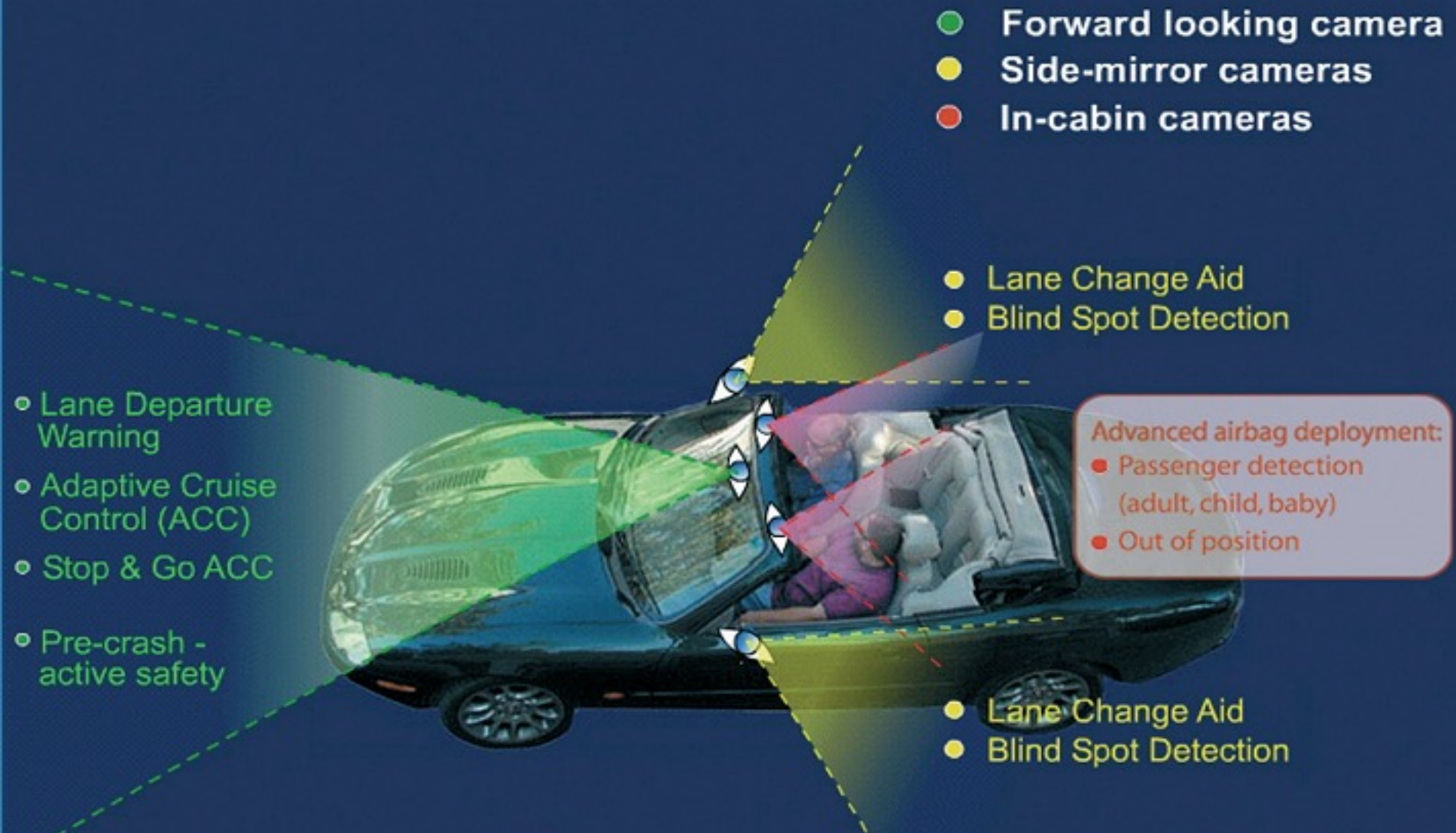
+ Global Positioning System (GPS)

- GPS is a space-based navigation system that provides location and time information in all weather conditions,
- The current position is obtained by reading signals from several satellites.

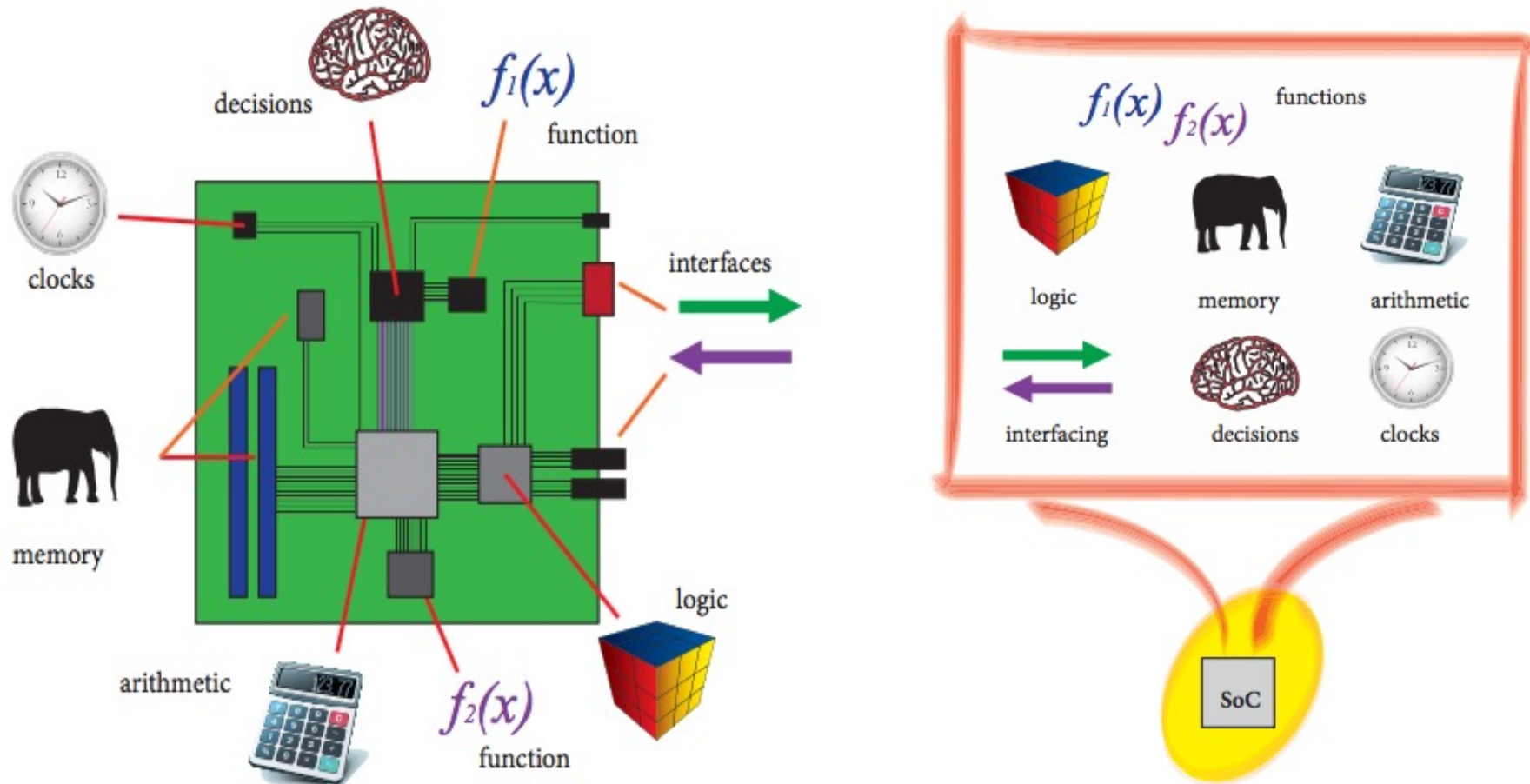


+ Système EyeQ

Fig 1: Mobileye's EyeQ driver assistance system



+ System-on-Board and System-on-Chip



Comparison of System-on-a-Board (Left) and System-on-Chip (Right)

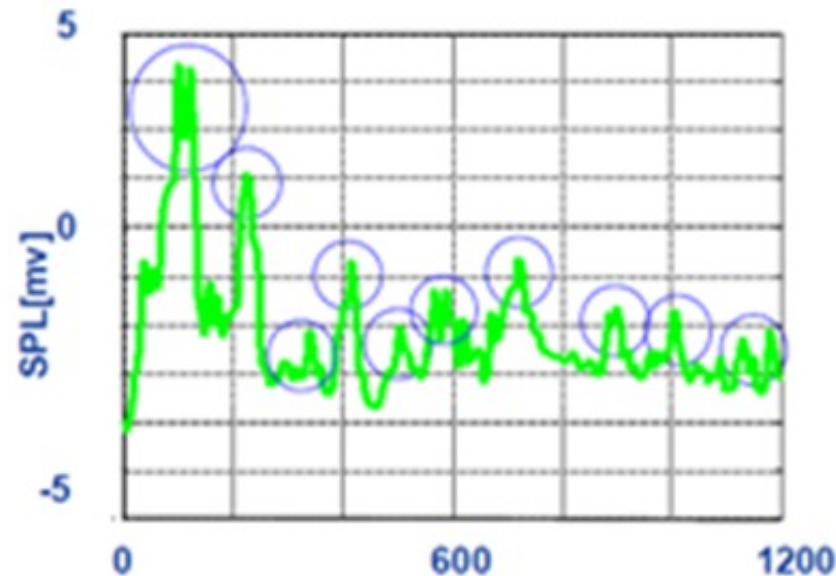
+ Why Driver Assistant Systems (DAS) ?

- **Road accidents cause the highest number of accidental deaths**
 - 94,000 road accident fatalities in 2006 in USA, Europe and Japan
 - 17% increase in road accident fatalities in 2009 in France
- **Driver's inattention a major cause of road accidents**
 - 2/3rds of the road accidents in Europe due to driver's inattention caused by physical and mental fatigue

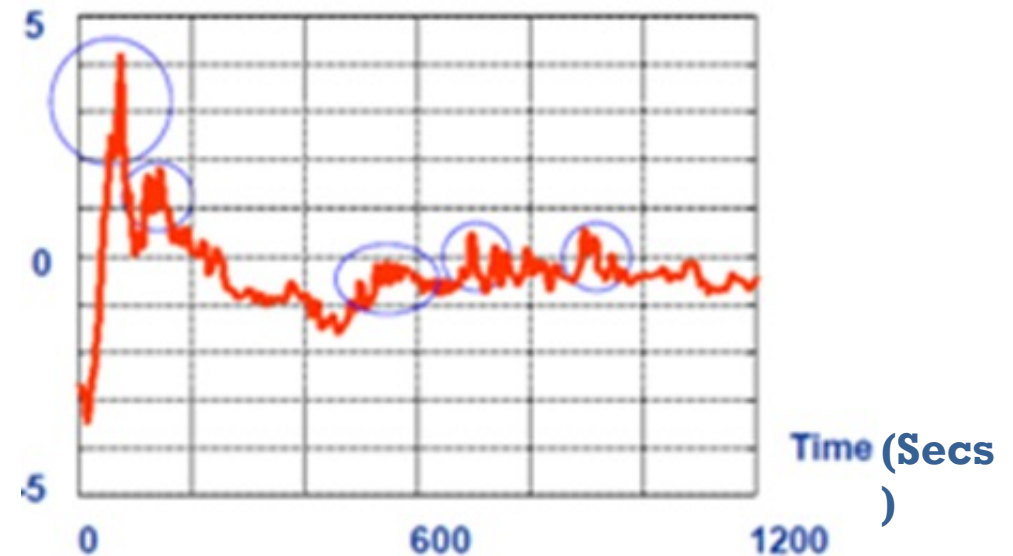
+ Cause of Driver's Mental Fatigue

Driver's Mental Tension Peaks

Without DAS (Driver Assistance)



With DAS



SPL: Skin (Electric) Potential Level

- **DAS reduce the frequency of tension peaks --- decrease fatigue**
- **At least 50% reduction in road accidents**

+ Existing Solutions

■ Current safety systems

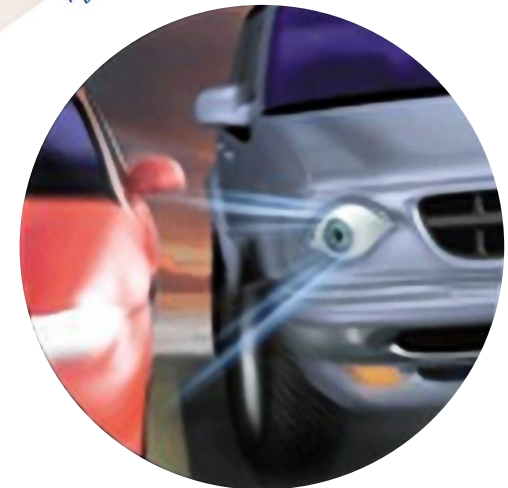
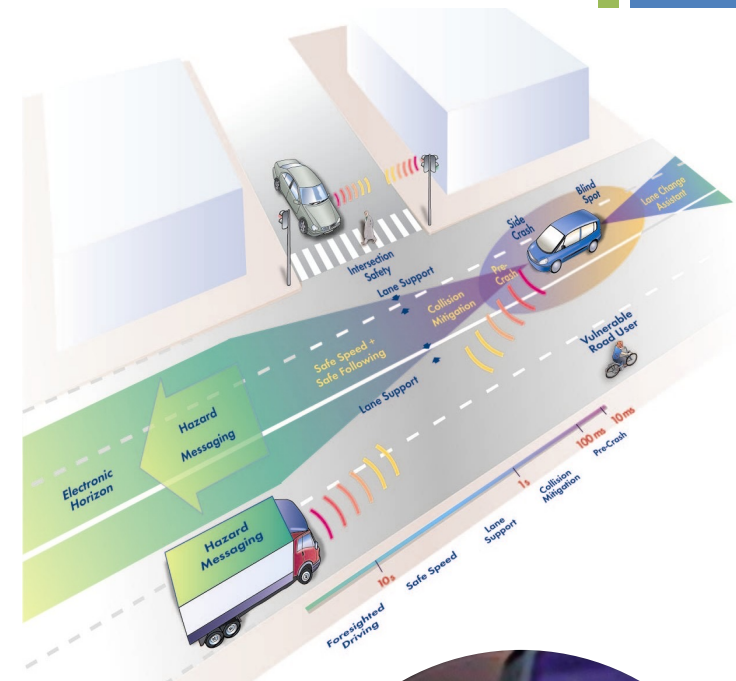
- Pre-crash safety mechanisms
- Post-Crash damage control
- **accident prevention**

Main projects: Prevent, SafeCar, RoadEyes,

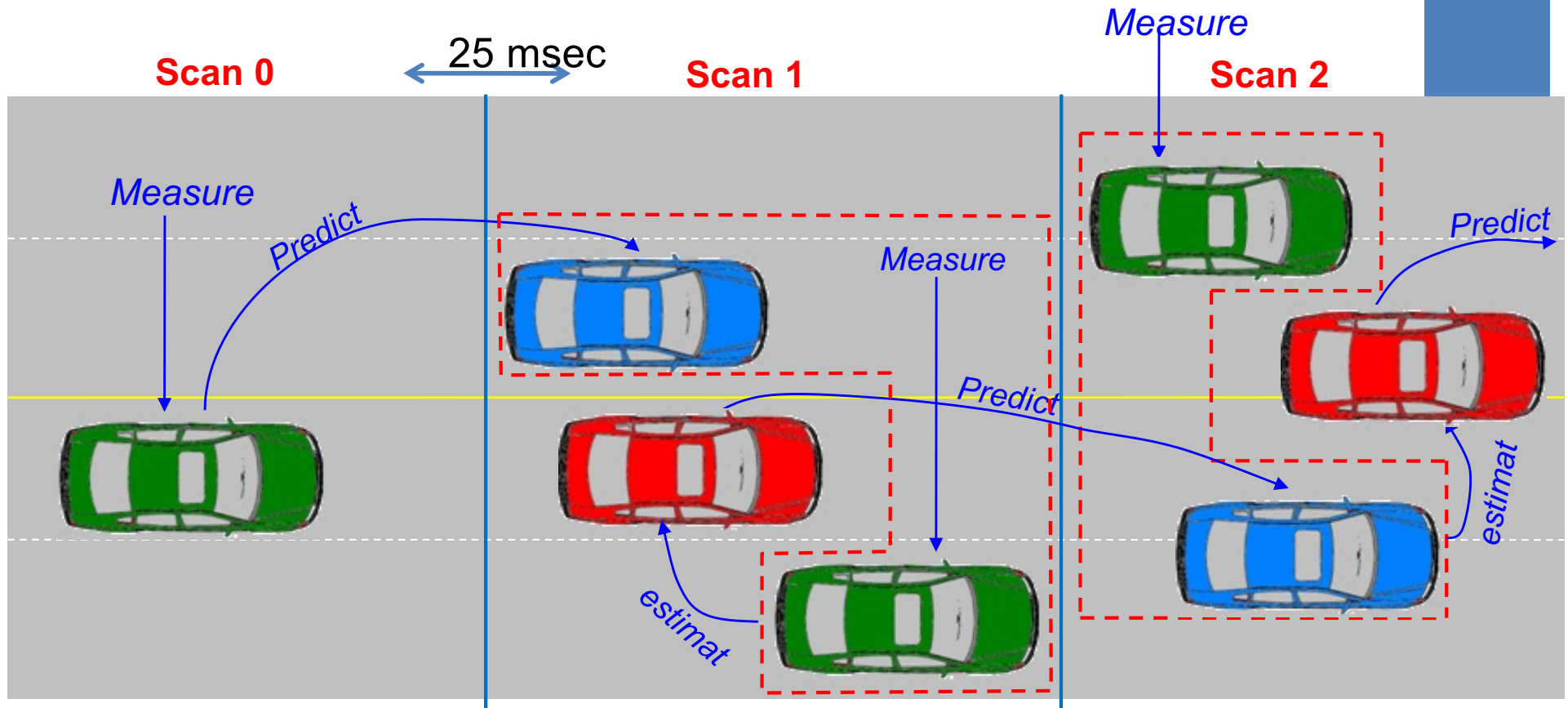
■ Emerging Prevention Systems

- Limited functionality and fixed architectures
- Proprietary
- Specific to manufacturers and vehicle models
- Costly

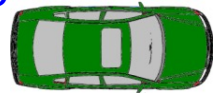
■ Main sensors: Camera, Lidar, Radar



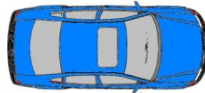
+ What is Target Tracking ?



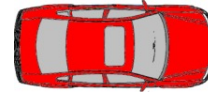
Measurement
(Sensor)



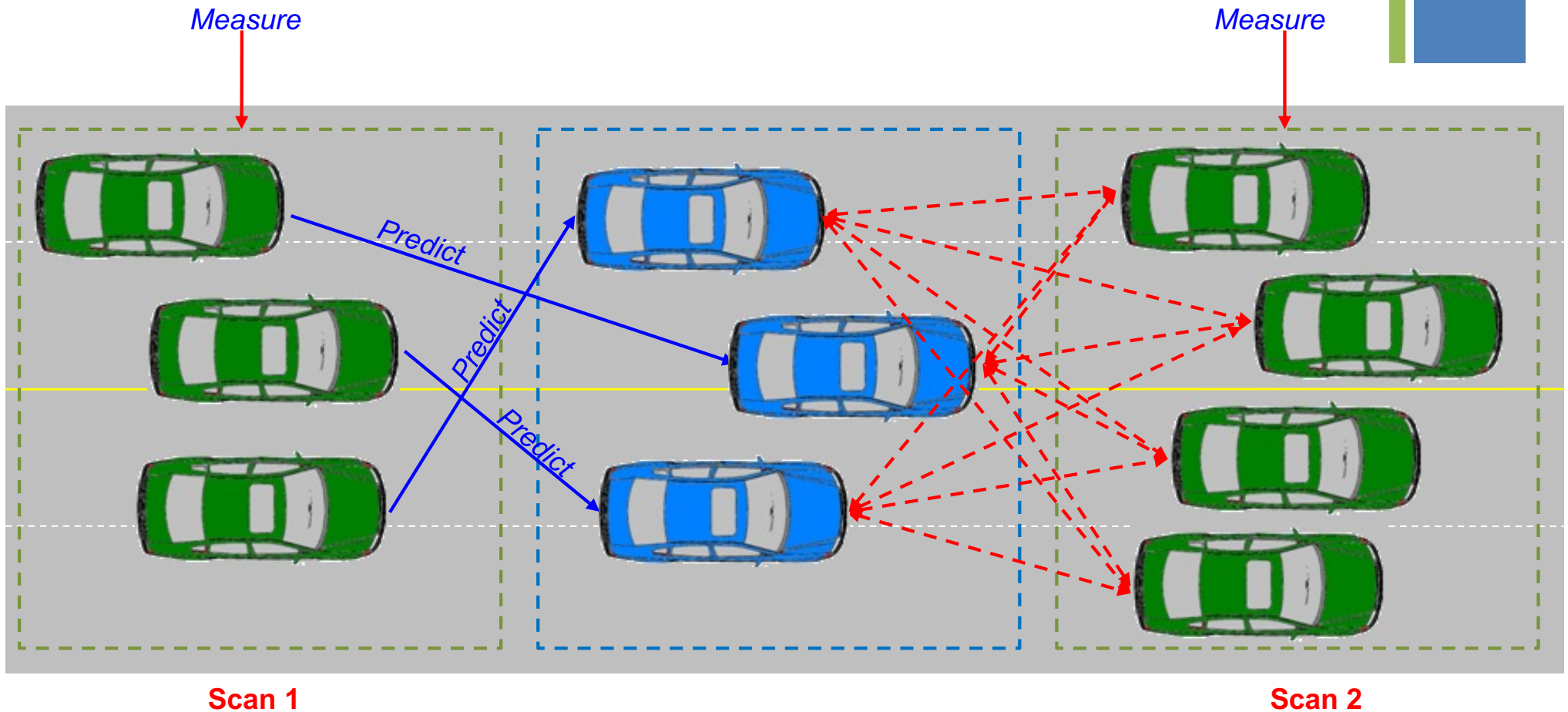
Prediction



Estimation



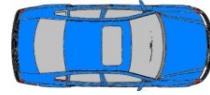
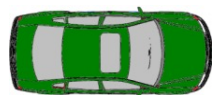
+ Multiple Target Tracking (MTT)



Measurement

Prediction

Possible Associations



+ Quelques vidéos



- <http://www.youtube.com/watch?v=X-Q8n8wM5PQ&feature=related>

- <http://www.youtube.com/watch?v=8R3vdF4lfuI&list=PL78FAE5143E681E0A>