# Le potenzialità dei sistemi ITS per la riduzione delle emissioni CO2: metodologia e modelli matematici per la valutazione degli impatti

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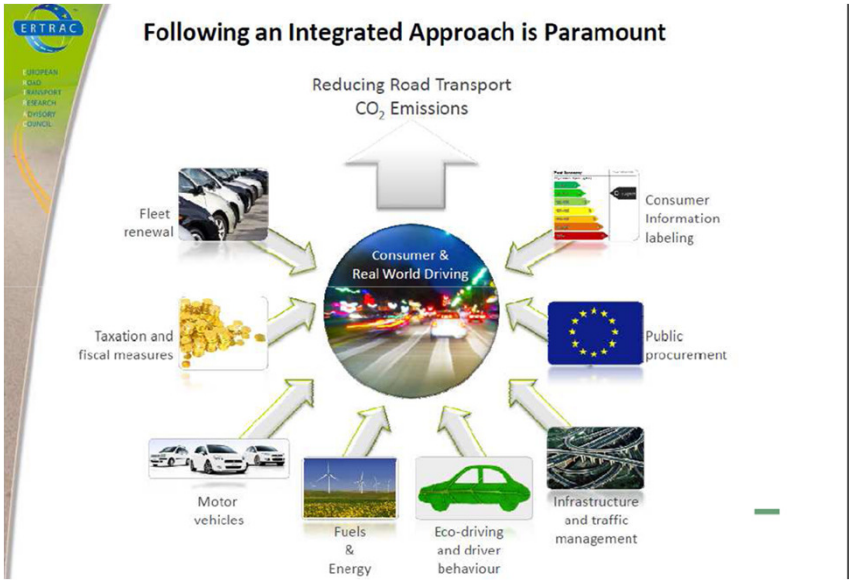
Roma 07-12-2012

# Obiettivo: ridurre $CO_2$

Come? Attraverso un approccio integrato.

Secondo ERTRAC European Road Transport Research Advisory Council



# Approccio integrato

Tutte le politiche e le soluzioni devono contribuire.

- **i sistemi ITS e le tecnologie ICT**

  sviluppati in passato con scopi diversi

  - safety
  - traffic & transport management
  - …

- **le politiche di gestione della mobilità**
- l'insieme di soluzioni *locali* determina effetti globali

# Quale beneficio?

Ad oggi vi sono alcune ipotesi sui possibili impatti sull'ambiente ma

- sono dati specifici
- quasi mai calati nella realtà delle nostre città

E' necessario un sistema di valutazione quantitativa effettivamente corretto

# ICT emissions

Sviluppo di una metodologia e di tool per

Valutare gli impatti sulle emissioni $CO_2$

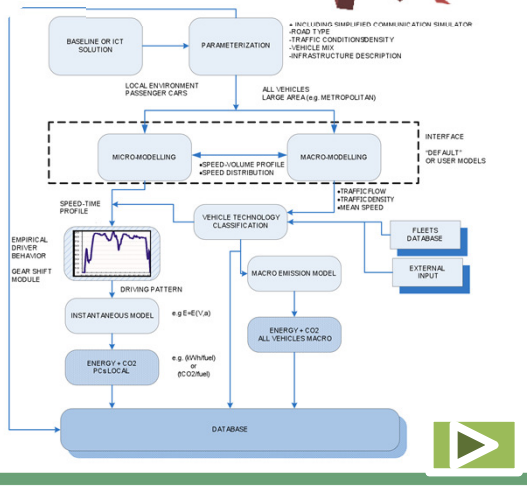
dei sistemi ITS e tecnologie ICT

- ✓ driver assistance systems (ADAS) and eco-solutions

  speed/cruise control, start/stop systems, eco-driver assistance etc.
- ✓ infrastructure measures

  traffic management, dynamic traffic signs, etc.
- ✓ integrazione di soluzioni (cooperative systems).





# Partecipazione di JRC in ICT-EMISSIONS



- interesse della commissione EU per le politiche di mobilità sostenibile
- attuali e future poliche EU per ridurre gli impatti CO2

La commissione EU commission ritiene

**ICT-emissions un progetto «strategico»**

quindi

**JRC (Joint Research Centre)**
**è effettivo partner del progetto**

# Il progetto

1. **Sviluppo di una metodologia  affidabile e trasferibile**
   per la valutazione degli impatti su CO2 di soluzioni ITS/ICT

2. **Sviluppo di modelli matematici per stimare in modo attendibile e  compatibile con la reatà  il consume energetico e le emissioni di CO2 dei veicoli**
   anche quanto sistemi ITS/ICT sono attivi e
   tenendo conto di tecnologie innovative – veicoli ibridi  ecc.

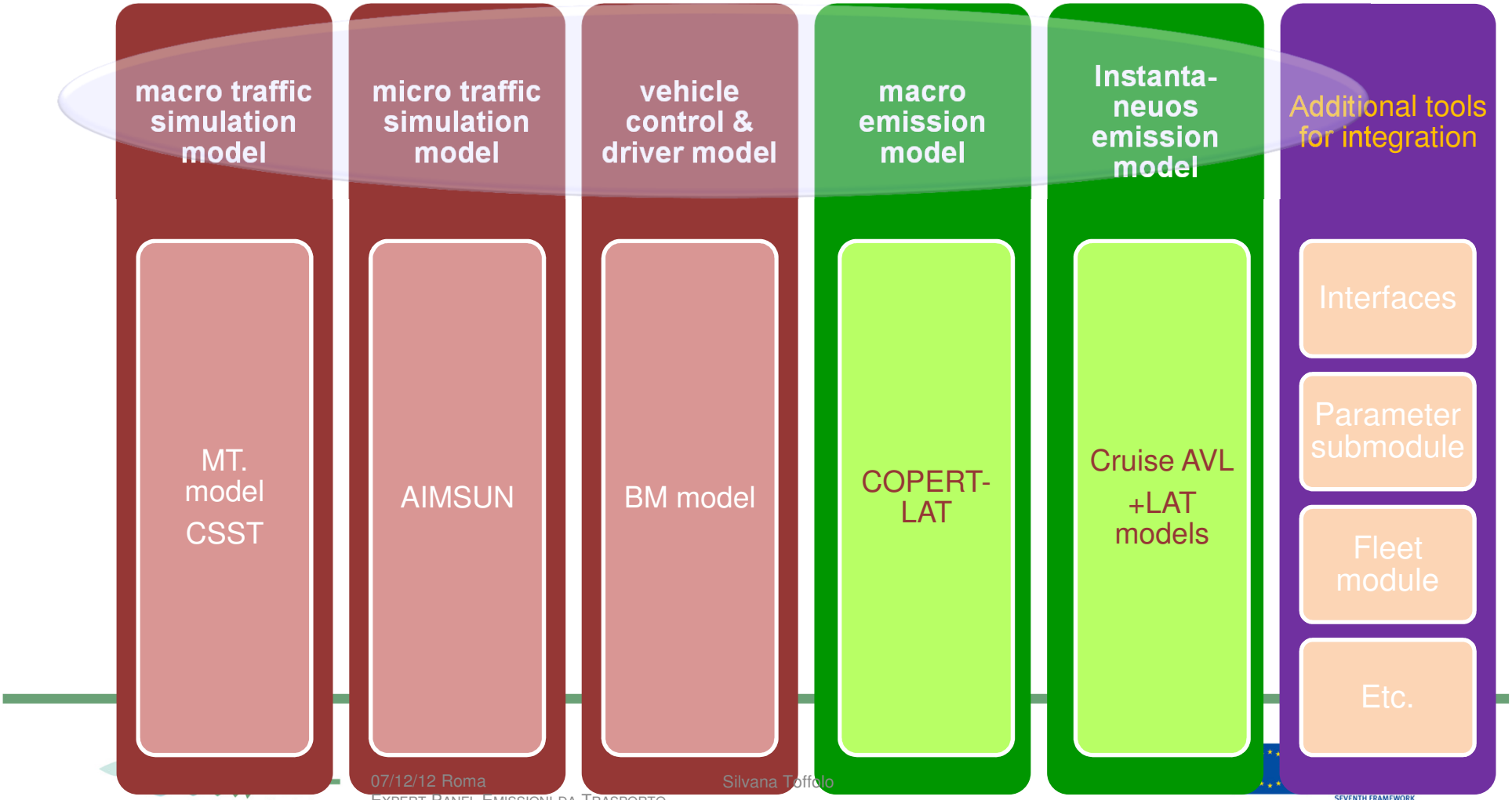
3. **Simulazione degli impatti di varie soluzioni ITS/ITC**
   implementando modelli matematicio commerciali a scala macro e micro

4. **Validazione della metodologia con dati reali**
   applicationi in tre città

5. **Sintesi dei risultati in termini di impatti in una libreria – database**
   traffico, energia,  emissioni

6. **Predisposizione di linee-guida con raccomandazioni sull'uso e l'implementazione di sistemi ITS e tecnologie ICT**

# I modelli matematici di simulazione: base essenziale

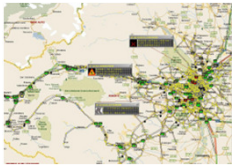


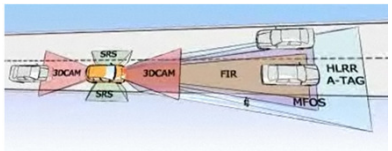
# Breve cenno alla metodologia

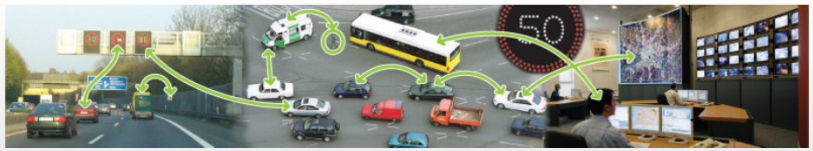
- Identificazione delle soluzioni ICT / ITS
- Esempi di architettura modellistica

# ITS measures to be assessed categories

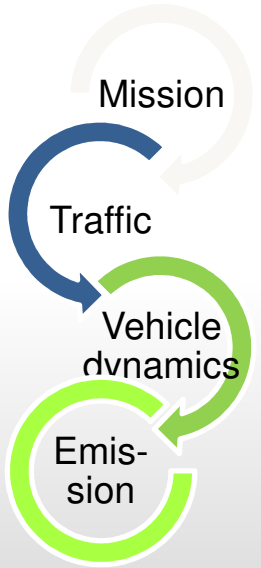




- ✓ Navigation and Travel Information
- ✓ Traffic Management and Control
- ✓ Demand & Access Management
- ✓ Driver behaviour change and eco driving
- ✓ ADAS
- ✓ Others



# Categorie ITS/ICT 1/6

| | NAME | BRIEF description | Code | ECOSTAND | METI |
|---|---|---|---|---|---|
| Navigation and Travel Information | **On-Board navigation Systems** | Route guidance, based on the fastest/shortest route toward destination calculated using digital maps and followed using Satellite positioning systems like GPS, Galileo. | Nav_His | ✓ | ✓ |
| | **Dynamic on-trip routing** | Route guidance as before, considering also real time information (traffic, accidents, roadworks, ..) received during trip through GPRS/UMTS to calculate the optimal route to destination. | Nav_RT | | ✓ |
| | **Green enhanced navigation system** | On board navigation systems equipped with maps that have the historical information about traffic on each road portion and time. Best route is calculated considering not a fixed cost for each road segment but a cost that depend on when the road segment will be travelled. This cost is proportional to the expected fuel consumption on such road segment. | Nav_Green_His | | ✓ |
| | **Dynamic Green enhanced navigation system** | As before for Green Enhanced navigation systems but adding real time information on traffic condition | Nav_Green_RT | | ✓ |
| | **Intelligent Parking** | Provide information on available parking spaces either on parking lots or roadside. Hence drivers spent less time to locate a suitable and available parking spot. | PK_int | ✓ | |
| | **Web based pre-trip information system** | Pre Trip planning of the route. Useful when the driver has different destination to reach in a single travel. | Nav_pre | ✓ | ✓ |

# Categorie ITS/ICT 2/6

| Classification | NAME | BRIEF description | Code | ECOSTAND | METI |
|---|---|---|---|---|---|
| Traffic Management and Control | **Isolated controlled intersections** | Traffic lights controlled using information based on local traffic sensors. Also called Intelligent traffic lights. | UTC_loc | ✓ | ✓ |
| | **Plan based control (including green wave strategy)** | Synchronization of lights to favor traffic flows on specific routes. Optimization criteria can be overall minimum delay or minimal number of stops. | UTC_plan | ✓ | ✓ |
| | **Traffic adaptive Urban Traffic Control – UTC** | UTC system which is able to measure and forecast queue length and adjust phases to optimize efficiency (not fixed plan). | UTC | ✓ | ✓ |
| | **Traffic adaptive Urban Traffic Control + V2I** | As before for UTC but driver are also informed about the best strategy to save fuel consumption without time delay (suggested speed) | UTC+V2I | | |
| | **Ramp Metering** | Traffic lights to manage influx of vehicles to ring road or motorway system | RM | ✓ | ✓ |
| | **Dynamic lane** | Opening or closing a lane on highways by means of signs over the lane, depending on traffic conditions. | Lane_dyn | | |
| | **Speed Control (point-to-point)** | Use consecutive cameras with license recognition to calculate true average vehicle speed of individual vehicles, instead of local instant speed. | Speed_ctr | ✓ | |
| | **Dynamic Speed Limits** | Traffic regulation to impose a given speed (on motorways) according to real-time flow conditions, to reduce fuel consumption or to improve safety. | SpeedDyn_Ctr | ✓ | ✓ |

# Categorie ITS/ICT 3/6

| | NAME | BRIEF description | Code | ECOSTAND | METI |
|---|---|---|---|---|---|
| Demand&Access Management | **Infrastructure-use pricing** | A classic fee collection based on the vehicle class and time of the day | Road_ pricing | ✓ | ✓ |
| | **Carbon-credit scheme** | Management of a system based on carbon assessment of trips, which can be bought or sold | Carbon_ scheme | ✓ | ✓ |
| | **Restricted traffic zones** | Entry restriction to given area. Criteria can be vehicle type, socioeconomic necessity, credits | Access_ restr | ✓ | ✓ |
| | **Pay-as-you-drive strategy** | On board black box to charge according to infrastructure use. Can potentially be made very complex, to include dynamic congestion charge functionality, additional fees for environmental zones, time of day etc. | Pay_As_ drive | ✓ | ✓ |

# Categorie ITS/ICT 4/6

| | NAME | BRIEF description | Code | ECOSTAND | METI |
|---|---|---|---|---|---|
| **Driver behaviour change and eco driving** | **Promotion of an energy-efficient style of driving** | Reccomendations e.g. on Internet, PC or via on board displays to encourage fuel saving driving behaviour | Eco_ driving | ✓ | ✓ |
| | **Gear Shift Indicator** | Suggestion of the gear shift to use. | Gear_shift | | |
| | **Start&Stop** | Automatic engine stop when vehicle is stopping | Start&Stop | | |
| | **Tyre pressure Monitoring** | Real time measurement of tyre pressure, warning to the driver is below threshold | Tyre_press | | |

# Categorie ITS/ICT 5/6

| | NAME | BRIEF description | Code | ECOSTAND | METI |
|---|---|---|---|---|---|
| | **Cruise Control** | Vehicle speed is kept at the value desired by the driver | | | |
| **ADAS** | **Navigation based Cruise Control** | As before, but the speed change considering the road geometry (curve) and, eventually, the speed limits. | | | |
| | **Adaptive cruise Control** | Vehicle speed automatic control, based on the desired speed and the traffic in the same lane. For speed above a certain threshold, 50 Km/h typical. | ACC | | |
| | **ACC+STOP&GO** | As before but with the capability to stop the vehicle if the vehicle in front stops. After driver confirmation the vehicle restart automatically also. | ACC+ STOP& GO | | |
| | **Cooperative Cruise Control - Lane merging Assistance** | Vehicle to vehicle communication allowing to control the speed of the following vehicle knowing the speed profile of the leading vehicle. The speed profile will not be duplicated but optimised to save fuel, while maintaining an adeguate safety level. | Cruise_ctr Lane_ merge | ✓ | |

# Categorie ITS/ICT 6/6

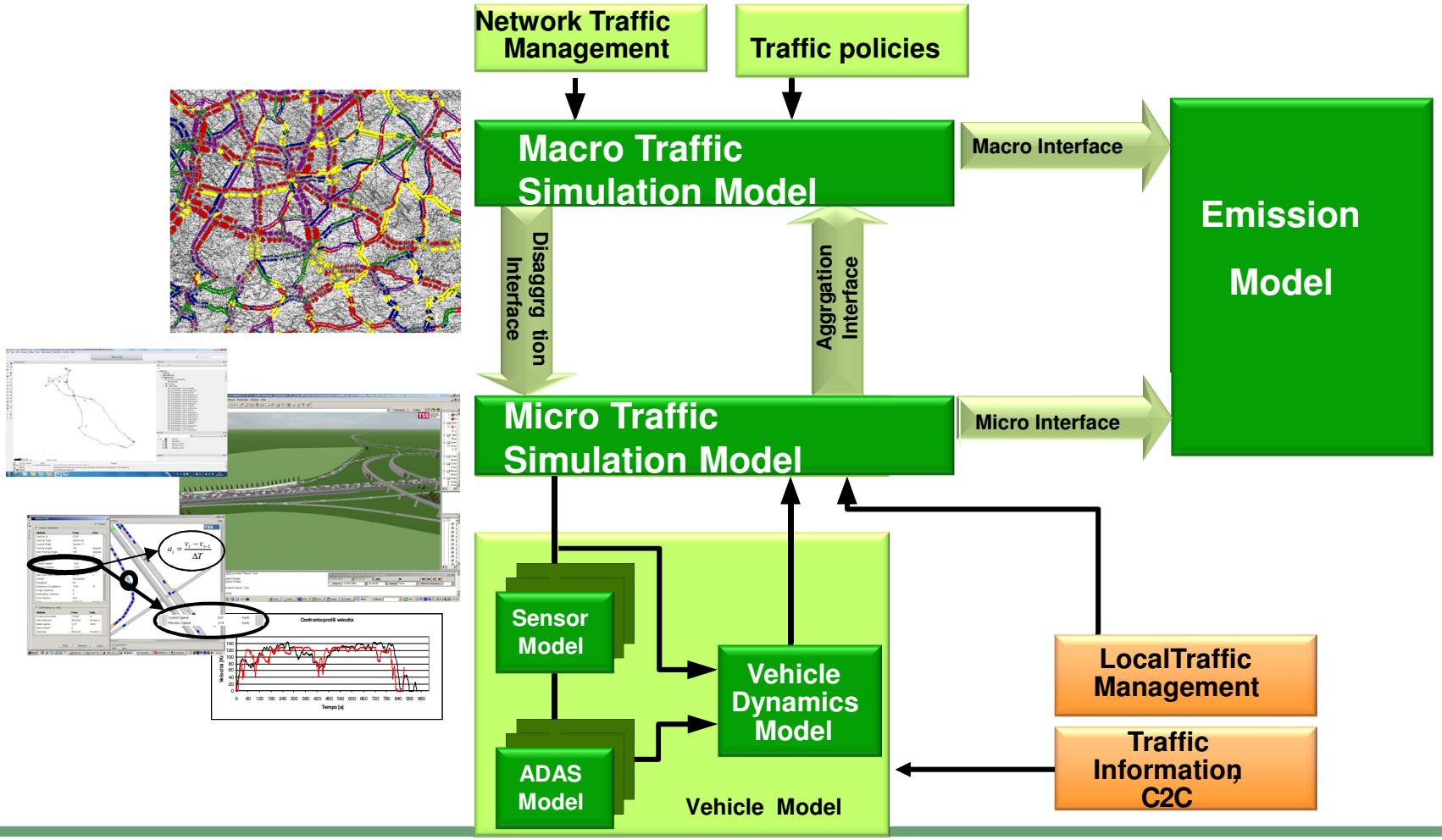
## - non ITS ma importante

| | NAME | BRIEF description | Code | ECOSTAND | METI |
|---|---|---|---|---|---|
| **Others** | **Road geometry** | Changes in the road geometry, like the transformation of an intersection with traffic light in a roundabout. | Road_geom | | |

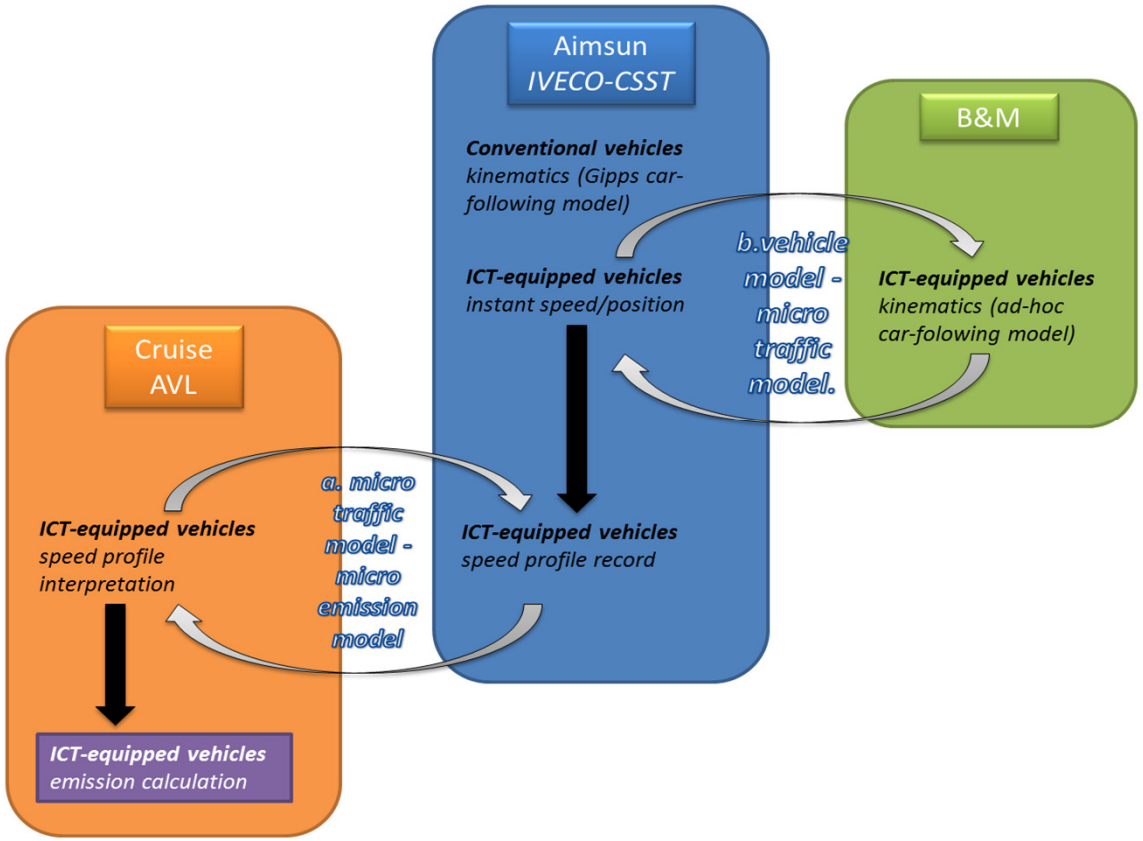
# Dettagli su impatti delle soluzioni

- **Road Type**:
  - Urban
  - Rural
  - Highway
- **Affected parameters:**
  - Road
  - Traffic Volume
  - Traffic Composition
  - Average Speed
  - Driving Dynamics
- **Models:**
  - Micro traffic model (AIMSUN, VISSIM, …)
  - Vehicle dynamic model (BM-model-Messina, …)
  - Macro traffic model (MT.model, VISUM, …)
  - Micro emission model (AVL CRUISE)
  - Macro emission model (COPERT, , …)

# Esempio of micro-macro simulation



# Integrazione di modelli a livello Micro



# Grazie per l'attenzione

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