Bari, 24 maggio 2018

Giornata di studio
«L'auto elettrica»

VEICOLI ELETTRICI A GUIDA AUTONOMA: LE TENDENZE ATTUALI

AUTONOMOUS ELECTRIC VEHICLES: CURRENT TRENDS

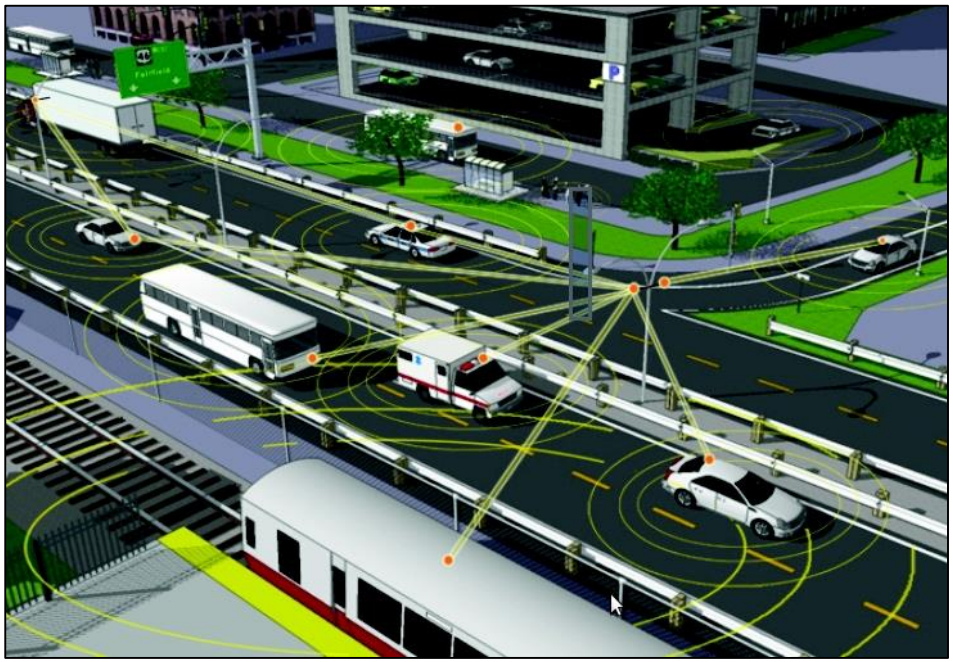
Prof. Mariagrazia Dotoli

Dipartimento di Ingegneria Elettrica e dell'Informazione - Politecnico di Bari

email: mariagrazia.dotoli@poliba.it

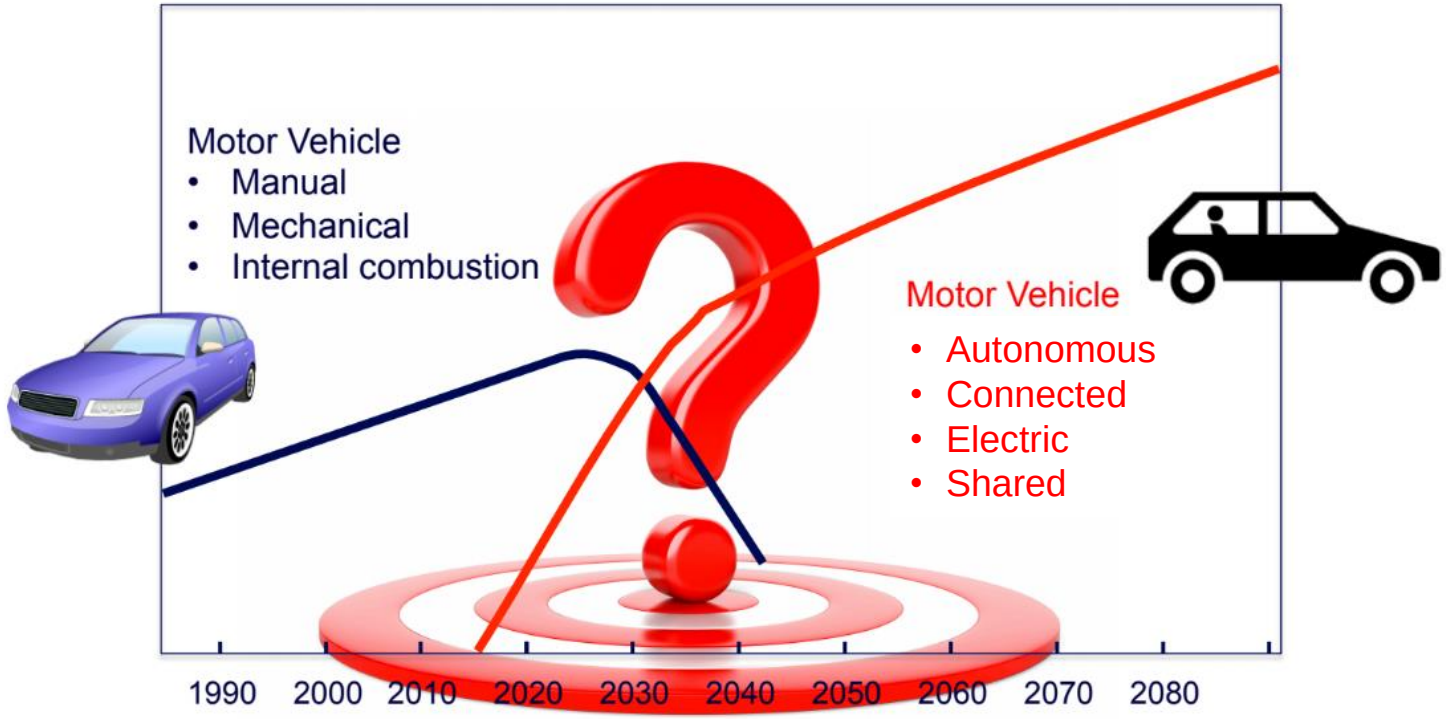
Outline

- Introduction
- Autonomous
- Connected
- Electric
- Shared
- ACES vehicles
- Conclusions



Introduction

- **The automotive and transportation industries are currently undergoing what is probably the most disruptive period in their history since Henry Ford first developed the mass production assembly line back in 1908.**



Towards the vehicle of future

- **Mobility is changing...and changing quickly**

Electric vehicle

- **The electric vehicle is the foundation for Autonomous Sustainable Transport**

Electric Vehicle Engineering in the ***next five years***

- **Manufacturing process improvements at a large scale:** high volume and low cost manufacturing of vehicle batteries;
- Processes for **vehicle battery recycling:** secondary uses or safe disposal;
- **Wireless EV charging stations** and **smart meters** at municipal parking facilities;
- Deployment of **on-site renewable energy generators** at public EV charging stations;
- **New parking facilities** (e.g., two-way communication capability) for connected and automated vehicles.

Electric vehicle

- **The electric vehicle is the foundation for Autonomous Sustainable Transport**

Electric Vehicle Engineering ***beyond five years***

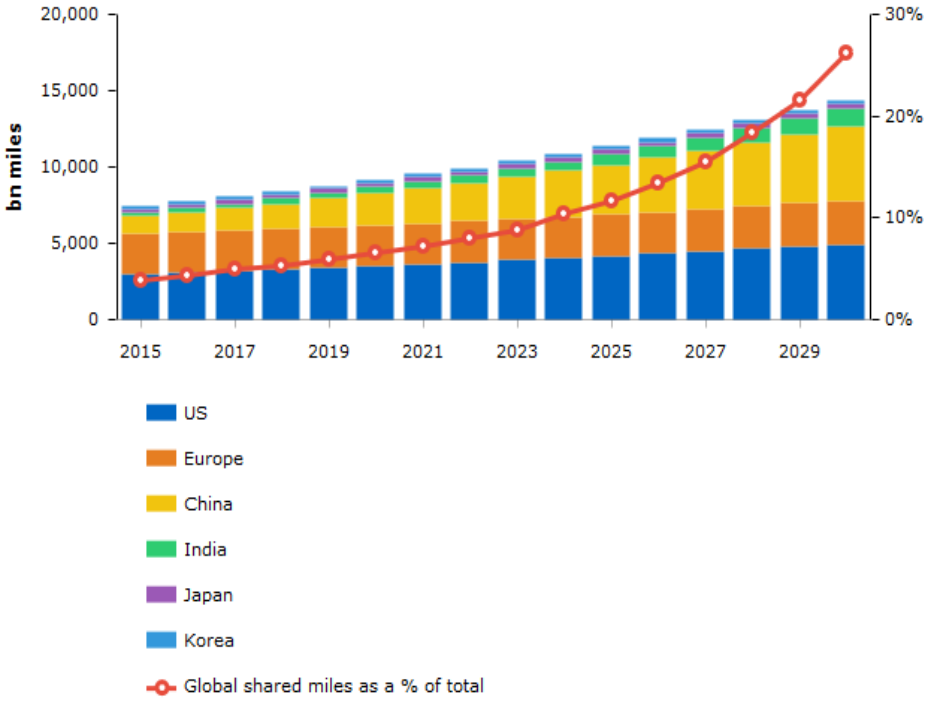
- **Battery swap techniques** developed for rapid "refueling" of battery Evs;
- **Standardization and mass deployment** of public EV charging stations
- **Standardization of wireless EV charging stations**;
- **Regulation, policy, business model** of public EV charging stations;
- **Industry-wide codes and requirements** for ancillary service (e.g., communication and information processing infrastructure) at public EV charging stations

Shared vehicle

- The vehicle-sharing service is currently considered as a **sustainable urban mobility service** for individual citizens and it is estimated that in 2030 its percentage of use in major world regions **will rise of more than 20%** with respect to 2015

Example of limitations:

- Use of fuel vehicles;
- Manual refueling;
- Under utilization of the service;
- Access to the service in fixed stations.



Shared vehicle

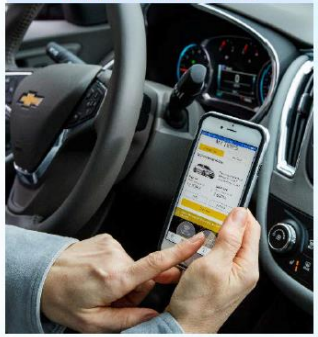
SIGNIFICANT URBAN MOBILITY PROJECTS

GOOGLE PILOT

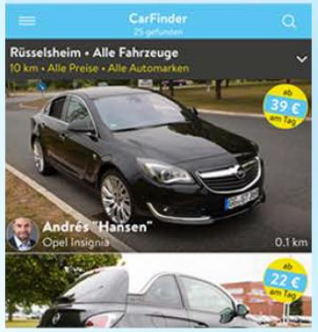
SJTU EN-V 2.0

WARREN TECH CENTER SHARING

MAVEN CITY-WIDE CAR SHARING

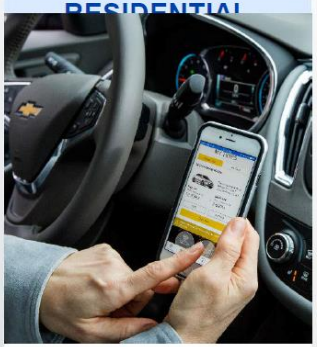


OPEL CarUnity



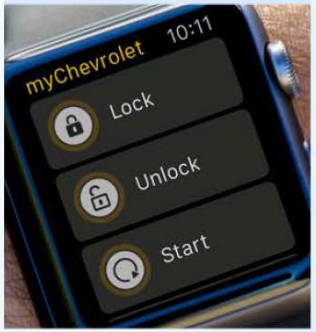
LET'S DRIVE NYC

MAVEN RESIDENTIAL



eBike concept

APPLE WATCH



Connected vehicle

- **Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication is essential for enabling autonomous driving**
  - **Information and communications capabilities in vehicles can make travel safer and more efficient**
  - **Each vehicle will need a V2V and V2I communication system to assist in tracking the vehicles, enabling vehicle platooning, collision warning, toll collection, triggering the road crossing signals, route guidance, obtaining entertainment services and information services, and many more applications!**

Connected vehicle

*Connected Vehicle Engineering in the **next five years***

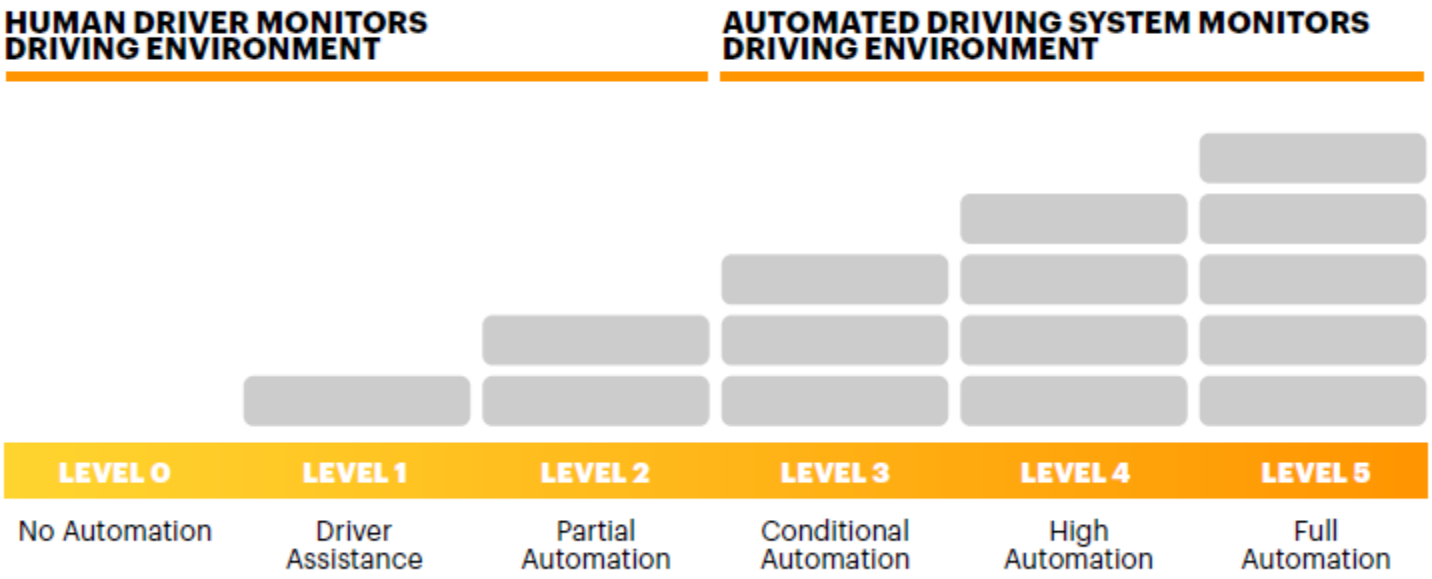
- Higher levels of **cooperation among vehicles,** supporting network level coordination of vehicles through intersections in order to minimize stops and delay.
- Analyzing vehicle to vehicle behavior in **merging, lane centering, and lane changing maneuvers** on both highways and surface streets

*Connected Vehicle Engineering **beyond five years***

- Integrating with and leveraging automated vehicle **sensors** like radar, lidar, and vision to increase the performance of the vehicles in specific maneuvers as well as extending the capabilities of the vehicle through communication with more remote objects
- Continued development of multi-sensor fusion and integration capabilities for improved perception including **V2V and V2I communication**
- Development of cross layer **communication protocols** to improve message delay performance for vehicles that are traveling at high speeds and where connectivity is unreliable

Autonomous vehicle

- **AV adoption is still in its infancy.**
  - **While various forms of intelligent driver assistance are now making their way into production models, high or full levels of automation (that is, levels 4 and 5 on the U.S. Department of Transportation's National Highway Traffic Safety Administration scale set out below) are still confined to the testing ground.**



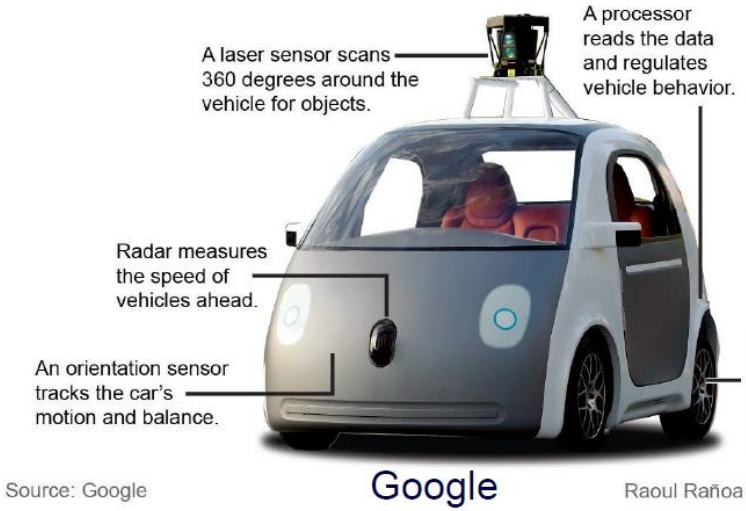
Autonomous vehicle

- **The SAE (Society of Automotive Engineers) classification**

SAE Level	SAE Name	SAE Narrative Definition	Execution of Steering/ Acceleration/ Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System capability (driving modes)
Human Driver monitors the driving environment						
0	No Automation	Warnings, Driver Information … driver of … even when enhanced by warning or intervention	Human Driver	Human Driver	Human Driver	N/A
1	Driver Assistance	Adaptive Cruise Control, (braking accel) Lane Keeping (steering), CACC Lane Centering (steering), ABS, ESC … that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human Driver and Systems	Human Driver	Human Driver	Some Driving Modes
2	Partial Automation	Traffic Jam Assist, (braking, acceleration, & steering) … one or more … and … about … expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human Driver	Human Driver	Some Driving Modes
Automated driving system ("system") monitors the driving environment						
3	Conditional Automation	Freeway Driving … performance by an … of all aspects of the *dynamic driving task* with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human Driver	Some Driving Modes
4	High Automation	Freeway Pilot, Campus Shuttle Freight Platooning, Urban Automation … not respond appropriately to a *request to intervene*	System	System	**System**	Some Driving Modes
5	Full Automation	Robotic Taxi … mance by an *automated driving* … cts of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	**System**	Some Driving Modes

Autonomous technologies - example

- **Automated Shuttle**



Autonomous technologies - example

- **Automated Freeway Driving**

Autonomous technologies - example

- **Truck Platooning**

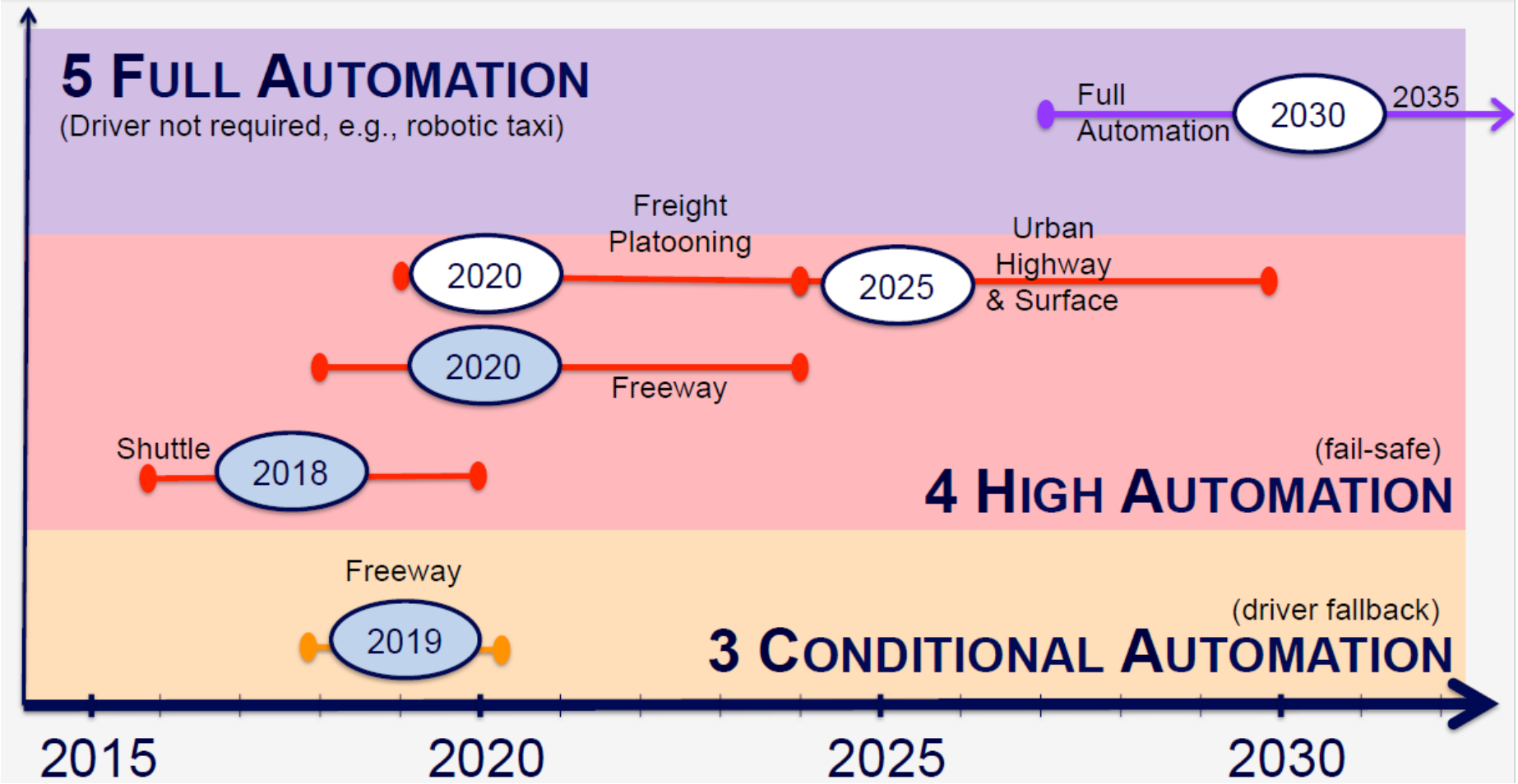
- **Freightliner Inspiration Freeway Pilot**

Autonomous technologies - example

- **Full automation**

Autonomous vehicle

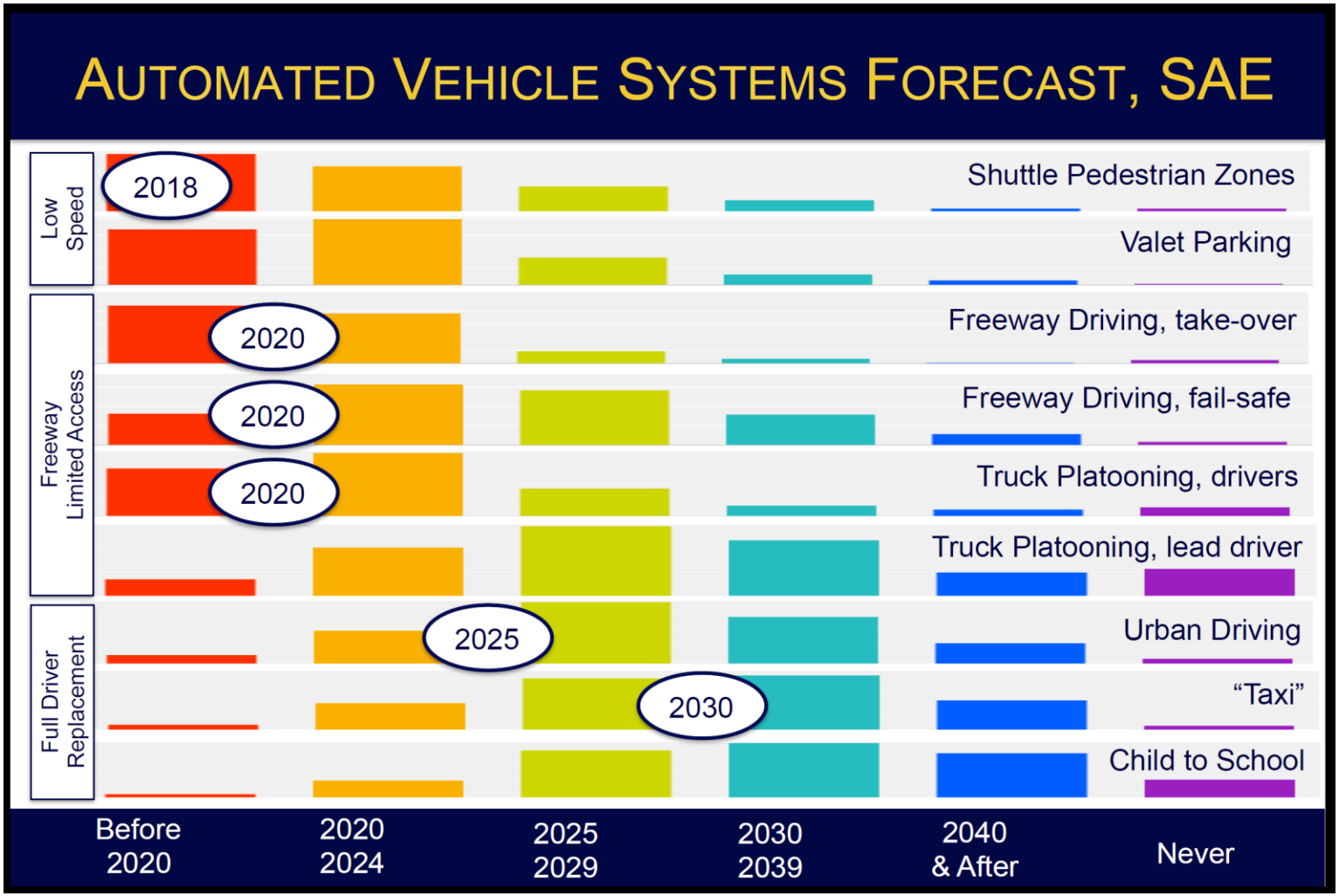
Market Introduction *



*** Survey at SAE Convergence 2016**

Autonomous vehicle

Market Introduction *

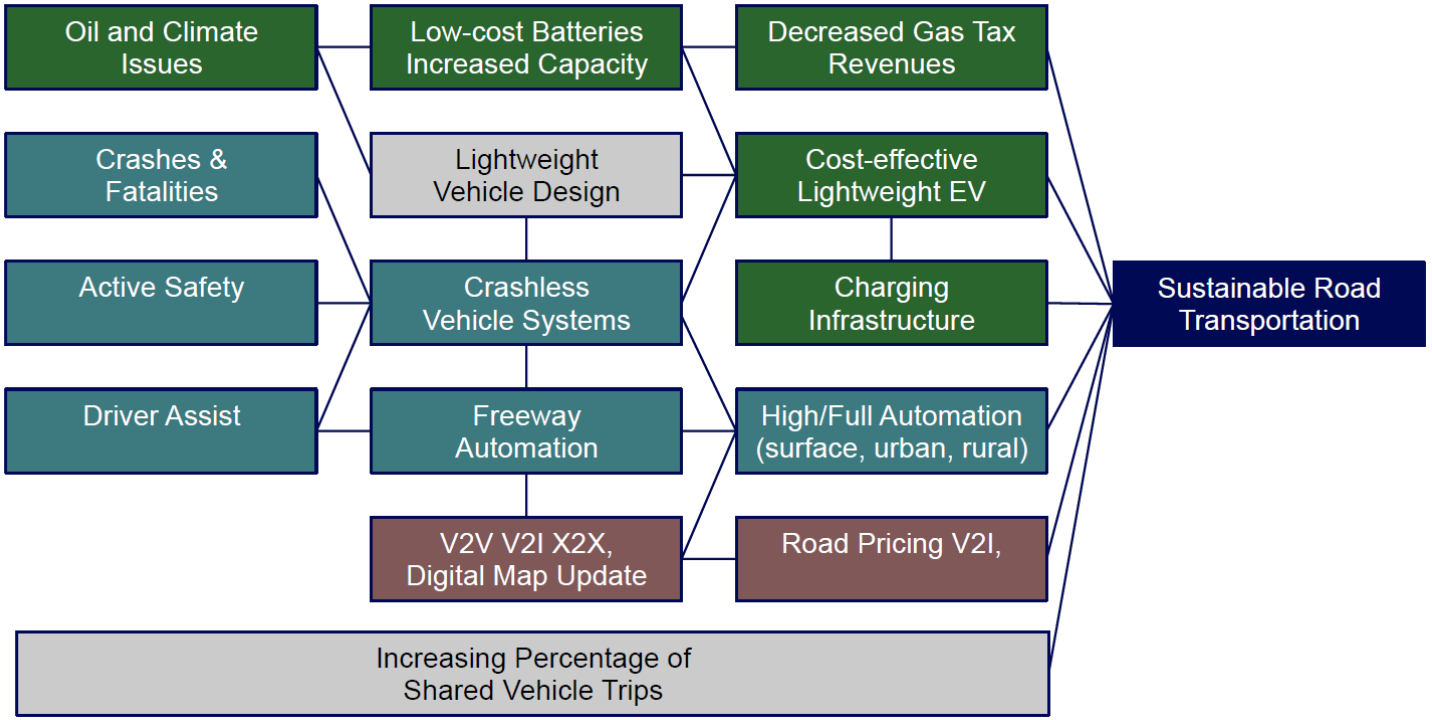


*** Survey at SAE Convergence 2016**

ACES vehicles

Autonomous Connected Electric Shared Vehicles can lead to…

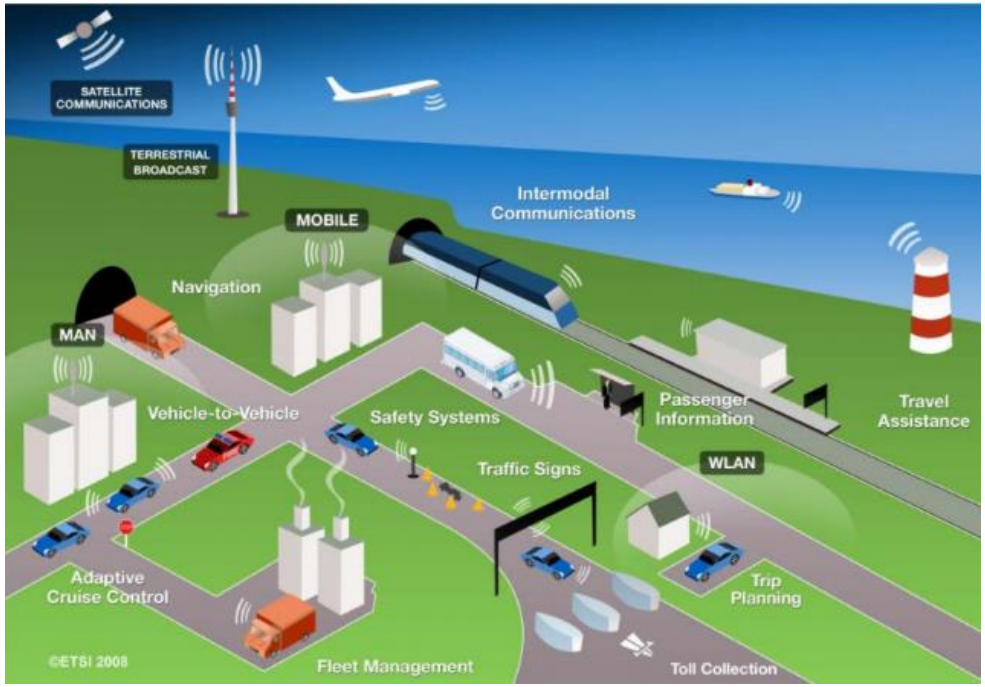
ZERO CRASHES | **ZERO EMISSIONS** | **ZERO CONGESTION**



ACES vehicles

ACES Vehicles engineering challenges:

- Regional-scale **vehicle flow dynamics** and **electric power demand profiles** modeling;
- **Large-scale simulation** to support optimal vehicle mixes and control strategies;
- Computerized and automated control functions to **min. energy consumption, max. range, red. collisions**;
- Simulation and testing to **ramp up car sharing systems** optimizing availability of mobility service while minimizing the fleet sizes;
- **Automated, driverless refueling** of EVs;
- Wireless connectivity for **software upgrades** and coordination of **maintenance requirements.**



The Italian Decree «**Smart Roads**»

- On **March 2018** the Minister of Infrastructures and Transport **Graziano Delrio** signed the **Ministerial Decree** (Law of 27 December 2017, n. 205 - Budget Law 2018), which authorizes the **experimentation** of technological solutions to adapt the Italian infrastructural network to new smart services and **automatic vehicles**.
- The **Smart Road decree** aims at digitalizing the Italian road network to allow:
  - Communication between the network and the new generation of **connected vehicles**;
  - Experimentation of advanced levels of **automatic driving assistance**;
  - Improve and **streamline traffic**;
  - Reduce **road accidents**.
- By **2025** interventions on the infrastructures belonging to the Trans European Network - Transport (TEN-T) and on the entire motorway network are planned.
- By **2030** then space for **advanced services**: services to divert flows in case of accidents, dynamic management of accesses, parking management and **refueling** (with particular reference to **electric charging**).

The Italian Decree «**Smart Roads**»

- **Interventions** necessary for the communication of high bit-rate data (eg: fiber) are expected:
  - Coverage of the whole road infrastructure with routing connection services to the data communication network,
  - Presence of a system of **hot-spot WiFi** for the connectivity of citizens' devices, located at least in all service and parking areas
  - A system to **detect traffic** and weather conditions and provide medium-short term **forecasts** and an estimate / forecast for successive periods of time.
  - On the basis of the data collected, then, the system will offer content for **advanced travel information services** to users, allowing any re-routing actions.

The Italian Decree «**Smart Roads**»

- The costs of the interventions will be borne by the concessionaire or the infrastructure manager.
- The decree authorizes the experimentation on the road of **automatic guided vehicles** and defines:
  - The **parties** who can apply for authorization (vehicle manufacturer equipped with automatic driving technologies, as well as universities and public and private research institutions);
  - The **preliminary investigation** that must be carried out before appliance;
  - The **means** by which the authorization is issued;
  - The **controls** to which the experimentation activity is subject

  with the aim of ensuring absolute safety during the experimentation phases.
- By May 24 th 2018 the Italian Ministry of Transportation will present the innovation framework to be developed for the digital ans sustainable development of smart roads in Italy.

Conclusions

- Before 2030, 35% of the distances covered in the world shall be covered by shared vehicles.
- **In 2025 the electric mobility market will be worth 2400 billions dollars.**
- By 2025 half of the produced cars will be with electric/hybrid propulsion
- The mobility market in Italy currently covers about 10% of the GDP (200 billions euros).
- **Only 0.1% of new cars in Italy in 2017 are electric/hybrid, which is three order of magnitude lower than the Norwegian percentage (a stunning 40%!)**
- **In Italy only 1700 charging stations for electric cars (200 in Rome) are available.**
- The EU launched GEAR2030 in 2016, to ensure a coherent EU policy on vehicles. The group gathers several Commissioners, Member States and stakeholders representing the automotive, telecoms, IT and insurance industries. GEAR2030 shall make recommendations to ensure that the relevant policies are in place for the roll-out of highly automated and connected vehicles by 2030.
- Italy has to participate in the run for ACES vehicles as a leader: it is required by the market. Otherwise automotive producers will lean back and even touristic input flows by car will fall back.
- **Staying still is not an option: adopting suitable laws/incentives/governmental policies is in order.**

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