



A Paradigm Shift Toward Zero Accident

Dr Amir Soltani, Lecturer

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The Motivations

Toward Intelligent Mobility



Current Transport System: Safety is Low

- Around 1.24mn people die every year in road crashes around the world, costing 1-3% of global GDP.
- That number is projected to reach 2.2mn by 2030, making it the fifth-leading cause of death.
- Another 20-50mn sustain non-fatal injuries as a result of road traffic crashes.
- More people are killed in traffic accidents each year than in all domestic airline crashes in the last 45 years combined.
- In 2012 in the US, large trucks were responsible for 330,000 accidents, in which 4,000 people were killed. 90% of these crashes were due to driver error.
- The 75+ population is 2.5x more likely to have a fatal car accident than those under 75.

(Sources: WHO, Association of Safe International Road Travel, Techcrunch, Roland Berger, Japan National Police Agency)

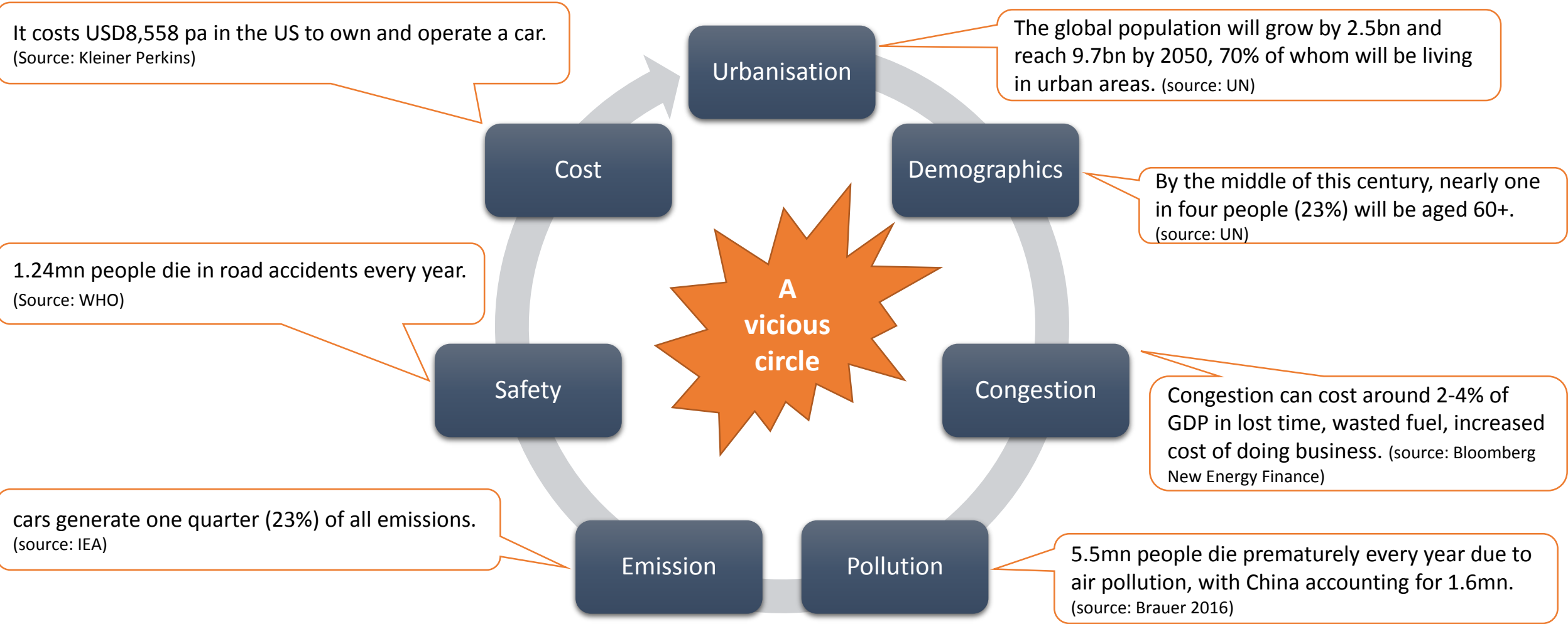


Current Transport System: Inefficient !

- USD8,558/year in the US to own and operate a car.
- The US average 2.2 vehicles/household with 20% of households with 3+ cars.
- 95% of the time a car spends parked, not being in use.
- 31% of urban land is parking spaces.
- 30% of urban traffic is looking for spots.
- 40% of fuel wasted in cities is by people looking for parking.

(Sources: WHO, Swiss Re, Kleiner Perkins, Google, Shoup 2005, Kenworthy & Laube, Casualty Actuarial Society)

Current Transport System Challenges

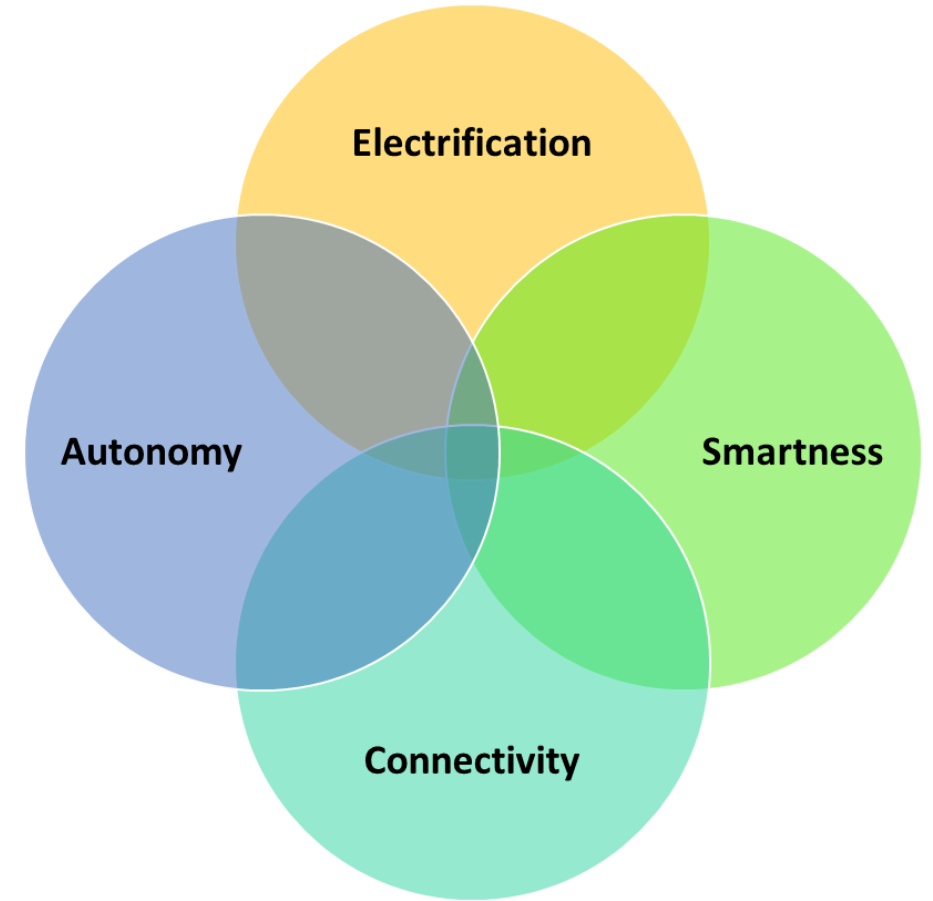
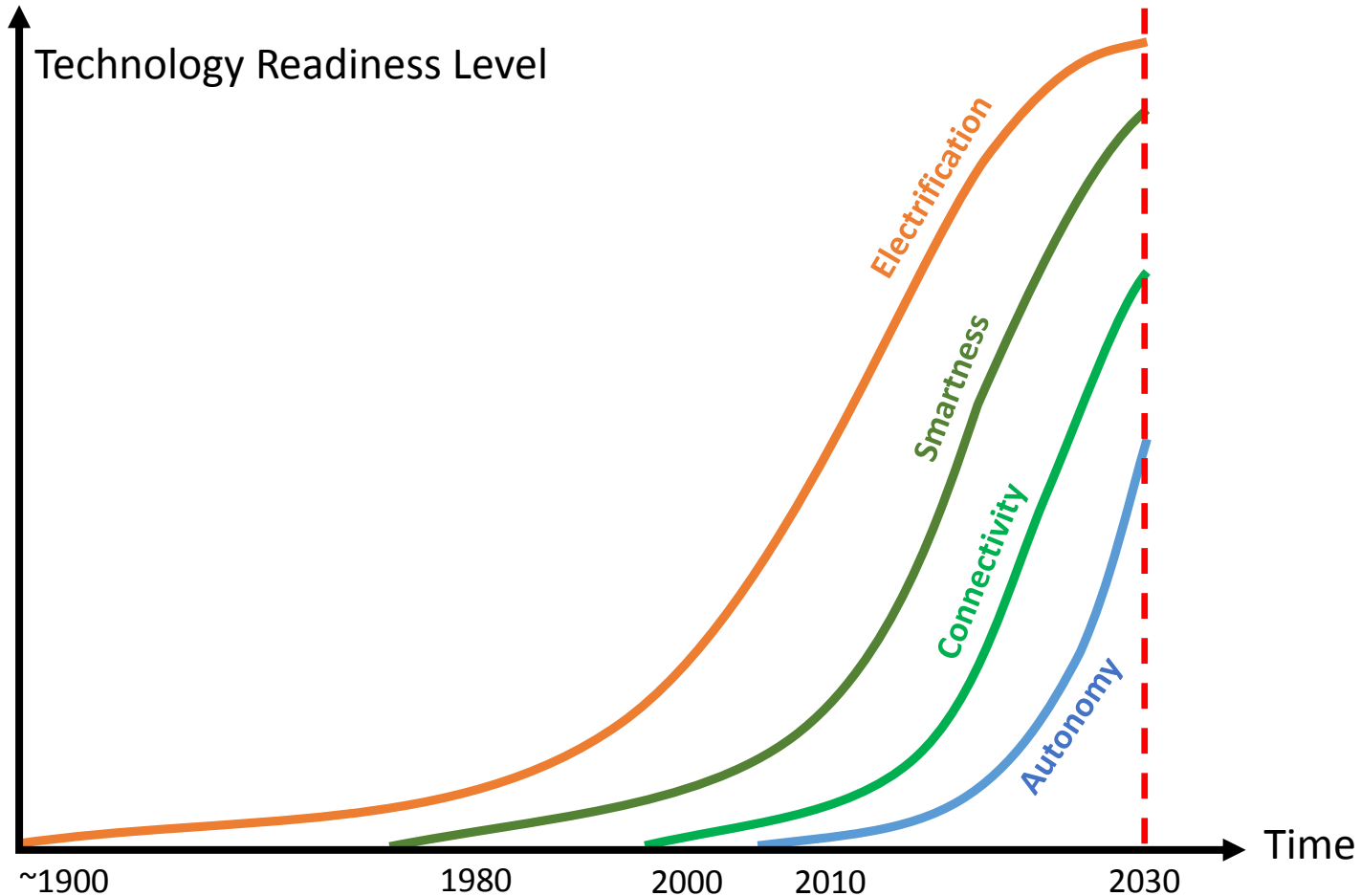


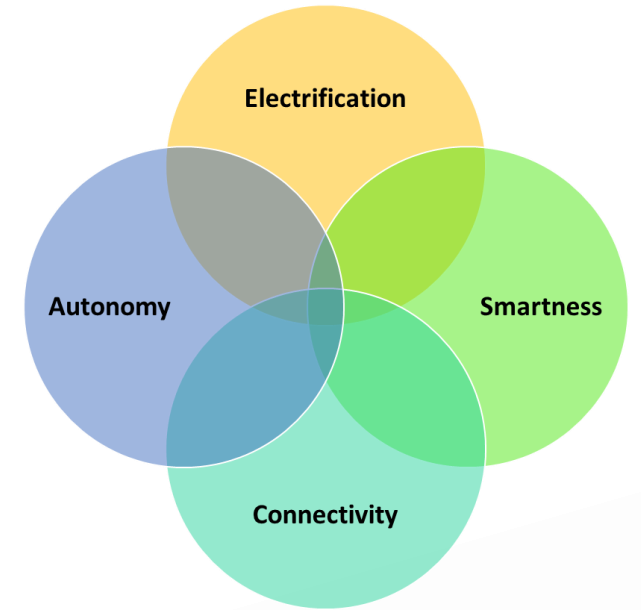


The Technological Enablers

Technology Pushes

4 Technological Enablers



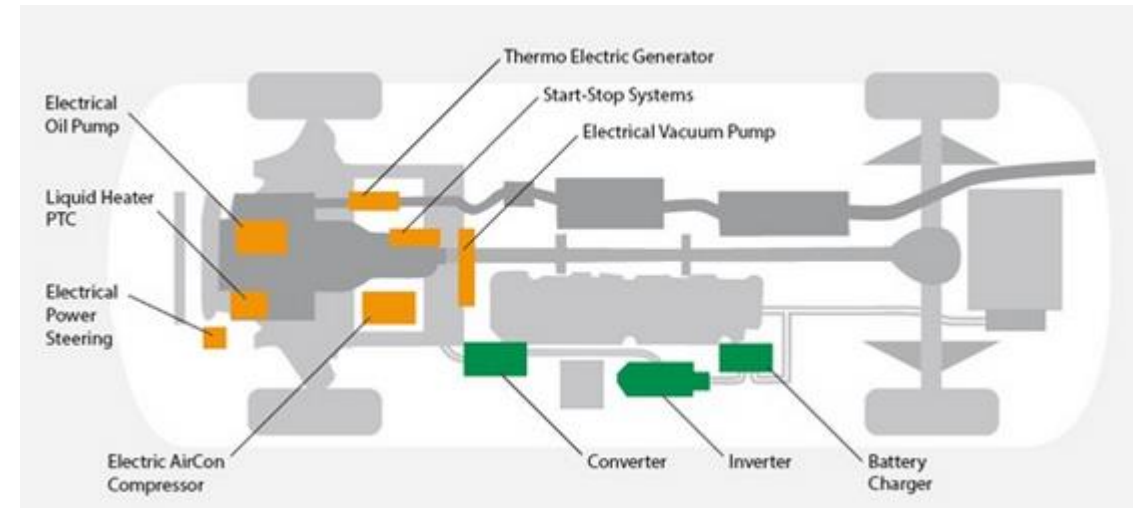


1- Electrification



Vehicle Electrification is not just about EVs

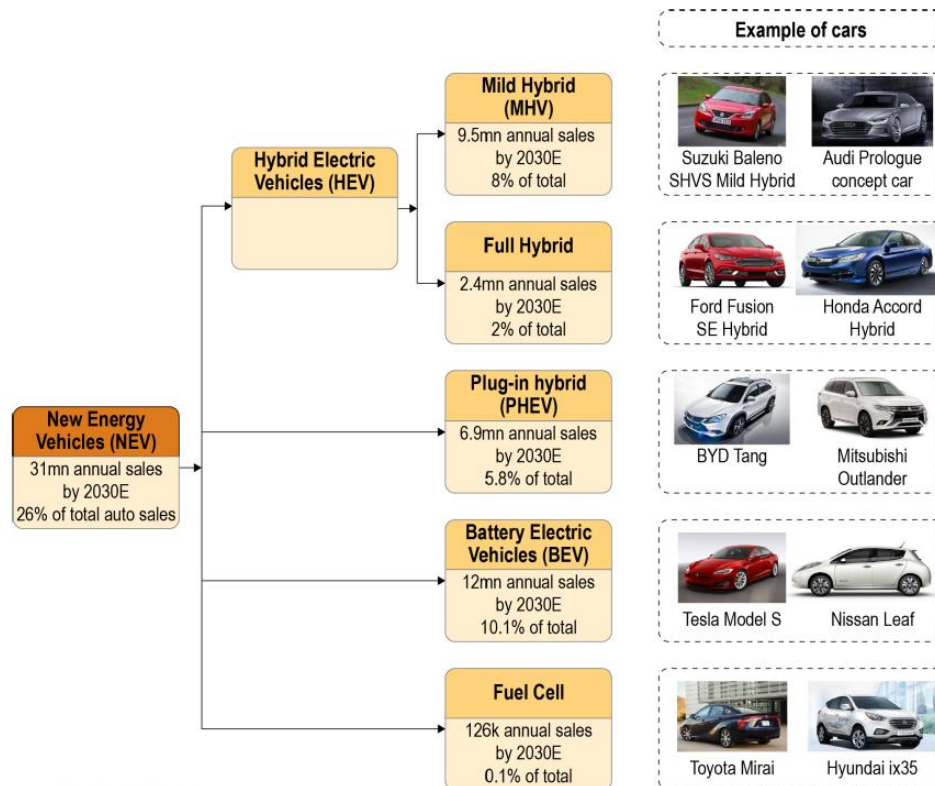
- Vehicle Electrification:
 - Electrical means of propulsion,
 - Electrical means of other actuations (Steering, Brake, suspension, e-turbo, etc), as well as,
 - Electricity playing a role in their functionality.
- Motivations:
 - CO2 Reduction, and Regulations
 - Fuel Economy
 - More Functionalities
 - More Control Opportunities
 - Weight Reduction
 - Packaging Flexibility



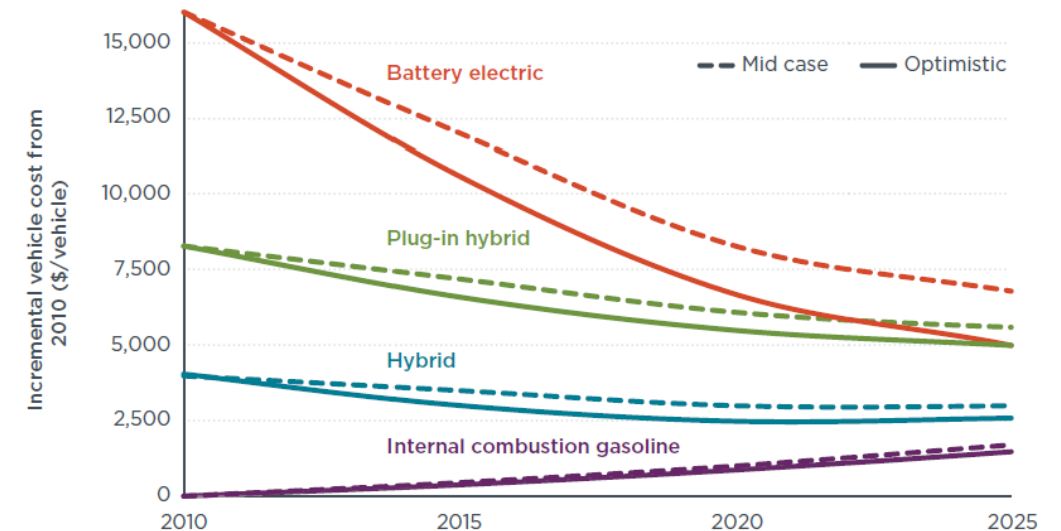
EV & HEV Market Outlook

Mass adoption of EVs could reduce annual emissions by nearly 1Gt by the late 2030s in the US alone, this corresponds to around 20% of total annual emissions from the country in 2014. (sources: Rocky Mountain Institute - IEA 2016)

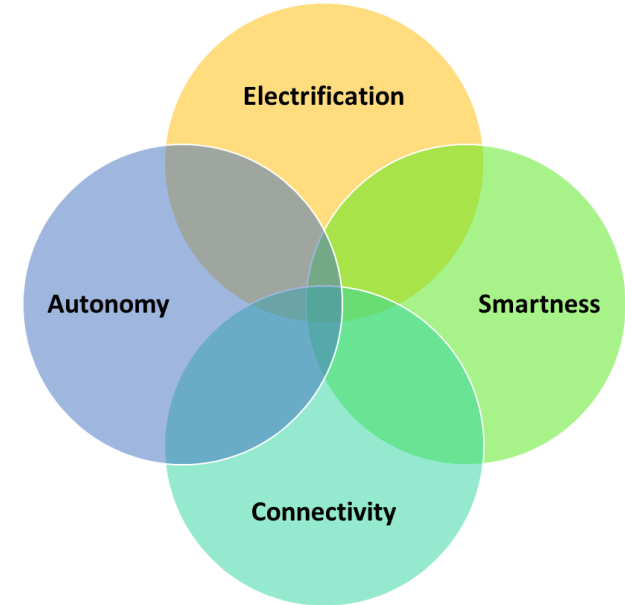
New energy vehicles are expected to reach 26% of global sales (31mn vehicles) by 2030



Source: BofA Merrill Lynch Global Research



Source: ICCT



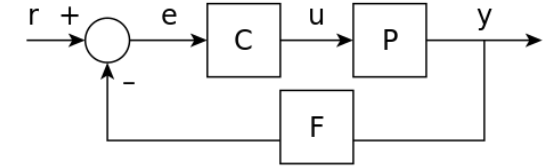
2- Smartness

(Embedded Systems)



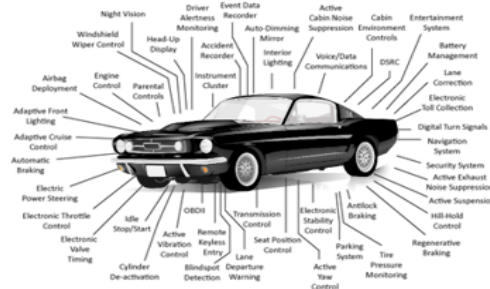
What do we mean by Smartness ?

Hardware and Software technologies for more powerful, cheaper and smaller:
Sensors, Processors and Actuators.



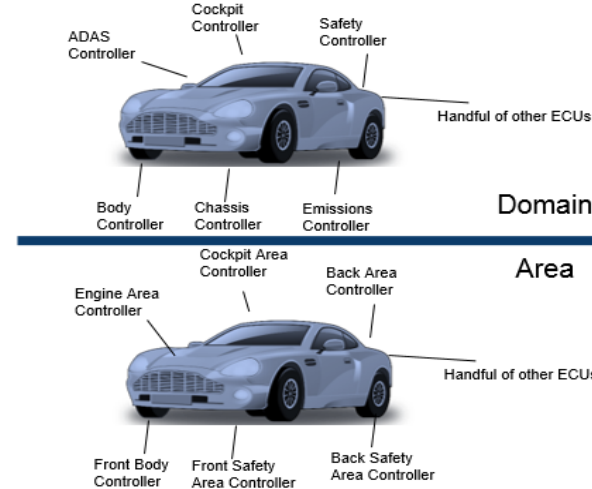
ECU Consolidation

Into a distributed central compute platform



TODAY

- 60-100 ECUs
- 6-8 operating systems
- Isolated operations
- Increasing cost & complexity



TOMORROW

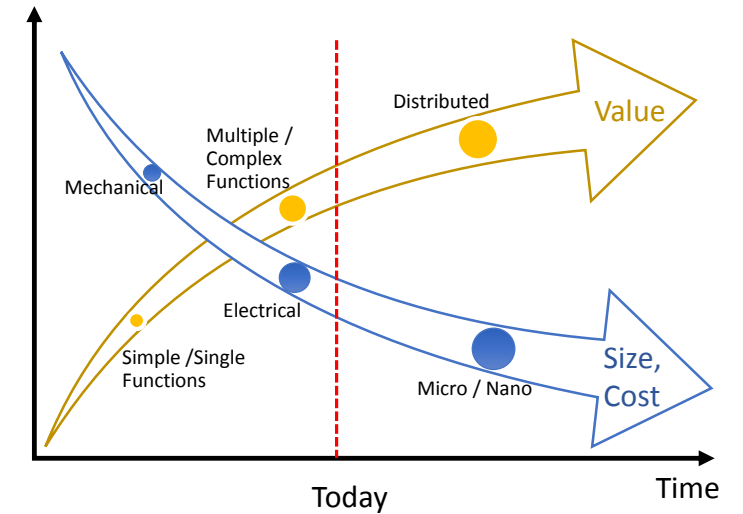
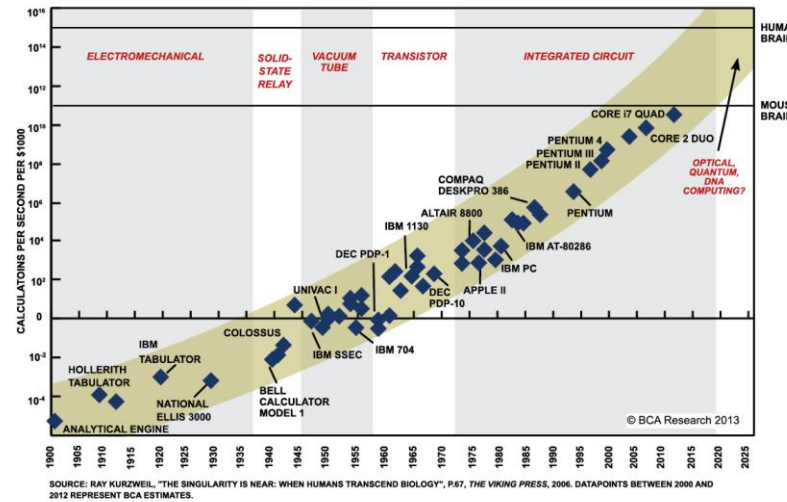
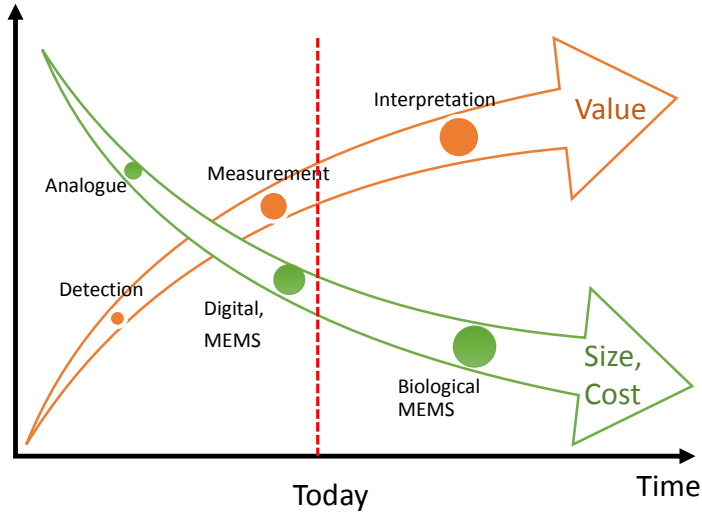
- 6-10 Domain/Area Mega-controllers
- Consolidated software system
- Coordinated operations
- Reduced weight, cost, & complexity

The Future Trend of Mechatronics (Smart) Systems

Sensing

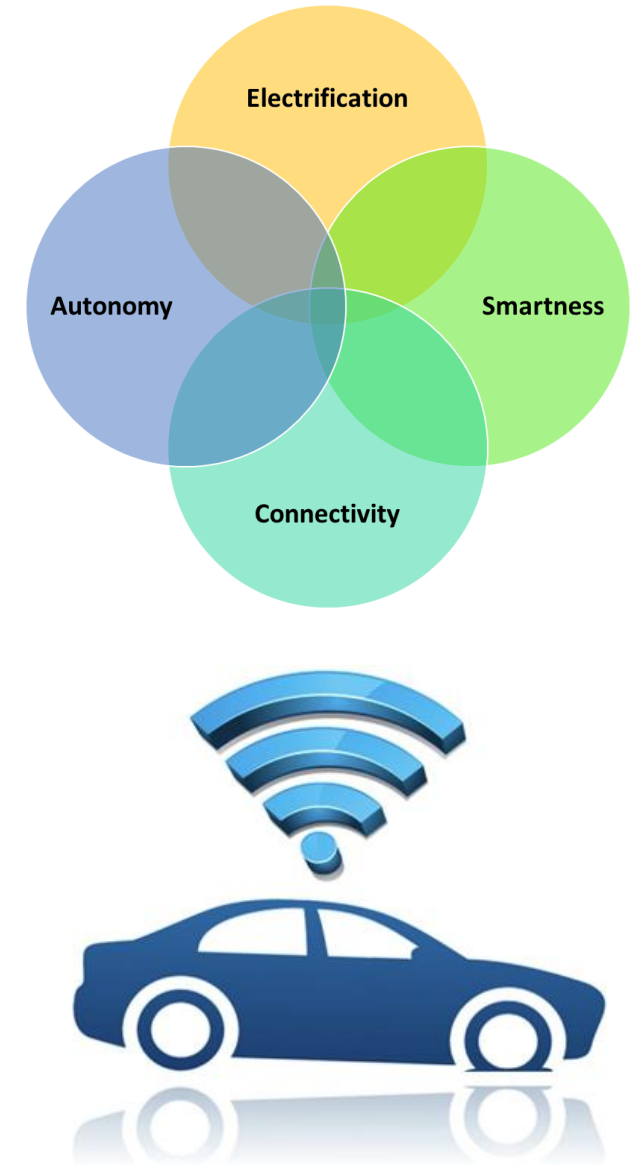
Computing

Actuating

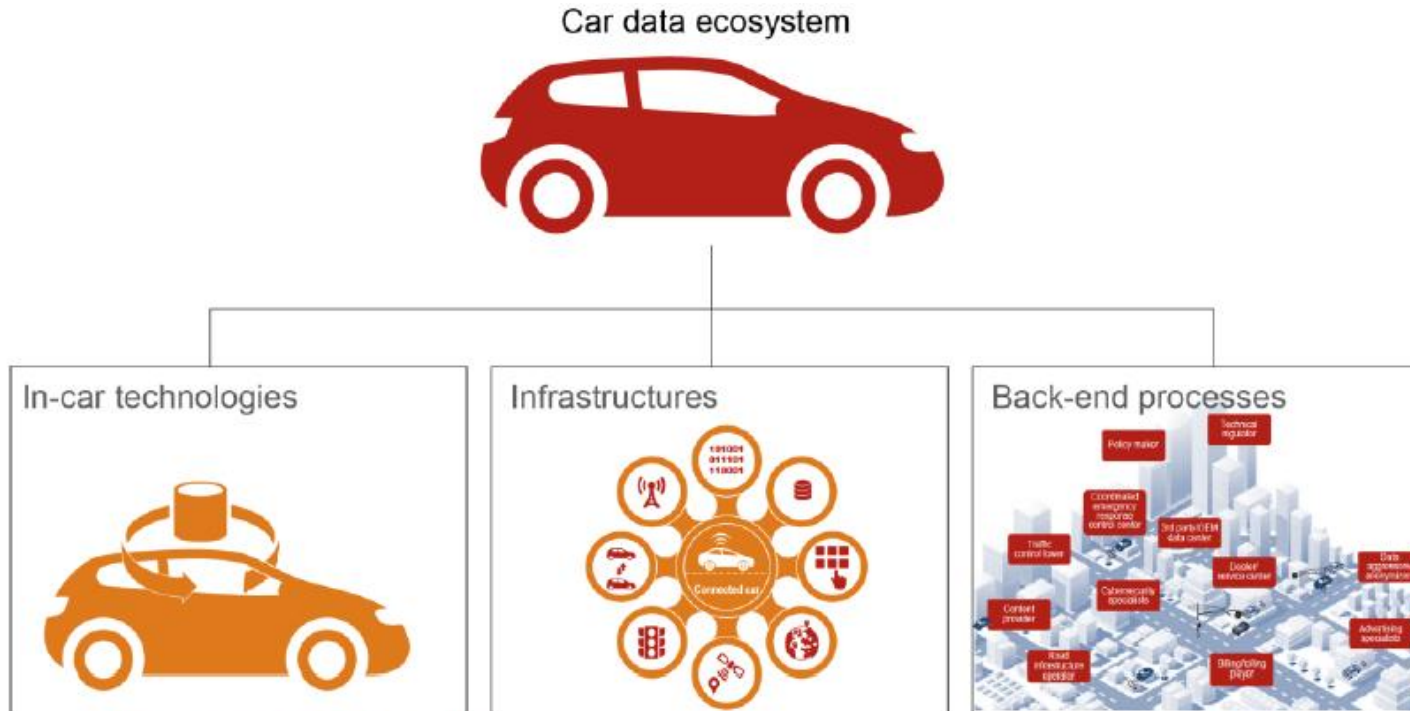


3- Connectivity

(Internet of Cars, IoC)



The Car Data Ecosystem (Main Enablers)



Connected:

- Within the car
- To the personal devices
- Around the car
- To the cloud

Source: McKinsey, BofA Merrill Lynch Global Research

As many as 80% of all crashes could be avoided using V2V AND V2I technologies.

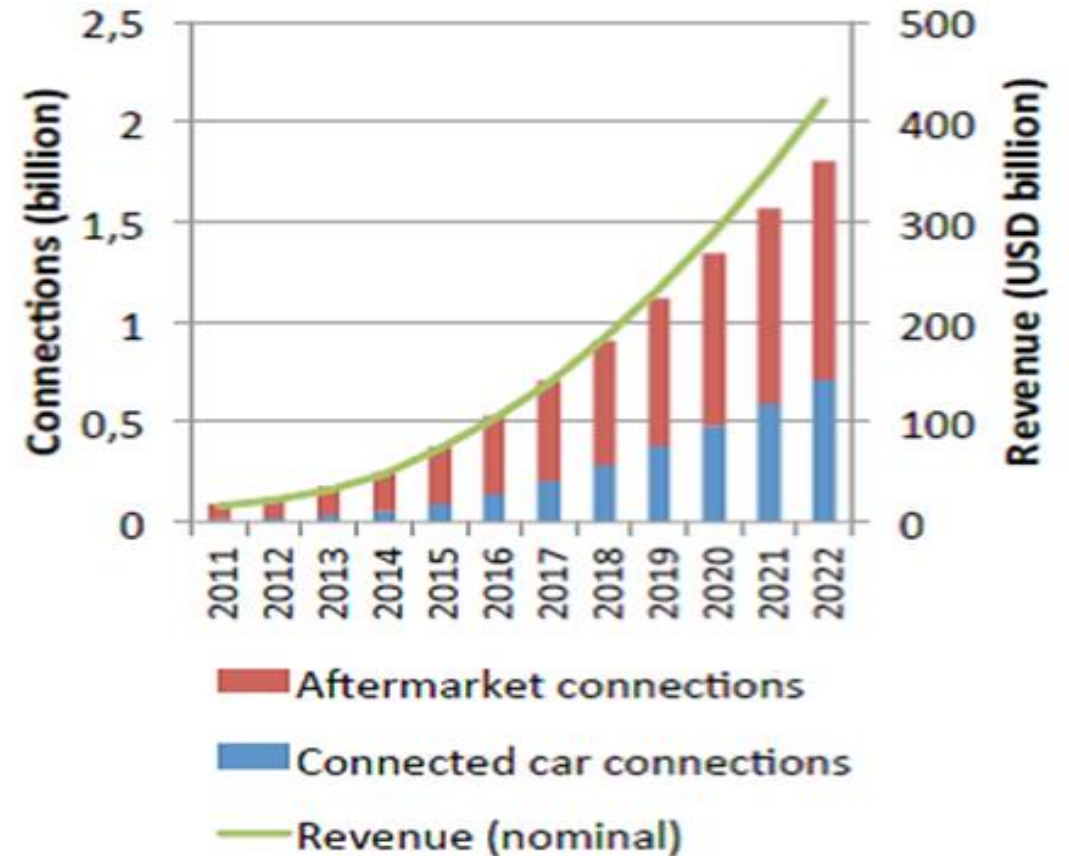
Source: US Department of Transportation (USDOT)



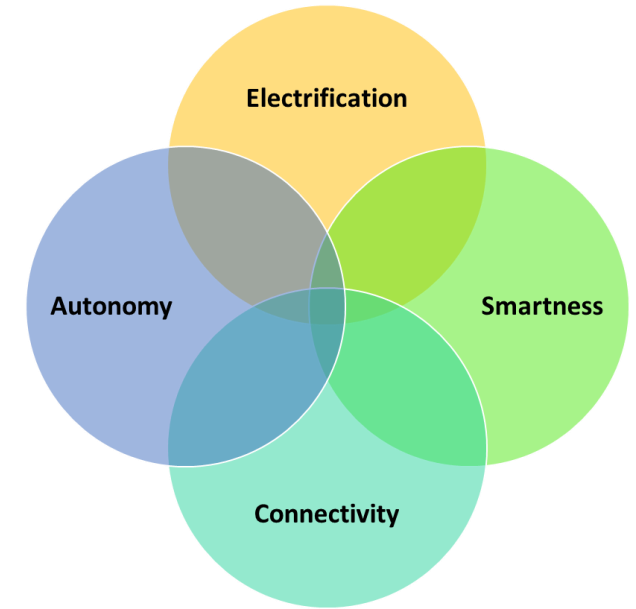
Connected Cars On the Rise

by 2020:

- 1.8 billion automotive M2M connections,
- 700 million Connected Cars,
- 1.1 billion aftermarket devices,
- Overall the M2M market in the automotive sector will generate USD**422**bi in 2022, compare to USD**22**bi in 2012.
- 90% of new vehicles will have factory-fitted connections by 2023.

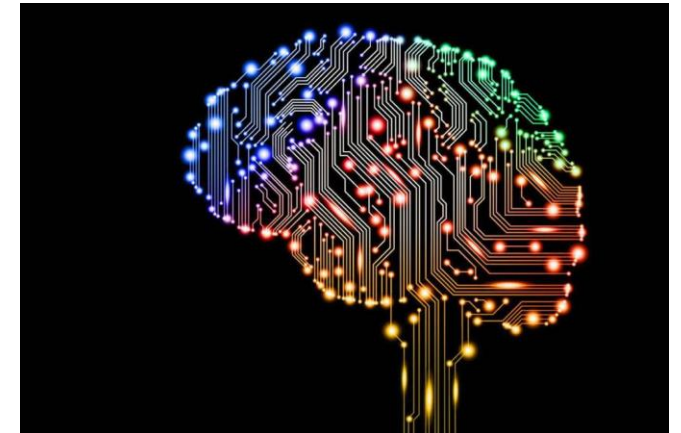


Source: Machina Research 2013



4- Autonomy

(Cognitive Technologies)





What do we mean by Autonomy

The application of Artificial Intelligence technologies, to replicate the complex task of human driving.

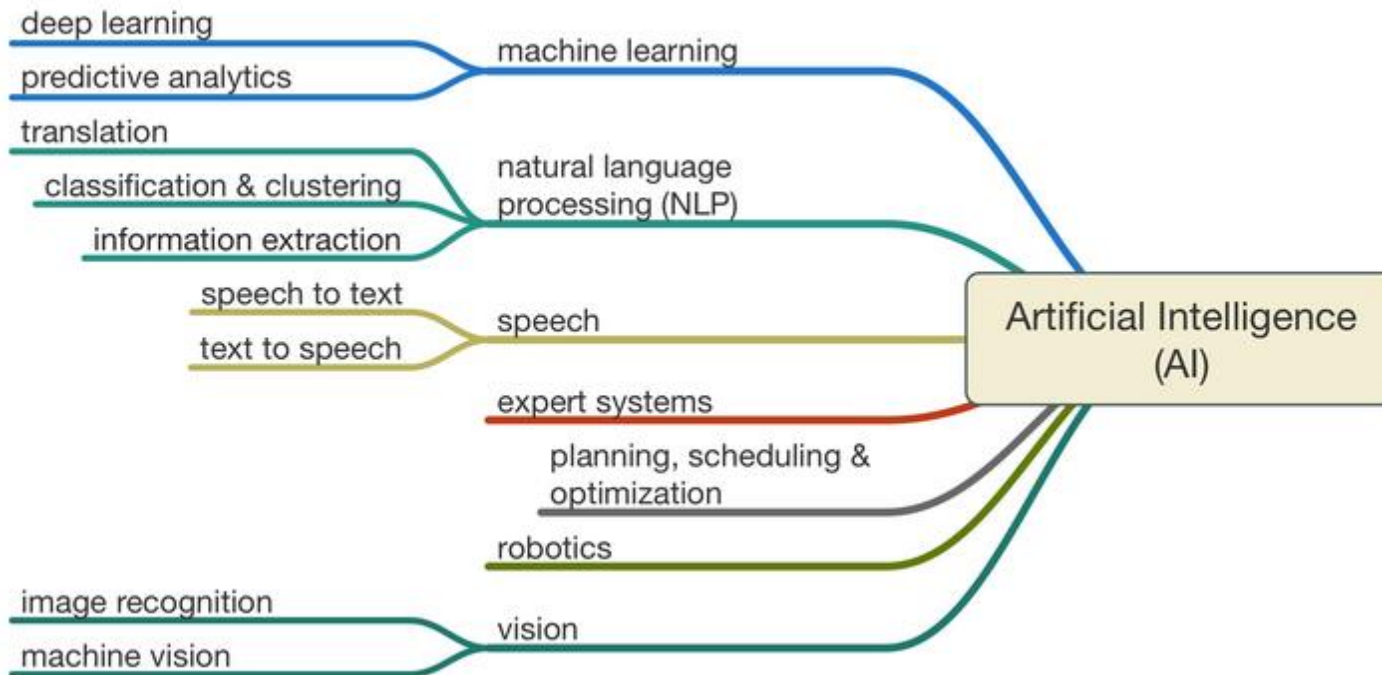
Autonomous Not Automated !!

- Autonomous means having the power for self-governance.
- Autonomous control implies good performance under significant uncertainties in the environment for extended periods of time and the ability to compensate for system failures without external intervention.

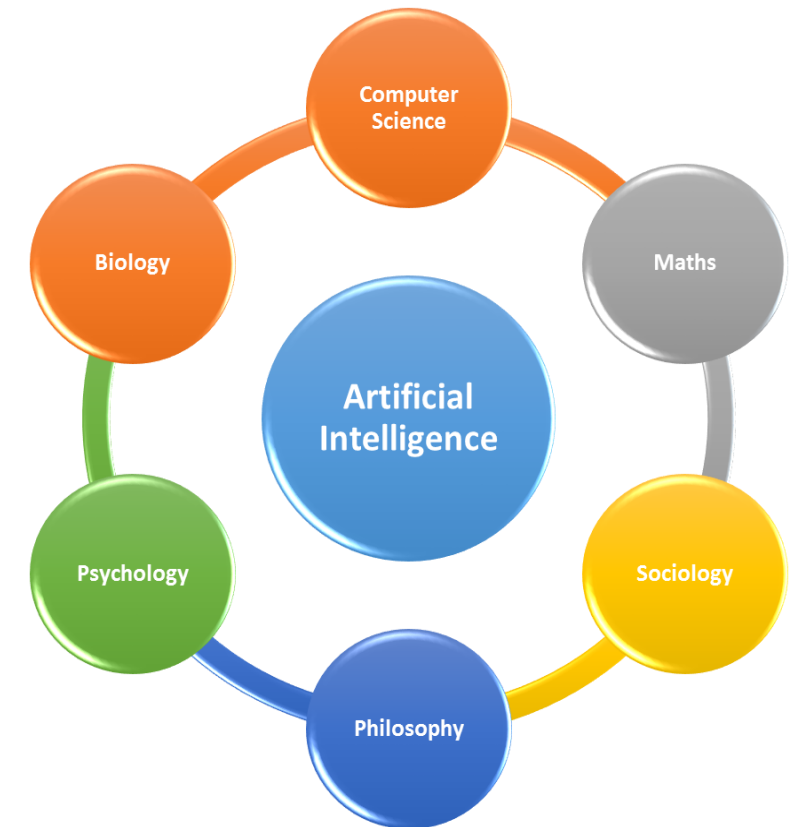
Antsaklis, Panos J.; Passino, Kevin M.; Wang, S.J. (1991). "An Introduction to Autonomous Control Systems". IEEE Control Systems. 11 (4): 5–13. doi:10.1109/37.88585

AI is an Interface between human and machine

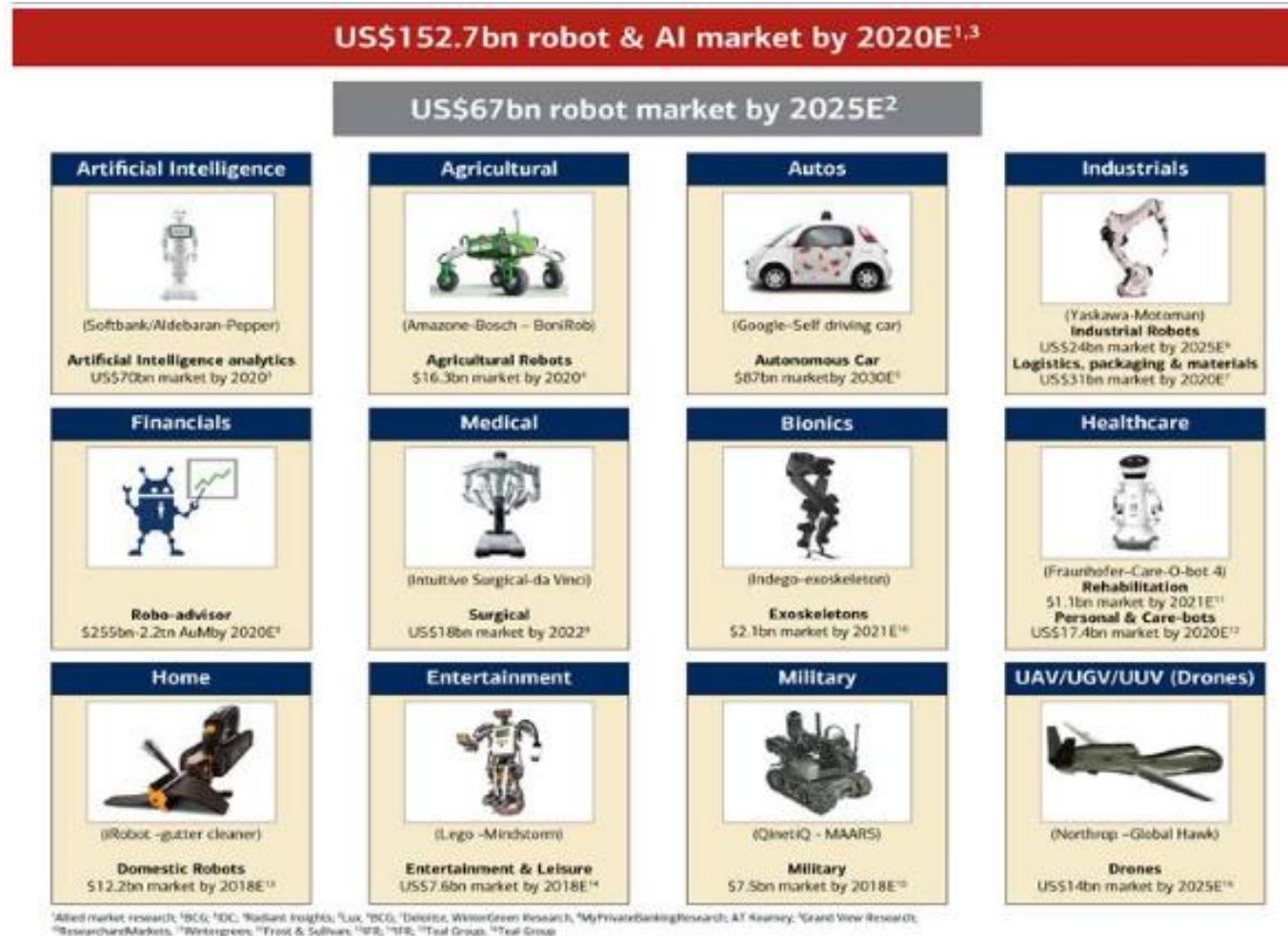
AI: The theory and computer systems able to perform tasks that normally require human intelligence.



Source: Ganesan Senthilvel, 2017



The global robots & artificial intelligence market



Source: BofA Merrill Lynch Global Research

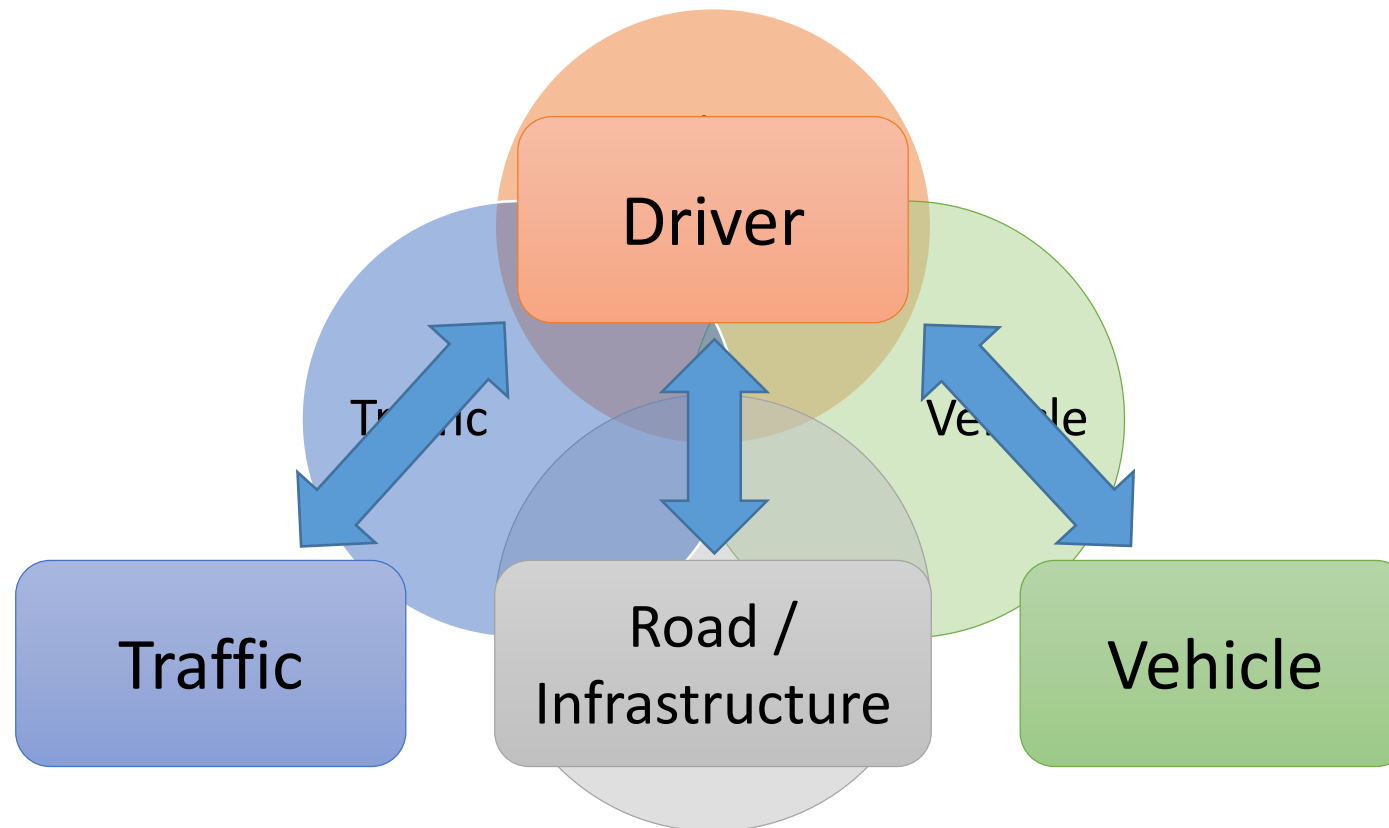


Intelligent Mobility

Toward Zero Accident Vision

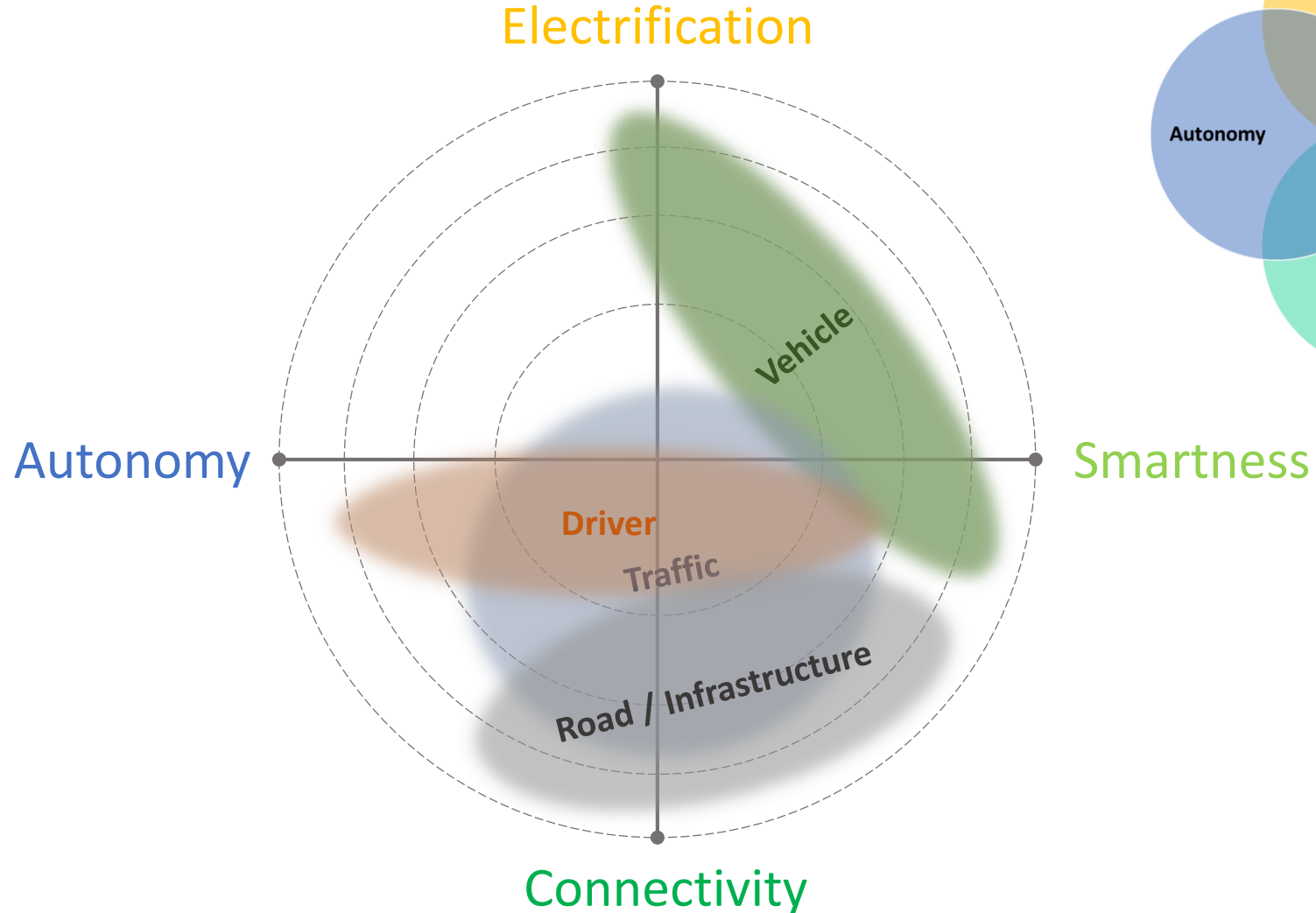
Elements of a Transport System

95% of accidents are caused by human error (source: NHTSA)

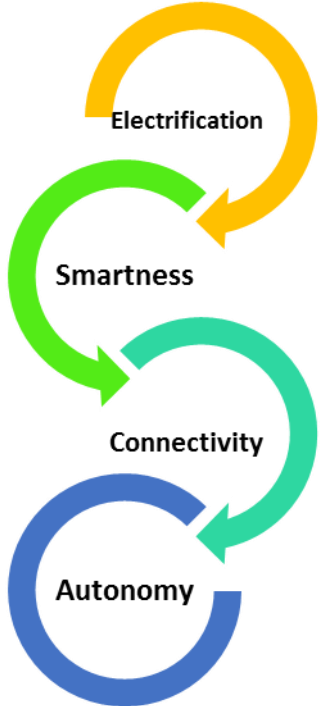


The 4 Technology Enablers and ITS

The Future Mobility market is projected to rise to USD1.5tn by 2030E versus USD30bn today. This includes over USD450-750bn in data connectivity, apps, navigation, entertainment, remote services, and other tech-based solutions which would be created on the back of new business models (source: McKinsey).



The Technology Trends

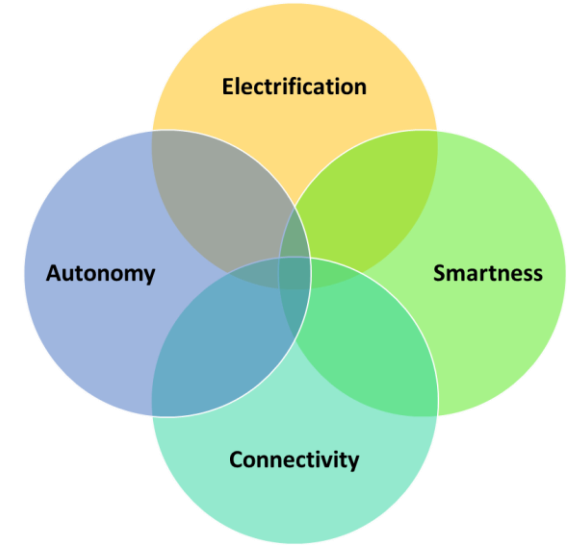
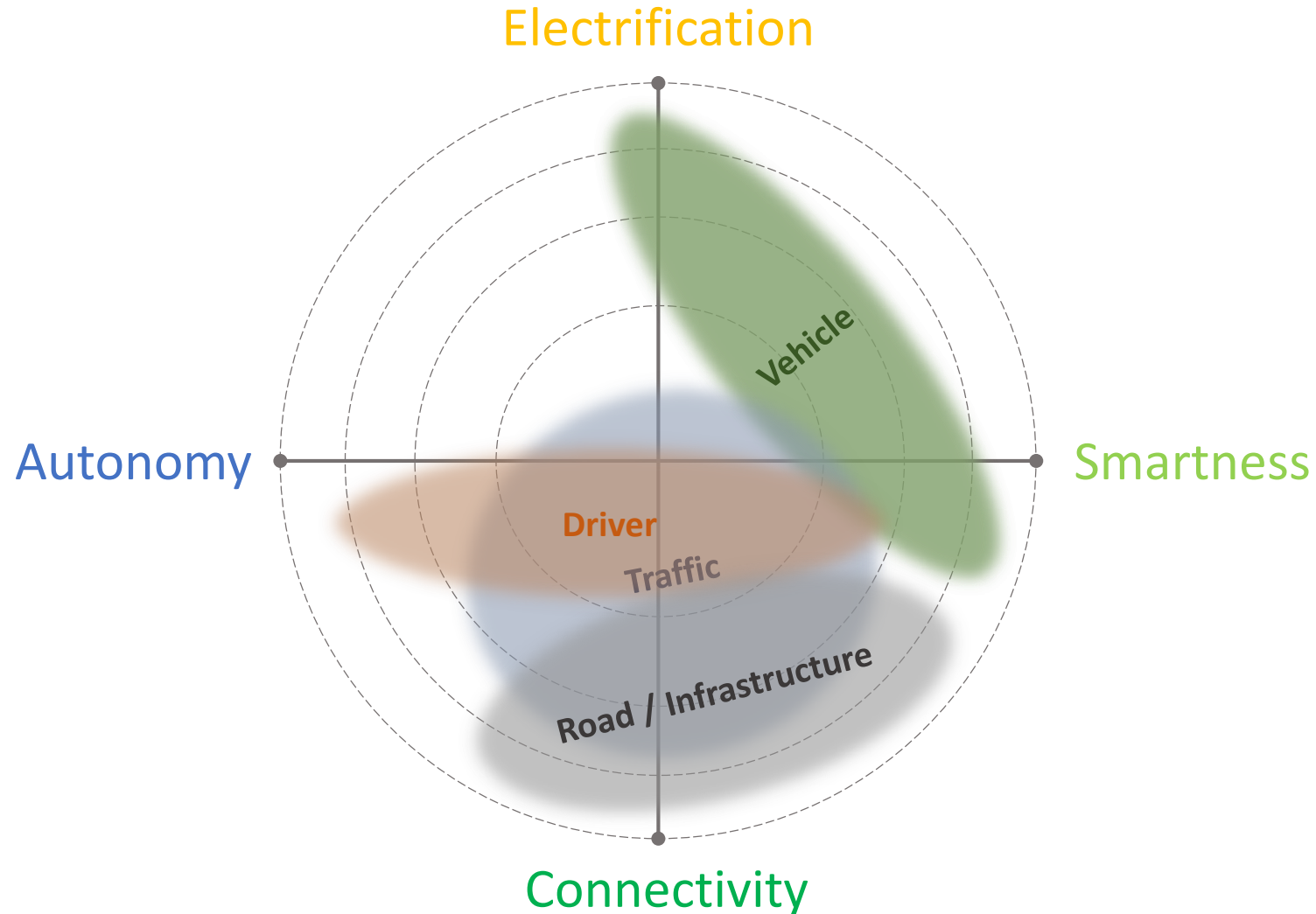
	Driver	Vehicle	Road / Infrastructure	Traffic
	Human Like Artificial Intelligence.	Full Electric, Smart, Connected, Autonomous Vehicles.	Fast charging, intelligent, connected roads. High-Speed cloud computing and storage systems.	Connected, Intelligent and Cooperative driving systems.



A Paradigm Shift

Toward Zero Accident Vision

The 4 Technology Enablers and ITS



Do we need a Paradigm Shift ?

Before Internet



After Internet



Present



Future

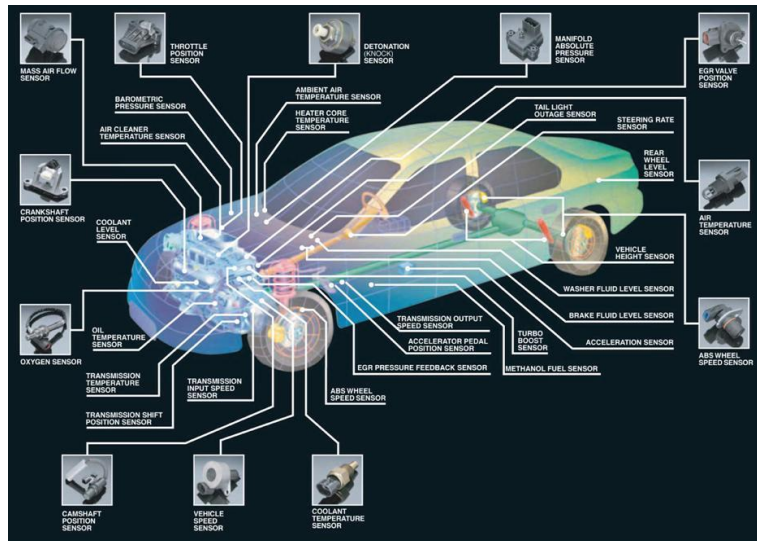




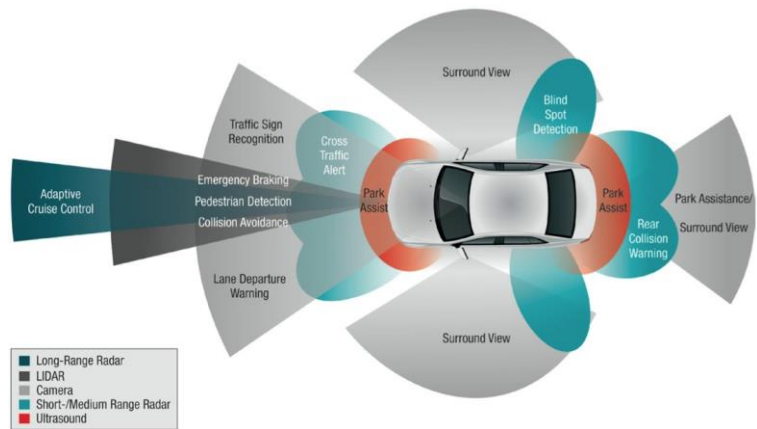
The difference

	Current	Future
Driver	Human Driver	Virtual (AI) Cooperative Driver
Vehicle	Vehicle Centric	Network Centric
Road	Isolated (disconnected) Roads	Connected Roads and Infrastructures
Traffic	(Passive) Visual Signs	Interactive Virtual Signs

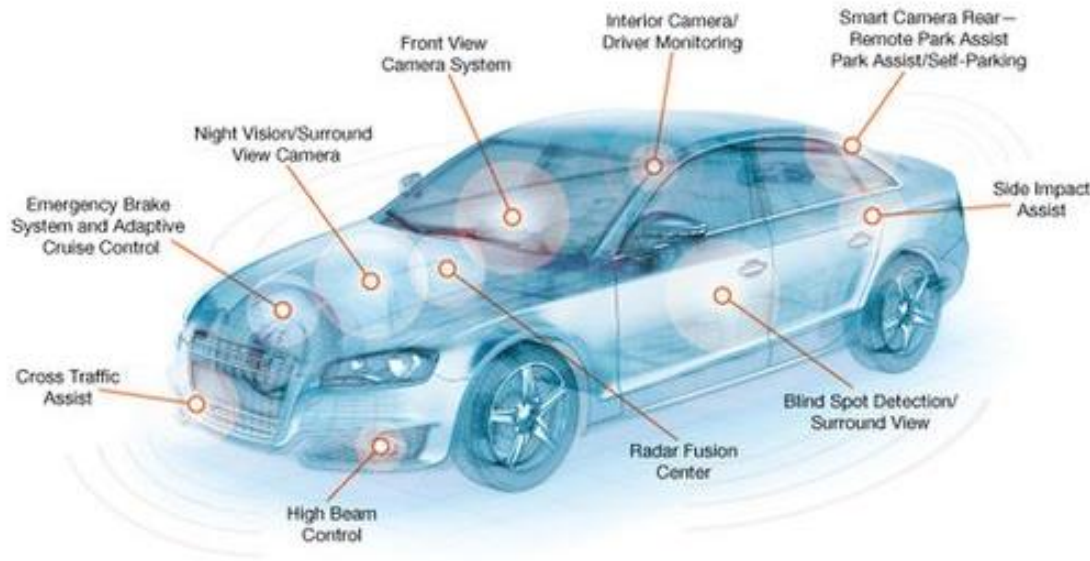
Vehicle Sensors



Do we need such huge number of individual, single tasking sensors in the vehicles?

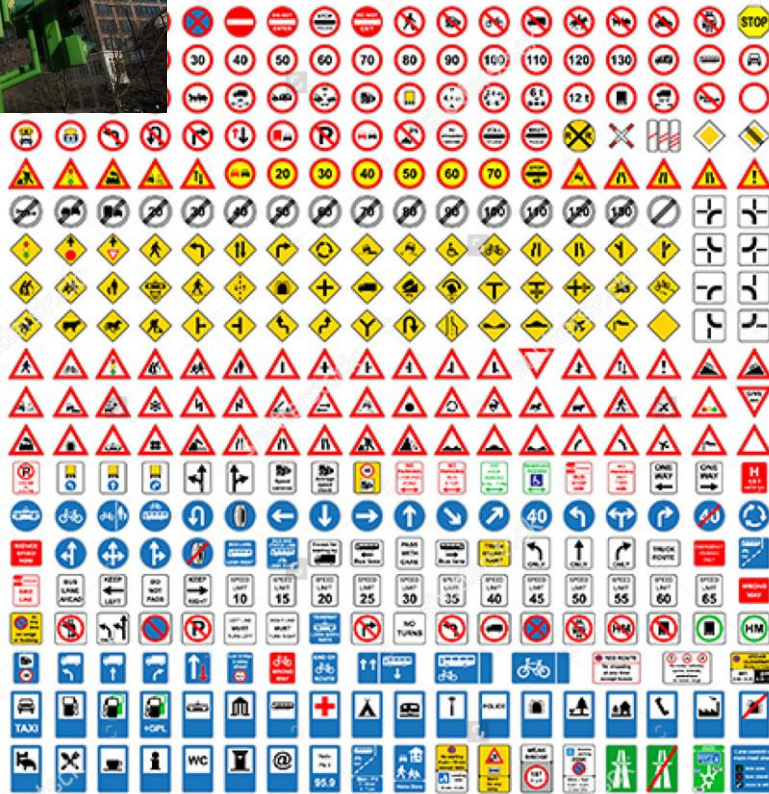


Active Safety Systems



Do we need such
complex,
distributed, and
Vehicle Centric
Active Systems?

Road Signs / Marks



Do we need such a complex, and confusing Road Signs / Marks in the future?



The Challenges

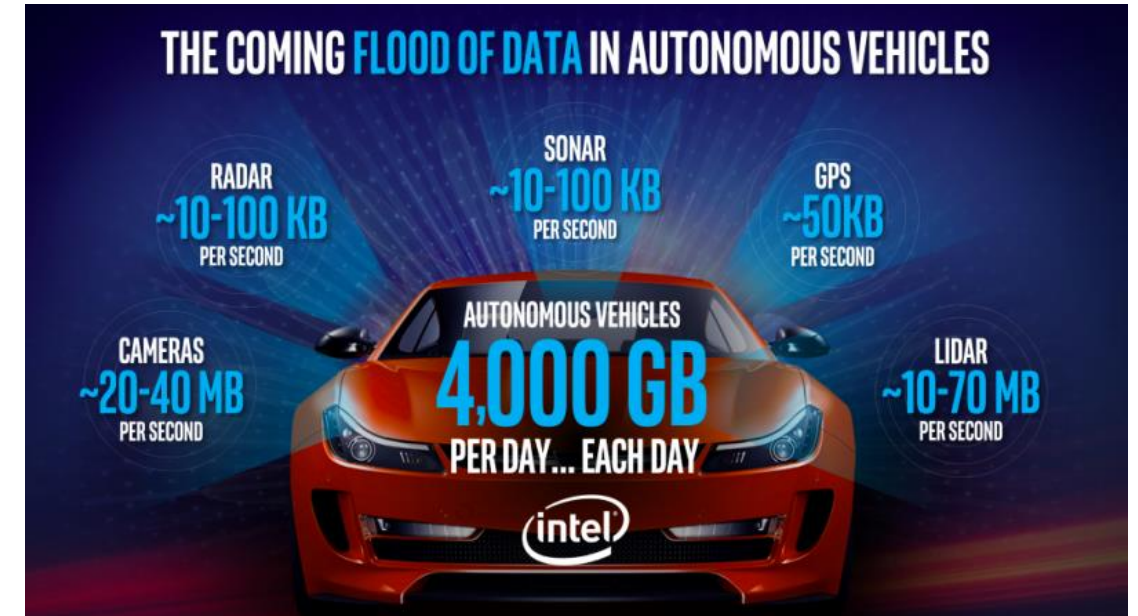
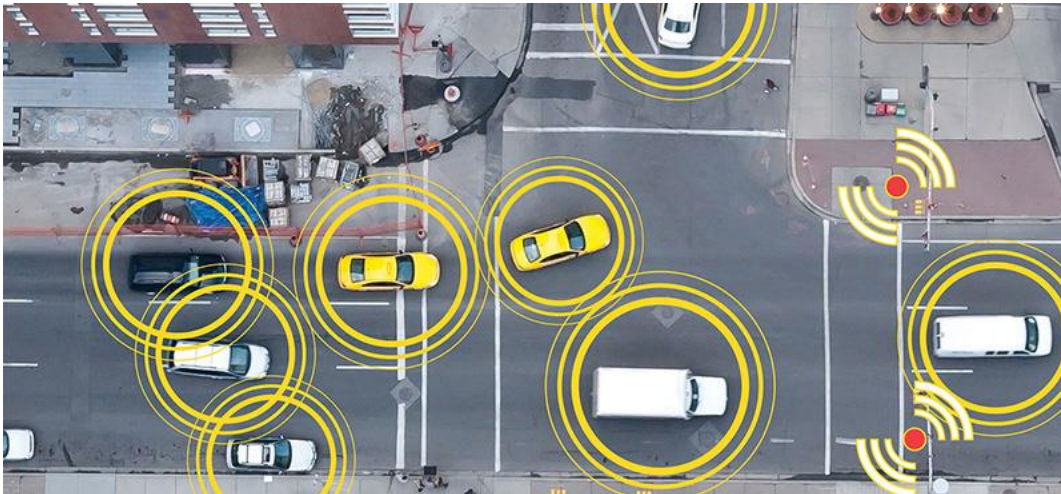
(Just a few examples !)



Some of the main Challenges

- Regulation
- Insurance
- Cost
- Technology Readiness
- Privacy
- Security
- Social Aspects
- Infrastructure Investments (Communication , Roads, Data, Cyber Security, ...)
- OEMs and Suppliers (development, validation and production)

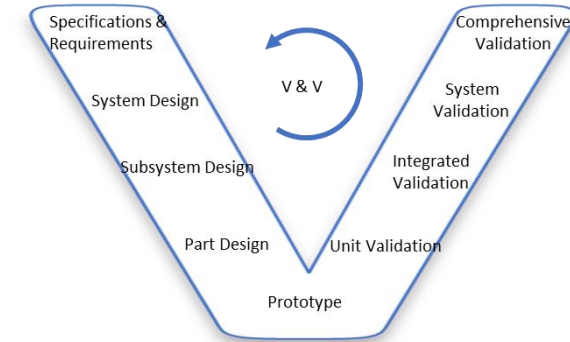
Big DATA (Storage, Management, Security)



An autonomous car will be generating approximately 4,000 GB – or 4 terabytes – of data a day, the data equivalent of almost 3,000 people. (Source: Intel)

Development Tools and Process

The whole development process, from requirements definition to final validation need to be revisited.



A full validation of AV is hard to achieve with the current methods

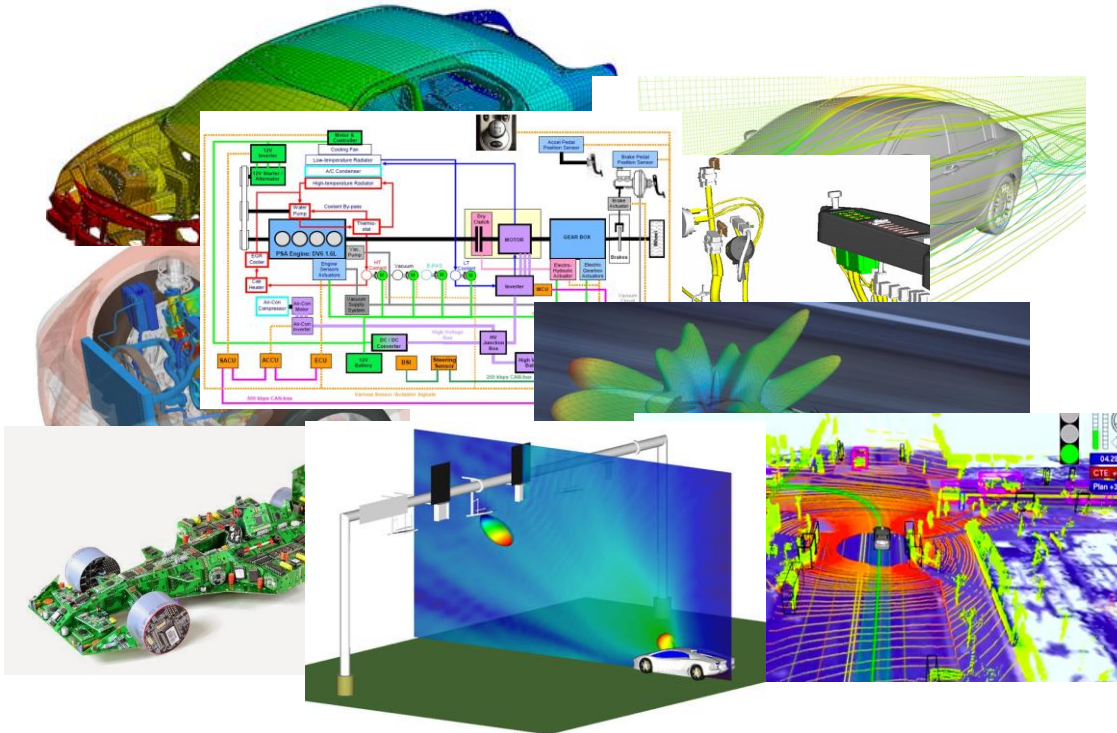
No real driver is in the Loop, so when the AI training would be complete?

A crash that results in a fatality occurs only once in every 100 million miles of driving.

Autonomous vehicles would have to be driven hundreds of millions of miles and sometimes hundreds of billions of miles to demonstrate their reliability in terms of fatalities and injuries.

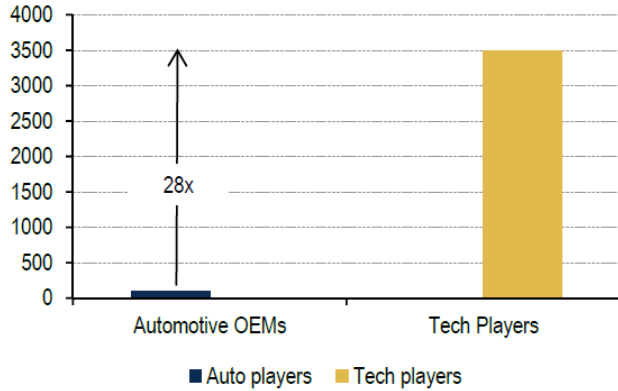
That would take tens and sometimes hundreds of years to drive these miles.

Source: Kalra, Nidhi, and Susan M. Paddock. "Driving to Safety." (2016)



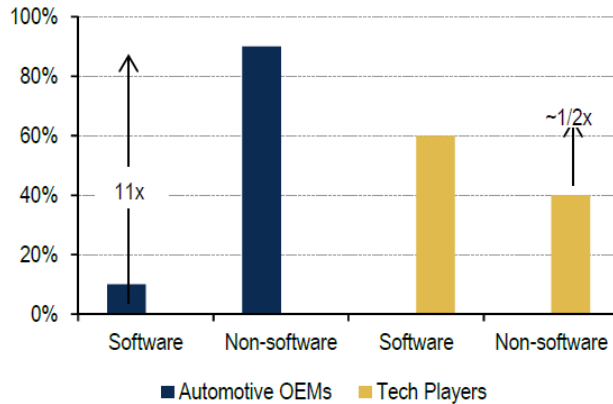
The Required Skill Set

Engineers with Artificial intelligence expertise

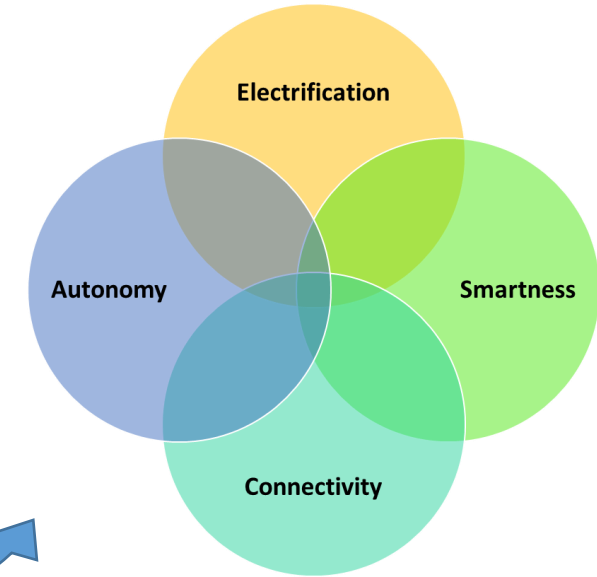
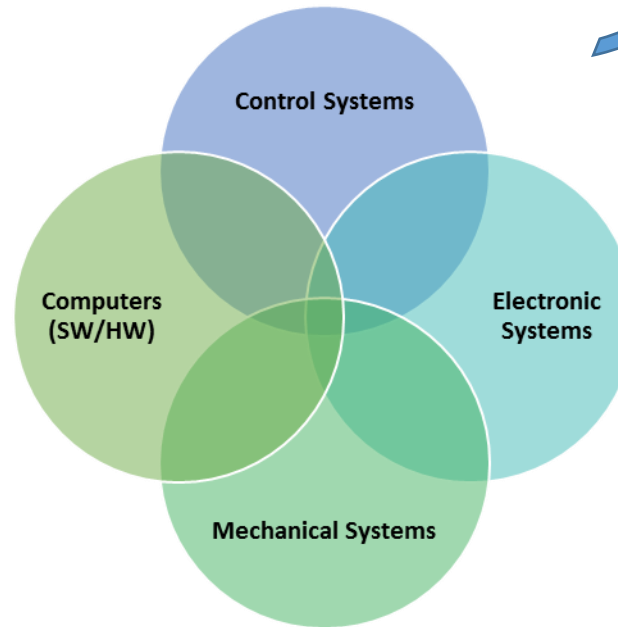


Source: McKinsey

Ratio of non-software to software engineers



Source: McKinsey



From **Mechatronics** to **Intelligent Mobility**
Domain of Expertise



Conclusion

- The current transportation system is unsafe, inefficient and unsustainable.
- Over the next 10 years, the disruptive changes in four technological domains, will change the whole auto industry for ever.
- Future Mobility – including an integrated, on demand electric fleet of autonomous taxis – can generate USD3.8tn of total positive impact in the next 10 year and lead to a “World of Zeros”, including a 59% decline in vehicle demand, 87% fewer accidents, 54% fewer parking spots, and 85% lower emissions. (source: BCG 2016).
- In even the most benign scenario, accidents are likely to be reduced by 19%, and vehicles generate 9% fewer emissions, with the advancement of ADAS and Active Safety Systems. (source: BCG 2016).
- To unlock the full potential of this revolution, a paradigm shift is required, to consider (virtual) Driver, Vehicle, Road and Traffic as an integrated, and intelligent eco system.
- Radical new approaches are needed if we have any chance of reaching the “World of Zeros” targets by 2030.



Thank you for your attention 😊

Any Question ?