« From human driving to automated driving"

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March 19, 2012

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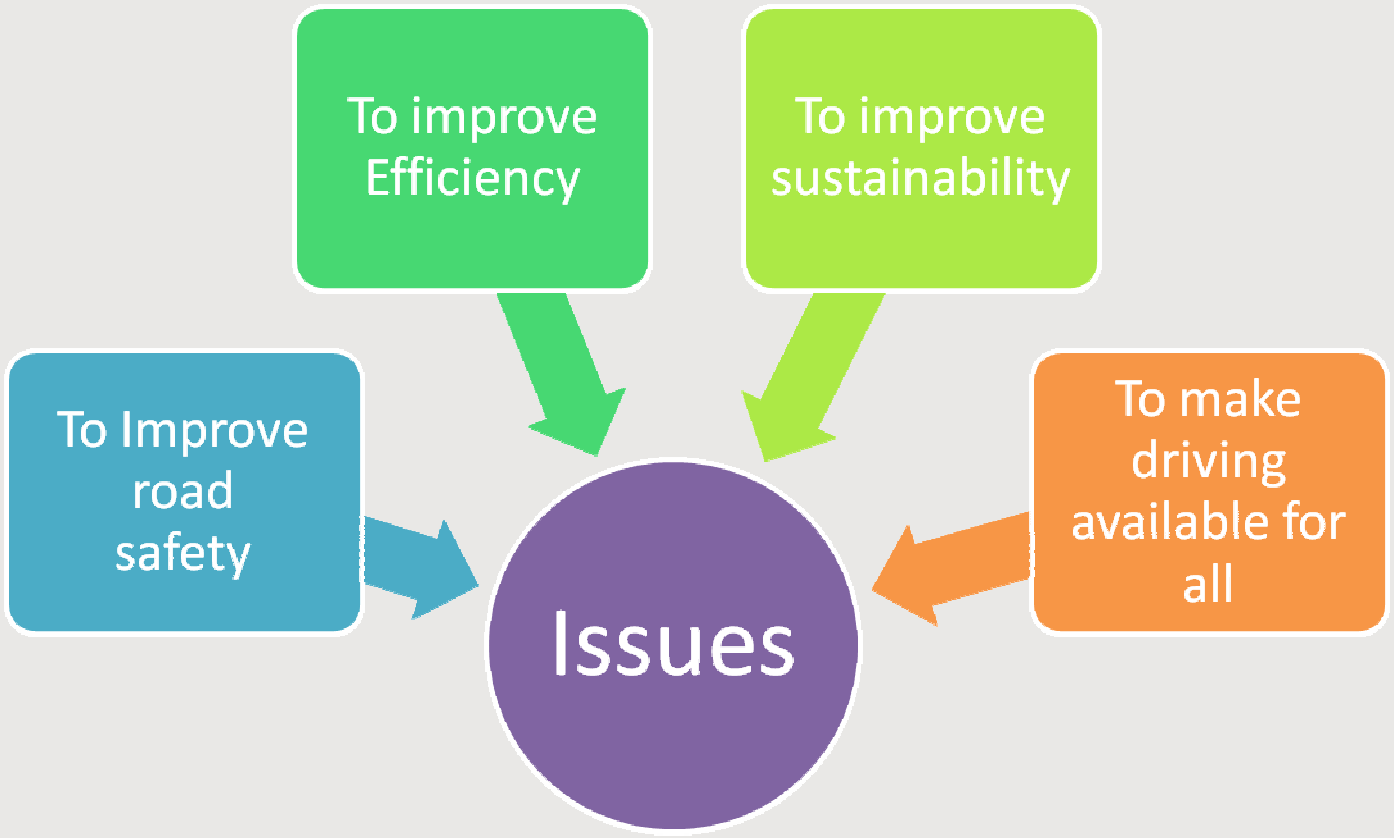
Why automation ?



Automation is a global answer to four important societal issues

Some definition : automation degrees

from Tom M. Gasser (BAST)

Possible today

In the future

- Driver Only:
  - Human driver executes manual driving task
- Driver Assistance:
  - The driver permanently controls either longitudinal or lateral control. The other task can be automated to a certain extent by the assistance system.
- Partial automation:
  - The system takes over longitudinal and lateral control, the driver shall permanently monitor the system and shall be prepared to take over control at any time.
- High automation:
  - The system takes over longitudinal and lateral control; the driver must no longer permanently monitor the system. In case of a take-over request, the driver must take-over control with a certain time buffer.
- Full automation: “hands-off, feet-off, brain-off”
  - The system takes over longitudinal and lateral control completely and permanently. In case of a take-over request that is not carried out, the system will return to the minimal risk condition by itself.

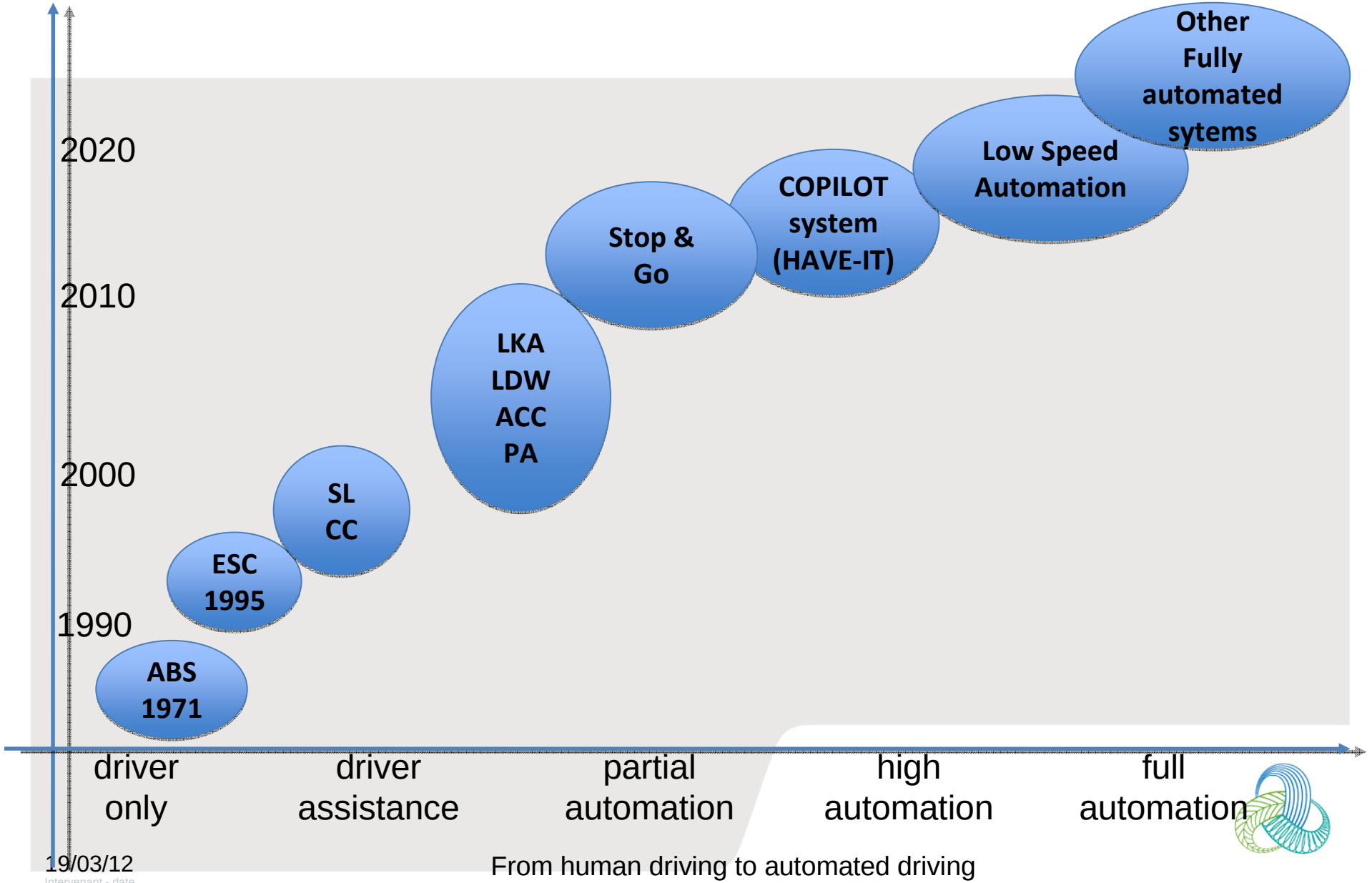
Out of classification but very important …

- Fully automated but without driver in the car
  - Possible now
  - In dedicated area
- Examples
  - Automated parking valet (eg « MIL » project in France)
  - Automated test on test tracks (Daimler)
- Open the way toward innovation
  - Allows to push the technlogy while minizing the risks
  - Allows to push innovation while legal framework is changing

Human-machine interaction : the horse-rider metaphor

- Horse and rider form a whole.
- The rider gives orders to the horse but ...
  ... the horse refuses to execute dangerous orders (e.g. collision, dangerous jump)
- If the rider gives up (no reaction), the horse stops or ... go back home (“MRM” : minimum risk maneuver)

State of the art



From human driving to automated driving

Some set ideas to sweep

- “Highway automation (HA) is a means to promote the automobile at the expense of other modes?”
  - No: HWA sets the optimal functioning of networks with a limited level of supply
- “Highway automation is technologically too complicated?”
  - Many technological building blocks already exist: the real challenge is their reliability at an acceptable cost
- “The automation poses insurmountable problems of responsibility?”
  - It has been solved for aircraft, train, subway (we all take highly automated aircraft and fully automated train (eg. Line 14 in Paris))
- “Trains roll on rails, aircraft flights in air corridors, not cars”
  - Cars have very low cost "rails" : lane markings
  - Cars could have "air corridors": dedicated roads

Main obstacles

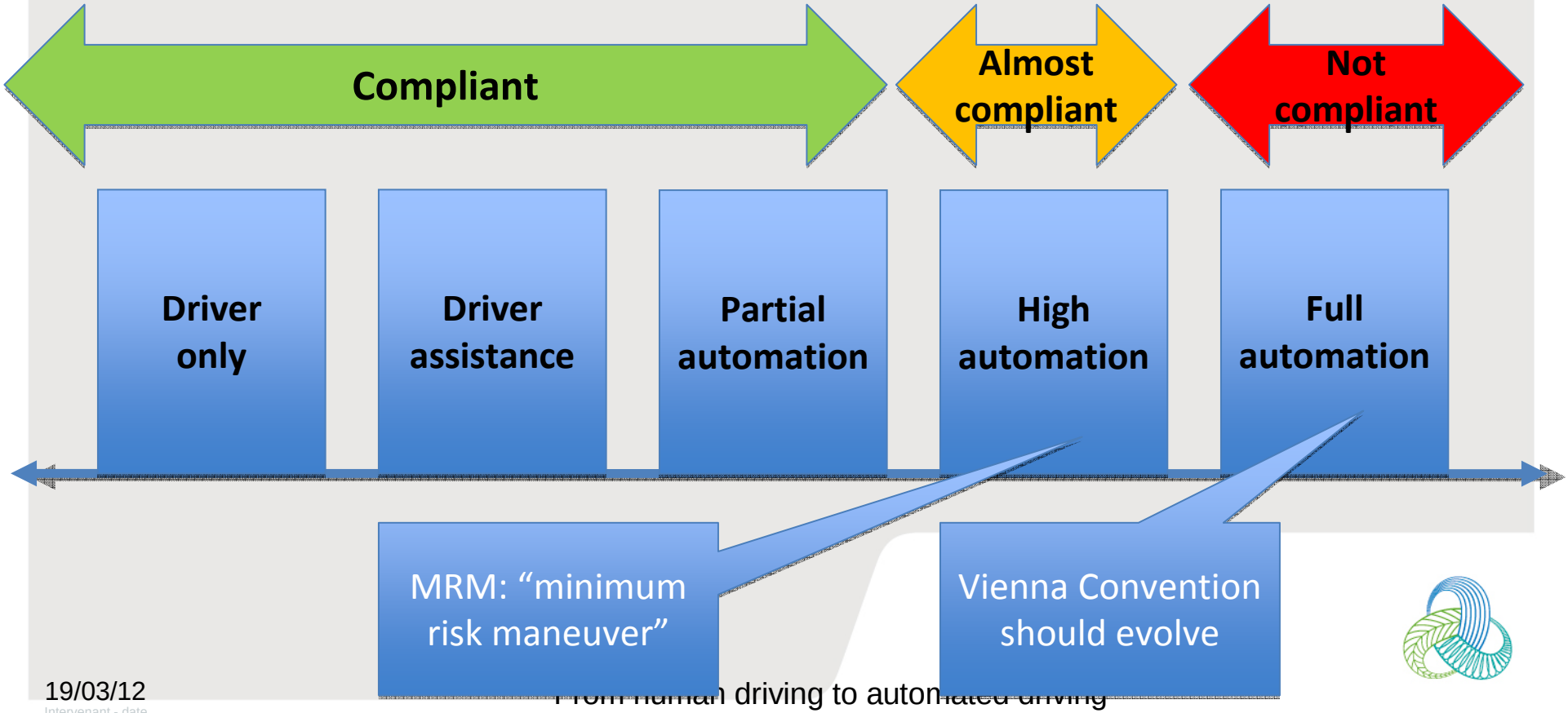
- Individual acceptability by the drivers (and passengers)
  - Are they ready to accept driving automation ?
  - What degree of automation do they expect ?
  - How do they use automation : in which context, under which conditions ?
- Legal acceptability
  - What is the compliance with existing laws (Vienna Convention) ?
  - What is the compliance with Highway Code ?
- Feasibility
  - What is feasible today, in the near future, later ?
    - We need a roadmap

Acceptability by the drivers

- Values carried by the vehicle are evolving
  - Vehicle no longer makes reference only to « power », « speed » but also…
  - … to values like : safety, efficiency, comfort, sustainability
- In urban area vehicle becomes an extension of living space (home, office)
  - Depending on the context (e.g. traffic jam), the possibility to delegate the driving task to a “copilot” becomes a growing customer aspiration
- For specific driving tasks drivers seem ready to “give up” (passer la main)
  - “Parking valet”
  - Maneuvers difficult to manage
  - Low Speed Automation

Legal acceptability (1/2) : Are we « Vienna Convention compliant » ?

- Vienna Convention remainder (art. 8.5)
  - Every driver shall at all times be able to control his vehicle …



Legal acceptability (2/2) : Are we « Highway Code compliant » ?

- Automated systems can easily implement national highway code
  - Speed compliance (e.g. speed limit respectful)
  - Interaction compliance (e.g. distance headway)
  - Meteorological condition compliance (speed limit adaptation)
  - Maneuvers compliance (e.g. overtaking rules)
  - Etc.
- To be compliant with different European Highway Code
  - Vehicle could have National Highway Code profile
  - Localization could be used to determine the profile to select

How could Vienna Convention evolve ?

- The horse-driver could be a the good paradigm
- Could we imagine a *revised article 8 ?*
  - "Every driver and its *driving assistance* shall at all times be able to control his vehicle …"
- What does it's mean ?
  - The confidence level assigned to the whole "driver-controller" system is as high as the trust level attributed to the driver only.
    - Implies a high level of reliability
  - Both drivers and system must be able to auto diagnose themselves.
    - Implies : driver and car monitoring

Feasability :
The challenge : low-cost, highly reliable

- I need to know
  - Where am I ? Accurate localization
    - GNSS, lane marking detection
  - Where are my close neighbors and what are their intention ?
    - Data fusion from different sensors
  - Where are my distant neighbors and what are their intention ?
    - V2V, V2I communication with high level of QoS
- I need to control the trajectory
  - With accuracy : precision actuators
  - With reliability : redundant architecture, deterministic latency time (i.e. Flexray bus)
  - With a variable feedback to the driver : steer by wire

Feasability (2/2)
Test and validation : an open issue

- Reliability must be proven
  - System must be standardized
  - Test and validation must cover the whole complex system including the wide variety of use case and environmental (sometimes adverse) conditions
    - However testing an infinite number of test cases is impossible → need new testing methods
- System assessment
  - In “naturalistic” driving conditions (“field operational test”)
    - Usage, usability, utility, impact

Low Speed Automation: « story board »

- I drive my car normally
- I arrive on a dedicated LSA area
- I meet a congestion zone at low speed
- The vehicle ask if I want to activate the LSA? OK!
- The vehicle is traveling in LSA mode
- The flow velocity increases : LSA conditions no longer exist
- The vehicle is asking me to take control.
- If I react,
  - it’s OK,
  - otherwise the vehicle stops on the emergency lane

Thank you for your attention

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