Road Vehicle Automation Workshop -

BASSt-study: Definitions of Automation and Legal Issues in Germany

25th July 2012

Tom M. Gasser / Daniel Westhoff

German Federal Highway Research Institute
BASt-Expert-Group definitions of vehicle automation-degrees:

- **Full automation:** The system takes over longitudinal and lateral control completely and permanently. In case of a take-over request that is not followed, the system will return to the minimal risk condition by itself.

- **High automation:** The system takes over longitudinal and lateral control; the driver is no longer required* to permanently monitor the system. In case of a take-over request, the driver must take-over control with a certain time buffer.

- **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.

- **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.

- **Driver Only:** Human driver executes manual driving task

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Tom M. Gasser 25th July 2012

*Due to editorial error on this slide, the wording "must no longer" has been replaced by "is no longer required"
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<th>Nomenclature</th>
<th>Task of the driver according to automation level</th>
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<td>- The driver <strong>need not</strong> monitor the system</td>
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<td>The driver continuously accomplishes either lateral or longitudinal control. The other/ remaining task is accomplished by the automating system to a certain level.</td>
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Source: BASt
### Criticism:

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| Fully automated| The system takes over lateral and longitudinal control completely within the individual specification of the application.  
- The driver **need not** monitor the system  
- Before the specified limits of the application are reached, the system requests the driver to take over with sufficient time buffer.  
- In absence of a takeover, the system will return to the minimal risk condition by itself  
- All system limits are detected by the system, the system is capable to return to the minimum risk condition in all situations. |
| Highly automated| The system takes over lateral and longitudinal control for a certain amount of time in specific situations.  
- The Driver **need not** permanently monitor the system as long as it is active  
- If necessary, the driver is requested to take over control by the system with a certain time buffer.  
- All system limits are detected by the system. The system is not capable of re-establishing the minimal risk condition from every initial state. |
| Partially automated| The system takes over lateral and longitudinal control specific situations).  
- The driver must permanently monitor the system  
- The Driver must at any time be prepared to take over |
| Assisted       | The driver continuously accomplishes either lateral or longitudinal control. The task is accomplished by the automating system to a certain extent.  
- The Driver must permanently monitor the system  
- The Driver must at any time be prepared to take over |
| Driver only    | The driver continuously (throughout the complete trip) a task with lateral (steering) control. |
Legal evaluation:

Consistency with Regulatory Law

Regulatory Law = National Road Traffic Codes ("danger defence"-law in traffic)

→ Addressee is the (human) driver,
→ drivers’ Duties:

Drivers’ obligation is to permanently:
- monitor surrounding traffic and status of the vehicle
- readiness to override/ oversteer in case system control seems inadequate

Tom M. Gasser
25th July 2012
Going beyond partial automation (that is still permanently monitored by the driver)...

...would definitely require a new approach to legal framework in road traffic: Otherwise drivers would be breaching their legal obligations.
**Full automation:** 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.

**High automation:** The system takes over longitudinal and lateral control; the driver is no longer required* to permanently monitor the system. In case of a take-over request, the driver must take-over control with a certain time buffer.

**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.

**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.

**Driver Only:** Human driver executes manual driving task

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Legal evaluation: Automation: Product Liability

**partial automation:**
- „Defectiveness“: Decisive are user instructions
- Risk of the manufacturer: Is it possible to sufficiently differentiate between: reasonably foreseeable misuse ↔ system abuse?

**Additionally for high and full automation:**
→ Damages during highly and fully automated operation mode lead to manufacturers’ liability (in case the accident is not solely caused by ill-driving on the side of a third party or an override by the driver).
Platooning – keeping in line with „individual“ mobility?

Specific legal consequences of platooning:

= Individual vehicle?

Source: SARTRE-Project, press Release (with modifications by author)

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Differences in point of view:

Driving Functions that Could Potentially be Automated

1. Actuation of steering, engine, brakes
2. Powertrain and chassis control (e.g., ABS, stability control – transparent to driver)
3. Real-time information collection (including driving environment perception from sensing and/or communication)
4. Hazard assessment
5. Decision making (tactical microscopic maneuvering to strategic route planning)
6. Management of vehicle flows (traffic management)
7. Combinations (up to all of the above)

Source: Steven E. Shladover
University of California PATH Program

Tom M. Gasser 25th July 2012
Indirect function of V2X-technology: (V2V or V2I, same effect!)
Indirect function of V2X-technology: (V2V or V2I: same effect!)
Realistic view on V2X:

Informing V2X

ADAS Automation

Tom M. Gasser
25th July 2012
slide No. 18 /20
Theoretical potential of vehicle automation for traffic safety (not quantified):

- [blue & green] Total number of "driver only"-accidents today
- [green] ...thereof: Accidents avoidable by means of automation
- [yellow] Accidents due to the (new) risk of automation

Source: Report of the BASt Expert Group
Research: four clusters

Cluster: Human-Machine-Interaction
- Driver-Feedback/Driver in the loop
- Stabilization at system limits/Driver takeover

Cluster: functional safety
- Requirements according to ISO 26262
- Application to vehicle automation

Cluster: Societal acceptance
- Benefits for traffic safety
- Societal acceptance of the automation risk

Cluster: legal
- Intended use (product liability)
- Adjustment of laws
### Description and categorization of automated driving functions

(not exhaustive)

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<th>Nomenclature</th>
<th>Description of automation level according to drivers' expectations</th>
<th>Exemplary systems</th>
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<td>Driver Only</td>
<td>The driver continuously (throughout the complete trip) accomplishes longitudinal (accelerating /braking) and lateral (steering) control.</td>
<td>No (driver assistance) system active that intervenes into longitudinal and lateral control</td>
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| Assisted           | The driver continuously accomplishes either lateral or longitudinal control. The other/ remaining task is accomplished by the automating system to a certain level only.  
  - The Driver must permanently monitor the system  
  - The Driver must at any time be prepared to take over complete control of the vehicle | Adaptive Cruise Control:  
  - Longitudinal control with adaptive distance and speed control  
  - Parking assistance: Lateral control is accomplished by the parking assistance (automatic steering into a parking space. The Driver accomplishes longitudinal control).- |
| Partially automated| The system takes over lateral and longitudinal control (for a certain amount of time and/or in specific situations).  
  - The driver must permanently monitor the system  
  - The Driver must at any time be prepared to take over complete control of the vehicle | Motorway assistant:  
  - Automatic longitudinal and lateral control  
  - On motorways up to an upper speed limit  
  - The driver must permanently monitor and take over immediately in case of takeover request by the system. |
| Highly automated   | The system takes over lateral and longitudinal control for a certain amount of time in specific situations.  
  - The Driver need not permanently monitor the system as long as it is active  
  - If necessary, the driver is requested to take over control by the system with a certain time buffer.  
  - All system limits are detected by the system. The system is not capable of re-establishing the minimal risk condition from every initial state. | Motorway-chauffeur:  
  - Automatic longitudinal and lateral control  
  - On motorways up to an upper speed limit  
  - The driver need not permanently monitor. In case of a take over request, the driver must react with a certain time buffer. |
| Fully automated    | The system takes over lateral and longitudinal control completely within the individual specification of the application.  
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  - Automatic longitudinal and lateral control  
  - On motorways up to an upper speed limit  
  - The driver need not monitor.  
  - In case the driver does not react to a take over request, the system will brake down to standstill |

Source: Report of the BAST Expert Group
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