# HAVEit

ISSUE 1

24 JULY 2008

## Editorial

INSIDE THIS ISSUE:



Welcome to the 1st HAVEit Newsletter which will provide an overview of the project.

You will learn about the key objectives of HAVEit and get an understanding of the project concept.

HAVEit Integrated Project combines the accomplishments of former projects like SPARC (STREP), PReVENT (IP) and AIDE (IP).

HAVEit aims at significant improvement in terms of traffic safety and efficiency by:

- further developing and implementing the failure tolerant, safe vehicle architecture including advanced redundancy management to suit the needs of highly automated vehicle applications;
- developing next generation ADAS with an optimised, easy to handle task repartition between the driver and the highly automated vehicle;
- higher level of automation compared to the current state of the art.

HAVEit integrates 6 cutting edge vehicle applications for both passenger cars and trucks.

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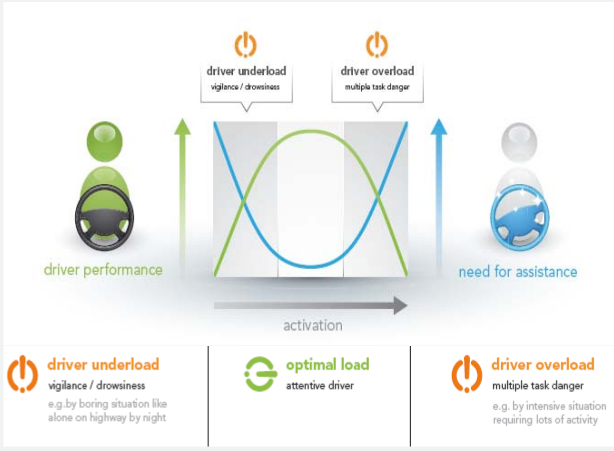
The future of driving.

# The vision behind: highly automated driving to improve safety, energy efficiency and comfort

The improvement of road safety, energy efficiency and comfort will be reached with the development of a virtual copilot, which will be able to support the driver in optimizing the vehicle control. To achieve this goal, HAVEit will investigate the level of adequate and internally synchronized support. Driver monitoring will be used to estimate the driver's performance.

As depicted in the figure, three driver performance classes will be taken into account: driver underload (e.g. monotonous driving in congested traffic situations), optimal load and driver overload (e.g. intensive situations with increased driver workload). Depending on the situation and the driver load class, different assistance systems will be implemented to substitute the driver. Furthermore, the application will intervene in time when the driver is not fully capable to handle the respective traffic situation. Putting the driver out of the control loop requires a failure tolerant architecture, which allows drive-by-wire and facilitates fully autonomous driving. Therefore, a scalable vehicle architecture will be mandatory for the migration from single Advanced Driver Assistance Systems (ADAS) to a powerful virtual co-pilot concept that integrates all needed functionalities. The HAVEit highly automated vehicle applications will attend to the problem of a high number of crashes, near-collisions and incidents of different conflict types, as well as to the efficient usage of energy.

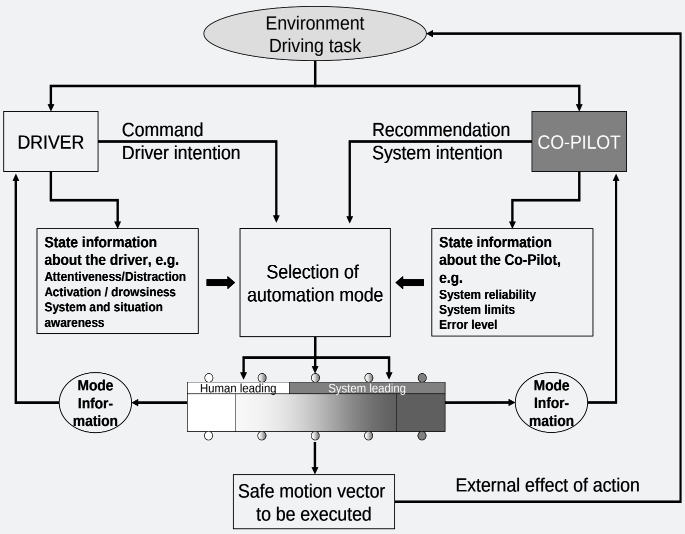



# HAVEit key objectives

While current Advanced Driver Assistance Systems have only two states – on and off – HAVEit aspires to advance further: As it contains various functions that assist the driver in different states, HAVEit also enables different grades of automation.

When one function hits its limits, others can still fulfill their task. Depending on the circumstances, the driver can also be in need of more or less assistance. Some situations require full automation, while others can be handled successfully with partial support. The driver's state of alertness must also be taken into consideration. HAVEit aims to define different degrees of automated driving to match every possible driving situation. A sophisticated system called co-pilot can fill in for the driver whenever it is necessary and provide the level of automation that the respective situation requires. In other words, the system takes over a part of the driving task to relieve the driver.

Usually the assistance system only acts out human orders. A well designed co-pilot forms a symbiosis with the driver, a joint system that drives better and safer than one partner alone could. The engineering of the transitions between lower and higher degrees of automation is crucial to uniting human and automation successfully.



# Task repartition between the driver and the co-pilot

Driver and co-pilot form an ideal symbiosis, a joint system that drives better and safer than any of the two partners would be capable alone.

**What are the driver's tasks ?**

The vehicle is a complex environment in which the driver has to fulfill

several tasks at each instant. These tasks can be divided in three categories: driving (primary task), driving support like indicators or lights (secondary task) and non-driving tasks like multimedia (tertiary task). The driver has a maximal load capacity that he distributes on the mentioned tasks. The risk hereby is that the driver might not constantly focus on the driving task as he is concentrating on something else or is just tired. Therefore, support has to be provided to the driver in order to ensure that the main core tasks are performed at all times.

**How to support the driver ?**

Some of the driver's tasks should be supported dynamically by the assistance systems. This should ensure that the driving task (primary task) is performed at all times. The driver can delegate some tasks (e.g. driving, automatic lights), while the virtual co-pilot can intervene when the driver fails in performing a task. Last but not least, an adequate human machine interface (HMI) can also help avoiding disturbances that are imposed by the multimedia applications, for instance.

Therefore, the virtual copilot should:

• have knowledge about how to drive the vehicle
• be aware of the driver's actions
• be able to support the driver in real time

However, the dynamical support established by the co-pilot may induce risks. The main identified risk is that the driver might not react to the provided support optimally.

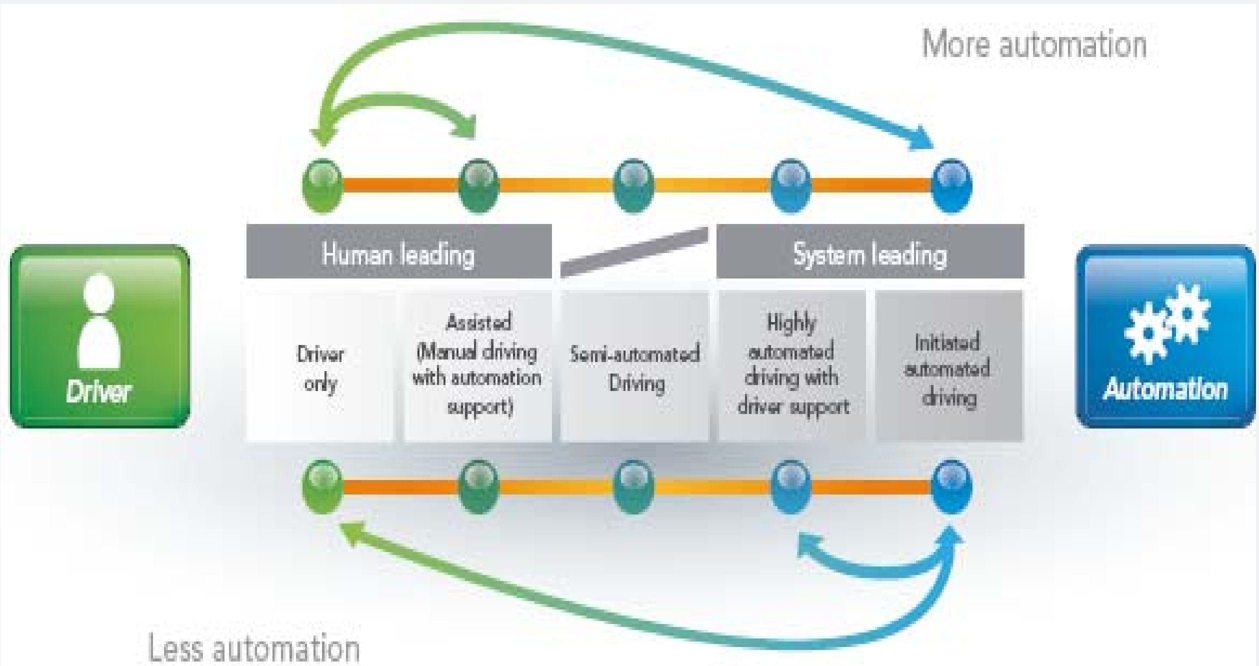
Thus, the driver has to know at each time:

• which support he will receive
• his responsibilities.

**How to obtain the task repartition ?**

Driver monitoring assesses the driver's behaviour in order to understand which state he is in (e.g. underload, overload) and what his expectations are. Meanwhile, coherent groups of assistant systems have to be defined, starting from passive feedback up to initiated automated driving. The driver can always select an automation level, as long as the virtual co-pilot system can provide the requested support. In addition, knowledge about the driver's needs and the automation's possible support will be generated constantly, with the purpose to offer help to the driver, if appropriate.

The main challenge is the organisation of transitions between the driver and the co-pilot. Indeed, feedback (source of interest, strategies, information) has to be provided to the driver to help him go back to the vehicle control loop as transition from or to automated modes. The risk here is that the driver may not be capable of driving again (overloaded, drowsy, etc...). Thus, the work should finally focus on the definition of a way to help the driver improving his maximal load capacity.



# Highly Automated Driving

**HAVEit will develop next generation highly automated vehicles, including both trucks and passenger cars, aiming at improved comfort, safety and efficiency.**

**All cutting edge HAVEit functionalities will be demonstrated in these vehicles.**

The vehicles will be equipped with numerous sensors, using sensor technologies such as laser, radar and camera to monitor the driver and the complete surroundings of the vehicle. With help of the environmental information the driver will be supported both in driver overload situations as well as driver underload situations. Environmental information from the support system can also be used to further improve the fuel consumption and efficiency. The following applications will be developed:

### Automated roadwork assistance

This application (demonstrated in a passenger car by Continental) aims at highly automated driver support in driver overload situations. The focus will be on construction sites and optimal longitudinal and lateral support. Traffic sign recognition, driver condition (driver monitoring, driver attentiveness) and environment monitoring (dedicated for construction sites) will provide the required information to initiate different warning and control levels by means of the joint system to be made up of driver, vehicle and environment. When approaching a construction site, the vehicle will automatically adapt to speed limits. In the construction site the lateral vehicle control in the narrow lanes will be optimized by monitoring also the adjacent lanes. Having passed the construction site area the vehicle will adapt to the traffic ahead.

### Automated queue assistance

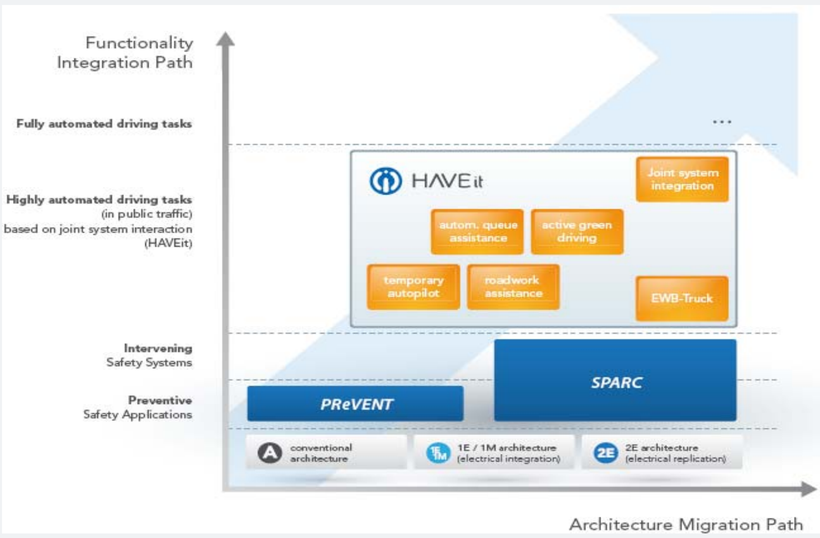
Automated queue assistance (to be demonstrated in a truck by Volvo Technology Corporation) will support the driver on motorways by integrated longitudinal and lateral control. The level of automated control will be continuously adapted based on the state of the driver, vehicle and environment. The main purpose of the automated queue assistance is to relieve the driver of the monotonous tasks associated with driving a truck in low speeds and in congested traffic situations (driver under load situation). Special attention will be paid to the development of safe transitions between semi-autonomous control and driver control of the vehicle.

### Temporary auto-pilot

This application (to be demonstrated in a passenger car by Volkswagen) aims at a higher degree of automation and at safety. The temporary autopilot system to be developed will integrate three different levels of functionalities: Pilot functionality (hands-off driving), e.g. driving in a traffic jam, assisted driving (hands-on driving, driver in the loop), i.e. driving in normal traffic mode, e.g. driving when the traffic jam terminates and intervening safety functions, e.g. driver initiated emergency braking.

### Active green driving

In active green driving applications (to be demonstrated in a hybrid truck by Volvo Technology Corporation) the fuel consumption and efficiency can be improved by using environmental information such as e-Horizon, forward looking sensors and dynamic traffic information. With this information the power split between the internal combustion engine (ICE) and the electric motor can be adapted to use the energy storage in the most efficient way.




***HAVEit highly automated vehicle applications - architecture migration and functionality integration path***

# Safety architecture applications

HAVEit proposes a solution for the migration from a fail-silent to a failure tolerant vehicle architecture, towards a safe platform for the development of a fully autonomous vehicle. The failure tolerant platform will be developed and implemented in a truck. A pre-homologation process based on the results of former projects will be initiated. The truck will be equipped with x-by-wire components (electrical wedge brakes) and a redundant deterministic network. On top of the platform, the functionalities can be plugged. An advanced demonstrator will reuse the basis of this platform to enable a full integration of the highly automated functionalities and pave the way for full autonomous driving. Here, the synchronization of the different functionalities will be the main focus in order to show the overall quality of service and the solving of potential

bottlenecks (e.g. perception, functionalities, and transitions between functions).

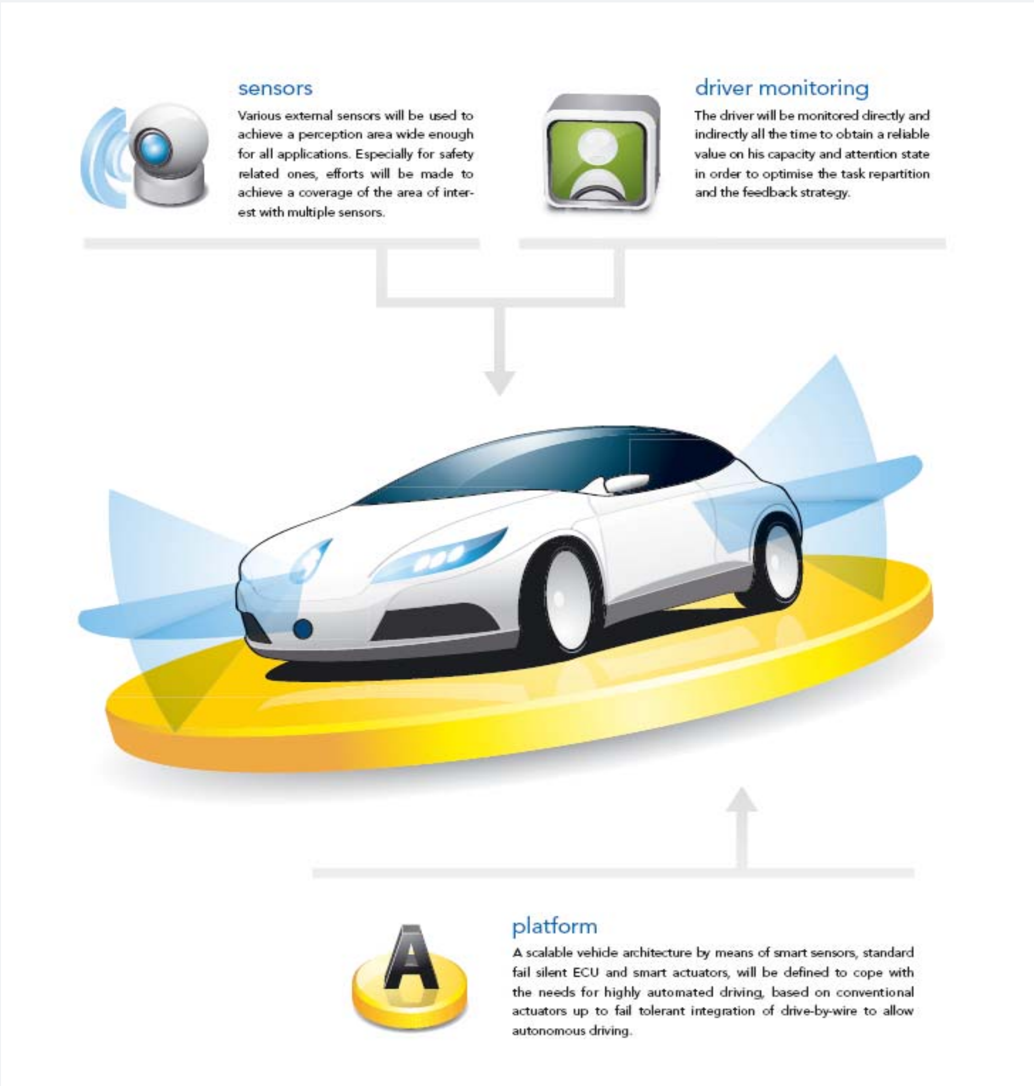
The following applications will be developed:

**Drive-by-wire truck for open roads**

This truck (to be demonstrated by Knorr-Bremse) that includes the failure tolerant architecture from the preceding European project SPARC, will be upgraded to define a safe but affordable architecture. Centered on two FlexRay backbones (replications of the generic project network) and a failure tolerant set of ECUs (duplication of the two failure silent ECUs), an improved redundancy management will be implemented. Electrical wedge brakes will be integrated as smart actuators to remove the pneumatic energy for the axles. In cooperation with the German authority TÜV, Knorr-Bremse will work on the pre-homologation of the system.

**Joint System Demonstrator**

This generic vehicle (to be demonstrated by DLR) will be equipped with x-by-wire components like steer-by-wire. Based on the new degrees of freedom, thanks to the x-by-wire components, a new human machine interface (HMI) including haptic feedback can be investigated and designed. This haptic feedback will be used for the transitions between driver and virtual co-pilot as lean integration and synchronisation of all assistant systems up to autonomous driving. With this vehicle, the driver's and passengers' acceptance will be assessed to investigate the exploitation potential.




***HAVEit architecture***

# HAVEit cooperation between driver and automation

In the HAVEit key objectives, different degrees of automation are described as a means to make the best use of automation in each situation. What are these degrees of automation, how are the transitions made and who initiates the transitions?

Regarding the degree of automation, the ultimate goal of purely technological driven research would envision full automation, where the technology does all the driving while the human is more like a passenger. HAVEit however, with its interdisciplinary mix of technological and human factors, has identified a more promising region on the far right of the automation spectrum, where automation is almost fully used, but the driver still holds a meaningful position. The hypothesis is, that compared to full automation, this can bring benefits regarding controllability and responsibility share, e.g. in case of an automation failure. Part of this hypothesis has recently been confirmed in a base research project at DLR (H-Mode), where automation dropouts have been introduced artificially in a simulator experiment. Five out of five subjects in fully automated condition left the road and crashed, while 5 out of 5 in the highly automated condition were able to recover and stay on the road (to be published soon).

Concerning the transitions between different regions in the automation spectrum, HAVEit will use a layered approach with a conservative “switch”-solution as base layer. More sophisticated layers are based on driver monitoring on top of that, for example. Part of this layer concept has been proven to work successfully in other projects. In the EU-project CityMobil for example, different approaches for transitions between manual and highly automated driving (here in the City) are part of experiments conducted at DLR, ITS Leads, CRF and TNO. Results will be made available to HAVEit as soon as they are published.

Regarding the initiation of transitions, HAVEit will also explore automation initiated transitions, where for example based on the driver monitoring, recommendations for different levels of automation are made. The long term vision is that automation does not only schematically react, but becomes more sensitive towards and cooperative with the driver.

## HAVEit at ITS Europe

### 4-6 of June 2008
### Palexpo Convention Centre, Geneva, Switzerland

***HAVEit participated in the 7th European Congress and Exhibition on Intelligent Transport Systems (ITS) with a Special Session entitled “Towards more effective Cooperation of Drivers with Assistant Systems: From FP6 to FP7-the HAVE IT Approach”, and in lots of discussions!***

***For more information, please visit www.itsineurope.com***


## HAVEit at ITS World

### 16-20 of November 2008
### Jacob K. Javits convention center
### New York City, NY

***HAVEit will participate in the 15th World Congress on ITS with a Technical Paper entitled “Highly Automated Vehicles for Intelligent Transport: HAVEit approach”.***

***For more information, please visit www.itsworldcongress.org***

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*Duration:*
01 February 2008 - 31 July 2011
*Total cost:*
*28 M€, 17 M€ EC contribution*
*Programme:*
7th FW, ICT2007.6.1

SEVENTH FRAMEWORK PROGRAMME

www.haveit-eu.org