INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME

AIDE

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Report on results of First User Forum

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List of Abbreviations

AAM	Alliance of Automobile Manufacturers
ABS	Anti-lock Brake System
ADAS	Advanced Driver Assistance Systems
AIDE	Adaptive Integrated Driver-vehicle InterfacE
BA	Behavioural Adaptation
BT	BlueTooth
DRM	Digital Rights Management
DVE	Driver-Vehicle- Environment
DVEM	Driver Vehicle Environment Monitoring
EASIS	Electronic Architecture and System Engineering for Integrated Safety Systems
EC/IST	European Commission/ Information Society Technologies
ESoP	European Statement of Principles
EU	European Union
GPS	Global Positioning System
HMI	Human Machine Interface
ICA	Interaction Communication Assistant
I/O	Input – Output
ISO	International Standardisation Organisation
IVIS	In-Vehicle Information Systems
ME	Million Euros
MOU	Memorandum of Understanding
MS	Member States
ND	Nomadic Devices
OEM	Original Equipment Manufacturer (used for car manufacturers here)
PReVENT	Preventive and Active Safety Applications
SP	Sub-Project
UF	User Forum
WP	Work Package

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EXECUTIVE SUMMARY

This deliverable aims to describe the discussions that took place during the 1st User Forum Workshop which was held at BAST premises, in Cologne, Germany, on 15-16 of March 2005 and organized by the AIDE consortium.

From the AIDE project's side the most straightforward goal of this meeting was to inform about the project and its work on the design and development of an adaptive integrated HMI and gather valuable feedback from the automotive society. Attendees outside AIDE consortium, including EC representatives, automotive industry and interested parties from institutes and universities created a multi- dimensional forum able to communicate the concerns of society and automotive area into the project on one hand and outcome possible guidelines back to the automotive industry, if possible, on the other hand. The ultimate goal of this initiative is to create a cross-sector European interest group concerned with all aspects of the future automotive HMI.

The basic issues that were addressed related to the AIDE project were: HMI architecture, Design scenarios for an adaptive HMI, Driver-vehicle-environment modelling for HMI design, behavioural adaptation to ADAS and IVIS and Nomadic Devices integration within the automotive environment. Moreover, HMI evaluation issues related to the European Statement of Principles were discussed towards the future possibility of the derivation of useful guidelines and standards with respect to future automotive HMI design which should guarantee road safety. Finally, a round table discussion concerned with all aspects of integration and HMI adaptivity was carried out where the positions of EC, industry and research institutes had the chance not only to be commuted but also weighted.

Open questions raised or possible conclusions drafted through the two days discussions in the forum will be communicated among AIDE partners in order to be evaluated inside the different subprojects and contribute in the development phase of the project. At the same time results and conclusions will also be open to the general public and will be communicated both through the User Forum and the web site of the project. The later already hosts all presentation of the specific workshop (see www.aide-eu.org)

Since the User Forum is a available tool for a project of the size and the aims of an IP additional events will be organised in the future.

1. Introduction

The AIDE User Forum aims to bring together all stakeholders in the area of the Automotive HMI and to create a community where AIDE concepts and developments will be discussed, reviewed and updated. One of the means that will be used to achieve the above goals is the organization of public workshops were all relevant issues are to be discussed.

The first User Forum Workshop was held at BAST premises, in Cologne, Germany, on 15-16 of March 2005. A number of issues were discussed among which the following:

- HMI architecture;
- Design scenarios for an adaptive HMI;
- Standards and Guidelines;
- Driver-vehicle-environment modelling for HMI design;
- Behavioural adaptation to ADAS and IVIS;
- HMI evaluation issues;
- Nomadic Devices integration within the automotive environment;

This report contains the proceedings of the first User Forum Workshop, organised under the auspices of the AIDE project in order to address these issues.

2. User Forum Workshop organisation

2.1. Objectives

The first AIDE User Forum Workshop aimed to:

- Create a cross-sector European interest group concerned with all aspects of the future automotive HMI;
- Inform about the AIDE project and its work on the design and development of an adaptive integrated HMI;
- Discuss the status of the European State of Principles with respect to future automotive environments;
- Inform about key issues for nomadic devices: safety, design, integration, installation, use, standardisation;
- Initiate an "AIDE User Forum" where the results of AIDE will be discussed, reviewed and updated.

2.2. Logistics

Invitations were sent out in January to a list of over 100 selected experts that were relative to the AIDE research area. Also, the User Forum announcement was forwarded to the mailing lists of relative research projects such as HUMANIST NoE, PReVENT IP, GST IP, EASIS STREP etc. The Workshop was further advertised through the AIDE website while participants had the opportunity to register on line. The Workshop was held at BAST

premises, in Cologne, and was jointly organised by BAST and AIDE Dissemination Manager (ICCS) with the active support of the whole AIDE consortium.

2.3. Agenda

Figures 1 and 2 show the workshop agenda.

Figure 1 Workshop's agenda 1st day

Final Programme

Wednesday, 16 March 2005

9:00-9:30 Registration and Coffee

Parallel sessions
Morning: 10:00-12:30

Track 1	Track 2	Track 3
AIDE Scenarios and Functions	From behaviour to risk	Nomad Forum workshop I
Chair: Johan Engstrom, VOLVO, Angelos Amditis, ICCS	Chair: Wiel Janssen, TNO	Chair: Patrick Robertson, MOTOROLA

12:30-14:00 Lunch Break

Parallel sessions
Evening: 14:00-16:30

Track 1	Track 2	Track 3
AIDE architectural concepts	Behavioural adaptation and DVE modeling	Nomad Forum workshop II
Chair: Holger Kussmann, BOSCH	Chair: Farida Saad, INRETS	Chair: Patrick Robertson, MOTOROLA

Networking Coffee

Figure 2 Workshop's agenda 2nd day

The programme was designed to be as attractive as possible, and featured several keynote addresses. Specifically, Mr. Mike Gardner, Director of Intelligent Systems Research Lab, Motorola USA, gave a presentation on the “Development of the Driver Advocate”. Also the EC representative Ms. Valerie Moutal made a short discussion on the European Statement of Principles (ESoP) while Mr. Peter Burns, member of transport Canada addressed the issue of road safety from the Transort Canada (department within the Canadian federal government) point of view. Other presentations featured the concept of AIDE addressed by Angelos Amditis (ICCS), Johan Engström (VTEC), Jan Arfwidsson (VTEC), Klaus Bengler (BMW),

Carlo Cacciabue (JRC) and Kussmann Holger (BOSCH) representing the AIDE project consortium.

2.4. Working approach

The first day of the workshop included plenary and keynote presentations and a round table discussion where key stakeholders participated (EC, EUCAR, CLEPA, FIA, public authorities, Transport Canada etc.).

Presentations addressed the following issues:

Presentations on AIDE results

1. AIDE Technical Overview by Johan Engstrom, VTEC.
2. Design Scenarios and HMI meta-functions: Towards an Adaptive Integrated HMI by Holger Kussmann, BOSCH.
3. Evaluation of Adaptive Integrated HMIs by Klaus Bengler, BMW.
4. Driver-vehicle-environment modeling in AIDE by Carlo Cacciabue, JRC.

Presentations from attendees outside AIDE consortium

5. The European Statement of Principles: Current Status and next steps by Valerie Moutal, EC/IST.
6. Road Safety Requires Smart Standards for Intelligent Driver Information and Assistance Systems by Peter Burns, Transport Canada.
7. Development of the Driver Advocate by Mike Gardner, Motorola.

The second day, participants were divided into three parallel tracks each one with different morning and evening sessions. Presentations on AIDE scenarios and functions as well as the AIDE results on architectural concepts and HMI designs were presented and discussed in the first session. In the second one, studies on the behavioral adaptation within the concept of AIDE was presented, whereas the third session addressed Nomadic devices issues (safety integration) and took place only in the morning. An exhibition of AIDE posters took also place during the workshop.

3. Workshop Proceedings

3.1. AIDE Technical Overview

Presenter: Johan Engström, AIDE User Forum, Cologne 2005-03-15.

The discussion began with a short summary of the basic facts of the AIDE project.

- AIDE is an integrated project on automotive human-machine interaction (HMI);
- It started on March 2004 and will continue for 4 years;
- The total budget is 12.5 ME with 7.3 ME EU funding;
- The project currently has 28 partners with a rough 50/50 industry-academia split;

- AIDE is part of the EUCAR Integrated Safety Program and is closely linked to other related FP6 initiatives such as EASIS, PReVENT and GST;
- AIDE is led by a core group consisting of VTEC (coordinator), BMW, Bosch, CRF, ICCS, JRC, PSA and TNO.

Then, the general vision behind the project, the concept of the Adaptive Integrated Driver-vehicle Interface, was presented. This concept entails a unified human-machine interface (HMI) that is shared by different applications (including those that run on nomadic devices) and is adaptive in real-time to relevant aspects of the driver, the vehicle and the environment.

The two key components in AIDE, integration and adaptation, were then explained in more detail. HMI integration is needed to handle the rapid functional growth in today's vehicles. There are today a rapidly increasing number of systems that interact with the driver in different ways, including ADAS (Advanced Driver Assistance Systems) and IVIS (In-vehicle Information Systems). HMI integration is needed to prevent interference between the different systems, but also to exploit potential synergies.

Regarding adaptation, there are today the technological possibilities to monitor the driver, the vehicle and the environment (DVE state) in real time. This can then be used to adapt different aspects of the HMI in order to optimize driver-system interaction to the current situation. Examples include locking out and/or postponing non-critical information in demanding situations or adapting the timing and/or intensity of safety warnings (e.g. warn earlier when the driver is inattentive).

Then, it was stated that, in order to realize the AIDE vision, substantial effort is needed on integrated and cross-disciplinary driver behavior research, evaluation methodology development as well as technological development. It was explained how this integration will be implemented in AIDE towards the development of the project: the three AIDE demonstrators (a city car developed by Seat, a luxury car developed by CRF and a heavy truck developed by VTEC). This also included a brief explanation of the project structure, with its four main sub-projects.

After this general overview of the project objectives and structure, some specific examples of work conducted in the project were given. These included:

- The empirical study in SP1 on adaptive forward collision warnings;
- The DVE modelling framework of SP1 and its envisioned applications;
- Examples of workload/distraction measurement methods and tools in SP2;
- The preliminary HMI architecture developed in SP3;
- The real time DVE monitoring in SP3;
- The work on guidelines and standards in SP4.

Finally, a few words were said on interactions with other projects, in particular EASIS, PReVENT, GST and HUMANIST, and the AIDE open forums (User Forum, Nomadic Device Forum and Architecture Forum) were briefly described.

In conclusion, it was pointed out that the AIDE IP is the first major European collaborative effort that really integrates major efforts on driver behaviour research, methods development and technological HMI development in a single multidisciplinary project. The project's *specification phase* is almost completed and it is now entering the *development and experiment* phase (M13-30).

3.2. Design scenarios and HMI meta-functions - Towards an Adaptive Integrated HMI

Presenter: Dipl.-Ing. H. Kussmann, Robert Bosch GmbH.

Today, more and more IVIS (in-vehicle information systems) and ADAS (adaptive driver assistance systems) applications are integrated in vehicles which individually interact with the driver and sometimes even dedicated I/O devices are used.

The main objective of AIDE is to improve the driver system interaction in terms of preventing interference between different I/O events coming at the same time and in terms of adapting the HMI depending on the driver state, driving situation and driver preferences. The I/O management and system adaptation should reduce driver distraction and improve driving safety.

In addition to that, a fully integrated in-vehicle HMI allows the exploitation of synergies and thus, reduces HW costs and enhances system performance. Last but not least in the AIDE project also the safe integration of nomad devices is part of the integrated HMI.

In order to reach that goal, a central component is introduced which manages the I/O events taking into account information about the driver state, driving situation and driver preferences. That information is summarized as "conditions" within AIDE.

It has to be mentioned that the HMI is a strong competitive factor for the car manufacturer and there do not exist a "best" HMI strategy which can be used. Consequently, the HMI is OEM specific.

Apart from that the amount of applications and the I/O device constellation is dependent on the vehicle segment. Therefore flexibility with respect to different HMI strategies and scalability in terms of system modularity are crucial requirements for the AIDE system.

For the description of the functional extent of the system, normally use cases are implemented. For AIDE project the different interaction events and the flow of these interactions are relevant. Within AIDE the interactions are called actions such as the output of a route guidance information, the dial up of a telephone number or a lane departure warning. Those actions have to be considered in different conditions. For the use case description every action has to be combined with all other actions and those actions can be considered in all different conditions. That would lead to an infinite amount of use cases which can not be managed and do not lead to a suited system description.

As a consequence a generalized description approach was introduced. In a first step all actions and conditions were categorized in groups. All actions belonging to one group are handled in the same way from the system. The scenarios are combined groups of actions together with a generalized solution. Solutions are the concrete system behaviour which is used for example in case of a critical combination of parallel actions. The amount of groups depends on the HMI strategy, i.e. to distinguish between different actions with respect to the system behaviour it is necessary that those actions belong to different groups.

This categorization is the basis for the system behaviour description and also for the architecture. It is crucial that those two aspects are harmonized to guarantee the flexibility to implement different HMI strategies easily.

The management of I/O events is done on the basis of the "importance" of a message for the driver, for example, because of the fact that one message is more important for the driver than another; the more important one will be presented first or even interrupt the other one. Thus, the importance or priority of a message was analysed and the characteristics were derived, forming the priority. For the actions these are:

- Initiator (user/system)
- Safety Criticality (high/low/none)
- Time Criticality (high/low/none)
- Driving Relevance (yes/no)
- Real Time (yes/no)
- Mandatory (yes/no)
- Duration (transient/sustained)
- Preference (yes/no)

In the next step all actions can be mapped on those parameters or characteristics. Assuming a clear definition of the parameters this mapping is objective and quite unambiguous. As a result, each action is represented by a specific combination of characteristics which can be used to derive the priority of the actions. That can be done without knowing the semantic of the action which increases the scalability of such a system realisation. Nevertheless, it is quite difficult to find a priority order for all the combinations of the generalized parameters, but it is necessary for the I/O management. Moreover, since all OEM's have different HMI strategies, this priority order will not be the same for different OEM's. To solve this problem AIDE introduces priority classes which can be chosen very flexibly by the different car manufacturers. All actions belonging to one of these classes have the same priority and these classes are the mentioned groups which are used for the scenario description.

In principle, AIDE distinguishes between three different priority classes:

- **Warning (W): urgent information to the driver mainly from ADAS;**
- **Dialog (D): directly desired and initiated action by the driver;**
- **Output Messages (OP): other output information,**

whereas the warning has the highest priority and the output message the lowest priority.

Everybody has the possibility to further sub-divide one class in order to distinguish for example different dialogs or output messages. For the AIDE HMI strategy 5 priority classes were chosen (W, D, OP1, OP2, OP3).

As mentioned before the conditions were also categorized. In the first step 5 different condition categories are defined:

- High traffic/environment risk;
- Manoeuvring (intention);
- Distraction;
- Driving demand;

- Driver impairment (fatigue).

Finally, for the scenario description three different conflict situations were considered:

- Conflict between concurrent actions;
- Conflict between one action and DVE conditions;
- Conflict between multiple actions and DVE conditions.

In order to get a better impression of the scenario description, one exemplary is given in the following:

AIDE design scenario 1.6: Conflict between two output messages
Action/s = {OP_i, OP_j}, where i=1...3 OP_1= Mandatory messages or important info related to the instant driving task OP_2= Temporary info related to the driving task, requiring an action in the near future OP_3= Permanent status-info related to the driving task, not requiring an action in the near future OR output messages related to the secondary task
DVE Condition/s: DVE_{1-5}=LOW/NO
Flow of events 1 1. OP_i is executed 2. OP_j is initiated
Possible AIDE solution(s) 1. OP_i and OP_j are presented in different modalities. 2. OP_j is delayed until OP_i has finished
Example: *Conflict scenario:* A route guidance message is given. While the message is executed, an incoming phone call is initiated. *Possible solution:* The phone call is delayed until the route guidance message has finished.

Table 1 AIDE Design scenarios – Conflict between two output messages.

This description format is unique today and offers the possibility to handle the integrated in-vehicle HMI taking into account the different HMI strategies of the OEM's.

The categorizations which lead to a generalized description of the functional extent of the system form a suitable basis for further system architecture development and fulfil the most important requirements with respect to scalability and flexibility. That is a crucial condition for an introduction of AIDE functionality in future vehicles.

3.3. Evaluation of Adaptive Integrated HMIs

Presenter: Klauss Bengler, BMW.

BMW as a member of AIDE project and a representative of one of the major automotive industries communicated the current state of the art on the integration fields and described the adaptation approaches adopted from several up-to-date European and United States funded projects.

Integration need occurred when several separate systems including in-vehicle entertainment and safety systems were installed in the car. Today more and more IVIS (in-vehicle information systems) and ADAS (adaptive driver assistance systems) applications are integrated in vehicles which individually interact with the driver and sometimes even dedicated I/O devices are used. The need for the development of a homogenous driver support system which integrates different ADAS and IVIS functions emerges imperatively.

Integration of many different in-vehicle functions opens several issues arising from the sequential steps of integration. From the simpler to more complex, different aspects of integration that can be encountered include:

- Geometric;
- Electric;
- Information;
- Interaction.

A short presentation of the early integration of the Audio and integration of Travel Information and HVAC to the actual status of integration today was made, showing the evolution of integration in BMW cars.

Integration fields within AIDE project were pointed out. The functionality that AIDE wishes to integrate concerns three types of functions: ADAS, IVIS and nomad devices. Nomad devices could ideally be managed by the AIDE system considered as IVIS but this is an ambitious and difficult task as not only ergonomic problems arise but also automotive industry and telecommunications industry are only in the beginning of a common understanding towards the safe use of nomad devices while driving. Moreover, one specific practical reason makes nomad devices' integration a difficult task: synchronization.

A step beyond integration is a step towards an adaptive integrated HMI. Adaptation is desirable as it gives to the system a kind of interpretation of the driving scenario and thus it gives the possibility to the system to match its information flow strategy to the driver state. In general, a given system changes its properties in dependence to additional external information. Different types of adaptation have been tested within recently finished or up-to date European research projects, which include:

• **Adapting to the situation**
(Weather, static traffic conditions, dynamic traffic conditions, ...)
SANTOS, IDIS, COMMUNICAR

• **Adapting to the user**
(User preferences, user state, ...)
SANTOS, AWAKE

• **Adapting to the combination of situation and user**

(traffic/environment conditions, driver's availability, user preferences, …)

However, adaptation is a tricky issue and one has to assure that once the HMI is adaptive, the user should be able to predict its adaptation features or at least not being surprised in order to achieve our ultimate goal which should be user support and acceptance. An important aspect that we should take into account during our study on adaptive HMIs is to compare the user's adaptivity and behaviour in different HMI adaptive features. Studies have shown that a not well- designed adaptive HMI can increase driver's reaction times to specific information.

Thus, HMI evaluation methods are needed in order to assure that the HMI is well designed and accepted by the drivers. The current State of the Art on evaluation methods include:

• Inquiry;
• Ratings;

• PDT;
• Occlusion;
• Lane Change Test;
• Driving Simulators;
• Equipped cars, field tests.

Towards a next generation of evaluation methodology the following challenges have been pointed out:

• Qualify existing methods for the evaluation of integrated and adaptive solutions.
• User Adaptation requires long term aspects during evaluations.
• Situation Adaptation requires complex evaluation scenarios.
• Integrated Solutions require complex evaluation settings.
• Provoke interactions between experimental treatments.

Development of evaluation methodology within AIDE is the task of Subproject 2. While SP1 will identify and model the behavioural effects of IVIS and ADAS functions, the objective of SP2 is to develop a cost efficient and industrially applicable methodology for quantifying these effects and their relation to road safety. An important goal is to extend existing approaches in order to account for new adaptive integrated interface solutions, new ADAS and nomad devices. Moreover, the methods and tools developed will be linked to design guidelines and standards (in particular the European Statement of Principles).

3.4. Driver-Vehicle-Environment modelling in AIDE within Sub-project 1 (Behavioural Effects and Driver-Vehicle-Environment Modelling)

Presenter: *Pietro Carlo Cacciabue, JRC.*

3.4.1. Objectives and Planned activity

The general objective of this sub-project is to develop a basic understanding of the DVE interaction and the behavioural effects of IVIS and ADAS and develop this into a model and computer simulation for predicting these effects. The sub-project will also develop the general conceptual framework to be used throughout the project, including the definition of taxonomies for IVIS/ADAS functions and their behavioural effects.

SP1 involves two major areas of work: modelling and simulation of the driver-vehicle-environment system (WP 1 and 2); and Studies on the behavioural effects of driver assistance systems and (WP 3).

The general goal of the behavioural studies is to identify the basic mechanisms and critical parameters underlying behavioural effects of driver assistance and information functions. The main focus will be on the effects of ADAS, e.g. behavioural adaptation, as this is where research is most urgently needed. Work will involve simulator studies as well as field operational tests.

On the basis of the empirical results, a model of the DVE interaction will be developed. This model will be a key input to the AIDE design and development in SP3 as well as to the methodological development in SP2.

In the later phase of the project, the model will be implemented in a computer simulation for predicting behavioural effects. A main end application of the model and simulation for prediction of the behavioural effects associated with driver assistance and information functions. The simulation will be a useful tool for evaluation of new HMI concepts and ADAS and IVIS functions early in product development. The simulation could also be used, in combination with accident analysis, for taking behavioural effects into account when predicting the actual safety benefit of different driver assistance functions.

3.4.2. Activities carried out to date

All partners involved in WP 1 of SP 1 contributed to the review of the literature by reviewing a number of models. Specific attention was dedicated to models in the domain of automotive transport. However models from other domains, e.g., aviation, were also considered. This activity was split in two parts: the identification of most suitable models for a so called Generic DVE (G-DVE) model and for an Electronic DVE (E-DVE) model.

The definition of the most relevant aspects that should be taken into consideration for the development of the G-DVE and E-DVE models should allow development of a complex and quite complete model for extended studies, and a fast running simulation for prototyping and preliminary design analysis.

The identification of a reference model of DVE for design purposes and fast running prototyping developed from the review of models was performed. Also, the preliminary guidelines for use of DVE in design and simulation have been developed. The research activity will continue for the whole duration of the project, as it aims at developing a modeling and simulation (WP 3) that respects the finding of the experimental work and the needs.

With respect to the behavioral adaptation research (WP 2), a review of the literature was performed that aimed at identifying the main types of problems that arise in the study of the behavioral adaptation induced by different driver support systems. Thus, the review did not seek to be exhaustive, but rather to highlight the issues to be considered prior to planning the experiments to be conducted during the SP1, and the identification of the most relevant parameters and variables that affect driver behavior for modeling purposes.

It should be noted that certain types of support systems, such as Lane Departure Warning Systems, were not included in the review. Although no definite choice has been made as yet between the different driver support systems on which we are working, the initial discussions within SP1 showed that preferences are towards ACC, Stop & Go or Frontal Collision Warning, on the one hand, and Intelligent Speed Adaptation systems, Cruise Controls and Speed Limiters, on the other.

The research activity on simulation development (WP 3) focused initially on the analysis of the methods and techniques that can be applied for the implementation of a Driver-Vehicle-Environment model in a software simulation that can run in PC. The programming approaches that best suit the modelling form proposed in WP 1.1.1 have been identified.

The simulation of DVE model that will be developed will depend on the granularity of the Task Analysis that will be associated with Driver behaviour and performance. This in turn will define the complexity and detail of the simulation being carried out.

3.5. The European Statement of Principles: Current Status and next steps

Presenter: Valerie Moutal, EC/IST

In-vehicle driver information and support systems (eg navigation, communications, collision warning) need to be carefully designed so that they do not distract the driver and can properly support the driving task. In December 1999 the European Commission (EC) adopted the European Statement of Principles (ESoP) in acknowledgement of the importance of Human-Machine Interaction (HMI) safety for in-vehicle telematics. In recommending adherence to the ESoP, the EC urged the European motor manufacturing and in-vehicle information systems supply industry to comply with the ESoP which outlined a number of basic safety requirements concerning the design of, and driver interaction with, in-vehicle information, communication and entertainment systems. Member States were invited by the EC to take steps to encourage industry to comply with the ESoP and report back on the awareness of ESoP within the industry and the degree of compliance to the ESoP by the industry by December 2001. Only a handful of Member States reported back. In recent months an EC e-Safety Working Group has identified the potential safety benefits of driver information and assistance systems for the driver and has recommended that HMI issues be given urgent attention. An Expert Group for HMI has therefore been set up under the e-Safety initiative. This Expert Group will effectively address the HMI safety issues as the 'next steps' to the outcome of the EC ESoP exercise.

The principles, 35 in total, are divided into six categories:

- Overall design principles

Since there are only three of them, they can be quoted here in full in order to get an idea of the principles format and content:
- *'The system should be designed to support the driver and should not give rise to potentially hazardous behaviour by the driver or other road users.'*
- *'The system should be designed in such a way that the allocation of driver attention to the system displays or controls remain compatible with the attentional demand of the driving situation.'*
- *'The system should be designed so as not to distract or visually entertain the driver.'*

- Installation principles

Five principles deal with the way in which in-vehicle systems should be positioned and fitted. It is not so much driver 'active' distraction as the possible obstruction of the driver's view and of controls and displays that is the subject here.

- Information presentation principles

This category, which contains five principles, together with the next two, forms the core of the statement. Several of the principles included in it deal explicitly or implicitly with driver distraction.

- Principles on interaction with displays and controls

This category deals with the 'hardware' of interacting with the in-vehicle system.

- System behaviour principles

This category deals with the way in which the system should be designed in order to promote road safety against specific messages presentation in a given situation.

- Principles on information about the system

This last category deals with the instructional material to be provided to the driver for using the system, for understanding what it can and cannot do, etc.

One can find the ESoP recommendations and the statement justification at:
http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/l_019/l_01920000125en00640068.pdf

3.6. Road Safety Requires Smart Standards for Intelligent Driver Information and Assistance Systems

Presenter: Peter Burns, Transport Canada

The first generation of adaptive integrated interfaces has only recently appeared in the field and the approach seems to be gathering momentum. It seems inevitable that all vehicles will have some adaptive features in the future, so it is crucial that safety and human factors lead these developments.

Transport Canada is a department within the Canadian federal government. Transportation safety and security is our main concern. Road safety is a shared responsibility between the federal and provincial jurisdictions in Canada. Transport Canada is responsible for the safety of vehicles and the provinces are responsible for how vehicles are used and aftermarket equipment.

My responsibility is within road safety research and motor vehicle regulations – specifically Ergonomics and Crash Avoidance research. My division supports the federal government traffic safety objectives by undertaking independent and collaborative scientific research and providing national leadership in human factors and crash avoidance.

An overview of some of the activities within Transport Canada that are relevant to the Aide IP were presented. The two most relevant themes in our work concern: 1) Assessing Distraction and 2) Distraction Countermeasures.

3.6.1. Assessing Distraction

With regard to developing assessment methods for driver distraction, we have a number of external and internal projects. Transport Canada was a partner in the European project HASTE, which is familiar to most people at the AIDE workshop.

We have also been evaluating multifunction displays in-vehicles using a variety of assessment techniques including Expert evaluations (Heuristic evaluations and the TRL Checklist), User Testing and the Occlusion test.

Most recently we applied the Lane Change Test (LCT) to evaluate the visual-manual tasks that were investigated in HASTE. Two typical navigation system tasks, Point of Interest (POI) Entry and Address Entry were performed on an aftermarket navigation system (Blaupunkt Travelpilot). The simple POI task required the driver to include one category of displayed information (e.g. gas station) to the map and required 8 button presses. The complex POI task required the driver to input six displayed categories of information and took 23 button presses to complete. The simple Address Entry task required the driver to enter the

only the city (16 button presses). The complex Address Entry task required the entry of both city and street information (27 button presses).

Twenty-one experienced drivers took part in this experiment. These participants performed practice trials with similar secondary tasks; 3 baseline drives; 3 drives with calibration tasks (low, medium and high complexity Circles Task); and 4 drives with the HASTE visual-manual tasks. Results found that the LCT discriminates lane change path deviations across the calibration tasks and between different types and complexity of secondary tasks. These differences are a function of time taken to complete the secondary tasks so it is essential that task duration is considered within LCT assessments.

Of course more research is needed to validate and refine the LCT procedure and the procedure would benefit from some criteria on which to set performance limits for unsafe tasks. Our next step will be to compare these results with the Occlusion Technique and HASTE, which run multiple studies on the same system and tasks using a variety of driving performance metrics. The results from this work should be completed before the summer.

3.6.2. Distraction Countermeasures

With respect to distraction countermeasures, Transport Canada has been assessing the Alliance of Automobile Manufacturers (AAM) "Statement of Principles, Criteria and Verification Procedures on Driver Interactions with Advanced In-Vehicle Information and Communication Systems". Although these principles promise to improve safety, there is uncertainty on the level of safety and effectiveness of the procedures and criteria. Thus, there is a need to thoroughly evaluate the AAM's 24 principles and to measure the compliance of current in-vehicle devices to these principles as a benchmark for change. Furthermore, there is a need to evaluate whether the verification procedures are explained in sufficient detail to be applied effectively. Our study evaluated the compliance of four vehicles to the AAM safety principles. The Phase 1 static testing will be completed in March 2005 and the Phase 2 dynamic testing will be completed by September 2005. The second phase will concentrate on AAM Principle 2.1.

This work will provide essential input into the Memorandum of Understanding (MOU) on Telematics that Transport Canada is currently negotiating with the automotive industry. A MOU working group was established in November 2004 and has had several meetings. The working group is comprised of Transport Canada, Canadian Vehicle Manufacturer's Association and the Association of International Automobile Manufacturers of Canada. We are aiming to have an agreement negotiated by early 2006. A central part of this agreement will be based on a safety management systems approach to the development of telematics devices to improve the safety of driver-system interaction and reduce the risks of driver distraction. Currently the most appropriate approach is for manufacturers to ensure that driver-vehicle integration considerations are systematically addressed within their product development process. This process based approach would not prescribe steps but would ensure that manufacturers have the capacity to successfully integrate human factors input into their design and development process. It would also require comprehensive, systematic and traceable application of human factors considerations throughout the product development cycle.

3.7. Development of the Driver Advocate (Mike Gardner, Motorola)

Presenter: Robert "Mike" Gardner, Director Intelligent Systems Research Laboratory and Fellow of Technical Staff Motorola Corporate

Motorola's Driver Advocate™ system is a driver assistance system that prioritizes and adapts the presentation of information to the driver, relative to the driving situation and, ultimately, to the driver's workload. This industry research and development program shares many common goals with the EU 6th Framework AIDE project and the US SAVE-IT program.

Driver distraction is ultimately a driver focus issue driven by a broad set of potential distracters including visual, psychomotor, auditory, or cognitive. The presentation engaged the audience in a cognitive focus exercise criticising a video. 70% of the audience failed to do misplaced cognitive focus. The literature establishes that telematics are a contributing factor in automotive crashes due to this misplaced focus. Studies indicate that there exist a number of distraction sources that create an impact in distraction related accidents. Research on these sources is disproportionately skewed towards cell phone studies. Intelligent adaptive driver interface systems should attempt to holistically address all of these distracters and not just a few.

A number of potential technology solutions are being proposed. There has been a 2 times increase in issued patents every year over the previous four years that claim to address the driver distraction issues. A prevalent approach is embedding intelligence in the automobile that controls all sources of potential distraction including enslaving any nomadic devices that find their way into the vehicle. These systems include a Workload Manager that attempts to limit the driver workload so that good driver focus can be retained. These systems require contextual knowledge but differ on what kinds of context is utilized: driving situation, driver input, vehicle performance or driver state. A number of industry players are developing various workload manager capabilities with Motorola as a major player.

Motorola's Driver Advocate™ system attempts to consolidate the driver human interface and deliver "the right information at the right time at the right way." It is a driver assistance system that prioritizes and adapts the presentation of information to the driver, relative to the driving situation and, ultimately, to the driver's workload. This program has been in progress for four years under a plan to develop a system in four technology generations. Generation One uses existing vehicle data to focus driver attention using a "One-at-a-time" workload paradigm. This has been demonstrated in the US and EU in a Minivan in partnership with an OEM. Generation Two harnesses the capabilities of collision warning, ADAS, and seamless mobility with a multi-task workload manager. Generation Three adds adaptation and learning to enhance performance. Generation Two and Three are being demonstrated at various technology/cost maturity points within a driving simulator system that models the architectures, software, sensor behavioral models, and actual driving interfaces. Subsets of these technologies are being demonstrated within real automobiles. Generation Four additionally manages the hand-off to autonomous vehicles. The presentation showed a video of a Driver Advocate Generation Two system in action.

Key R&D challenges center around the ability to design these multi-modal, multitasking, adaptive intelligent systems with the narrow human factors testing methodologies now employed and existing technology limitations. Motorola is developing new methodologies and technologies that support the creation, modeling and testing of advanced automotive

intelligent systems that overcome the previous challenges. Furthermore advances in seamless mobility technologies also hold many of the keys to reducing driver workload and distraction from nomadic devices.

3.8. Round Table discussion

Subject:

Roadmap towards the future automotive HMI that integrates ADAS, IVIS, nomadic devices and cooperative systems.

Chaired by Angelos Amditis (AA) – AIDE DM (ICCS)

Participants:

Johan Engstrom – AIDE (Volvo)

Friedemann Kuhn – EUCAR SGI (DC)

Winfried Koening – CLEPA (Bosch)

Wolfang Hofs – EC/IST

Peter Burns - Transport Canada

Following the presentations, a round table discussion took place. This was chaired by AIDE Dissemination Manager under the title *"Roadmap towards the future of automotive HMI, taking into account the complex automotive environment which includes ADAS, IVICS, Nomad Devices and cooperative environment* .Five attendees were invited to answer specific topics /questions introduced by AIDE partners. Short statements were made by EUCAR SGI, Transport Canada, CLEPA, EC/IST and AIDE on the topics they were interested in and then a breakout session followed. Below, one can read the statements and the discussions that followed:

3.8.1. Topics for discussion

The following topics were introduced by AIDE partners:

1) What are, in your view, the key features of a future adaptive integrated driver-vehicle interface? Does the HMI need to be adaptive and/or integrated at all?

2) What are the key human-factors-related issues associated with future automotive HMIs?

3) What are the main driving forces in this field?

4) What types of HMI personalization are desirable/ feasible?

5) To what extent is standardization possible in the HMI area? Which features could be subject to standardization?

6) What will be the effect of the increasing use of nomadic devices in the vehicle? To what extent is it feasible to integrate them in a safe, reliable and effective way with the in-vehicle HMI?

7) What are the key HMI issues with respect to cooperative systems?

3.8.2. Procedure

1. Every participant made a short opening statement addressing all or a subset of the questions above.

2. An open discussion followed between the participants of the round table but also between the panellists and the audience through questions and answers.

3. The Chair gave the speech both to the panellists and the audience for questions and answers.

3.8.3. Opening Statements

➢➢***Johan Engstrom (AIDE)*** *addressed the first four questions**:***

Topics/Questions

1) What are, in your view, the key features of a future adaptive integrated driver-vehicle interface? Does the HMI need to be adaptive and/or integrated at all?

Integration is something we cannot avoid with all these new in-vehicle systems. From a safety point of view this is absolutely necessary. HMI adaptivity on the other hand is still something not well studied and as AIDE consortium we consider it as something we need to investigate and which could be a positive factor if implemented with respect to the user.

2) What are the key human-factors-related issues associated with future automotive HMIs?

Human factors with respect to

i) ADAS

We need to investigate the field of human behaviour adaptation. We still do not have a methodology for predicting behaviour changes, how people adapt their behaviour to various situations which could provoke ADAS messages' activation.

We also need to investigate how to evoke the right response from the driver. Creating a clear picture of the driving scenario (e.g. surrounding traffic) is not the ultimate goal of an integrated ADAS system. The goal here is that along with the driver's enhancement of level of awareness, we should eventually investigate the right actions. This is the only way to prove that our system is both efficient and accepted by the driver.

ii) IVIS

For IVIS, distraction is clearly the most critical HMI issue. Although the phenomenon has been studied a lot we need to continue working e.g. on valid and efficient methods for assessing distraction.

3) What are the main driving forces in this field?

The main, sometimes competing factors here are the market and public safety. They need to be balanced.

4) What types of HMI personalization are desirable/ feasible?

Personalization could be considered in two steps:

iii) 1st step: "cosmetic" functions (mainly regarding skins, graphics, ergonomics aspects etc).

iv) 2nd step: more advanced dynamic personalization of the system (for the time being these more complex features are under investigation mainly in European projects like AIDE and their consideration is only in an early stage).

➢➢ *Friedemann Kuhn **(EUCAR SGI)***

Topics/Questions

1) What are, in your view, the key features of a future adaptive integrated driver-vehicle interface? Does the HMI need to be adaptive and/or integrated at all?

- Yes, the HMI should be both integrated and adaptive. Due to an increase of functions in future vehicles integration will be needed. Integration is needed from a packaging, cost and safety perspective.
- ***Integrated HMI***: several functions share the same interface to the driver. The more functions that will be available in our vehicles the bigger the need of integration of functions. Modularity is important. Integration is necessary if the number of functions will grow in the pace we foresee, for several reasons: safety, cost, efficiency and styling. The level of integration can be discussed, most of the SGI members felt that a well balanced approach needs to be found.
- ***Adaptive HMI***, the HMI could be adaptive to:
  i. the driver/user
  ii. the situation – some members in SGI thought this was difficult and were not convinced that this is useful. Having the systems adapted to the situation could make the driver confused. The vehicle will not behave as

expected and this could result in a prolonged learning curve. If the system is adaptive to the situation the question of communication and information to the driver need to be solved. The vehicle needs to inform the driver why a function is blocked.

iii. Conclusion: research is still needed in order to understand how and what functions to make adaptive.

2) What are the key human-factors-related issues associated with future automotive HMIs?

- Integration of internal and external devices (nomadic), of all reasons mentioned above;
- Learnability of new systems;
- Acceptance;
- Methodologies for measurement of positive and negative safety effects;
- Distraction;
- Adequate HMI with respect to driver (and situation);
- Behavioural adaptation.

3) What are the main driving forces in this field?

- Safety;
- Comfort;
- Brand identity and competitiveness;
- HMI is an enabler to realize other functions;
- To create acceptance for new products.

4) What types of HMI personalization are desirable/ feasible?

- Basic settings like colours, gauges etc. can be desirable and feasible for the individual to change. The possibility to personalize your HMI could make it possible to satisfy the global user (cultural differences).
- What more to personalize depends upon:
  i. Safety effects of the personalization;
  ii. Brand identity (the manufacturer want the HMI to look like a Volvo, DC, BMW etc);
  iii. Possibility to make it feasible for the user to manage by him/herself (the user should not need to be a programmer to handle it).

5) To what extent is standardisation possible in the HMI area? Which features could be subject to standardisation?

Standardization could be seen in different levels:

1) Basic functions, like placement of pedals and important controls and icons should be (and already are) standardized;
2) Warnings and warning strategies, could benefit from being standardized from a safety point of view;
3) Evaluation methods – could benefit from being standardized;
4) Communication protocols etc. (not seen by the user) – could benefit from being standardized.

A lot of the HMI area could not be standardized – it is brand specific and a differentiator. More research is needed in this area.

6) What will be the effect of the increasing use of nomadic devices in the vehicle? To what extent is it feasible to integrate them in a safe, reliable and effective way with the in-vehicle HMI?

Not enough research done in order to know the real consequences of more nomadic devices in the vehicle. The problem is not defined yet because of several reasons: it is difficult to measure, too few users of nomadic devices in vehicles today etc.

But, we see risks for the future:

- Nomadic devices are not developed for in vehicle use.
- There must be sure that the in car communication will not be disturbed by software from nomadic devices (e.g. Blood brain border in human beings).

Future scenario:

1. Offer the same functionality in the vehicle as in the nomadic device (probably not realistic);
2. Provide possibilities to integrate the nomadic device in a safe, reliable and effective way;
3. Let the provider of the nomadic device (telecom) be responsible for installation (keep the input/output devices of the nomadic device also when in the vehicle).

According to the discussion in SGI, alternative 3 is probably the most feasible.

How can we integrate nomadic devices with in-vehicle HMI:

- Cooperate with the telecom industry;
- Let the nomadic device use displays in the vehicle;
- No legislation against the use of nomadic devices in vehicles;
- Continue discussion in AIDE Nomadic Device Forum.

7. What are the key HMI issues with respect to cooperative systems?

Similar to the issues of developing ADAS.

The amount of information will increase with cooperative systems – the need of integration will grow. It is also important to define what the relevant information for the user is:

- What the user wants.
- What the user needs.

The goal here is also not to cause information overload and distraction.

➢➢ ***Winfried Koening (CLEPA)***

1. What are, in your view, the key features of a future adaptive integrated driver-vehicle interface? Does the HMI need to be adaptive and/or integrated at all?

We think that the key features are user acceptance and improvement of driving safety.

From our experience driver acceptance can be reached if he or she either:

1. does not recognize that the system is adapting;
2. the driver understands why the system is adapting.

2. What are the key human-factors-related issues associated with future automotive HMIs?

Additionally keeping the driver in the loop, keeping him aware of the situation is essential.

3. What are the main driving forces in this field?

Reducing the number of fatalities is our global goal. We think that the installation of combined active and passive safety systems can contribute to this goal. All these systems need a careful design of their user interaction. In the second step we have to integrate these separate systems to a homogenous driver support system.

4. What types of HMI personalization are desirable/ feasible?

Personalization to individual ergonomic features and to individual preferences and experiences makes sense.

5. To what extent is standardization possible in the HMI area? Which features could be subject to standardization?

Standardization of minimum performance requirements is important and is already subject of activities in ISO. Standardization of design does not make sense in our opinion because these systems have to be integrated into different cars from different brands.

The standardization process needs much time and effort. It starts very early, already in the concept phase and continues through the development phase. As soon as experience from the field is available we have to integrate this into the standard.

6. What will be the effect of the increasing use of nomadic devices in the vehicle? To what extent is it feasible to integrate them in a safe, reliable and effective way with the in-vehicle HMI?

Nomadic devices will play a certain role as components of information systems. They must be installed in a way that no negative effects on traffic safety will happen. They have to fulfill the same standards as integrated systems regarding safety and usability. We think that they are not feasible if an interaction with the vehicle dynamic is concerned.

➢➢ ***Wolfang Hofs (EC/IST)***

The EU expectations from a project like AIDE are:

- Within the context of e-safety initiative, the main expectation is to improve road safety in Europe. A good HMI design is a valuable tool towards our efforts to reduce fatalities on the roads.
- The political perception behind the funding of projects like AIDE is to gather as much knowledge as possible and eventually implement this knowledge through standardization or even legislation. Relevant actions have already been undertaken in the context of ESoP.
- From the social point of view, a clear modern need is to find ways in order to control the numerous new devices that have sprung up with the technological growth of the last years and are used inside the vehicles. We have to face the fact that there is a lack of integration in new systems in order to build a safer automotive environment.
- Apart from the integration issue, the adaptivity features also promise to play an important role in the vehicle, by enhancing the driver's perception and by following driver's needs and preferences. It is very important to build systems that can adapt to current driving situation and provide a reaction that is not only relevant to the

driving scenario but to driver's preferences too. For example, the driver could decide on the I/O device which will be responsible for warning him in a FCW (vibration or visual warning).

➢➢***Peter Burns (Transport Canada)***

Peter Burns said a few words about SAVE-IT, a similar with AIDE project that is in progress in the United States. SAVE-IT perception of HMI adaptivity is focalized in two different aspects:

i) various automation processes and ii) human factors' consideration. Peter Burns addressed questions 2,3,4,5 but in a mixed order:

With respect to adaptivity features, I wanted to notice that the word adaptivity can mean a lot of things. Basically, if we have achieved an optimal HMI design then possibly no adaptivity is needed. But, in the case of a bad HMI design, adaptivity features may improve system's interaction methods.

Criteria for HMI design should be in the hands of policy makers. Unfortunately, today, these lie only in the hands of OEMs (suppliers, car manufacturers).

The adaptation features can be distinguished into two categories with regard to their implementation quality: - transparent and

- hidden.

Perhaps the better way is the second one where the driver does not have the knowledge of when and how the interface is adapted. In both cases, adaptation of the system should be logic and predictable and should be implemented in an easy to understand and acceptable way from the driver.

System's adaptation is a complex issue and most of the users possibly are not aware of the possibilities of an adaptive HMI. More research in this field will be welcomed and is needed.

With respect to personalization matter, we believe that this could lead to problems:

- It may increase system's complexity
- Create difficulties in the domain of standardization. We should question the users' awareness and understanding of their responsibilities while driving. People often do not know what the right thing to do for themselves is. If, for instance, someone wants to use an IVIS system like DVD while driving, this could be dangerous. Thus, we should pose some limits.

3.9. Track I: AIDE Scenarios and Functions (morning session, attendance list can be found in Annex A)

Chairman: Johan Engstrom, VOLVO
Angelos Amditis, ICCS

3.9.1. Summary

A presentation of the adopted methodology towards the derivation of AIDE design scenarios was made. The key elements which, combined, constitute an AIDE design scenario description were addressed one by one. In order to explain the format of the scenarios' description, a description of the key terms used by subproject 3 of AIDE project was presented through the presentation of the AIDE glossary. More specifically, the following terms were discussed: AIDE design scenario, Driver-Vehicle-Environment conditions, Actions, AIDE meta-functions, driver distraction, driving demand, and application.

The description of the adopted methodology involves mainly three of the aforementioned terms: Actions, Driver-Vehicle-Environment conditions and AIDE metafunctions. The first two represent the driver-vehicle interaction in various driver-vehicle-environment states, whereas the last one represents the system's general solution to the possible action or condition depending conflict.

3.9.2. Methodology adopted for the derivation of the AIDE design scenarios

Having in mind the adaptive characteristics that AIDE project envisions to adopt towards a real-time adaptive HMI design and development, the design of the driver/vehicle dialogue should be based on clear scenario descriptions, able to represent not only the set of interactions between systems and the driver, but also the rationale behind system's adaptivity. While standard use case templates are mainly intended for individual IVIS/ADAS functions (e.g. route guidance, phone, ACC, collision warning etc.), the AIDE system will implement "meta-functions" that supports the interaction between a large number of such functions and the driver (e.g. resolving conflicts between functions and enabling adaptation of individual functions). Thus, the standard use case methodology is not applicable. Still, in order to derive the AIDE requirements and specifications, we need a parsimonious way to describe the use cases and scenarios that AIDE will address. Such a methodology does not currently exist and thus had to be worked out in the project.

Action categorization – required steps:

- Define a set of basic parameters that can be used to characterize the actions

AIDE action = f (initiator, duration, safety criticality, time criticality, real time, mandatory, driving relevance, preference)

- Assign the parameters to the considered actions (list of 50 AIDE actions)
- Three classes are derived from the in-vehicle HMI expert point of view considering the individual interaction content:

•**Warnings**, which present very urgent information to the driver and which comes mainly from driving assistance systems like a lane departure warning system or collision avoidance

systems. Such information is of highest priority for the driver and has to be presented in any case.

•**Dialogs** which should be answered or followed by the system immediately, because they are directly desired and initiated by the driver. Nevertheless the first "warning" class is of higher priority and might even allow an interruption of a dialog.

•Other **output messages** which comprises all output information not belonging to class 1 and 2.

- Group the actions into these classes respectively to their parameterization

Example:

Action Parameter list		Initiator		Dura-tion		Safety Criticality			Time Criticality			Real Time		Manda-tory		Driving Relevance		Preference		
Identification Number	Action	System	User	Transient	Sustained	None	Low	High	None	Low	High	Yes	No	Yes	No	Yes	No	Yes	No	*Priority class*
ID 1	Route guidance information (turn left immediately)	x		x		x					x		x		x	x			x	OP_1
ID 2	Route guidance information (turn left in 300m)	x		x		x				x			x		x	x			x	OP_2
ID 3	Entering destination in the navigation system		x	x		x			x				x		x	x			x	D

With respect to the latter, the categories represent characteristics of the interaction which allows managing or influencing them. One of the most important information which is used for this management is the "priority" or "importance" for the driver. Thus, some of the categories should directly indicate the priority, e.g. a parameter like "safety criticality" or "driving relevance". The characteristics are expressed with those parameters and all interactions should ideally belong to one of the classes defined as subsets of those parameters and reflect AIDE intended action categorization.

Assignment of the action parameters' necessity and objectiveness was argued. It was explained that ISO method is insufficient for actions' prioritization as AIDE had to consider various parameters except of the ISO existing ones which are related only to time and safety criticality of an action/message. It was argued that AIDE's purpose should ultimately be some kind of consensus, adopted by both car manufacturers and EC, on a minimum of standardization for actions. Maybe, in the future, we could agree on a minimum set of management parameters. It is not so important if these AIDE proposed parameters are the most suitable ones, What is important is the concept behind the use of such objective parameters to be accepted. Besides, this idea of action parameterization let the OEMs to change the parameters' criteria or even add new parameters if they want to distinguish otherwise between actions. This approach offers maximum flexibility for the vehicle manufacturers, but nevertheless it allows a common generalized description of the scenarios and finally a modular architecture.

With respect to the architectural effects of this categorization scheme, several advantages were argued in comparison with the AMI-C approach:

- Improves the scalability of the architecture, since applications do not have to be changed for different system configurations (as well as during the integration phase and during the runtime (field) phase).
- Application development is independent from the system behaviour and the ICA module, since no explicit priorities values have to be fed by the application to the ICA module. Therefore the architecture fulfils the requirement of modularity.
- The applications and the context can be objectively categorized.
- The generalized categorizations of the context and characteristics of application I/O reduce the complexity to be handled.

Thus, central intelligence module of AIDE recognises an application in an abstract way, according to the provided action parameters. AMI-C's intelligent kernel, on the other hand, has to know exactly the application.

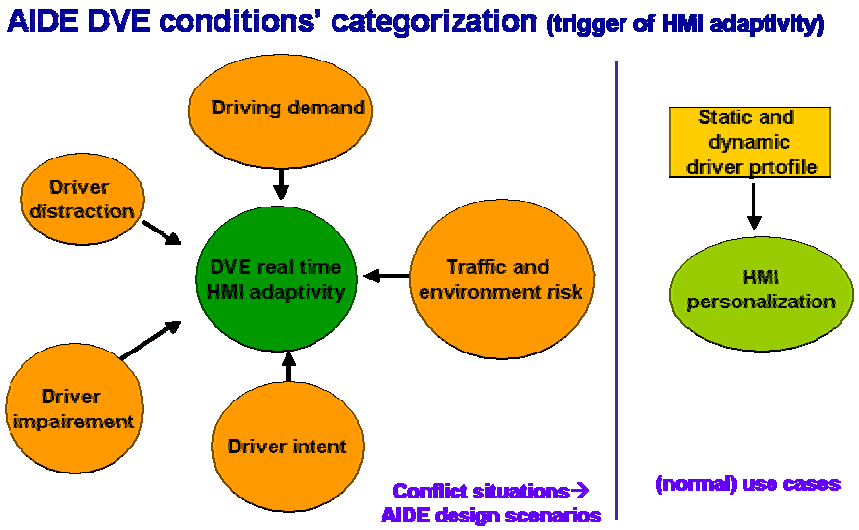
With respect to the dialogues priority class, it was argued that no conflict should be considered involving dialogues, since a user-initiated action signifies that the driver considers himself as capable of accomplishing the action. This is more obvious in situations where the initiator of the action is a passenger instead of the driver.

Commenting on the metafunctions, it was argued that the action scheduling regarding visual messages should take into account the existence or not of a fellow-passenger in the front seats. It was also mentioned that most of the cars involve IVIS functions in a passenger-oriented way.

Dialogues should not be confused with output messages. Dialogues represent the initialization of a driver initiated action. It is when the driver starts a dialogue that the system should allocate an I/O device and this is the crucial moment for prioritization.

3.9.3. Towards DVE-dependent HMI adaptation within AIDE

In order to adapt the system reaction to different aspects of availability, ability and traffic/environment conditions, in a personalized way, a Driver-Vehicle-Environment state was defined based on the considered dimensions of availability, ability and traffic/environment factors. There is no inherently "correct" set of DVE parameters since the relevant aspects are dependent on the HMI- and adaptation-strategy of the OEM. Thus, for the AIDE system, the relevant DVE parameters are those that are needed for implementing the defined (meta-) functions and scenarios. For example, if AIDE should implement adaptation of warning timing to driver distraction, we must be able to measure the DVE parameter distraction (which has to be clearly operationally defined). The selected DVE state dimensions are the followings: primary task demand, distraction, driver impairment, traffic/environment risk, driver intent and driver profile.



Concerning the DVE state assessment, questions were raised on the considered inputs. Some controls were identified both as actions and as input for DVE state assessment. It was explained that it is an architecture issue whether you consider the steering wheel handling as an action or as a DVE condition element. In the adopted methodology these actions that do not represent a discrete functionality of the system but rather a driving task action (e.g steering wheel handling) but affect the DVE state are taken into account by the DVE modules which then produce a corresponding condition (steering wheel angle is taken into account for driving demand assessment as well as for traffic risk assessment).

Especially, an interest was expressed from PReVENT's side regarding TERA inputs and outputs parameters. It was argued that only if those parameters were communicated we could find out if AIDE and PReVENT can share a common understanding and cooperate with respect to the environment scenario assessment. From AIDE's side, it was explained that there is no generic list of DVE output parameters shared by all applications. The specific DVE outputs' definition depends on different applications needs and OEMs' focus. The synergies between PReVENT and AIDE projects were discussed in profound. PReVENT explained their work on sensors' fusion outputs and argued that their module could edge in between the AIDE sensors' set and the DVE modules in order to provide the needed fused sensors' information. A common will on investigating the synergies between those two projects was expressed by both sides.

3.10. Track I: AIDE Architectural concepts (evening session, attendance list can be found in Annex A)

Chairman: Holger Kussmann, BOSCH

3.10.1. Introduction of AIDE:

The session starts with a presentation of the AIDE idea and objectives. The idea to have a suitable management and adaptivity of the input/output events in a vehicle addresses the following main issues:

- Prevent **interference** between I/O events;
- Exploit **synergies** (reduce HW costs, enhance performance);

- Adaptation to the driver state and /or the driving situation (DVE);
- Integration of nomad devices.

Considering those aspects the system has to offer central functionality which coordinates the I/O events and interacts with the main known components of the system (applications, I/O devices, etc.). Within AIDE this central functionality is called AIDE meta functions and are listed below:

- Derive action priority;
- Conflict recognition depending on actions / conditions (not I/O devices);
- Scheduling according to the driver/environment model;
- Channel and modality selection and device allocation;
- Changing information strategy depending on conditions.
  Results in:
  - Terminate actions;
  - Interrupt actions and resumption of actions;
  - Include pauses.
  - Delay actions;
  - Modality/channel selection;
  - Modality/channel alteration;
  - Change spatial layout (location of output);
  - Change physical layout (volume, size, form, colour).

Thus the applications have to make available some additional functions like delaying or interrupting outputs or choosing a subset of the possible output modalities.

These additional functions must be integrated in the in-vehicle information system taking into account a variety of crucial requirements. The HMI is a strong competitive factor for the car manufacturers and there is no "best" in-vehicle HMI strategy. Therefore the HMI strategy is OEM specific.

In addition to that, the amount of applications (IVIS and ADAS) and also the amount of I/O devices depends on the vehicle segment and differs much.

As a conclusion, the most important requirements for such a system are flexibility in terms of the HMI strategy and scalability in terms of the amount of applications and I/O devices.

In order to concentrate on the discussions on the architecture no more requirement issues were considered in this session.

3.10.2. AIDE architecture:

Within the AIDE project a HMI software architecture will be developed which focus on I/O management and adaptive assistance for the driver. The results should be used to initiate or to support a standardisation initiative like AUTOSAR or ISO. Additionally the architecture has to be harmonised with other running IP's like EASIS, GST, Prevent, etc.

Thus, as a result of the architecture work the following can be expected:

- A component structure on different levels (logical view);
- A clear analysis and definition of central components in terms of tasks, responsibilities and dependencies;
- A generalized data exchange protocol with respect to data-content, -structure and communication flow;
- 3 Demonstrator instances for validation.

3.10.3. ICA component:

In the following the overall component structure of the software architecture was discussed. It was pointed out that the ICA component has to be as modular as possible to fulfil the mentioned crucial requirements of flexibility and scalability. The ICA has to prioritize the I/O events and decide which output is presented at which time, at which location and in which form - see meta functions. Nevertheless, the ICA should not have any knowledge about the ADAS or IVIS applications, but should communicate with the applications using a generalised interface (see later).

The rough communication flow is like that:

For example, if a navigation application wants to present a route guidance information to the driver, it asks the ICA whether it is allowed to do that. In that request the application informs the ICA about what modalities it intends to use and it provides some characteristic information about the output information which can be used by the ICA to derive a priority value. Based on this information and the actual system status (other running outputs, driver status, driving situation, etc.) the ICA decides whether the navigation information can be given or in which form, at which time and on which modalities. The application has to follow these conditions given by the ICA.

It was stressed out that the output information itself do not flow via ICA, i.e. the applications do not send all output information to the ICA module which collects them and send them in the correct form and at the correct time to the I/O devices. This would first of all produce a critical bottle neck and what is more the ICA has to have a lot of knowledge about all applications. In the latter case the ICA is a very comprehensive module which makes the system error prone and the system integration much too complex. Apart from that the system is not able to work without ICA and for each vehicle a new ICA must be developed. Thus, the system architecture would not be scalable or flexible in terms of their extent or HMI strategy.

In Figure 3 the agreed communication flow is shown which was described in the example above.

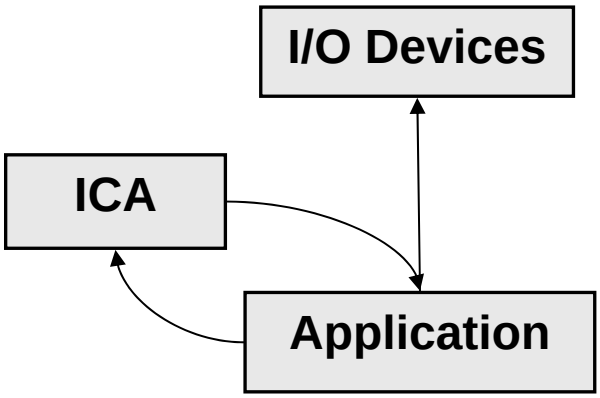


Figure 3: Communication flow between ICA and applications

3.10.4. DVE component

The description above also makes clear that the ICA module needs information about the driver and the environment. Therefore, the DVE component sends this information to the ICA module. The DVE component includes the DVEM (driver vehicle environment monitoring) which uses several sensor information to detect defined driver states, driving and environment situations and it includes the PM (profile manager) which manages the driver preferences. Those two modules are combined in the DVE component because the distribution strategy of that information might be the same and all those information are used by the ICA to adapt the HMI output strategy.

It was recommended to separate the DVEM module in three modules (environment, driver and vehicle), since it might be easier to integrate results from other IP's like environment information from the PREVENT project.

The DVE information also is fed to the applications because some condition dependent adaptations can only be performed by the application itself, e.g. if a ACC application should warn earlier in case of high driver demand that is only known by the application itself and not by the ICA

Furthermore the content of the DVE information was discussed. It was stressed out that this information has to be generalised, which derives from sensor fusion raw material. Thus, for example the driver demand will be provided in different levels which have to be derived from several raw sensor information. The necessary conditions clearly depend on the individual solutions which should be provided. Within AIDE, a first subset of conditions is chosen which might be extended in the future work.

3.10.5. I/O device access:

In the first step, the AIDE architecture does not allow a direct access of the I/O devices by the applications which is state of the art today.

Figure 4 illustrates the I/O device access principle. The application addresses virtual device to present information to the driver. Thus, there is no difference from the application point of view compared to today. The only difference is the availability for the driver, i.e. the addressed virtual device or proxy do not effect the real output device. The ICA component acts as a switching device and connects the proxy and the real device when it allows the desired output.

This approach prevents the system from timing problems, i.e. if for example an output has to be interrupted and a new, more important one has to be presented the ICA can switch

off the old output and then switch on the new output. If this flow is controlled by the applications the system cannot secure a correct output timing, because the new output could be activated before the old one is deactivated. Apart from that, in a "plug and play" environment where new applications could be installed in the field, the desired HMI strategy cannot be guaranteed when the application has direct access on the I/O devices.

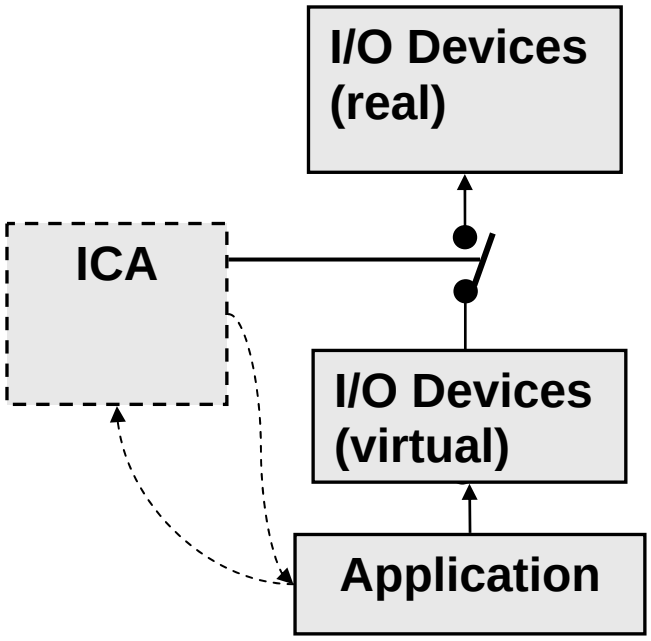


Figure 4: I/O device access

3.10.6. I/O device access for warnings

It might be necessary to allow an exception for the I/O device access in case of warnings from ADAS applications, because warnings have to be presented immediately (without any delay) to the driver and with a very high reliability. Depending on the implementation and the used HW platform this might not be possible. There are much different reliability requirements for IVIS and for ADAS applications.

In such a case the ADAS could access directly a dedicated I/O device to present a warning and only informs the ICA about that (see Figure 5). All other non-warning outputs from an ADAS are presented using the virtual I/O device approach.

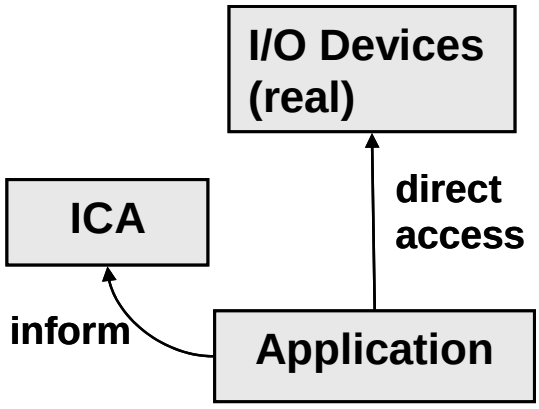


Figure 5: I/O device access for warnings

It was pointed out that this approach might be problematic when different warnings should be combined. The presentation of two concurrent warning is a quite new research area and several problems have to be solved, e.g. timing, derive an appropriate joined warning, etc. It was also remarked that in the future a warning might not address a dedicated I/O device.

3.10.7. AMI-C HMI approach

The AMI-C HMI architecture approach was introduced by Mr. Scott Andrews via phone conference.

This approach is based on the following situation and resulting requirements:

- Addition of new functionality to the car implies additional HMIs
  - Every device or software application will need to interact in some way with the driver/occupants.
- The car makers need to control HMI
  - "look and feel" for the mark,
  - safety and liability.
- We can't allow arbitrary applications, devices or services to impose their own HMIs in the car.

Therefore the AMI-C approach strictly separates the HMI from the application functionality. This is illustrated in

Figure **6**. The application interacts with a HMI manager which is similar to the ICA component in the AIDE architecture.

The HMI manager implements the interfaces to the visual, tactile and audio HMI systems available in a car and it implements the HMI policies and priorities for the car maker. For this purpose XML based interfaces between application and HMI Manager were defined to have a common way of referencing HMI needs (outbound from application) and HMI results (inbound from car/user).

Thus the HMI Manager renders the output according to the OEM HMI strategy.

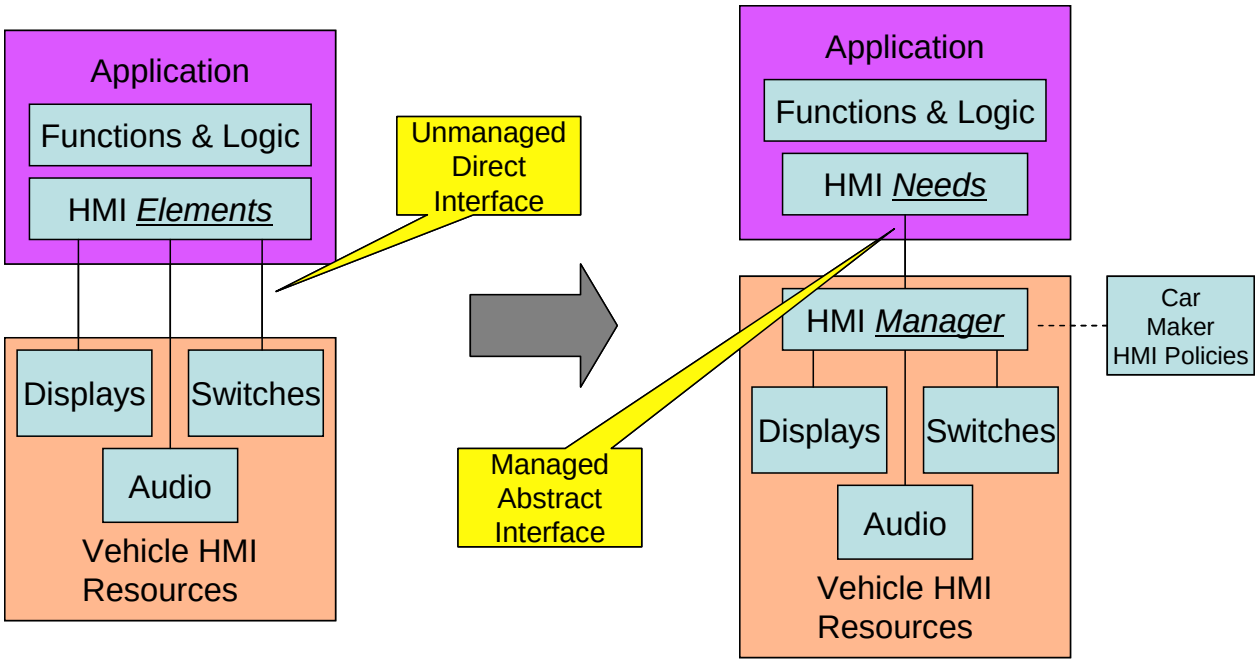


Figure 6: Separation of HMI and application

The AMI-C HMI spec (AMI-C 4002) defines two XML Schemas:

- General Purpose: Generic access to vehicle HMI resources
- Application Specific: Unique, application oriented access to vehicle HMI resources

It was stressed that the AMI-C approach and the general purpose XML schemas are a good solution for connecting applications from external devices with the vehicle HMI when those applications are not known during the vehicle HMI development. That could be a part of the solution for the nomad device integration within AIDE.

Furthermore it was discussed whether it is meaningful to use the XML approach also for ADAS applications which are integrated in the vehicle from the beginning. On the one hand this would allow the development of applications which could be plugged in arbitrary vehicles because of the standardised interface, but on the other hand the XML parsing and rendering process might produce timing problems for warnings and seems to be quite complicated.

Another drawback of the XML-interface - at least for the general purpose pages - is the limitation in terms of HMI, because the output is rendered by the HMI Manager which do not know the application. Thus, it can only be presented what was defined in the XML schema even when the form can be chosen arbitrary by the OEM.

3.11. Track II :From behaviour to risk (morning session, attendance list can be found in Annex A)

Chairman : Wiel Janssen, TNO

3.11.1. AGENDA

Wednesday 16/03/05		
Time	**Topic**	**Presenter**
10:00 – 11:00	From behaviour to risk: Introduction and discussion	Wiel Janssen/all
11:00 - 11:30	Demo of new gaze tracking device	Mr. Krantz, Smart Eye AB, Gothenburg
11:30 – 12:30	Continuation of discussion	All

3.11.2. Introduction

TNO presented introductory material for the discussion, grouped along the three issues (Tasks) of AIDE Work Package 2.3, as follows (see the Appendix):

- On Task 2.3.1, Behaviour-risk functions.
- On Task 2.3.2, Trade-offs between workload and behaviour.
- On Task 2.3.3, Getting to the combined risk reduction estimate.

3.11.3. With regard to behaviour-risk functions:

Behavioural research usually stops with a report of behavioural effects of some independent variable, like a driver support system. However, we should by now go further than that, and try to extrapolate to what these behavioural effects really mean for the consequent accident risk. Some of the looked-for behaviour-risk functions are already available. However, it was noted by the audience that some essential ones are still lacking, notably:

- Functions extrapolating overtaking behaviour to accident risk. However, it was suggested that some material could possibly be found in the specialized traffic science literature.
- Functions relating several types of interactions between drivers of neighbouring vehicles. However, no one knew of a source dealing with this problem.

It was also pointed out that it could possibly be useful to look into the conflict observation literature, so as to form a judgment regarding how far they get with respect to the predictive capacities of conflicts for the resultant accident risk on a location. The occurrence of violations might be another precursor of accidents from which useful material for AIDE WP 2.3 purposes could be derived.

3.11.4. With regard to workload-behaviour trade-offs:

It was pointed out by the audience that there exists a certain amount of knowledge already on how drivers trade off workload and behaviour, although it is clear that the trade-off is not at all perfect. If it were, we would actually not have a problem, because we would then simply be dealing with a single underlying parameter capable of predicting accident risk. Sources pointed to were by De Waard (1994) and by Veltman (2002).

Florence Nathan (PSA) drew our attention to the work performed by Amalberti from the aviation sector, in which it was sketched how humans (pilots) always try to stay within a certain safety margin by adjusting both their workload and their behaviour. In driving, similar ideas appear to have been proposed by Fuller, and by Näätanen and Summala.

3.11.5. With regard to getting to a combined risk reduction estimate:

Here the audience proved itself to be quite skeptical of the way we have considered to go forward in this respect, which is by means of micro-simulation. It was remarked that micro-simulation can never be better than its input, and that it is exactly the modality and the contents of the input that we will be lacking in the present case. It was recommended that micro-simulation should not be the only horse on which we should be betting.

3.12. Track II: Behavioural adaptation and DVE modelling (evening session, attendance list can be found in Annex A)

Chairman : Farida Saad, INRETS (AIDE SP1)

3.12.1. Workshop presentation and discussion

The aim of the workshop was to discuss the issue of behavioural adaptation to new driver support systems. The presentation was organised around the main following points:

- What is Behavioural Adaptation?
- What are the main results of research studies dealing with Behavioural Adaptation?
- What are the needs for future research?
- How can we account for Behavioural Adaptation in the design and assessment processes of new driver support systems?
- Research activities in the AIDE project

3.12.2. Behavioural adaptation

In road safety research, Behavioural Adaptation is mainly defined as “unexpected behavioural changes in response to changes in the road system which may jeopardize the

expected safety benefits". Thus the emphasis is put on the negative consequences of behavioural changes as regards safety.

In the AIDE project, we choose to adopt a broader (and more classical) definition: any behavioural changes in response to new conditions, which consequences as regards safety could be either positive, neutral or negative. This means that the scope of our investigation will involve more potentially relevant behavioural changes associated with the use of support systems and that we will study how these behavioural changes evolve through training and experience.

Behavioural Adaptation may appear at different levels of the driving task and may take more or less time to appear. The main concerns when studying Behavioural Adaptation are related to: the adequacy of drivers' mental model of the assistance provided (range and limits of the competence of support systems); the "calibration" of drivers' trust for an optimal use of the systems; Drivers' allocation of attention and drivers' workload; drivers' trade-off between mobility and safety.

- In the discussion some participants expressed the need to focus the analysis on the identification of safety critical changes.

3.12.3. The main results of research studies on Behavioural Adaptation

Many research studies have been carried out, focusing on the impact of various individual support systems. Most of these research studies have been short or medium term studies. Few studies have dealt with the learning process and with the long-term effects.

Some critical issues have been identified related to the diversity and variability of driving situations and to diversity of the driver population. The importance of the situational context and the collective dimension of driving as well the influence of individual characteristics (age, experience, driving style, personality traits) have been emphasized. These variables seem to play a crucial role in terms of overall usage of the support systems, the direction and magnitude of behavioural changes.

- In the discussion, it has been stressed that, until now, most studies were made with experienced drivers. There is a gap in our knowledge regarding Behavioural Adaptation for novice drivers.
- Some discussion also takes place about two dimensions of Behavioural Adaptation: "situational adaptation" and "time adaptation". These dimensions will be taken into account in the research studies planned in the AIDE project.

3.12.4. The needs for future research on Behavioural Adaptation

The main needs for future research on BA have been stressed, in particular: the need to clarify the models used for studying BA and for predicting behavioural effects; the need for studying the learning process and long-term effects.

- The discussion turns around the availability and the design of models of BA, models that could integrate the relevant variables and their interactions.

- The issue of using results from other domains, such aviation or industry, for product design has also been raised. However, the transferability of results is not straightforward.

3.13. Track III – Nomadic forum workshop (attendance list can be found in Annex A)

Chairman: Patrick Robertson, MOTOROLA

3.13.1. Agenda

- Overview of 1st European Nomadic Devices Workshop 20th January 2005.
- Overview of eSafety HMI recommendations.
- Discussion.

3.13.2. Summary

The purpose of the meeting was to:

- Present an overview of the first Nomad Device Forum.
- Present eSafety Recommendations on Nomad Devices.
- Continue discussions from first Nomad Device Forum.

The meeting had some open discussions derived from the eSafety recommendations, then went onto focus on key Nomad Devices services, the stakeholders and the requirements for them. Pat Robertson from Motorola gave a short presentation summarising the first ND forum in January.

Clarification was sought on one of the ND issues, namely "Safety" – wanted to clarify that it was not security. Patrick Robertson explained that it was specifically safety – i.e. the safe use of these devices in the automotive environment by the driver. E.g. ensuring safe use of these devices by limiting functions during dangerous or high work load scenarios.

Patrick Robertson then continued the overview, concluding with the summary /conclusions of the 3 working sessions from that day:

Conclusions - Safety

- *We have not got enough evidence to say if NDs pose extra risks (for certain functions); but safety should continue to be monitored; may produce positive benefits also.*
- *A cross-industry group should work together to assess these risks and work out solutions throughout the product life-cycle.*
- *The ESoP should be extended to address Product-Responsible Organisation responsibility; and extend to organisational, project-management aspects.*
- *There is a need to identify incentives for nomadic device Product-Responsible Organisations to apply revised ESoP.*

Conclusions - Industry perspective

- *It is not clear where intelligence/functions should lie between the car and the nomadic device.*
- *Car manufacturers want to keep control of safety issues and of the overall value.*
- *Industry prefers standardisation and (self-)certification to legislation or regulation by governments.*
- *Industry should come up with standards for ND-vehicle interfaces.*
- *Smaller working groups should be set up to work on definition of these requirements and standardisation.*

Conclusions - Integration issues

- *A good understanding was needed of market needs, and requirements should be defined.*
- *Work should focus on a few concrete examples and discuss the integration in detail.*
  - *MP3/music players;*
  - *Mobile phone;*
  - *Navigation.*
- *Who is responsible for what?*
  - *The OEM is responsible for the "look and feel" of any integration in the vehicle;*
  - *…so the HMI and the functions should be standardised.*
- *It was a common responsibility to handle driver distraction.*
  - *workload management was too difficult for now to extend to ND.*

Patrick Robertson highlighted some main issues/themes from these lists–

- Who is responsible (legal, safety…) with numerous stakeholders involved (car manufacturers, system suppliers, software /application suppliers, service providers…).
- Where should the "intelligence" or control reside (ND? Car? ...).
- Self certification/regulation is preferred by the industry rather than legislation which can be too extreme and "knee jerk" (e.g. Complete ban of the use of hand held mobile phones while driving).

The main ND related recommendations from the eSafety HMI working group report (recently published) were later summarised, –with *3 main areas of interest:*

a) Assigned responsibilities (SyM, SP, MS …) are defined.

b) Installation of the ND by using the installation kit provided by the System Manufacturer (SyM). HMI I/Os remain with the ND. (R-SyM-2)

c) Integration fully into the vehicle HMI including I/Os. (R-SyM-4)

In b) that would mean, that the ICA should control (the document says "filter") the HMI with respect to DVE conditions. The ND interface then has to provide ICA commands for the ND. This is AIDE improvement to R-SyM-3. It could be demonstrated e.g. by integration of MOTOROLA installation kit in our test vehicle.

This list provoked a lot of discussion –

A simple question on the abbreviations was raised – This was explained that the-

- "R" were specific references to this document.
- SyM was the system manufacturer, and in this document meant the manufacturer of the ND,
- SP was service provider
- MS was Member States.

A question was raised about the difference between "integration" and "installation" – it was explained that integration meant this was an "option" included by the car manufacturer with it fully integrated, and "installation" was after market with very little "integration".

Question raised about the example of the user having a BT enabled phone (after market) that linked with the car system and was fully under control by the car telematics system for example – which category did this fall into? It was initially explained that this was after market (as ND was after market) but this was clearly an open issue and required clarification with respect to the recommendations.

Discussions lead onto related areas with associated topics.

Focus of AIDE was on full integration (or discussions/expectations were) - does this mean that it was only focused on high end cars which only account for 10% of the market?

It was explained that ideally, both scenarios would be met – and demonstrated although there is currently a constraint with the limited budget. It was suggested there may be the possibility of getting additional funding or software resources to help.

Example scenarios were discussed – how certain functions of the ND could be disabled/held off as a result of the driving condition from the DVE.

A question was asked as to what the motivation of the driver would be if she/he would lose some functionality eg currently legislation in certain countries that hands free should be used for all calls, but one participant explained that he didn't do this as it wasn't convenient.

The discussion went onto explore what the motivation would be – concluded that comfort/convenience would be the main advantage to the consumer – easier to interact with the ND –eg using the car interface to initiate the call, use the car audio/mike to make the call. Also the ability to know that the system would hold off calls (by either passing direct to VM with notification after the dangerous/high workload situation, or putting the caller on hold by playing a suitable message "please wait till I connect you..").

After the above general discussions that were generated by the eSafety report, it was suggested the group will focus on one of the following topics:

- Safety;
- Benefits of stakeholders;
- Functions within the car;

- IO resource requirements;
- Market issues;
- Legal issues;
- Security;
- Interface (architecture).

It was suggested to focus on interface/architecture. The issue that was raised was that if BT would be used as the main interface that the current BT profile would be inadequate for AIDE requirements (and eSafety) uPNP was mentioned as another option for this but not explored further in discussions.

After further discussions, it was agreed that we would focus on the main ND services, and requirement of the main associated Stakeholders.

First the main ND services were brainstormed:

- Phone;
- Music;
  - DRM (see below);
  - Portable Storage;
- Navigation;
- Information;
  - PIM;
- Fleet Management Services.

Some discussion on the DRM (Digital rights management) aspect of music that could be a major concern – it was agreed that from a ND point of view, it was just he portable storage of music that was of interest, and not copying/moving the media to the car (which invokes the DRM issues).

It was raised that at the last ND forum that Nokia did some studies and found that the main ND services that customers required and were interested in was phone, music and GPS.

It was agreed to focus on these 3 areas. The next stage was to explore the requirement for (not from) the stakeholders. The stake holders were identified as below:

- Car Manufacturer;
- Phone Manufacturer;
- Telecom Provider.

The requirements for each stakeholder were then explored:

- Car Manufacturer;
  - EMC;
  - Microphone;

- Loudspeakers;
- Audio Management;
- User interface availability (ie what is available in the car);
- Physical location;
- Data interface;
- Voice Interface;
- Antenna Interface;
- Controls;
- Voice control;
- Power (especially an issue if BT is to be used);
- Screen;

- Phone Manufacturer;
- Data interface (inc. ICA info);
- Voice interface;
- Control state of phone call (eg via ICA);
- Manipulate state of VM;
- Services availability;

- Telecom Provider;
- (most of phone manufacturer list – as this will depend on implementation of phone/provider);
- Sim Management (e.g. how to manage multiple sims, handover when in car);
- Network Services.

Note that the above is the full list (from the brainstorming) and subsets would be required for different scenarios and configurations – e.g. low end car, high end car.

It was also discussed about the accessing of email and SMS. It was pointed out that the I/O of these should be done by voice/audio and thus could be considered in the same way as a voice call (i.e. effectively not a different scenario to be considered with the ICA).

Some issues were raised but not explored in detail:

- What about the situation of when mobile phone is handed over to a passenger – the ICA type filtering should not be applied – so how this would be managed?

- What about multiple mobile phones (e.g. from different members of a family that all could be the driver)?

- What about possibility of using ND as another input sensor for the car eg using the mobile phone camera to detect road signs? It was pointed out that currently the technology for this was not adequate for this purpose.

At this point it was a natural stop to the discussions due to timing constraints. The above task should be expanded to cover at least the other 2 main NDs types (either in the next ND forum, or as a small separate group to enable it to be used as an input to the next ND forum)

It was however suggested that we missed out a stage before the above, that could be explored in a future meeting – before looking at what is required of stakeholders, we should look at the benefits to the stakeholders of this type of relationship – otherwise we wouldn't get any involvement from them to meet this list of requirements.

Everyone was thanked for their contributions. It was summarized what had been covered. It was agreed that it had been a well attended, and productive meeting, with excellent contributions from all interested parties.

4. Conclusions

In this first User Forum Workshop organized within the framework of AIDE integrated project, a wide range of opinions and experts' knowledge had the chance to counter each other under the umbrella of a common pan-European goal which is the improvement of road safety in the modern and complex automotive environment. Attendees outside AIDE consortium, including EC representatives, automotive industry and interested parties from institutes and universities created a multi- dimensional forum able to communicate the concerns of society and automotive area into the project. In parallel attendees were able to pose questions and discuss research items concerning the HMI integration and adaptation aspects that concern the project.

Since the AIDE IP is the first major European collaborative effort that really integrates major efforts on driver behaviour research, methods development and technological HMI development in a single multidisciplinary project, different aspects of the project's on-going work were presented and discussed. First day's presentations involved four presentations from the AIDE side concerning:

– The AIDE design scenarios

– The AIDE HMI architecture concept

– Evaluation methodologies of adaptive integrated HMIs

– Evaluation methodologies of driver-vehicle-environment modelling towards the identification of the basic mechanisms and critical parameters underlying behavioural effects of driver assistance and information functions.

The above were followed by the presentations of three external attendees on:

– The European Statements of Principles' status

– Intelligent driver information and assistance systems as being investigated by Transport Canada

– and the development of a driver advocate system by a key stakeholder in the area , which gave us a picture of the key R&D challenges as viewed inside Motorola.

This deliverable provides a quite analysed presentation of all the issues that have been discussed during the AIDE User Forum workshop. Specific questions raised and technical results drafted can be found inside each chapter. In the following, the outcome of the two-day discussions is drafted, not including technical issues.

4.1. Open issues raised or conclusions drafted after the presentations

Outcome of AIDE concept presentation:

- The AIDE design scenario methodology involving categorization of actions and DVE conditions offer a methodological tool to describe the driver-system interactions in an AIDE-like future system and is considered a step ahead of the standards use cases templates used by HMI designers so far. This methodology is in alignment with the AIDE architecture principles. The categorizations which lead to a generalized description of the functional extent of the system form a suitable basis for further system architecture development and fulfil the most important requirements with respect to

scalability and flexibility. That is a crucial condition for an introduction of AIDE functionality in future vehicles.

- Driver Vehicle Environment monitoring within AIDE was briefly presented along with the expected DVE-dependent condition detection for HMI relevant adaptation. Possible synergies between PReVENT and AIDE project were also discussed. PReVENT explained their work on sensors' fusion outputs and argued that their module could edge in between the AIDE sensors' set and the DVE modules in order to provide the needed fused sensors' information. A common will on investigating the synergies between those two projects was expressed by both sides.
- The functionality that AIDE wishes to integrate concerns three types of functions: ADAS, IVIS and nomadic devices. Nomadic devices could ideally be managed by the AIDE system considered as IVIS but this is an ambitious and difficult task as not only ergonomic problems arise but also automotive industry and telecommunications industry are only in the beginning of a common understanding towards the safe use of nomad devices while driving. Moreover, one specific practical reason makes nomadic devices' integration a difficult task: synchronization. The need for ensuring the safe in-vehicle use of nomadic devices was stressed by most of the participants.
- With respect to the behavioural adaptation research (WP 2), a review of the literature was performed that aimed at identifying the main types of problems that arise in the study of the behavioural adaptation induced by different driver support systems. Thus, the review did not seek to be exhaustive, but rather to highlight the issues to be considered prior to planning the experiments to be conducted during the AIDE SP1 (Behavioural Effects and Driver-Vehicle-Environment Modelling), and the identification of the most relevant parameters and variables that affect driver behaviour for modelling purposes. We need to investigate the field of human behaviour adaptation. We still do not have a methodology for predicting behaviour changes, how people adapt their behaviour to various situations which could provoke ADAS messages' activation.

Outcome of the presentations made from the attendees outside AIDE consortium:

European Statement of Principles current status was communicated, giving the opportunity to the EC representative to invite everyone interested or involved in the automotive research area to read this document and comment on it before this is finalised from the e-safety working group. EC representative introduced also ideas for the need for standardization and drivers' proper education to the new ADAS and IVIS systems. Standardization of minimum performance requirements is important and is already subject of activities in ISO. Standardization of design though is a difficult issue because these systems have to be integrated into different cars from different brands.

- Commensurate distraction countermeasures were presented from the Transport Canada's representative.This work will provide essential input into the Memorandum of Understanding (MOU) on Telematics that Transport Canada is currently negotiating with the automotive industry.
- Key R&D challenges center around the ability to design these multi-modal, multitasking, adaptive intelligent systems with the narrow human factors testing methodologies now employed and existing technology limitations. Furthermore

advances in seamless mobility technologies also hold many of the keys to reducing driver workload and distraction from nomadic devices.

The fruitful round table discussion that followed proved that the multi-dimensional synthesis of the forum gave the opportunity to different representatives of technical research (either coming from industry or institutes) in the automotive field to compare their results and identify possible common problems or ideas.

A step beyond integration is a step towards an adaptive integrated HMI. Adaptation is desirable as it gives to the system a kind of interpretation of the driving scenario and thus it gives the possibility to the system to match its information flow strategy to the driver state. **Some of the key issues that were stressed out from the majority of the participants during the round table discussion addressing both integration and adaptation issues were the following:**

- With respect to HMI adaptation, the key features are user acceptance and improvement of driving safety.

  From our experience driver acceptance can be reached if he or she either:

  - does not recognize that the system is adapting;
  - the driver understands why the system is adapting.
- Personalization to individual ergonomic features and to individual preferences and experiences makes sense.
- The HMI should be both integrated and adaptive. Due to an increase of functions in future vehicles integration will be needed. Integration is needed from a packaging, cost and safety perspective. The level of integration can be discussed, most of the SGI members felt that a well balanced approach needs to be found.
- Main risks identified regarding the nomadic devices in-vehicle use and thus implying the need for an integration study are:

  - Nomadic devices are not developed for in vehicle use.

  - There must be sure that the in car communication will not be disturbed by software from nomadic devices (e.g. Blood brain border in human beings).

4.2. The future of AIDE User forum

AIDE User Forum will continue to be active throughout the duration of the project and hopefully it will continue uniting its members beyond AIDE's closure. Within AIDE User Forum activities the editing and dissemination of regular informative newsletters is planned while more User Forum workshops that will discuss state of the art issues around the HMI research area will be scheduled.

AIDE consortium will also maintain the forum of experts as a pool for receiving feedback on their undergoing research through disseminating the public project's deliverables and inviting the members to a variety of project's events such as workshops, special sessions to conferences etc.

The AIDE User Forum will continue to be of great importance to AIDE project for the wide dissemination of the project's research activities and results while more User Forum

workshops will provide opportunities to researchers and stakeholders of the automotive area to interact and discuss critical issues on the related areas.

It would be also very interesting to assess the possibility of common events between the different E-SAFETY projects, which will increase the exchange of information and will support the identification of synergies.

5. Annex A: Attendance Lists

5.1. General attendance list

Surname	First name	Organisation	Country	E-Mail
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5.2. Attendance list: Track I

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Werner		

5.2.2. Track I-evening session

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5.3. Attendance list: Track II

5.3.1. Track II-morning session

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5.4. Attendance list-Track III

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6	A. Kienath	BMW
7	V. Lauer	DC
8	B. Kaempte	Tu Chemnitz
9	R. Morich	Carmeq
10	W. Hofs	EU
11	A. van der Buekel	JCL
12	R. Gardner	Motorola
13	A. Amditis	ICCS
14	N. Marina	EPFL
15	R. Becker	Panasonic
16	J. Schwarz	DC
17	V. Moutal	EU

6. Annex B: Breakout on round table discussion

Rapporteur: Anastasia Bolovinou (ICCS)

Open discussion that followed the round table statements:

Below elements of the discussion that took place at the Round Table discussions are noted. These statements are not exclusive and in no way imply that these are the more important ones.

Valerie Moutal(EC): Standardization is a matter of high importance and we agree that is a complex issue which needs time and money. Adaptation in HMI design in our point of view, is a matter that should be expected to go through standardization. Undoubtedly, if

we standardise products we should also educate people how to use them. So, all the maters that could affect in-vehicle safety should meet not only issues of European policies but also issues of education in order to make new users familiar and responsible when they use the new technologies.

Kuhn (EUCAR SGI): We can not neglect the fact that every customer has a different background and he/she is used to different things.

Valerie Moutal(EC): Then, maybe it would be more useful to standardize the functions and not the products themselves. In that way, we standardize the concept of the system and we can educate people from the beginning in order to use with safety numerous in-vehicle systems.

Kuhn (EUCAR SGI): There are already standards regarding the basic functionality of the vehicle and this represents a minimum of understanding between all car manufacturers. It would be very difficult to standardize further from that and from our point of view it would make no sense due to very different bases of customers.

Koning (CLEPA): We can not start judging between good and bad solutions in wide-range products. Since we had no standards from the beginning of the development it is not possible to implement now new solutions when the product is already in the market.

Cacciabue (JRC): Our opinion is that we definitely need to standardise functions. But so far authorities say that let's train the people instead of standardizing the functions. It seems like going-around the problem.

Amditis (ICCS): EU has reasons to vote for standardization while OEMs have their own reasons like competitiveness of the products to worry about a standardization policy. Of course we can not standardise every product and I/O device. However we think that it would be wise if we could reach a common understanding and try to standardize functions and propose modalities.

Engstrom (VTEC): We agree too that functionality standardization is a positive thing.

Amditis (ICCS): In what ways can we evaluate the adaptive features of HMI? There is a point while driving where from system's adaptivity we pass to driver's adaptivity and it is not always clear when this devolvement takes place or when these two phenomena occur simultaneously. So, can we isolate and "measure" system's adaptivity?

Kuhn (EUCAR SGI): You can use groups of both users and experts. But what the criteria should be? In my understanding, adaptivity can not be discussed in global but in specific functions. For instance, in my experience, an adaptive BrakeAssistanceSystems which has been well designed does not have any negative effects. In general, if the design is well studied then we should not fear of adaptive functionality.

Koening (CLEPA): In my own experience though, in tests with users adaptivity in an ACC system didn't result in the expected result which was to make the time gap between the ACC activation and the braking of the driver smaller. On the contrary the time gap which reflects the reaction time of the driver was increased. Most of them had no feeling of increased efficiency or safety for the system with the adaptive features...

Robertson (MOT): Have you tried to let the drivers free without knowing of the system's adaptive features with no instructions? Then you can call it a real evaluation.

To make a short interposition in the issue of nomad devices integration I would like to ask car manufacturers: Suppose that there is a mobile phone equipped with a good navigation tool but when entering the car the ND should transfer its functionality and control to the

vehicle system. Would you not mind if the mobile phone would use the vehicle's navigation tool when the owner of the ND wasn't in his car..? In other words this transferring of control between ND-vehicle can be considered vice –versa too? The user can be seen not only as a driver but as an entity which has the quality of a pedestrian for some time, of a driver some other time and so on...

Burns (Canada), Moutal (EC): They try to explain to MOT that the use of a mobile phone in the vehicle for driving purposes should guarantee somehow that this use can be appropriate for an automotive environment. Of course we recognise the fact that the user is also a pedestrian but walking in a street and using a ND and driving and using a ND are two wholly different things. Only with cooperation between the two industries we can be sure of no negative effects from the use of NDs in the car while driving as a telematic option. Besides, a bad use of a standalone product while driving (if something wrong happens) might only discredit the product.

Nathan (PSA): Speaking as a driver, adaptivity is something that i can not easily comprehend and maybe an issue that me, as a driver, do not need to address. I am concerned about the driving conditions if we suppose that half of the vehicles are equipped with adaptive systems and the rest not. Thus, I think that adaptive features should concern us from the point of feasibility but also affordability in order to be implemented in every car.

Amditis (ICCS) : But, this was exactly the case with ABS, 10 years ago. They were missing from half of the cars.

Nathan (PSA): OK, but we should guarantee adaptivity is being reached in a user-centred approach. We should consider the fact that perhaps our roads are not compatible with the new systems (not equipped) as well as the other vehicles.

Klemencic (Ease of Use): Adaptivity features should meet some requirements:

- to define content of use
- to be very careful not to surprise the driver , otherwise it would lead to distraction. The only way to do that is to design the system to be predictable
- HMI design which will take into account the driver's state and current driving situation. For example, an intelligent navigation system should recognise when the driver is in his way to his destination and present "time to get there", whilst when the destination is reached "time to get there" is replaced with time.

We should have in mind that an adaptive system we have in our home (like a PC) is a more simple case of an adaptive system in car. The in-vehicle use of an adaptive system has different parameters and may include some potential risks. These new generation systems will open a whole new section in the market of in-vehicle equipment. OEMs should be ready to assist their customers on the use of new and more complex technologies and also updating their products to keep their customers constantly informed.

Robertson (MOTOROLA): What methods of cognitive load assessment are available within AIDE? In our experience the distraction can be measured with regard to the visual inattention based on sensors inside the cockpit but the cognitive load is a difficult evaluation. Can you tell if the driver is mentally distracted without using sensors but methods of behaviour analysis?

*Engstrom (VTEC):*He describes the methods used by Cockpit Activity Assessment module and explains that is feasible to assess cognitive load by eye measurements based on studies that prove that eye activity can be related with the driver's concentration.

Burns (Canada): To test adaptivity features in real conditions is a very difficult problem. There are different tests and approaches. You can test for example the worst case scenario. But, using what method? You leave the adaptive system turned on and observe what is happening or you deactivate the subject adaptive system and have your results from the inverse point of view?

Apart from the testing methods, an other question comes up: How do we test if the new adaptive system meets the ESoP regulations? Either you can test the worst case scenario or you can have your system activated in a normal driving scenario.

Amditis (AIDE): My concern is how can we evaluate DVE demanding situations and distinguish somehow between a normal driving scenario and a scenario with adaptation .

Nathan (PSA): If we had only the case of adaptivity to the user then the case would be feasible. But now, we want to take into consideration the driver, the environment and the vehicle. This DVE state can be comprised by too many sub states. I think it is very difficult to test the real perception of the system in these DVE dimensions since the driver can not be aware of all adaptive features that are involved. So, this adaptivity that we envision would be better functioned in our opinion if we talked about a seamless adaptivity. An adaptivity that is hidden from the user and thus we do not need to evaluate every aspect of it but the general ergonomic design of the system (the same way we evaluate systems that don't involve any adaptive features).

Engtsrom (VTEC): He argues that each case is different. We should only concentrate to one adaptive function at a time. If we want for example to test how FCW can be adapted to driver's level of distraction then we have to test the cooperation of two individual functions: FCW and measurement of distraction. The things get complicated if we want to test more complex issues like workload management. In that case it is indeed difficult to isolate the functions you want to test and eventually evaluate HMI adaptivity to this selected functionality.

Amditis (ICCS): AA opens the discussion on personalisation saying between other things that we should first address personalisation as cosmetics features which is less complex. His opinion is that the most important issue is to achieve personalization of the system into specific groups of users.

Kuhn (EUCAR SGI): He agrees arguing that personalization is certainly a positive characteristic of a system, leaving some choices to the user.

Cacciabue (JRC): We should be careful with the words personalization and adaptation. In my view it is the adapted technology that interests us and not the personalized one.

Amditis (ICCS) : He tries to clarify the need of a profile manager module which will take into account not only static driver characteristics (data base) but the dynamic behaviour of the driver too.

Nathan (PSA): Argues that the final aim should be to create an adaptive system which will be so well designed that it will work so adaptive that the user won't know whether it is adapted or not.

Klemencic (Ease of Use): This is indeed our goal and I think with cosmetics characteristics is feasible. Skins change for example with the lightings conditions without being noticed by the driver.

Mutal (EC): Personalization should be reached with consciousness. We always have to pose some limits in the driver's freedom to choose modalities or systems. Especially with drivers that undertake a lot of responsibility like a fleet- manager.

...end of the discussion.

7. Annex C: Workshop Presentations

Introduction to the Workshop
by Angelos Amditis (ICCS)

Workshop Welcome

Dr. Angelos Amditis
ICCS

Welcome to AIDE User Forum Workshop

BAST PREMISES

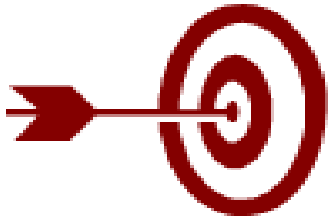
BERGISCH GLADBACH, GERMANY

15-16 March 2005

AIDE User Forum

Goals:

- Bring together all stakeholders in the area of the Automotive HMI
- Create a community where AIDE concepts and developments will be discussed, reviewed and updated towards an Integrated Adaptive HMI that could have a wide adaptation by the automotive Industry



User Forum members

The User Forum will involve external organizations including:

- End users
- Unions
- NGOs,
- Industrial and
- Research organizations etc.

that are not participating directly to AIDE

AIDE User Forum Workshop

Workshop Agenda

Tuesday, 15 March 2005

Fritz-Heller-Saal 1

9:00-9:30	***Registration and Coffee***
9:30-10:00	**Welcome** *Jan Arfwidsson VTEC* *BASt President* *EC representative*
10:00-10:10	**Introduction to the workshop** *Angelos Amditis ICCS*
10:10-11:30	**Presentations on AIDE results** ***1. AIDE Technical Overview*** *Johan Engstrom, VTEC* ***2.Design Scenarios and HMI meta-functions: Towards an Adaptive Integrated HMI*** *Holger Kussmann, BOSCH* ***3. Evaluation of Adaptive Integrated HMIs*** *Klaus Bengler, BMW* ***4. Driver-vehicle-environment modeling in AIDE*** *Carlo Cacciabue, JRC*

AIDE User Forum Workshop

11:30-12:00 **The European Statement of Principles: Current Status and next steps**
Valerie Moutal, EC/IST

12:00-12:30 **Road Safety Requires Smart Standards for Intelligent Driver Information and Assistance Systems**
Peter Burns, Transport Canada

12:30-14:00 ***Lunch Break***

14:00-14:30 **Development of the Driver Advocate**
Mike Gardner, Motorola

AIDE User Forum Workshop

14:30-16:00 **Round Table Discussion**

"Roadmap towards the future of automotive HMI, taking into account the complex automotive environment which includes ADAS, IVICS, Nomad Devices and cooperative environment."

Chair:

Angelos Amditis AIDE DM

Participants:

Friedemann Kuhn, EUCAR SGI

Peter Burns, Transport Canada

Winfried Koenig, CLEPA

Caroline Ofoegbu, FIA

Wolfang Hofs, EC/IST

Engström Johan, AIDE

Procedure

1. Every participant will make a short opening statement
2. An open discussion will follow between the participants of the round table but also between the panelists and the audience through questions and answers.
3. The Chair will give the speech both to the panelists and the audience for questions and answers.

AIDE User Forum Workshop

16:00-16:10 **Conclusions of the first day, introduction of the 2nd day**
Jan Arfwidsson, VTEC

Networking Coffee

19:30

Gala Dinner
Intercontinental Hotel Cologne

Directions are included to the participant's package

The dinner fee of 35 € - includes the gala menu + 2 beverages. Please pass the dinner coupon you received during check-in to the restaurant

AIDE User Forum Workshop

Wednesday, 16 March 2005

9:00-9:30 | ***Registration and Coffee***

Parallel sessions
Morning: 10:00-12:30

Track 1 **Room D1.073**	**Track 2** **Fritz-Heller-Saal 2**	**Track 3** **Fritz-Heller-Saal 3**
AIDE Scenarios and Functions	**From behaviour to risk**	**Nomad Forum workshop I**
Chair: *Johan Engstrom, VOLVO* *Angelos Amditis, ICCS*	*Chair: Wiel Janssen, TNO*	*Chair: Patrick Robertson, MOTOROLA*

AIDE User Forum Workshop

12:30-14:00 Lunch Break

Parallel sessions
Evening: 14:00-16:30

Track 1 **Room D1.073**	**Track 2** **Fritz-Heller-Saal 2**	**Track 3** **Fritz-Heller-Saal 3**
AIDE architectural concepts	**Behavioural adaptation and DVE modeling**	**Nomad Forum workshop II (contin. of session I)**
Chair: Holger Kussmann, BOSCH	*Chair: Farida Saad, INRETS*	*Chair: Patrick Robertson, MOTOROLA*

Networking Coffee

Participants package

You should have with you:

- Workshop agenda
- List of participants
- A printout of workshop’s presentations
- Leaflet "AIDE Project Overview"
- Location plan for the restaurant/dinner
- Leaflet BASt Research
- Leaflet "Traffic and Accident Data - Germany"
- Leaflet "International Road Traffic and Accident Database"
- Writing pad + pencil

AIDE Technical Overview
by Johan Engstrom (VTEC)

The AIDE (Adaptive Integrated Driver-vehicle Interface) Integrated Project: Technical Overview

Johan Engström, Volvo Technology Corporation

AIDE User Forum Workshop

Bergisch Gladbach, 2005-03-15

AIDE Consortium©

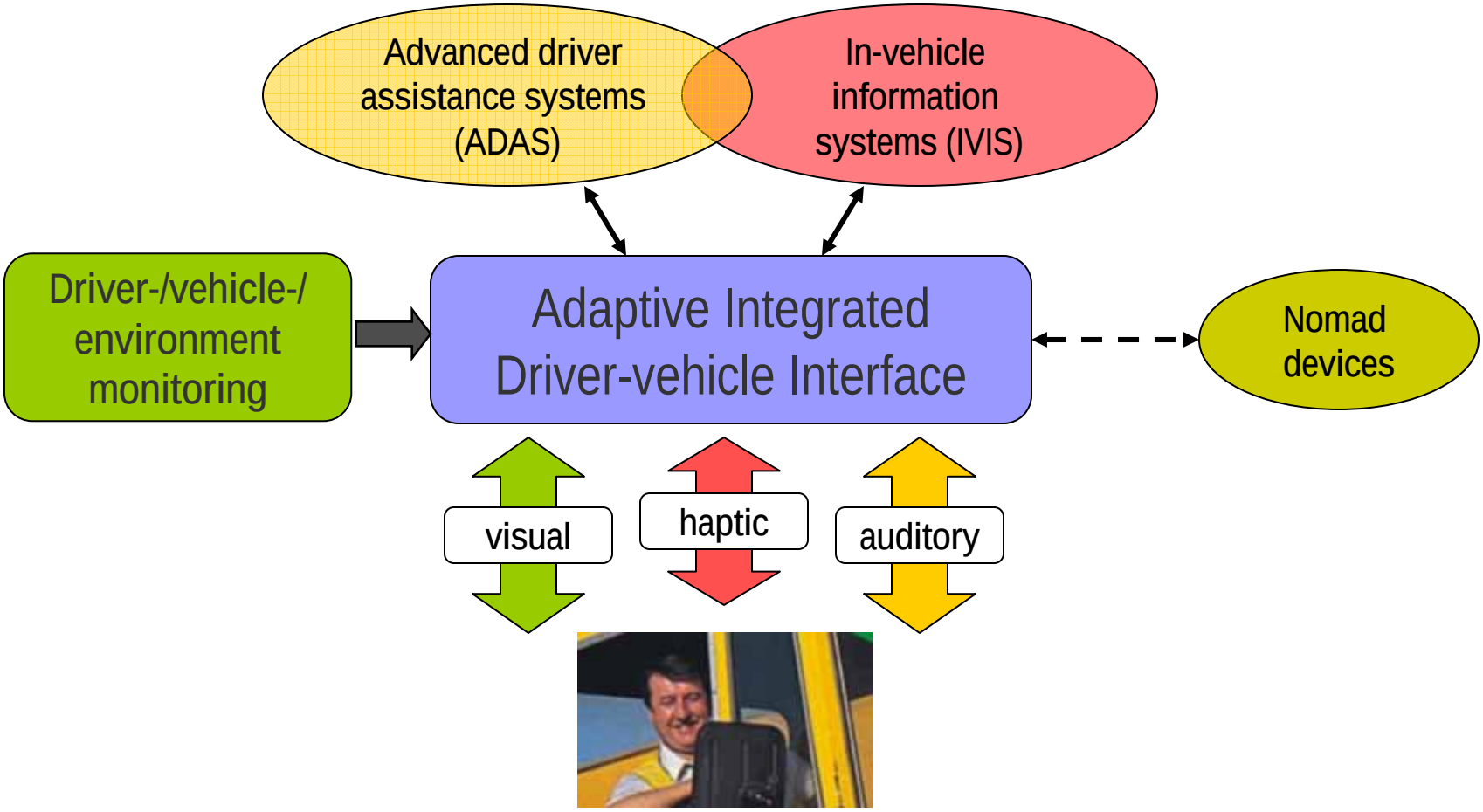
Project summary

- Integrated project on automotive human-machine interaction (HMI)
- 4 years duration
- Started: March 04
- Budget: 12.5 ME (Total), 7.3 ME (EU funding)
- 28 partners (~50/50 industry-academia division)
- Part of the EUCAR Integrated Safety Program – close links to other related FP6 initiatives
- AIDE core group: VTEC (coordinator), BMW, Bosch, CRF, ICCS, JRC, PSA and TNO

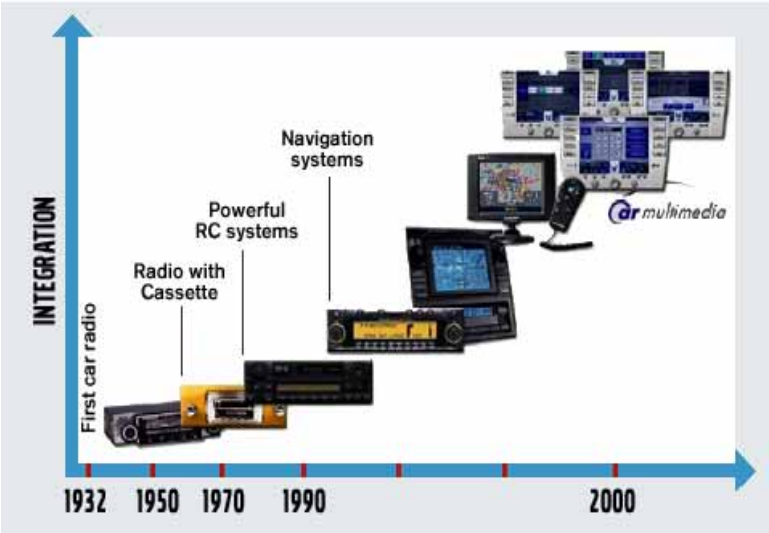
AIDE Partners

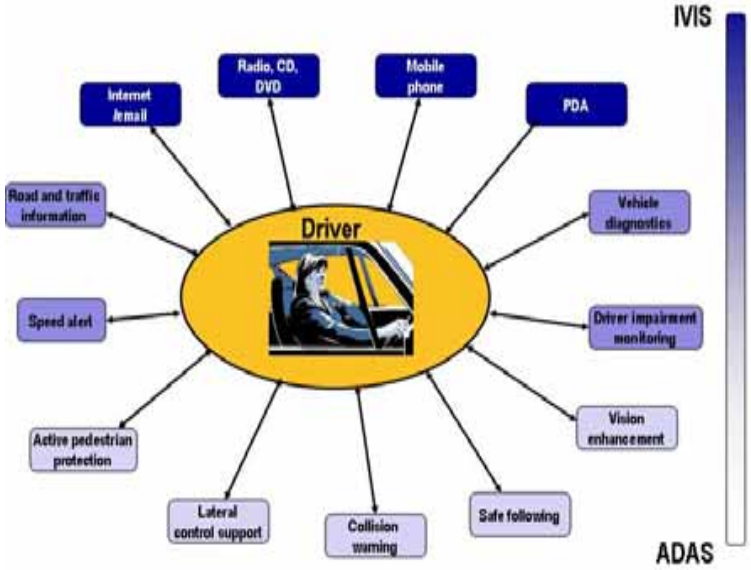
Industry	Research Institutes and others
Volvo Technology	European Commission Joint Research Centre (JRC)
BMW Group Forschung und Technik	INRETS
DaimlerChrysler	TNO
Ford-Werke	Institute of Communications and Computer Systems (ICCS)
Adam Opel	German Federal Highway Institute (BASt)
Peugeot Citroën Automobiles	CIDAUT
Renault Recherche Innvation	Swedish National Road and Transport Research Institute (VTI)
Centro Richerche de Fiat	VTT Technical Research Centre of Finland
Seat Centro Técnico	Centre for Research and Technology – Hellas
Robert Bosch	University of Stuttgart
Johnson Controls	University of Leeds
Siemens VDO	Linköping University
Motorola	University of Genova (DIBE)
KITE Solutions	ERTICO

The Adaptive Integrated Driver-vehicle Interface (AIDE) vision



HMI Integration



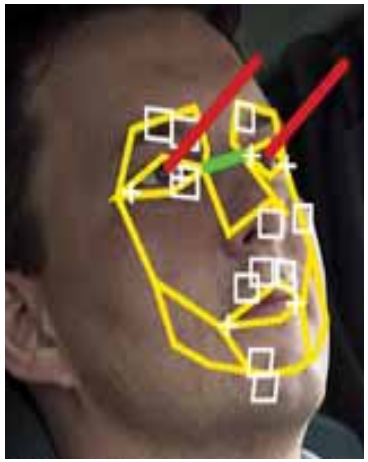


Key issues:

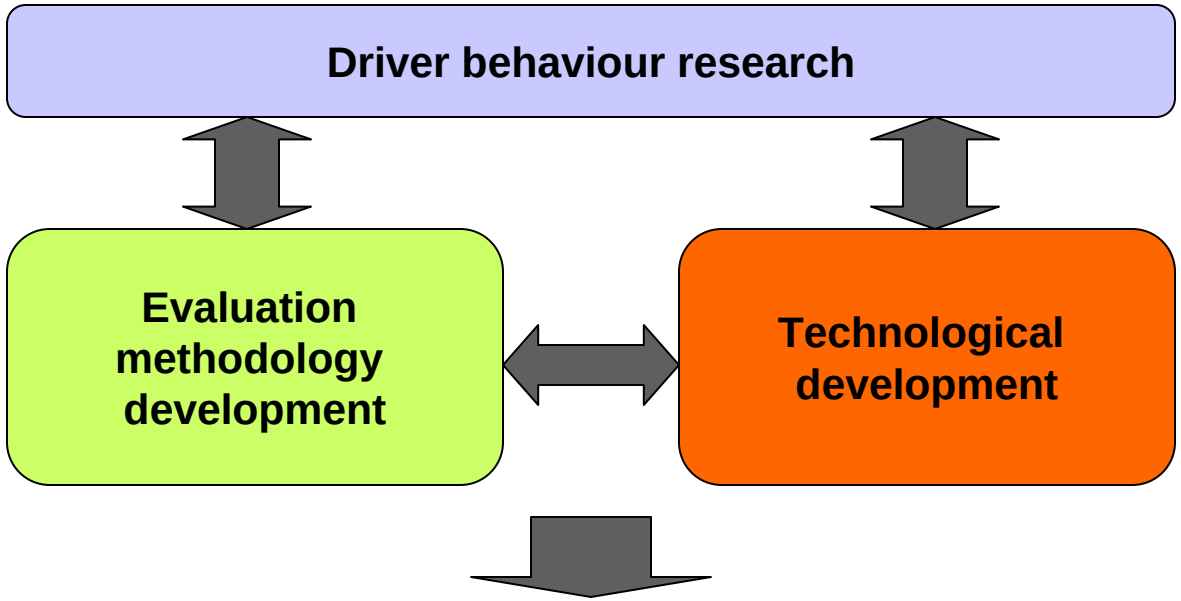
- Prevent **interference** between systems (e.g. information presented simultaneously)
- Exploit **synergies** (reduce HW costs, enhance performance)
- Requirements on system architecture

HMI Adaptation

- We can monitor the Driver, the Vehicle and the Environment (DVE state) and adapt the driver-vehicle interface accordingly
- Examples:
  - Lock-out/postpone non-critical information on demanding situations
  - Adapt the timing/intensity of safety warnings (e.g. warn earlier when the driver is inattentive)
  - Personalisation

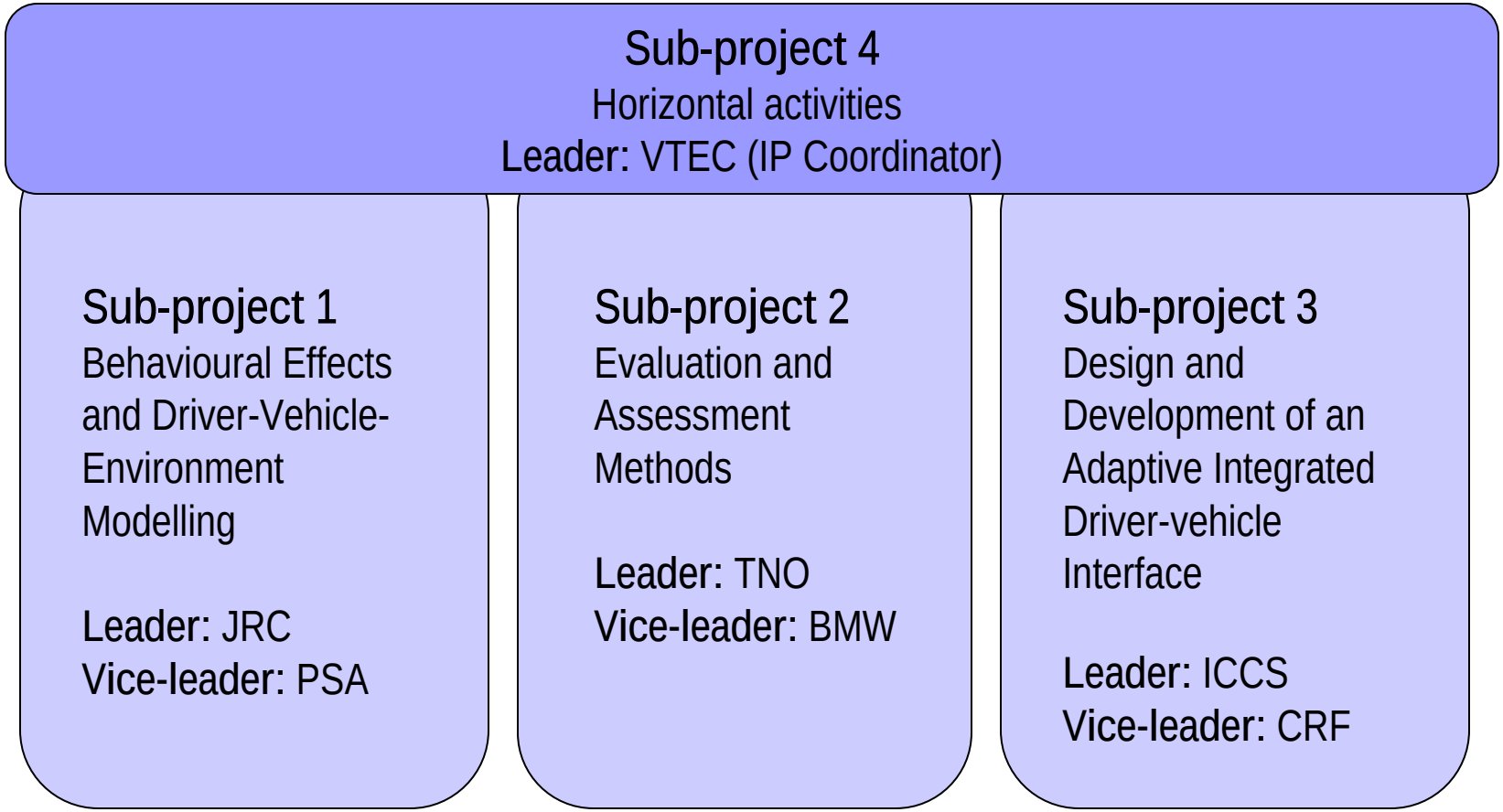


Realising the AIDE vision: Integration of research, methodological development and technological development

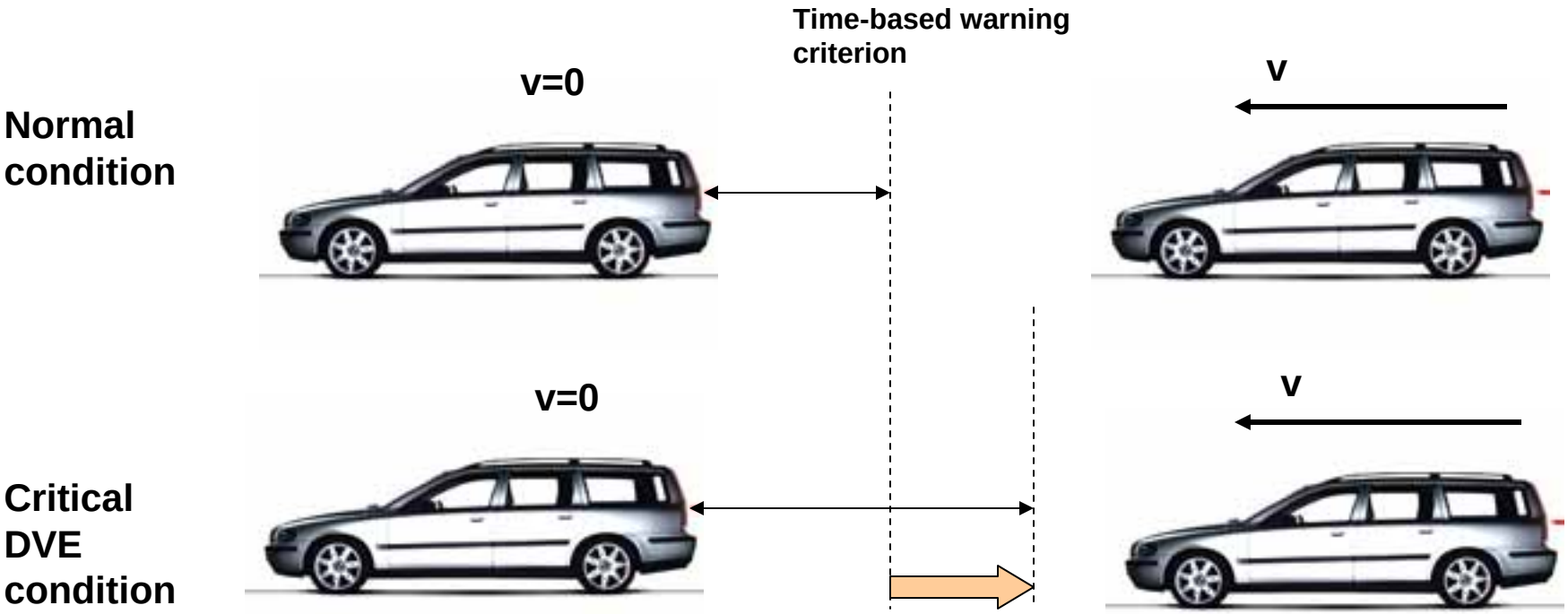


Validated AIDE demonstrators

Project structure



Examples of ongoing work (I): Study on adaptive Forward Collision Warnings (SP1)

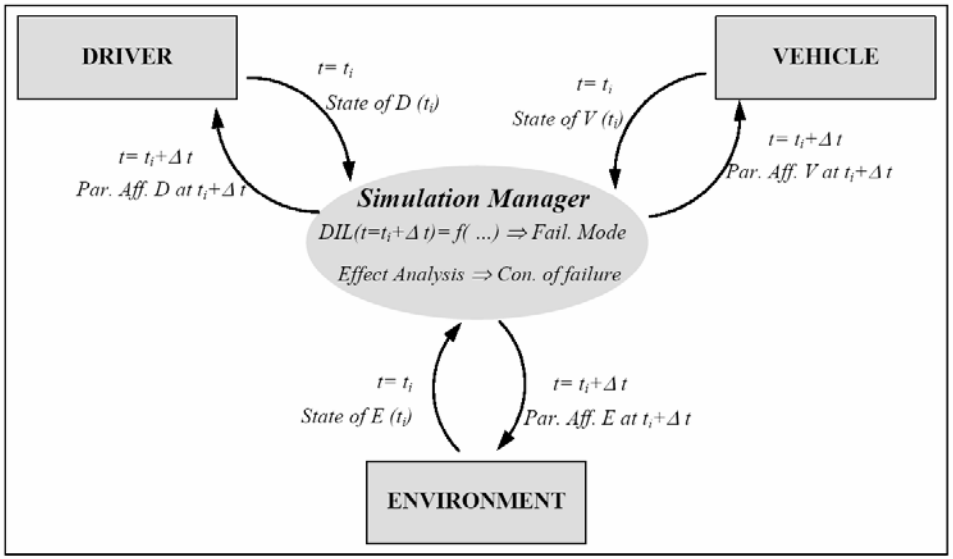


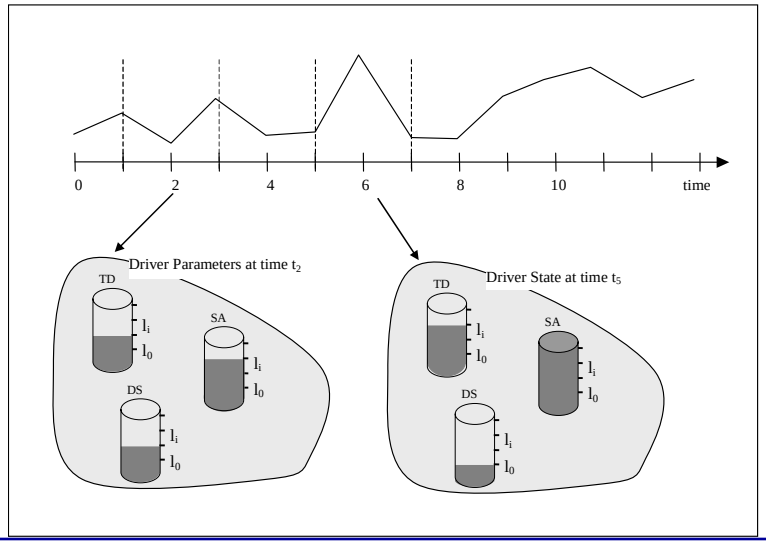
Types of adaptation to be investigated (relevant DVE conditions) :

- VTI: Weather/road surface condition
- TNO: Driver distraction
- Leeds: Driver style

Examples of work: DVE modelling framework (SP1)

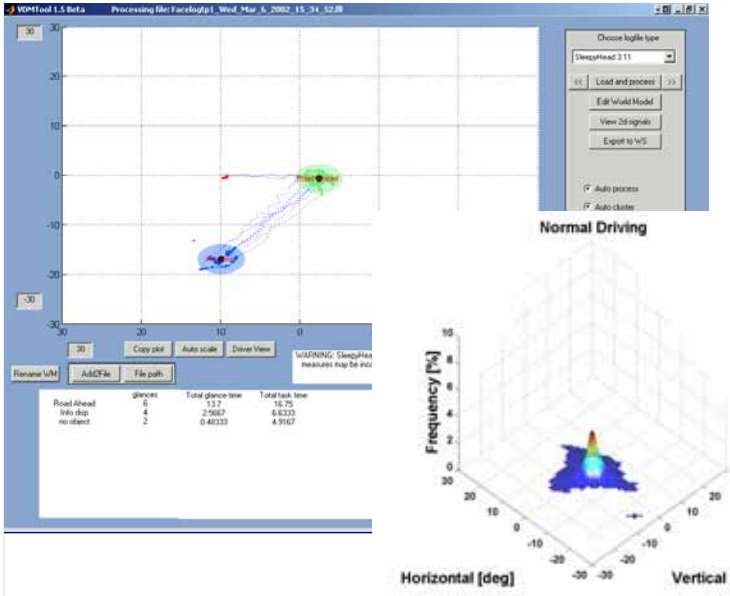
- Potential DVE model applications
  - Conceptual description of the AIDE problem domain
  - Predicting behavioural effects of interacting with **individual IVIS/ADAS**
  - Predicting behavioural effects of interacting with **combined IVIS/ADAS**
  - Predicting effects of **AIDE meta-functions**
  - Use as part of **real-time algorithm** in the AIDE system



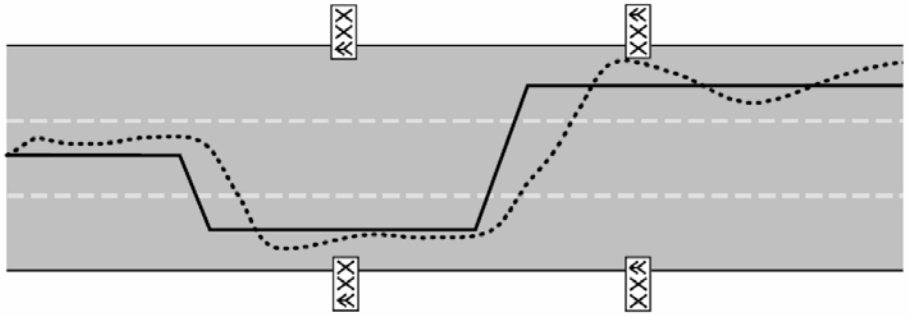


Examples of work: Workload/distraction measurement tools (SP2)

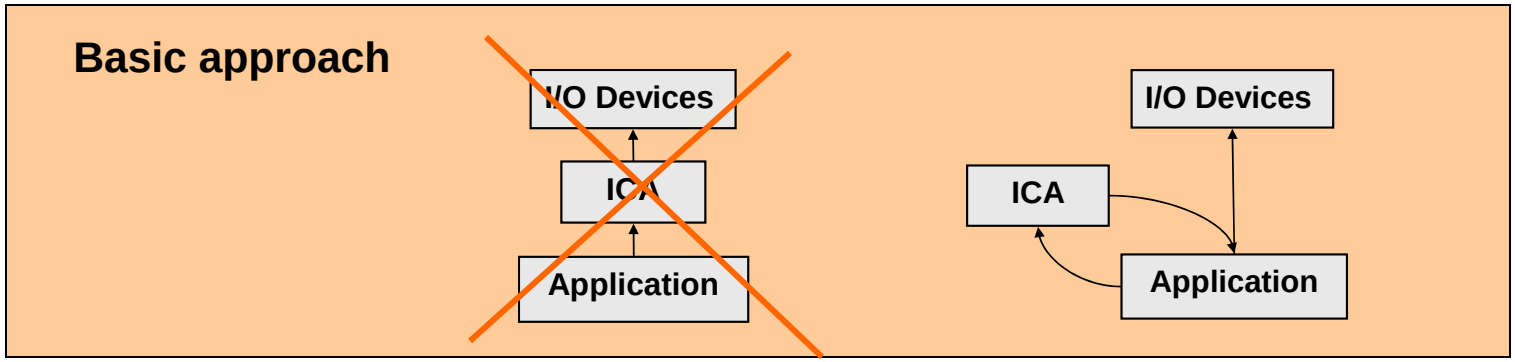
Visual demand measurement tool

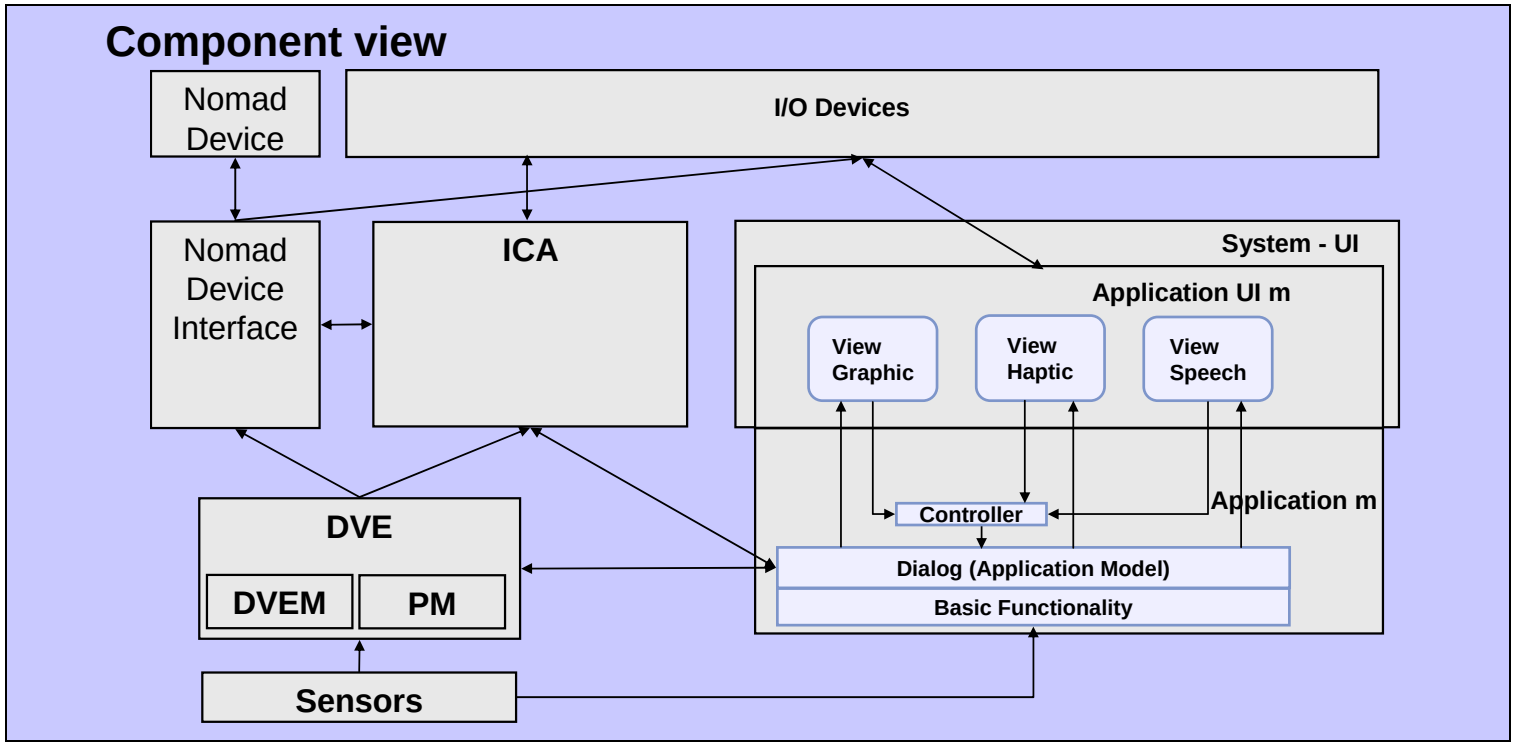


Lane Change Test

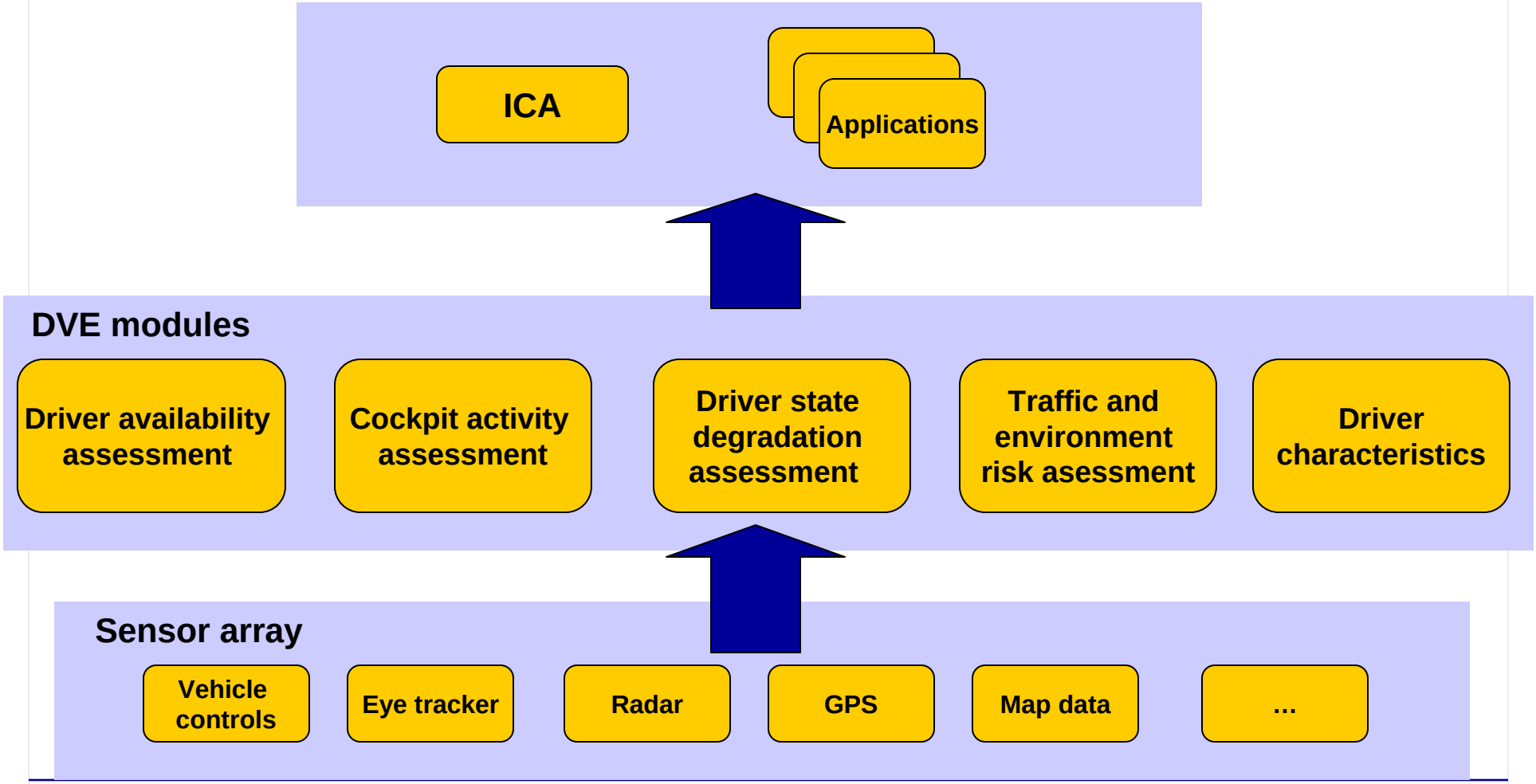


HMI architecture (SP3)





Real-time DVE monitoring (SP3)



Guidelines and standards (SP4)

- **So far:** Review of existing guidelines and standards (public deliverable)
- **Starting now:** Support the update of the ESoP
- **By end of project:** Develop new guidelines and proposal for standards

Interaction with other initiatives

- EASIS (STREP)
  - Requirements on system architecture
- PReVENT (IP)
  - Exchange of specifications to ensure compatibility
  - Common demonstrator vehicle
  - Response3 checklist
- GST Online Safety Services (IP)
  - HMI access for remote services
- HUMANIST NoE
  - User needs
  - Evaluation methods
  - DVE modelling
- Strong overlap in partnership with all these initatives!

AIDE open forums

- User Forum
- Architecture forum
- Nomadic device forum

Conclusions

• The AIDE IP integrates, for the first time in Europe, major efforts on driver behaviour research, methods development and technological HMI development in a single multidisciplinary project

• Initial **specification phase** is almost completed -> enter **development and experiment** phase (~M13-30)

Design Scenarios and HMI meta-functions: Towards an Adaptive Integrated HMI

by Holger Kussmann (BOSCH)

Design Scenarios and HMI Meta Functions: Towards an Adaptive Integrated HMI

Dipl.-Ing. Holger Kussmann
Robert Bosch GmbH

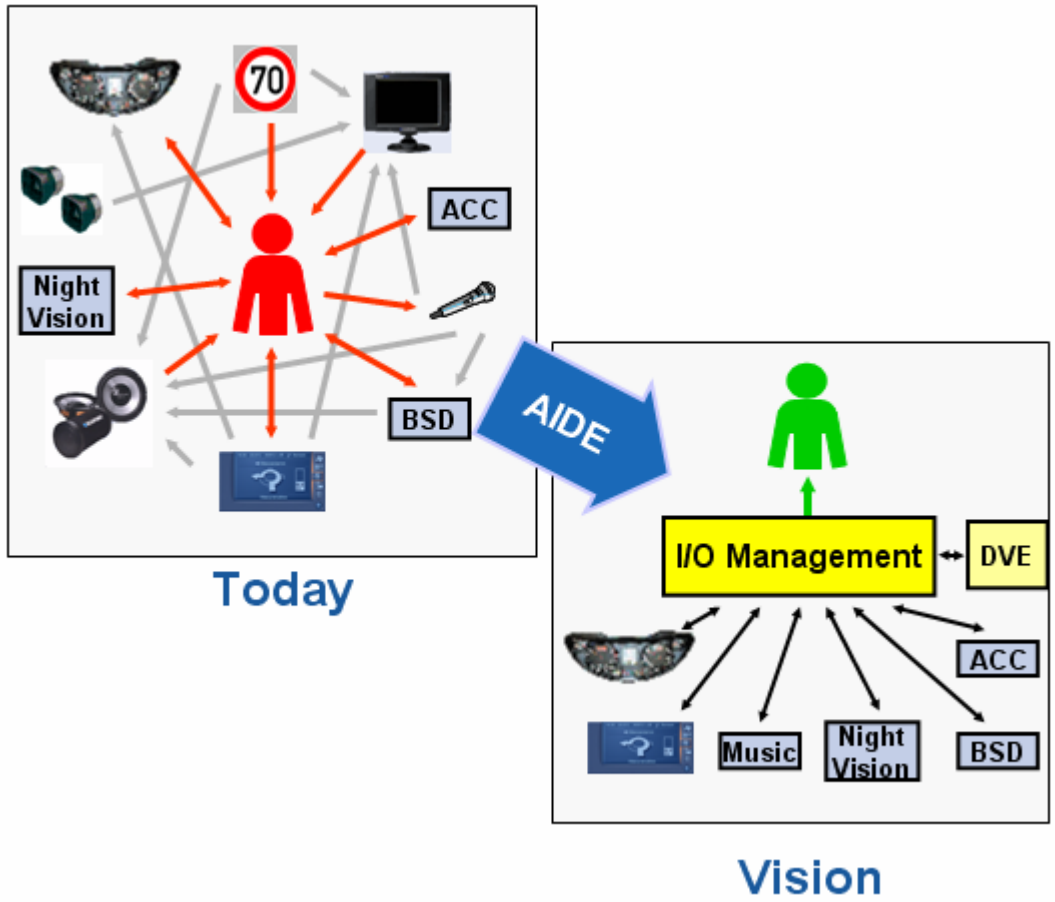
Overview

- Idea : Suitable Management & Adaptation of Interactions
- Use Cases & Scenarios
  - Derive Use Cases & Scenarios for I/O Management
  - Categorization Procedure
  - Action Categorization
  - Scenario Description
- Meta Functions
- Outlook

Idea : Suitable Management & Adaptation of Interactions

Key issues:

- Prevent **interference** between I/O events
- Exploit **synergies** (reduce HW costs, enhance performance)
- Adaptation to the driver state and /or the driving situation (DVE)
- Integration of nomad devices



Use Cases & Scenarios

Facts to be considered:

- The HMI is a strong competition factor, since there is no “best” in-vehicle HMI strategy → HMI strategy is OEM specific
- I/O device constellation depends on the vehicle segment
- The amount of applications depends on the vehicle segment
- Reducing development and HW costs requires standards and platform concepts

→ **Flexibility** for the system design (HMI strategy, “Look and Feel”) and
Scalability in terms of the system extent

are mandatory requirements.

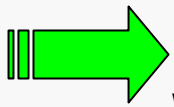
Derive Use Cases & Scenarios for I/O Management

Collecting in-vehicle interactions

Interaction (Action)
Route guidance information (turn left immediately)
Entering destination in the navigation system
Status information water temp
Warning high water temp
Status information fuel level
Traffic announcement
Information about forthcoming date
Incoming normal phone call (signalling)
Phone call conversation
Entering a telephone number
Control the radio (e.g. start program scan or change radio station)
ACC take over request
lane departure warning
Blind spot warning
Frontal collision warning
. . .

Generalized approach:

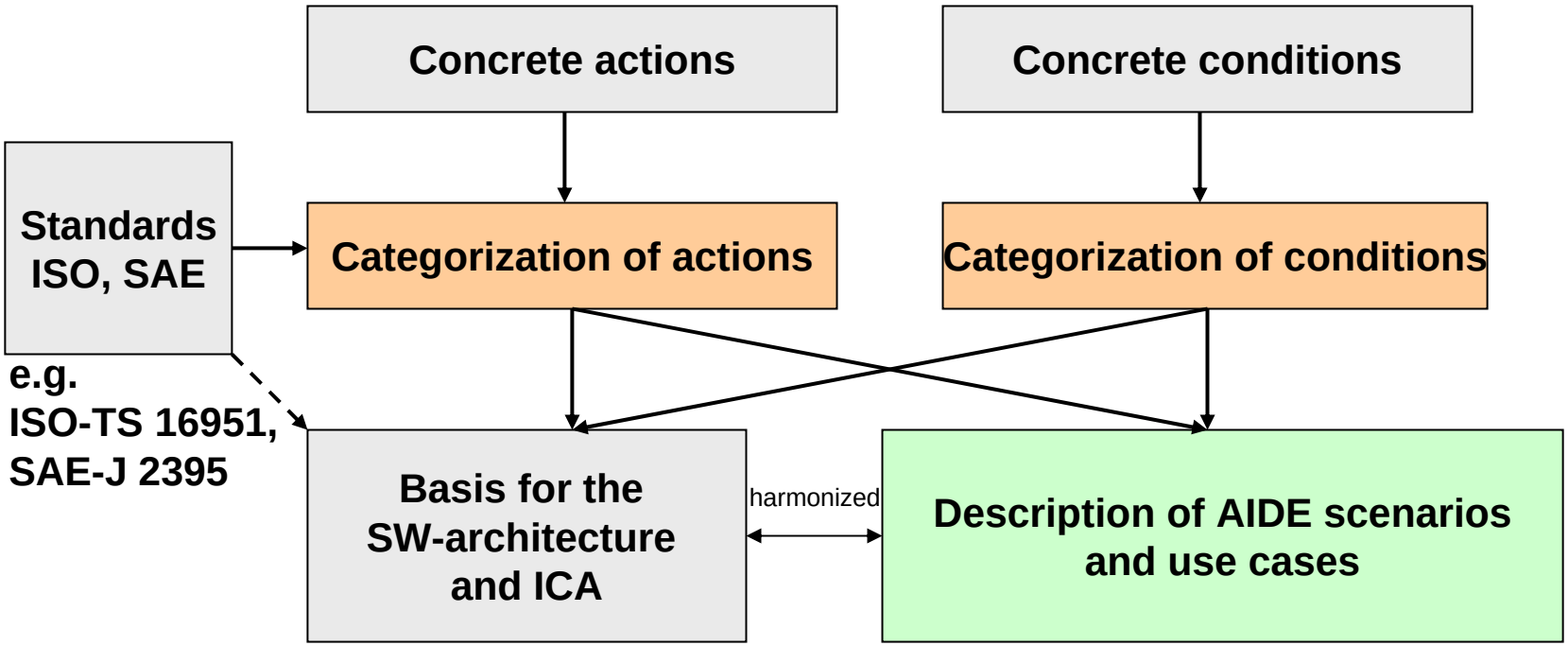
1. Categorize actions in groups
2. Define general „solutions“
3. Combine groups and add a general solution to get use cases



Reduced amount of possible combinations with exemplary „solution“

- **only the groups of actions are distinguished and “managed” in a different way**
- **the general “solutions” can be mapped on arbitrary combinations of actions**
- **Fulfil requirements**

Categorization Procedure



- I/O management is mainly based on the „importance“ of an action for the driver → interaction priority necessary
- Adaptation is mainly based on the most important generalised conditions (e.g. level of driving demand or traffic risk)

Action Categorization

Goal:
Define groups of actions having the same “importance” and use those groups for scenario description.

How can the “importance” be judged ?

AIDE approach:

The “importance” or priority of an action depends on specific characteristics

→ identify the most relevant criterions which can be used to derive the priority

Action Categorization

Action Characteristics in Terms of “Importance”

- Initiator (user/system)
- Safety Criticality (high/low/none)
- Time Criticality (high/low/none)
- Driving Relevance (yes/no)
- Real Time (yes/no)
- Mandatory (yes/no)
- Duration (transient/sustained)
- Preference (yes/no)

Action Categorization

Action Criterion List	Initiator		Dura-tion		Safety Criticality			Time Criticality			Real Time		Manda-tory		Driving Relevance		Preference	
Action	System	User	Transient	Sustained	None	Low	High	None	Low	High	Yes	No	Yes	No	Yes	No	Yes	No
Route guidance information (turn left immediately)	x		x		x					x		x		x	x			x
Entering destination in the navigation system		x	x		x			x				x		x	x			x
ACC take over request	x		x				x			x		x	x		x			x
Traffic announcement (normal)	x		x		x			x				x		x	x		x	
Incoming VIP phone call (signalling)	x		x		x				x		x			x		x	x	
Phone call conversation		x		x	x			x			x			x		x		x

Action Categorization

Due to the different HMI strategies of the OEM's and to fulfill the requirement of scalability the amount of groups which have to be distinguished will be different for each product.

- AIDE defines three principle groups (priority classes)

Warning (W) **urgent information to the driver mainly from ADAS**

Dialog (D) **directly desired and initiated action by the driver**

Output Messages (OP) **other output information**

- If necessary each group can be divided in subgroups to distinguish for example also between different output messages

Action Categorization

→ Mapping of the priority classes to the actions following your individual HMI strategy

→ The combination of criterions is unambiguous for each action

→ The priority classes are used for the scenario description

→ **Complete system behaviour description and flexibility for HMI strategy at the same time**

Route guidance information	x		x		x					x		x		x	x			x	**OP1**
Entering destination in the navigation system		x	x		x			x				x		x	x			x	**D**
ACC take over request	x		x				x			x		x	x		x			x	**W**
Traffic announcement (normal)	x		x		x			x				x		x	x		x		**OP2**
Incoming VIP phone call (signalling)	x		x		x				x		x			x		x	x		**OP1**
Phone call conversation		x		x	x			x			x			x		x		x	**D**

Scenario Description

- 5 priority classes for the AIDE HMI strategy (W, D, OP1,OP2,OP3)

- 5 categorized conditions (DVE):

  - High traffic/environment risk
  - Maneuvering (intention)
  - Distraction
  - Driving demand
  - Driver impairment (fatigue)

- Consider three different conflict situations for the scenarios in AIDE:

  - Conflict between concurrent actions
  - Conflict between one action and DVE conditions
  - Conflict between multiple actions and DVE conditions

Scenario Description (Example)

AIDE design scenario 1.6: Conflict between two output messages
Action/s = {OP_i, OP_j}, where i=1...3 OP_1= Mandatory messages or important info related to the instant driving task OP_2= Temporary info related to the driving task, requiring an action in the near future OP_3= Permanent status-info related to the driving task, not requiring an action in the near future OR output messages related to the secondary task
DVE Condition/s: DVE_{1-5}=LOW/NO
Flow of events 1 1. OP_i is executed 2. OP_j is initiated
Possible AIDE solution(s) 1. OP_i and OP_j are presented in different modalities. 2. OP_j is delayed until OP_i has finished
Example: *Conflict scenario:* A route guidance message is given. While the message is executed, an incoming phone call is initiated. *Possible solution:* The phone call is delayed until the route guidance message has finished.

Meta Functions representing the general “solutions”

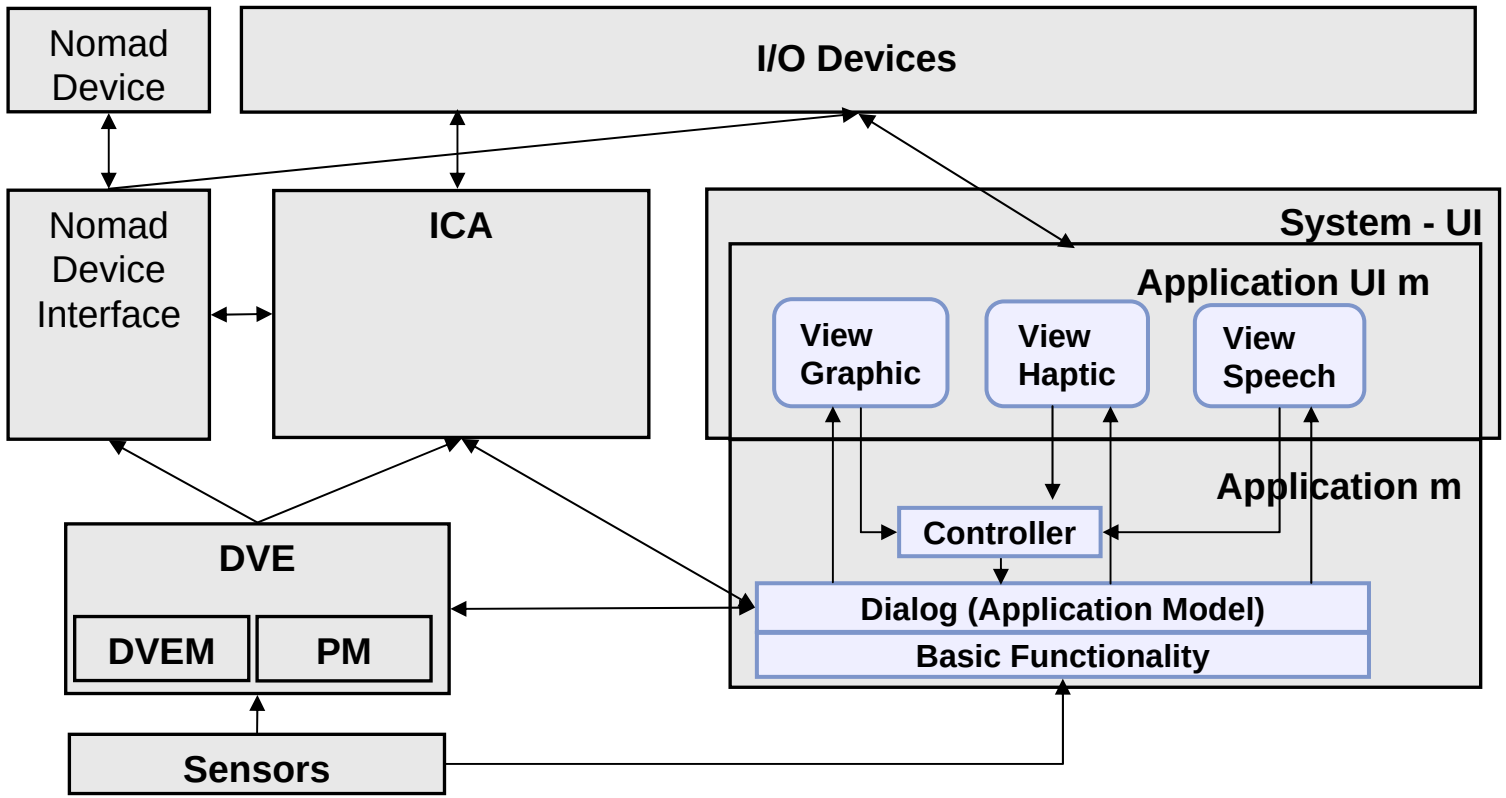
- Derive action priority
- Conflict recognition depending on actions / conditions (not I/O devices)
- Scheduling according to the driver/environment model
- Channel and modality selection and device allocation
- Changing information strategy depending on conditions

Results in:

- Terminate actions
- Interrupt actions and resumption of actions
- Include pauses
- Delay actions
- Modality/channel selection
- Modality/channel alteration
- Change spatial layout
- Change physical layout (volume, size, form, colour)

Outlook

- Use of categorization supports the required scalability and flexibility
- The generalized approach is basis for the architecture work



Evaluation of Adaptive Integrated HMIs by Klaus Bengler (BMW)

Evaluation of Adaptive Integrated HMIs

User Forum Cologne 15-16 March 2005

A. Keinath, K. Bengler

AIDE Consortium©

Integration

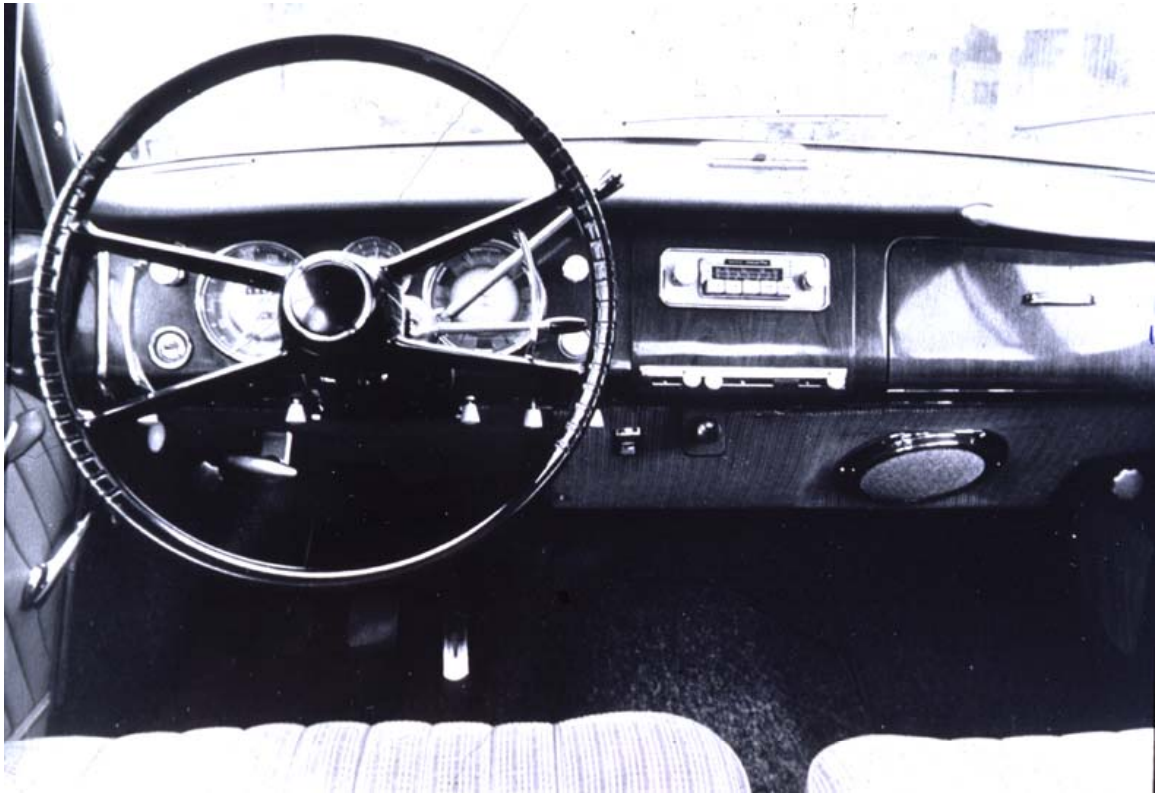
Integration as the

Combination of parts to a whole

Some Aspects of Integration

- Geometric
- Electric
- Information
- Interaction
- ...

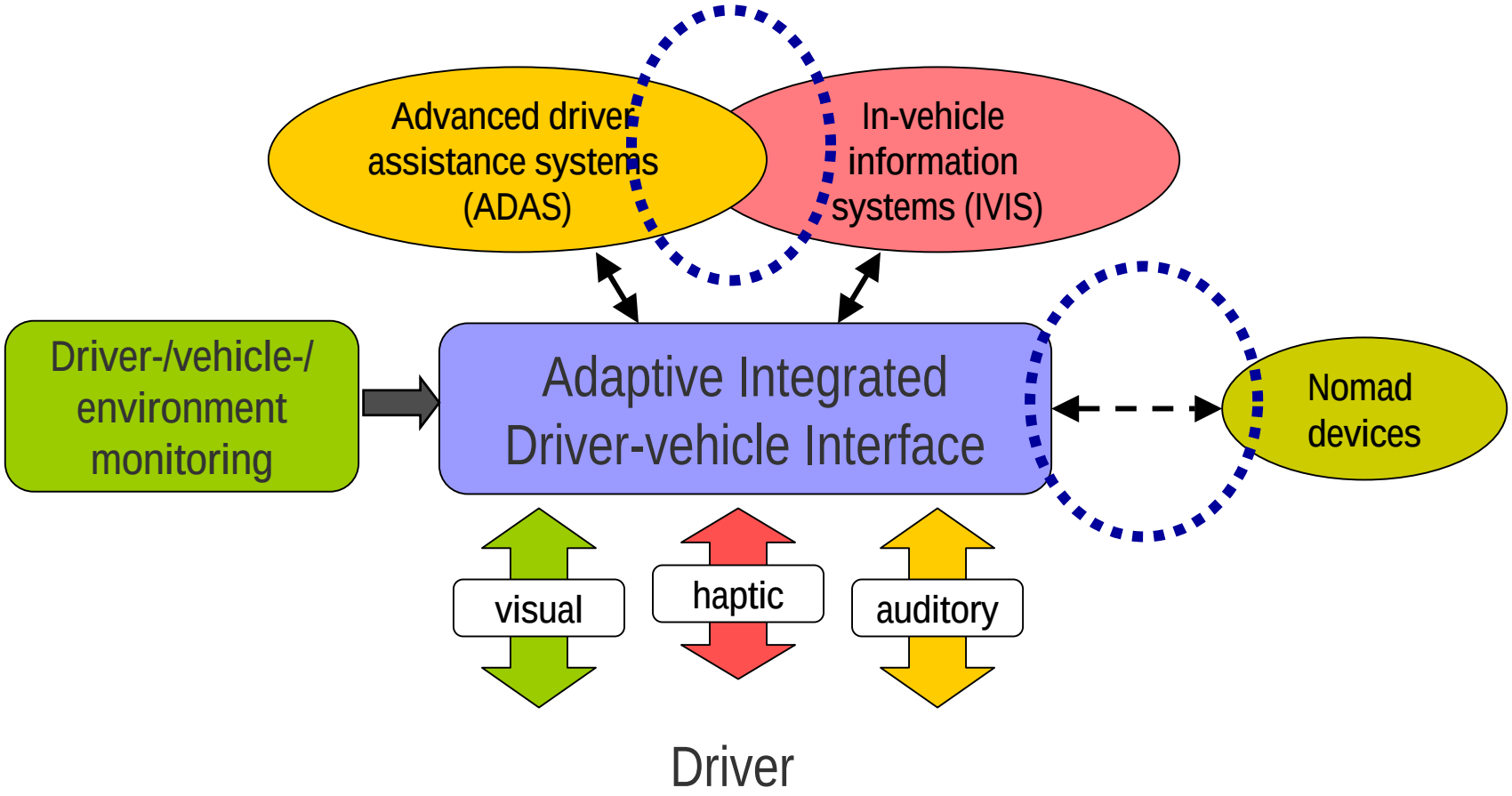
Early Integration of Audio



Integration of Travel Information and HVAC

Actual Status of Integration

Integration Fields within AIDE



Future Integration of Information and Interaction

Synchronization

Adaptivity – Types, Approaches

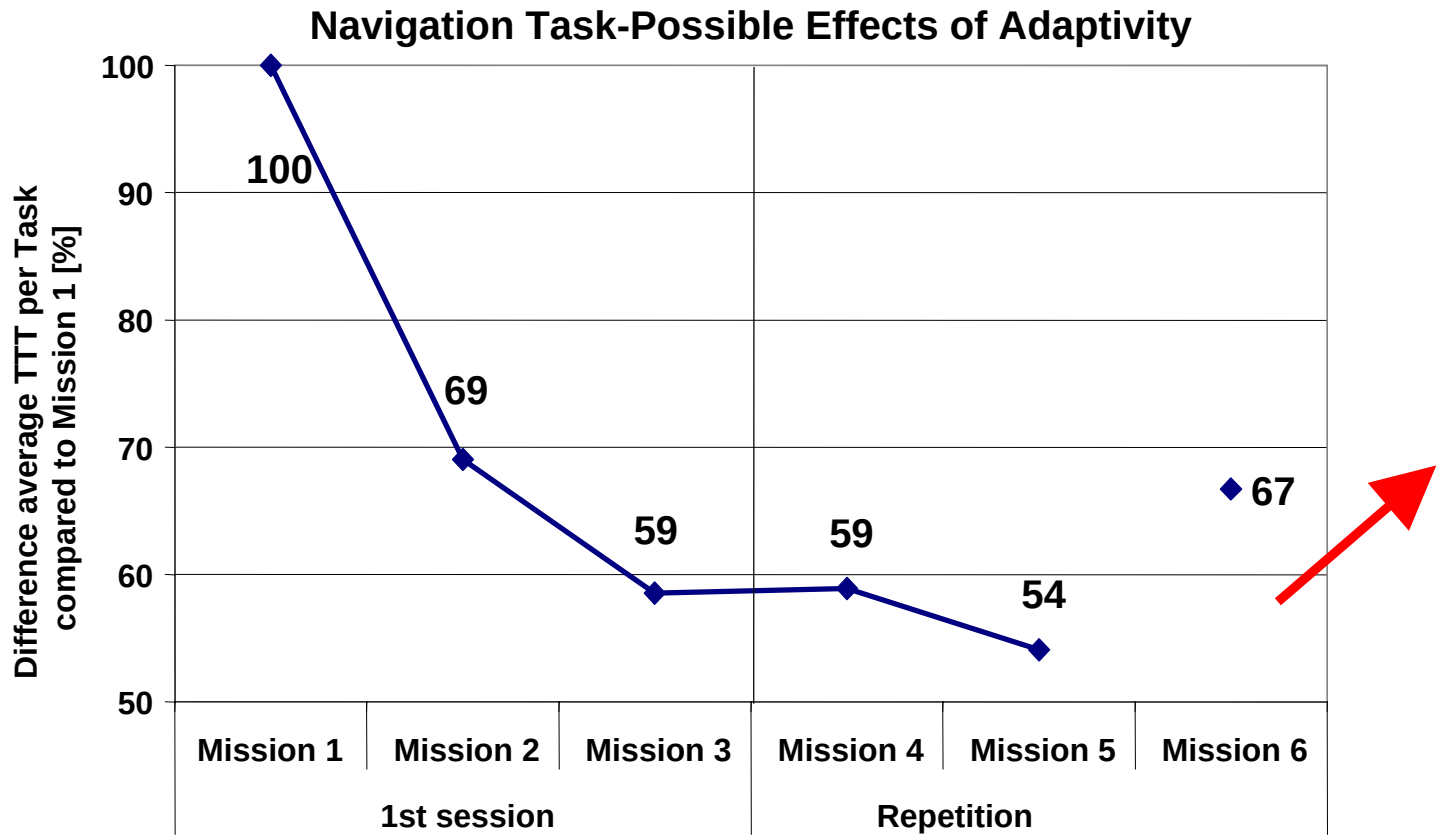
- Adapting to the situation
  (Weather, static traffic cond., dynamic traffic cond., ...)
  SANTOS, IDIS, Communicar

- Adapting to the user
  (User preferences, user state,...)
  SANTOS, AWAKE

- Adapting to the combination of situation and user
  SAVE-IT, AIDE

  In general - A given system changes its properties in dependence to additional external information

User Adaptivity – Example Data



Krüger et al. 2002

Evaluation – State of the Art

- Inquiry
- Ratings
- PDT
- Occlusion
- Lane Change Test
- Driving Simulators
- Equipped cars, field tests

Challenges in Evaluation

- Qualify existing methods for the evaluation of integrated and apdaptive solutions
- User Adaption requires longterm aspects during evaluations
- Situation Adaptation requires complex evaluation scenarios
- Integrated Solutions require complex evaluation settings provoke interactions between experimental treatments

Development of Methodology within AIDE

- Make existing more efficient (Visual behavior -> VDM-tool)
- Use already existing (LCT for longterm evaluations)
- Identify reliable, valid (driving) performance criteria

Conclusions

- Two major integration aspects
  ADAS/IVIS
  Nomadic Devices

- Differentiation in User adaptive, Situation adaptive and User/Situation adaptive solutions

- Make the first steps in a next generation of methodology

Driver Vehicle Environment modelling in AIDE
by Carlo Cacciabue (JRC)

Driver-vehicle-environment modelling in AIDE

P. C. Cacciabue
European Commission, Joint Research Centre

Modelling objectives

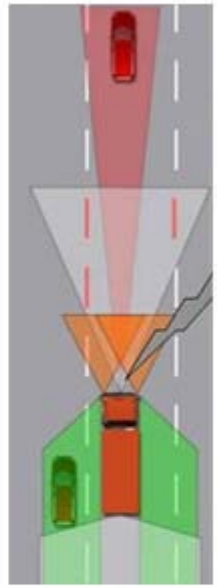
- **To develop a modelling architecture of human behaviour to satisfy designer requirements for inclusion in the design and development of control system.**

- **To define a set of safety critical parameters that describe *learning* process & *long-term* behavioural effects when using ADAS and IVIS systems such as AIDE**
- **To indicate the critical parameters that sustains modelling architectures**

- **To implement Driver-Vehicle-Environment (DVE) model and Behavioural Effect (BEDA) parameters into a simulation for performing predictive analyses of Human Machine Interaction**

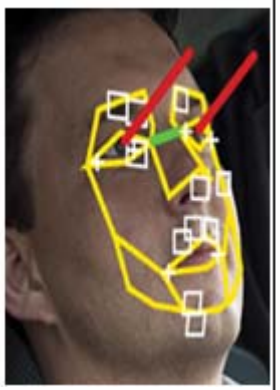
Interface Adaptation

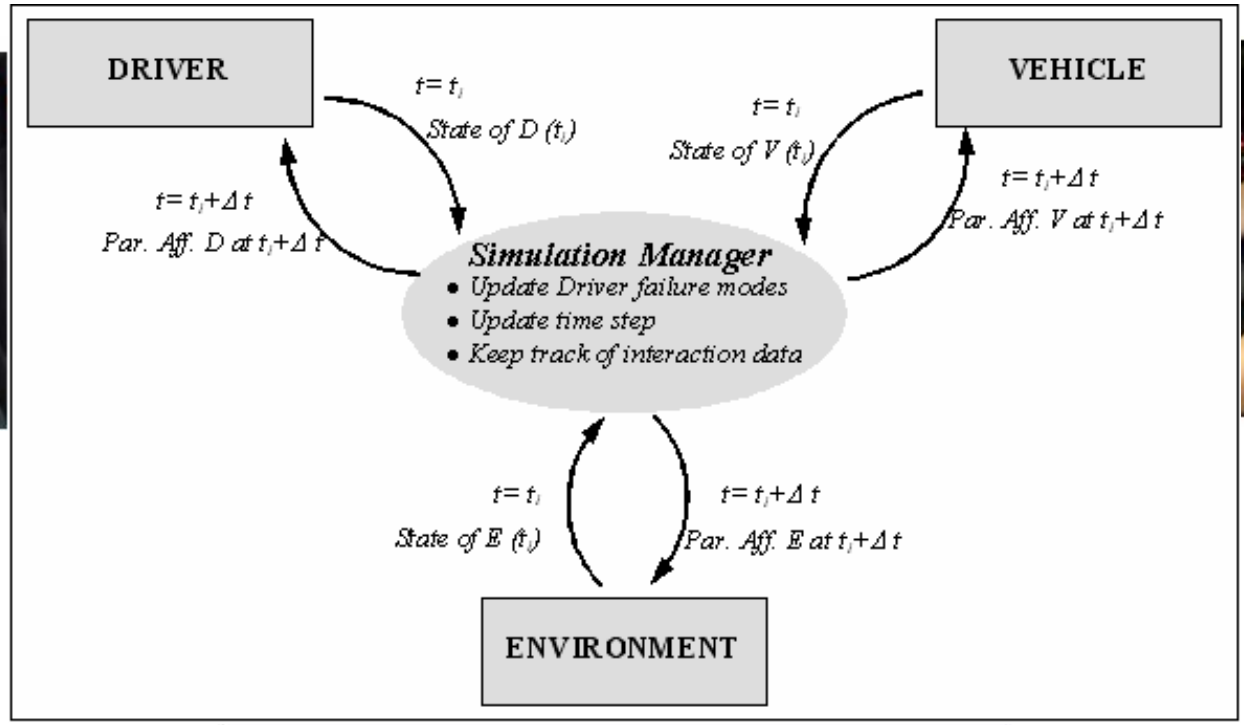
- Monitor the **D**river, the **V**ehicle and the **E**nvironment (DVE) state and adapt the interface accordingly

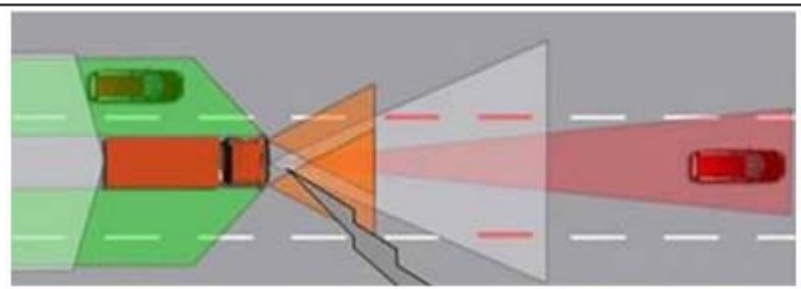


- **Examples:**
  - Lock-out/postpone non-critical information on demanding situations
  - Adapt the timing/intensity of safety warnings (e.g. warn earlier when the driver is inattentive)

Driver – Vehicle – Environment Model - DVE MODEL

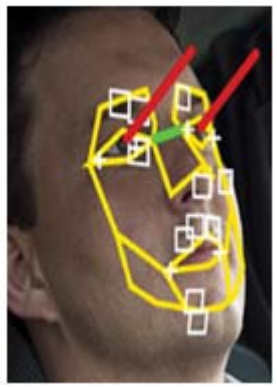


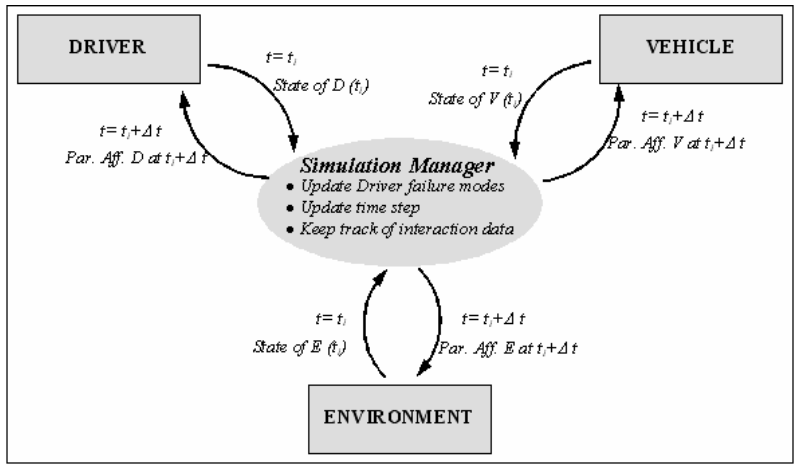




Interface Adaptation

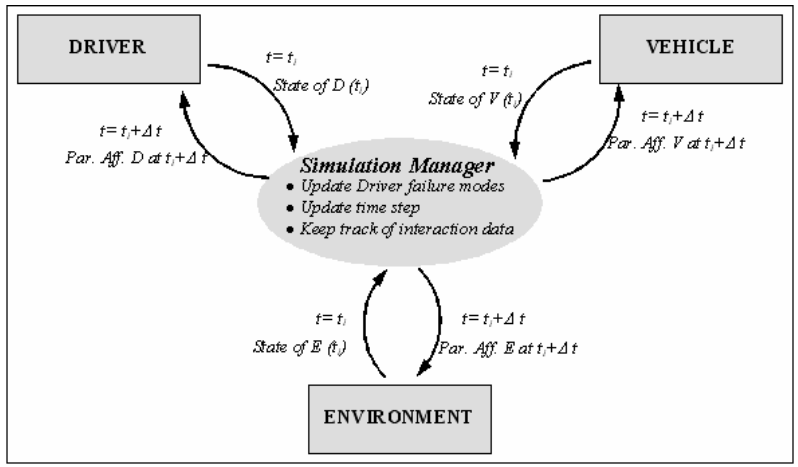
Driver model variables





- **Static**
  - ✓ **Age, Gender**
- **Quasi-Static**
  - ✓ **Expertise, Experience, Attitudes, Behaviour adaptation**
- **Dynamic**
  - ✓ **Workload, stress, distraction**
  - ✓ **Measured from driver profile and in-vehicle sensors**

Interface Adaptation



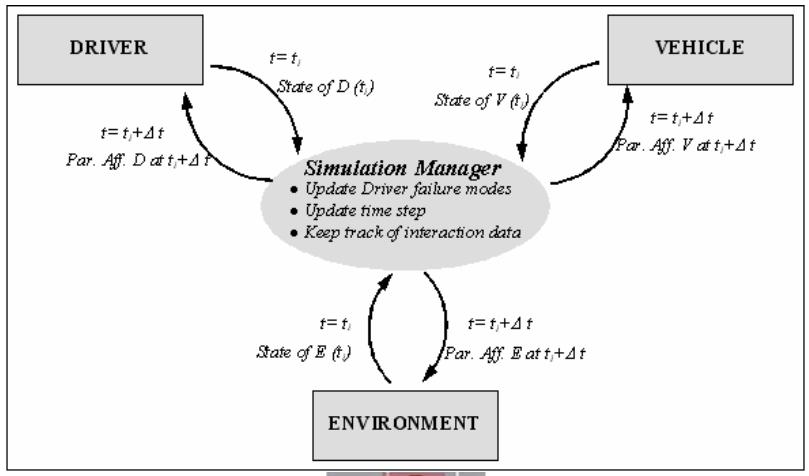
<u>Vehicle</u> model variables

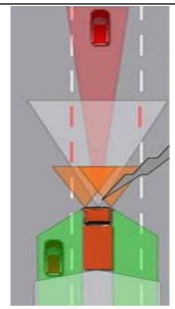
- **Static**
  - ✓ **Type of Vehicle**
- **Quasi-Static**
  - ✓ **State of vehicle**
- **Dynamic**
  - ✓ **Driving task: Speed, steering angle..**
  - ✓ **Secondary task: GSM phone, Navigation system, Audio system**
  - ✓ **Measured from in-vehicle sensors**

Interface Adaptation

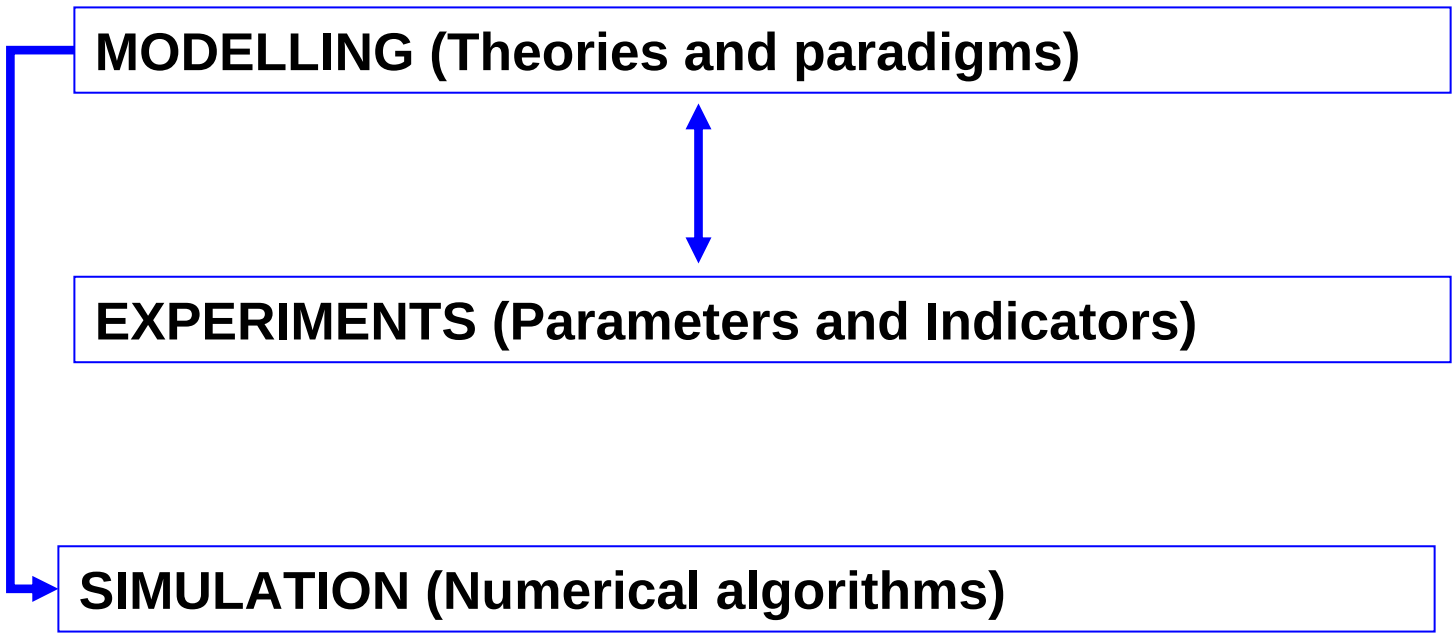
Environment model variables

- **Static**
- **Quasi-Static**
  - ✓ **Road type, Weather, Street lightning**
- **Dynamic**
  - ✓ **Intersections ahead, Curves, Long and Lat pos**
  - ✓ **Measured from in-vehicle sensors + E-horizon**





AIDE IP


MODELLING (Theories and paradigms)
EXPERIMENTS (Parameters and Indicators)
SIMULATION (Numerical algorithms)

MODELLING (Theories and paradigms)

Examples of mental models of driver

Model name	Reference
Adaptive Cruise Control Field Test	Francher et al. (1988)
Behavioural adaptation and adaptive cruise control	Parker, Rudin-Brown,and Malisia (2003)
Car following behaviour	Saad and Schnetzler (1994)
COCOM / ECOM	Hollnagel, et al. (1993, 2003)
COSIMO	Cacciabue et al. (1992)
Driver behaviour model	Michon (1985)
Driver steering control	McRuer et al. (1977)
Driving with intelligent vehicles	Hoedemaeker (1999)
Fallible Machine	Reason (1986, 1987)
Integrated driver model	Salvucci (2001), Salvucci et al. (2004)
Intelligent Speed Adaptation	Comte (1996, 2000)
In-vehicle speed adaptation	Hjalmdahl (2004)
MIDAS	Corker et al. Smith (1993, 1995)
Multiple resources Theory	Wickens (2002)
PROCRU	Baron, et al. (1980)
Psychological model of the driver	Stanton and Young (1998, 2001)
RMC/ PIPE	Cacciabue, et al. (2003)
SHELL	Edwards, E. (1972)
Supervisory Control Paradigm	Sheridan, T. B. (1992, 1999)
System Response Generator (SRG)	Kjær-Hansen, Cacciabue, Hollnagel, (1992)

MODELLING (Theories and paradigms)

Model Selection Criteria

- ability to *predict* performance
- account for *multiple, simultaneous activities*

Criteria for Comparison of mental Models of Drivers

	Criterion	Comment
1	Is model recursive	A model is recursive if it is applies the same principles of analysis at all levels of descriptions. A model that is not recursive invokes different concepts at different levels.
2	Interactions described by the model	Between **Driver and Vehicle? Between Driver and Environment? Between Vehicle and Environment? Between all three (D, V, E)?**
3	Links with other DVE models, hence representation of traffic dynamics	A DVE model should offer a balanced approach to the modelling of the **D, V, and E components. Each component should be represented in its own right rather than as a set of input parameters to another component.**
4	Model include an explicit description of	The **Driver? The Vehicle? The Environment?**
5	Does the model account for driver look head (anticipation)?	The model should be able to account for the anticipatory nature of human performance. A dynamic model must also have the ability to handle time, cf. below.
6	Does the model account for multiple and simultaneously lines of event (dynamics)?	The model should go beyond a traditional event-response (processing) model, hence be able to describe how multiple, simultaneous lines of events are organised and how they determine behaviour.
7	Does the model account for performance variability / deviations?	The model should be able to account for human performance deviations, either as an emergent feature or as by referring to specific categories of performance failure (“error”).
8	Does the model include categories for performance deviations?	Does the model comprise a specific set of failure categories or a classification scheme.
9	Performance limitations of model	Which are the limiting conditions of the model in terms of processes, e.g. decision making, dynamic configuration, time and processes, etc.

MODELLING
(Theories and paradigms)

Model Characteristics

- E-DVE (Electronic DVE Model) Simplified & fast running
- Few parameters for behavioural adaptation

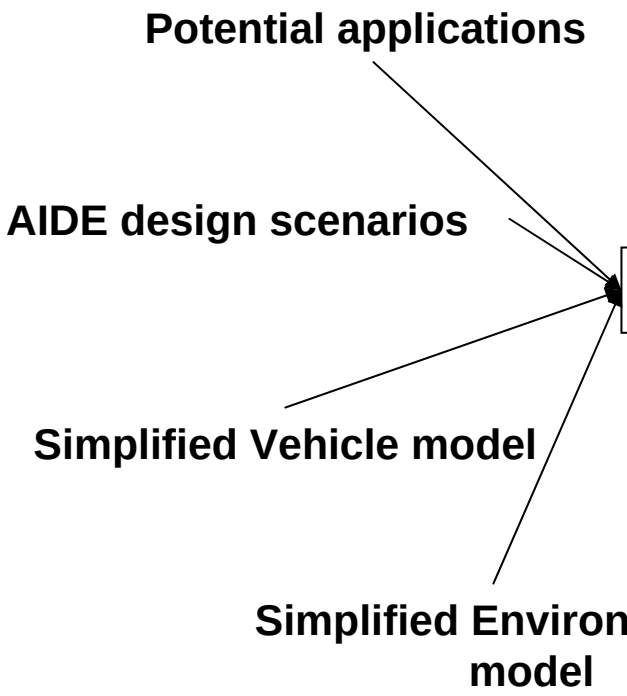
Model Characteristics

- Simple **Functions of Cognition** Perception – Interpretation Planning - Execution
- Use of Frames of knowledge for **"built-in"** chunks of actions
- Limited number of **Parameters** for Driver behavior modelling
- Use of **DIL** (Driver Impairment Level) as single measure of possible errors
- Simplified **Task Analysis** for definition of sequences of actions

AIDE IP

MODELLING
(Theories and paradigms)

SIMULATION
(Numerical algorithms)



PARAMETRS

- *Attitudes/personality*
- *Experience/competence*
- *Task Demand (TD)*
- *Driver State (DS)*
- *Situation Awareness (SA)*
- *Intentions/goals*

Correlation of PARAMETRS with MEASURBLE VARIABLES

Correlation of PARAMETRS with DRIVER BEHAVIOUR

Task Analysis

EXPERIMENTS
(Parameters and Indicators)

ADAS and IVIS Effects on Driver behaviour

Great diversity of the driver population.

Objective driver characteristics
- *age*
- *gender*
- *degree of experience*
- *practice*

Subjective driver characteristics
- *driving style*
- *personality traits*

Circumstantial conditions
- *nature and extent of behavioural changes*
- *conditions in which changes take place*
- *reasons of changes*
- *characteristics of the drivers*

Temporal factors affecting adaptation
- *Learning and appropriation phase*
- *Integration phase*

EXPERIMENTS (Parameters and Indicators)

Four possible behavioral changes in both strategic and maneuvering level as a result of behavioral adaptation to (ADAS).

Changes at maneuvering level		Changes at strategic level	
		ADAS as a reference tool	*ADAS as a "slave" system*
Unsafe acts under Critical traffic situations	High ↑ Low	• Learning to comply with warnings	• Allocating attention to secondary tasks
		• Learning to make better distance estimations	• Driving to the limit

EXPERIMENTS (Parameters and Indicators)

EXAMPLES of General EP for long term behavioural assessment

	HIT	LEEDS-TNO-VTI* only for the learning phase	PSA* only for the learning phase	INRETS-REGIENOV
System (s)	Time Headway feedback Lateral control feedback	Forward Collision Warning	Adaptive Cruise Control	Speed Limiter Cruise Control
Type of system	ADAS	ADAS/IVIS	ADAS	ADAS
Characteristics of the system studied	Combination of two types of support systems	Isolated support system Adaptive to: - Weather - Driver state - Driving style	Isolated support system Longitudinal control: speed and headway	Two modes of speed control with an integrated interface
Task (s) supported	Time Headway control Lateral control	Time headway control	Time Headway control Speed Control	Speed control
Expected system Intervention	Continuous	Discrete	Continuous	Continuous

EXPERIMENTS (Parameters and Indicators)

EXAMPLES of General EP for long term behavioural assessment

	HIT	LEEDS-TNO-VTI* only for the learning phase	PSA* only for the learning phase	INRETS-REGIENOV
Identifying the main phases of the Learning process	X	X	X	X
Identifying and assessing short and long term behavioural changes	X	X	X	X
Contribution to the design	-	Design of "adaptive" systems	Design of "self-Explaining" systems and/or support for learning	Design of "self-Explaining" systems and/or support for learning
Contribution to modelling	X	X	X	X
Studying driver mental model of and trust in the support system	-	X	X	-

Main objectives of the studies

Road Safety Requires Smart Standards for Intelligent Driver Information and Assistance Systems

by Peter Burns, Transport Canada

Harmonized Standards and Research for Adaptive Integrated Driver-Vehicle Interfaces

Peter C. Burns

Transport Canada Transports Canada

This presentation reflects the authors opinions and not the views of The Government of Canada

Canada

Canada's Road Safety Vision 2010

- RSV 2010 Vision: The safest roads in the world
- 30% decrease in the number of road users killed or seriously injured.
- Strategic Objectives:
  - to raise public awareness of road safety issues;
  - to improve communication, cooperation and collaboration among road safety agencies;
  - to move toward a risk-based approach to traffic law enforcement;
  - to improve national road safety data collection and quality.

Ergonomics and Crash Avoidance Division

- Research and share human factors knowledge relevant to motor vehicle safety.
- Prioritize research according to the potential crash and injury reductions that could result from collision avoidance systems and new vehicle standards.
- Assess performance characteristics and potential benefits of crash avoidance systems.
- Support the development of guidelines, standards, regulations and crash countermeasures.
- Contribute to international automotive safety research efforts by presenting and discussing its research results with other governments and industry, technical committees and conferences.

Relevant Activities at Transport Canada (TC)

- **Assessing Distraction**
  - HASTE
  - ✓ Multifunction displays in-vehicles
  - ✓ Lane Change Test (LCT)
- **Distraction Countermeasures**
  - ✓ Assessing the Alliance Code of Practice (AAM)
  - ✓ Memorandum of Understanding (MOU) on Telematics

Assessing Multifunction Devices In-Vehicles

- Study to investigate the technology and assessment methods
- Two 2004 European luxury vehicles containing multifunctional information systems
- A combination of human factors assessment techniques were applied:
  - Experts - 6 people using TRL Checklist and Heuristic Evaluations on complete systems;
  - User testing - 12 people with 4 tasks in a rental car scenario;
  - Occlusion – same people and tasks repeated with and without occlusion goggles (ISO, 2004).

Multifunction Devices: Results

- With the TRL Checklist, the experts identified several safety concerns with the two multifunction devices. More safety concerns were identified on Device B.

- Heuristic Evaluations identified a number of basic usability problems in both devices. Device B had more heuristic violations than Device A (e.g., visibility of system status, consistency and standards).

- User tests indicated people had more errors and more trouble completing tasks on Device B than Device A.

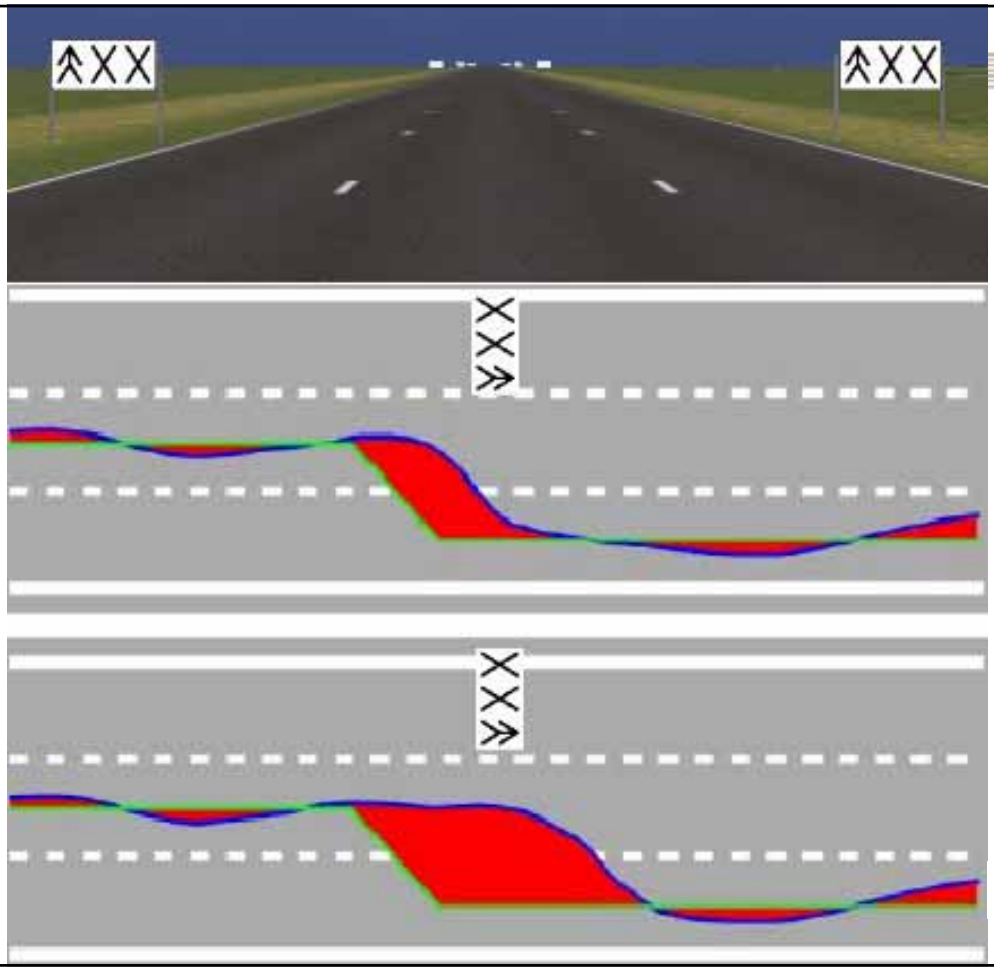
- With occlusion, the total shutter open time (TSOT) showed that Device A was less visually distraction than Device B for the two more complex tasks (i.e., “Set address as destination” and “Set point of interest” tasks).

Multifunction Devices: Conclusions

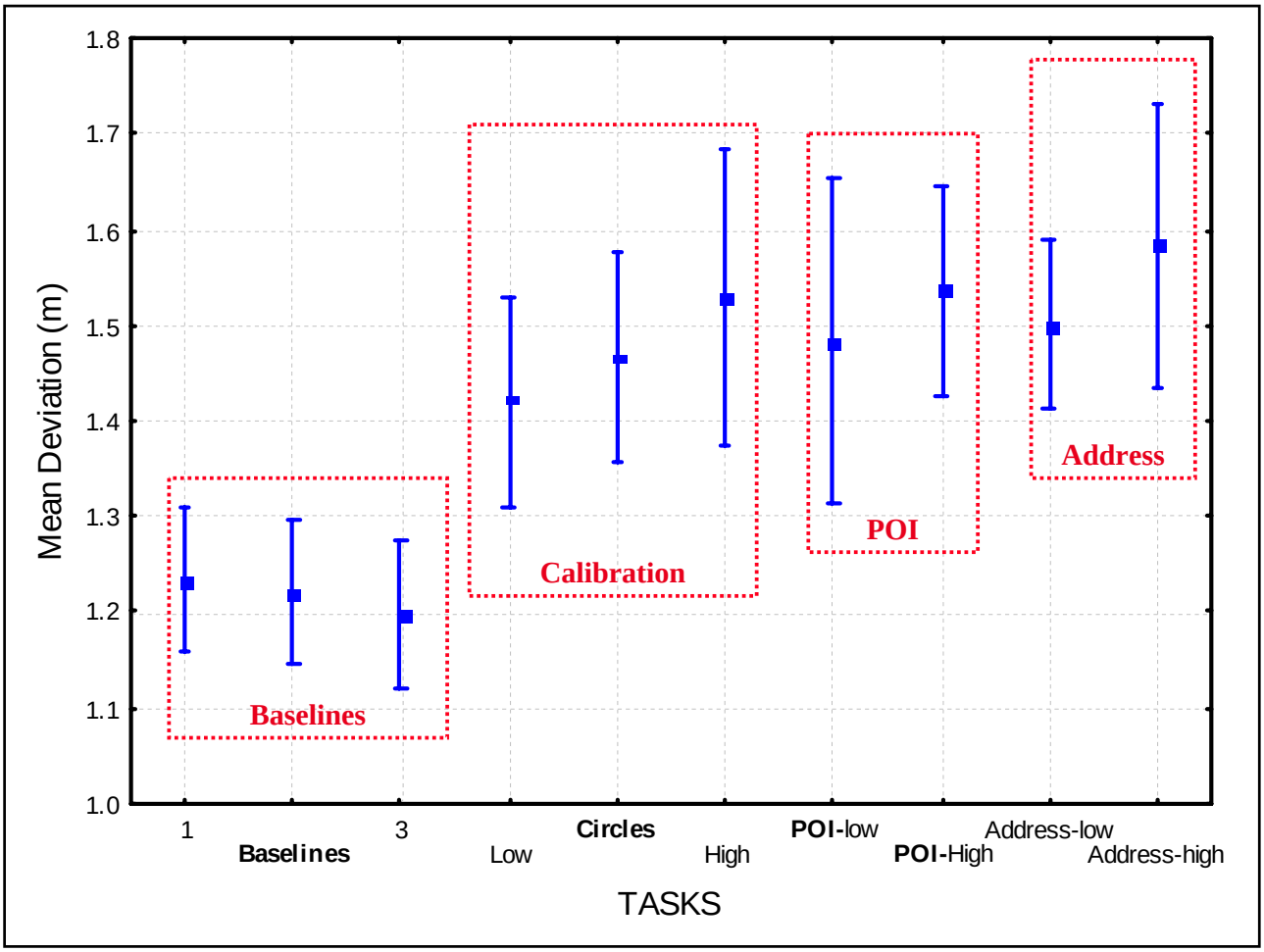
- All methods lead to the same general conclusion (Device B worse).
- Although one device was consistently worse across all the assessments, both devices had usability and safety concerns.
- Together, expert evaluations, user testing and performance tests can help designers identify the areas and seriousness of usability and safety issues.
- An iterative multi-method approach is needed to assess in-vehicle HMI.
- Good usability is a foundation for safer devices.
- If HMI is inadequate on current multifunction devices, this gives limited assurance that it will be done correctly on much more complex systems such as adaptive integrated interfaces.

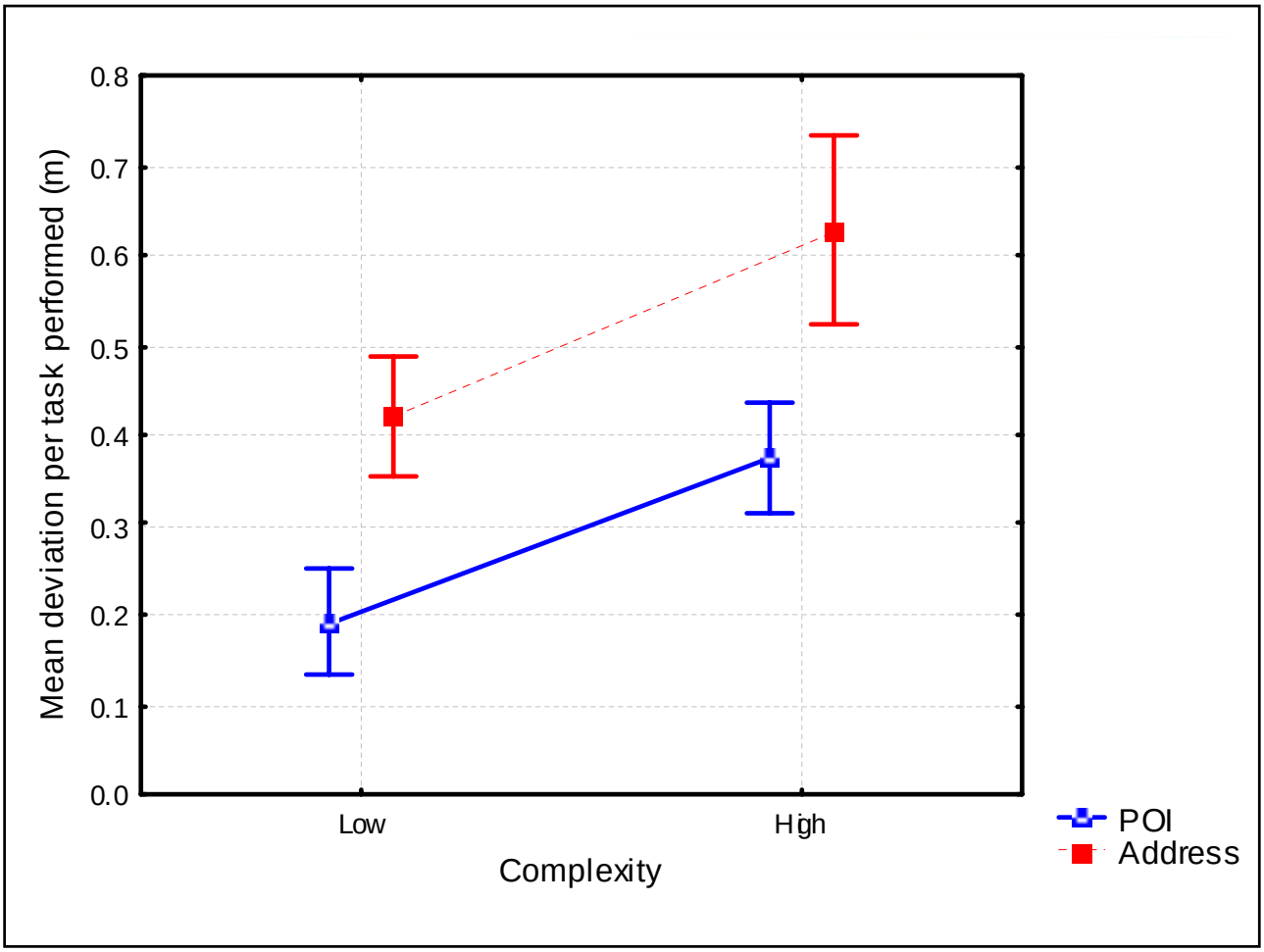
Lane Change Test (ISO, 2004)

- The purpose of the present study was to evaluate the LCT's ability to discriminate between different secondary tasks with different levels of complexity.
- 21 Participants aged 19 to 38 years.
- Tasks
  - 3 Baseline drives.
  - 2 typical navigation system tasks, Point of Interest (POI) Entry and Address Entry (Blaupunkt Travelpilot) at 2 levels of complexity.
  - 3 Calibration tasks (easy, medium and hard)



(Mattes, 2003)


Mean Deviation (m)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
Baselines
Calibration
POI
Address
1
3
Baselines
Circles
Low
High
POI-low
POI-High
Address-low
Address-high
TASKS

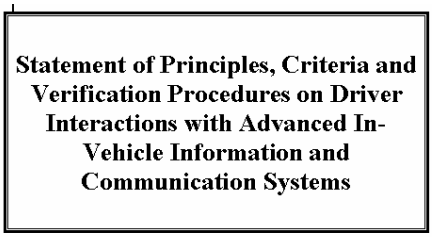

Mean deviation per task performed (m)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Low
High
Complexity
POI
Address

LCT Summary and Conclusions

- LCT discriminates lane change path deviations between different types and complexity levels of secondary tasks.
- These differences are a function of time taken to complete the secondary tasks.
- More research is needed to validate and refine the LCT procedure.
- The procedure would also benefit from some criteria on which to set performance limits for unsafe tasks.
- The next step will be to compare these results with the Occlusion Technique and HASTE, which ran multiple studies on the same system and tasks using a variety of driving performance metrics.

Alliance of Automobile Manufacturers (AAM) Statement of Principles: Update

- North American voluntary “best practices” document addressing safety aspects of driver interactions with IVIS
- Originally planned for 2001
- Final Version was expected Dec 2004, but is now scheduled for June 2005
- Applies to vehicles with design freezes 2006 and beyond
- An annex of speech-user interfaces is also being developed


Statement of Principles, Criteria and Verification Procedures on Driver Interactions with Advanced In-Vehicle Information and Communication Systems

Draft Version 3.0

Driver Focus-Telematics Working Group

June 17, 2003

Japanese Automobile Manufacturers Association (JAMA) Guidelines: Update

- Version 3.0 was published in August 2004.
- JAMA Guidelines sets visual demand criteria for in-vehicle tasks:
  - Total task glance time maximum of 8 seconds.
  - For Occlusion, the Total Shutter Open Time (TSOT) is 7.5 seconds (i.e., five 1.5 seconds vision intervals).

TC Assessment of the AAM Statement of Principles

Although these principles promise to improve safety, there is uncertainty on the level of safety and effectiveness of the procedures and criteria.

- TC is conducting a study that aims to:
  - evaluate the compliance of four vehicles to the AAM safety principles to see how current vehicles rate on the principles and to gather benchmark data on which to assess the impact of the principles.
  - evaluate the usability, validity and reliability of the AAM verification procedures
- Phase 1 is static testing and will be completed in March 2005.
- Phase 2 is dynamic testing and will be completed by September 2005.
- This work will provide essential input into the MOU that is currently being negotiated with the automotive industry.

Possible Strategies for Limiting Driver Distraction

	Option	Level of Intervention			
1	Design criteria	Voluntary (situation stays the same)	MOU	Advisory	Regulation
2	Limits on features				
3	Safety testing				
4	Safety design process				
5	Awareness		Advertising and media campaign		
6	Education		Driver training		
7	Deterrence		Ban certain “careless” driver behaviours		

Transport Canada Transports Canada

Canada

Memorandum of Understanding (MOU) on Telematics

- MOU working group was established in November 2004 and has had several meetings.

- The working group is comprised of TC, Canadian Vehicle Manufacturer's Association and the Association of International Automobile Manufacturers of Canada.

- The working group is aiming to have an agreement negotiated by early 2006.

Proposed Memorandum of Understanding (MOU) on Telematics

The parties to this MoU recognize and acknowledge:

- that distraction is a safety issue and that telematics devices should be designed to minimize their potential to distract drivers.
- there are currently no performance criteria that have been proven effective in setting limits on distraction across a range of technologies
- there are basic principles that can help designers limit distraction
- currently the most appropriate approach is for manufacturers to ensure that driver-vehicle integration considerations are systematically addressed within their product development process.

MOU Part 1: Guidelines for Limiting Driver Distraction from In-Vehicle Telematics Devices

One or more of the following documents will provide a basis for the design guidelines (to be discussed and decided).

1. European Statement of Principles (ESOP)
2. AAM principles
3. AAM or ESOP
4. Revised principles (i.e., best of principles from JAMA, AAM, ESOP)
5. Some other principles or new principles.

Safety Management Systems (SMS) at TC

- An emerging approach in TC across all modes of transport is to require that industry, where appropriate, adopt SMS.

- SMS is a set of principles and procedures for the allocation of resources for managing risks. It includes safety goals and performance targets; risk assessments; clear responsibilities and authorities; rules and procedures; and, monitoring and evaluation processes.

- With SMS, the regulator provides the overarching framework, which includes legislation, regulations and programs (e.g. education, audit, inspection, enforcement, etc.)

- This is consistent with evolving management tools that are being promoted by the central government agencies, and within TC.

- This is also consistent with “smart regulations” initiative underway in the federal government.

MOU Part 2: Recommended Safety Design Process for Limiting Driver Distraction

Process concept – not prescribed steps but rather:

- the organizational requirements to ensure manufacturers have the capacity to successfully integrate human factors input into their design and development process.
- comprehensive, systematic and traceable application of human factors considerations throughout the product development cycle.

Scope

- applies to manufacturers of in-vehicle telematics devices, software, functions, interfaces and services and addresses the development and integration of such elements to the extent that these affect human-machine interaction while driving.

General requirements

- Establish, maintain and apply a human factors process to optimize the safety of driver-system interaction and minimize the risks of driver distraction
- Appoint a manager for this process:
  - with the authority to ensure human factors is incorporated in the design and development of telematics devices.
  - to set the requirements criteria for safe driver-system interaction.
  - to assess compliance with these criteria, and to ensure that the manufacturer is made aware of any non-compliance and is given guidance as to how to achieve compliance.
  - to use professional judgement to determine the state of compliance based on the evidence gathered during the design, development and testing of the telematics device.
  - to document actions taken to reduce the risks of driver distraction

General requirements…continued

- Development activities shall be assigned to qualified personnel equipped with adequate resources

- The design personnel must include persons possessing core competencies in human factors and ergonomics and these personnel should become involved at the project's inception.

- The manufacturer shall periodically review its policy and procedures for their safety design process and records of these reviews shall be maintained.

Another possible requirement

- Manufacturer shall conduct post-market surveillance to track the performance of their products in the field.

SAVE-IT Adaptation Strategies

LEVEL OF AUTOMATION	DRIVING-RELATED STRATEGIES		NON-DRIVING-RELATED STRATEGIES	
	System Initiated	Driver Initiated	System Initiated	Driver Initiated
High	*Intervening*	*Delegating*	*Locking & Interrupting*	*Controls Pre-setting*
Moderate	*Warning*	*Warning Tailoring*	*Prioritizing & Filtering*	*Place-keeping*
Low	*Informing*	*Perception Augmenting*	*Advising*	*Demand Minimizing*

Donmez et al., (2004 SAVE-IT Task 4 Literature Review)

Considerations for Adaptive HMI: Automation and Behavioural Adaptation

- General human factors concerns about automation must be considered (e.g., use, misuse, disuse, abuse).
- Would a good HMI need to be adaptive? Adaptivity could be used as a crutch for bad HMI.
- A high level of reliability is crucial to initiate automation/adaptation
- Valid standard evaluation procedures are essential - avoiding the safety criteria question will put that decision entirely in the hands of policy makers.
- Intensive testing is required for complex systems (i.e., multiple, repeated and long term).
- It is easy to get it wrong to the extent that an adaptive system increases workload by confusing the driver.

Considerations for Adaptive HMI: Automation and Behavioural Adaptation

- Salience of adaptation is crucial (transparency, invisible, fast appropriate feedback)
- Timing/ activation criteria and duration of adaptations (hysteresis)
- Adaptivity should be intuitive, consistent and logical/ predicable (rule-based versus intelligent agents)
- Conflict between driver as an adaptive system and vehicle as adaptive system

Considerations for Adaptive HMI: User Needs

- What demand is there for adaptive driver interfaces?
  - x Drivers have indicated a strong desire for this
  - ✓ Designers/ researchers think it's a good idea
  - ✓ Emerging scientific and technical ability to adapt interfaces
  - ✓ Need to compensate for the problems created by the other new in-vehicle technologies
- Nothing is more important than user testing. This must be performed and the results must be integrated into the design.
- Problems of personalization/ customization
  - Increases complexity for adjustments/ customization,
  - Decreases standardisation,
  - People don't always know what is best for them.
- Standardisation versus Market Competition

Development of the Driver Advocate
by Mike Gardner (MOTOROLA)

AIDE User Forum Workshop

"Development of the Driver Advocate™"

Robert "Mike" Gardner
Director Intelligent Systems Research Laboratory
Fellow of Technical Staff
Motorola Corporate

Mar 15-16, 2005

Embedded Video:
Humorous video of a carried-in distraction

Our Agenda

- Review Driver Distraction
- Review Potential Solutions
- Report on:
  - Motorola's Driver Advocate
  - Key R&D issues
  - Seamless Mobility

Competition for Drivers Attention

Distraction: Broad & Complex Issues

Examples of Distraction Types:

- Visual
  - Eyes on the road?
  - Example: Looking at a dashboard display while driving.
- Psychomotor
  - Hands on the wheel?
  - Examples: Tuning radio, adjusting the heating and air conditioning system, drinking coffee.
- Auditory
  - Unable to perceive traffic and vehicle sounds; diversion
  - Examples: Children screaming in back seat, radio too loud
- Cognitive
  - Mind on the drive?
  - Example: Preoccupied with thoughts or a conversation
  - “Driver Overload”, “Cognitive Capture”, “Inattention Blindness”

A Cognitive Example:

Embedded Video:
Audience participation exercise demonstrating visual blocking

The Crash Literature key points:

- There are crashes in which telematics are a contributing factor.
- In crashes where telematics use is a contributing factor, drivers become so engrossed in the in-vehicle task that they lose sight of the driving task.
  - Drivers need to look at the device a great deal of the time to use it
  - The act of thinking about the task changes driving scanning patterns
  - Completing the task is compelling resulting in momentary overload

Green (2004)

Driver Distraction Sources and Impact

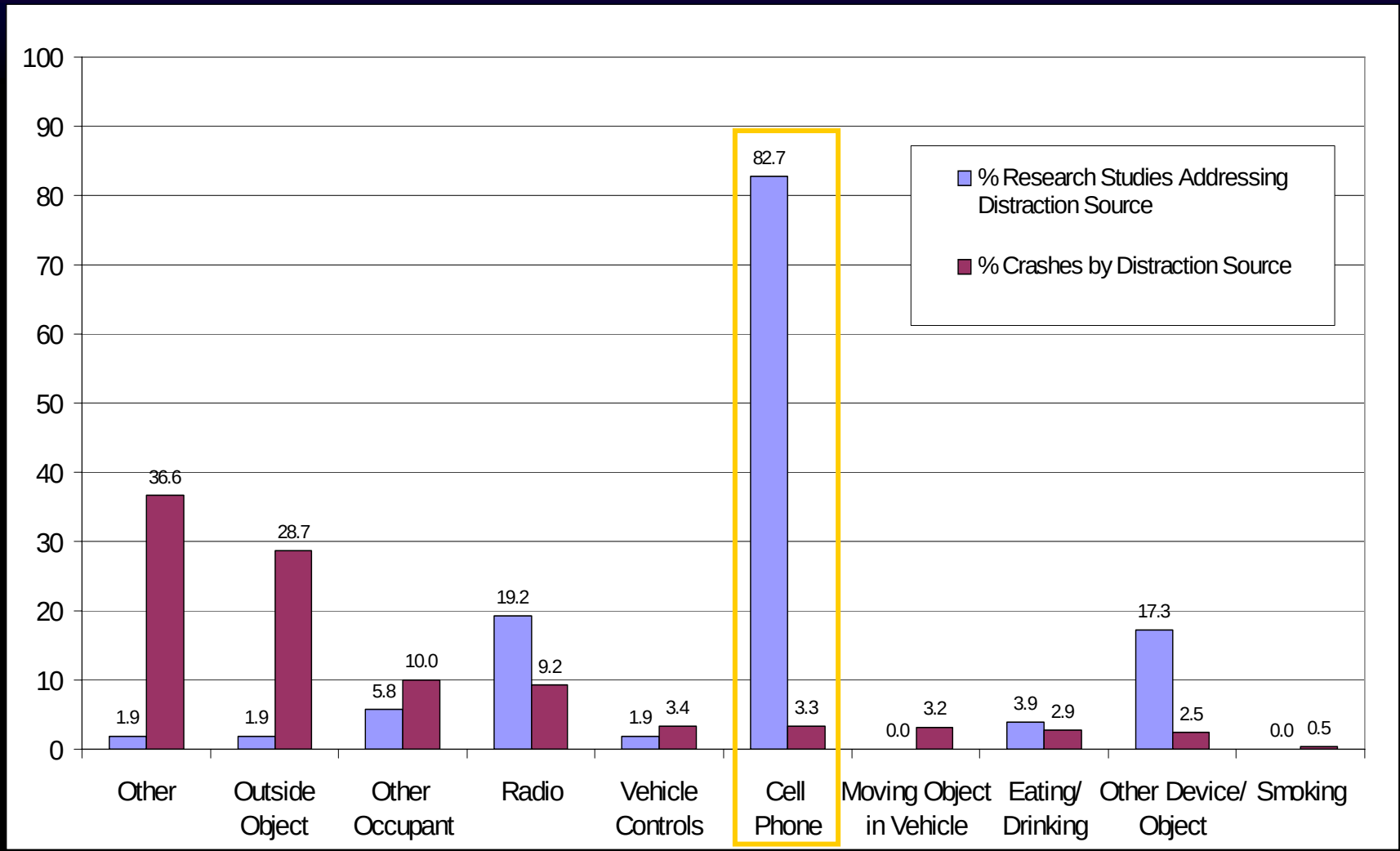
Source of Distraction	*% Occurrence*
Outside person, object, or event	30%
Adjusting radio/cassette/CD	11%
Other occupant	11%
Moving object in vehicle	4%
Other device/object	3%
Adjusting vehicle/climate controls	3%
Eating and/or drinking	2%
Using/dialing cell phone	2%
Smoking related	1%
Other distractions	27%
Unknown distraction	9%

Stutts et al. (2003)

% Occurrence	*Source of Distraction*
16%	Looking at crash, vehicle, roadside incident, or traffic
12%	Driver fatigue
10%	Looking at scenery or landmarks
9%	Passenger or child distraction
7%	Adjusting radio or changing CD or tape
5%	Cell phone
5%	Eyes not on road
4%	Not paying attention, day dreaming
4%	Eating or drinking
4%	Adjusting vehicle controls
2%	Weather conditions
2%	Unknown
2%	Insect, animal, or object entering or striking vehicle

Glaze and Ellis (2003)

Prevalence of Research on Each Source of Driver Distraction

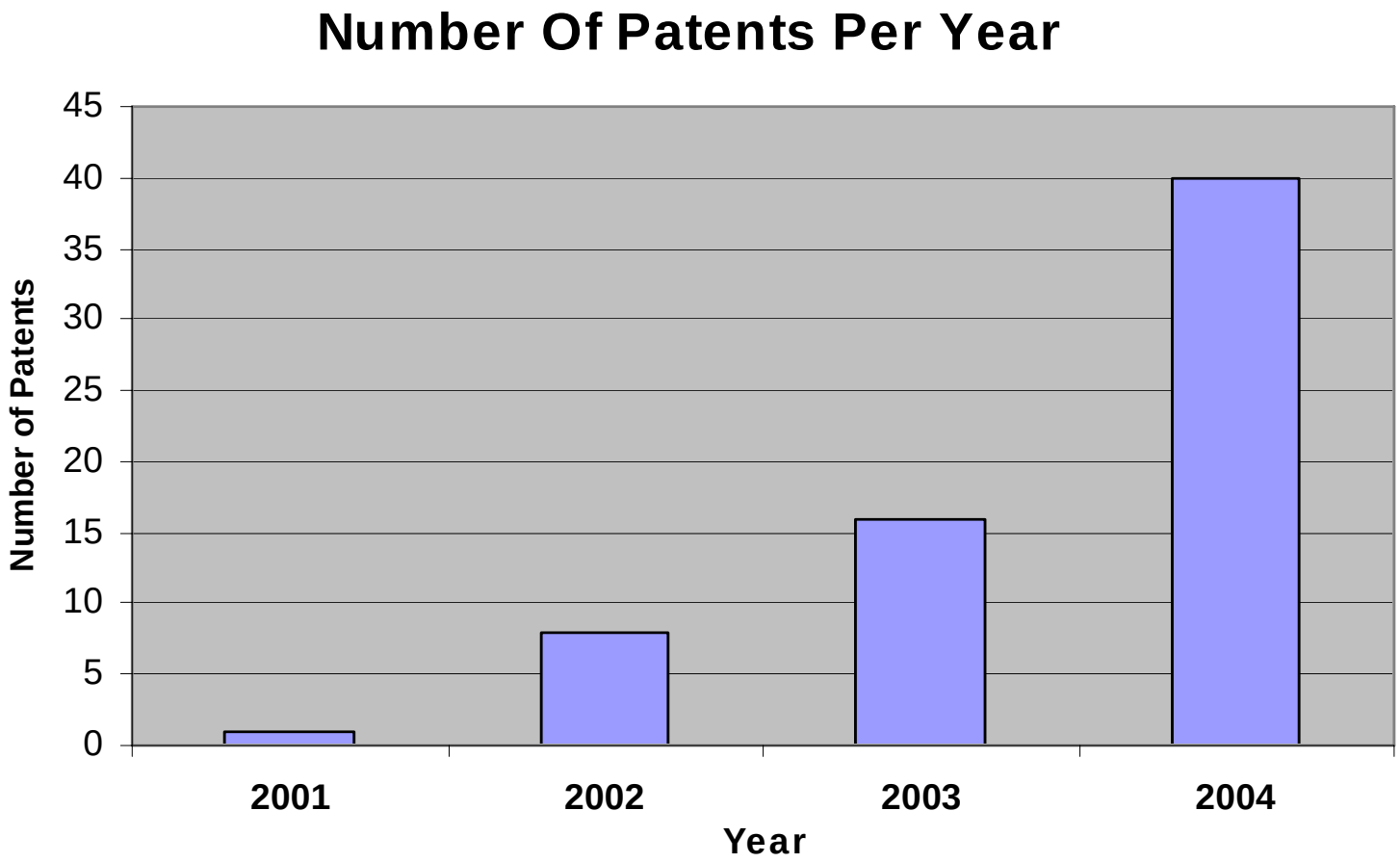


Schreiner & Gardner (2004)

Our Agenda

- Review Driver Distraction
- Review Potential Solutions
- Report on:
  - Motorola's Driver Advocate
  - Key R&D issues
  - Seamless Mobility

Creative solutions are being proposed



Massey & Gardner (2004)

Typical Approach – Embedded in a Vehicle

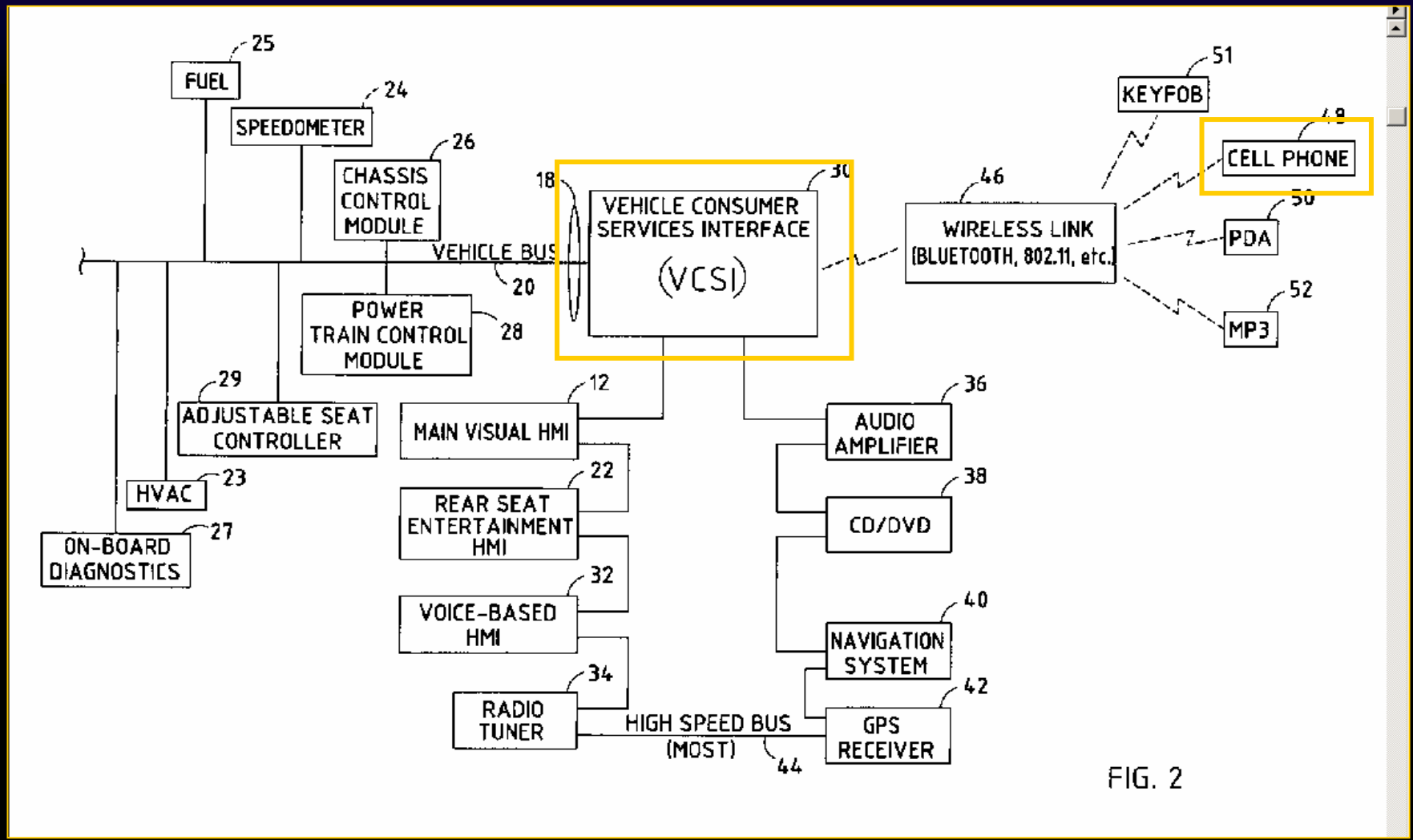


FIG. 2

Workload Manager

SAVE-IT Integrates Information to Manage Driver Workload
Volpe National Transportation Systems Center (2004)

- An intelligent system that alters the availability and HMI of telematics, infotainment, and vehicle warning systems based on an estimation of driver distraction or overload.

- It typically is a reasoning system composed of:
  - Context Recognizer
  - Workload Estimator
  - Policy Manager
  - Dialog Controller

Workload Manager Types

Type	Example Factors	Advantages	Disadvantages
Situation	Situation Traffic, road width, curvature, visibility, time of day, coefficient of friction, path (turning), headway, posted speed	Road segments can be connected to crash data Data for crash analysis is a well-developed civil egr practice	Collection of crash data by segment is not easy Low number of crashes in some situations Requires navigation system for road data, traction control for friction
Driver Input	Steering wheel angle, throttle angle	Data is often easy to obtain	Easiest for electronic steering and braking Alone, it is not sufficient to predict workload
Vehicle Response or Performance	Speed, lane position, acceleration	Speed is easy to obtain	Lane position requires lane tracker, not widely available Good predictions use lateral acceleration (added sensor)
Driver State	Heart rate, direction of gaze	Gaze direction is best indicator of distraction	All driver state measures require special, non-shared sensors

Current Industry Situation for Workload Managers

Organization	Status	Implementation Likely?
Bosch-BMW	Working with BMW on research (SANTOS project)	Yes
Delphi	Working on SAVE-IT; Looking at many measures; ISS test vehicle	Yes
DaimlerChrysler	R&D in Germany	Yes
Ford	S40 and V40 in Europe have dialog managers; Some research on distraction in its simulator in Dearborn	??
Fiat	CRF involved in several EU projects on workload over many years	Yes
GM	Internal effort related to GMability project; Saab 9-3, 9-5 have dialog managers	Yes
Motorola	Conducting internal research at Motorola labs for several years; Plans for several generations of interfaces; Demo'd 1st generation with DaimlerChrysler	Yes
Nissan	InfoMan project with U of Michigan and others	Yes
Renault	Involved in several EU project on workload over many years	Yes
Toyota	Carrying out R&D in Japan	Yes
Visteon	Had plans for an effort, now inactive	No
Volvo Truck	Pursuing research for Volvo cars (Ford) and Volvo/Mack/Renault trucks Interested in eye fixations; First product on market (S40, V40)	Yes
Yazaki	No effort	No

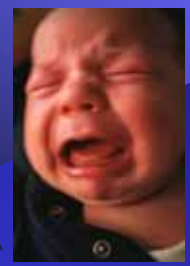
Unknown: Daihatsu, Denso, Honda, Hyundai, Johnson Controls, Lear, Magna, Mazda, Mitsubishi, Subaru-Isuzu, United Tech, VW-Porssche-Audi

Green (2004)

Our Agenda

- Review Driver Distraction
- Review Potential Solutions
- Report on:
  - Motorola's Driver Advocate
  - Key R&D issues
  - Seamless Mobility

Driver Advocate

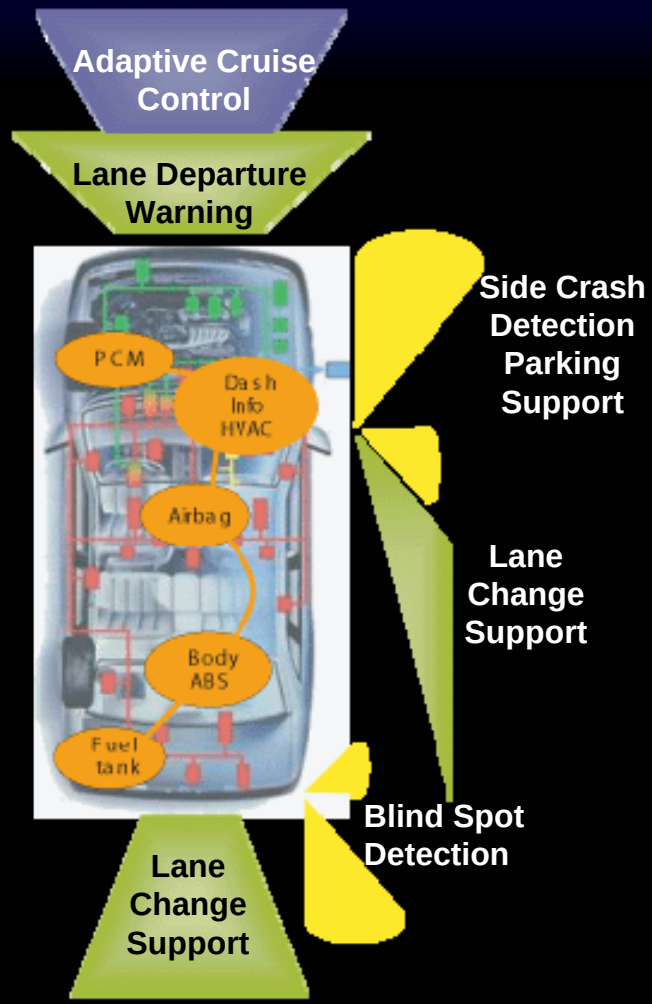


Consolidate the Human Interface

The **right** information
at the **right** time
delivered the **right** way

Driver Advocate

- A driver assistance system, in four generations, that prioritizes and adapts the presentation of information to the driver, relative to the driving situation and, ultimately, to the driver's workload.



Motorola's Approach

- First do no harm
  - Design a system that will turn itself off gracefully if there is a sensor, sw, or hw failure
  - Design a system that will not interfere with the basic functioning of the vehicle
  - Do not take control of the vehicle
- Do what we can safely do... now
- Don't wait until driver modeling is sufficiently developed and tested as a basis for workload management

Goals of the System

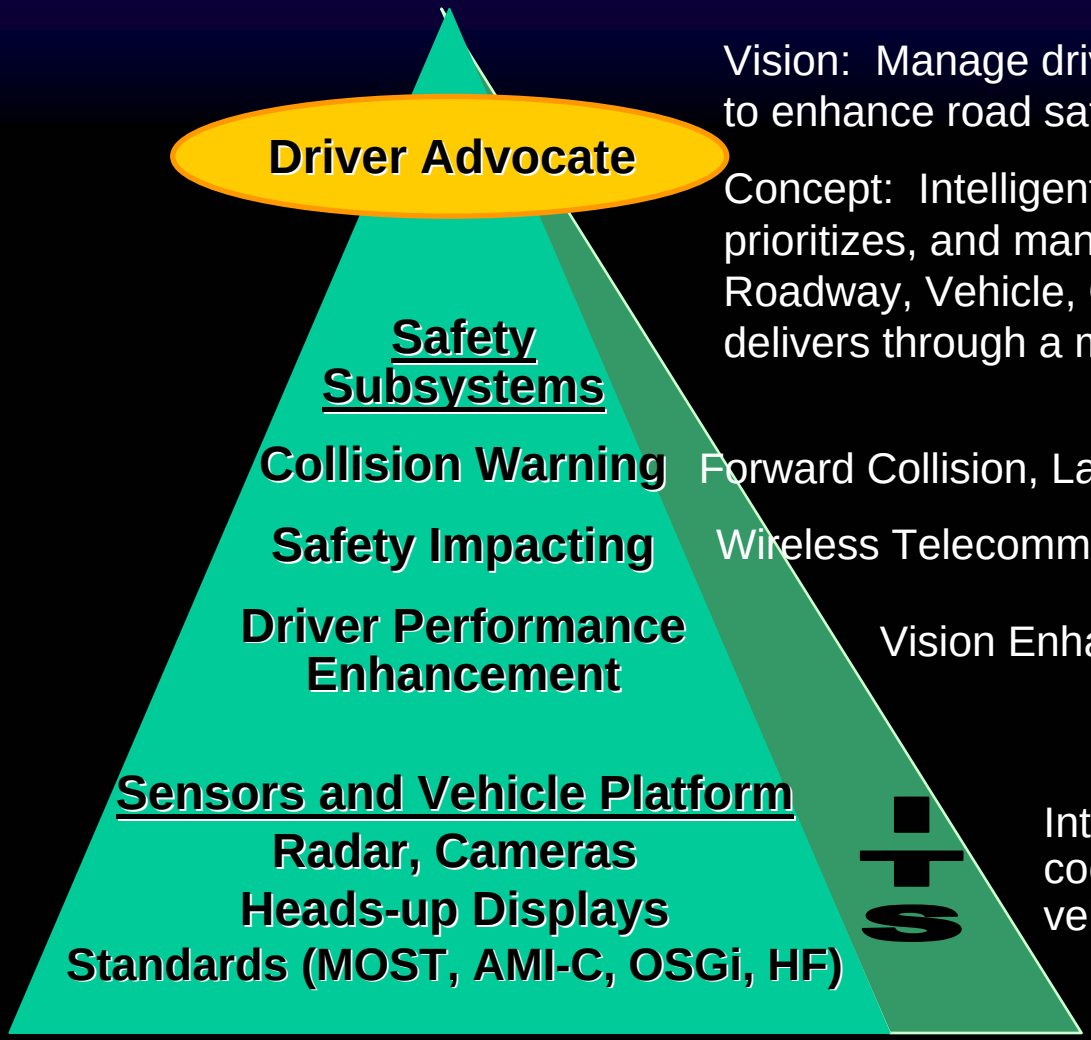
- Generation One:
  - Mitigate driver distraction by
    - Presenting information one-at-a-time
    - Using existing data on the vehicle to draw inferences about workload and to use those inferences to orchestrate the prioritization and presentation of information to the driver
- Generation Two:
  - Enhance the effectiveness of collision warning and other driver assistance systems
  - Empower consumer Seamless Mobility
- Generation Three:
  - Improve the effectiveness and user acceptance of the first two generations by personalizing Driver Advocate™to the needs, preferences, and habits of individual drivers.
- Generation Four:
  - Manage the hand-off to autonomous vehicle control features.

Gen One Prototype

- Demonstrating:
  - Maneuver identification and classification
  - A Three-Button-Interface—to handle incoming wireless, navigation and vehicle condition information
  - Handling an incoming cell phone call
  - Retrieving and saving voice mail messages
  - Integration with our ViaMoto navigation-on-a-phone into the system

Motorola “One-at-a-Time” Workload Manager (2004)

Intelligent System Technology Pyramid



Vision: Manage driving and non-driving information to enhance road safety

Concept: Intelligent system controller integrates, prioritizes, and manages information from the Roadway, Vehicle, Cockpit, Driver, Infotainment and delivers through a multimodal user interface.

Forward Collision, Lane/Roadway Departure, Intersection

Wireless Telecomm, Infotainment, Adaptive Cruise Ctrl

Vision Enhance, Impairment Monitoring

Intelligent Transportation Systems: cooperative, interactive systems vehicle-roadway & vehicle-vehicle

Generation Two and Three Simulator Prototypes

- Collect perfect perceptions
  - Driving Performance
  - Driver Behavior
  - Roadway and Traffic
- Simulate technologies
  - ADAS Behavioral Models
  - Infotainment Applications
  - HMI Strategies & Modalities
  - Software Architectures
- Controlled Experimentation
  - Repeatable
  - Complete observability
  - Safe

Embedded Video: Subject testing of a telematics function within Motorola's driving simulator

Motorola Driving Simulator(2004)

Generation Two and Three Experience

Embedded Video:
Demonstration of Driver Advocate generation 1 and 2 within Motorola's driving simulator as seen through the eyes of a news reporter:

-Real time navigation
-DSRC vehicle-to-vehicle and vehicle-to roadway communication
-Driver Email based on driving situation
-Forward collision and safe distance following.
-Lane tracking and departure
-Side and rear object detection
-Speech recognition, TTS and earcons.
-High heads-up see-through display, high heads down display, and visual safety cocoon
-Rumble seat
-Eye tracking
-Driving and driver context recognition
-Driver workload, Prioritization of Applications/messages, and escalation of warnings
-Fast software prototyping environment
-Modular and distributable architecture
-Multivariate data collection, semi-automated annotation, and advanced data mining

KPHO Channel 12 News (2003)

Intelligent System Simulation Advancements

- New Technologies:
  - Hypervariant HF Methodology
    - "Naturalistic" driving experience
    - Advanced data mining technology
  - Semi-automated Data Annotation
    - 10x faster, 2x accuracy, 120% insights
  - Automated Hypothesis Generation
  - Driving and Driver Modeling Algorithms
  - Rapid software prototyping environment
- Beneficial Results:
  - Data rather than Expert opinions
  - Reduced cycle times to broader insight
  - Quantification of
    - Theoretical performance limits
    - Optimal subsystem choices given economic price points
    - Driving performance impact
  - System Performance Specs and Architecture Design

Understanding the meaning…

…is knowing HOW to look.

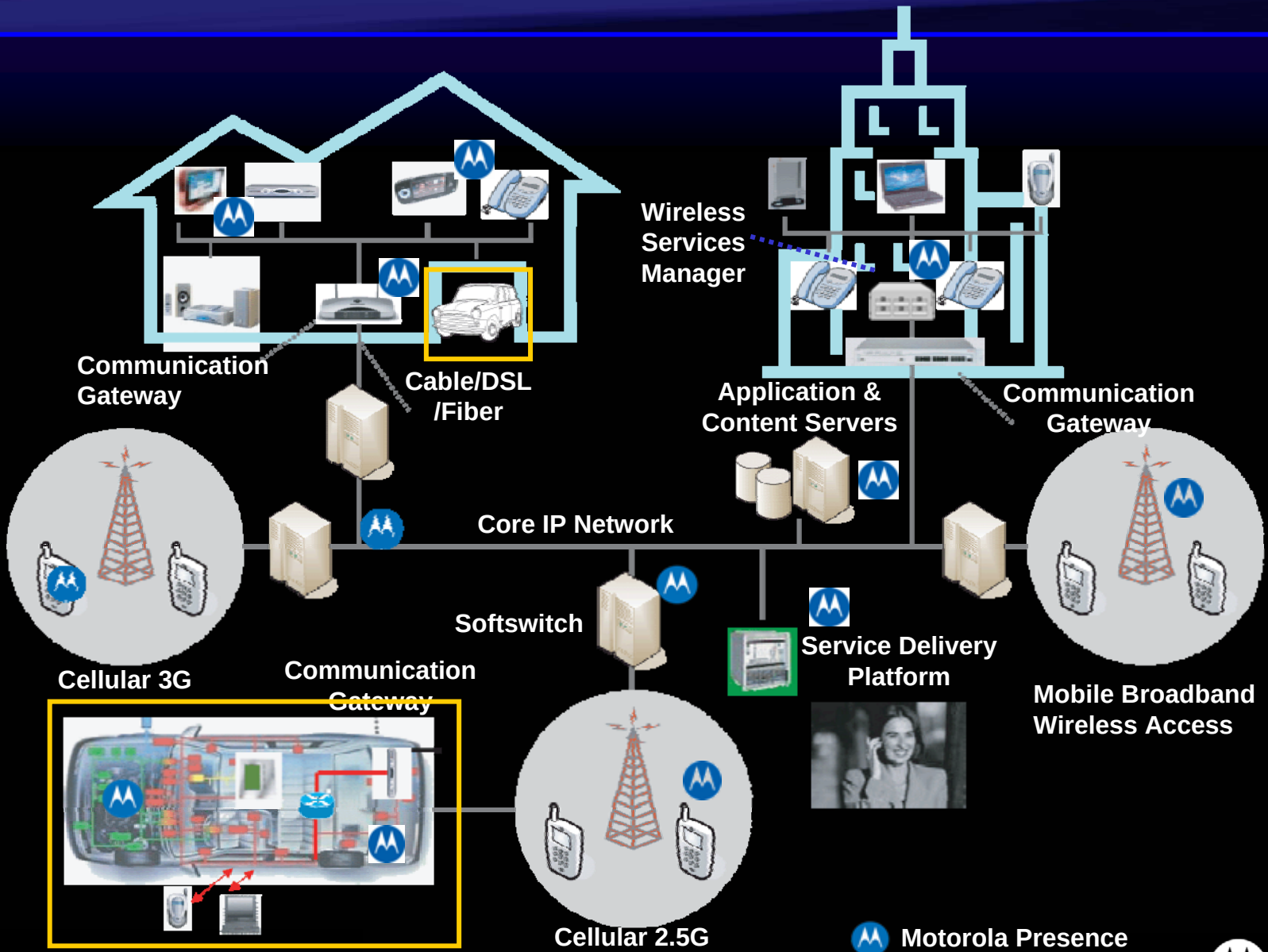
Seamless Mobility - The future of Communications

- **User centric content** - device and context sensitive driven by affordable, available broadband
- **Applications explode** – digitization of everything at the edge of the network
- **Privacy, safety and security** – critical for content that is purchased and created
- **Full mobility** – across heterogeneous networks
- **Always on, always here** – sessions that cross networks and devices, seamlessly

Example: Video Conferencing Everywhere?

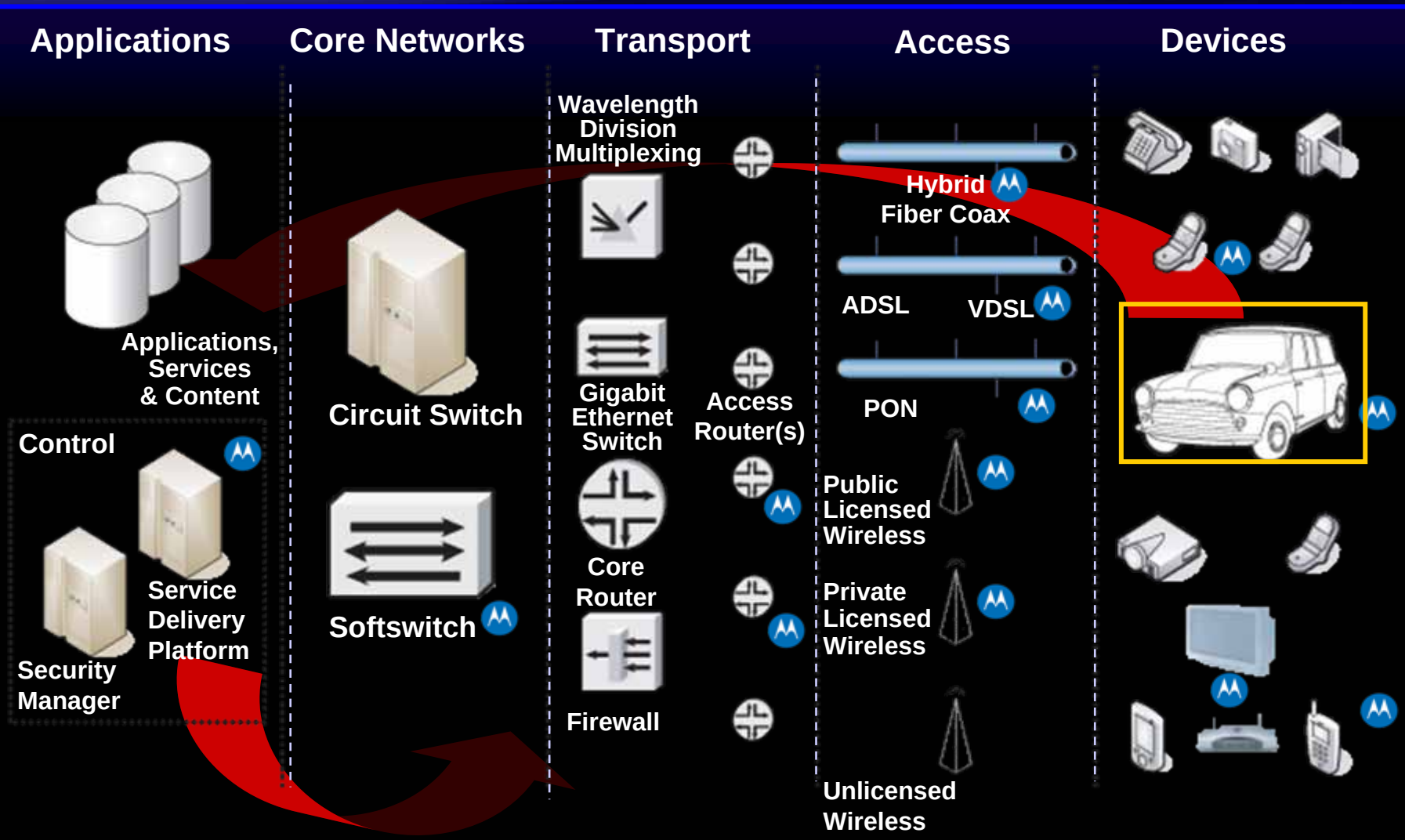
Consumer Electronics Show – Panasonic (2005)

Seamless Mobility: the Car is Connected



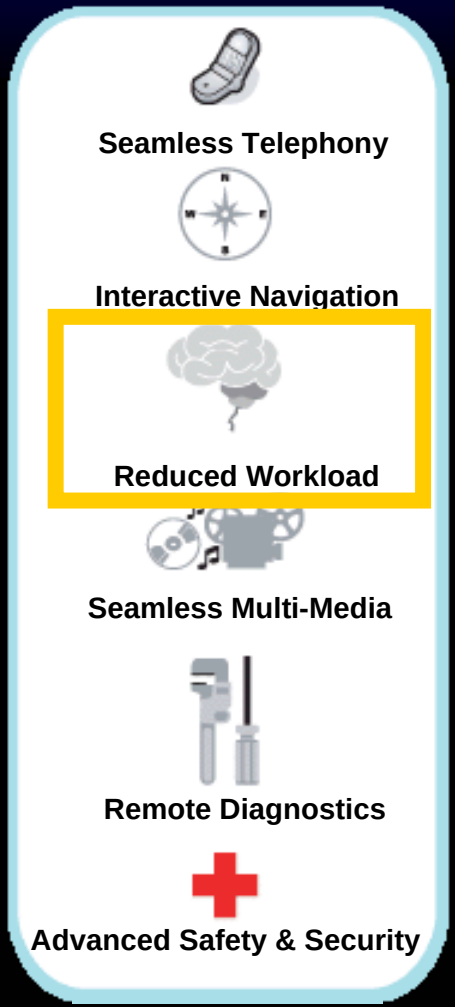
Motorola Presence

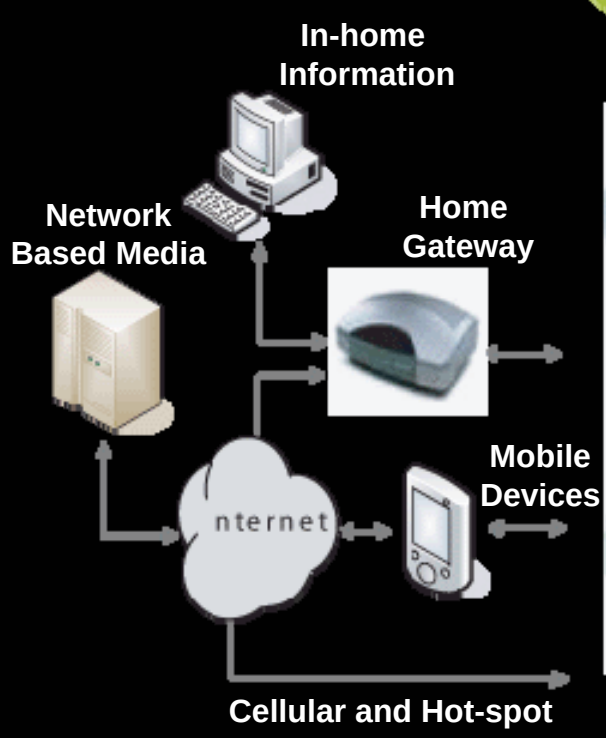
Seamless Mobility: The Car is But Another Device

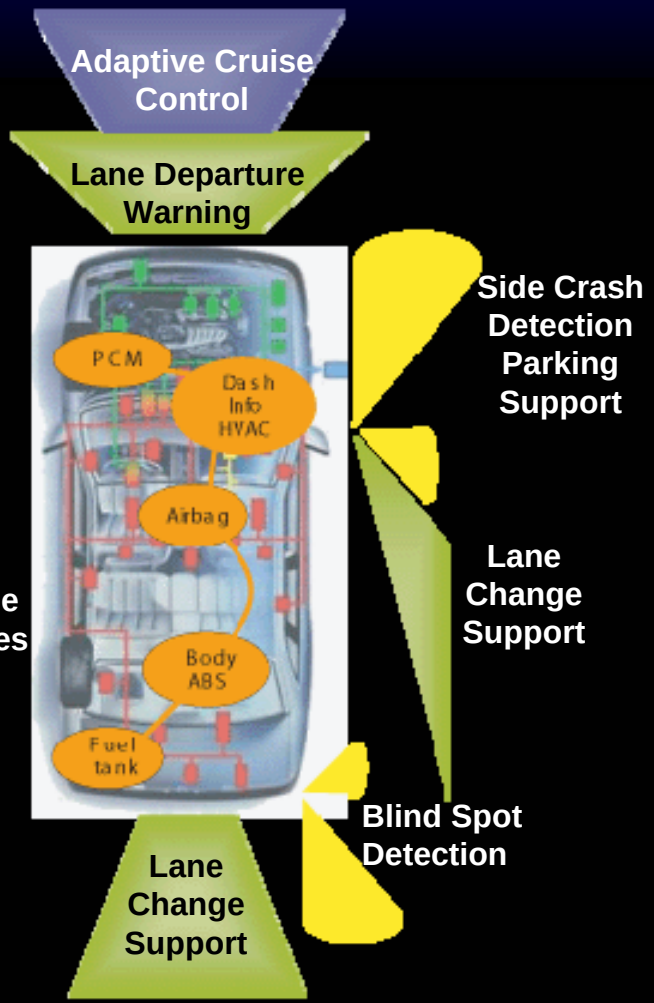


Motorola Leadership

Seamless Mobility Technology - Addresses Distraction Issues







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References

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AIDE User Forum Workshop

"Development of the Driver Advocate"

Thank You

Robert "Mike" Gardner
Director Intelligent Systems Research Laboratory
Fellow of Technical Staff
Motorola Corporate

Mar 15-16, 2005

Measures of Driver Distraction

- Eye glances
  - Where the driver was looking while performing the task
  - Examples: Number of glances toward device or toward the roadway, length of glance
- Braking behavior
  - How the driver used the vehicle brake either while driving normally or during a critical event
  - Examples: Brake response time, maximum brake pressure, time to stop, stopping distance
- Accelerator behavior
  - How the driver used the vehicle brake either while driving normally or during a critical event
  - Examples: Accelerator release time, accelerator pressure
- Headway
  - Normally used in a car following task, describes driver's car following behavior
  - Examples: Mean headway, headway variance
- Speed
  - Measures of vehicle speed and speed maintenance
  - Examples: Mean speed, speed variance, number of speed violations
- Lane position
  - Measures of how well driver stays in lane
  - Examples: Lane position variance, lane exceedences
- Steering behavior
  - Another set of measures describing how well driver stays in lane, also used occasionally in critical incident scenarios (swerving to avoid object)
  - Examples: Steering entropy, steering variance

Measures of Distraction (2 of 2)

- Time to collision
  - Time before the driver, traveling at the current speed, would strike a particular object, normally a lead vehicle
- Collisions
  - Number of instances driver strikes another vehicle or object, used in simulator experiments or in crash database studies
- Gap acceptance
  - The amount of space (normally in measure of seconds) at which a driver will choose to turn left when there is opposing traffic
- Physiological
  - Measures of the biological functioning of the driver
  - Examples: Heart rate, EEG, skin conductivity
- Subjective workload
  - The driver's own rating of the difficulty of the task, their performance on the task, or their driving performance
- Secondary task performance
  - How well the driver carried out the in-vehicle task of interest
  - Examples: Task time, number of errors
- Object/event detection
  - An additional task in some experiments in which driver has to make a response when a specific event occurs or when they see a specific object
  - Examples: Response time, number of missed events
- Primary task performance (non-driving)
  - For experiments in which the main task is not driving (e.g. a pursuit tracking task), these measures describe their performance on the main task

Round Table discussion presentation

AIDE User Forum Workshop

14:30-16:00 **Round Table Discussion**

"Roadmap towards the future of automotive HMI, taking into account the complex automotive environment which includes ADAS, IVICS, Nomad Devices and cooperative environment."

Chair:

Angelos Amditis AIDE DM

Participants:

Engström Johan, AIDE

Wolfang Hofs, EC/IST

Friedemann Kuhn, EUCAR SGI

Winfried Koenig, CLEPA

Peter Burns, Transport Canada

Procedure

1. Every participant will make a short opening statement
2. An open discussion will follow between the participants of the round table but also between the panelists and the audience through questions and answers.
3. The Chair will give the speech both to the panelists and the audience for questions and answers.

ROUND TABLE DISCUSSION

Topics/Questions

1. What is, in your view, the key features of a future adaptive integrated driver-vehicle interface? Does the HMI need to be adaptive and/or integrated at all?
2. What are the key human-factors-related issues associated with future automitve HMIs?
3. What are the main driving forces in this field?
4. What types of HMI personalisation are desirable/feasible?
5. To what extent is standardisation possible in the HMI area? Which features could be subject to standardisation?
6. What will be the effect of the increasing use of nomadic devices in the vehicle? To what extent is it feasible to integrate them in a safe, reliable and effective way with the in-vehicle HMI?
7. What are the key HMI issues with respect to cooperative systems?

Nomad Forum workshop
Chair: Patric Robertson

NOMADIC DEVICE WORKSHOP – INTEGRATION ISSUES

Patrick Robertson

Global Software Group, Motorola

Scotland

Summary

- Overview of 1st European Nomadic Devices Workshop
- Overview of eSafety HMI recommendations
- Summary of Integration areas (areas + potential solutions)
- *Discussion (of integration areas)*

1st European Nomadic Device Forum summary

Overview of the first nomadic device forum.

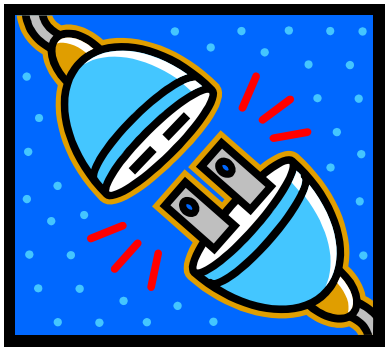
overview of the presentations

overview of the workshops and any outcomes/findings

Recommendations from the eSafety-HMI working group

Summarise the recommendations - focussing on the nomad devices recommendations.

Nomad Devices : Integration Areas



What do we mean by Integration?

•Covers a number of integration areas-

- **Physical** – Where will it be mounted? What if there is more than one device? Devices are not all the same physical shape!
- **Electrical** – If there is a physical mount, will it be wired for electrical, and communications? (for recharging, and communication with the car systems)
- **Communication** – How will the nomad devices communicate with the car systems? (wired? Bluetooth? Wifi?)
- **Protocols -** what communication standards will it use?

Nomad Devices : Integration Areas

Other integration areas for consideration-

- **Control -** What level of control/management is required of the device (from the vehicle and/or nomad device)?
- **Security** – System implemented must be secure.
- **Safety –** The solution requires to be safe, and meet any legislation requirements (this may be multiple requirements in different countries)
- …

Towards a Solution – Current SoA

Some of these integration areas are seeing solutions and standards being applied-

- **Communication**
  - Bluetooth – fast becoming *the* standard for short range communication for nomad devices
  - Wifi - increasing in popularity – especially in PDAs. Some mobile phones with this facility now appearing.
- **Protocols**
  - Bluetooth - profiles
  - AMI-C (Automotive Multimedia Interface Collaboration) – Standardisation of mobile information and entertainment systems [*nomad devices]* for vehicle communication systems. Protocol definition part of this collaboration standardising communications (Issue with these standards is the limited take up by manufacturers?)

Towards a Solution – Current SoA (cont)

- **Electrical/Physical**
  - Some factory-fit options are available for specific devices (manufacturers, devices – e.g. BMW & iPOD). Typically limited to mobile phones.
  - After-market options - often “ad-hoc” consumer fit – and integration really just means a “sucker” holder!
  - AMI-C has standards and definition of electrical/physical connections in place
  - CEA has a MOST standard (CEA-2012) defining the requirements for implementing an Aftermarket Network based on the Media Oriented Systems Transport (MOST®) standard. This can be used independent of any vehicle network, or connected to a factory-installed network with a gateway function.

Towards a Solution

Standardisation?

- Can standardisation cure these issues?
  - AMI-C seems like a potential solution (protocols, electrical, physical standards for Nomad devices) **BUT**
    - Unclear what the take up is of these standards.
    - Is it dead?
  - MOST Gateway function - is this the new way ahead?

- Does the industry really want standardisation in this area? (if its standardised, then where is the USP?)

INTEGRATION ISSUES - PHYSICAL

Discussion points (not limited to the following)

Is it required?

Who is responsible? (eSafety)

INTEGRATION ISSUES - ELECTRICAL

Is it required? (for power)

INTEGRATION ISSUES – COMMS

Bluetooth? Wired? Wifi? MOST Standard

INTEGRATION ISSUES - PROTOCOL

AMI-C?

BLUETOOTH PROFILE?

BESPOKE?

INTEGRATION ISSUES - OTHER

Issues with multiple devices?

Aftermarket v's factory-fit

Thank You

Patrick Robertson

Software Architect Manager

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AIDE architectural concepts
Chair: Holger Kussmann (BOSCH)

Behavioural Adaptation and modelling session
Chair: Farida Saad (INRETS)

Behavioural Adaptation to driver support systems

Farida Saad

Overview

- What is Behavioural Adaptation?
- What are the main results of research studies dealing with BA to new driver support systems?

  Variability and diversity of road situations

  Diversity of the driver population
- What are the needs for future research?
- How can we account for BA in the design and assessment processes of new driver support systems?
- Research activities in the AIDE project

Main Objectives

To Identify the main classes of problems for studying behavioural adaptation induced by different driver support systems

To highlight the issues to be considered prior to planning new studies within the AIDE project

To identify the most relevant parameters and variables that affect driver behaviour for modelling purposes

New systems and behavioural changes

New sources of information and/or new modes of action regulation

Modifications of the conditions in which the driving task is currently performed and as a result changes in drivers activity can be expected within:

- The activity of the « assisted » drivers
- Their interactions with other road users
- The overall traffic conditions

It is important to specify the nature and extent of the changes at these different levels

Behavioural Adaptation in Road safety research

"Unexpected" behavioural changes in response to changes in the road system which may Jeopardize the "expected" safety benefits

- BA may appear at different levels of the driving task
- BA may take more or less time to appear

The factors likely to explain it and the processes underlying its occurrence (in time and space) and magnitude are not yet clearly established

Various models are referred to for studying BA: influence of cognitive and motivational processes on the occurrence, direction and magnitude of behavioural changes (models of drivers' risk control for instance)

Behavioural Adaptation

Several variables likely to induce the occurrence of a BA, such as :

- The drivers' perception of the change introduced in the traffic system : does the change directly influence the way the driving task is performed, does the change alter the drivers' subjective safety ?
- The degree of freedom that the change allows drivers : is there any opportunity for drivers to change their behaviour ?
- The presence of competitive motives for changing behaviour, and so on

Behavioural Adaptation

Main concerns

- Adequacy of drivers' mental models of the assistance provided : range and limits of the support system competence
- Trust and trust "calibration" for an optimal use of the system
- Drivers' allocation of attention
- Drivers workload : increase or decrease
- Trade-off between mobility and safety

Behavioural Adaptation in AIDE

A larger definition

- Any behavioural changes in response to new conditions
- The consequences as regards safety could be either positive, neutral or negative
- More potentially relevant behavioural changes associated with the use of the support systems
- To find out how behavioural changes evolve through training and experience

Studying Behavioural Adaptation

Studying the integration of a new aid into driving activity and identifying behavioural changes entails:

- Taking account of the essential dimensions of the road environment in which that activity takes place (nature of the interactions at work, regulatory, structural and dynamic constraints, etc.)
- Choosing functional units of analysis making it possible to examine not only the aid's impact on the performance of the specific task to which it is dedicated but also its compatibility with the performance of other driving tasks
- Selecting the relevant indicators for revealing the changes likely to take place in drivers activity

These issues make direct demands on knowledge of the driving task and of the psychological mechanisms that govern drivers' activity

Research studies

- Impact of various individual support systems such as Collision Avoidance System, Speed Limiters or Adaptive Cruise Control

- Studied either in a controlled context (driving simulator) and/or in the complexity of real driving situations

- Most of the research : Short or medium term studies

- Learning process : very few studies

The diversity of behavioural changes

Adaptive cruise control

- Speed, safety margins, lateral control of the vehicle
- Lane occupancy, frequency of lane change manoeuvres

Intelligent Speed Adaptation

- Speed, safety margins
- Interactions with other road users

The results obtained are sometimes contradictory, sometimes similar

Observed diversity may be due to

- The functional characteristics of the support systems studied
- The methods used, the type and number of variables selected for assessing the impact of the system, and finally the (implicit or explicit) model governing their choice

The importance of the situational context and the collective dimension of driving

Influence of the overall traffic conditions and of the characteristics of the road infrastructure on :

- The decision to use the support systems
- The magnitude of the behavioural changes observed when using them

Use of the support system and interactions with other road users

- Deviations from their usual strategies
- Interpretation of their behaviour by others
- Impact on other interaction situations

The importance of the situational context and the collective dimension of driving

Diversity and variability of road situations

Circumstantial requirements of driving assistance

- The dynamics of various road situations
- The drivers' motives, objectives and intentions

A multi-level approach is needed

- The activity of "assisted" drivers
- Their interactions with other road users

The differential impact of driver support systems

Diversity of the driver population

"Driving style"

A relatively stable characteristic of the driver, which typifies his/her personal way of driving, the way he/she chooses to driver

- The overall frequency of system usage
- The magnitude of some behavioural changes when using the system
- The level of acceptance of the system

" Locus of Control" and "Sensation Seeking"

Individual characteristics that are assumed to more or less directly influence the occurrence of behavioural adaptation either through

- A general tendency for "risk compensation" (for "High sensation seekers")
- A propensity to manifest "over-reliance" in automation (for "External LOC")

Such individual characteristics seems to *amplify* some behavioural changes

The relationship between these general individual traits and other individual characteristics such as "driving style" are not quite clear and should be clarified

Further research on Behavioural Adaptation

To clarify the underlying models and structuring the results

Models governing the choice of variables and parameters as well as the interpretation of the results

Models for structuring the results with respect to design and safety assessment requirements

Models for predicting behavioural effects of new driver support systems

Interacting Variables and BA

Many interacting variables may account for behavioural adaptations and their links has to be more precisely established. For example :

Links between mental workload and driver ability to reclaim control

Links between mental models of the support system, trust in the system and behavioural changes

Further research on Behavioural Adaptation

Sharing the control with new driver support system (s)

Understanding how drivers learn to share the control of their driving with new support systems, in order to perform the overall driving task efficiently and safely

Studying the learning process

The learning process is crucial for helping drivers to built appropriate representation of the assistance afforded by the support system and for “calibrating” their trust in it

Research in this area should provide useful information for designing « self-explaining » support systems and for providing the drivers with support likely to facilitate the learning process

Studying long term effects

Research activities within the AIDE Project

Studying short and long term behavioural adaptations to driver various driver support systems

Defining the layout of a models of driver behaviour that support the design and development of integrated tools and interface

Studying the issues of the circumstantial and temporal management of the assistance provided by various systems in the driving process

The circumstantial conditions

- The nature and extent of behavioural changes associated with the use of various driver support systems
- The conditions in which these changes take place
- The "reasons" why these changes occur
- The characteristics of the drivers more likely to present these behavioural changes

As a function of the type of support systems being studied (informative, prescriptive or intervening systems)

As a function of similar driving situations or tasks and/or of drivers' common characteristics

The temporal conditions

Learning and appropriation phase

- The driver discovers the system
- Learns how it operates,
- Identifies the precise limits of its competence and delimits its domains of utility

Integration phase

- The driver, through experience with the system(s), reorganises his/her activity by integrating the system in the management of the overall driving task

To assess the temporal span of the different phases

To identify means for optimising the learning and integration processes