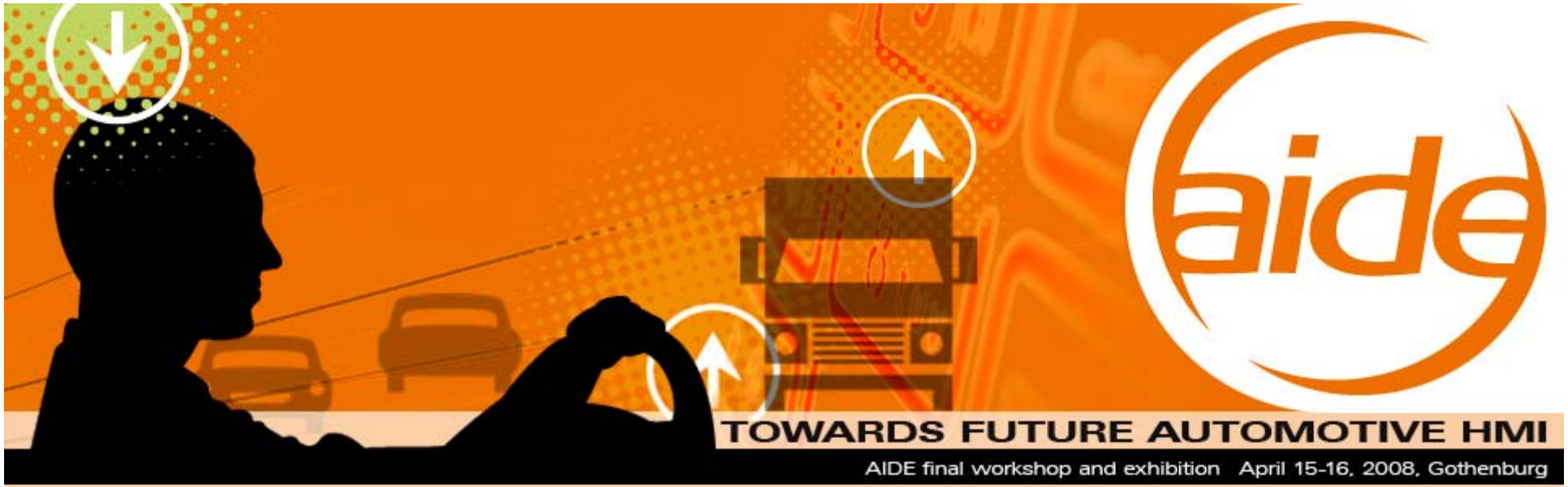


AIDE prototype vehicles

Gustav Markkula, VTEC

Purpose and outline of presentation

Provide insights not immediately available from exhibition demonstrations:

- Purpose of AIDE prototypes
- Full list of integrated functions
- How to implement an AIDE HMI
- Product feasibility testing
- Conclusions

Purpose of AIDE prototype vehicles

Implement the AIDE concepts of:

- HMI integration
- HMI adaptivity

Using the general AIDE system design, in terms of:

- Use cases
- Functional architecture

In order to:

- Prove the **technical feasibility** of the AIDE system design
- Prove that the AIDE system design is **flexible** enough to permit OEM/vehicle specific HMI
- **Demonstrate** AIDE concepts
- Provide **test vehicles** for end user evaluation of AIDE concepts

The city car
SEAT Leon

The luxury car
Fiat Croma

The heavy truck
Volvo FH12

The test car
Peugeot 407

Functions integrated in the prototypes

Active safety

- Lane departure warning
- Active lane keeping support
- Frontal collision warning
- Curve speed warning
- Blind spot monitoring / start inhibit
- Distraction / drowsiness warning
- Traffic sign recognition
- Parking distance control

Information and communication

- Navigation
- Traffic information
- Telephone
- Address book
- SMS messages
- Calendar reminders
- Fleet management

Entertainment

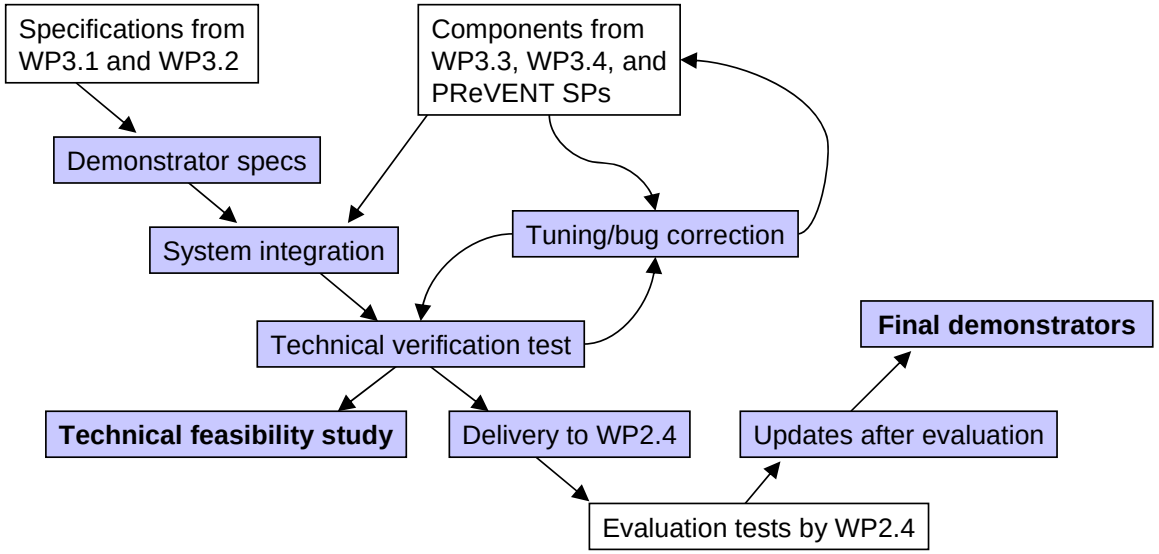
- Radio AM/FM
- CD audio
- MP3 audio

Vehicle information

- Basic car instruments
- Trip computer
- Time and date
- Vehicle diagnosis and service info
- Axle loads

Implementing an AIDE HMI

The AIDE WP3.5 process

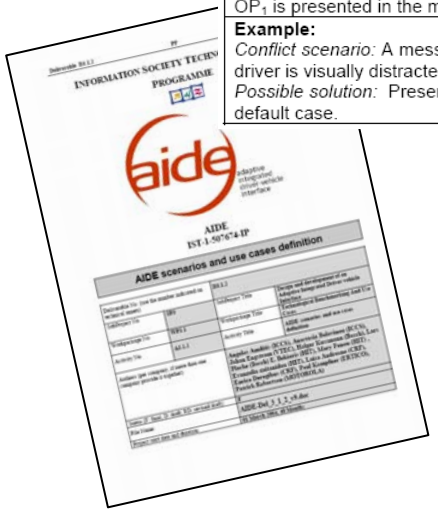


Simplifying, there are three main steps…

Implementing an AIDE HMI – step 1

Define use cases based on AIDE design scenarios – **HMI layout and behaviour**

AIDE design scenario 2.2: An important output message (OP_1) is given while driver is distracted.
Action/s = {OP_1}, where OP_1= Receiving mandatory messages or important info related to the instant driving task
DVE Condition/s: Driver Distraction (DVE_2)=HIGH, $DVE_{2\text{-}5}$=LOW/NO
Flow of events 1 1. DVE_2 turns from LOW to HIGH 2. OP_1 is initiated 3. DVE_2 turns from HIGH to LOW
Possible AIDE solution(s) OP_1 is presented in the most efficient way (choose/change modality)
Example: *Conflict scenario:* A message notifying the driver for over speeding has to be presented while the driver is visually distracted by an external event. *Possible solution:* Present the message in a vocal mode instead of a visual mode, if that was the default case.



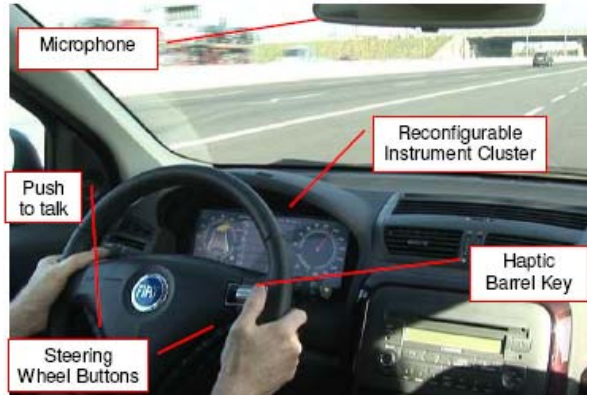
MF_DVE_DISTR

1. The driver is distracted, with { Driver Visual Time Sharing = HIGH | Driver Cognitive Distraction = HIGH}, when a High Engine Temperature message (OP2) is triggered.
2. The HET message is given in (CIC, Voice Output) (instead of its standard form (CIC, Sound)).

Can be further divided into two sub-steps…

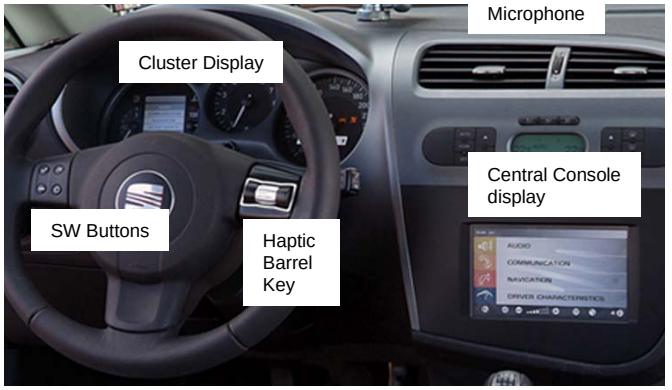
Implementing an AIDE HMI – step 1A

Use case definition step A: Define general HMI layout and integration strategy



Fiat

Volvo



SEAT

- Fiat: A single visual display, integrating all functions
- Volvo: Functions divided among three visual displays (HUD, CIC, SID)
- SEAT: Two visual displays (CLD, CCD), with some functional overlap

Implementing an AIDE HMI – step 1B

Use case definition step B: Define conflict resolution strategies

- Conflicts between application actions
- Conflicts between application actions and DVE state

Examples (action-action):

MF_OC_VCHAN_EQ (OP2-OP2)

1. An OP2 action (e.g. low brake fluid level) is initiated while another Op2 action (e.g. excessive engine coolant fluid temperature) is executing. (e.g. An OP2 message (low brake fluid) is triggered and immediately after that another OP2 message (excessive engine coolant fluid temperature) is triggered)
2. Incoming action has same priority as current action (OP2)
3. These OP2 require the same visual and acoustic channels and their priority is quite high.
4. The two OP2 are visualized in cycle, for some seconds each, alternating.

MF_OC_NOVCHAN_HILO

5. A Low Battery Charge message (OP3) is triggered and given in (CIC, Sound).
6. While the message is being given, a New Order message (OP6) is triggered.
7. The New Order message is queued.
8. When the Low Battery Charge message has terminated (either by button-press acknowledgement by driver or by time-out) and a time-to-calm period has passed, the New Order message is given in (SID, Sound).

Implementing an AIDE HMI – step 1B

Examples (action-DVE):

MF_ DVE_POST_DEM (OP3)

1. An OP3 action (e.g. automatic gear failure) arrives while Driving Demand =HIGH (DVE1) (e.g. Close to a roundabout an OP3 message (automatic gear failure) is triggered)
2. Incoming OP3 is postponed until Driving Demand become = LOW

3.3.5.09 – MF_DVE_DEM_SMS_RISK

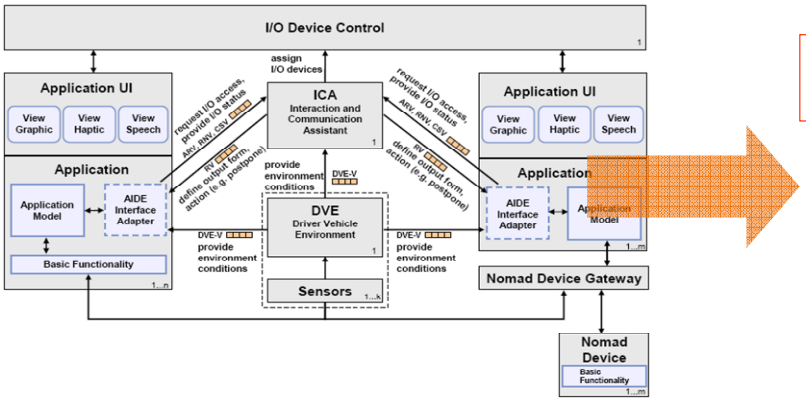
1. The driver is in a Traffic Risk Situation.
2. There is an Incoming SMS (OP6)
3. OP6 is shown without any sound alert, instead of normal conditions.

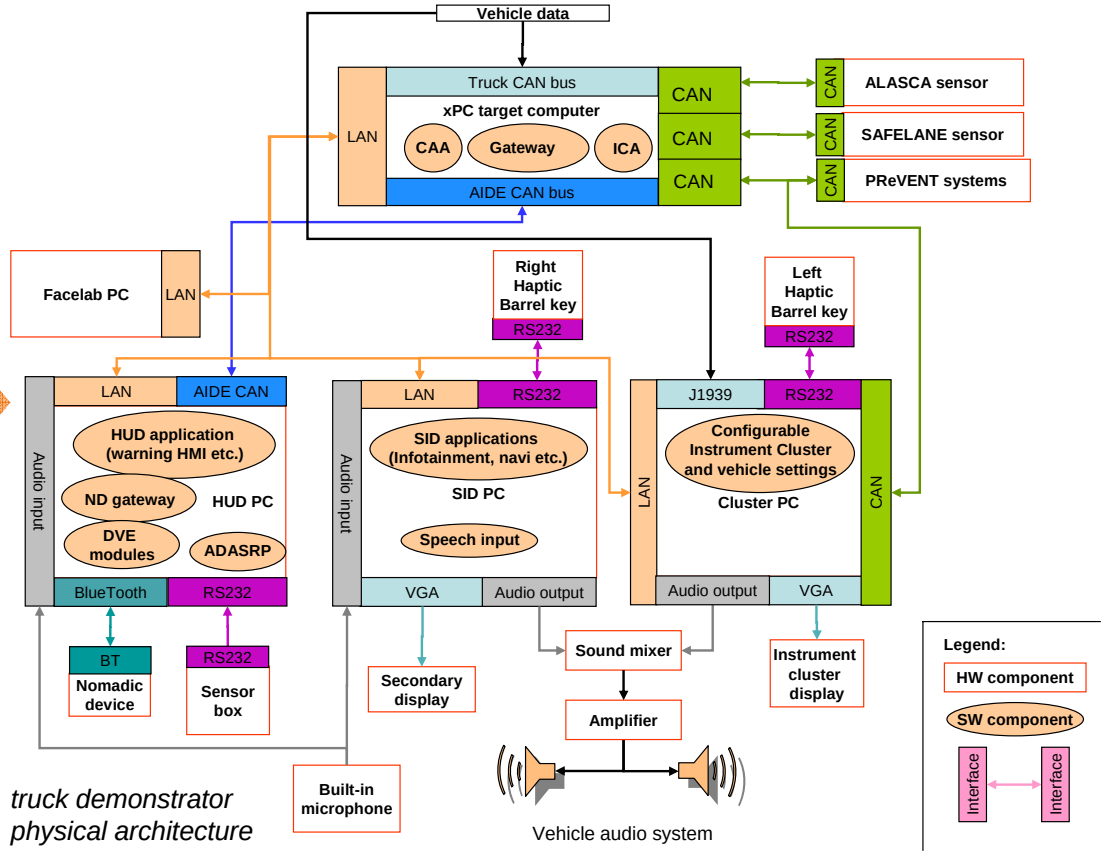
WARN_ADAPT_SAFELANE_INATT

1. The driver is in a state of reduced attention, with { Driver Eyes Off Road = HIGH | Driver Visual Time Sharing = HIGH | Driver Cognitive Distraction = HIGH | Driver Drowsiness = { DROWSY | SLEEPY }}.
2. A potential lane departure is detected by the SAFELANE system.
3. Due to the DVE state, a lane keeping support intervention is given with both a steering wheel vibration and a corrective torque in the steering wheel, instead of just the corrective torque.

Implementing an AIDE HMI – step 2

Define physical/electrical architecture based on AIDE functional architecture





truck demonstrator physical architecture

Vehicle audio system

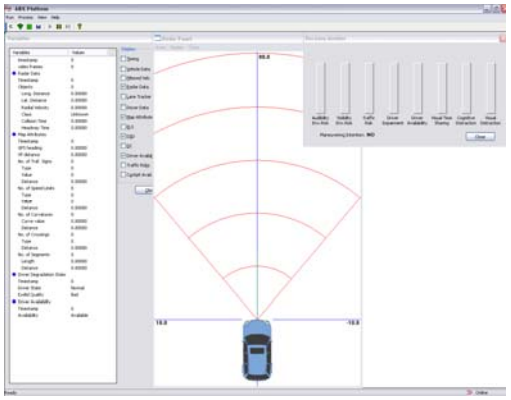
Implementing an AIDE HMI – step 2 (cont'd)

… and integrate components

- Input/output devices
- HMI/GUI software
- ICA module
- DVE monitoring modules

AIDE demonstrator component integration

Figure 13: Two Haptic Barrel Keys integrated to the VOLVO FH12 steering wheel.



Implementing an AIDE HMI – step 3

Define Application Request Vectors (ARVs) implementing use cases

Action	Application ID	Action ID	Initiator	Duration	Safety Critical	Time Critical	Real-time	Mandatory	Driving Relevance	Preference	Primary Standard	Secondary Standard	Tertiary Standard	Primary Simplified	Secondary Simplified	Primary Enhanced	Secondary Enhanced	Primary Extended	Secondary Extended
CIC Dialog	Dialogues	1	User	Duration	-	Hi	N	N	N	N	-	-	-	-	-	-	-	-	-
SID Dialog	Dialogues	2	User	Duration	-	Hi	N	N	N	N	-	-	-	-	-	-	-	-	-
Speech Dialog	Dialogues	3	User	Duration	-	Hi	N	N	N	N	S2	S2	S2	S2	S2	S2	S2	S2	S2
APALACI start inhibit	Prevent	1	System	Transient	Hi	Hi	N	N	Y	N	SID+S1	CIC+S1	CIC+S1	CIC+S1	CIC+S1	CIC+S1	CIC+S1	CIC+S1	CIC+S1

…

e																			
Low Oil Pressure	Warnings	7	System	Transient	-	Hi	N	N	Y	N	CIC+S1	CIC	CIC	CIC+S2	CIC+S1	CIC+S2	CIC+S1	SWV+CIC	CIC
Turn-By-Turn	Navigation	1	System	Transient	-	Lo	N	N	Y	<User def>	CIC+S2	CIC+S1	CIC	S2	S2	CIC+S2	CIC+S1	CIC+S2	CIC+S1

…

… and tune ICA and DVE modules to meet requirements

✓ All set!

Product feasibility testing

But are these solutions feasible in production vehicles?

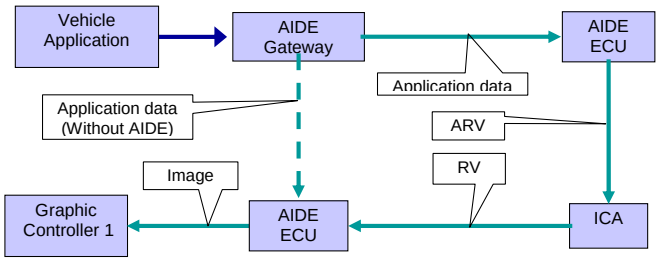
Experimentation in the PSA test car

- Integration of an AIDE ICA in the actual vehicle architecture

Worst case ICA communication overhead

- **Raised CAN bus load from 30% to 32%**
- **Added 30-70 ms of response time** (per action initiation, not per button press)

This overhead is not negligible, but should be small enough to be acceptable



Conclusions

- Envisioned AIDE concepts are feasible with present technology
- The generic, modular AIDE functional architecture:
  - Can implement envisioned AIDE concepts
  - Allows implementation of a wide range of HMIs (e.g. for different vehicle types, brands and models)
  - Seems to be feasible in product