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SMART DRIVING INTO TOMORROW: THE MOTOR OF THE FUTURE IS NETWORKING

Tesla's HMI design shows how the convergence between infotainment and connectivity will revolutionise driving.

With regards to designing a state-of-the-art **automotive human machine Interface (HMI)**, the last ten years were extremely exciting, with both opportunities and challenges of immense proportions for technology providers, system integrators, and HMI designers in OEMs. Never before have drivers experienced more **infotainment technologies** in their cars, and this strong trend is set to become a permanent fixture affecting all vehicle segments, including what are referred to as low-budget cars.

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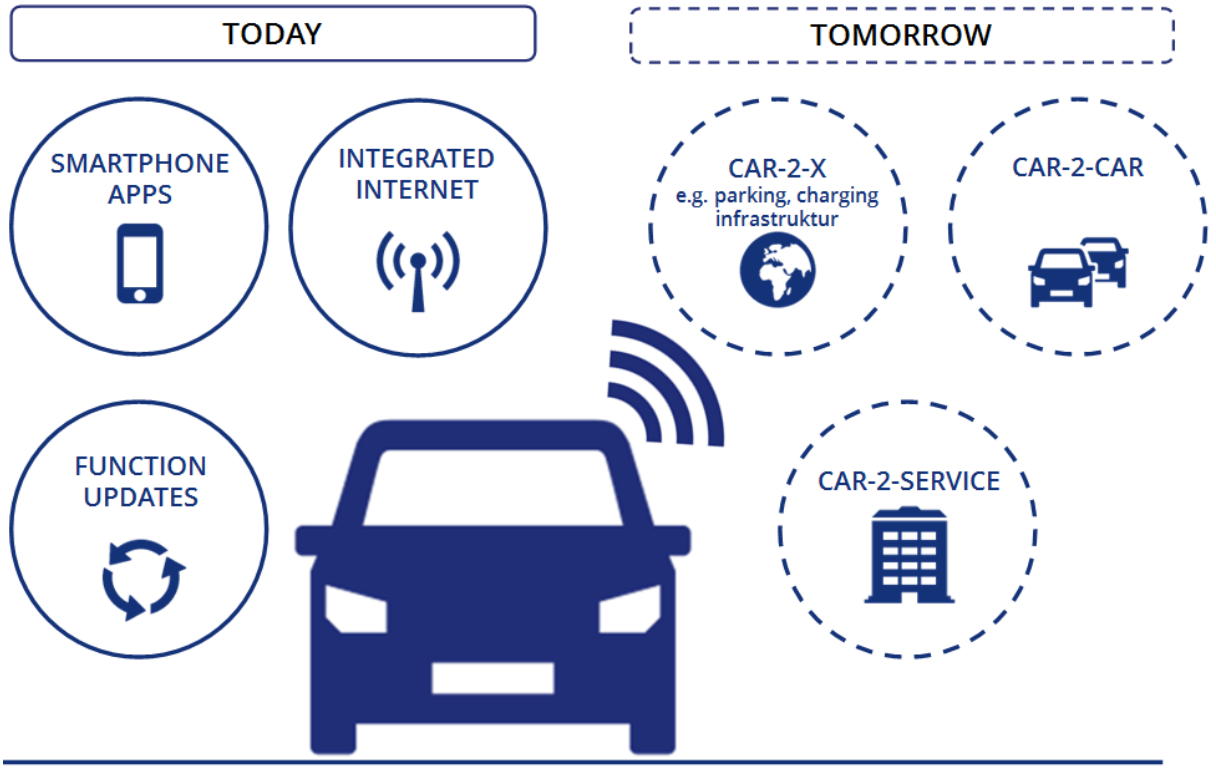
The most important drivers of innovation and the macro-trends in this industry environment are the integration of extended telematics functions due to better networking, the introduction of entertainment electronics technologies into vehicles, and an ever-increasing number of safety solutions e.g. driver assistance systems. Not just the best-in-market products of premium OEMs

such as Mercedes, BMW, and Audi, but the innovative infotainment solutions from the electric vehicle segment (e.g. Tesla) show that automotive HMI design has become a new battlefield – and minefield – for carmakers looking to differentiate themselves from the competition. The driving force behind future developments in automotive HMI is the **connected car concept**, fast showing itself to be the new technology trend in the automotive industry. In all of the developments outlined above, besides the convergence of technology with the car, the strongest driver of innovation is the flood of information that comes with it, and the necessity of processing and visualising this data using information technology tailor-made for the automobile in the form of multimodal and multi-touch HMI designs.

This, however, represents a tall order for the developers of the next generation in terms of specific technology. Security has to date been, and will continue to be, the most important cornerstone in the development of HMI designs; yet as well as minimising distractions for the driver, optimising the travel experience of both the driver and the passengers will go on to play a central role. In this area, new on-board interactive systems such as large capacitive touchscreens will offer real possibilities for intelligent HMI design concepts, the aim is to offer the driver and passengers a unique in-car experience and thus to differentiate the brand from competitors: there is a pole position to be taken in driving infotainment.



1| CHALLENGES IN DEVELOPING HMI.

Developing a concept for an automotive HMI requires an innovative and far-reaching approach. A particular challenge is posed by problems resulting from the radically divergent innovation and product cycles in the electronics and automotive industries. Both developers and HMI designers are both faced with high hurdles in that they must pre-empt future trends and technologies in the hardware and software areas and then harmonise these with the typical product cycles in Automotive. Examining visualisation and display technology by way of example, we see that technology cycles in displays are essentially defined by consumer electronics, above all by mobile devices and flat-screens. The automotive industry takes on the role of the fast follower, both in terms of applying new display technology and in implementing large production runs; this means that the number of companies involved in automotive displays – i.e. making up the supply base for system suppliers is far much smaller, with all that this entails in terms of pricing.

Further challenges arise from the **connectivity** macro-trend and the entry of **nomadic devices** into vehicles which forms a part of it. Here too, future hardware and software trends have to be considered and their direct effects on the development of the vehicle HMI evaluated. Typical questions that arise from this are:

1. Which companies have a market-dominating role in nomad devices and how can their technological solutions be integrated into the vehicle environment (interfaces, protocols)?
2. How can brand recognition be preserved in spite of the connection and convergence of non-OEM products?
3. How can the overall costs for hardware and software used be optimised (licencing agreements and royalties)?

Taken together, the challenges listed above lead to taxing requirements for development projects in the infotainment environment, making it indispensable to tightly integrate product management, requirement engineering, system engineering, and concept validation. An important factor in success is thorough planning and definition when it comes to product features, using comprehensive product benchmarking and requirement management in the early phase of the development project. In this context, two questions play a key role:

1. Which market forces are driving complexity in infotainment systems?
2. What is the optimal hardware and software solution with regard to costs and time to market?

Technology trends & marketing analysis

User needs & technical features

Functional cockpit layout & visualisation using displays

Evaluation

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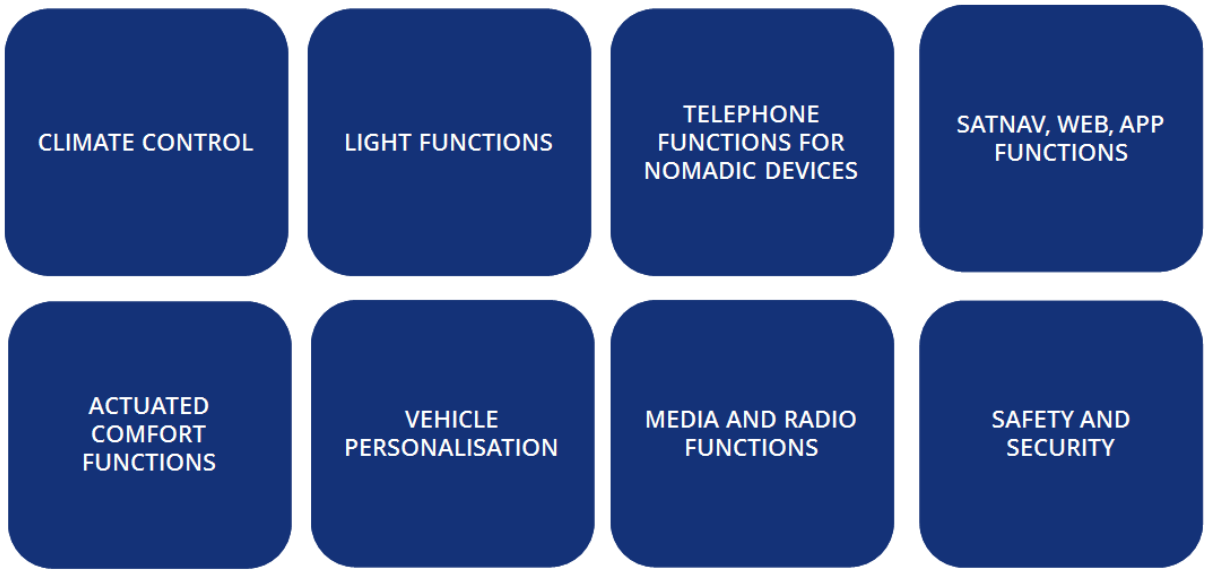
2| THE TESLA HMI CONCEPT

The new Tesla infotainment system is clearly a milestone in the development of infotainment systems. This is down to more than just its 17" capacitive touchscreen – however impressive it may be in the central cockpit area due to its sheer size alone – but rather as a result of its control concept and its consistently modular hardware and software structures. Besides the central computer, the main unit also houses the radio tuner and audio amplifiers.

1 | CONTROL CONCEPT

The Tesla control concept is, more than any other before it, centred on using the touch function on the display as a substitute for switches in the vehicle. This control philosophy brings together functions that competitors typically implement as classic manual switches, as this overview of the soft-touch functions on the central display shows:



The concept sketched out offers advantages beyond the simple look and feel in the home area: as our benchmarking costs analyses shows, it also offers a significant benefit in view of overall costs because it replaces all switch hardware in the vehicle. Another side effect that is not to be underestimated is cockpit tidiness – and the fact that space freed up can be used for other vehicle features. While this control concept is clearly suited to a technology-friendly, generally younger customer segment – referred to as **digital natives** – and it remains to be seen what effect this control concept has in terms of distracting the driver, there have as yet been no negative reactions following the roll-out of the vehicle.

2 | HARDWARE CONCEPT

Analysing the hardware architecture of the Tesla central displays and the main unit, we have seen how Tesla has adhered to a strictly modular principle, and this is also the case for the 17" TFT touchscreen, which is not customer-specific, but is a standard display module made by Innolux featuring indirect LED fibre-optic backlighting and up to 600cd/m²; this reliance on

standard hardware modules can also be seen in the main unit, in which a GPS/GSM module, a graphics module from Nvidia, and a Bluetooth/WiFi connectivity module are used.

There were most probably two main reasons for choosing this hardware architecture:

1. Minimising the development risk by using validated hardware and software components > **RISK MANAGEMENT**
2. Accelerating the product development process > **TIME TO MARKET**

The advantages detailed above are evident for a Model S unit number scenario, so it easy to see why this hardware architecture was selected. By the same token, this modus operandi cannot necessarily be applied to all planned volumes: in fact, with very large production runs, a modular architecture tends to lead to higher costs as more module suppliers are involved and the supply chain becomes more and more complex. Yet given that Tesla's development resources in infotainment are still being built up and that the manufacturer nevertheless wants to cement its image as a technology leader, this was clearly an excellent decision to take.

3 | SUMMARY

Looking at each item in the tesla control system on its own merits, none of them contains any kind of technological novelty or any revolutionary elements. The Tesla system applies tried and tested hardware and software technology, but what makes the Tesla control system truly unique, and thus a milestone in the generally evolutionary course of vehicle infotainment system development, is the particular combination of proven technology with a control concept which is highly recognisable from devices in the home and has the look and feel of a tablet or pad. In order to underline its brand image as a technology leader in areas other than electric vehicles, Tesla has gone down an as yet untrodden path and pushed the boundaries, particularly in the way it has implemented a 17" capacitive TFT touchscreen in a series vehicle. This is completely new, as is the use of the touch display to control all most all switch functions.

For these reasons, the Tesla S infotainment system is enjoying a lot of attention from product planners and developers at almost all OEMs and is being intensively benchmarked; it has set the standard that development departments will be aiming at with future infotainment and HMI concepts.

4 | YOUR PROJECT PLAN. PRODUCT AND COSTS MANAGEMENT IN HMI

Some central questions that must be asked:

- Who has the best-in-market HMI concepts and what makes them different from competitors'?
- What will be the macro-trends in infotainment systems over the coming 5 years?
- Which features are relevant to which vehicles?
- What are the external drivers influencing your infotainment developments?
- Which costs management strategies are available for developing hardware and software for infotainment systems?

POLARIXPARTNER has proven product and costs management expertise in automotive infotainment systems as shown by numerous projects for big-name OEMs and system suppliers. If you have been asking yourself any of these questions and would like to discuss new ideas and impulses for your HMI solution, we are looking forward to hearing from you.

THE GUIDING STAR FOR THE MANUFACTURING INDUSTRY

3 | THE AUTHOR: YOUR EXPERIENCED POLARIXPARTNER CONTACT

Hassan El-Bouloumi – Principal

- More than 12 years' experience in the manufacturing industry – primarily in Automotive
- Excellent knowledge of the particular challenges in the automotive industry with regard to costs, quality, and timescales
- Profound understanding of both product creation and manufacturing
- Numerous cost reduction programmes implemented for major automotive manufacturers focusing on materials and production costs
- Certified value management professional (PVM): European Governing Board for Value Management Europe)

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4 | ABOUT POLARIXPARTNER

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