Connected Digital Cockpit – Redefining Mobility

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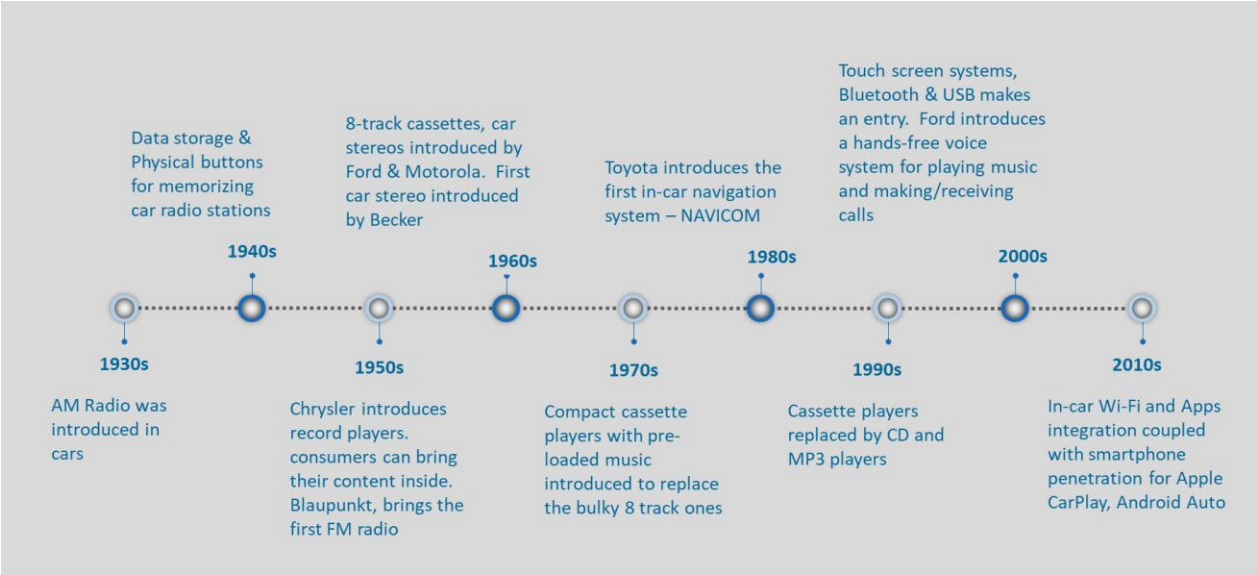
ABSTRACT

Global carmakers are today competing to design the next-gen digital cockpits with an array of advanced features. These features are heavily borrowed from other associated technologies that the end-users are using today. The future of the cockpit is redefined since advanced safety features are getting added to the cars to achieve full autonomy. The future digital cockpit hence would require sophisticated processing to meet the user demands for connected, safe and advanced mobility interfaces.

Digital Cockpit Controller solution facilitates the simultaneous working of Infotainment, Instrument Cluster and ADAS functionalities real-time from a single SoC without compromising on the security or the performance requirements. It can drive multiple high-resolution displays including HuD. Differentiating this Cockpit electronics has become very important for OEMs, as new connected features, intuitive HMI, entertainment on go and safety attracts the end consumers. Infotainment capabilities that connect to the internet, providing a virtual assistant and streaming media, larger and higher resolution 3D displays, all-digital instrument clusters, Augmented reality-based head-up displays and other ADAS features like surround-view, eMirror, etc. are defining the digital cockpit of today. Cockpit domain controller architecture that integrates all of these heterogeneous capabilities onto a single multi-core SoC and ECUs are creating growth opportunities for the connected digital cockpit providers. Powering this new era of mobility are new centralized computing approaches that consolidate separate domains in the vehicle cockpit. This white paper provides a view of features consumers are looking forward to in a new vehicle and the technologies required to support these features.

THE EVOLUTION OF IN-VEHICLE INFOTAINMENT SYSTEMS

There is at least a good 90 years history behind the In-Vehicle Infotainment (IVI) system that provides entertainment and connectivity on the go. It all started as a simple broadcast of information from one point to the consumer and over the years, more rich and personalized content evolved in the form of on-board content, Radio services, multimedia, USB, Bluetooth, Wi-Fi in head units and then later on online content-based services. Today with mass penetration of smart gadgets, consumers are tech-savvy and they expect more enhanced IVI systems with mobile phone integration – Apple CarPlay, Android Auto, MirrorLink etc. This brings in lots of advanced technology and architecture to the car infotainment systems. The evolution of IVI systems is shown below.



As we have seen above, IVI systems have evolved from just being a box featuring Radio, cassette, CD/MP3 player. The last 10 years have witnessed tremendous growth, thanks to cheaper displays that allowed touch screens that replaced physical buttons to seamlessly move from one feature to another. We also saw how connectivity and technology have advanced that consumers are now demanding smartphone-like features in their cars. This is now making car makers shift from traditional IVI systems to more immersive digital cockpit solutions.

Transforming from a traditional IVI system to a Digital Cockpit environment

Today cars come with lots of features – ADAS, Connected car, Autonomous Driving, etc. also calls for making the car drive a safer activity. This makes the car's IVI system not just a platform for providing entertainment but it also needs to work in unison with other safety systems and deliver an enhanced user experience to driver and passenger. To effectively manage all these functions, cars would need multiple displays, futuristic HMI and more enhanced computing power. This is best seen in some of the modern-day cars that have shifted from their traditional mechanical clusters to a fully digital screen that not only displays speed, fuel level, engine speed but also other important info like vehicle telemetry and

navigation. Today's Digital cockpit is a combination of all these systems – Infotainment, Rear Seat entertainment, Cluster and Heads-up display.

An ideal digital cockpit design should include safety, connectivity, maintainability, user experience, and technology. Most of the global carmakers have included the digital Cockpit in their growth strategy and are evaluating various innovative solutions. As the cost of automotive-grade high resolutions displays is reducing we can see the digital cockpit feature is making its way into the mid-level vehicle segment as well. Even though there are multiple solutions available in the market, safety and security concerns are the drawbacks for most of them. A solution that addresses the Safety and Security requirements, efficient display systems, virtualization, ASIL compliance, OTA (Over-The-Air), Hypervisor requirements, etc will open up a huge market for the digital cockpit in the near term.

Key factors for adopting Digital Cockpit

1. Increasing demand for great, digital user experience is driving the transformation from analog car dashboards towards a multi-screen and multimodal digital experience for drivers and passengers
2. Automakers are moving towards ECU consolidation to share resources, eliminate components and reduce associated costs. ECU consolidation is an important step in the automotive industry's transition towards the software-defined vehicle. Software-designed systems give automakers flexibility in adding new features, responding to emerging security threats and migrating workloads among different compute resources
3. Modern cars have several digital displays in different sizes and shapes for the instrument cluster gauges and meters, infotainment, see-through head-up displays, HVAC control panels, per seat passenger displays. Reducing driver distraction is a key attribute here through feature consolidation and smart HMI screens

CHALLENGES INVOLVED IN BRINGING AN IMMERSIVE DIGITAL COCKPIT EXPERIENCE

Advancements in Connected, Autonomous, Shared, and Electric (C.A.S.E) vehicles have brought in the digital revolution to vehicle interiors with integrated displays for infotainment and instrument cluster becoming a norm. Increasing demand for great digital user experience is also driving the transformation from analog car dashboards towards a multi-screen and multimodal digital experience for drivers and passengers. Automakers are also moving towards ECU consolidation as it is an important step in the automotive industry's transition towards the software-defined vehicle and to share resources, eliminate components and reduce associated costs. The dynamic technology advancements make it challenging to maintain the lifecycle of in-vehicle infotainment systems. Another key challenge comes with providing HMI solutions across various digital displays that minimize driver distraction and are user-friendly. A single powerful ECU can execute functions of several systems, but it is the complex software architecture that enables ECU consolidation as a step towards the software-defined vehicles.

Some of the challenges suppliers and OEMs encounter for the design and development of digital cockpits are as follows:

1. Design, Cost, and Performance – Bring the right product which is intuitive and futuristic providing the best user experience in the minimum time possible and at lower costs
2. Safety standards – As cockpit includes instrument clusters and they demand functionally safe software that complies to ISO26262 standards and thus stable process and specialized people are required to develop these
3. Software complexity – Since the digital cockpit is an integration of multiple safety systems and it involves different operating systems, virtualization techniques, development, and test frameworks.

There are technologies and associated process frameworks that help in digital cockpit design and most of the companies have to follow those for developing the solution.

WHAT DOES A MODERN-DAY DIGITAL COCKPIT COMPRISES OF?

An ideal digital cockpit design should encompass the following aspects on safety, connectivity, maintainability, user experience and technology. The full digital cockpit solution consists of multiple layers like:

- Base Operating systems – Android Auto, Linux or QNX
- Application frameworks – Qt, GL Studio, Kanzi, Android UI, etc.
- Connectivity standards – Ethernet, CAN, LIN, FlexRay, etc.
- Hypervisor – For seamless switching and operations of features from single SoC provided by QNX, Green Hills, etc.
- Key Infotainment platforms – NXP i.MX, TI J7x, Qualcomm 820a, Renesas RCar M3/H3, NVIDIA TX2 and many more

The various other aspects which are important in the Digital cockpit design include the following:

Safety – As the number of features increases in the digital cockpit, managing driver distraction becomes more important

Functional Safety –ASIL requirements to be met since the cockpit is going to be an integrated system

Security – Making the car hack-proof is very important as access to vehicle data could be risky

OTA – Ability to bring improved & upgraded user experience without hassles

Right processor – Fast, cost-efficient, HD graphics processing capability, low power consumption

Software Technology – Selecting the right technology for OS, Hypervisor, virtualization, boot time optimization, UI/UX, etc.

CONCLUSION

Redefining IVI experience for a better tomorrow

Today automakers have a complex task in hand as more advanced safety & infotainment features are getting introduced in the vehicles. This asks for more complex hardware and software to take care of the next gen vehicle cockpit design especially when autonomous cars are going to be unveiled in the next 5 years. *Personalization is a key attribute in which the passenger is demanding and hence suppliers and automakers need methods to bring this technology*. Once fully autonomous cars are introduced, the users will want greater ability to personalize since the user wants access to safety-critical information. The connected digital cockpit will continue to provide an improved array of infotainment options customized for each passenger.

There are a number of technologies that automakers are using to develop and build the cockpit of the future. Cellular, Wi-Fi, Bluetooth and wireless technologies are interlinked and have become absolutely critical to delivering an advanced infotainment experience. There are also efforts for bringing over-the-air (OTA) updates to fix cybersecurity issues, add/delete features, fix software bugs, etc. Regardless of what the long-term future holds, advanced IVI systems are already in production. The trend toward consolidation of infotainment and safety-critical features is very important as is the desire for personalization. Enabling all of these advanced technologies will require an efficient supply chain system that encompasses feature-rich processors and System on Chips (SoCs), Operating systems, application frameworks, virtualization techniques, software suppliers who have to work in close tandem.

ABOUT TATA ELXSI

Tata Elxsi is a design and technology services company that blends technology, creativity, and engineering to help customers transform ideas into world-class products and solutions. Tata Elxsi addresses the Automotive, Communications, Consumer Electronics, Healthcare, Media and Semiconductor sectors. Tata Elxsi has been at the forefront of automotive design and engineering for over 20 years. Certified for ISO 9001 and 27001 standards and compliant to Automotive SPICE® Organization Maturity Level 5 requirements.

Tata Elxsi has comprehensive engineering design capability in Connected Infotainment services. Involved right from the specification design, development, 3rd party application development, middleware development, HMI design and development, verification and validation, tear down analysis and has proven our capability in various production programs. As part of our solutions portfolio development strategy based on market trend analysis, Tata Elxsi has developed a complete e-Cockpit licensable solution addressing all the requirements of the vehicle cockpit. Tata Elxsi's e-Cockpit is a platform-agnostic solution supporting infotainment, Instrument Cluster, HUD and ADAS functionalities on a single SoC without compromising on the security and performance requirements.

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