

Adaptive AUTOSAR for future automotive ECUs

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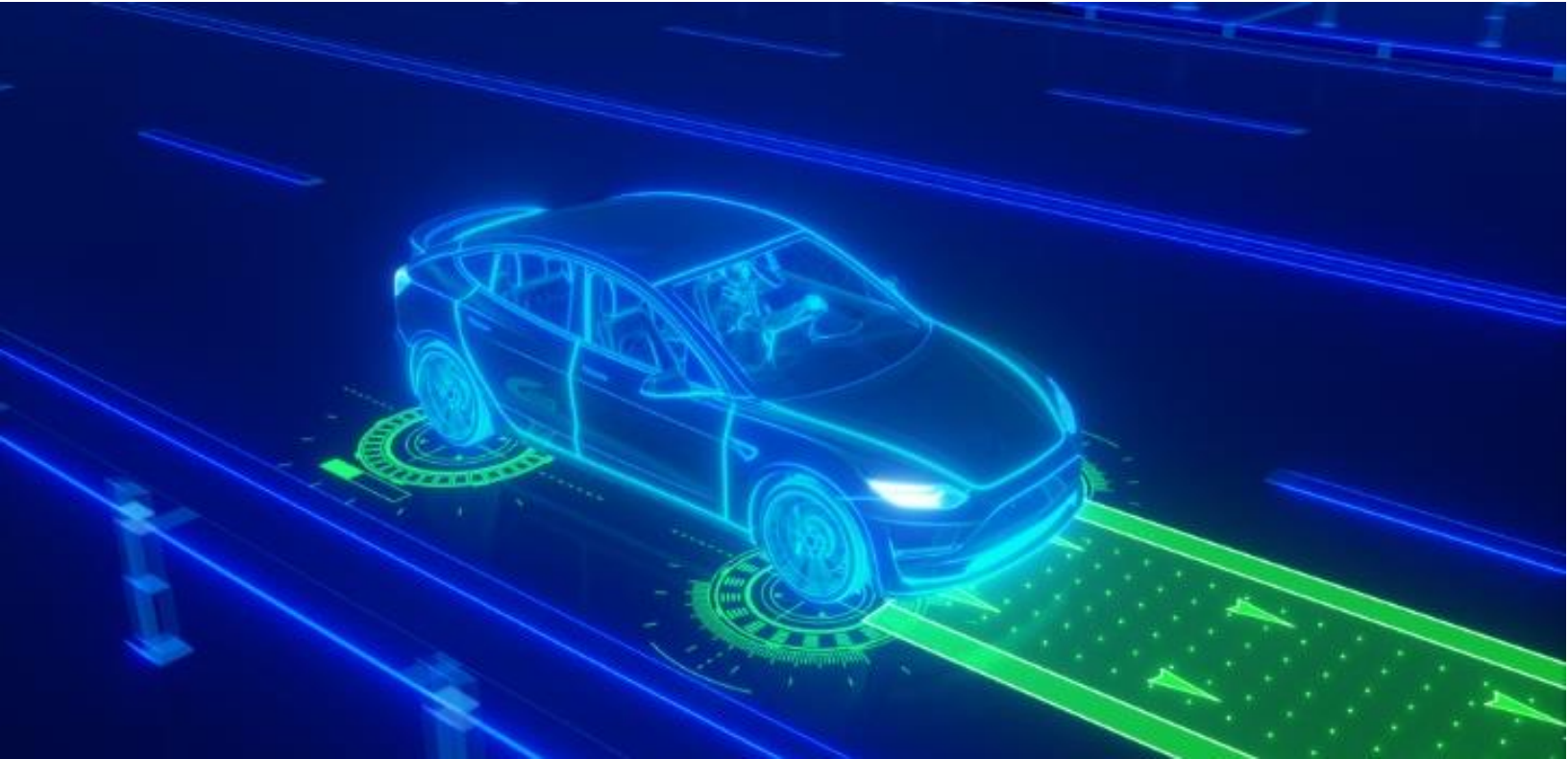
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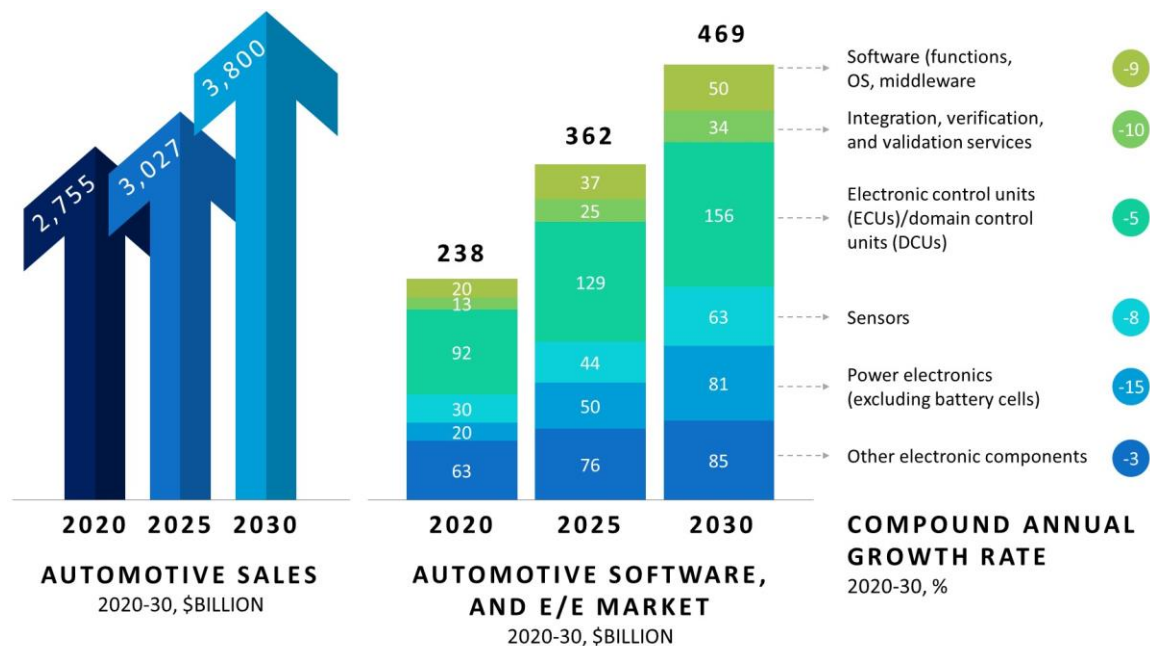
ABSTRACT

The rapidly growing technologies in the automotive industry have set-up new trends, goals and need for more complex systems that maneuvered the AUTOSAR community to develop a new platform called AUTOSAR Adaptive. The aim of AUTOSAR Adaptive is to address and serve the demands defined by the newer technology drivers in the modern automotive industry. The new performance requirements for processors have grown extensively in recent times as vehicles are becoming more and more intelligent. The AUTOSAR Classic platform already uses multicore processors, but the need for the processing power calls for much more than multicore. The increased need for computing power, power efficiency were becoming an issue even in data centers and it is in fact much more significant for these intelligent automotive ECUs. There are combined effects of both processors and faster communications to achieve the high-performance needs of modern automotive E/E architecture. As a single chip is combined with more processing elements the communication between the processing elements is becoming orders of index faster and efficient than legacy inter-ECU communications.

The major values AUTOSAR Adaptive furnishes are mainly in the high-performance computing and communication mechanisms and offer flexible software configurations thus paving the way for connected and autonomous cars. The software needs for this can be achieved by the use of off-the-shelf software based on open-source development. This paper will provide answers to how AUTOSAR Adaptive is an integral part of future automotive ECUs.

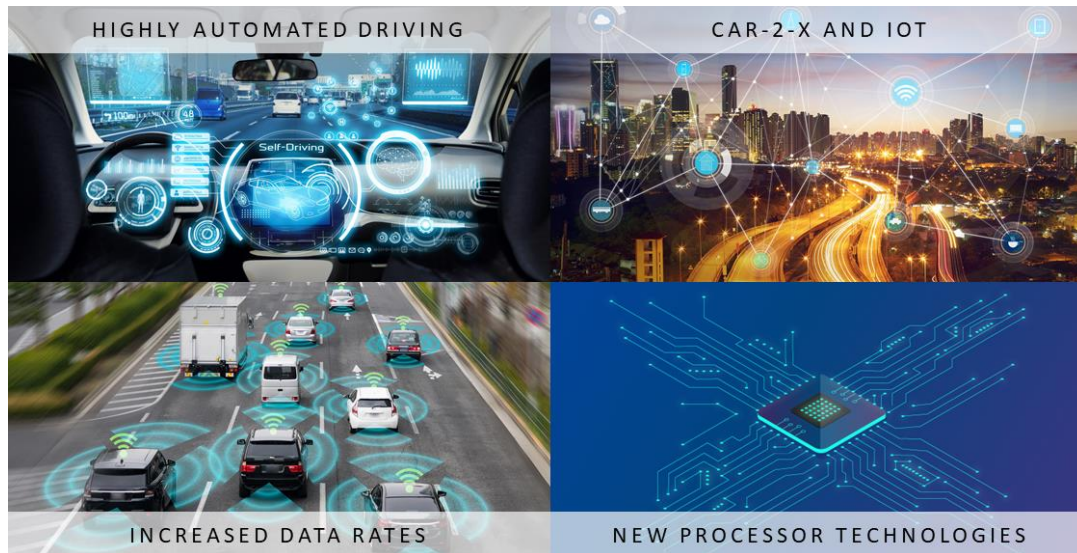
INTRODUCTION

In the new technology era, innovations and trends are rapidly changing the automotive industry by defining new challenges and new goals. The need for the development of new systems is encouraging the development of new technologies to serve the huge increase in software complexity and the data exchanged between different applications. The newer technology needs are classified as Autonomous Driving, Car-2-X applications, stronger interaction and connectivity which requires an advanced platform that can support the features of the Intelligent Vehicles. Moreover, these technology needs are also the significant drivers of the compound annual growth rate of 7 percent in the market for automotive software and for electrical and electronic components (E/E), which is projected to grow to \$469 billion, from \$238 billion, between 2020 and 2030 as per McKinsey Center for Future Mobility report.



To pace up with the new innovations in the automotive market, the current AUTOSAR classic architecture may not be sufficient to support high-end applications which should observe their environment using multi-sensors or easy communication with the environment and even usage of such data to take driving decisions which can be critical to health or sometimes life. Thus the recent technology needs were not feasible anymore on the AUTOSAR Classic Platform which offers real-time signal based communication, this resulted in introducing a new platform to handle the high-performance requirements. The AUTOSAR Adaptive Platform aims to provide an environment with higher computing power, higher data rates, active deployment of new functionalities, interaction with non-AUTOSAR applications, and also supports over the air system updates, etc. This inspired the independent development of the AUTOSAR Adaptive Platform with the aim of having both platforms co-existing and functioning together on the same network without risking the stability of the existing Classical AUTOSAR architecture that has been proven over the years.

AUTOSAR ADAPTIVE PLATFORM MAIN DRIVERS:



- Highly automated driving: An enabler for the Level 4 and Level 5 autonomous vehicles where the vehicle driver will temporarily or partially transfers responsibility of driving to the vehicle. This requires communication with traffic infrastructures like traffic signs and -lights, cloud servers to access the latest traffic information or map data and the use of microprocessors / high-performance hardware for parallel processing for taking decisions.
- Car-2-X applications, Internet of Things and cloud services require interaction with vehicles and off-board systems such as Connecting to the internet, secure onboard communication, support of cross-domain computing platforms, integration of non-AUTOSAR systems and exchanging data with smartphones. Future cars will be connected to almost everything such as Smart homes, roadside infrastructure and even vehicles around them and they will become a part of the internet of things. This will also help in enabling the remote diagnostics, over the air(OTA) update, easy repair and exchange handling.
- Increasing data rates to enable future Autonomous and connected vehicles as more the number of sensors the more the data. It is said that the connected cars generate around 25 Gigabytes of data per hour and accumulates to Terabytes of data when it combines with more self-driving features.
- New processor technologies to meet the high-performance requirements, as the current SoCs and software systems available for self-driving vehicles, may not be enough to handle autonomy on real roads. This would need new processor technologies that can handle high-performance computing and is power efficient and easily scalable.

HOW ADAPTIVE PLATFORM WILL EXTEND THE AUTOSAR CLASSIC PLATFORM

AUTOSAR services and solutions right from evaluation, assessment to migration strategy and actual implementation of standardized architectures are becoming increasingly popular in the modern automotive product development. The OEM's standardizations are striving towards lowering the cost and reduction of lead time through easily available well-tested modules. High-performance in-car computers are replacing the current domain controller-based architecture for increased flexibility and distribution of functions. Maximum freedom in the Adaptive platform implementation helps offers more computing powers, which caters with the next-gen vehicle architectures.

The AUTOSAR adaptive platform is not intended to replace the classic platform, however, the ECUs developed by both platforms will co-exist and communicate in the same vehicle network. The AUTOSAR Classic which is for deeply embedded ECUs based on microcontrollers where the Adaptive contains the platform required for developing future automotive ECUs running on state-of-the-art multicore SOCs. The interfaces allow customers to implement autonomous driving, over-the-air software updates, IoT features, media streaming and other services to their future cars. By the support of adaptive deployment and interaction with non - Autosar systems through a common bus interface and thus will be treated as an extension for the Autosar classic platform.

The opportunities we foresee in the market include

- The increased need for Safety and Security measures
- Improvement and stabilization of existing standard
- Migration and Integration with the existing systems
- Validation –Automation, Intensity of test cases and competent engineering team



Further updates of today's driver assistance/ safety systems like Adaptive Cruise Control, Automatic Emergency Braking, blind spot detection, park assist, Lane Departure Warning system, etc. paves the way towards highly automated driving and autonomous parking. Future cars will be connected to almost everything such as the Smart homes, roadside units and vehicles around them and thus they become a part of the internet of things. For achieving all these recent trends Adaptive platform will play the role of a secure platform that helps in enabling future automotive needs. Thus a combination of AUTOSAR Classic and Adaptive will drive the automotive Software infrastructure for safe and secure high-performance applications.

Adaptive AUTOSAR Adaptation Challenges

We know the advantages of Adaptive AUTOSAR ECUs – high computing power, dynamic deployment of applications, compatibility between applications, etc. Along with adapting to Adaptive Autosar, it brings in various challenges right from its initial stages. But this being a newly emerging standard, in its initial stages there will not be solutions to all the challenges, finally resulting in exhaustive usage of the new standard in high-end applications using powerful SoCs.

- **Adaptive Autosar Platform Maturity:** Adaptive Autosar is an evolving standard. Hence Adaptive Platform does not guarantee backward compatibility with the previous version. Upgrading to a newer version will require huge effort and time. In case of a specific feature as per the new version is required to be supported then, this needs to be custom developed.
- **Adaptive Functional Cluster and tool development challenges:** Specifications for Adaptive AUTOSAR Foundation, Services and System tests are in concept phase and still evolving
- **Integration Challenges:** There are certain dependencies with specific POSIX compliant OS. Migration effort is involved to support multiple OS platforms. A design approach needs to be devised to develop an OS abstraction layer catering to some of the widely used and preferred OSes such as QNX, VxWorks, Integrity etc to some extent.
- **Challenges when Migrating from Classic to Adaptive:** Migrating a non-SOA application into Adaptive AUTOSAR architecture is complex. The existing applications need to be converted into services and check if needed by other ECUs, ensure these services are not redundant, then host the Service catalog etc. The Migration/integration of the existing C based application or components into the Adaptive Platform will require huge time and effort as Adaptive Autosar is based on C++.
- **Open Source usage challenges:** The evaluation of OSS and coming up with the strategy of ensuring that the OSS does not impact the system where it is being used. This becomes more of a problem when it comes to Safety-critical systems.



CONCLUSION

Since 2003 the AUTOSAR consortium has shown the potential as the well-suited platform to drive the standardization of the software infrastructure that meets the requirement of the automotive industry with the well adopted Classic platform. With the ongoing demand for new features, challenges and functionalities in line with the new market trends raise the need for a new automotive E/E architecture. With the new alignment of its portfolio with the introduction of the new AUTOSAR Adaptive platform the consortium has adopted these challenges and will provide a common platform for the development of next-generation vehicles.

ABOUT TATA ELXSI

Tata Elxsi is a global design and technology services company, headquartered in Bangalore. It addresses the automotive, broadcast and communications, consumer electronics and healthcare industries. This is supported by a network of design studios, development centers, and offices worldwide.

Tata Elxsi works with leading OEMs and suppliers in the automotive and transportation industries for R&D, design and product engineering services from architecture to launch and beyond. It brings together domain experience across Infotainment, Autonomous Driving, Telematics, Powertrain, and Body electronics, along with technologies such as Artificial Intelligence, Analytics, Cloud and IoT.

Tata Elxsi has licensed AUTOSAR Adaptive to Great Wall Motors, China's largest SUV and pickup manufacturer. Tata Elxsi's AUTOSAR Adaptive platform will help accelerate the development of connected autonomous and driverless vehicles. Tata Elxsi licenses modules and the stack for Classic version 4.3 as well as Adaptive platform for high computing applications such as Autonomous driving, V2X, predictive analysis, OTA to OEMs, Tier-1 and Semicon companies worldwide.

Tata Elxsi is accredited with Automotive SPICE Level 5 certification and is a member of leading consortiums such as AUTOSAR and OPEN Alliance. For more information, please visit www.tataelxsi.com

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