ARM Moves Further Into Automotive with NXP's Launch of S32K Series to the General Market

Automotive Electronics (AES)

Report Snapshot

NXP has now launched its new S32K range of microcontrollers for the general market. These devices are targeted at automotive body and motor control applications. NXP is thus now offering ARM-based devices to a broad range of customers in a segment that has been dominated by proprietary-architecture devices. The increasing demands on controllers in body applications mean that this is unlikely to be the last such development.

Automotive

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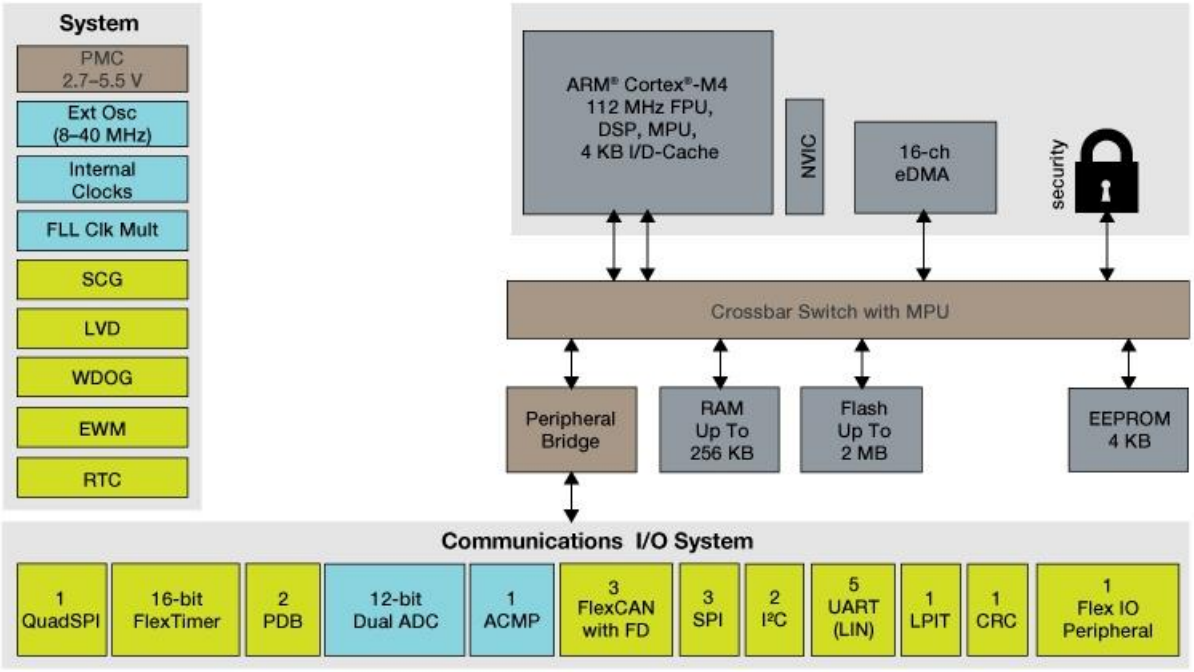
Analysis

With the launch of its S32K Series to the general market, NXP is now offering ARM-based microcontrollers targeted specifically at applications in the body domain, including motor control to a broad base of customers. The first devices will be based upon the ARM Cortex-M4, and will be followed by lower-end variants based upon the Cortex-M0+. The single-core devices feature ECC, memory protection, core self-test and other safety mechanisms supporting ASIL-B applications. Software and hardware design features are implemented in the S32K to address for low power consumption requirements.

Pre-announced in 2015, the S32K MCUs feature a Secure Hardware Extension (SHE) compliant module to help secure communications and protect the integrity of subsystems. Devices at launch will support CAN Flexible Data rate (CAN-FD) as well as the FlexIO configurable peripheral. Planned family variants yet to launch will support Ethernet. The devices will all be manufactured on a 90nm process.

Exhibit 1 NXP S32K Block Diagram



Source: NXP

Body Control Market Growth

Body control applications can sometimes be overlooked in favor of application areas which at face value are seeing a greater rate of change, such as advanced driver assistance, safety and electrified powertrains. However, the

sheer volume of body domain functions, and the associated high number of microcontrollers used to implement them, means that body applications are of significant importance to semiconductor vendors.

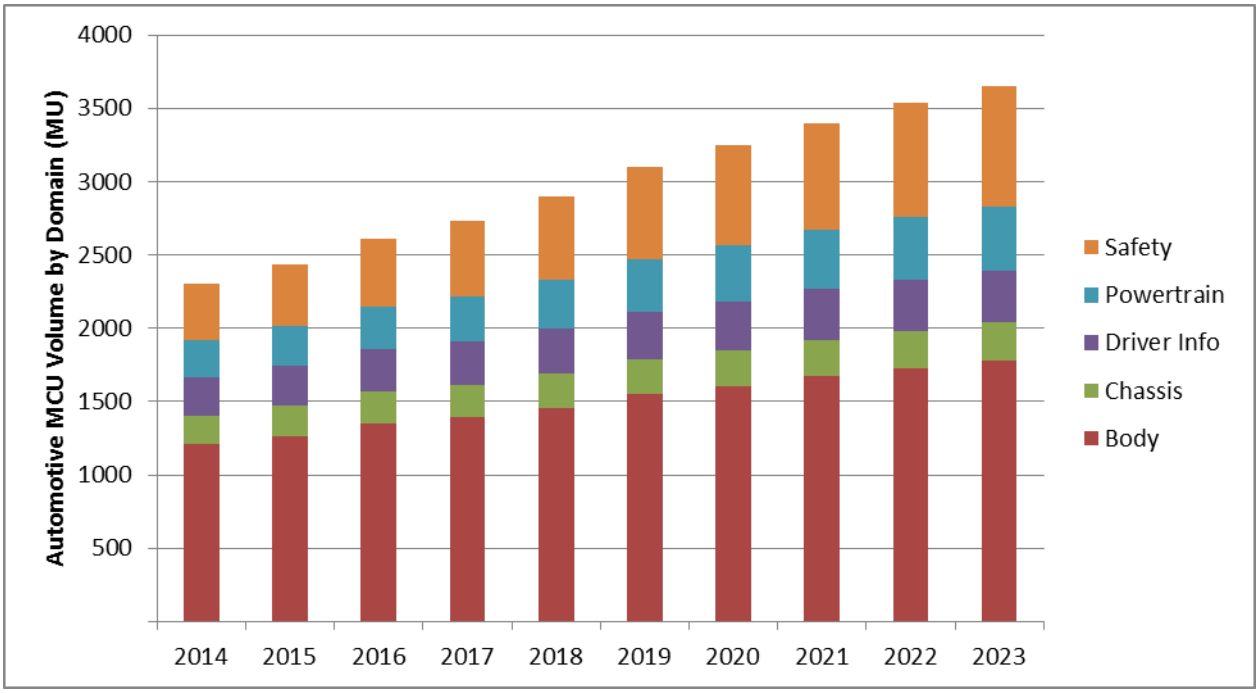
As the second largest automotive microcontroller vendor (after Renesas), NXP has been a major player in this space, with a range of products such as its S08, S12 and 32-bit Power Architecture-based devices. These products series will all continue, with the new-for-general-market S32K offering suppliers and carmakers an alternative to these proprietary core approaches.

S32K already has design wins in several automotive suppliers. The availability of the product for the general market will now make the product family available to a wider base of customers. NXP now has a scalable portfolio of ARM-based automotive-grade body MCUs accessible to a broad range of customers. This range offers an extensive ecosystem that NXP claims can simplify the implementation and reduce time to market and development costs.

- Renesas is also a significant player in body control, with devices such as its RL78 and V850 series. However, there are also many other players in this space, with some (e.g. Microchip and Cypress) specializing in highly cost-optimized devices for relatively low-value applications.

In 2016, Strategy Analytics data shows that over 50% of all microcontrollers fitted to light vehicles were used in body domain applications, with over 1.3 billion MCUs fitted (Exhibit 2).

Exhibit 2 Automotive MCU Volumes by Domain (MU)



Source: Strategy Analytics

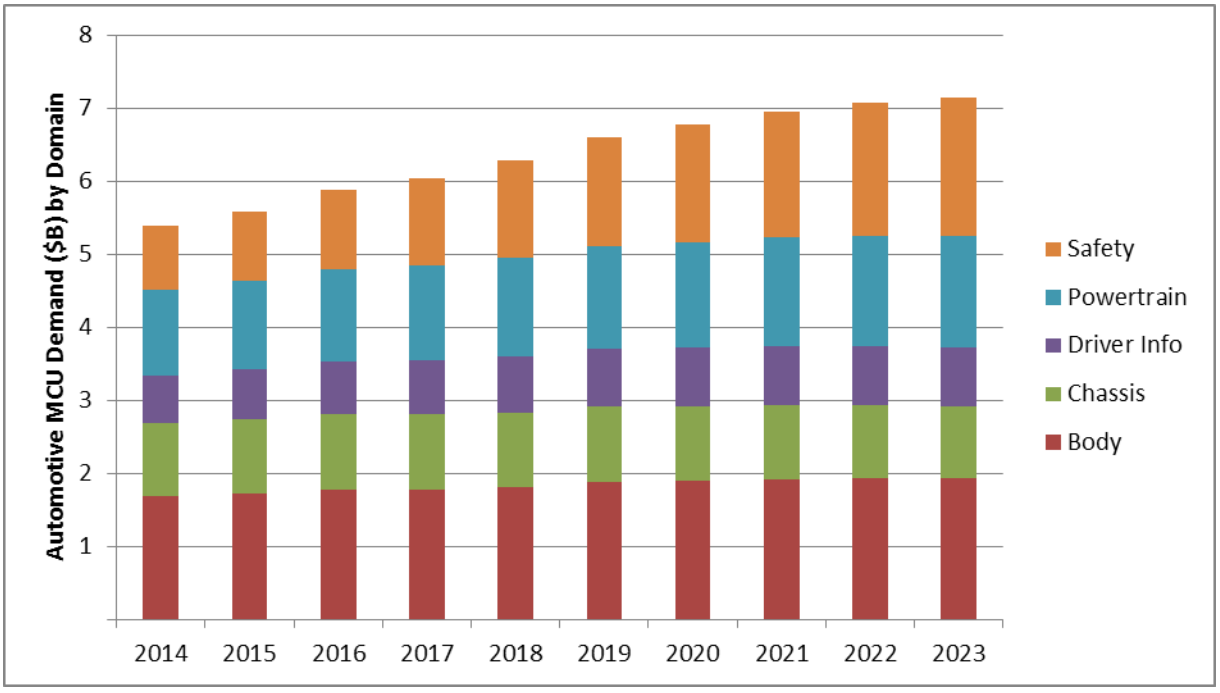
This works out at approaching 15 body MCUs per vehicle, on average. Moving into this (for automotive) high-volume space is thus clearly of interest to ARM, which receives a small royalty payment for each device shipped using its IP.

- Although not growing as strongly as powertrain and safety, body applications will remain hugely important in volume terms, and will still account for 49% of total MCU volume demand in 2023, with the use of almost 1.8 billion MCUs expected in body applications.

Body applications typically have much lower processing requirements and are highly cost sensitive compared to many other automotive areas, so in value terms the market for body control devices is somewhat less dominant.

However, Strategy Analytics calculates that in 2016 the total value of MCUs fitted to light vehicles reached almost $1.8 billion. This again makes it the largest domain application area, accounting for around 30% of total automotive MCU dollar demand. By 2023, demand for MCUs in body control applications is expected to reach over $1.9 billion (Exhibit 3).

Exhibit 3 Automotive MCU Revenues by Domain ($B)



Source: Strategy Analytics

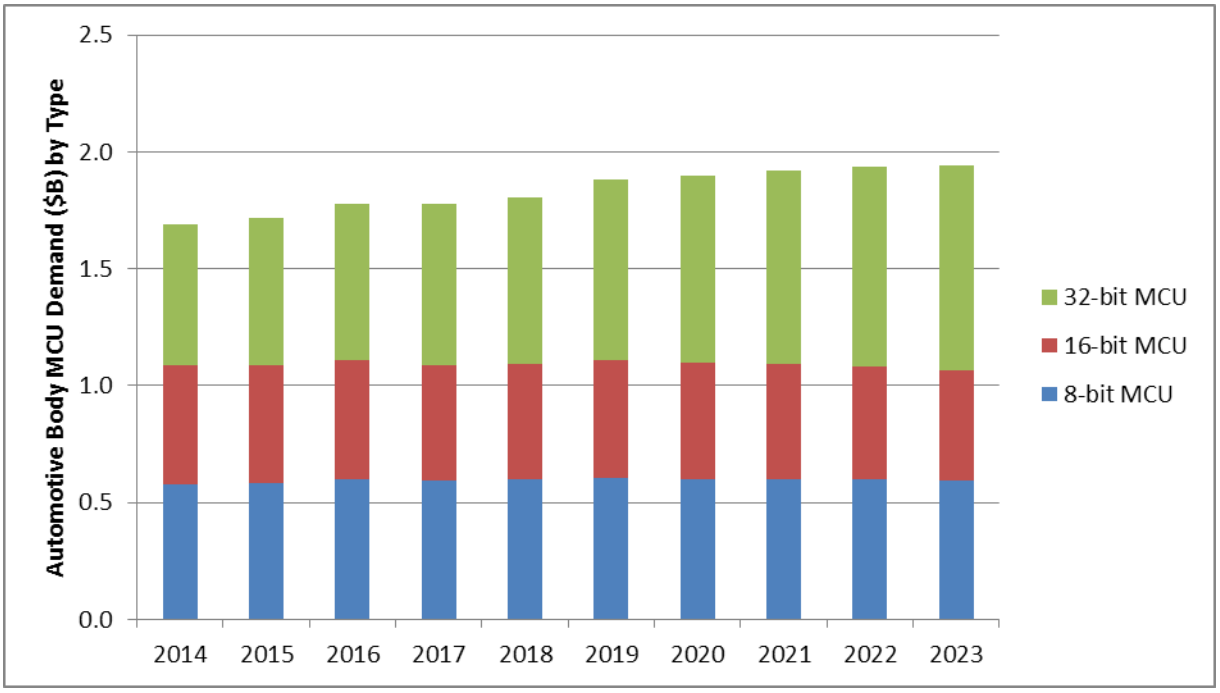
Changing Dynamics in Body Domain Applications

Despite the lower level of attention that body control applications often receive, the market is not static and changes are underway.

Although the overall demand is continuing to grow, Strategy Analytics expects demand for the lower-end 8- and 16-bit MCUs used in body control to stagnate or even fall in dollar terms. All of the growth is being driven by the use of more powerful 32-bit devices – and it is into this market that NXP is launching the ARM-based S32K.

32-bit microcontrollers are thus expected to grow from around 38% of total body MCU dollar demand in 2016 to over 45% by 2023 (Exhibit 4). With the wider availability of S32K, there is potential for this to accelerate further, and Strategy Analytics thus believes that there is upside potential on 32-bit designs in body control applications.

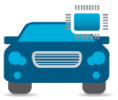
Exhibit 4 Automotive Body MCU Demand ($B) by Type



Source: Strategy Analytics

The key market forces taking place in body control applications are seen by Strategy Analytics as follows:

- **There is a constant demand for more consumer features.** In emerging markets and low-end vehicles there is still growth to be found in features such as window lift and HVAC. In more mature markets, functions such as power seats, power-fold mirrors and power-operated lift and tailgates are becoming available on a much wider range of vehicles.



  - This is leading to a still increasing demand for the number of physical ECUs fitted to vehicles, and thus the number of MCUs used to control the applications. Although there is much talk of vehicle architecture change, consolidation and integration, this has yet to make any significant impact on the market. For volume, mass-market vehicles which comprise the majority of demand, Strategy Analytics believes that we will be well into the 2020s before vehicle architecture change starts to make an impact. When it does, ECU consolidation will likely be around higher-value powertrain, safety/automation and infotainment/cluster application areas.
  - Even for those OEMs (such as BMW) who are in the vanguard when it comes to vehicle architecture change, the relatively low-value body electronics is likely to be the last area to see significant centralization. We are likely to see standalone modules for many body functions for years to come, and there is an increasing argument to move these to cost-effective 32-bit designs.

- **Body application requirements are increasing.** As can be seen by the much higher growth expected for 32-bit devices in body applications, there is an emerging need for higher-performance devices.

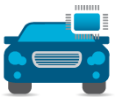
  - After years of relative stability, vehicle networks are seeing change. Increasing use of electrical actuators, including BLDC motors, requires a greater level of distributed processing and intelligence for sensing, control and diagnostics.
  - In the near term, CAN-FD is becoming much more highly specified, even in body applications. The need to move ever increasing amounts of sensor data around the vehicle is requiring greater bandwidth, and greater processing power to process and manage the data. Longer-term, Ethernet will become much more widely used, with body control modules and network gateways requiring significant processing power to manage the higher data rates.

- **Security requirements are growing.** Automotive has rightly been criticized for paying too little attention to cyber security and hacking concerns. This is an accusation perhaps more levelled at carmakers and tier 1 suppliers, as semiconductor vendors have been offering hardware security modules for many years, which have often been under-utilized.

  - Although security concerns have often focused on telematics and infotainment systems, core body systems such as security and access control systems have also shown vulnerabilities. In general, increasing the security of a solution requires more processing power and more memory.
  - The importance of a layered security architecture is also becoming much more apparent. Simply securing access points and hoping nobody breaches those is typically not sufficient. Building security features into a much wider range of modules will help stop the propagation of the network, even if it is breached at some point.

- **Functional safety design support is increasingly expected,** as body control systems themselves are now forming part of vehicle safety systems.

  - Increasingly, OEMS are looking to optimize seat position and close windows and roof systems based upon input from vehicle sensors if a crash is seen as imminent. This means that there is



potential for these systems to "move up" the ASIL rankings, and see tighter requirements for cyber security, as they are now forming part of the vehicle safety solution.

- **Low power consumption is vital**, despite the trend to higher performance. This is especially the case for body systems such as access systems which frequently have to "wake up" and cannot so easily go into a long-term deep-sleep or power-off condition to save power. ARM solutions typically offer a much better power/performance ratio than the proprietary architectures offered by many vendors today. The cores have been developed with mobile applications in mind, where power consumption is arguably an even greater consideration.
  - Body applications are numerous, and thus even if individually they do not consume much power, when added up the total can be much more significant.
  - Functions such as security and access systems need to operate when the driver has parked the vehicle. These devices have to cope with a cycle of frequent wake-up; fast start-up; high-performance task execution and then fast shutdown, and do so whilst consuming the minimum of power. They also need to offer low static mode leakage and multiple low power run modes for when the vehicle is parked for an extended time.
  - TPMS systems can also be subject to frequent wake-up calls from both the wheels on their own vehicle but also those nearby. In multi-storey carparks that can be significant, with vehicles to the left, right, front, rear, above and below all potentially triggering a wake-up call.
- **AUTOSAR needs platform-based approach.** OEMs and suppliers are increasingly looking to re-use code and applications across vehicle lines, and are thus moving to more abstracted software development, such as AUTOSAR. This typically puts a higher requirement on the host MCU. OEMs and tier 1s also require a wide product family at varying price/performance points so that they can scale solutions appropriately.
- **Strong ecosystem support is required.** NXP has already been offering ARM-based solutions to its industrial clients for some time with the Kinetis range. The ARM ecosystem is large, with plenty of suppliers of the various toolsets required to bring a solution to market in a timely manner.
  - Automotive is attracting attention from vendors outside of the sectors. Market entry is made easier by microcontroller products with automotive-grade toolset support.
  - There is a more diffused body electronic module supplier base, of varying company sizes, compared to say powertrain or safety modules. The smaller companies are typically served via semiconductor distributors and are highly reliant on the free availability of design support toolkits.
  - Time-to-market is an important consideration in tier 1 product selection decisions. Strong ecosystem support has the potential to reduce design-cycle time.

Implications

Strategy Analytics sees that the automotive market is inexorably moving towards ARM-based approaches. ARM-based solutions are already commonplace in many advanced safety and infotainment applications. ARM is also

starting to move into powertrain solutions, as reported last year by Strategy Analytics in its Insight report "ARM Addresses $1B Powertrain Processor Market with New Cortex R52 Core".

This latest move by ARM and NXP continues this trend. As body control electronics evolve and require new designs requiring greater performance, while maintaining very low power consumption, off-the-shelf ARM becomes a more obvious solution. In some instances the investment required to bring existing proprietary architectures up to competitive levels will not be insignificant, so Strategy Analytics would not be at all surprised if more semiconductor vendors followed NXP down the ARM route for body control solutions.

Nothing ever changes overnight in automotive, and NXP has stated that its S08, S12 and 32-bit Power Architecture devices will continue alongside S32K. The new device, with an anticipated price falling in the $2 to $5 range will be positioned very much at the upper-end of body control MCUs, and so will not initially threaten much legacy business. However, as body requirements increase and the range of devices offered scales across the initial M4 and then lower-cost M0+ cores, ARM-based solutions will start to look more attractive for a wider range of applications in the body space.