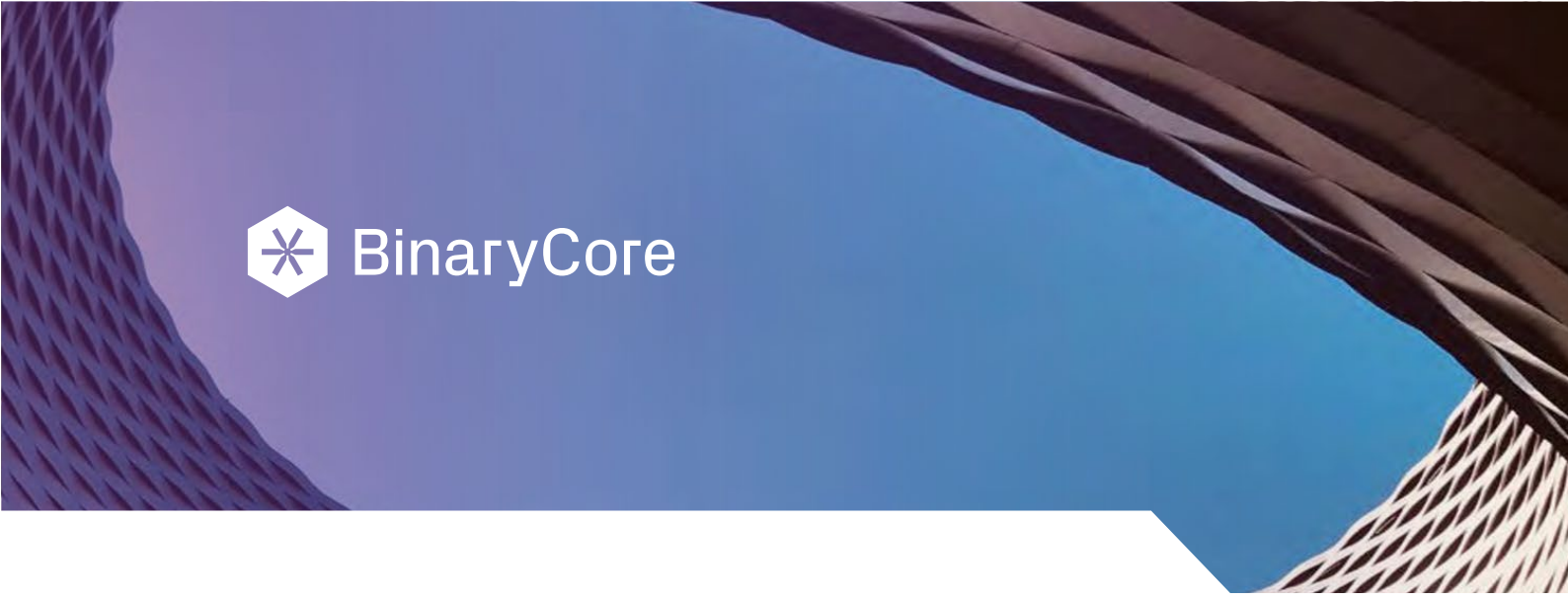


BinaryCore

12 September 2022

How focusing on hardware today can boost returns in tomorrow's software-driven world

For traditional automakers, it's time for a whole new way of thinking. The right hardware investments now can boost revenue and lower costs down the road when the spotlight is on software.

For decades, hardware has been a major factor in the automotive industry's push to be more cost-effective. But now, software is beginning to create even more value. New entrants in the automotive field and in the tech industry are having no problem embracing this change, but traditional automakers are struggling to figure out what this shift means when it comes to product development

and the hardware that will be needed for the vehicles of tomorrow.

In addition, the focus on hardware-driven cost optimization is preventing traditional original equipment manufacturers (OEMs) from delivering the expected market returns in three promising areas: recurring software revenue, faster time to market, and lower development costs. To unlock their full potential, these automakers will need to remove the barriers that are preventing them from capturing higher market returns in these three areas. It's time for a full-blown rethink of the hardware-centric approach.

Using today's hardware to magnify tomorrow's ROI

Fortunately, the secret to becoming a market leader actually lies in an area that these OEMs are already experts in: investing in hardware now can fuel tomorrow's revenue and efficiency gains in a more software-driven world. How? With a lens that is focused on addressing some specific challenges to magnify the return on investment (ROI) (see figure 1).

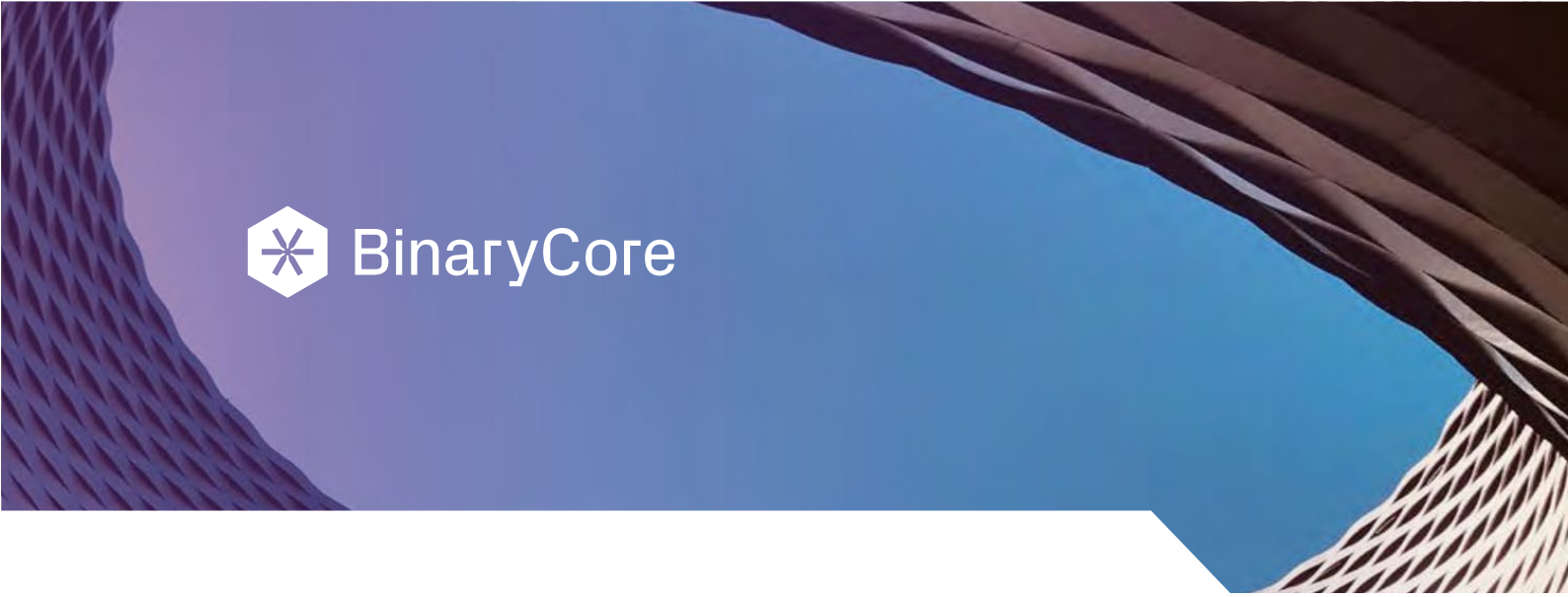


Figure 1
A variety of challenges are preventing automakers from unlocking their full potential in a software-driven world

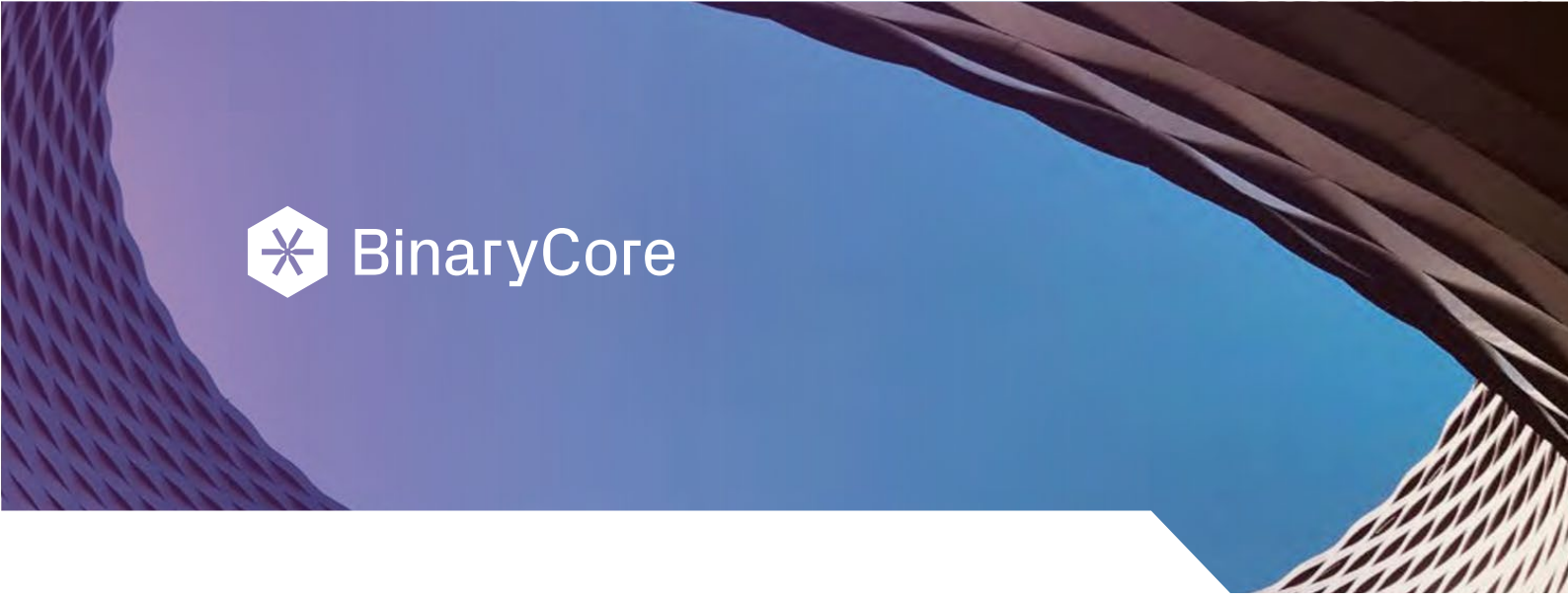
Goals	Challenges	Hardware overspecification	Power to magnify the return on investment
50% recurring software revenue by 2030	In-field vehicles with sufficient hardware capacity	Accessible in-field capacity for future recurring revenues (more than seven years covering first and second customers and beyond)	4
Development costs below the competition	Complexity, development time, manual tasks, and required FTE	↑ Scalable hardware platform for complexity and development cost reduction	4
A time to market for lead vehicles of less than 15 months	An organizational mindset that is open for "digital and fast" development	↑ Highest accessible hardware quality in the market for SOP at feasible costs	3

Note: FTE is full-time equivalent; SOP is start of production.
Source: Kearney analysis

The leaders are prioritizing their hardware investments based on the capabilities they'll need tomorrow, when the environment will be more software-driven, by developing products that are a step ahead of what today's customers need. Hardware overspecification can address all three areas—recurring software revenue, faster time to market, and improved cost efficiencies—by providing more hardware capacity across all vehicle models to create in-field capacity for customer-driven connected services later on down the road.

Three forward-thinking approaches can help OEMs lower the barriers to success:

One cohesive architecture. In-field vehicles will need to have enough hardware power to capture recurring revenues over a product lifetime of more than seven years. Developing a coherent service portfolio across all model



classes will require having one homogeneous architecture. This will include providing the most in-demand features without constraining in-field end-to-end hardware requirements, and it will lead to other new services, such as augmented reality navigation, dedicated in-car app platforms, and AI-driven functions for autonomous driving. With this approach, OEMs can create a continuous customer engagement cycle and tailor many car features to the customer, including in secondary and tertiary markets.

Lower development costs. In a more competitive market, platform development costs need to be lowered with simplification, shorter development time, and more automation. Capturing real cost efficiencies and accelerating in-field revenue will require having fewer revisions, spending less on optimizing performance, and getting vehicles to market in less than 15 months.

A "digital and fast" mindset. Customer demand drives the need for automakers to release models faster, which amplifies the complexity of hardware specifications across platforms and limits the potential for testing the quality of every component to ensure zero faults. This requires a new organizational mindset that aims to deliver digitally and at speed.

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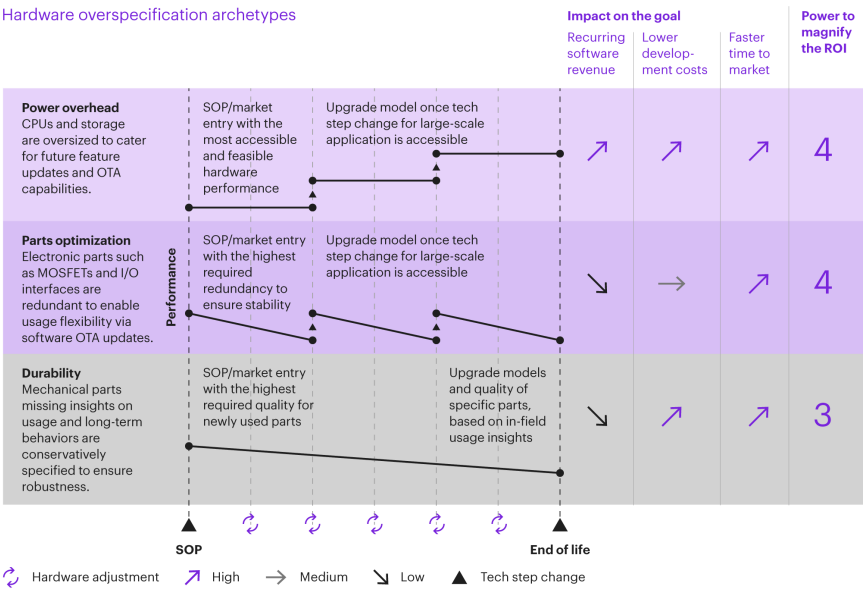
Improving the hardware even after production has begun

Three hardware overspecification archetypes map out a way for OEMs to meet or even exceed their market potential (see figure 2). The goals of each archetype are different, as is the power to magnify the ROI with the most effective investments.

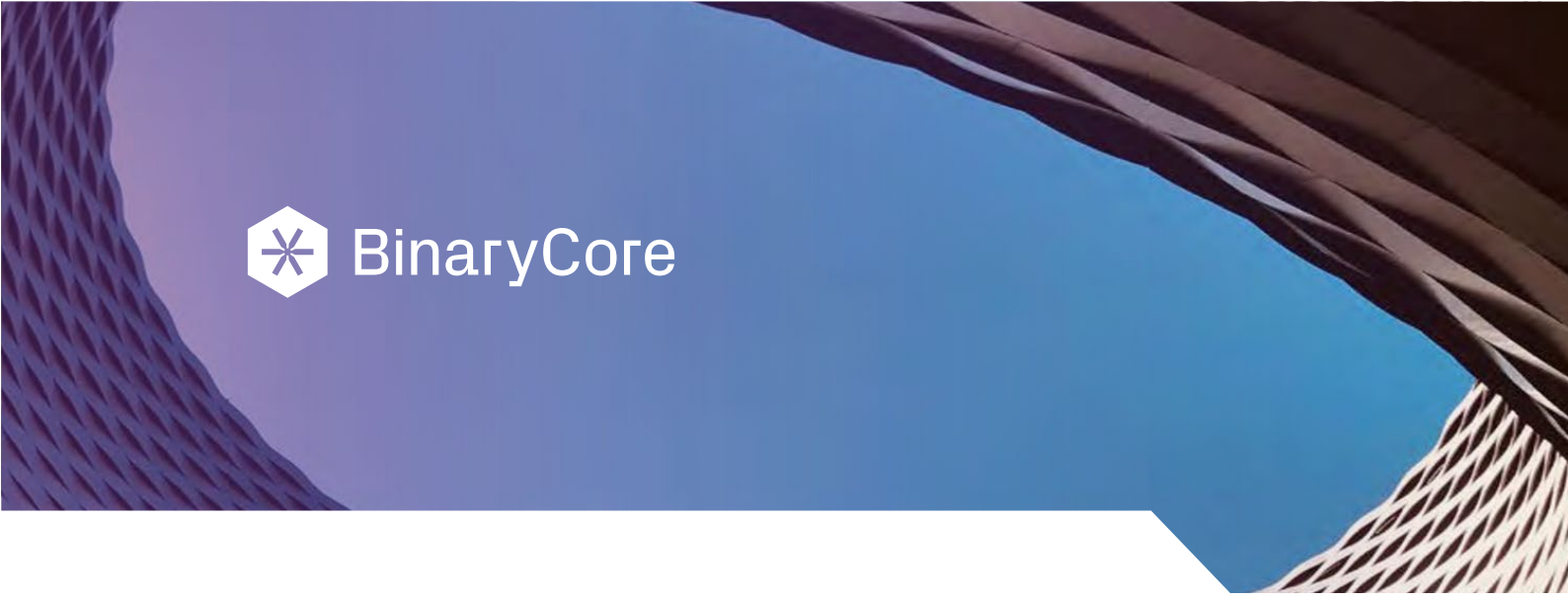
Figure 2
Automakers can meet or even exceed their market potential with three approaches



Notes: OTA is over the air; MOSFETs are metal oxide semiconductor field-effect transistors; I/O is input/output; SOP is start of production.
Source: Kearney analysis

Archetype 1: power overhead

Oversized CPUs and storage can help OEMs continuously adapt and scale the performance of their vehicles with upgrades that can be installed as soon as new technology



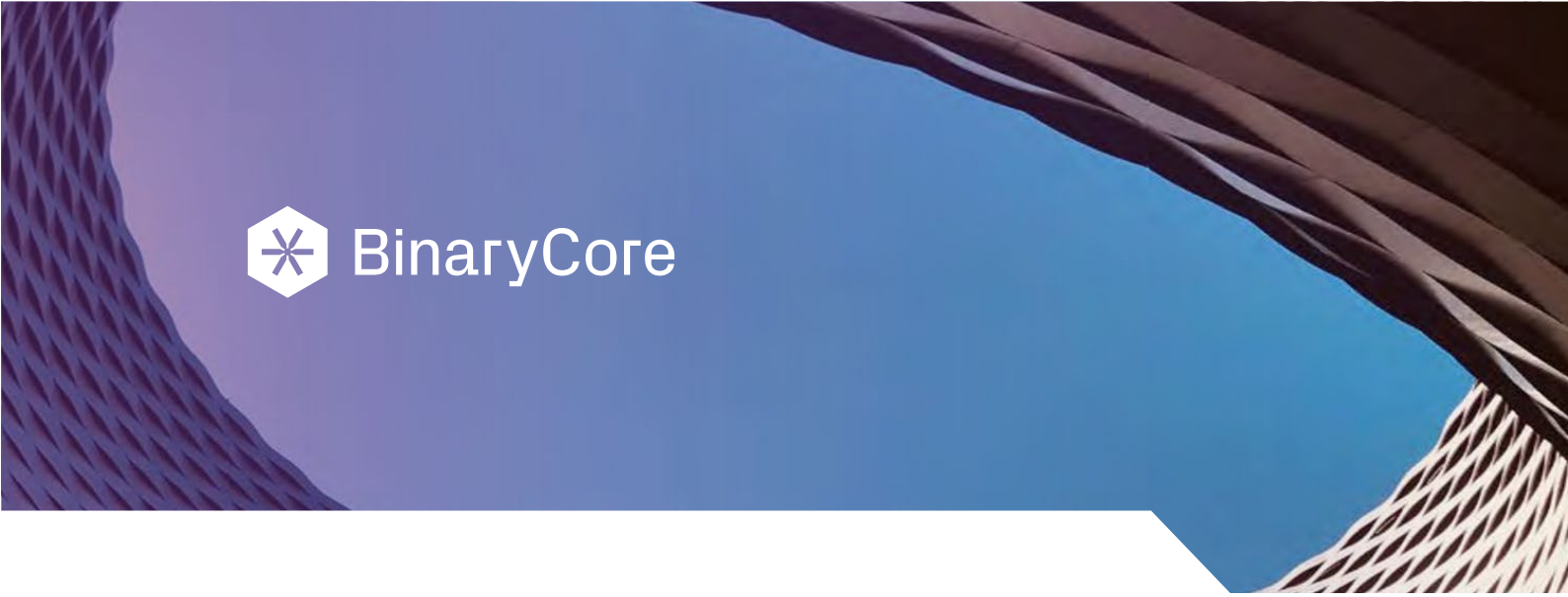
is available. This will be essential to serve the growing hardware requirements across vehicle zones, such as infotainment.

Using the power overhead can boost revenue by expanding in-field platform capacity, which allows for differentiation with functions on demand (FOD) and features over the air (FOTA), leading to a higher service take rate and enhanced customer value over the lifetime of the vehicle. Integrating the most-scalable performance components can lower unit costs and reduce vehicle-specific complexity (see sidebar below: Eyeing today's software budget to invest in tomorrow's revenues). Additionally, maximum accessible supplier performance along with centralized sourcing with a focus on the most-demanded, highest-resource features and critical-feature rapid prototyping can shorten the time to market.

Sidebar: Eyeing today's software budget to invest in tomorrow's revenues

Situation

Optimizing software performance accounts for about 10 percent of the budget for a software control unit in order to meet an original equipment manufacturer's hardware requirements.



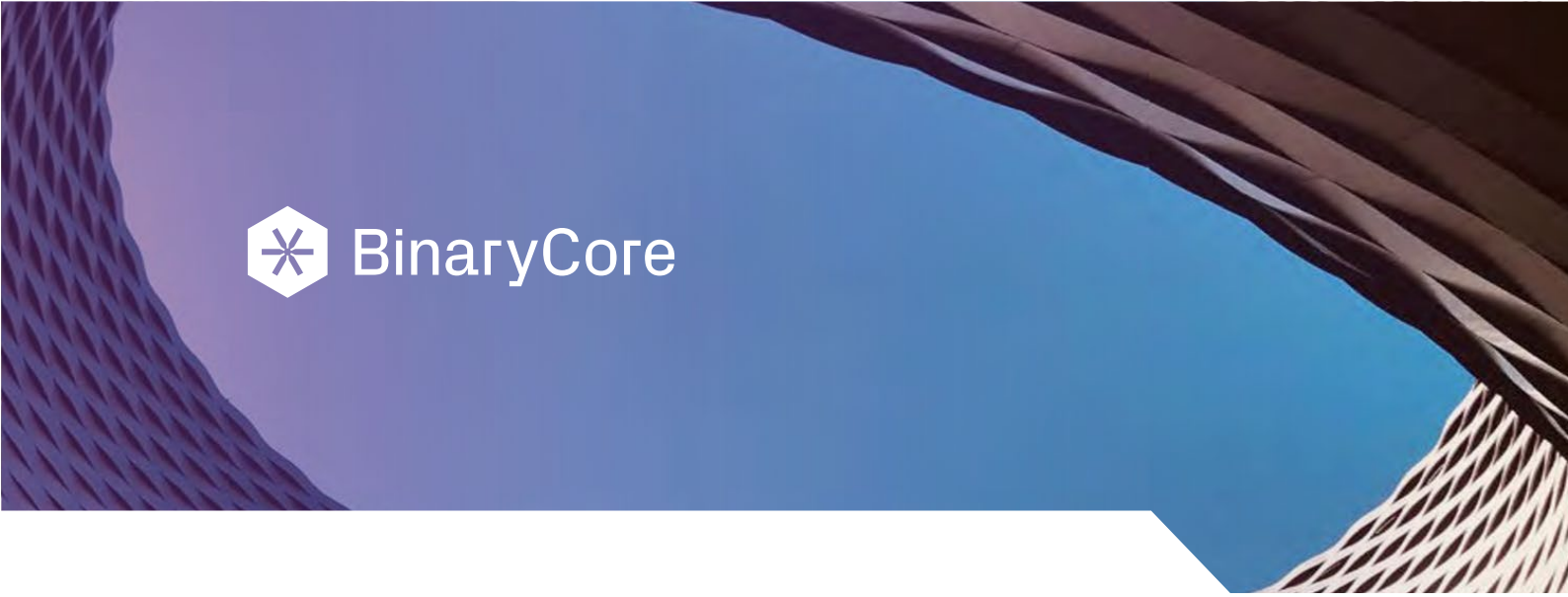
Approach

Optimizing software performance by about 80 percent, **while also factoring in physical constraints such as heat development**, maximizes the impact on the software control unit budget by lowering costs by about 4 percent. Investing this saved amount into more specified hardware components creates an investment into the future revenue platform.

Implications

A radar control unit's software budget might be €20 million. Reducing performance optimization to 80 percent removes 4 percent of the radar control unit's software budget (€800,000), which can then be reinvested into hardware specifications. Assuming an average number of 200,000 vehicle models sold relying on the same radar specification, there is an additional budget of €4 per radar electrical control unit. On average, the hardware of a radar electrical control unit accounts for €20, depending on the specifications—creating an uplift of about 20 percent and providing the next generation of hardware **with a range of new revenue stream opportunities including service level differentiation through shadowing and data monetization, while continuously redefining the customer experience.**

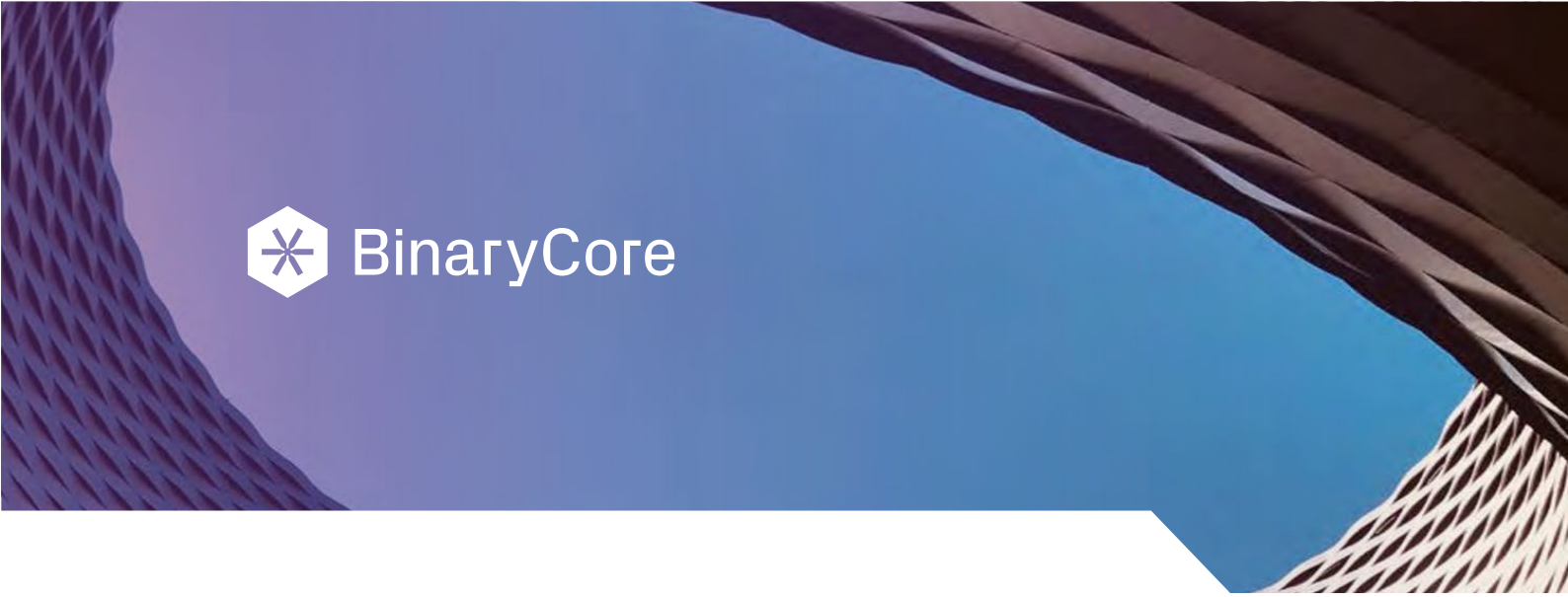
Outsourcing hardware performance to the cloud is becoming common practice in other tech markets, such as



the gaming industry, where high-demand storage and performance capacity can be moved to optimized servers with only the control signals or images being streamed to the customer. Consequently, performance resources can be offloaded and the cost of customer-facing hardware optimized.

Challenger OEMs are already moving in this direction—for example, by offering game streaming in their cars. However, there are two major challenges: transaction costs and network availability. First, with more streaming adding more Internet traffic, transaction costs for managing the data also go up. These costs must either be paid for by the OEM or included in customer subscription fees, similar to streaming service business models. As a result, many services run the risk of becoming less attractive for customers to purchase or for OEMs to provide. And second, outsourcing car functionality to the cloud requires continuous high-speed Internet connectivity. With only 30 percent of mobile connections working on the 5G network, even in leading 5G countries, outsourcing infotainment or safety features could drastically impact the customer experience.

Although the cloud can certainly complement on-board hardware, the overspecification of customer-facing hardware will be a prerequisite for adequate service delivery.

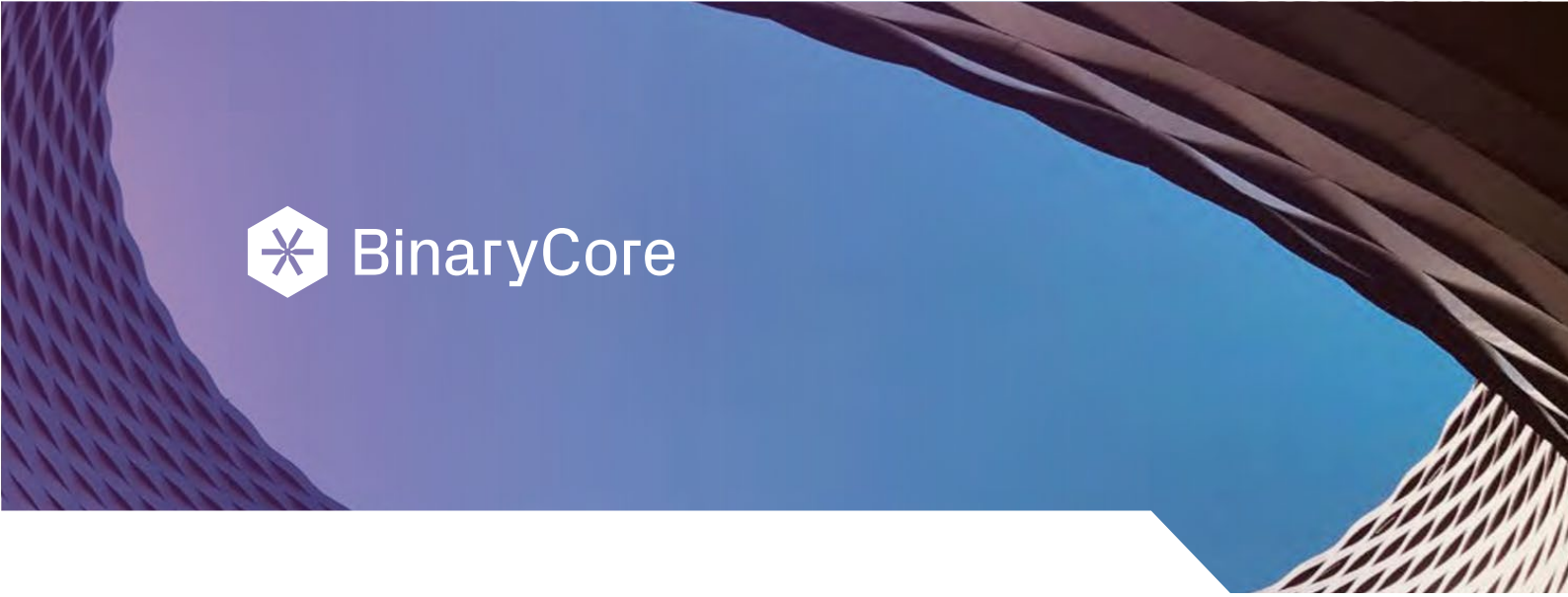


Archetype 2: parts optimization

Compared with automotive OEMs, traditional technology players are mastering the trade-off between time versus cost or quality. At the start of production (SOP), they use the most-accessible and best-performing electronic parts, such as metal oxide semiconductor field-effect transistors (MOSFETs) and input/output (I/O) interfaces. If a bug or error occurs, over-the-air (OTA) updates can reduce the impact on customers because the performance headroom and redundant parts allow the company to make immediate fixes without the customer having to come in or, in extreme cases, avoid a costly recall.

Once in the market, products can be continuously optimized, redundant parts can be revised, and high-cost or high-performance parts can be replaced with more efficient parts. The OEM can gather in-field usage data about the performance of particular parts and reduce costs without compromising the customer experience—lowering margins for lead vehicles while potentially realizing higher margins for derivative vehicles.

Our analysis of an established consumer tech player revealed that some components could be optimized. After observing customer behaviors, the company eliminated a feature to upgrade RAM by soldering the storage to the printed circuit board, thus reducing costs. Rerouting the



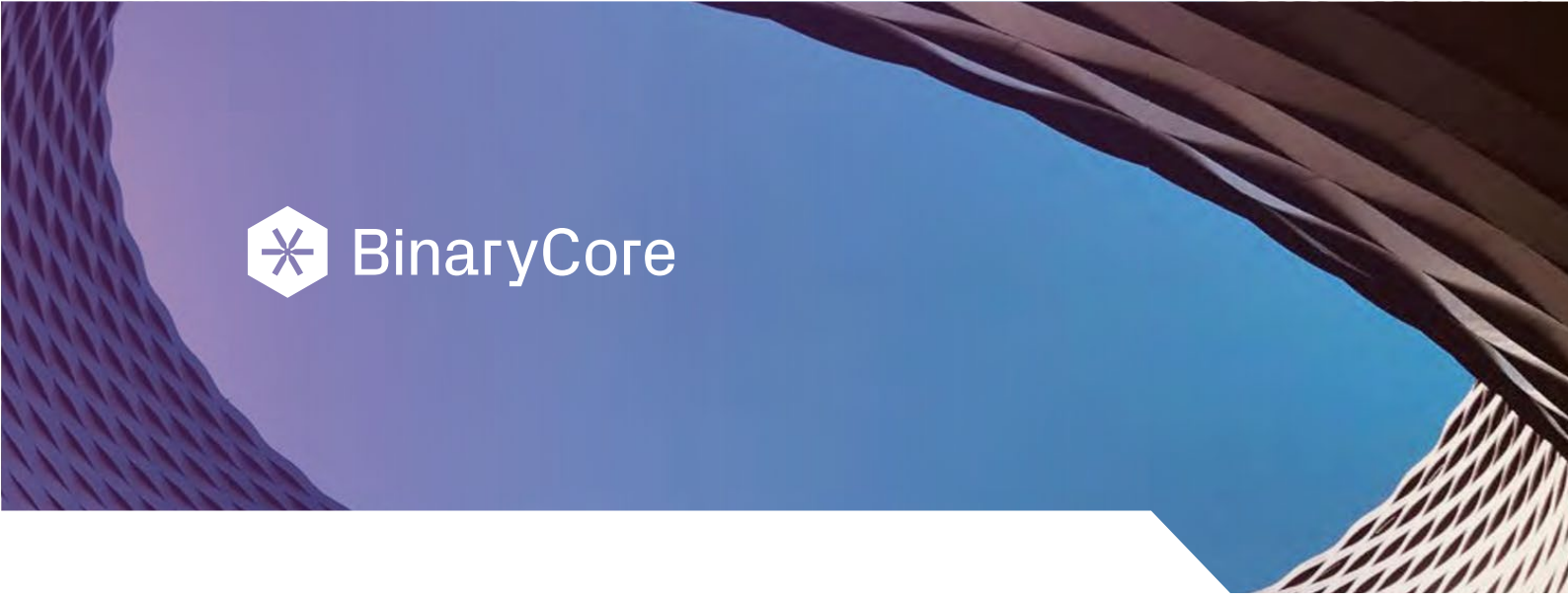
signal wires also reduced the layer count on the board, creating even more cost-saving potential.

One exemplary challenger OEM has already proven that redundant components can also work in the automotive world. To accelerate the industrialization process, the automaker's new power amplifier for brake lights was not tested for long-term capabilities. To mitigate the risk, a backup amplifier was installed—preventing a costly, large-scale recall. After the first reports of brake-light failures, the developers rolled out a fleet software OTA update to split the current between the two amplifiers. Based on the in-field data, the hardware design was updated with an optimized single amplifier and rolled out to production within three months.

This approach not only contributes to recurring revenue but can also decrease the time to market and enhance the OEM–supplier relationship with more customer insights. By lowering margins at the start of production with collaborative cost reduction, we have seen hardware costs, including redundant parts and durability, drop by up to 30 percent.

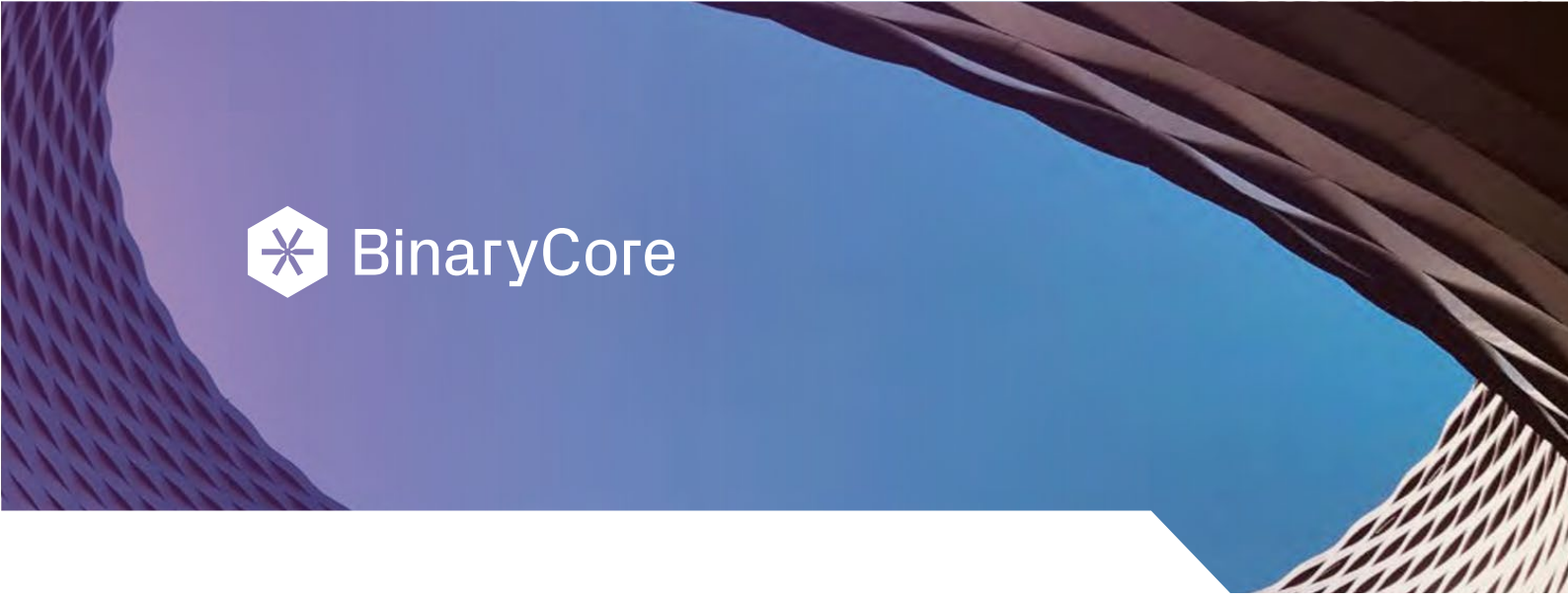
Archetype 3: durability

Conservative specification of mechanical parts without in-depth insights about actual usage and long-term customer behaviors has been a foundation of automotive



engineering for decades. This design principle ensured that an SOP or market entry for new parts were manufactured to the highest quality. Adapting this principle in the form of an optimized in-vehicle high-performance computing (HPC) stack with oversized CPUs and storage guarantees the robustness that will be required for future features—features that allow the kind of software-driven differentiation that both traditional OEMs and challengers are striving for. Once basic software and the ecosystem can be updated remotely, not only will the new releases excite customers, but they will also give OEMs valuable in-field insights that can be used to enhance the product.

In the short term, this game-changing in-vehicle HPC stack will raise the hardware-specific costs by about half. On one hand, because of the iterative nature of defining a robust hardware architecture on a large scale and the lack of applicable workforce skills, OEMs and their car software organizations will need to bridge the required large-scale investments. On the other hand, a robust HPC stack lowers R&D spending (for example, for model- or hardware-specific change requests) and can create synergies across the automotive value chain, such as in purchasing or production—reducing R&D spending by 10 to 30 percent per vehicle and creating a potential cost savings that is much higher than the initial investment in hardware-specific costs.



Interested in exploring a new approach?

We understand the complexity involved in a new software-centric automotive world and the organizational changes that will be needed to make the shift. Success will require a cross-company approach, establishing hardware requirements that are focused on magnifying the return on investment followed by continuous optimization after the start of production. Contact us to learn more about the opportunities in hardware overspecification.

To read our "Achieving excellence in automotive software" series in collaboration with Kearney click here, or to access our software features database contact: socialmedia@binarycore.com

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