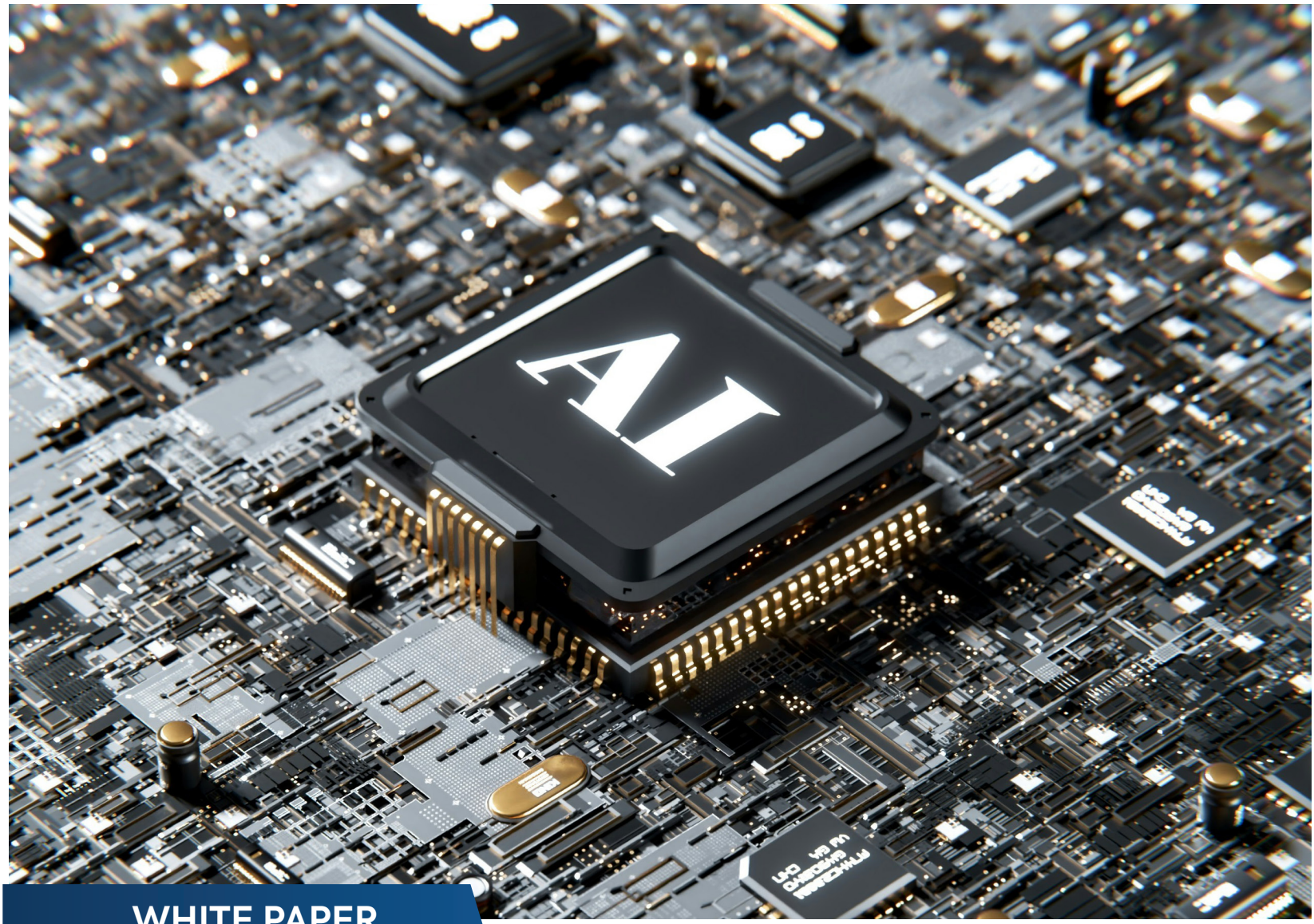

WHITE PAPER

AI Acceleration at the Edge: Optimizing Product Design

PARKS ASSOCIATES

DEVELOPED FOR:

SILICON LABS

AI Acceleration at the Edge: Optimizing Product Design

As the smart home and broader IoT ecosystem mature, AI is becoming a core driver of product innovation. Consumers increasingly expect devices that learn, adapt, and respond intuitively, and many OEMs are introducing new AI-powered services to drive recurring revenue and increase customer retention.

AI, particularly when deployed at the edge, is powering more personalized, proactive, and secure device experiences. Edge intelligence supports real-time decision-making without cloud reliance, unlocking use cases like presence detection, voice classification, and context-aware automation. Edge compute also improves development cycles through real-world data feedback and faster feature testing.

This paper assesses how intelligent edge devices support competitive strategies through personalized automation and AI-driven support tools. **For OEMs, delivering this level of intelligence requires SoC choices that align compute power with specific applications while managing energy use and cost.** This research assesses how SoC decisions impact the practicality of AI features across device categories. Matching silicon to workload, whether sensing, audio, or vision, improves performance, reduces BOM complexity, and speeds time to market. As cost remains a top concern for mass-market adoption, edge AI supports innovation while helping companies deliver smarter, more affordable products.

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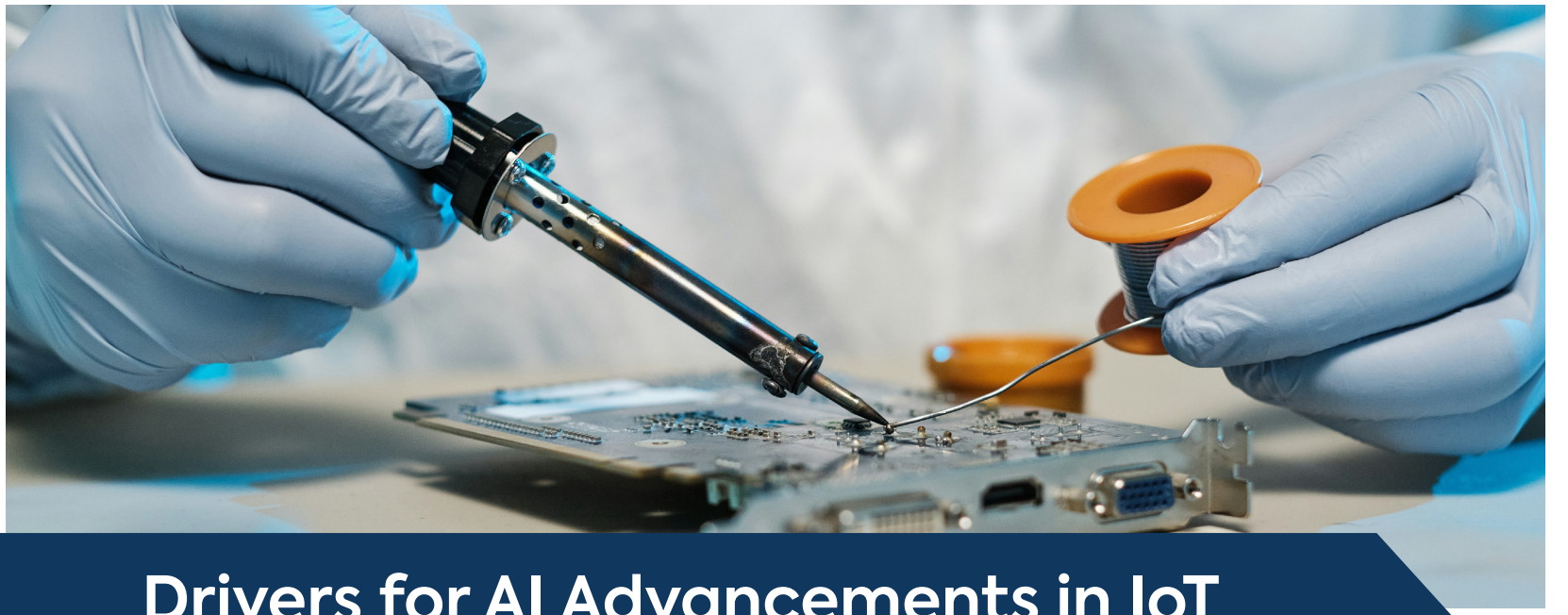

Drivers for AI Advancements in IoT

As the smart home market expands and competition intensifies, OEMs are evaluating the potential of AI to achieve real business impacts:

- Cut through the competition with **differentiated products and user experience**
- Generate **new revenue** through service offerings
- Expand solution value and **applications**
- Achieve operational **efficiencies**

Competitive Differentiation

Smart home device adoption has reached the mass market in the US, with 48% of US internet households owning at least one smart home device and consumer IoT markets growing globally. A deluge of competitors have entered the market seeking a piece of the pie; in the smart camera segment alone, Parks Associate counts 98 brands active in the US market.

In a Parks Associates survey of 133 consumer IoT businesses executives, **industry leaders report that AI, ecosystem integrations, and affordability are the keys to differentiation** in the smart home market today.

Q: What competitive advantages do you see as most critical for success in the smart home market?

- "AI capabilities and ecosystem integration" – **Smart water product OEM**
- "Hardware capabilities; value of products and services in an economic climate that may drive increased price sensitivity by consumers; AI for advanced security system functions." **– Security system provider**
- "Simplicity in engagement and AI use cases that are able to be monetized." **– Smart HVAC/ thermostat OEM**

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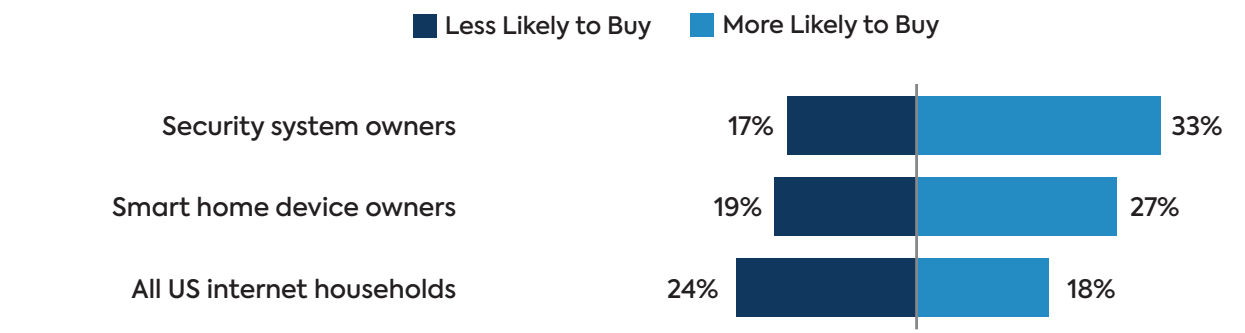
Consumer IoT players have been leveraging AI for years to power some of their most innovative features, but a new crop of consumer-facing AI tools is raising customer awareness of AI benefits. Parks Associates research finds consumer familiarity with AI features and technologies is growing. As AI familiarity accelerates, it is reshaping how consumers evaluate what their technologies can do for them. Smart home device and security system owners are early adopters of next-generation AI tools and over-index on familiarity, use, and spending on generative and conversational AI apps.

51% of US internet households currently use generative AI tools.

Parks Associates research indicates that advertising products as having AI makes consumers less likely to buy those products today — but smart home and security products are an exception. More security system and smart home device owners would be convinced to buy a product with AI marketing than turned off by it — the opposite is true for the average consumer.

Impact of AI Marketing on Likelihood to Purchase Products



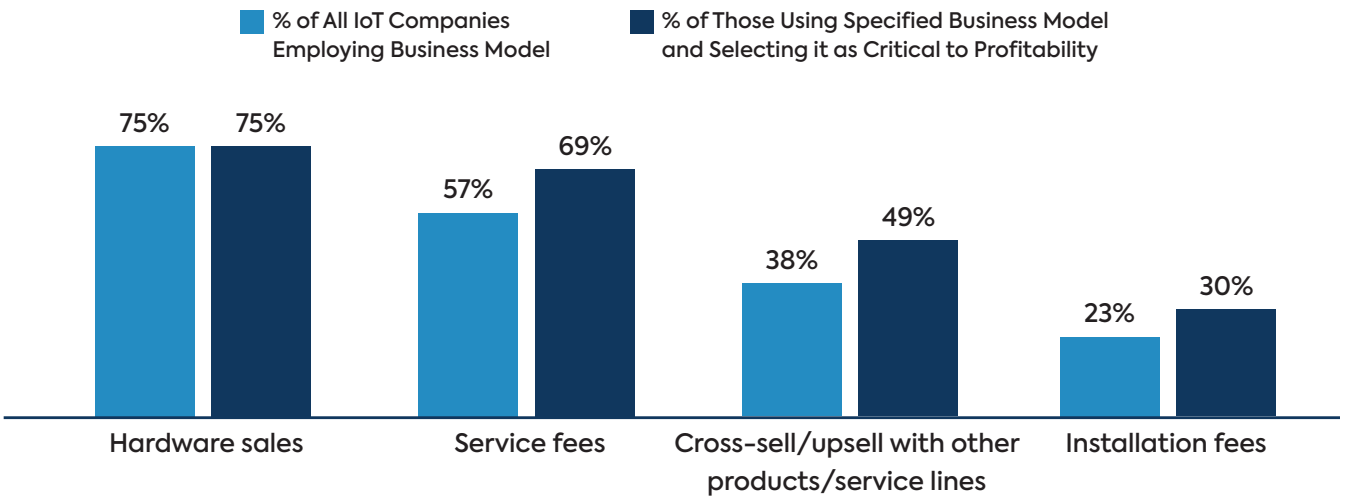
Service Monetization and Recurring Revenue

Companies bringing products to market in the smart home or consumer IoT sectors must think differently about costs compared with traditional, non-connected product development. The sensors, networking, and ongoing connectivity required for smart home products require a long-term view that accounts for ongoing development, cloud connectivity and support.

Smart home companies offering attached services report 76% customer retention after 12 months, highlighting the long-term value of this approach.

Companies employ a variety of business models to recoup their ongoing costs, in many cases offering subscription services to create a recurring revenue stream. After hardware sales, IoT companies report services fees are most critical to solution profitability. These services not only drive new revenue streams but also help strengthen customer loyalty.

Consumer IoT Business Model Use & Impact on Profitability



AI has the potential to be a service revenue engine in a market where hardware providers desperately seek recurring revenue to cover ongoing connectivity and support costs. Several industry players already charge for premium AI services in tested price ranges:

Dealer-focused smart home controls player **Josh.ai** offers its own AI model, JoshGPT, that powers its voice control and automations. Its Josh Core hub performs device control and voice processing on the edge for speed and privacy. Monthly pricing ranges from $10-$30/month, depending on control capabilities.

Wyze enables some Edge AI features like Person Detection for no additional cost, but premium Edge AI features like Motion Warning and motion-activated lights require a paid subscription.

Arlo uses a combination of edge and cloud AI for real-time threat detection for its paid security camera and system subscribers.

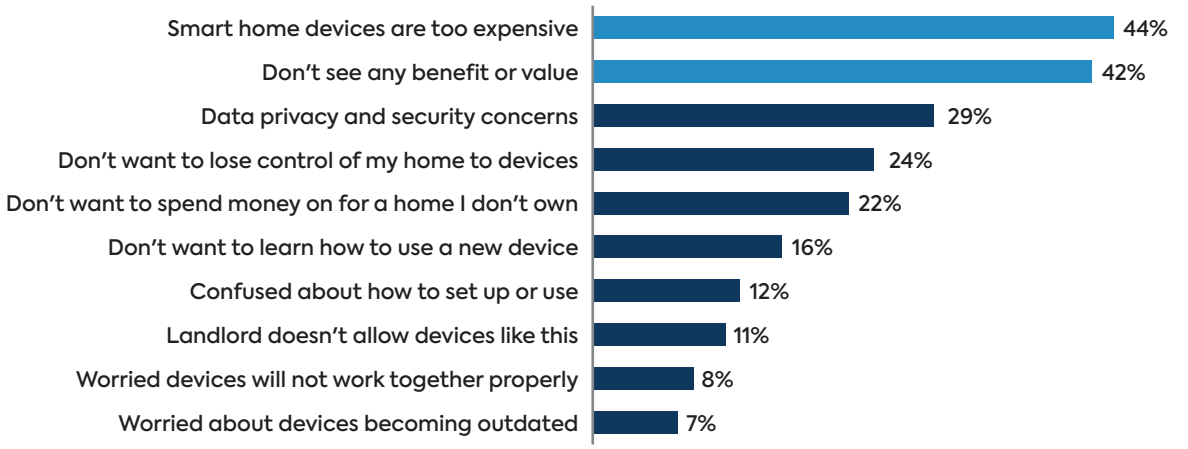
Parks Associates' concept testing finds that 52% of consumers are willing to pay monthly for an intelligent home assistant that offers premium value through security, convenience, and automation, representing a service opportunity that exceeds $12 billion annually.

Expanded Solution Value and New Applications

To capture the next wave of adopters, smart home manufacturers must both deliver new layers of value and do so at affordable prices, as cost and lack of value are consistently the top two barriers to adoption.

Smart Home Device Purchase Inhibitors

Among Those Not Owning or Intending to Buy



AI-powered enhancements that personalize the user experience and offer intuitive control are compelling differentiators and promise to add value through expanded capabilities and applications:

- **Deepening value through integration:** Just 40% of smart home device owners have devices working together today, and 39% of these users found it difficult to create the routines or automations. AI-generated routines can simplify these integrations, helping devices recognize context and suggest meaningful automations. In doing so, AI not only enhances convenience but also addresses the core use cases driving adoption.
- **Adding context to alerts and emergencies:** Being notified that there's an issue at home and potentially requesting emergency assistance is at the core of smart security solutions, but high rates of false alarms have spurred major investment in systems and solutions that can more intelligently understand context to better determine when an emergency is real and dispatch is warranted. AI helps solution providers leverage information from the sensors and wireless signals coming from the vast device landscape in the home to ensure consumers are only alerted of meaningful information, to get residents the right support when they need it — and avoid utilizing precious first responder resources unnecessarily.

- **Training sensors for improved performance:** The sensors providing the contextual data are also getting smarter. Adaptive learning is a critical innovation in sensor performance, improving accuracy and reliability. Glass break sensors, for example, can incorporate SoCs that have been trained on large datasets of audio samples, helping the sensors differentiate the unique sound of glass breaking from other ambient sounds.

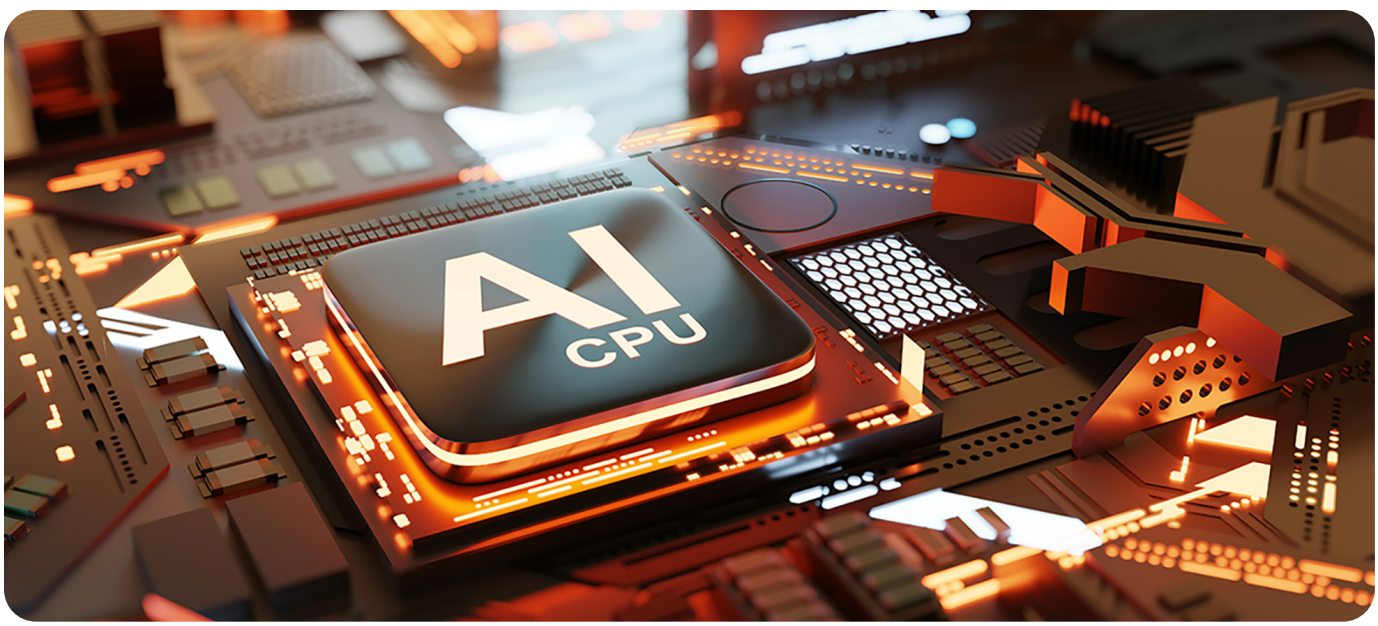
Device manufacturers are prioritizing delivering smarter, more capable devices at lower hardware costs to keep building value while keeping products affordable and profitable. Edge-based AI is a key enabler in reaching that two-pronged goal, supporting advanced behaviors such as presence detection and audio/voice classification without requiring cloud service.

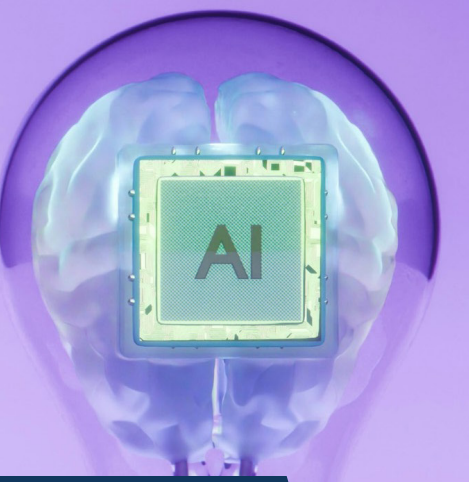
Innovations in AI-focused silicon, including on-chip accelerators and low-power SoCs, allow edge devices to handle complex tasks like anomaly detection, sensor fusion, and environmental awareness with minimal latency. Hardware accelerators make these on-device capabilities possible, offering low-power, low-cost implementations that broaden adoption.

Hardware Accelerators

Hardware accelerators are co-processors that offload complex calculations (e.g., matrix and vector operations, cryptographic operations) from the main core, freeing up the CPU for other tasks or to enter a low-power sleep state. AI acceleration on the device can significantly reduce reliance on cloud-based processing, improving responsiveness while lowering bandwidth and operating costs.

IoT products using hardware accelerators in their SoC design enjoy faster performance with lower power consumption. For instance, Silicon Lab's MVP hardware accelerator results in up to eight times faster inferencing and up to six times lower power for inferencing over Cortex-M, which is critical for battery-powered devices.[1]





OEM Decisions at the SoC Level to Enable AI at the Edge

OEMs want to limit risk, starting small with AI and scaling as needed for enhanced applications, such as low-power options for small, battery-powered devices. There are many options to enable AI today, including multiple protocol and processing decisions and combinations to choose from. Selecting the right mix depends on trade-offs between latency, cost, energy consumption, and data privacy. For example, vision-based sensors may use edge AI to classify motion locally, while energy management systems may use cloud processing for broader analytics and control. Hybrid approaches that blend edge and cloud are also gaining traction, offering manufacturers flexibility as they experiment and expand.

Some of the most critical factors for OEMs in enabling AI at the edge include power efficiency, compute optimization, cost management, and security.

Power Efficiency: Enabling Long-Lasting Intelligence

Traditionally, AI computing has been highly power intensive. However, AI at the edge must operate within constrained energy budgets, particularly in battery-powered devices. To address this, low-power capabilities such as deep sleep states and efficient edge inferencing can optimize both idle and active power states. Energy-efficient SoCs are designed with these constraints in mind, enabling prolonged device uptime without compromising performance.

Dedicated hardware accelerators are key to enabling AI at the edge, while preserving power. As demand grows for always-on intelligence in compact devices, efficiency becomes as critical as raw compute power.

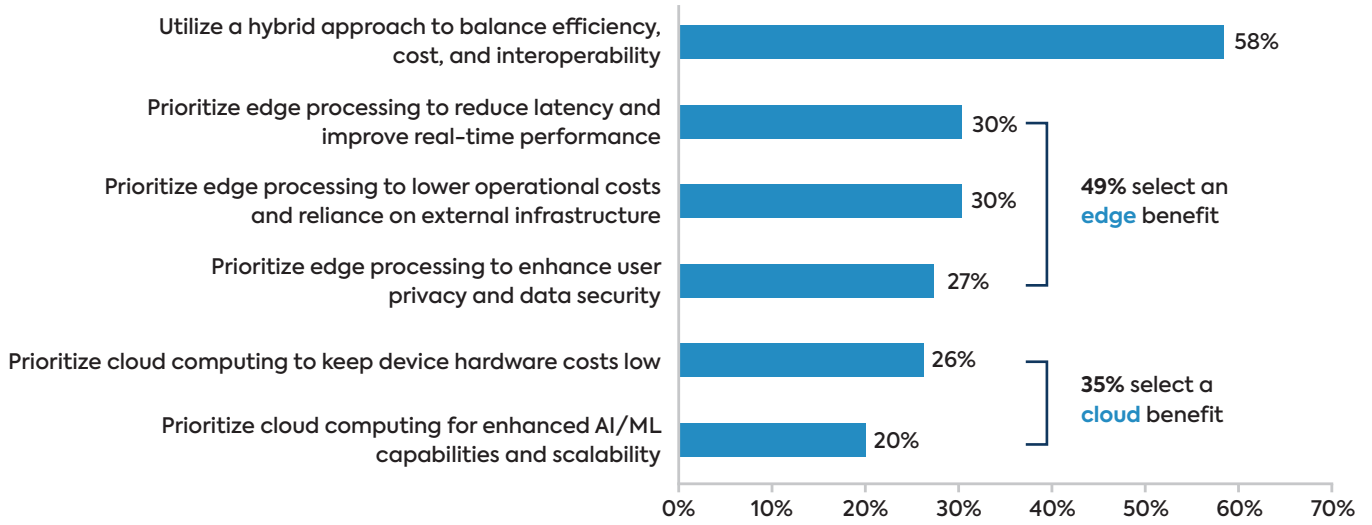
Compute Optimization: Building at the Edge

AI acceleration built directly into the chip improves processing efficiency and makes real-time audio, sensor, and presence detection possible. Matching the right silicon to the right application is vital, such that energy-efficient SoCs can handle lighter-loads and are well-suited for sensor-heavy applications, while more specialized chips will hit energy/performance needs for audio/voice and for vision. Each option is tailored with the compute capabilities required for its workload, allowing OEMs to align silicon choices with both performance needs and product design constraints. This approach helps avoid unnecessary cost or power overhead.

On-device processing and storage can help keep cloud costs down, improve real-time performance, and offer user privacy/data security benefits. More extensive use of the cloud can help keep hardware costs low by minimizing the need for on-device processing and storage and leveraging the power of external data tools. Slightly more IoT executives see edge benefits as core to their strategy than cloud benefits. While some design decisions leverage the best of both, companies must decide if their business model best aligns.

Most OEMs today employ hybrid AI models, balancing the responsiveness of edge intelligence with the scalability of cloud processing.

Edge vs. Cloud Compute & Storage Strategy



49% of surveyed IoT company leaders favor edge compute benefits over cloud alternatives, reflecting the strategic importance of pushing more intelligence to the device level.

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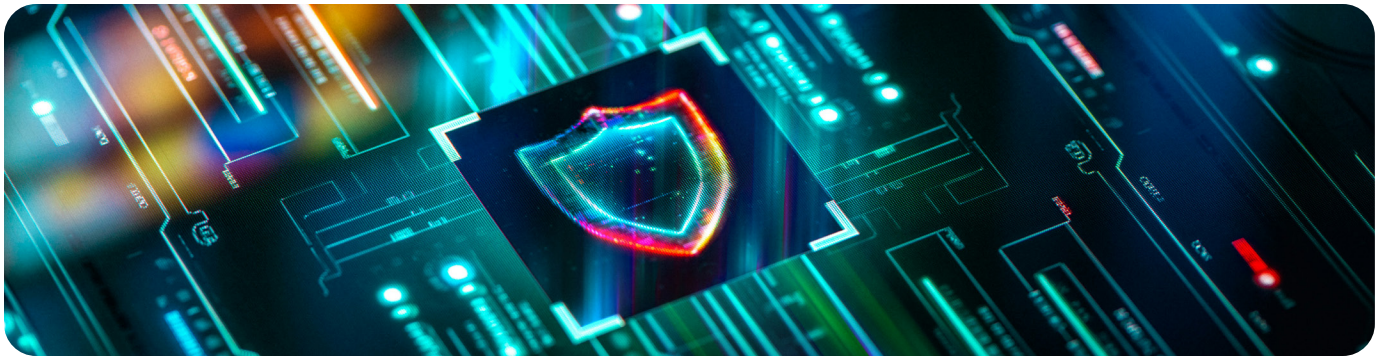
Cost Management: Smarter Silicon Without Overdesign

To avoid overbuilding for specific applications, OEMs need to carefully weigh the tradeoffs between precision, performance, and cost. For example, OEMs of a product like smart tags that need highly precise location accuracy may choose to embed ultra-wideband (UWB) but at a premium price point. If less precision is acceptable, OEMs can reduce costs by leveraging Bluetooth SoCs for both connectivity and intelligence — using techniques like channel sounding as a substitute for UWB. Similarly, AI inference does not always require high-end SoCs if hardware accelerators are available to support key workloads.

Minimizing the number of microcontrollers needed is another key design principle. Single-chip solutions that combine Bluetooth connectivity with AI acceleration simplify product architectures, lower bill of materials (BOM) costs, and reduce system complexity. This makes it possible to extend AI capabilities into mainstream and value-tier products, rather than reserving them only for premium devices.

Even leaner SoCs can still support high-value features such as wake-word detection or presence sensing, demonstrating that advanced intelligence does not always require top-end silicon. As smart home adoption broadens into the mass market, manufacturers are increasingly focused on delivering affordable, differentiated features that resonate with cost-conscious consumers. These design choices will determine which companies succeed in scaling AI to the widest set of households.



Product Security Starts at the Chipset

Beyond compute performance, secure SoC features are equally important. Capabilities such as device attestation, non-trackable IPs, and strong cryptographic protections help ensure trust in edge devices. These safeguards are particularly critical as the number of connected endpoints grows, increasing the surface area for potential attacks.

Parks Associates data shows that 19% of smart home device owners would switch platforms if a different platform offered better security, and 16% would switch for control without internet connectivity, showing the importance of both security at the edge and control at the edge.

Case Studies: Selecting SoCs for AI-Powered Products

Case Study: Intelligent Access Control Using a Heavier-Load SoC[2]

Smart audio-sensing door locks can recognize sounds like knocking, key-turns, or voice commands (through voice ID recognition) to activate the lock — and even allow for unlocking on approach. These capabilities are powered by a heavier-load SoC, such as Silicon Labs' BG24 series, which combines AI/ML acceleration, multiple protocols, and low-power operation.

Key features enabled by the technology include low power consumption, multi-protocol support, Bluetooth channel sounding, and AI/ML acceleration. In practice, developers use machine learning model building pipelines with Silicon Labs' AI-accelerated BG24 SoC to collect and label acoustic events — such as knocks, key insertions, or deadbolt movement — and train models that run directly on the device.

This architecture not only supports real-time, on-device AI but also allows for firmware updates without altering hardware. This extends the lock's intelligence over time, either by adding tamper detection, voice signature recognition, or even glass-break detection.

Case Study: Appliance Anomaly Detection Using a Lighter-Load SoC[3]

Consumer IoT devices like washing machines, HVAC units, or fitness trackers can be monitored with sensors to detect vibration, movement, or temperature in real time, spotting issues such as imbalance, overheating, or unusual use patterns without relying on cloud connectivity. This edge-based monitoring reduces latency, improves reliability, and ensures that critical insights are available even when connectivity is limited.

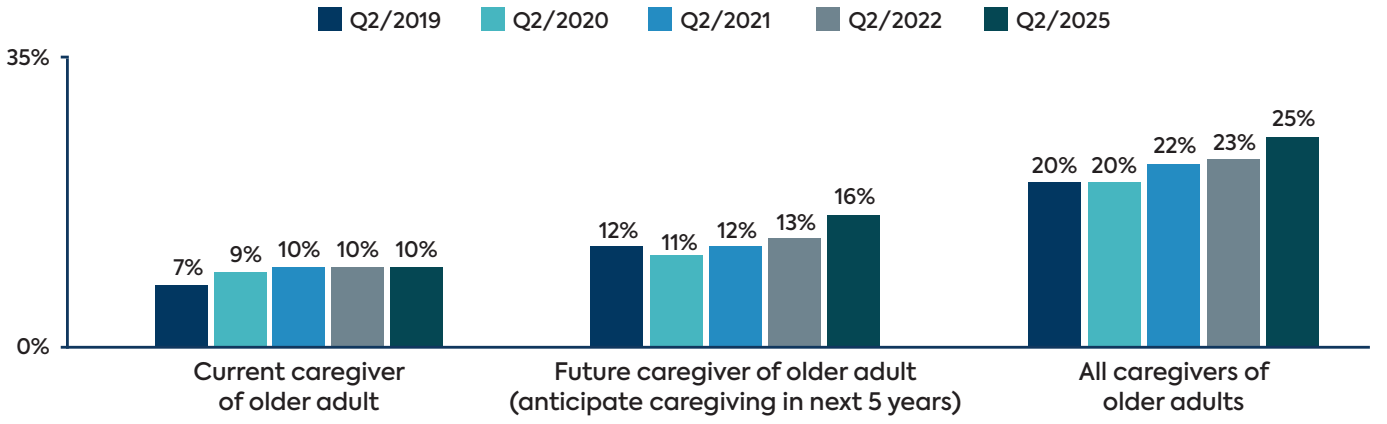
Key features include ultra-low power consumption, fast processing, and built-in AI pattern tracking tailored for lean, resource-conscious devices. This allows predictive maintenance and anomaly detection to run directly on the device, ensuring issues are detected early without draining the battery. The BG22L further emphasizes efficiency, offering long lifetimes on coin-cell batteries, the ability for devices to enter deep sleep and wake up only when a specific external RF signal is detected, and a simplified design that reduces external components.

Together, these "Lite" SoCs provide a balance of performance and cost for appliances and sensors that need intelligence at the edge but don't require heavy-duty compute.

Case Study: Intelligent Health Monitoring Using a Lighter-Load SoC

The addressable market of seniors and their caregivers continues to grow, with 25% of consumers in US Internet households currently serving as a caregiver to an older loved one or anticipating doing so in the next five years. 16.3 million family caregivers report embracing technology as a means to care for their loved ones, using both multi-purpose technologies like smart watches, smart speakers, and smart cameras and specialized devices and systems like Personal Emergency Response Systems (PERS) and sensor-based systems tracking their loved ones Activities of Daily Living (ADLs). This is up from 14.4M caregivers in 2022.

Family Caregivers of Older Adults (Age 65+) among US Internet Households



AI at the edge is reshaping how health and wellness devices deliver value to consumers. Home health monitors are moving beyond basic tracking to recognize patterns that could indicate distress, enabling proactive care. In elder care, presence detection and gesture recognition empower systems to provide timely emergency assistance, offering families greater peace of mind. Fitness devices are evolving into intelligent companions that can identify posture and exercise gestures, giving users real-time guidance without reliance on the cloud, benefiting users of all ages.

These use cases highlight the growing demand for responsive, secure, and always-available AI experiences directly on the device. SoCs with hardware accelerators are purpose-built to handle AI workloads efficiently at the edge. By offloading processing from the main CPU, the BL26 delivers the performance required for continuous monitoring while keeping power consumption low — essential for wearable and always-on devices. This approach eliminates latency issues tied to cloud dependency, ensures critical functions remain reliable even in bandwidth-limited environments, and preserves user privacy by keeping sensitive health data on-device. For device manufacturers, the BG26 provides a scalable path to deliver intelligent, secure, and differentiated products in the competitive health and wellness market.

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Redefining Possibilities: Impact of AI/ML

AI/ML is redefining what is possible in IoT, and SoC decisions are critical to delivering smarter, more efficient products. Whether enabling presence detection in smart homes or predictive maintenance in appliances, purpose-built SoCs allow manufacturers to add intelligence without draining power or inflating costs. Features like on-device inferencing and integrated AI accelerators make it possible to bring advanced capabilities into leaner, more accessible designs.

OEMs that align SoC choices with application needs can unlock new service opportunities, differentiate their offerings, and meet rising expectations for privacy and performance. By optimizing for compute, power, and cost, manufacturers can build AI-enhanced products that scale from premium to mass market without compromise. As AI capabilities continue to evolve, these design decisions will shape not only individual devices, but the landscape of the entire connected consumer ecosystem.

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About Parks Associates

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Parks Associates, a woman-founded and certified business, is an internationally recognized market research and consulting company specializing in emerging consumer technology products and services. Founded in 1986, Parks Associates creates research capital for companies ranging from Fortune 500 to small start-ups through market reports, primary studies, consumer research, custom research, workshops, executive conferences, and annual service subscriptions.

The company's expertise includes new media, digital entertainment and gaming, home networks, internet and television services, digital health, mobile applications and services, consumer apps, advanced advertising, consumer electronics, energy management, and home control systems and security.

About Silicon Labs

www.silabs.com

Silicon Labs (NASDAQ: SLAB) is the leading innovator in low-power wireless connectivity, building embedded technology that connects devices and improves lives. Merging cutting-edge technology into the world's most highly integrated SoCs, Silicon Labs provides device makers with the solutions, support, and ecosystems needed to create advanced edge connectivity applications. Headquartered in Austin, Texas, Silicon Labs has operations in over 16 countries and is the trusted partner for innovative solutions in the smart home, industrial IoT, and smart cities markets. Learn more at www.silabs.com.

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[1] https:// www.silabs.com/blog/mcu-ai-ml-intelligence-and-embedded-systems

[2] https:// sensiml.com/blog/collecting-and-labeling-silabs-xg24-smart-door-lock-sensor-data
https:// www.silabs.com/wireless/bluetooth/efr32bg24-series-2-socs

[3] https:// www.silabs.com/blog/bg22l-and-bg24l-bluetooth-lite-socs-are-purpose-built-for-iot

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