

# Performance and Scalability for IoT Innovation

arm

Solution Brief

Powerful, highly scalable IoT solutions lay a path to success for thousands of global companies already shaping the digital transformation.

## Deliver Secure IoT Systems to Market Quickly and Efficiently

In the coming decades, billions of intelligent IoT devices will provide the building blocks for a new services-driven, data-powered global economy. Today, Arm solutions are already at the foundation of this evolution, enabling organizations to bring high-quality, secure IoT devices to market quickly and cost effectively.

Arm's powerful continuum of IoT solutions offers proven and secure hardware, software, and services designed to help organizations reap the full benefits of transforming their business models through IoT, such as:

- ✦ **Comprehensive, chip-to-cloud coverage:** Arm helps you build any kind of IoT system at any scale and with seamless, secure connectivity, whether your system connects to a local cloud, or is fully cloud connected.
- ✦ **Extensive partner ecosystem:** Arm is at the epicenter of the world's largest compute ecosystem, comprising a vast community of software, tools and service providers that support the proliferation of IoT technologies across markets, industries and apps.
- ✦ **IoT device security:** With the support of its ecosystem, Arm has a full spectrum of security solutions to help mitigate all types of attacks. At Arm, security is never optional—regardless of connectivity requirements and time-to-market constraints—and remains a key consideration built in at the earliest design stages right through to delivery.

## Arm's Continuum of IoT Solutions

The following Arm-based IoT solutions are designed to help organizations grow revenue and expand into new areas of business:



### Single-Board Computers

Single-board computers (SBCs) have matured into commonly manufactured, ready-to-use embedded platforms that feature a wide range of functionality. Today's IoT devices employ SBCs for their compact, production-ready form.

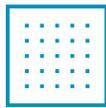
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The SBC is one of the most popular entry points, as it offers a strong yet simple approach to building an IoT product. SBCs can be used to:

- ✦ Accelerate the initial development cycle and substantially reduce development costs
- ✦ Combine high-performance with low-power consumption
- ✦ Leverage ever-increasing availability and competitive pricing due to mass production
- ✦ Integrate and customize into a range of applications

Extensive customization in SBCs can be achieved through the combination of a computer-on-module (CoM) and a carrier board. Companies can choose any CoM and a compatible carrier board to create a solution that is fine-tuned to specific needs. In addition to the SBC hardware available, an ecosystem of frameworks, libraries and tools help facilitate software creation and smooth entry into the marketplace.

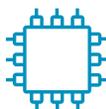
Increasingly, single-board computers and modules are enabling developers to use artificial intelligence (AI), industrial-grade security, connectivity and real-time control, FPGAs, ASICs, and much more. [Arm Leading Edge](#) is our approach to recognize and raise awareness of these new capabilities.



### System Modules

The Arm ecosystem offers a variety of options for IoT system development, beginning with small module boards that add functionality to existing products. The addition of a Bluetooth-enabled module, for example, can turn a standalone sensing device into a connected device.

With Arm's system modules, companies can transition to more tailored solutions without discarding work already invested in the software. Consistency in the toolchain enables not only the reuse of existing software, but also increased efficiencies due to familiarity with the development tools. In addition, significant cost savings are realized through the use of Arm's [PTCRB](#) and FCC pre-certified modules.



### Commercial Off-The-Shelf Silicon

Companies with hardware design expertise may choose an off-the-shelf processor to optimize their board. These silicon products provide companies with the benefits and knowledge their vendor has established across the industry.

More than 500 partners license Arm technologies to meet performance, memory, price point or virtually any other requirements. Silicon manufacturers have been developing embedded solutions based on Arm technology for decades, and are part of a rich ecosystem of software, system tools and reliable toolchains. A wide range of operating systems and software helps companies offer a range of solutions based on the same hardware architecture. This provides flexibility to differentiate software features tailored for target markets.

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[Arm-based processors](#) offer performance and scalability for a diverse array of applications:

- ✦ **Cortex-A Processor Series:** Processors for a range of solutions for devices undertaking complex compute tasks.
- ✦ **Cortex-R Processor Series:** A range of processors optimized for high-performance, real-time applications.
- ✦ **Cortex-M Processor Series:** The smallest/lowest power processors by Arm, optimized for discrete processing and microcontrollers.



### Custom Chips & Field Programmable Gate Arrays (FPGA)

As technology continues to pick up pace and push boundaries, the need for flexibility in product designs grows. This has led to greater pressure for OEMs to develop flexible, application-optimized designs at a faster pace and with less investment.

To meet these demands, it is crucial for developers to have easy access to the most widely adopted processors and the broadest set of software, tools and know-how, whether on FPGAs or custom SoCs.

The high power efficiency, low gate count and cost-effectiveness offered by Cortex-M processors make them the preferred choice for hundreds of microcontroller (MCU) vendors creating off-the-shelf parts. However, many devices today require a custom solution to take optimization into hardware, offering flexibility and product differentiation.

For companies looking to differentiate with a truly unique product, custom SoCs (or application-specific integrated circuits, aka “ASICs”) may be customized for a specific use. SoCs offer design control and the ability to fine-tune cost and performance for unique form factors. This is necessary for applications where conventional PCB-based designs that use off-the-shelf components may not be sufficient.

Custom SoCs deliver several advantages:

- ✦ Fewer components curtail costs, improve reliability, and reduce the number of suppliers and supply chain issues
- ✦ Additional opportunities for feature differentiation and IP protection
- ✦ Reuse of software investments for future enhancements
- ✦ A wide ecosystem of tools, software and expertise support ongoing efforts

Furthermore, companies interested in adding artificial intelligence (AI) or machine learning (ML) to IoT devices can take advantage of [Arm's Project Trillium](#). Through a new class of ultra-efficient processors and highly optimized software, Project Trillium offers a complete heterogeneous ML compute platform.

A single customized SoC can replace many of the discrete functions performed by a patchwork of components, resulting in reduced board space and power consumption and new logistical efficiencies that help ensure interoperability.

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Note that ‘customized’ doesn’t mean creating everything from scratch. Building on top of an established programming model is an important factor in controlling cost, risk and complexity—even for a highly bespoke design. To help reduce complexity while accelerating design time, [Arm Corstone](#) foundation IP, includes pre-verified, configurable and modifiable subsystems that pre-integrate the processor and security IP with the most relevant system components.

Today, many design houses offer a flexible approach to custom silicon development and a low-cost entry point (see Arm Design Support & Software Development below). They can either supplement in-house teams or execute the full design process.

### Design Support & Software Development

From simulation to emulation, FPGA prototyping and bring-up, Arm offers solutions to access industry-provided IP and SoC-design support to help accelerate time to market. [Arm DesignStart](#) allows you to license processors, including the Cortex-M0 and Cortex-M3 without upfront license fees.

The DesignStart program includes a fully verified subsystem, making it easier to integrate the specific peripherals needed for SoC design. Additional benefits of Arm DesignStart include simple FPGA prototyping, thousands of Artisan Physical IP libraries, community support, and a range of services and knowledgebase offerings.

### Arm Design Support

In addition to DesignStart, Arm offers instant access to information and support from Arm experts and ecosystem partners, as well as other design tools:

- + [Arm Fast Models](#) provide early access for software development
- + [Arm development boards](#) deliver a combination of ASIC and FPGA technology
- + [Arm SoC bring-up tools and services](#) offer a full suite of IP, tools and training from a single source to get you started with minimal time and risk

For specialized design expertise, [Arm approved design partners](#) can provide the support you need.

## Arm Pelion IoT Platform: Connectivity, Device and Data Management

With its [Pelion IoT Platform](#), Arm accelerates the development of connected devices and the implementation of full IoT solutions including connectivity, device and data management. Pelion reduces the complexity in IoT deployments—from designing, connecting, and managing devices, to streamlining the ingest and integration of device data with enterprise data—all with the goal of helping businesses gain actionable insights faster.

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The Arm Pelion IoT Platform provides a secure and efficient foundation via three main components:

### Device Management

Pelion device management lets customers securely and reliably on-board new devices, connect them to the network, and update them throughout their lifecycle. The platform supports whatever device, cloud vendor (public, private or hybrid cloud), or communication protocol a customer is required.

### Connectivity Management

Connecting a large number of IoT devices on multiple network standards is a daunting proposition, particularly on a global scale. Pelion connectivity management enables enterprises to connect devices for a global IoT deployment easily, securely, and cost effectively. It also provides connectivity management as a service to mobile network operators.

### Data Management

Pelion data management makes it easy to ingest large volumes of IoT device data and integrate it with enterprise and third-party data. The unique insights enabled by this data management capability often help businesses discover new revenue potential, improve operational efficiency, and make critical decisions with confidence.

### Mbed OS

[Mbed OS](#) is a free, open-source embedded operating system that includes all the features necessary to design and develop IoT devices, including standards-based security and connectivity stacks, an RTOS kernel, middleware for storage and networking, and remote device management.

Combined hardware and software stacks are essential to the system component approach, for both ease of use and flexibility. The advantages of adopting an IoT platform versus adding modules to an existing device include:

- + Improved performance
- + Customizable functionality
- + Ease of adding new differentiating features
- + Reduced costs through software reuse

Furthermore, the Arm Pelion IoT Platform offers all the tools needed to develop and support a communications stack and security service for the application.

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## Arm Security: A Layered Approach

All internet-connected devices are vulnerable to attack. [The Arm Security Manifesto](#) is an industry-wide call to action, highlighting many of the risks of unsecured devices and systems and providing options for mitigating them.

### Introducing Platform Security Architecture (PSA)

#### A recipe for building a secure system and a reference implementation

The Arm [Platform Security Architecture](#) (PSA) brings an industry-wide common foundation to establish secure IoT devices - and their corresponding services - at scale. Built on industry best practices, it outlines common standards for security. Four key phases cover security analyses, architecture specifications, open source firmware code, and independent certification. The PSA ensures security is built in from the ground up.

#### The four key stages:



##### Analyze

Threat models  
& security analysis



##### Architect

Hardware &  
firmware architecture  
specifications



##### Implement

Firmware source code



##### Certify

Independent  
security evaluation

[Arm security solutions](#) help mitigate attacks with products that support a layered approach.

[Arm TrustZone Technology](#) introduces the concept of secure and non-secure worlds that are hardware-separated with non-secure software blocked from directly accessing secure resources.

[The Arm SecurCore processor family](#) provides smart card and secure IC giving developers easy access to the benefits of Arm 32-bit technology such as small die size, energy efficiency, low cost, excellent code density and outstanding performance.

[Arm CryptoCell and Arm Cryptol Island](#) provide platform security for devices with strict power and area constraints. A rich set of cryptographic services target multiple threats and help protect assets (code and data).

## Arm: Empowering IoT Innovation

Companies need a solid foundation today to build on for tomorrow. After years of developing a robust software platform for IoT, and with more than 130 billion Arm-powered chips shipped by partners, Arm understands what it takes to make IoT secure and scalable.

The following table summarizes the options available to companies looking to innovate in the IoT space today.

Solution	When to Consider	Main Advantages
Single-board computers	Companies looking to prove their IoT idea quickly with little hardware investment.	Good entry point. Ready to use platform. Wide range of functionality.
System Modules	Companies looking to add communications to existing products, or swap out communications protocols or frequencies.	Mix-and-match communications approach. Flexibility.
Off-The-Shelf Chips	Companies with an embedded background looking for performance and scalability.	Scalability. Choice. Vast support ecosystem. Reusable code.
Custom Silicon	Companies spending more than \$2M on silicon looking to reduce cost, size, and power.	Design control. Tune for costs and scalability. Protected IP. Supply chain control.

No matter where you are in the design cycle, and whatever challenges you're currently facing, Arm can help you bring even the most ambitious IoT projects to life. See how the IoT is fueling new [business models](#) and learn more about [IoT technologies](#) at Arm.