# Arm Total Solutions for IoT Starter's Guide

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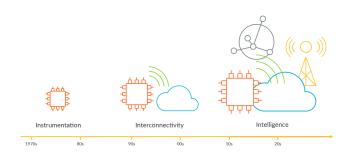
Introducing a New Approach to IoT Design

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### The IoT has evolved in three distinct phases, and Arm has led this evolution for decades.

We started with instrumentation: together with its vast ecosystem, Arm provided the core technology for adding microcontrollers to billions of devices at scale. The industry then turned to interconnectivity, and from Bluetooth to 5G we now have a wealth of options for connecting these "things" together.

### **Three Phases of the Internet of Things**



Today, we're entering a third phase of the IoT: intelligence. This phase is about bringing new technologies and services together across billions and billions of endpoints in a global infrastructure, all the way through to the cloud. If we get this right, we will enable new ways to improve human productivity, drive economic growth, and create opportunities that solve some of the world's toughest problems, fueling a new IoT economy that rivals the shape, speed and size of the smartphone industry's 'App Economy.'

### A vision that transforms IoT design.

To seize this opportunity and to mobilize the IoT ecosystem now, Arm is introducing a radical change to IoT design with its <u>Arm Total Solutions</u> for IoT – an industry first that brings together best-in-class, specialized processing solutions for specific IoT use cases along with applicationspecific reference software and tools including Arm Virtual Hardware. Arm Total Solutions for IoT are based on standards. For Linux-based systems, Project Cassini and Arm SystemReady enable the use of cloud-native software development at the edge and ease deployment across



different Arm-based platforms. Project Centauri brings homogeneity to Cortex-M based IoT endpoints, enabling software leverage at scale across diverse Arm-based hardware. <u>PSA Certified</u> enables the security required for IoT.

Another key aspect of Arm Total Solutions for IoT – Arm Virtual Hardware – is an evolution of our modeling technology that addresses the new realities of IoT development. It delivers accurate functional models of Arm-based SoCs, providing mechanisms for simulating memory, peripherals and more, enabling the development and testing of software before silicon availability resulting in a shift-left in the entire IoT product design cycle, with faster time to market for all. We believe this is the beginning of a new era for IoT – one of true hardware/software system-level co-design. This transformation takes years off of product design cycles, and empowers everyone to spend less time integrating and MORE time building great products and services. Thanks to the cloud, Arm Virtual Hardware provides an easy way to scale your software test infrastructure to both improve quality and increase cadence of software releases. On the hardware side, the IP is available through <u>Arm Flexible Access</u>. On the software side, you have free access to the complete Total Solutions Software Development Kit today on Arm's Github.

You can run those SDKs – and the software you develop – on the first beta release of <u>Arm Virtual</u> <u>Hardware</u>, available as an Amazon Machine Image on the AWS Marketplace (Not currently available on AWS in Mainland China). This combination of the Arm Virtual Hardware AMI and the Total Solution SDK is integrated with some of the most popular CI/CD workflows, like Github Runner. Head to <u>Arm's Github</u> and enter 'Total Solutions' into the GitHub search bar to find all Total Solutions repositories.

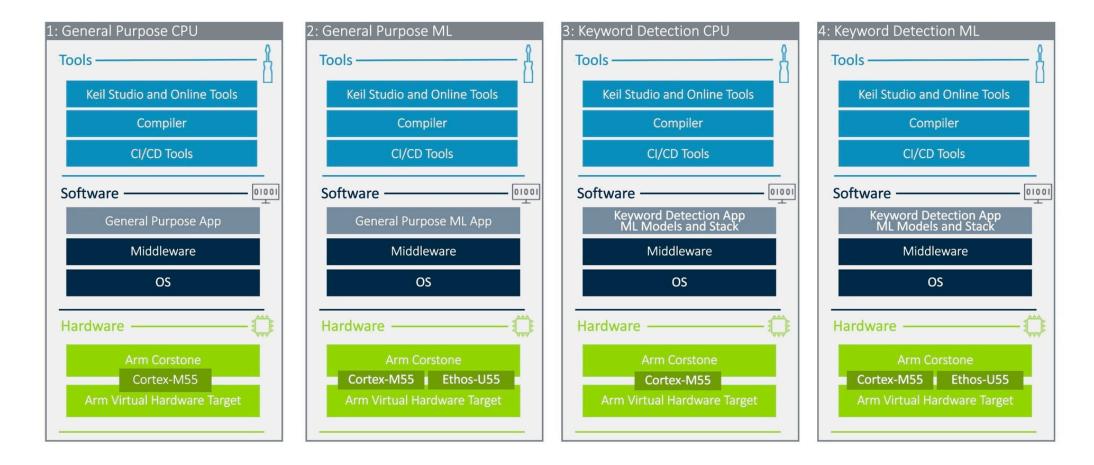
### First Configurations of Arm Total Solutions for IoT – Available Now

The first Arm Total Solution addresses general purpose compute and ML workload use cases, including an ML-based voice keyword recognition example. It is available today and supports multiple configurations of the <u>Arm</u> <u>Corstone-300</u> platform, incorporating <u>Cortex-</u> <u>M55</u> and <u>Ethos-U55</u> processors. Users will be able to choose from these configurations and apply them to their specific workload, significantly accelerating and optimizing their development cycle. It is available in the cloud for immediate access to test.

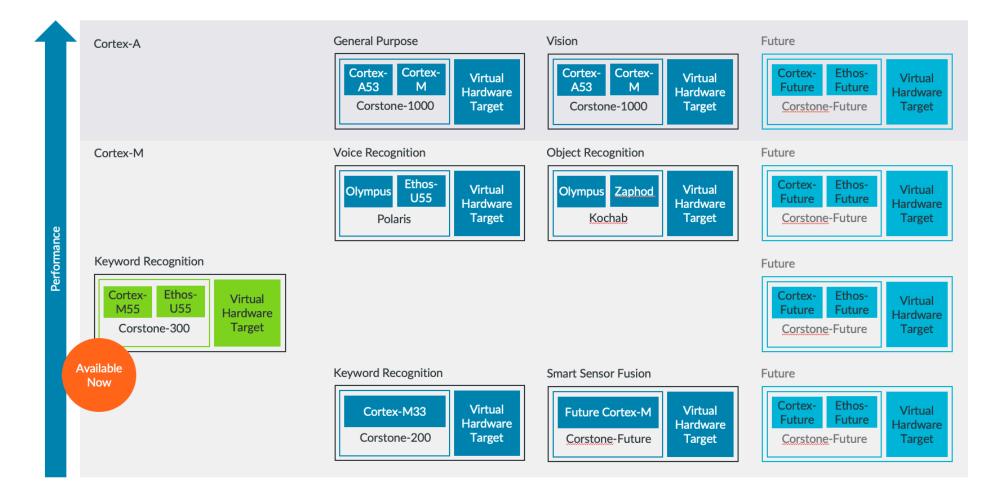
### What's limiting IoT's potential?





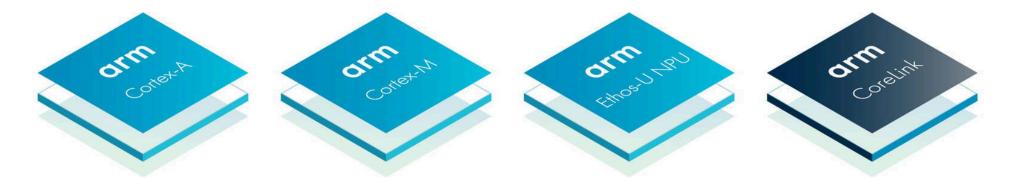


Examples of Total Solutions for IoT packages.



Arm's roadmap will cover applications such as voice recognition and object recognition.

# loT's future – built on proven foundations



### Simplifying and accelerating design and development

The IoT is based on Arm, which is why we have invested in paving the wayfor the new IoT economy. We've shipped over 70 billion Cortex-M-based MCUs to date. In the last three years, more than 150 designs have used Arm Corstone subsystems to accelerate time to market, including nearly 70% of our <u>Cortex-M55</u> licensees. As we enter the next phase of IoT growth, our partners looked to us for a way to further simplify and accelerate their development cycles, and we've delivered this with Arm Total Solutions for IoT.

Using Arm Corstone as the foundation plus working with the ecosystem to add end-to-end tools support, robust OS enablement and application-specific reference code, Arm Total Solutions for IoT is a complete solution, ready to implement or build upon. It offers use case-specific solutions, giving you everything you need to simplify your design process and streamline product development. Arm Total Solutions for IoT simplifies the end-to-end developer experience and enables faster development and deployment of IoT applications for everyone, from silicon companies to OEMs to cloud service providers (CSPs).

Arm processor and system IP is the basis of chips that will power the future of IoT. These microcontrollers, application processors, NPUs and associated system IP enable a range of different processing capabilities, energy requirements and workloads for IoT applications.

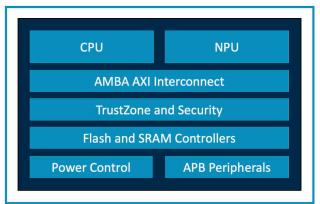
To make sure that these technologies are integrated into a successful, secure IoT SoC, Arm Corstone provides everything you need to start your SoC design, helping you build SoCs faster and more securely, with the right architecture choice and verified, and validated subsystems.



### **Corstone reference package**

The package contains all the relevant system IP to expand and complete the subsystem, building SoCs that can meet complex and diverse requirements, while balancing trade-offs between performance and power. Hundreds of hours of verification work are dedicated to these subsystems, allowing you to get to market quickly. Each subsystem is configurable and modifiable, enabling you to focus on differentiation by customizing the system for your needs. Corstone reference packages have been designed to be extensible so you can build the rest of your SoC on top of the sub-system.

### arm corstone



### Find out more about Arm Corstone here

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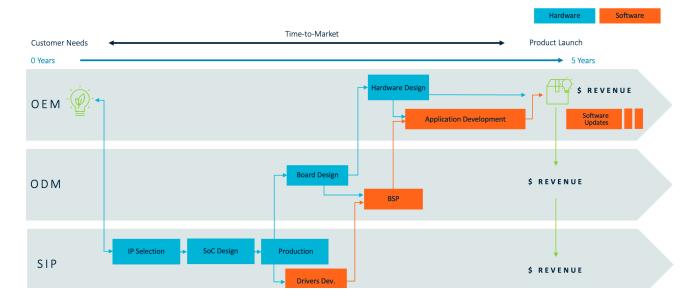
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## A simple and scalable way to reduce dependency on physical hardware

Developing IoT applications has been historically tied to availability of hardware platforms, which can limit flexibility and scalability: Although IoT boards and chips are not necessarily expensive, building and managing board farms requires expertise and investment. Moreover, when new technologies become available, for example a new <u>Cortex-M</u> or <u>Ethos-U</u> processor, it is not possible to start software development until silicon becomes available or an FPGA emulation is created, which is time consuming and expensive.

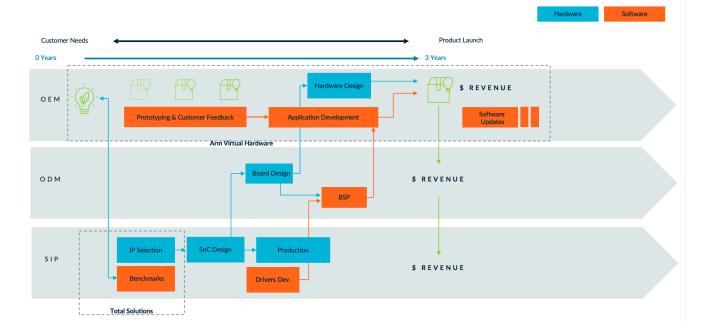
Arm Virtual Hardware is a simple and scalable way to reduce dependency on physical hardware and open the door to new paradigms such as cloudnative software development for the embedded edge. Imagine Arm Virtual Hardware as the equivalent of virtual machines but for endpoint devices. It provides a functionally accurate representation of an Arm-based SoC, simulating the behavior visible to the software but abstracting the complexity of the underlying hardware.



The challenge: A typical 5-year development cycle, with application development trailing hardware design.

Our silicon partners have used the Arm Virtual Hardware model in traditional on-premise EDA workflows for more than 15 years, primarily to start developing software support ahead of silicon availability. Today we are excited to offer these capabilities directly to any Arm-based IoT software developer. Software engineering teams will benefit from a scale never seen before as the bottleneck of physical hardware availability is removed.

At the heart of this benefit live two traditional embedded workflow constraints: developer efficiency and the availability of quality control data to inform business decisions around the software workloads. Arm Virtual Hardware breaks through these historical ceilings by leveraging the scalability of today's modern cloud environments. For example, if a team would like to halve the software testing time or double the test coverage, they can simply duplicate the number of Virtual Hardware instantiated in their continuous integration (CI) cloud environment. Arm Virtual Hardware eliminates the need to manage physical lab space or similar logistical tasks that plague common IoT software product lifecycles.



The Solution: Enabling cloud development at the same time hardware is designed shrinks cycle time from 5 to 3 years.

Arm Virtual Hardware goes beyond just simulating the Arm CPU; it provides mechanisms to accurately simulate the memory subsystem as well as peripherals. As such, Arm Virtual Hardware is suitable for bare-metal development up to kernel and application development on rich operating systems such as Linux.

With the initial release of Arm Virtual Hardware, Arm is providing a 'virtual peripheral driver' that will mimic common I/O formats such as audio front ends. Users will configure the virtual driver for the appropriate analog to digital data stream your product requires. In the future, Arm and its partners will be investing in additional peripheral configurations which will further ease common data I/O requirements your products need.

The vast majority of Arm IP portfolio is available as components to build your own Arm Virtual Hardware, including Cortex CPUs, GPUs as well as System IP and interfaces.

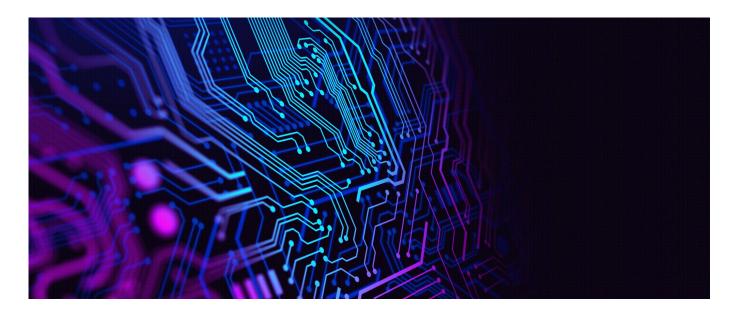
Arm Virtual Hardware will be available as part of Arm Total Solutions for IoT at the same time the underlying hardware design is ready. As a result, the whole ecosystem, including OEMs, can start to develop software for new devices long before silicon is available. This means faster time to market for everyone as well as an additional insurance for silicon partners that demand for your future chip is generated even before tapeout.

**Read how Arm Virtual Hardware** can help you scale design and get to market faster.

### "

Arm Total Solutions for IoT simplify and streamline development for makers of IoT products, accelerating time to money and for the entire IoT ecosystem and value chain from our silicon partners all the way through to OEMs and service providers. "

Mohamed Awad, Vice President, IoT Business, Arm



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Enabling workload portability in a diverse and fragmented IoT value chain

### **Project Centauri: Standards** that drive scale

Cloud-based development is becoming a key technology across multiple markets, and Arm has helped enabled this with activities such as <u>Project</u> <u>Cassini</u> for the edge and <u>SOAFEE</u> for Automotive. The new IoT economy needs technologies within IoT to achieve the pace and scale of the cloud native, DevOps- and MLOps-driven software development lifecycle that has revolutionized the data center.

Project Centauri does this by drawing upon and including Arm's rich portfolio of Cortex-M software, bringing together complementary initiatives under a single MCU software strategy. These initiatives have laid the foundation for Arm Total Solutions for IoT, giving the entire value chain foundational standards, such as Open-CMSIS-Pack, secure device management with PSA Certified and Trusted Firmware-M and ecosystem support for use case specific IoT solutions.

Project Centauri standardizes aspects of the system that enable software leverage across





### Enabling a Cloud-Native IoT and Edge with Arm Cortex-A

Driving Rapid Exponential IoT Growth for Cortex-M

Through project Centauri, we are laying the groundwork to help scale IoT so partners across the value chain don't need to worry about it.

diverse hardware. This gives IoT partners that want to provide cloud services, real-time operating systems, and platform software packages the leverage to scale. Project Centauri also includes our work on <u>Trusted Firmware-M</u> (TF-M), which provides a reference implementation aligned with PSA Certified.

A huge opportunity: The market for IoT silicon was \$9 billion last year, expanding to almost \$19 billion in 2025.

While based on the same core pillars as Project Cassini, Project Centauri will deliver standards and software specific to the Cortex-M architecture. This includes existing and new initiatives from Arm and partners with a renewed focus on widespread adoption and enabling a rapid path to scale.

### **Standards**

- <u>Open-CMSIS-Pack</u> has launched as a Linaro Incubation project to deliver the infrastructure to integrate and manage software components and improve code reuse across embedded and IoT projects
- Open-CMSIS-CDI joins this as an initiative to deliver key abstraction layers for cloud connected IoT devices

### Security

• Arm and partners will continue to build upon the success of PSA Certified in raising the security bar across IoT and Embedded

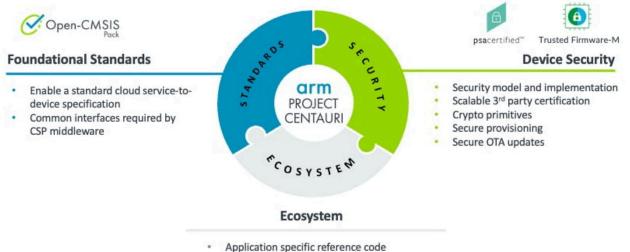
• Arm is making a renewed investment in Trusted Firmware-M to make it more widely adoptable as an accelerated path to PSA Certification

#### Ecosystem

 Arm is working with innovative partners across areas such as low/no-code development, ML Ops, and cloud services to unlock step changes in scale to the entire ecosystem. Project Centauri standardizes aspects of the system that enable software leverage across diverse hardware.

Find out more about **Project Centauri** here

### Driving standards and frameworks to scale IoT software innovation



Platform software and middleware



### Sparking IoT's tomorrow

The promise of the IoT is clear: collect vast new sources of data to transform businesses, leveraging distributed compute and AI and ML in the process. But traditional methods development methods can't support the immense scaling to come.

ROI can be expanded and time-to-market drastically accelerated for the entire value chain through a radical change in how systems are designed: Arm Total Solutions for IoT. This industry first brings together software and hardware in a simple, use-case specific package. Making these solutions available in the cloud brings modern development flows to IoT and gives software developers access ahead of silicon. In the process, it transforms the economics of IoT:

- Arm Total Solutions for IoT provides a full stack solution designed with specific use cases in mind
- Powered by the new Arm Virtual Hardware program, cloud software development begins immediately, before silicon production
- Arm Corstone, proven foundations delivering predesigned, pre-verified, and pre-validated subsystems
- Project Centauri, a new ecosystem initiative delivering software leverage and scale with defined standards



Arm is committed to this comprehensive solutions approach with our IoT roadmap which will be rolled out over the coming months and years. In the coming months we'll be releasing our next Arm Total Solutions for IoT with next generation Arm IP. They will target new use cases and support our newest IP; more to come on that in the future. Meanwhile, you can get started with the foundational tools to transform your IoT development:

- Arm Total Solution SDK based on Centauri is available for download: <u>https://github.com/ARM-</u> <u>software/ATS-Keyword</u>
- Arm Virtual Hardware is available as an Amazon Machine Image, working with AWS we are offsetting initial infrastructure fees: <u>https://www.arm.com/products/development-</u> tools/simulation/virtual-hardware

• Arm Corstone is available to license now and through Arm Flexible Access: https://www.arm.com/products/flexible-access



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