

A row of wind turbines stretches along a sandy beach towards the ocean under a dramatic, cloudy sky at sunset. The sun is low on the horizon, casting a warm glow. A few people are visible walking on the beach in the distance.

arm

The Value of the Arm Architecture

August 2019

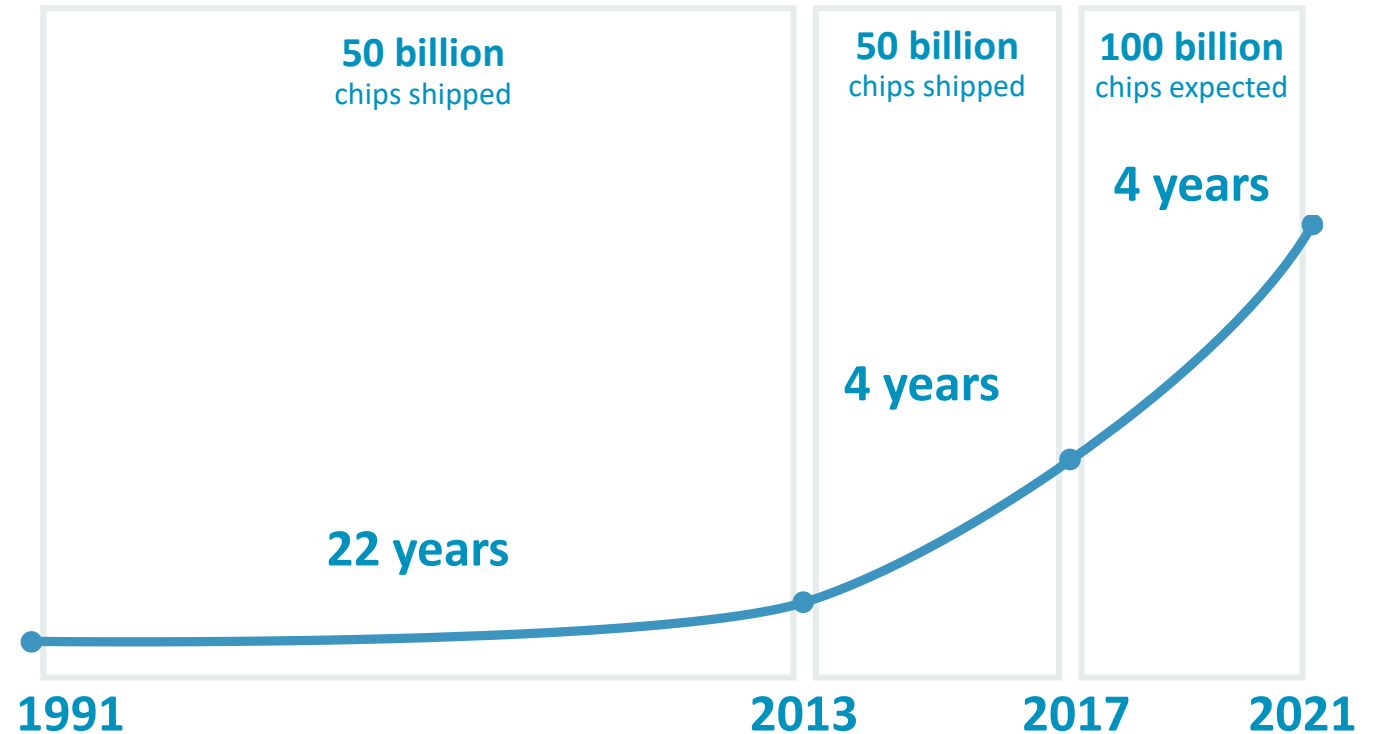
Contents

- This guide is designed to show benefits of working with Arm based technology
- The intended audience is SiPs and OEMs

Arm and Our Partners

Transforming the way people live and businesses operate

- Arm and its global ecosystem of technology innovators empower the world's most successful business and consumer brands, powering mobile, IoT, automotive and more
- Arm and our partners are driving growth towards a world of a trillion connected devices
- Arm has a partnership-based culture and business model, driving innovation wherever compute is happening from the device to the cloud



The Architects of Global Possibilities

Fuelling our partners innovation



145+bn

Arm-based chips shipped
to-date by our partners



530
licensees

Industry leaders and high-growth
start-ups; chip companies and OEMs



22+bn

Arm-based chips shipped in
2018



1,690+

licenses, growing by
100+ every year

Arm is Committed to Open Source Innovation

Contributing to around 200 Open Source projects



500+

software engineers contributing to open source projects across Arm

110 Arm-based boards
out of 136 are supported in Zephyr

Building Secure Foundations



Trustedfirmware.org

500+

Open Source, Open Governance,
Secure World Software
Launched in 2018

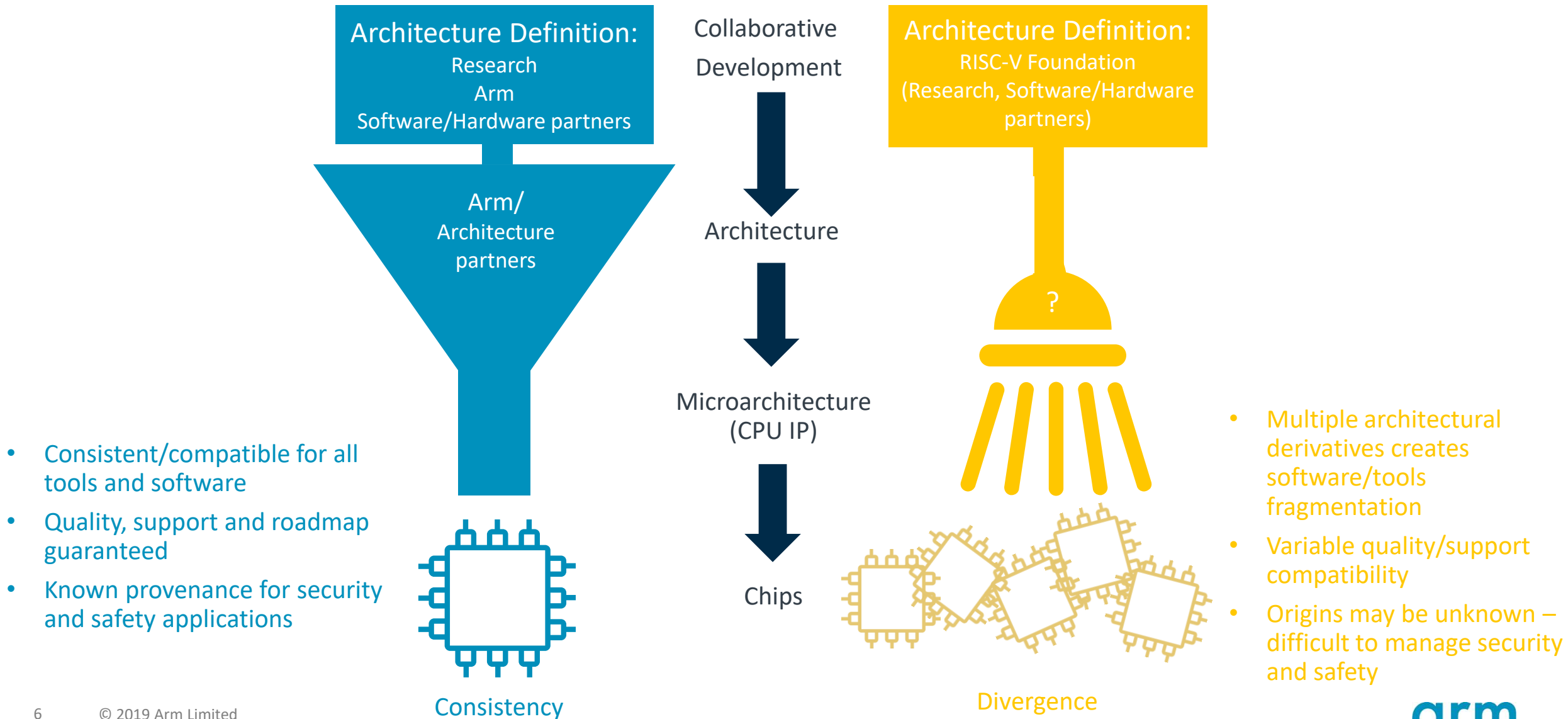
Collaborating across the ecosystem

Thriving partnerships, offering a wealth of benefits:

- Driving standardization
- Reducing time-to-market
- Reducing maintenance cost
- Reducing fragmentation

Arm and Linaro combined are in the **top three contributors** to the Linux kernel and Zephyr.

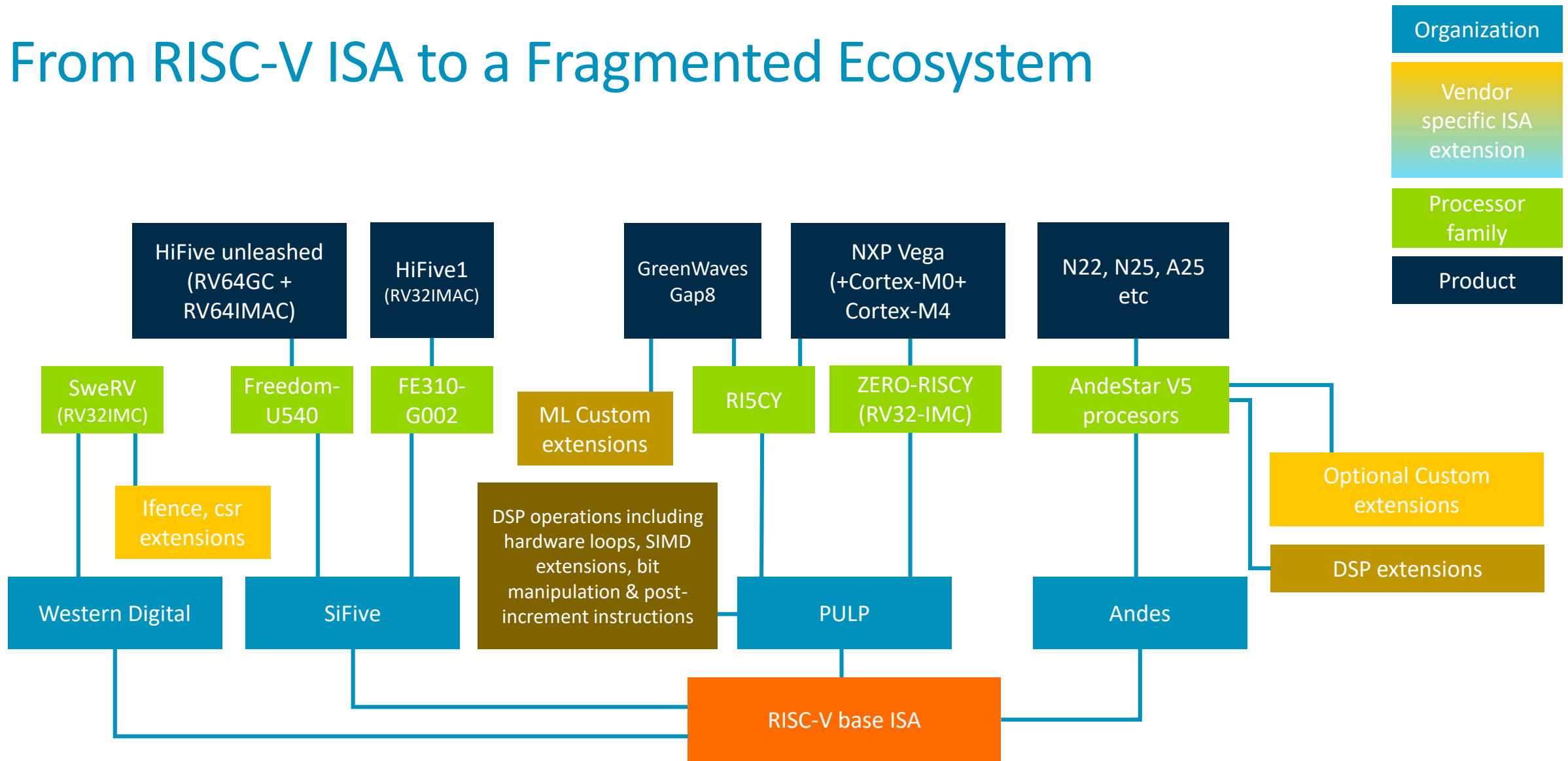
Open Collaboration with Governance



What do we Mean by “Fragmentation”

- Instruction set compatibility allows portability and reuse of code
 - So long as the processors implement the same instruction set
 - i.e. code written for Armv8-M processors is portable between different implementations of that instruction set
 - CMSIS libraries improve abstraction across peripherals, RTOS etc
- RISC-V implementations encompasses many variations of the base ISA
 - From floating point to atomics to multiplication to SIMD, vector and hypervisor as standard extensions plus potentially many individual custom extensions
 - Only the base instruction set is formally ratified
 - Andes latest DSP extensions are incompatible with RISC-V ‘P’ specification
- Incompatibilities may require recompilation of code, or even different toolchains
 - GCC for PULP family (including NXP VEGA) is incompatible with SiFive, SweRV, Rocket cores, despite all being RISC-V implementations

From RISC-V ISA to a Fragmented Ecosystem



What Fragmentation Means

Supporting multiple forks is expensive and supporting all of them may not be possible

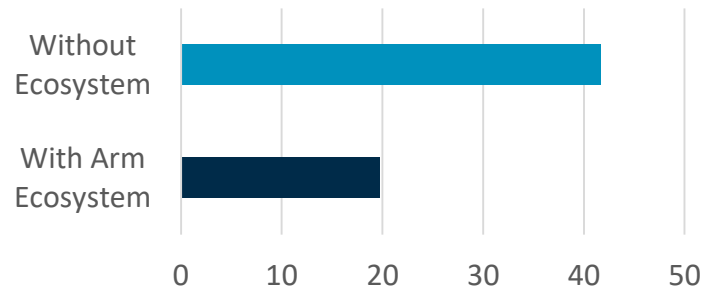
	GCC	GCC (specific Andes)	GCC (specific PULP)	GCC (specific SiFive)	IAR
Andes MCU	BASIC*	YES	NO	NO	?
RI5CY (Vega board)	BASIC*	NO	YES	NO	?
SiFive core	BASIC*	NO	NO	YES	?

*Basic means no DSP, custom instructions, specific optimizations, etc.

	GCC	IAR	Arm/Keil MDK	Specific vendor toolchain
Cortex-M0 Cortex-M3 Cortex-M4	YES	YES	YES	YES
Cortex-M7	YES	YES	YES	YES
Cortex-M23 Cortex-M33	YES	YES	YES	YES

The Arm Ecosystem – Reducing Development Cost

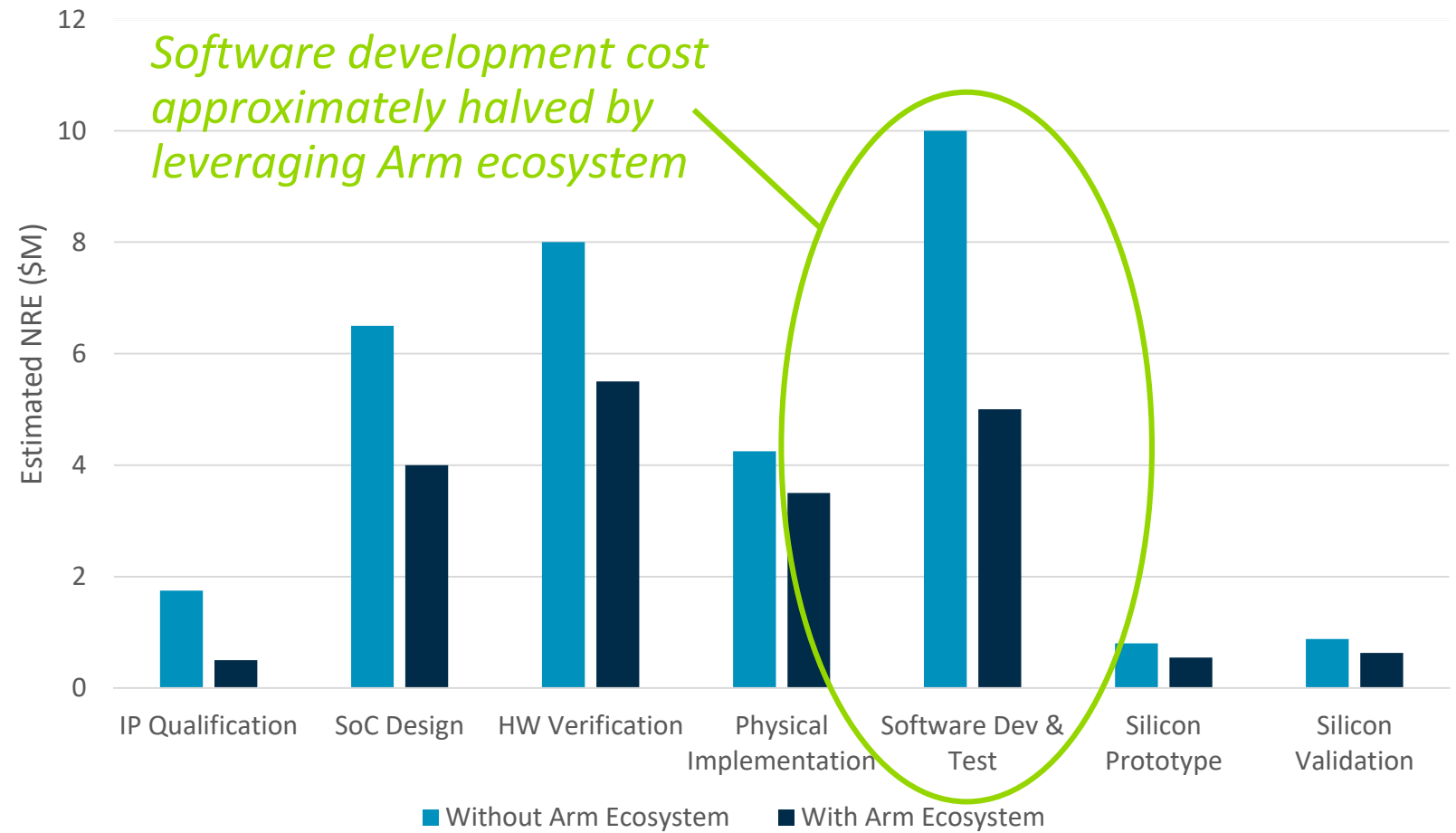
Total Development Cost (\$M)



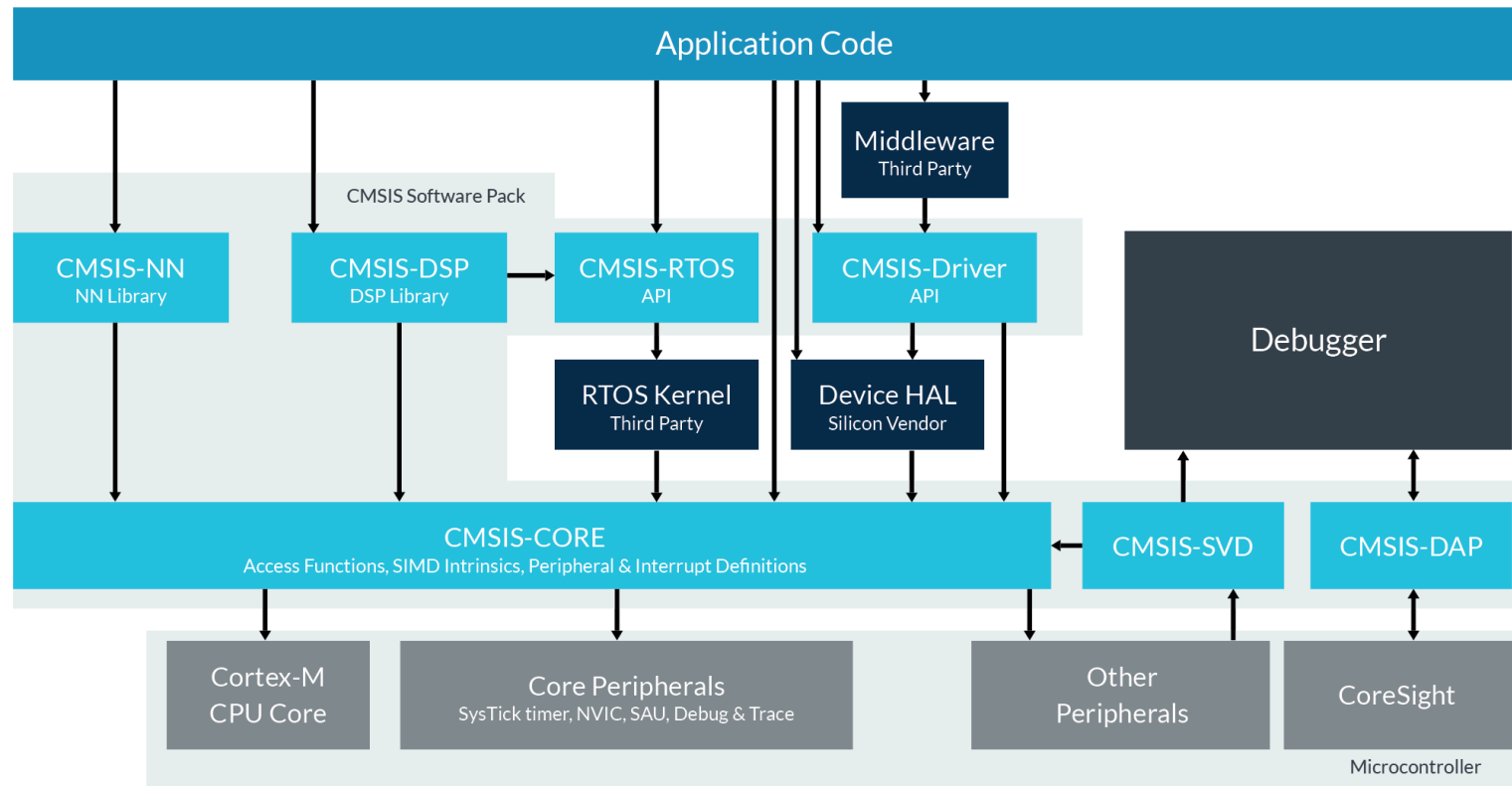
- Data is based on a **medium complexity** 28nm SoC grounds up SoC design
- Value of Arm ecosystem is an **estimate** of **engineering hours saved** due to ecosystem contribution
- Costs are **estimates** based on **analyst data** and **Arm estimations**
- Does not include potential upside:
 - Lost opportunity cost
 - EDA license/infrastructure cost savings

[Linley whitepaper on ecosystem value](#)

28nm SoC Development Costs – Arm Ecosystem Value



CMSIS - Cortex Microcontroller Software Interface Standard



CMSIS enables consistent device support and simple software interfaces to the processor and its peripherals, simplifying software reuse, reducing the learning curve for microcontroller developers, and reducing the time to market for new devices.

Benchmarks Don't Tell the Full Story

The wider picture

- Ease of development, availability of tools and software libraries
- Does it reflect your application accurately?
- Is the score from a processor configuration you will actually use?

Features that matter, but may not be in a benchmark score

- Context switching, interrupt latencies, MPU configuration
- Small MCU benchmarks such as Coremark and Dhrystone won't measure system performance on a complex Cortex-A SoC
- Code size may be more important than performance
- Only a few benchmarks consider energy efficiency – eg EEMBC ULPMark
<https://www.eembc.org/ulpmark/>

Arm's Vision for IoT Security

A holistic approach from design to product

<https://www.arm.com/why-arm/architecture/platform-security-architecture/>

1

Security needs
to be built-in from
the ground up

2

A collective
industry
responsibility

3

Security needs
to be simple,
with seamless
integration

Platform Security Architecture (PSA)
is the perfect starting point

Providing a framework to ensure consistent security

Recent Industry Observations

<https://semiengineering.com/open-source-processors-fact-or-fiction/>

- ***“When you buy a core from the likes of an Arm, you know it is going to be an Arm and you know it is going to work... The amount of verification that has to be done in the average SoC project is probably 10X if they use an open ISA compared to buying a standard off-the-shelf part.”*** Simon Davidmann, chief executive officer for Imperas
- ***“With open source, there is a danger of hardware Trojans or unintended behavior sneaking into the design.”*** - Raik Brinkmann, president and CEO for OneSpin solutions
- ***“A standard, robust golden test suite to make sure your RISC-V implementation is compliant does not exist yet,”*** Jerry Ardizzone, VP of worldwide sales for Codaip
- ***“It may run the compliance suite, but that does not mean it is a fully verified core,”*** - Neil Hand, director of marketing at Mentor, a Siemens Business

Conclusion

Scalable solutions

- Arm's architecture scales with your product line, allowing you to re-use your software.
- Fastest time to market
- Lowest total cost of ownership (reduced software development time)
- Choice and availability of tools, libraries, software, developers, documentation, support, etc.

Many choices available

- Arm's mature ecosystem consists of many choices for silicon, tools, software, and models that are proven and prolific
- Arm has a strong commitment to open source with over 500 software engineers regularly contributing, with Arm and Linaro being in the top 3 contributors to the Linux kernel

Lowest risk

- Arm has a proven history in the marketplace shipping over 138Bn units.
- Arm is the low risk solution
- The Arm instruction set is governed, evolving over time to continue to meet the needs of industry while recognizing the value in not allowing arbitrary extensions



arm

Thank You

Danke

Merci

谢谢

ありがとう

Gracias

Kiitos

감사합니다

धन्यवाद

תודה

We believe that
the whole is
greater than the
sum of its parts.