arm

The Changing Face of Edge Compute

- Alvin Yang
- Nov 2018

Market trends – acceleration of technology deployment

26 years

4 years

100 billion
chips shipped

100 billion
chips shipped

1 Trillion
chips shipped

1991

2017

2021

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Requirements for intelligent edge computing

- Real time / latency
- Reliability
- Safety

- Bandwidth / Cost / Power
- Security
- Privacy

Sensor

Actuator

Local

Gateway

Global

Base Station

Server

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Edge compute

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"Think local"

Optimized DSP

Heterogeneous system architecture

Functional Safety

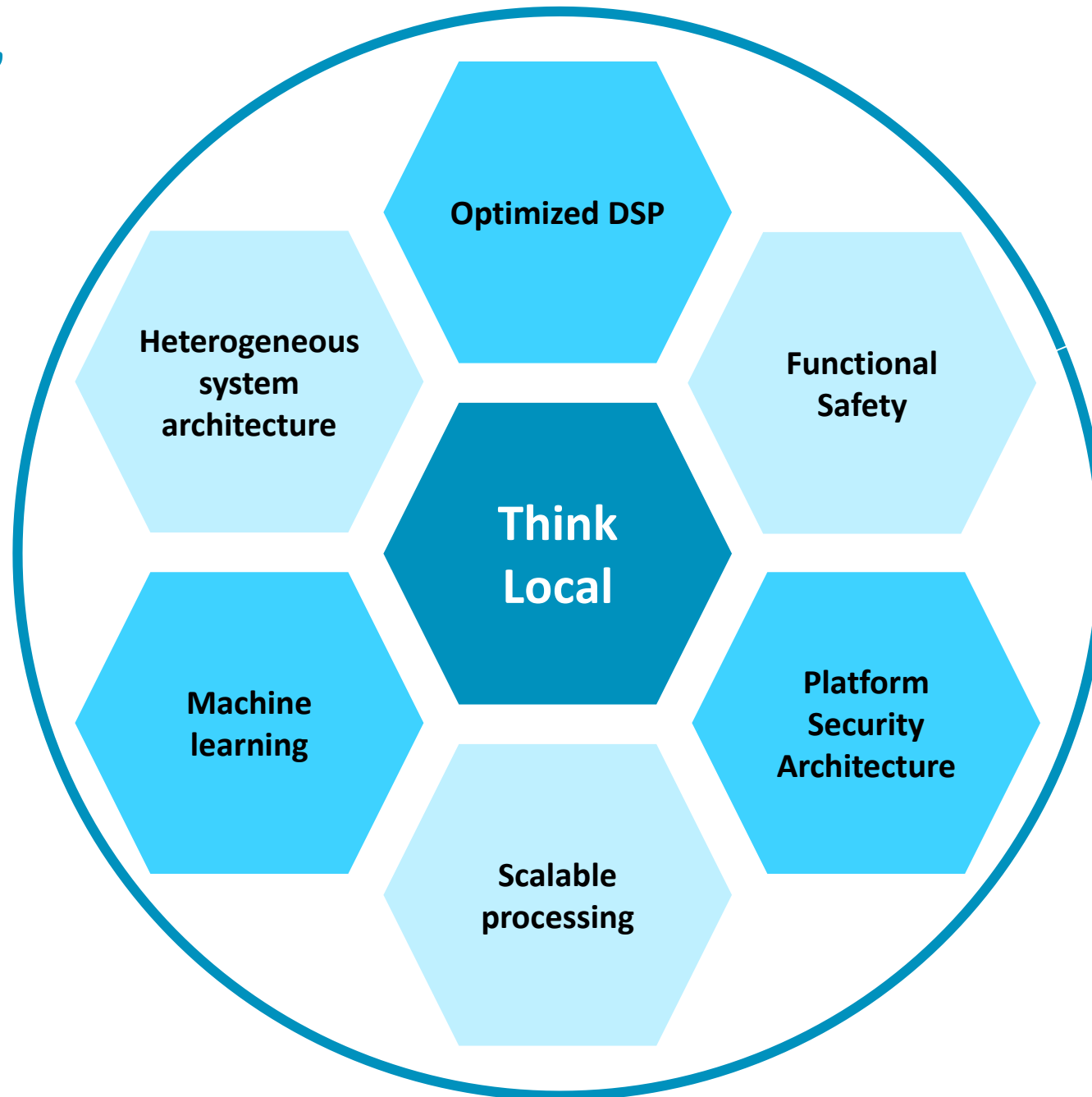Think Local

Machine learning

Platform Security Architecture

Scalable processing

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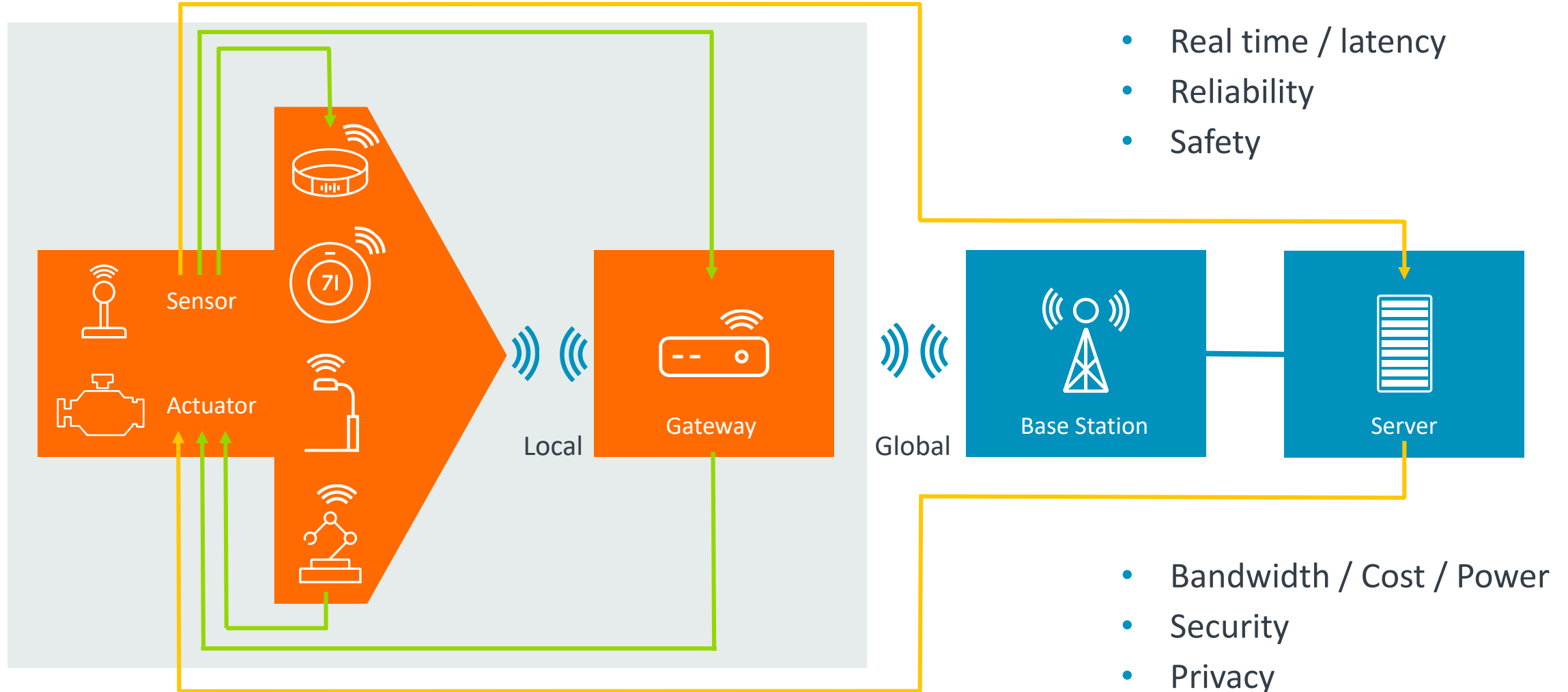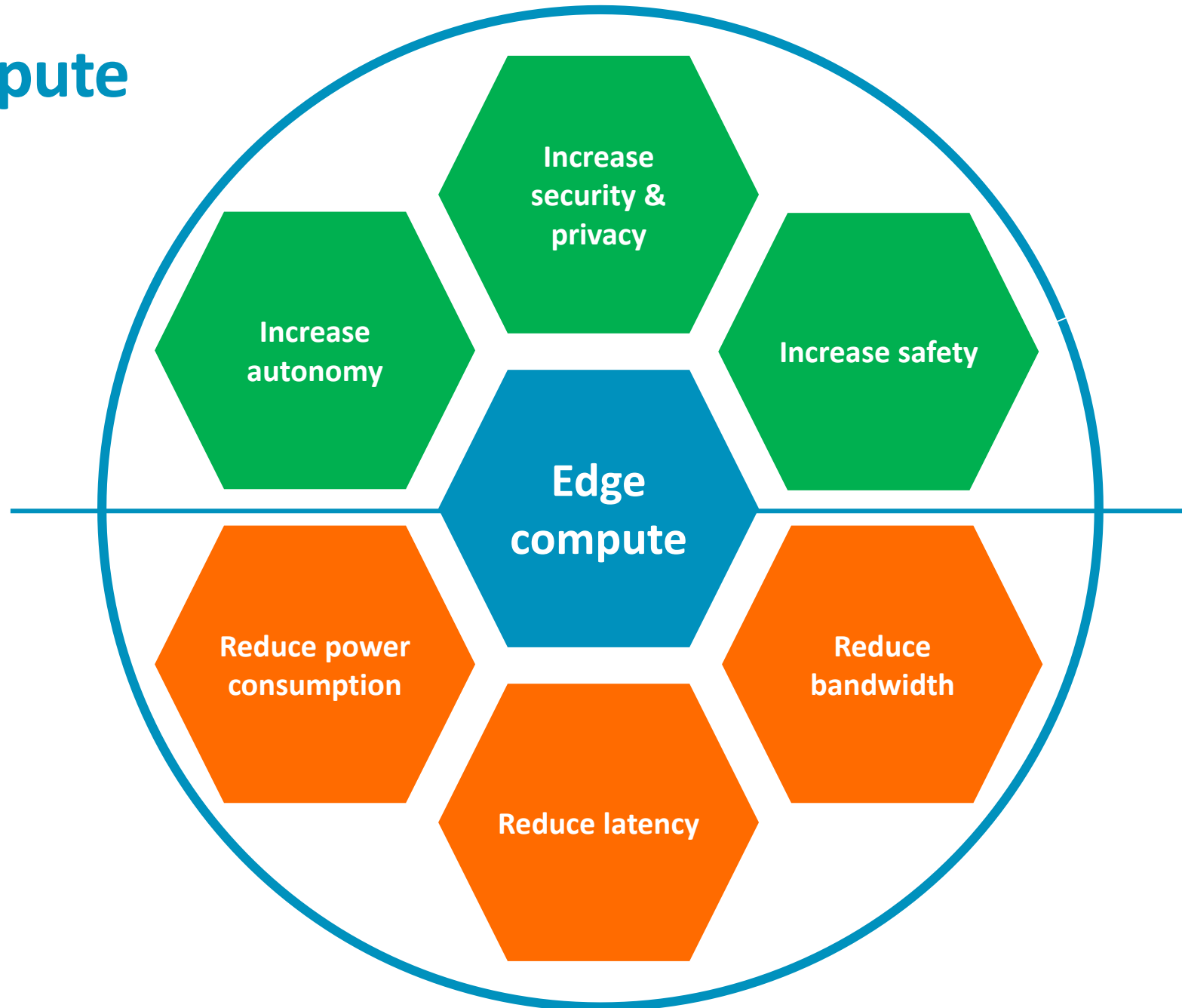
Anatomy of an embedded device

Application-specific interfaces
Ability to sense input and actuate output
Connectivity to local devices

Sense

Actuate

Embedded device

● Security

IO	CPU
Analog	Memory

Development ecosystem
Choice of tools, operating systems and middleware to speed time to market

Ground-up security
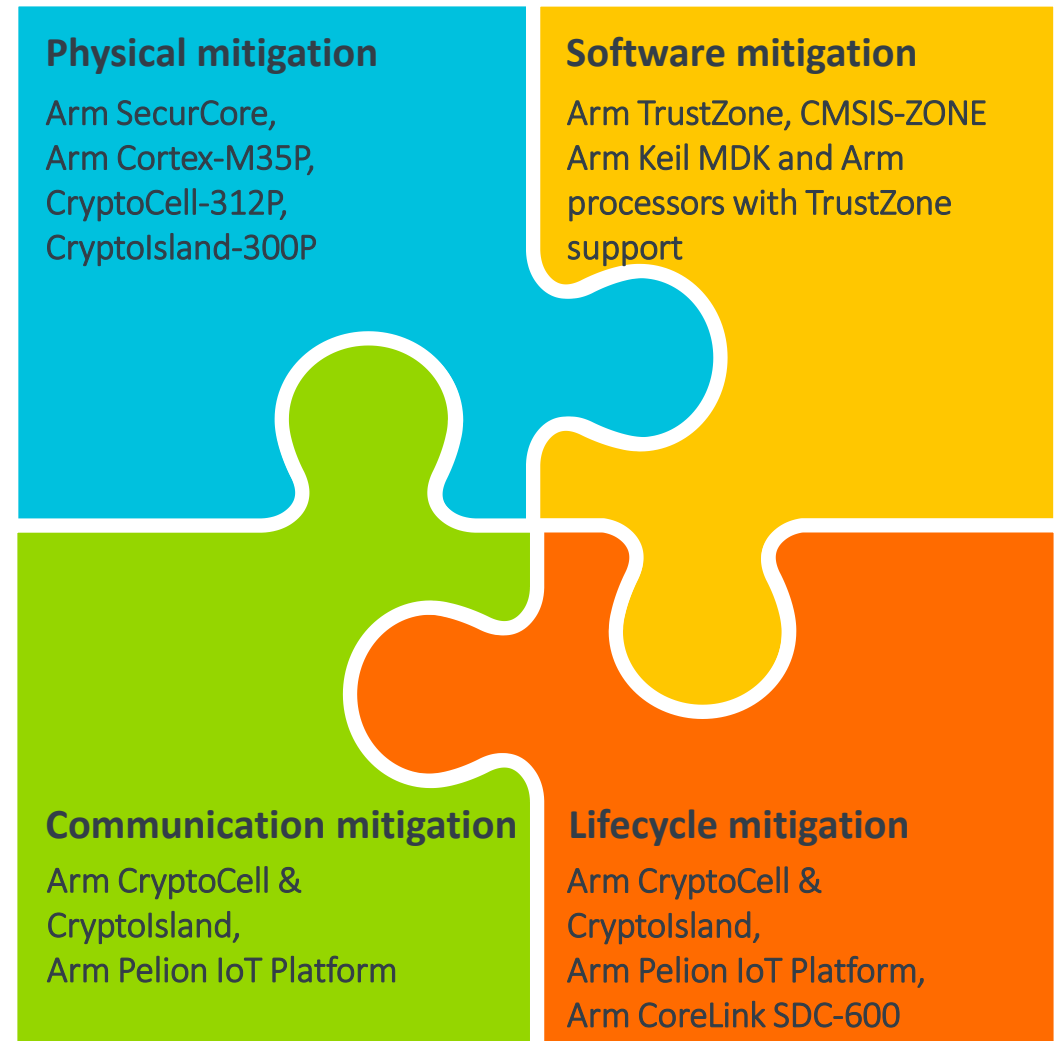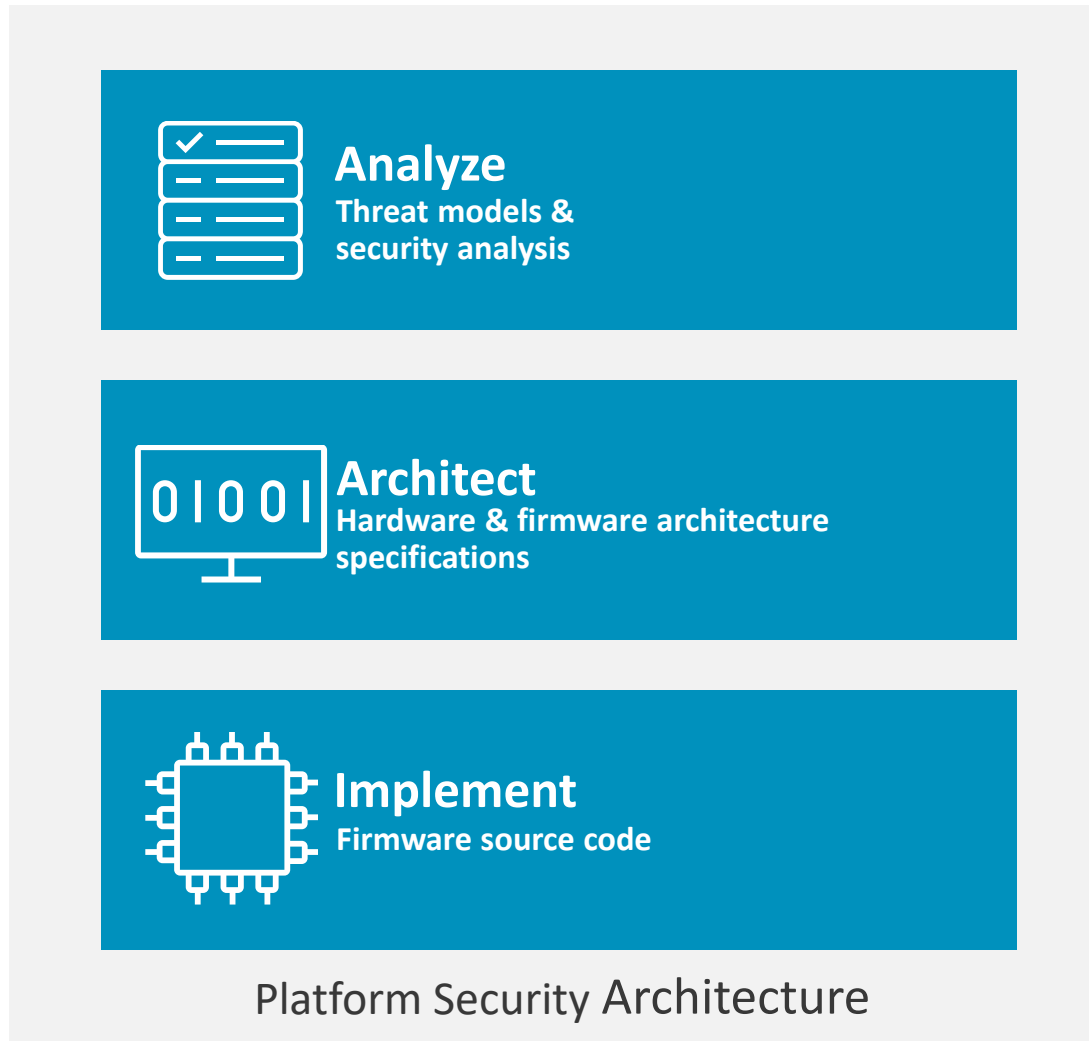Protect data, firmware, integrity and lifecycle management

Efficient compute
Ability to process inputs and make intelligent decisions

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Increase security

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Security architecture and IP

Platform Security Architecture

Analyze
Threat models &
security analysis

Architect
Hardware & firmware architecture
specifications

Implement
Firmware source code

Physical mitigation

Arm SecurCore,
Arm Cortex-M35P,
CryptoCell-312P,
CryptoIsland-300P

Software mitigation

Arm TrustZone, CMSIS-ZONE
Arm Keil MDK and Arm
processors with TrustZone
support

Communication mitigation

Arm CryptoCell &
CryptoIsland,
Arm Pelion IoT Platform

Lifecycle mitigation
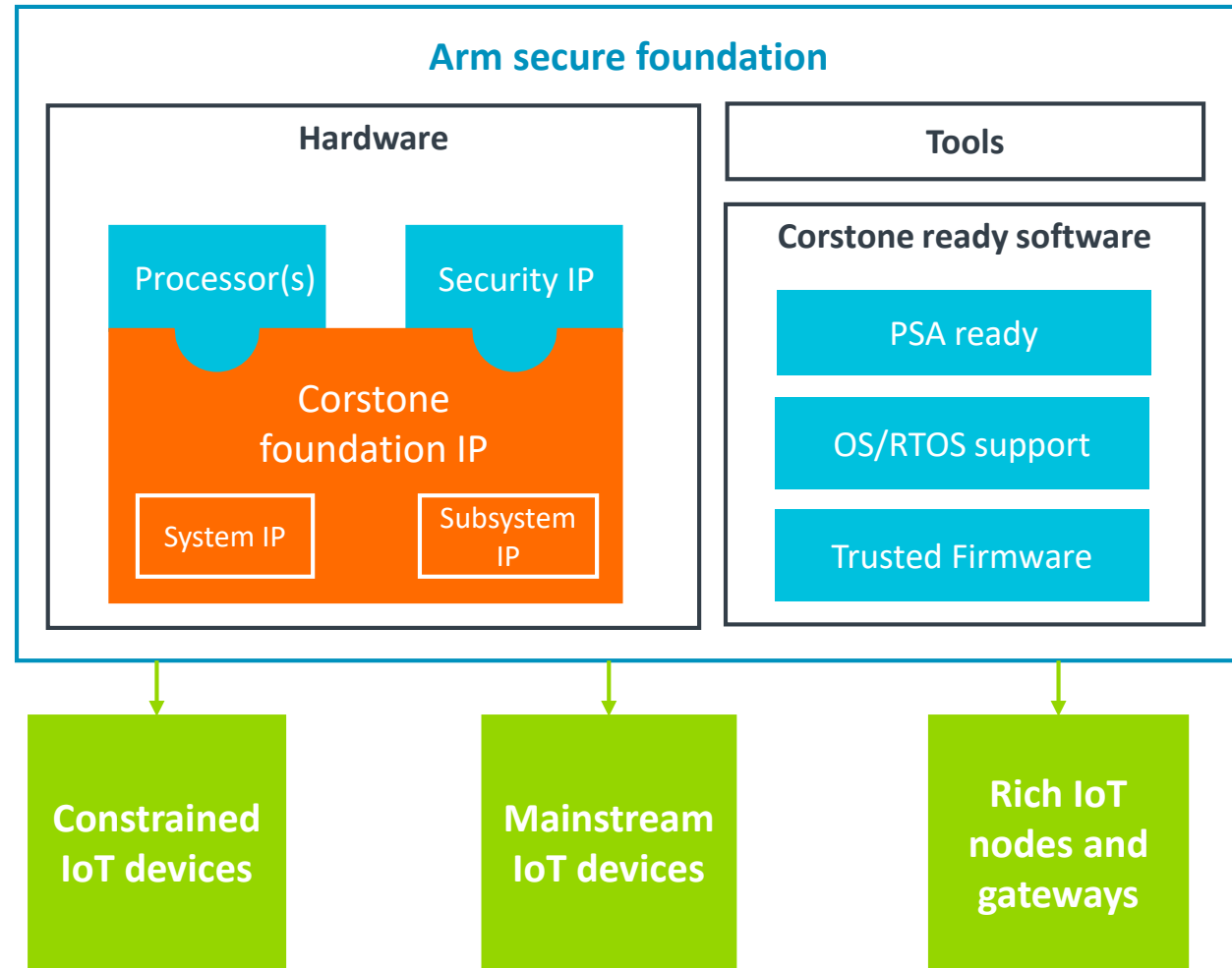
Arm CryptoCell &
CryptoIsland,
Arm Pelion IoT Platform,
Arm CoreLink SDC-600

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Arm secure foundations enable secure devices

- Flexible processor choice
  - Multicore and heterogenous options

- Optional security IP
  - TRNG
  - RTC
  - Cryptographic acceleration
  - Key management

- On-chip SRAM

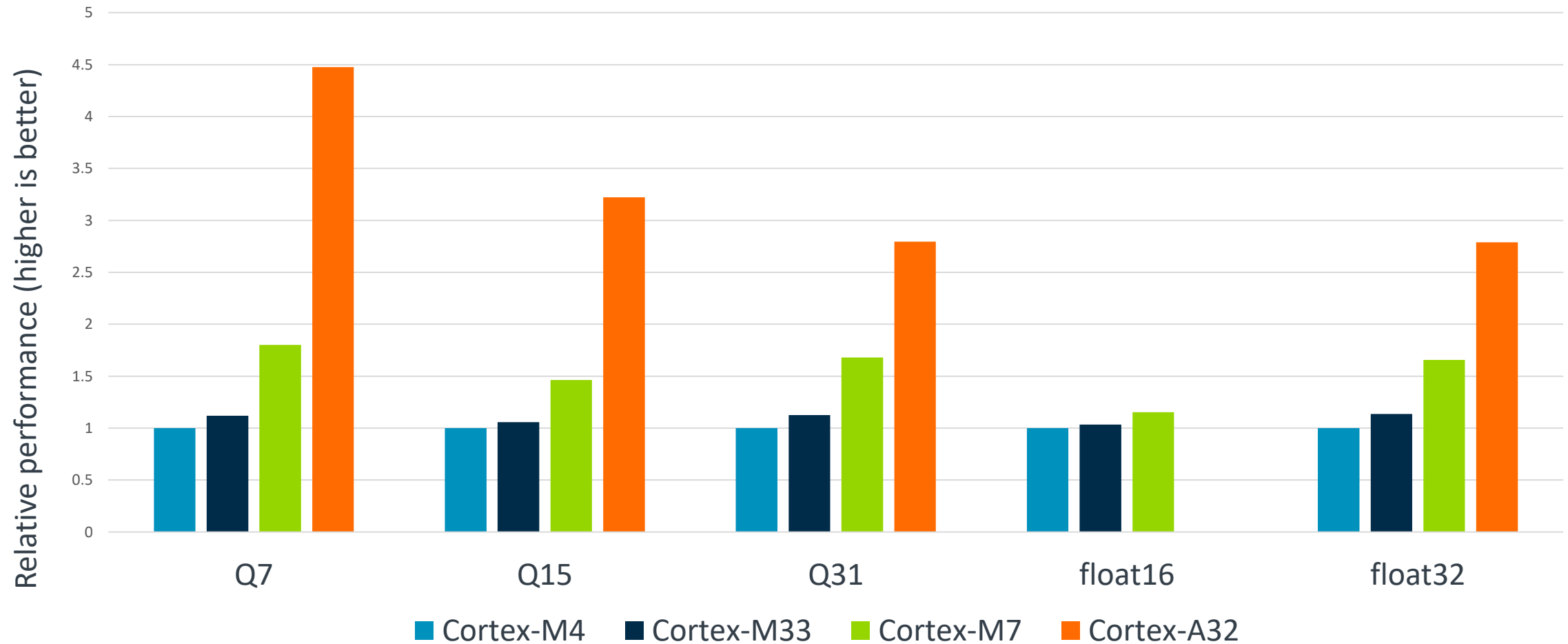- TrustZone-aware fabric

- Readily-available software

arm CORSTONE

Arm secure foundation

Hardware

Processor(s)   Security IP

Corstone foundation IP

System IP   Subsystem IP

Tools

Corstone ready software

PSA ready

OS/RTOS support

Trusted Firmware

Constrained IoT devices

Mainstream IoT devices

Rich IoT nodes and gateways

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Optimized DSP functions

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Scalable DSP performance for edge devices

Simulation results using fast model and prototype compiler using selected CMSIS-DSP kernels such as CFFT, FIR, RFFT, matrix mul, vector dot product. Compared to Cortex-M4.

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A versatile DSP ecosystem for Cortex-M

Fundamental DSP functions on Cortex-M – available for free!

CMSIS-DSP library	
Filters	Controller functions
Basic math functions	Interpolator functions
Statistical functions	Matrix functions
Support functions	Complex math functions
Fast math functions	Transforms

CMSIS COMPLIANT
ARM® Cortex® Microcontroller Software Interface Standard

Examples of ecosystem solutions and partners

- Audio codecs
- Voice codecs
- Image processing
- Keyword spotting
- Audio enhancement
- Sensor fusion
- Motor control
- Connectivity
- Simulation tools

MathWorks®

fortémedia

hillcrestlabs.

PICUSTECH SOFTWARE

WAVES

VOCAL TECHNOLOGIES, LTD.

ADAPTIVE DIGITAL

audio analytic

QUANTIMETRICA

DSP CONCEPTS

ALANGO Technologies and solutions

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A versatile DSP ecosystem for Cortex-A with NEON

- Extensive 3rd Party Ecosystem
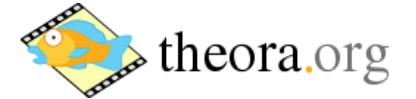
2D GUI Library
and GUI Visual Effects

NEON-optimized Audio and Video Codecs

ESPICO

- Extensive support in Open Source
  - **Android** – NEON optimizations
  - Skia library is **5x faster using NEON**

The Arm Computer Vision and Machine Learning Library.
Optimized functions for both Arm CPUs and GPUs using SIMD technologies.
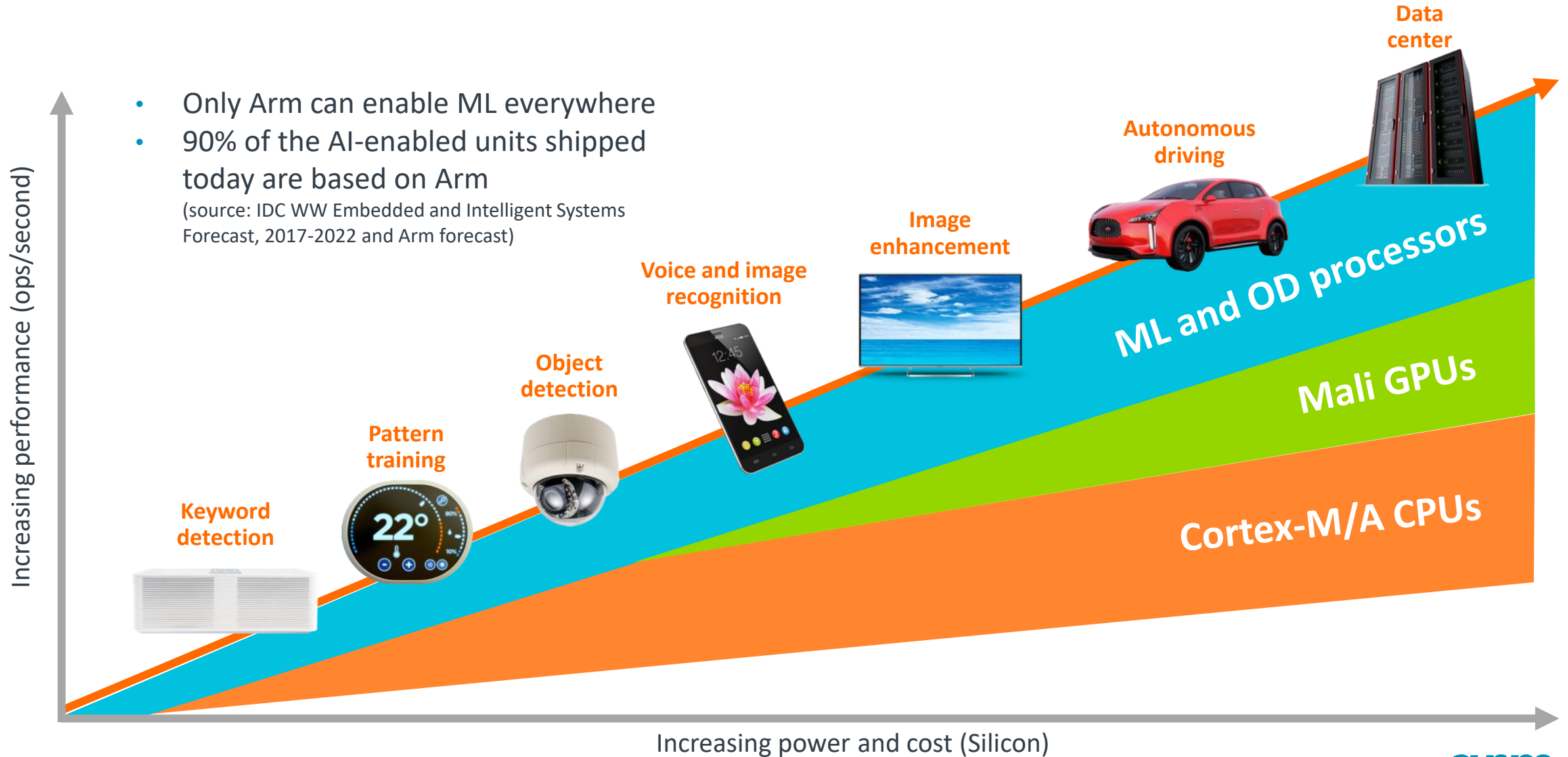
https://github.com/Arm-software/ComputeLibrary
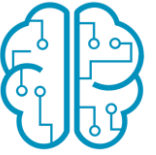
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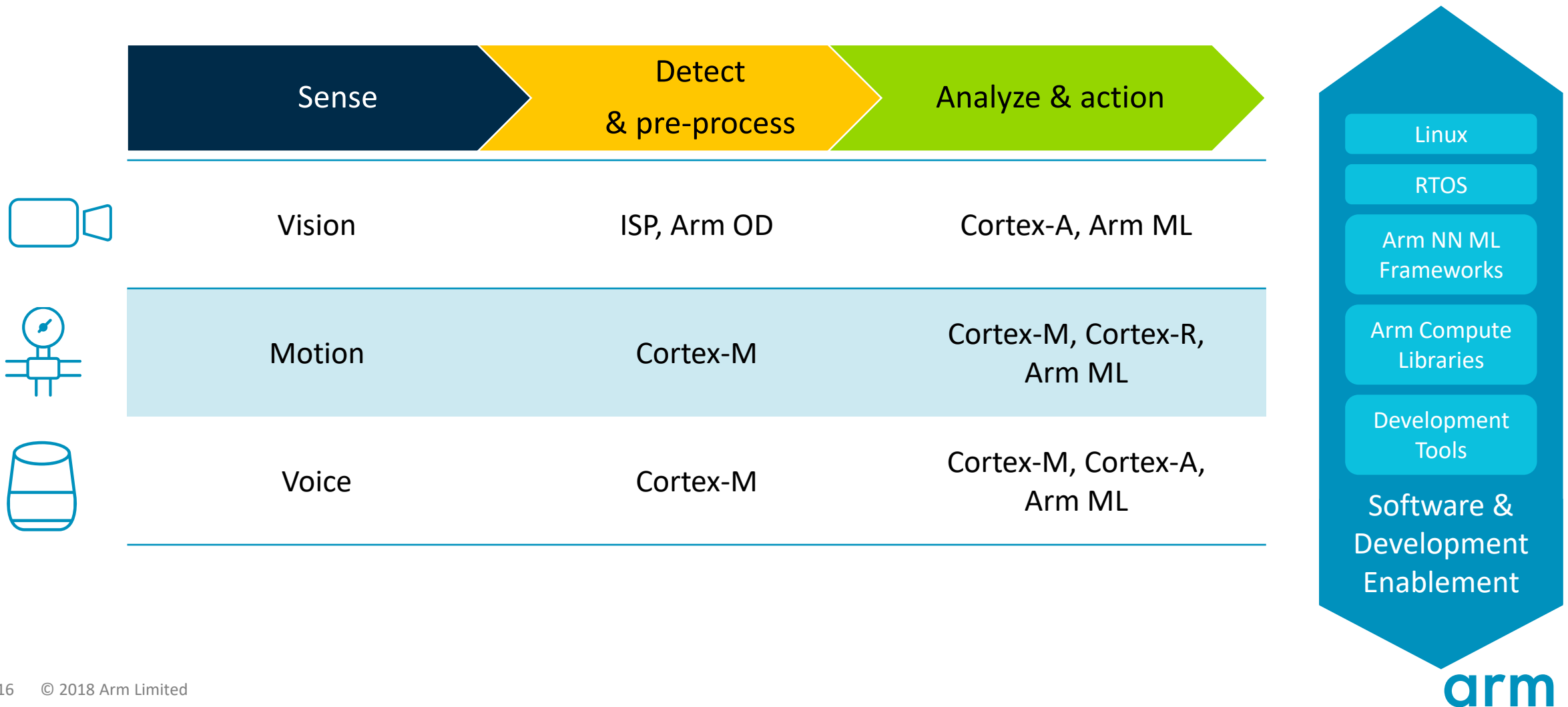# Machine learning capability

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Flexible, scalable ML solutions

- Only Arm can enable ML everywhere
- 90% of the AI-enabled units shipped today are based on Arm
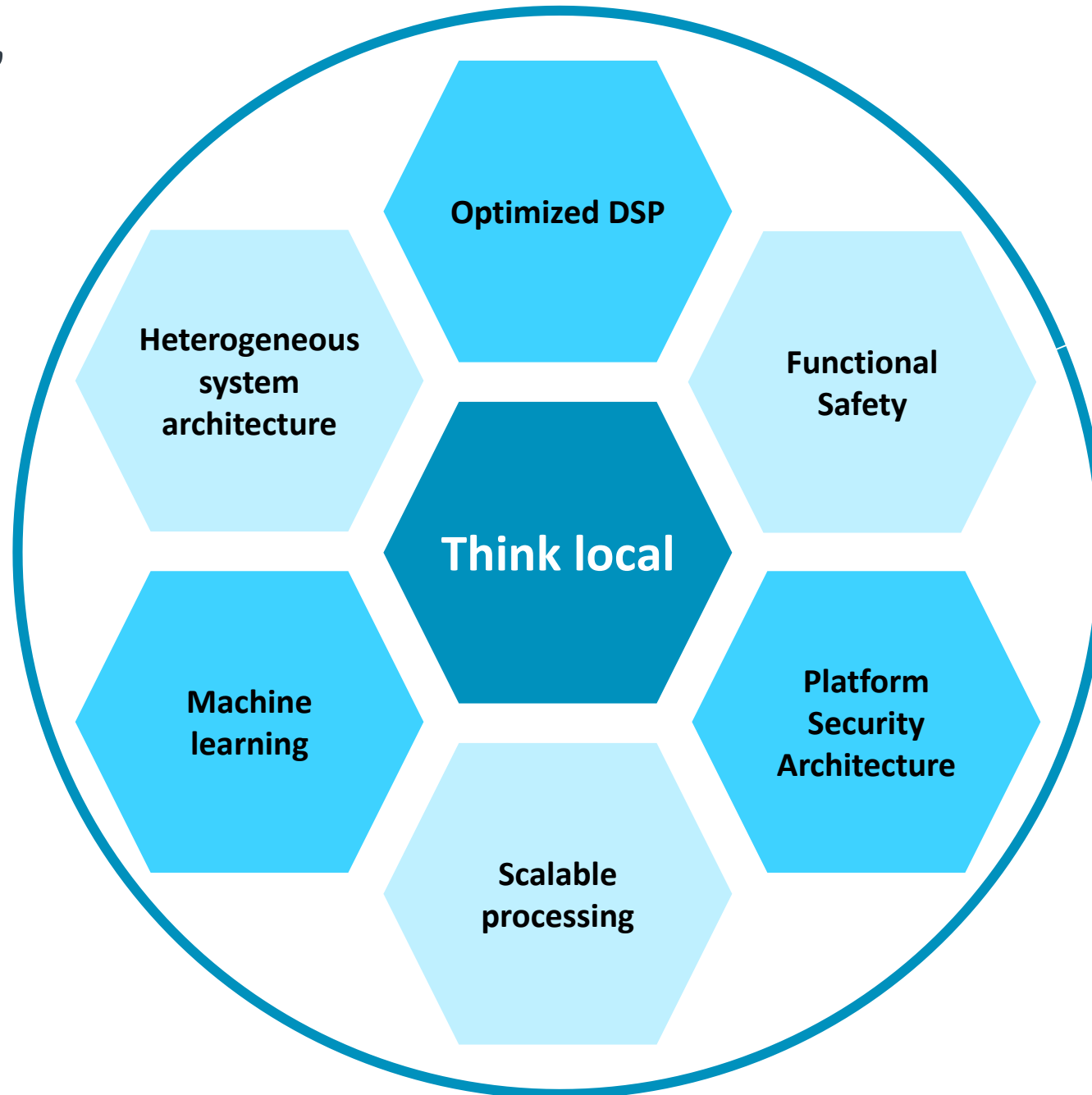 (source: IDC WW Embedded and Intelligent Systems Forecast, 2017-2022 and Arm forecast)

Increasing performance (ops/second)

Increasing power and cost (Silicon)

Keyword detection

Pattern training

Object detection

Voice and image recognition

Image enhancement

Autonomous driving

Data center

ML and OD processors

Mali GPUs

Cortex-M/A CPUs

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Embedded intelligence requires best blend of compute

CPU, NN Acceleration (Arm ML), Image Signal Processor (Arm ISP), Object Detection (Arm OD)

Sense	Detect & pre-process	Analyze & action
Vision	ISP, Arm OD	Cortex-A, Arm ML
Motion	Cortex-M	Cortex-M, Cortex-R, Arm ML
Voice	Cortex-M	Cortex-M, Cortex-A, Arm ML

Linux

RTOS

Arm NN ML Frameworks

Arm Compute Libraries

Development Tools

Software & Development Enablement

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"Think local"

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Arm architecture for total computing

SoC IP

Widest, most proven choice of IP to meet diverse PPA needs

28 billion
Arm-based embedded chips shipped*

*As of CY Q1 2017

Ecosystem

Worlds #1 embedded software ecosystem

Security
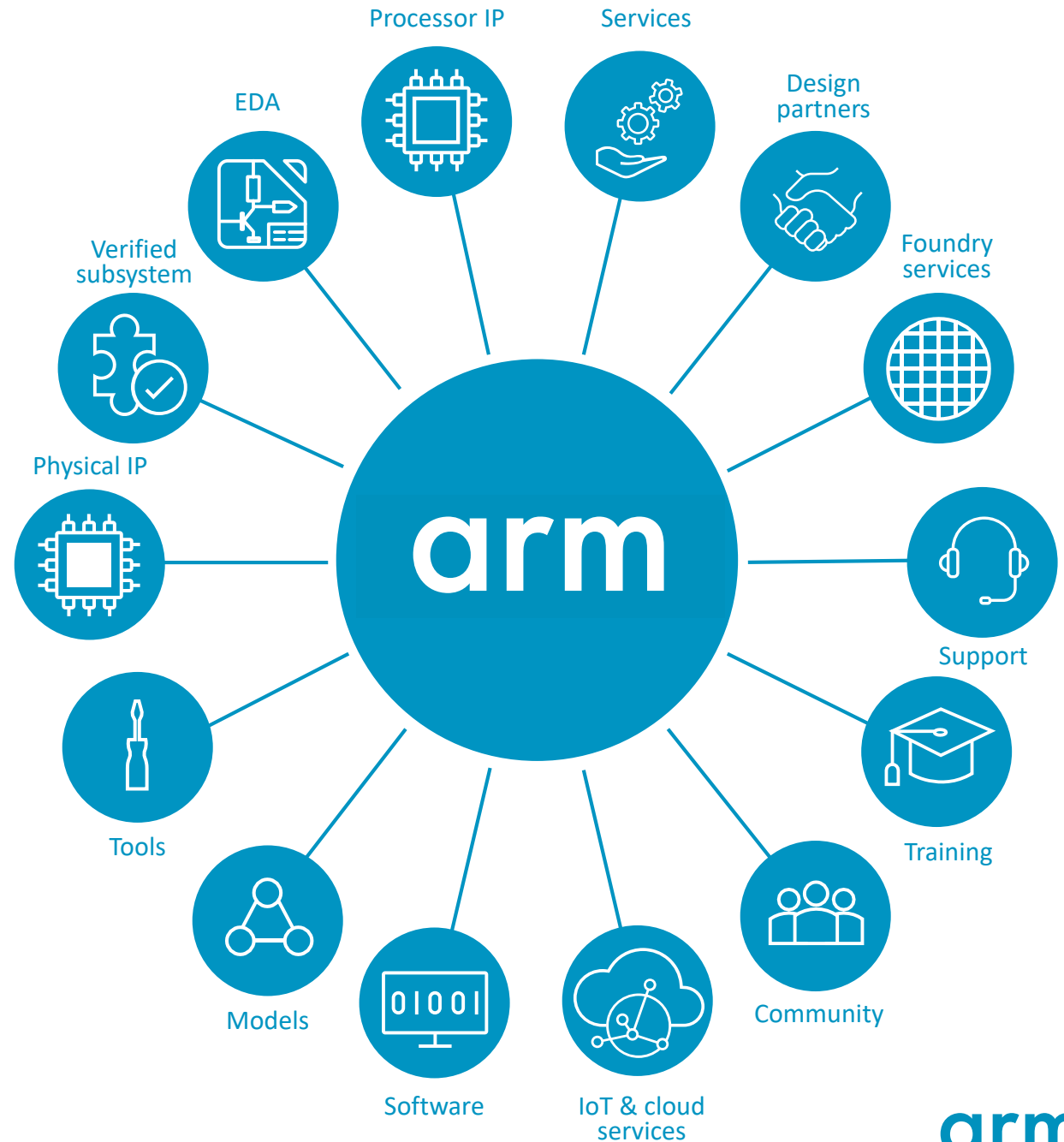
Support across all Cortex-A and some Cortex-M CPUs

Intelligence

Arm hardware IP and software support accelerate intelligence at the edge

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Much more than a CPU for silicon success

Processor IP

Services

EDA

Design partners

Verified subsystem

Foundry services

Physical IP

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Support

Tools

Training

Models

Software

IoT & cloud services

Community

arm

arm

Thank You
Danke
Merci
谢谢
ありがとう
Gracias
Kiitos
감사합니다
ધન્યવાદ
תודה

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