arm

Investing in Disruptive Technologies

NOTWICS Cambridge Roadshow

Ian Thornton, Head of Investor Relations

June 25, 2019

Arm Limited is a subsidiary of SoftBank

Agenda

Arm introduction

Technology trends to disrupt all industries

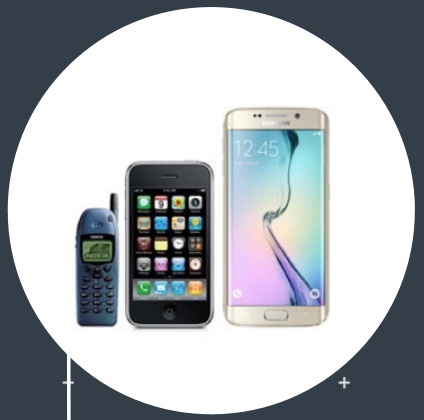
- From virtual to augmented reality
- Artificial intelligence everywhere
- Securing the Internet of Real Things
- Autonomous vehicles

Arm Introduction

Arm: From Inception to Now

1990

Joint venture between Acorn Computers and Apple.



Designed into first mobile phones and then smartphones.

1993 onwards

SoftBank

2016

Today

All electronic devices can use intelligent Arm technology.

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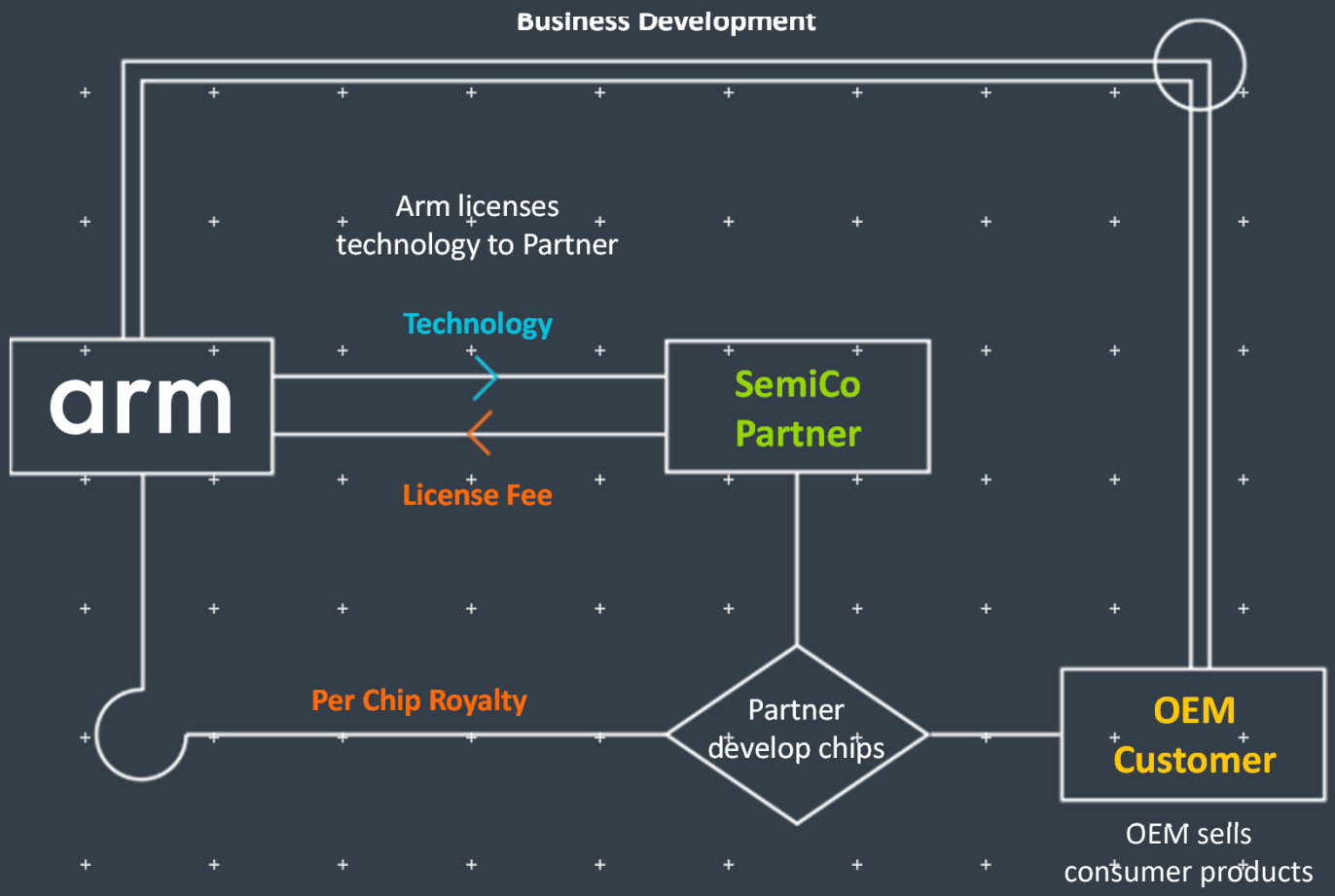
A continuous partnership model

Arm develops technology that is licensed to semiconductor companies.

Arm receives an upfront license fee and a royalty on every chip that contains its technology.



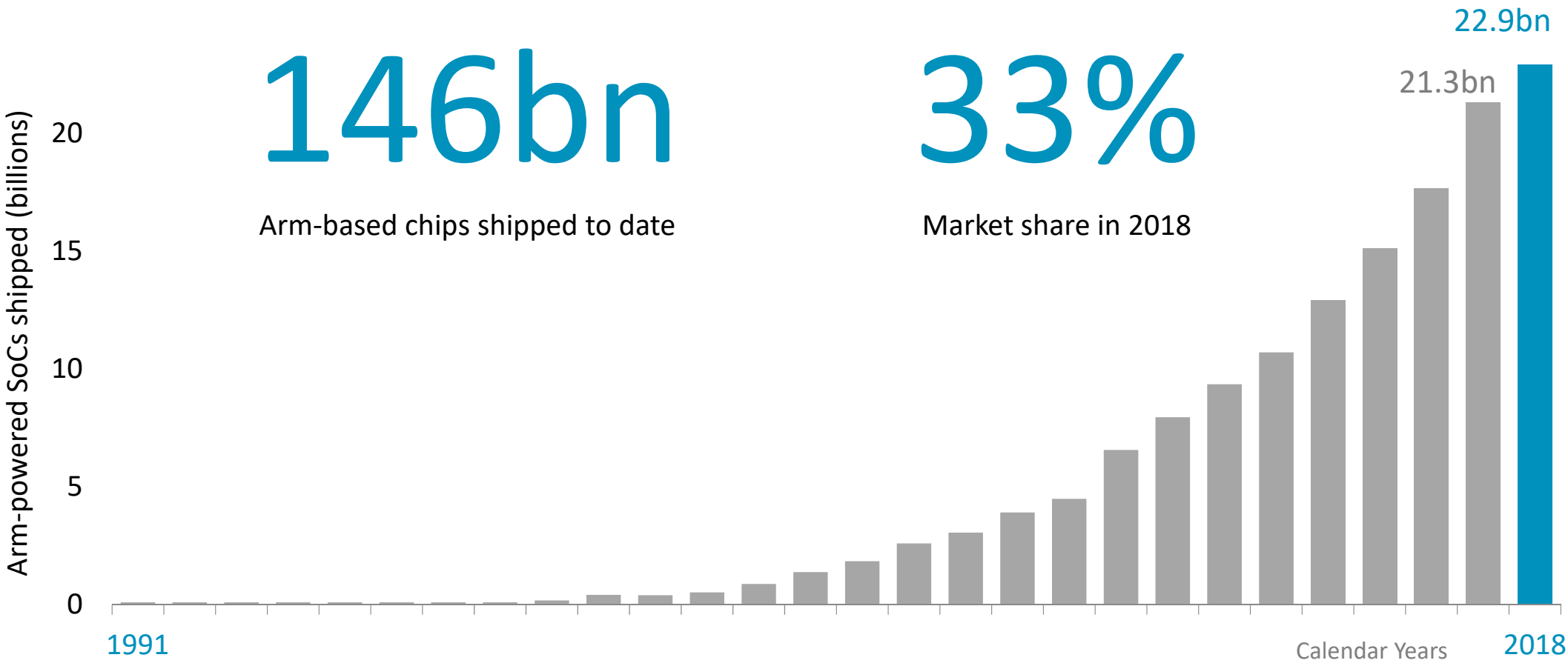
Arm-based chip shipments

146bn

Arm-based chips shipped to date

33%

Market share in 2018



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Arm's expanding opportunity

	2018		2028
	Market Share	Market Value	Market Value
Mobile – Applications processor	90%	$34bn	$47bn
Mobile – Other mobile chips	40%	$18bn	$23bn
Infrastructure – Networking	30%	$15bn	$20bn
Infrastructure – Data Center/Cloud	4%	$20bn	$28bn
Automotive – IVI and ADAS	75%	$7bn	$19bn
Automotive – Other automotive chips	10%	$5bn	$12bn

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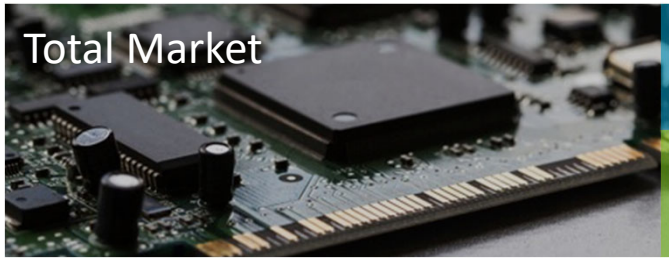
Arm's expanding opportunity



		2018		2028
		Market Share	Market Value	Market Value
Embedded	Controller in IoT Devices	90%	$7bn	$20bn
	Microcontrollers/ SIM Cards	25%	$18bn	$22bn
Other Markets	Consumer Electronics	40%	$12bn	$37bn
	Other chips	35%	$15bn	$21bn
Total Market	All chips with processors (current TAM)	33%	$150bn	$250bn
	All addressable chips (future TAM)	25%	$165bn	$270bn

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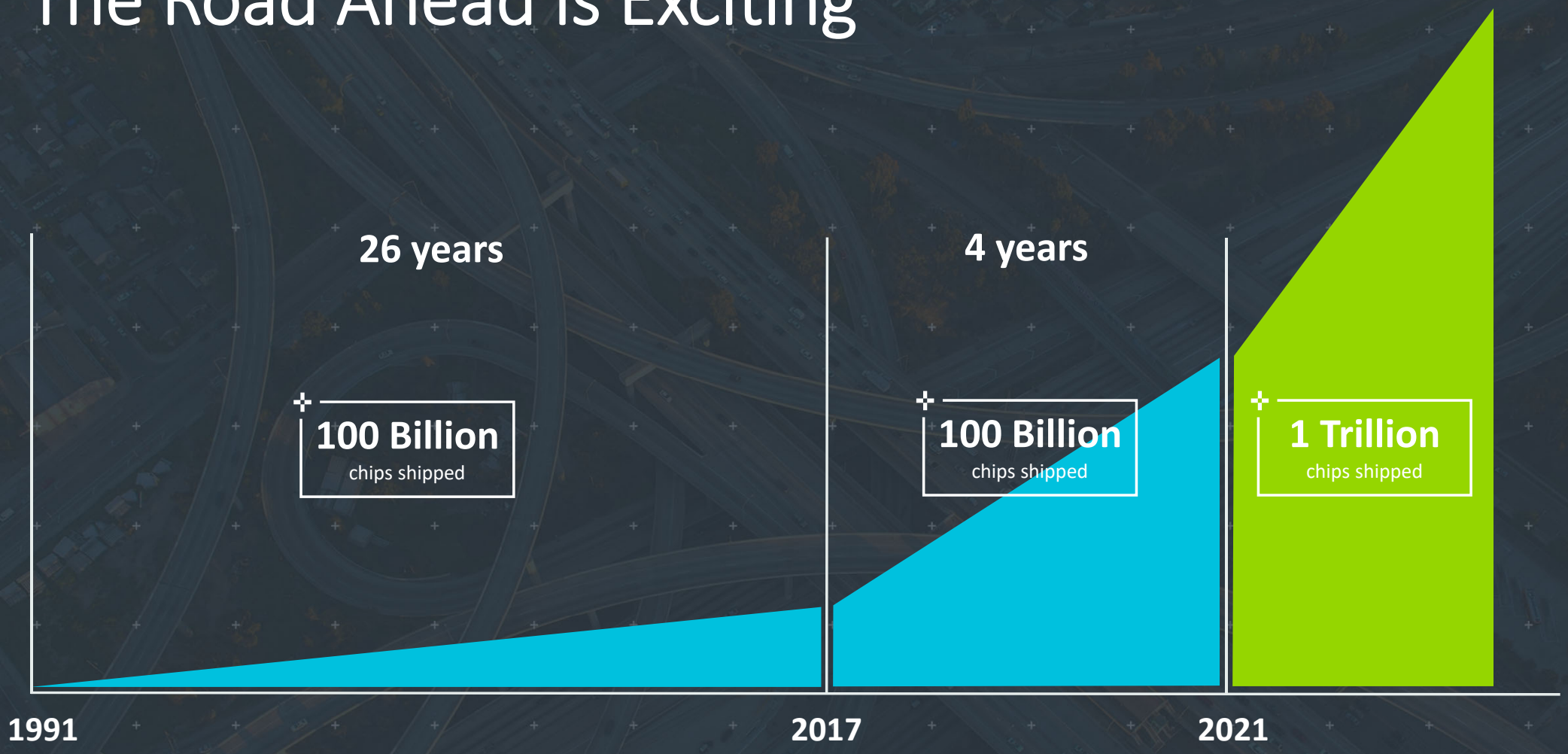
The Road Ahead is Exciting



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The Evolution of Computing

WAVE ONE | MAINFRAME

WAVE TWO |
PERSONAL COMPUTING
& SOFTWARE

WAVE THREE | INTERNET

WAVE FOUR | MOBILE & CLOUD

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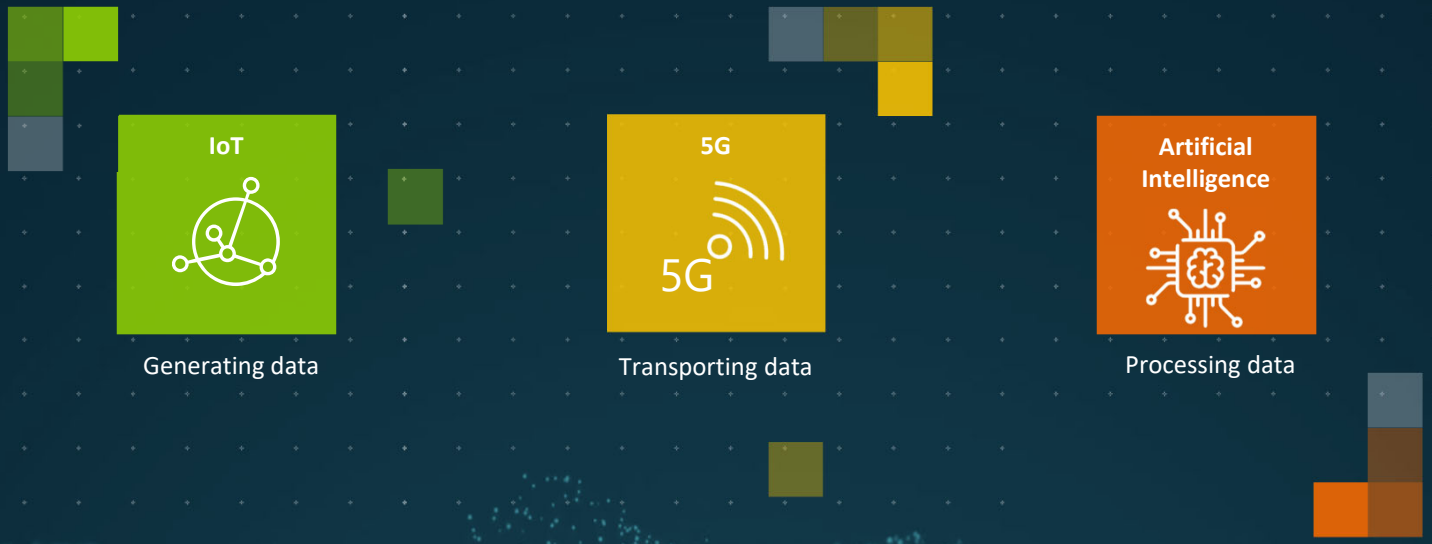
The Fifth Wave

Data-driven computing era



Generating data

Transporting data

Processing data

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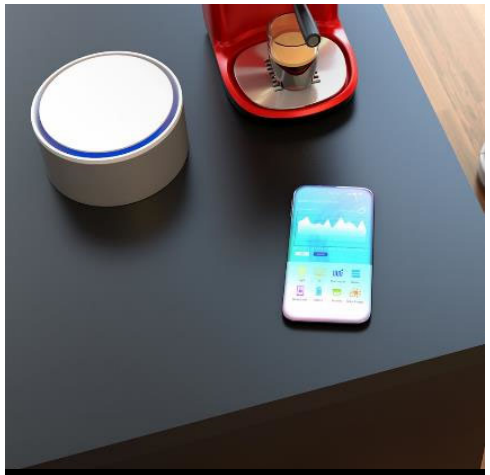
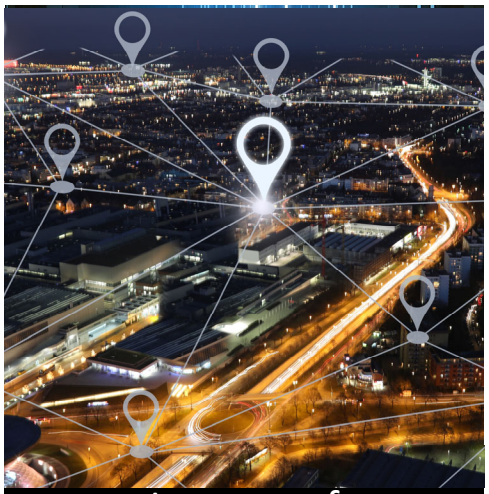
Technology trends that will redefine all industries

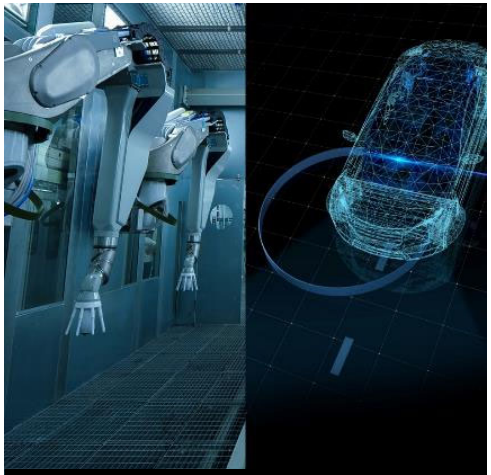
Augmented reality



Machine Learning in every device



Internet of Things



Autonomous machines

Security and Privacy

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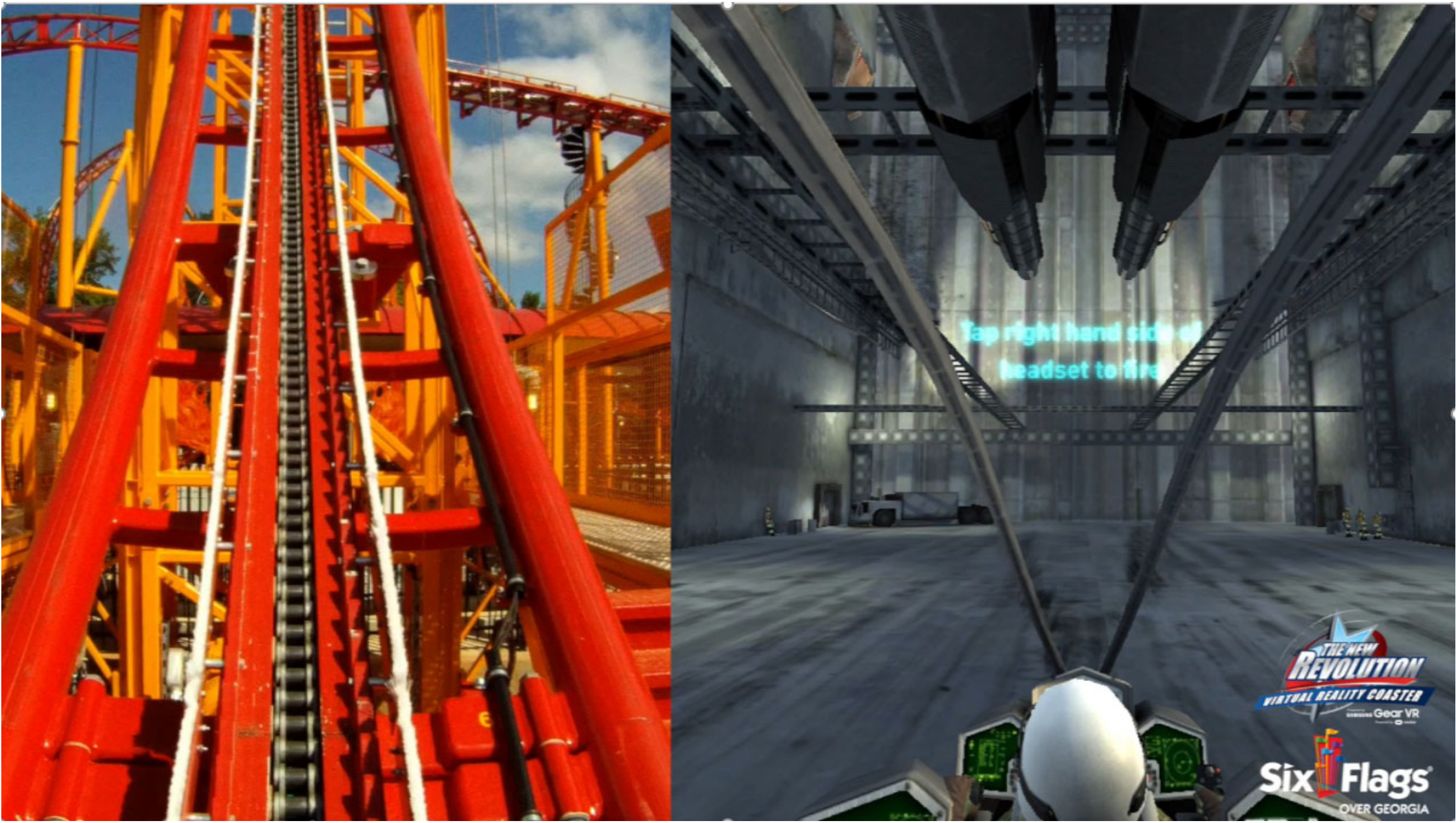
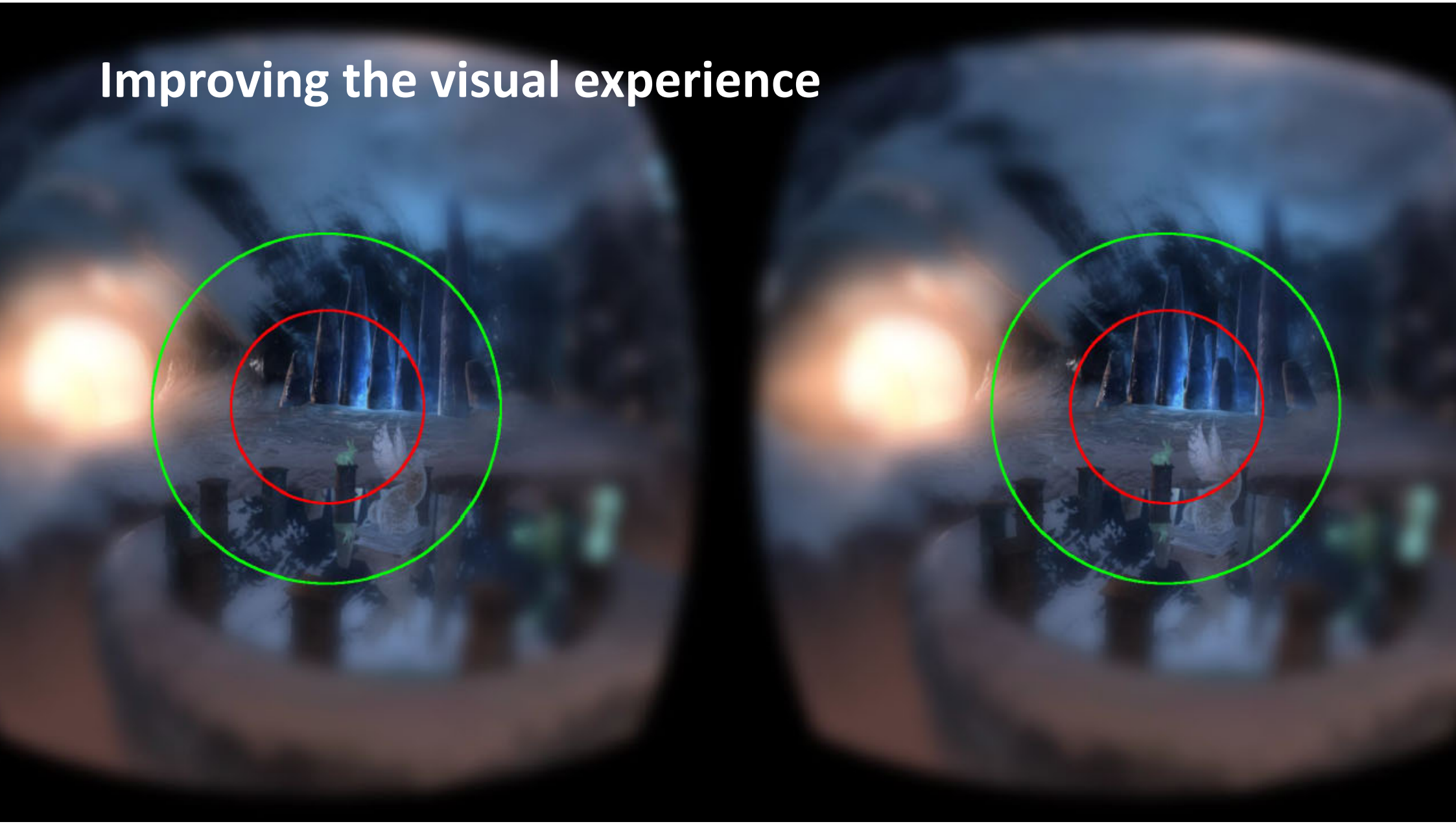
Augmented
reality


THE NEW
REVOLUTION
VIRTUAL REALITY COASTER
Gear VR
Six Flags
OVER GEORGIA

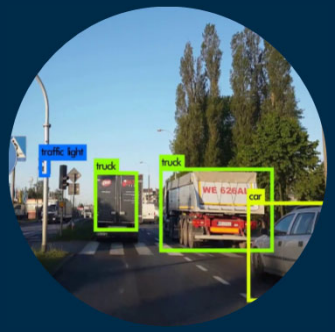
Improving the visual experience




THE NEXT SPACE RACE
STREET SMART
TESLA EARNINGS: WHAT TO WATCH

Machine Learning in Edge Devices

Machine Learning use cases in edge devices today



Vision

Images and video

Object detection, face unlock, defocus (bokeh), beautification, scaling, etc.

Voice

Recognition and creation

Keyword spotting, speech recognition, natural language processing, speech synthesis, etc.

Vibration

Any ‘signal’

Accelerometer, pressure, lidar/radar, speed, shock, vibration, pollution, density, viscosity, etc.

ML performs well with ‘patterns’ of data

Arm/Facebook: Instagram focus

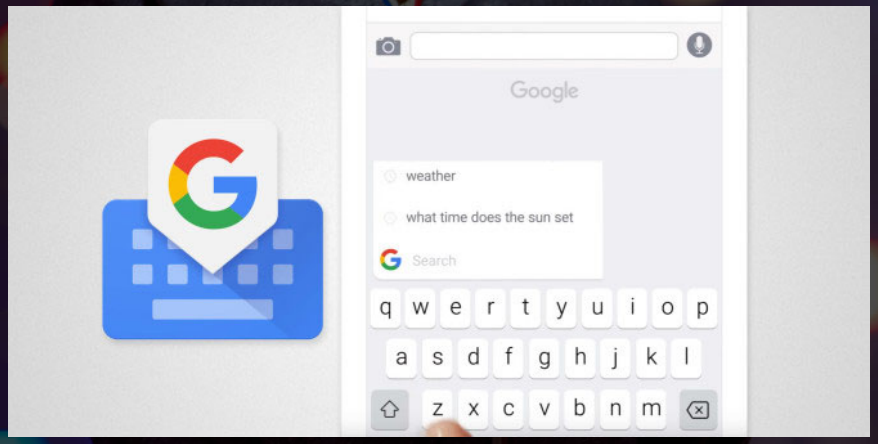
ML-powered ‘bokeh’ effect creates a professional-looking photograph

Automatically identifies the subject of the image and blurs the background

- Uses an image segmentation network to identify foreground and background
- Collaboration between Facebook and Arm (in 2017)
- Optimised for billions of Arm CPU and Mali GPU-based devices

Arm/Google: On-device speech recognition for Gboard

Powers accurate speech input in Gboard, outputting words character-by-character



No latency or network issues — always available, even offline

- Model is trained using recurrent neural network technology, compact enough to reside on a phone
- >1Bn Gboard downloads*
- Runs on Arm CPUs

* Android store, March 2019

Different use cases need different technology

Keyword spotting, 2 Mic
397 MOP/s, 34% NN

ASR wav to transcript
4.91 GOP/s, 85% NN

Face unlock
30 GOP/s, 84% NN

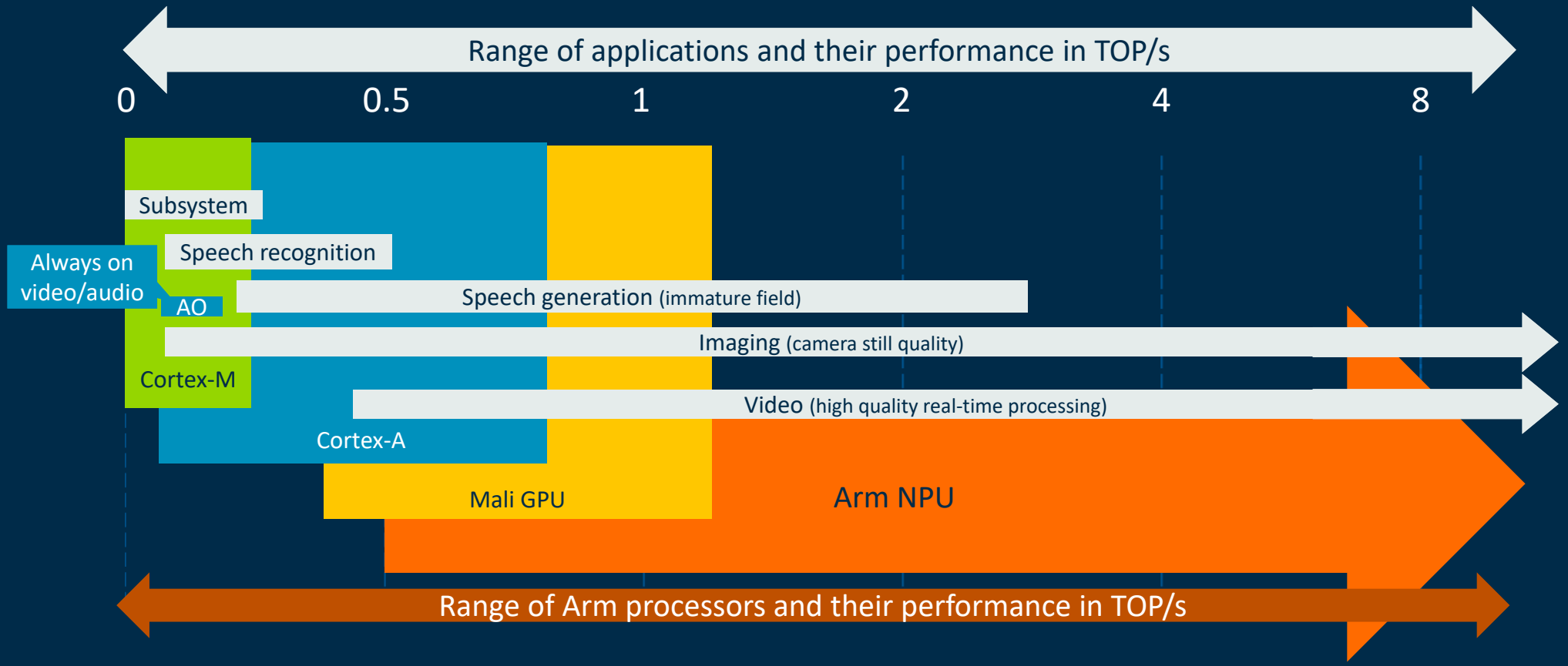
Edge voice assistant
72 GOP/s, 83% NN

Bokeh camera still
199 GOP/s, 70% NN

Video “Greenscreen”
10.7 TOP/s, 97% NN

*Source: Arm ML group, analysis of key operation complexity over multiple use cases

Heterogeneous platform enables multiple ML workloads



Majority of ML use cases are running just on the CPU today

Source: Arm ML Group, analysis of customer and third-party use cases running in production systems

Securing the Internet of Real Things

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The Internet of Things

A ‘hyper-connected’ world of devices

Now

3+ billion Smartphones

2+ billion Personal computers

8+ billion IoT devices

Future

1 trillion

Connected devices by 2035

Source: Gartner, Statista, Strategy Analytics, Arm Estimates

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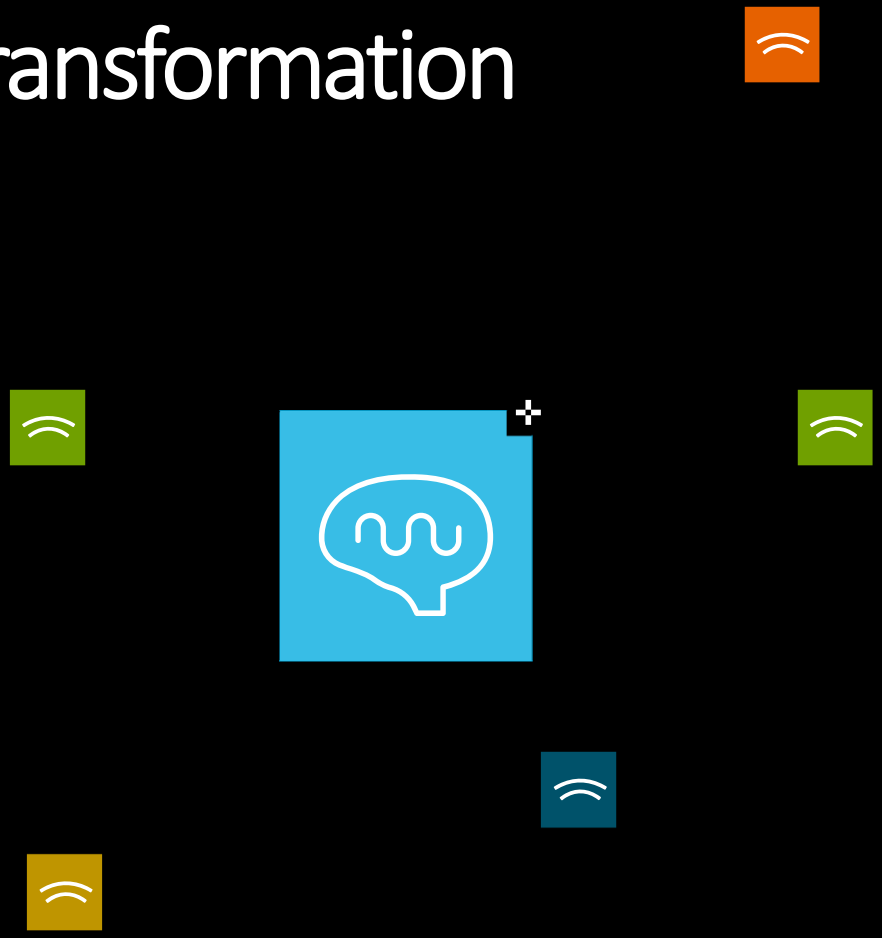
The Value of Digital Transformation

$11 Trillion

Global economic value of IoT by 2025*



*McKinsey Global Institute, 2017

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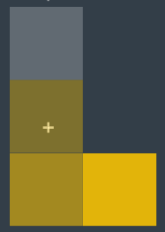
The Cost of Security Inaction is Significant

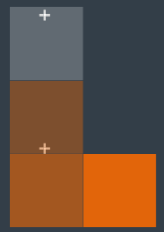


>300%

Increase in malware loaded onto IoT devices[2]

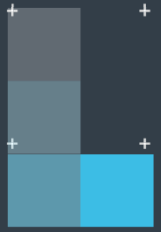
29%

Increase in industrial control system vulnerabilities[1]



600%

Increase in IoT device attacks[1]



$6 trillion

Cost of damage related to cybercrime by 2021[3]

1 – Symantec Internet Security Threat Report 2018
2 – Kaspersky Labs, New Trends in the World of IoT Threats 2018
3 – Annual Cyber Crime Report, Cyber Security Ventures 2019

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Connecting Chip-to-Cloud - Securely

Energy efficient processing, with right-fit security

Secure devices - trusted data, secure identity

Secure, open OS - designed ground-up for IoT

Device, connectivity & data management

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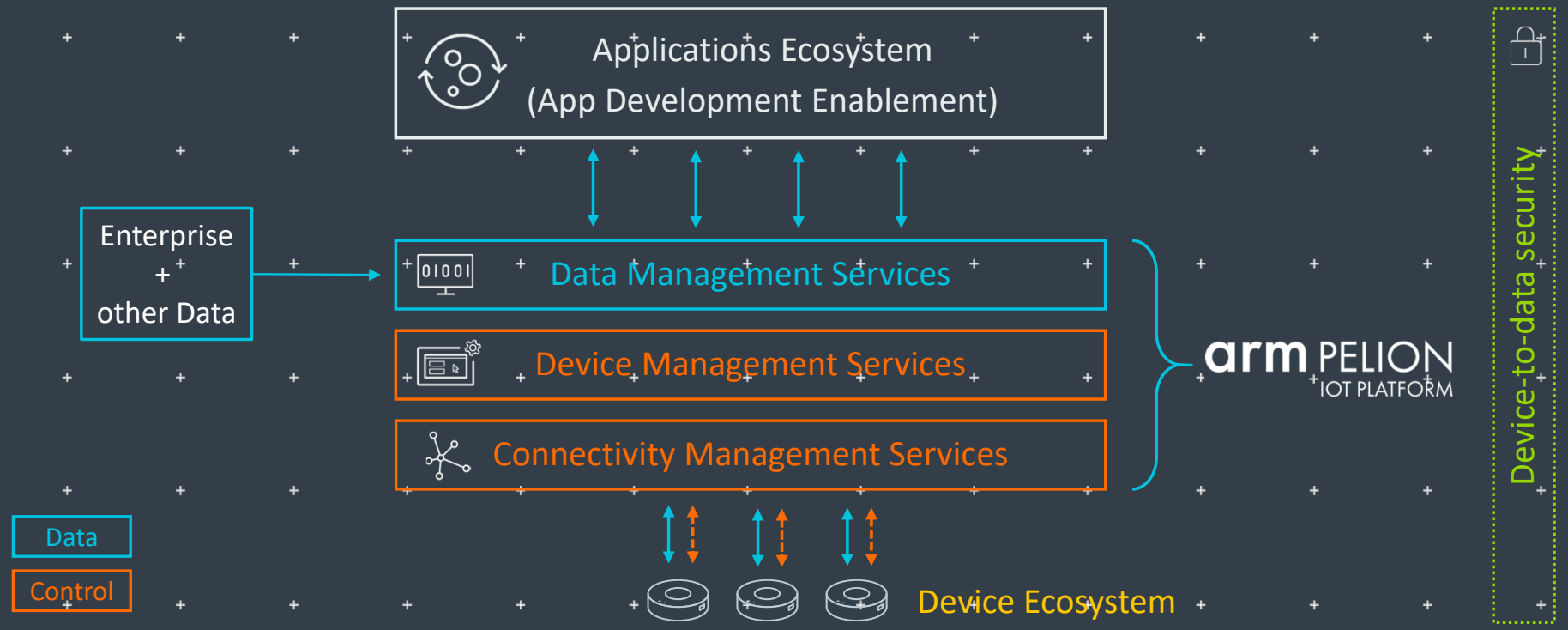
Arm's IoT platform - Pelion

Device, Data & Connectivity management



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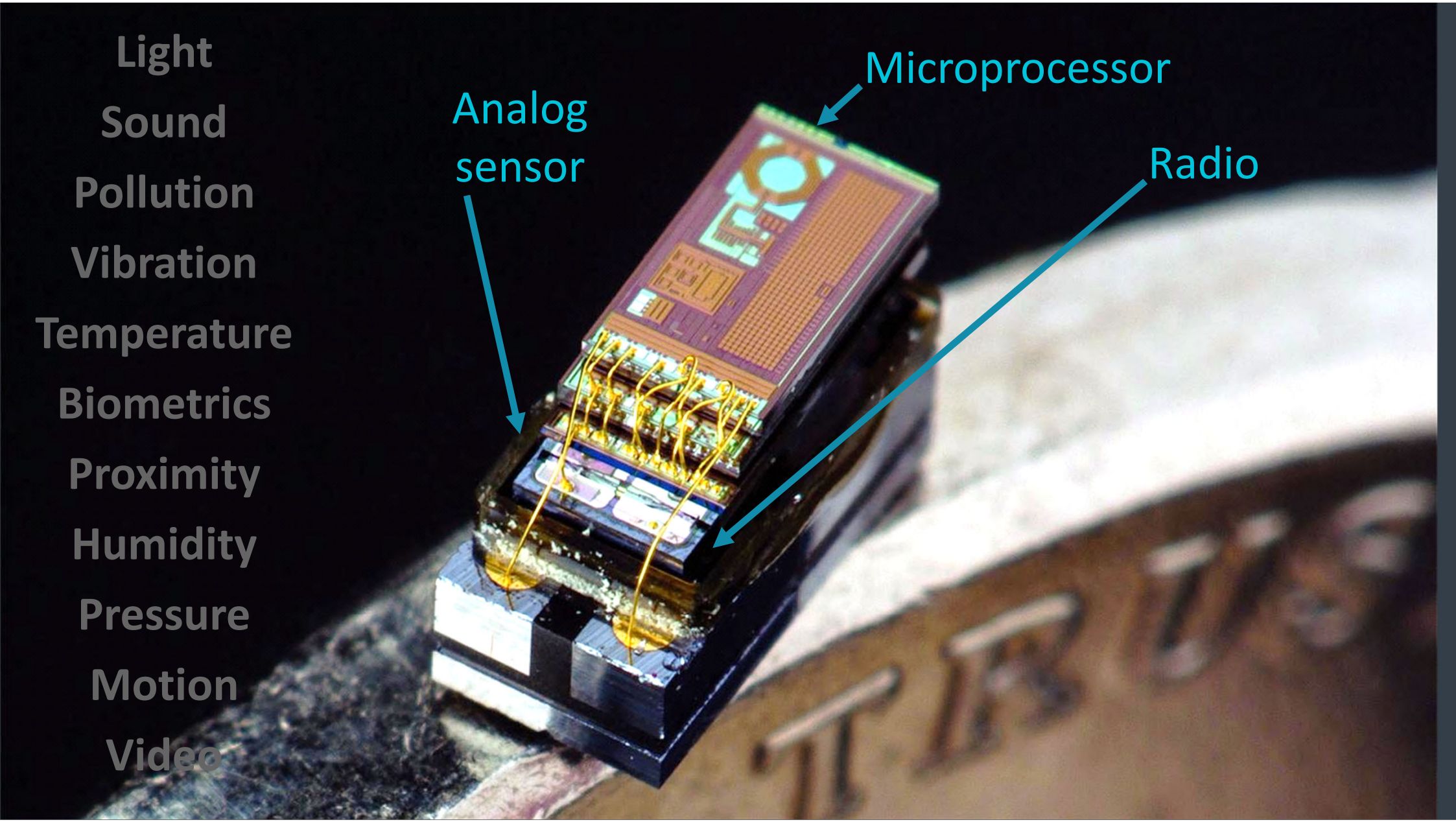
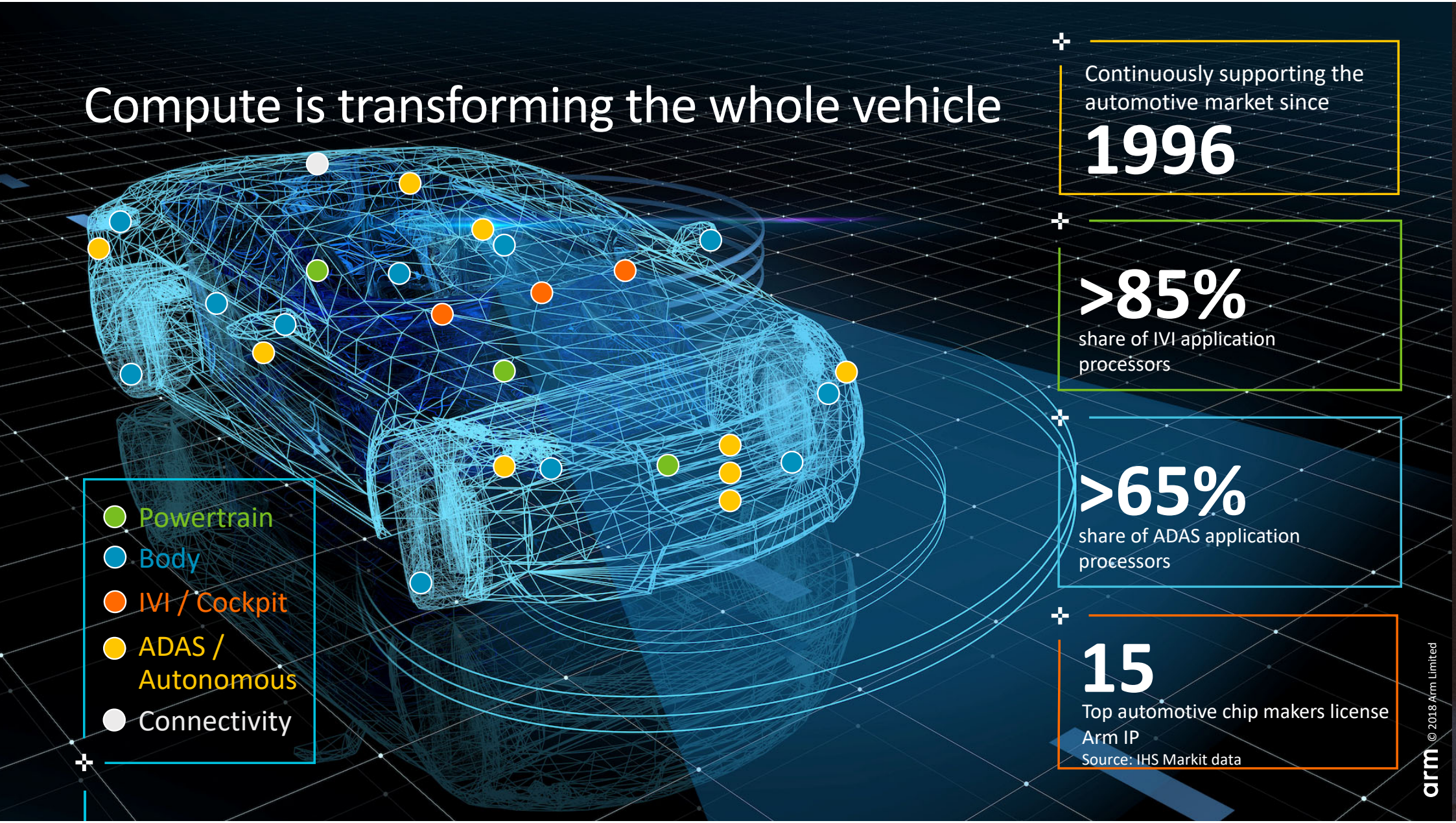

Light
Sound
Pollution
Vibration
Temperature
Biometrics
Proximity
Humidity
Pressure
Motion
Video
Analog sensor
Microprocessor
Radio

“90% of automotive innovation comes from electronics and software.”

– Audi at CES Asia

Compute is transforming the whole vehicle



Continuously supporting the automotive market since

1996

>85%

share of IVI application processors

>65%

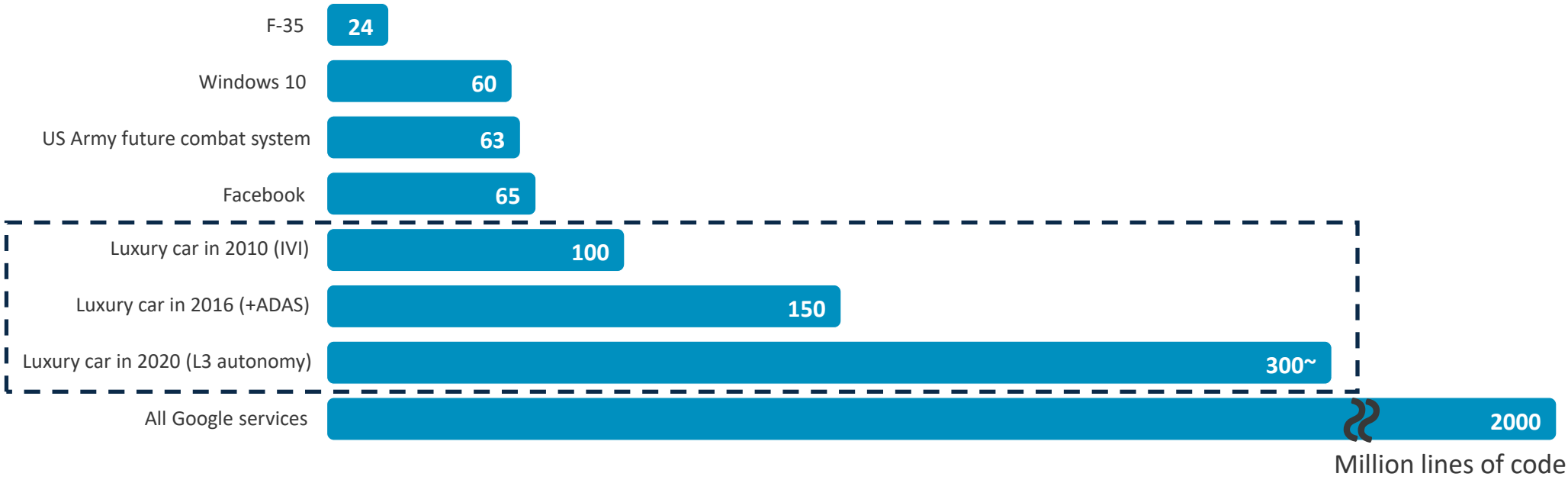
share of ADAS application processors

15

Top automotive chip makers license Arm IP

Source: IHS Markit data

Cars run on code



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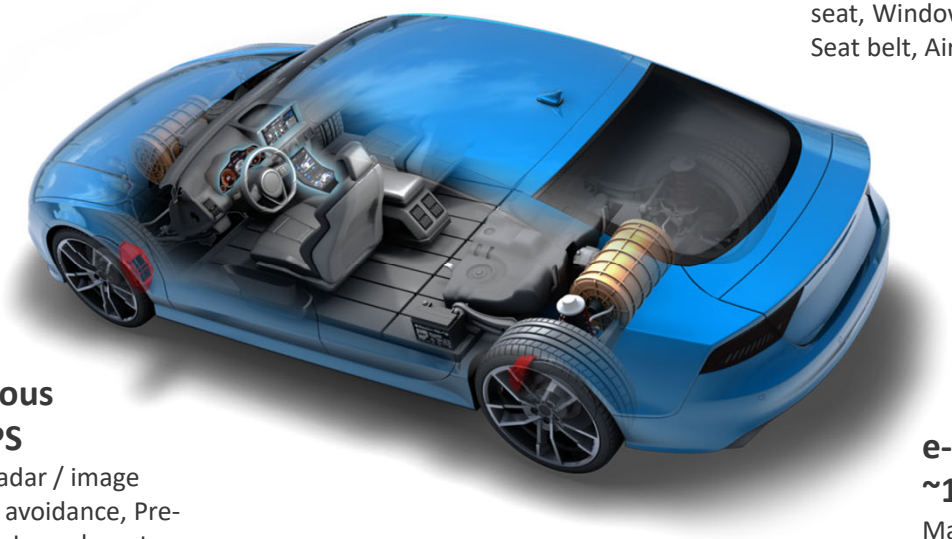
Automotive compute in 2020

Cockpit
~50,000 DMIPS
Audio Visual, Maps, Traffic, Toll payment, Google services
Rear entertainment, Voice recognition, Gesture control, Cluster and HUD

Connected Gateways
~20,000 DMIPS
LTE 5G, WiFi, Bluetooth connecting to CAN FD, LIN, Flexray, Ethernet

Body Electronics
<10,000 DMIPS
HVAC, Lighting, Doors, Electric seat, Windows, Mirrors, Cameras, Seat belt, Air bag, BCM



Semi Autonomous
~350,000 DMIPS
Level 3 autonomy, Radar / image processing, Collision avoidance, Pre-crash, Cruise control, Lane departure, Parking

Chassis
~15,000 DMIPS
EPS, ABS/EBS, Active VDC, EPB

e-Powertrain
~15,000 DMIPS
Main Motor control, Transmission, Engine control, Generator/E-water pump
Battery management

High-end smartphone
30,000-50,000 DMIPS
Main applications processor, WiFi, modem, sensors, etc.

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Investing in high-performance technology for safety-critical systems

Processors locked for safety

Two cores run the same instructions

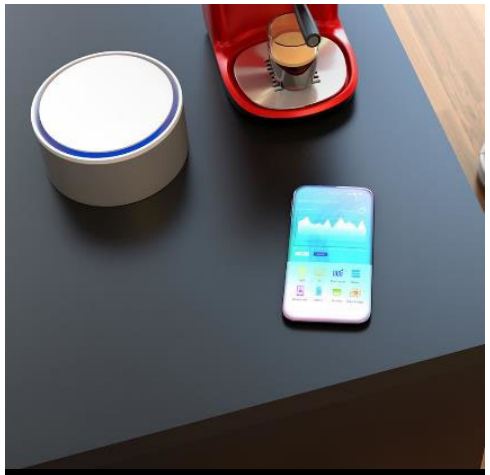
Each operation is checked

Giving a higher level of safety

Without increased software complexity

Technology trends that will redefine all industries

Augmented reality



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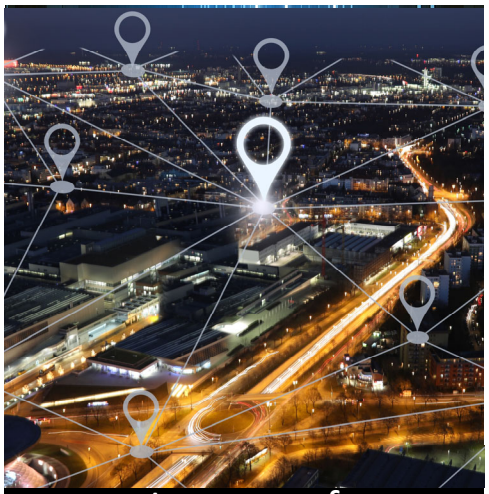
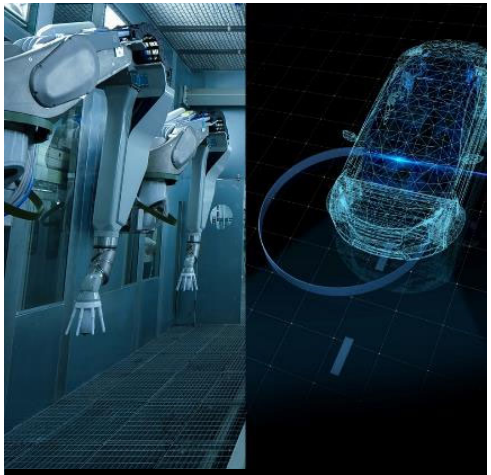


Internet of Things



Autonomous machines

Security and Privacy

Bringing it all together