



CEVA TECHNOLOGY  
SYMPOSIUM SERIES

# Fusion of AI, IoT and 5G – the Perfect Storm

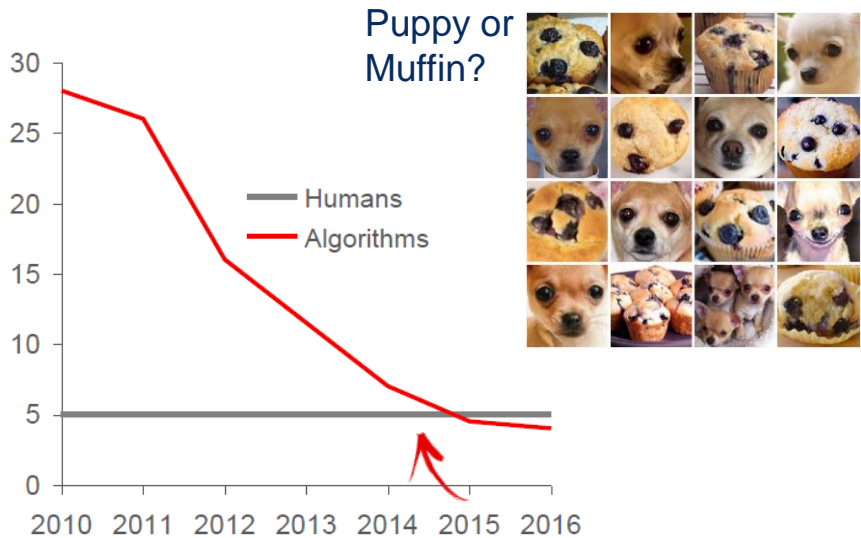
Moshe Sheier, VP Marketing, CEVA

[www.ceva-dsp.com](http://www.ceva-dsp.com)

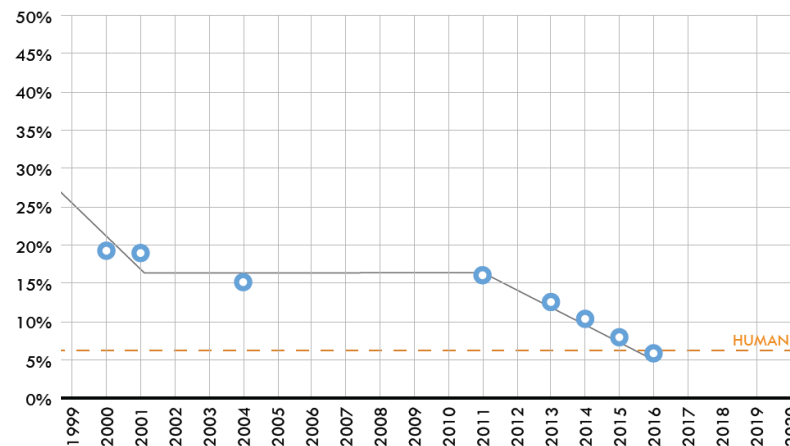


# AI – Accelerated Growth

ImageNet visual challenge error rate (%)

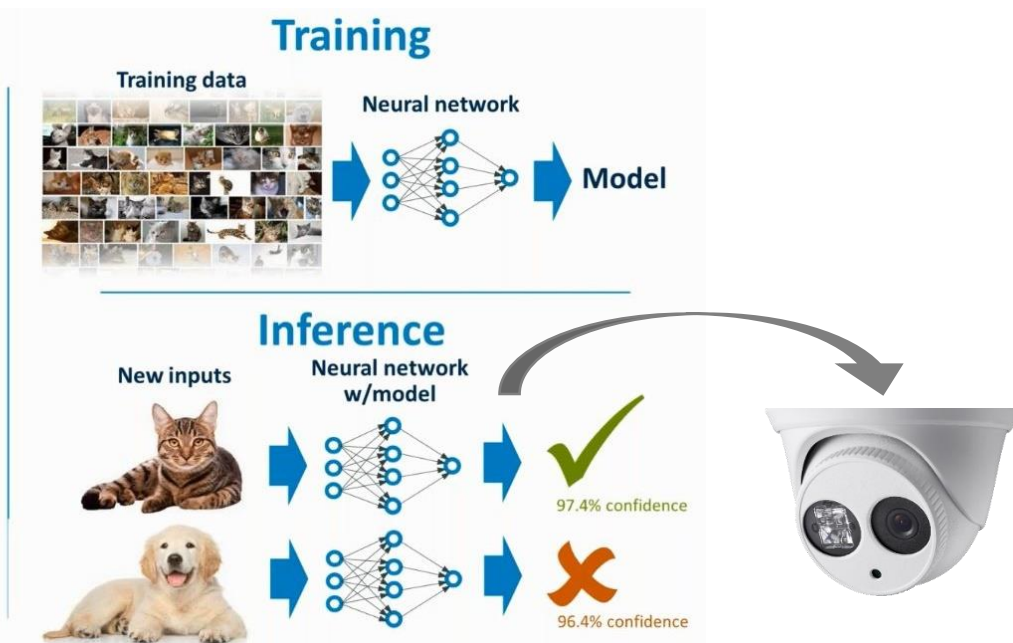
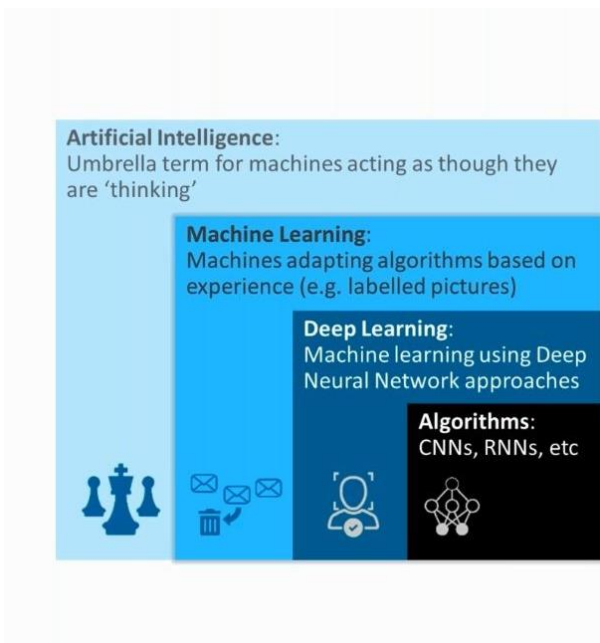


Speech to Text Transcription error rate (%)



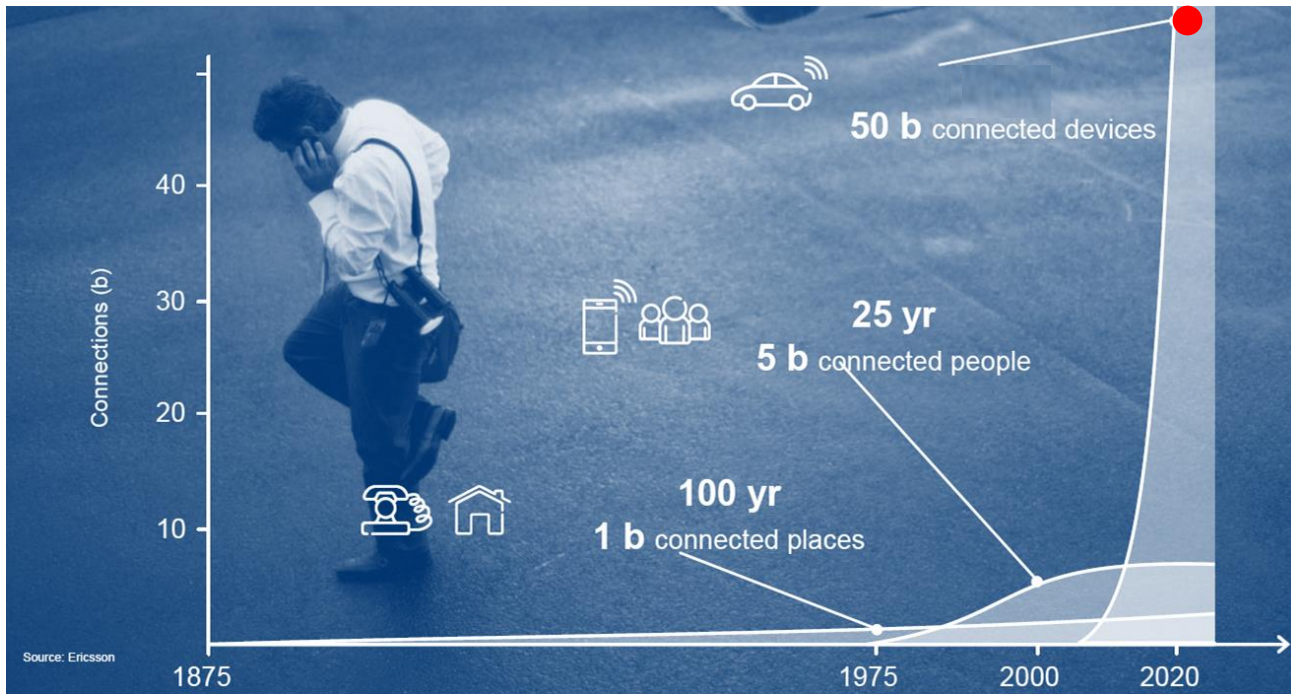
Cognitive machines are getting smarter than humans

# AI has Many Forms



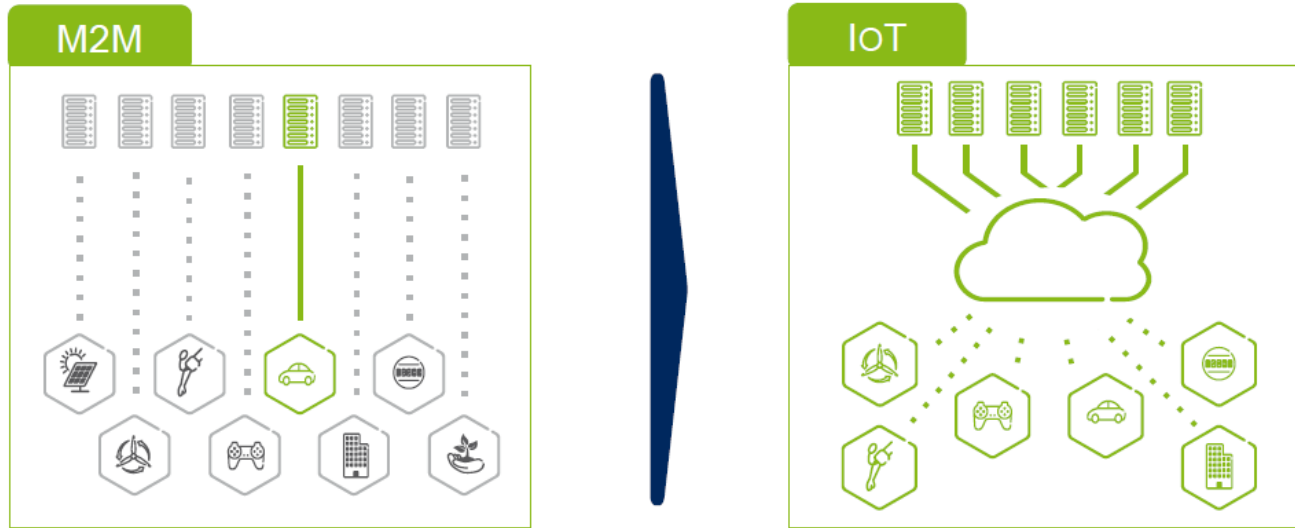
► Inference is the AI element that mostly happens at end nodes

# IoT – Accelerated Growth



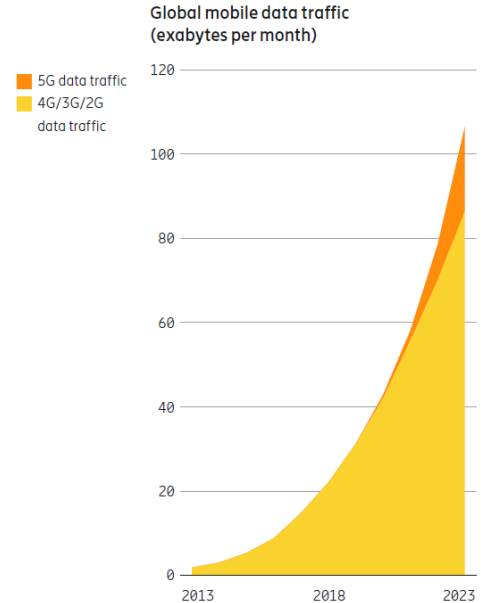
30-50 Billion connected devices by 2023

# IoT is not M2M



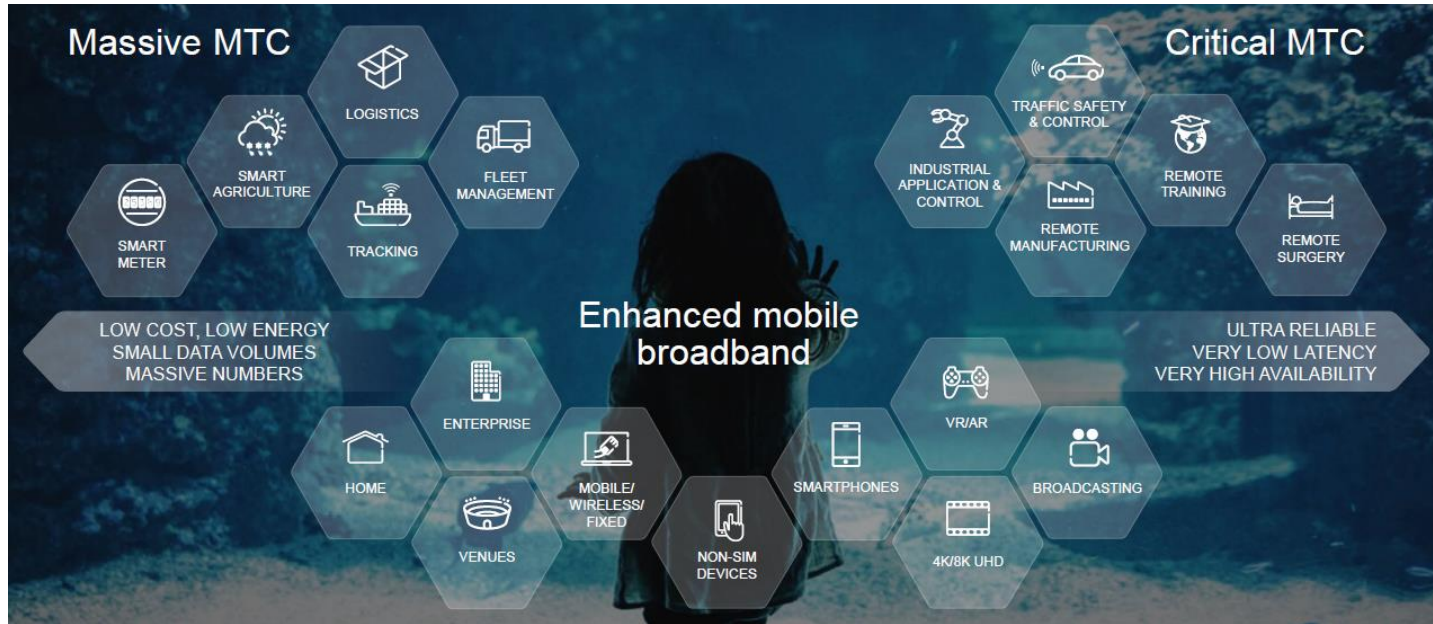
- ▶ IoT is not just a technology that brings efficiencies and value within **industry verticals**, but a way of tying **industries, people, and society together** to create substantial value

# 5G – Accelerated Growth



5X increase in mobile data – 110 Exabyte by 2023

# 5G is Use Case Driven (not 4G evolution)



- ▶ 5G supports cellular IoT (e.g. asset tracker), eMBB (e.g. mobile, AR), and critical MTC (e.g. automotive, industrial)

# Combined Together ... The Perfect Storm

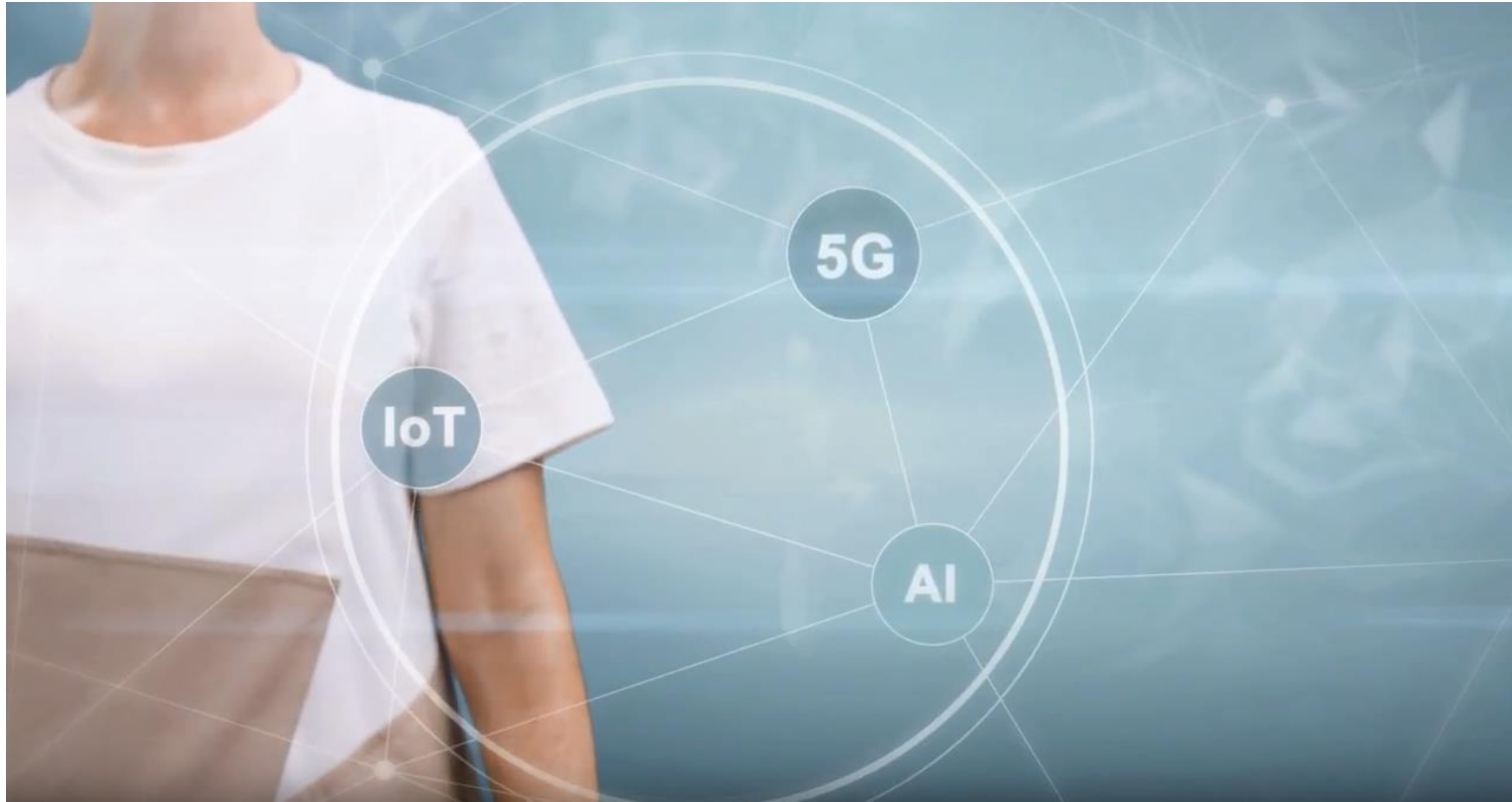
“A perfect storm is an unusual combination of events or things that produce an unusually powerful result”



**AI + IoT + 5G = Intelligent Connectivity**



# Intelligent Connectivity



Source: 

# Automotive Use Case

**Forbes**

AI critical to the  
future of  
autonomous  
vehicles

Forbes

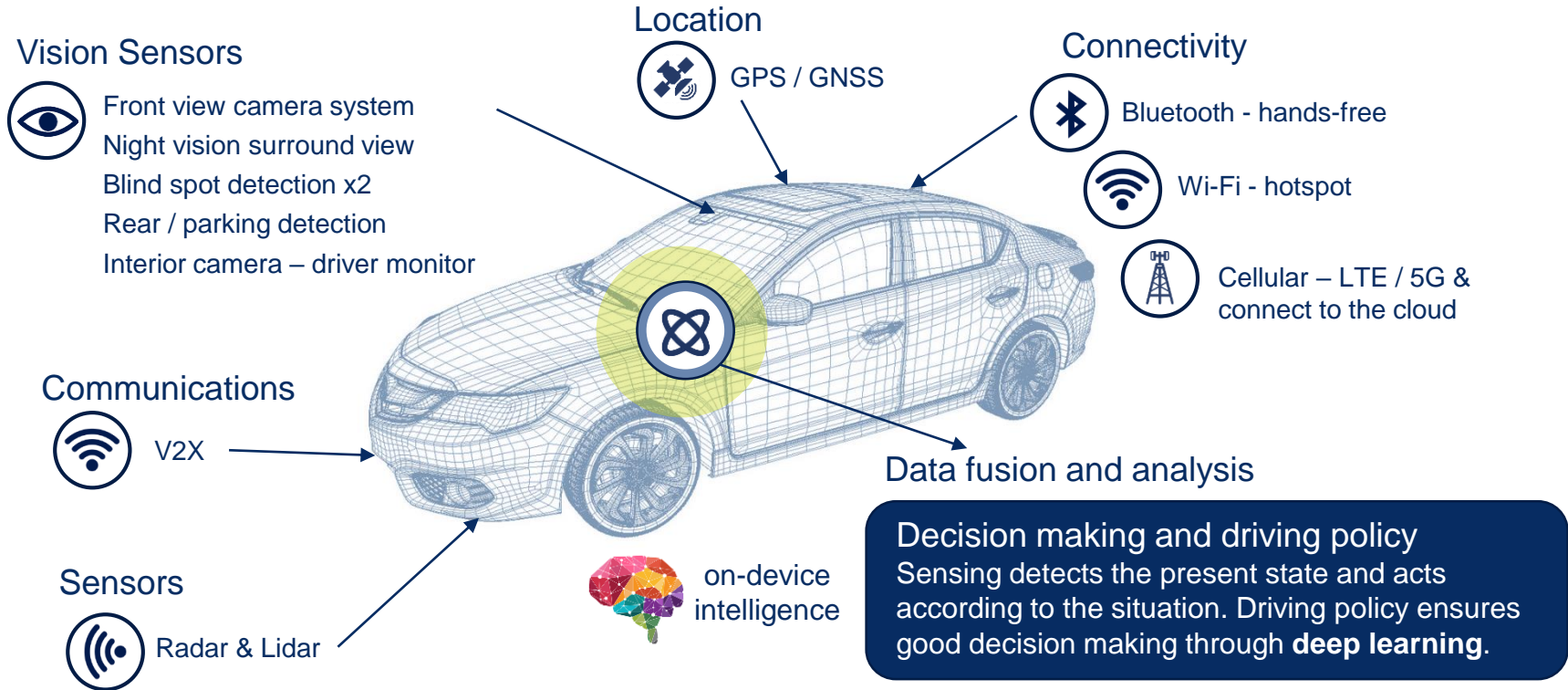
**VB**

5G wireless will  
make autonomous  
cars smarter

VentureBeat

- ▶ Fully autonomous vehicles would be impossible without AI and 5G

# Intelligent Connectivity – Automotive





## Amazon may launch versatile robots integrating new-generation tech in 2019

*Cage Chao, Taipei; Willis Ke, DIGITIMES*  Tuesday 16 October 2018   

Amazon is likely to launch in 2019 a versatile robot integrating **cloud service, big data, smart voice, IoT, AI and even 5G** technologies, which is expected to serve as the web giant's secret weapon for outracing its rivals in developing innovative smart devices, according to Taiwan supply chains sources.

# Intelligence Moving to the Edge

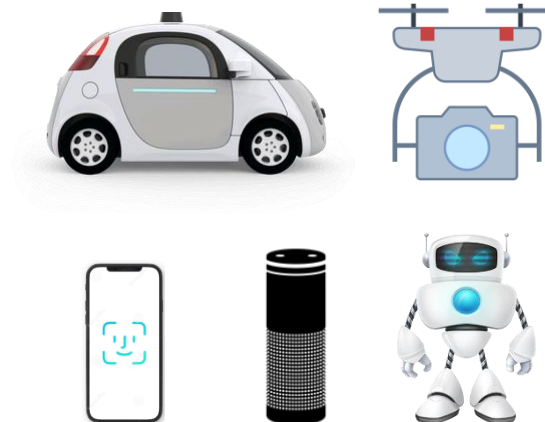
## Cloud AI



## Intelligence & Analytics



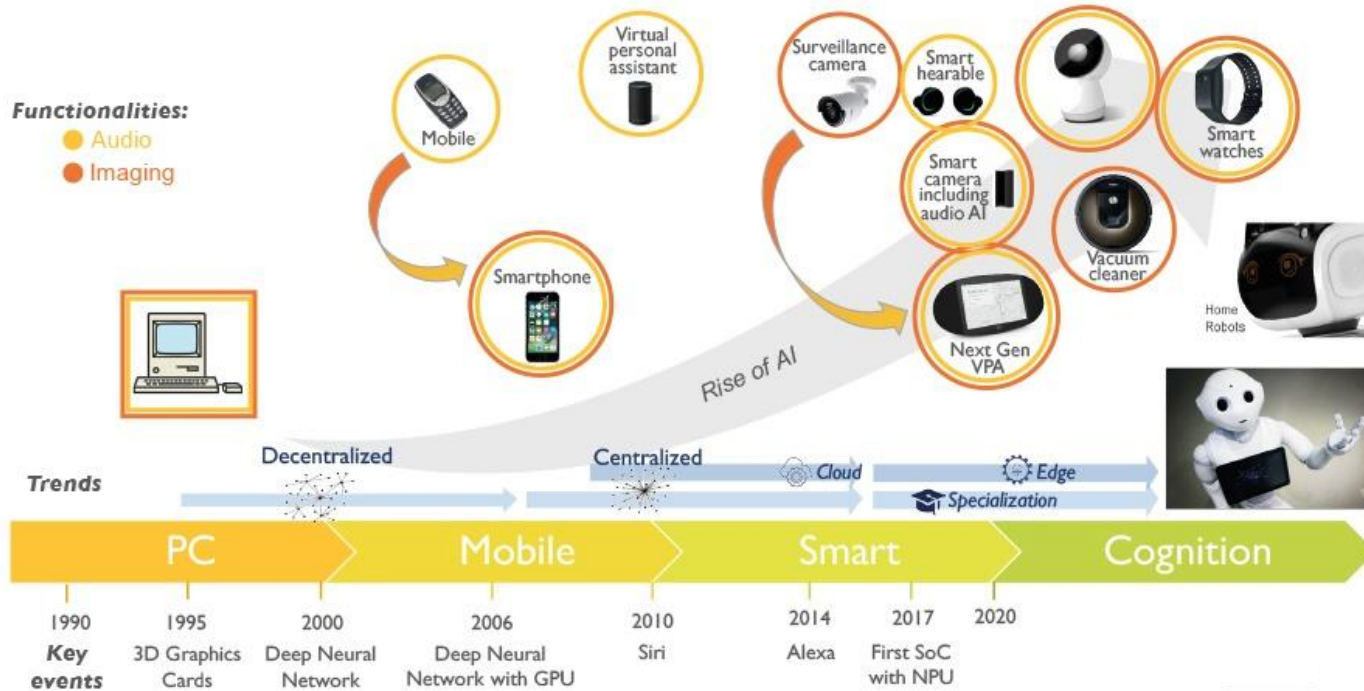
## Edge Devices



## *Key Benefits*

**Low Latency / Low Power / Low Cost / High Privacy / High Reliability**

# AI on Edge is Driving Cognitive Machines



## On the road to an intelligent interface

(Source: Hardware and Software for AI 2018 – Consumer focus, Yole Développement, September 2018)

# IoT Use Case



**Mat:**  
tells users when  
a product is  
almost empty



**Fridge Cam:**  
allows to see  
the contents of  
your refrigerator  
from anywhere



**Microphone:**  
detects beeps  
and alarms from  
other  
appliances



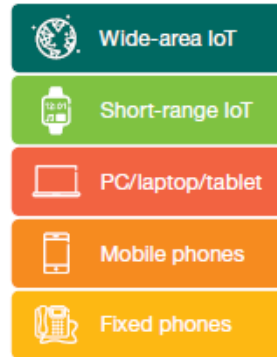
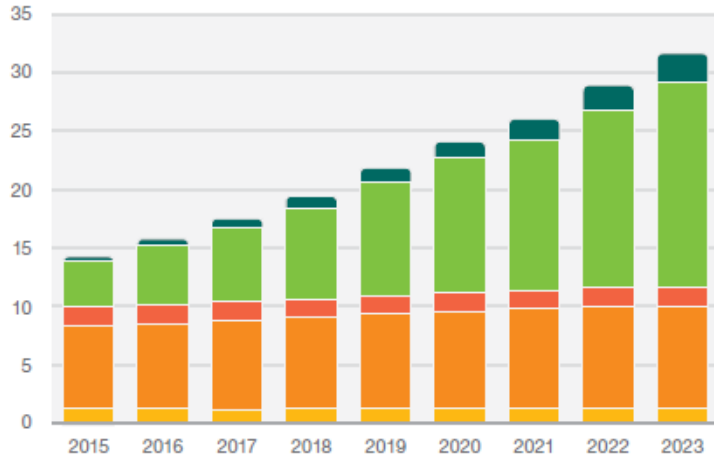
- ▶ Microwave with camera sees an unrecognized new food; Microwave has small food DB
- ▶ Microwave connects to fridge via BT to ask what is it? Fridge has larger food DB
- ▶ If the fridge doesn't recognize it, it goes to the cloud via Wi-Fi to get an answer ...

# Intelligent Connectivity – IoT





# IoT Connections















Connected devices (billion)

IoT	2017	2023	CAGR
Wide-area IoT	0.8	4.1	30%
Cellular IoT <sup>2</sup>	0.7	3.5	30%
Short-range IoT	6.2	15.7	17%
<b>Other devices</b>			
PC/laptop/tablet	1.6	1.7	0%
Mobile phones	7.5	8.6	2%
Fixed phones	1.4	1.3	0%
<b>Total connected devices</b>	<b>17.5</b>	<b>31.4</b>	<b>11%</b>

- ▶ Long range **cellular IoT** connections will reach **3.5 billion in 2023** – 30% CAGR
- ▶ Short range **BT/Wi-Fi** connections will reach **15.7 billion in 2023** – 17% CAGR

# What will 5G bring?

	Peak Data Rate	1 - 20 Gbps		Connection Density	10k - 1m devices / km <sup>2</sup>		Reliability	99.999% (of packets)
	User Experienced Data Rate	10 - 100 Mbps		Network Energy Efficiency	×1 - ×100		Latency	1 - 10 ms
	Spectral Efficiency	×1 - ×3		Area Traffic Capacity	0.1 - 10 Mbps / m <sup>2</sup>		Battery life	10 years*
	Mobility	350 - 500 km/h		Availability	99.999% (of time)		Security	Strong subscriber authentication, user privacy and network security

► 5G supports multiple use-cases in cellular IoT, eMBB, and critical MTC

# 5G Use Case

## ► Remote robotic surgery



- ✓ Improved outcomes
- ✓ Patient convenience
- ✓ Reduced cost



## ► What is the role of 5G?



Latency



Security

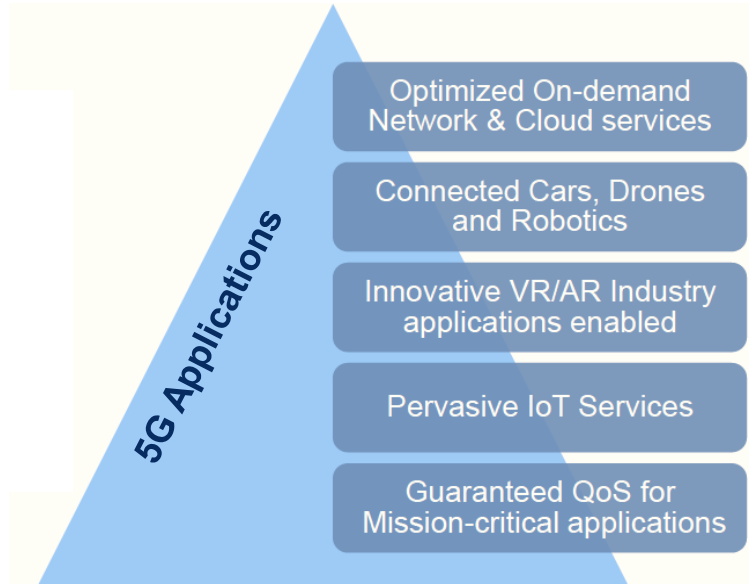


Availability



Reliability

# 5G Experience

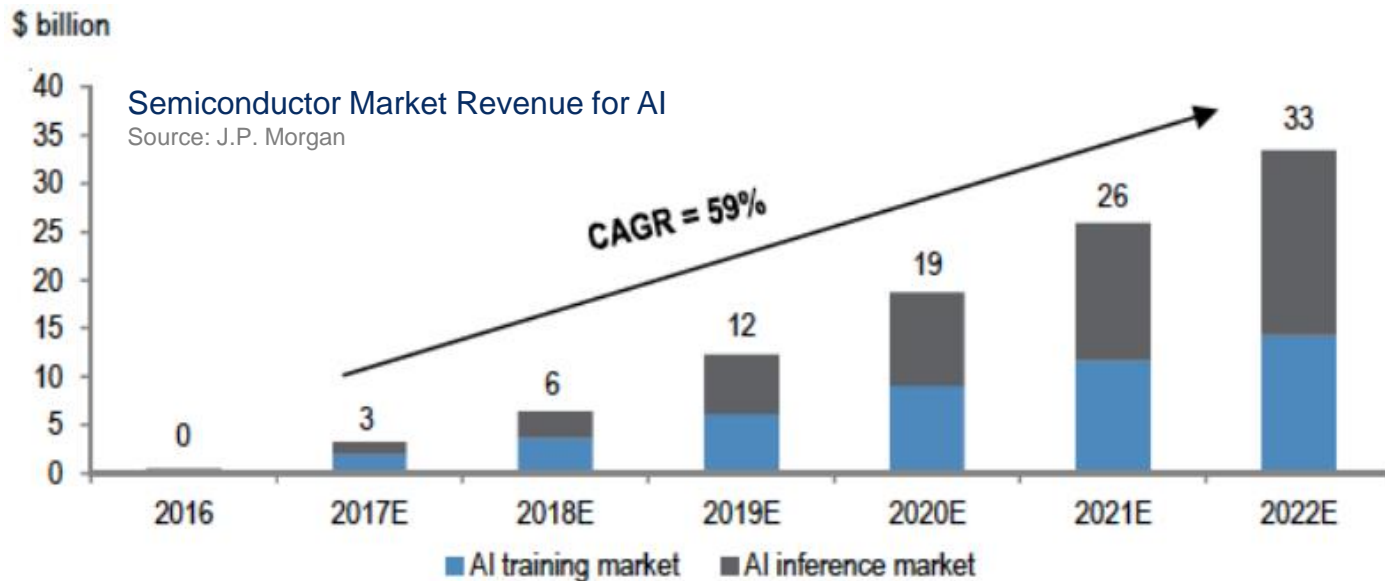


5G Experience		
Enhanced Mobile Broadband		Immersive experience
Automotive		Autonomous control
Manufacturing		Cloud robotics and remote control
Energy & Utilities		Machine intelligence and real-time control
Health Care		Remote operations

- **5G Technologies:** NR, Virtualized RAN, Federated network slicing, Distributed Cloud, Real time Machine learning/AI

# AI to Lead Semiconductor Growth

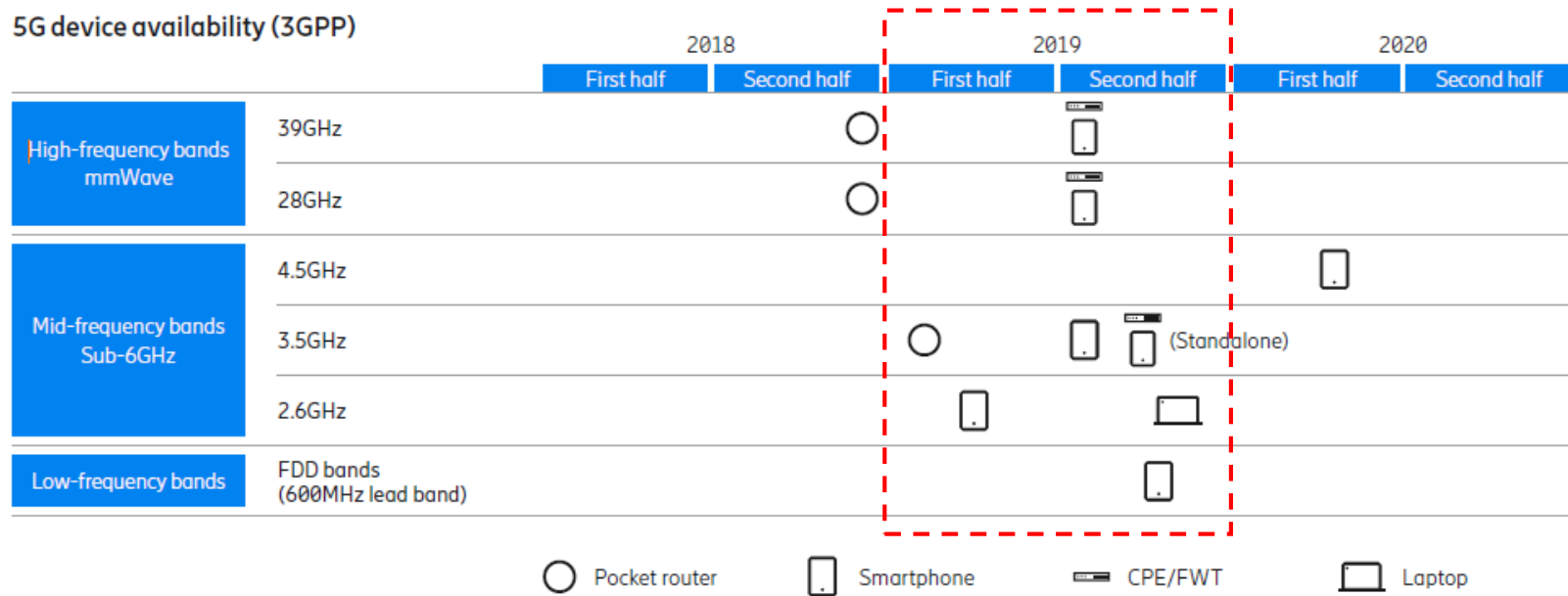
- ▶ **Global semiconductor** market is expected to grow **5-6% CAGR** from 2018-2022
- ▶ During the same period, **AI semiconductor** revenue will grow at **59% CAGR**



# 5G Chipsets are needed in 2019

- ▶ By 2023, **1 billion 5G devices** for enhanced mobile broadband are expected to be connected worldwide ... first ones are due in 2019

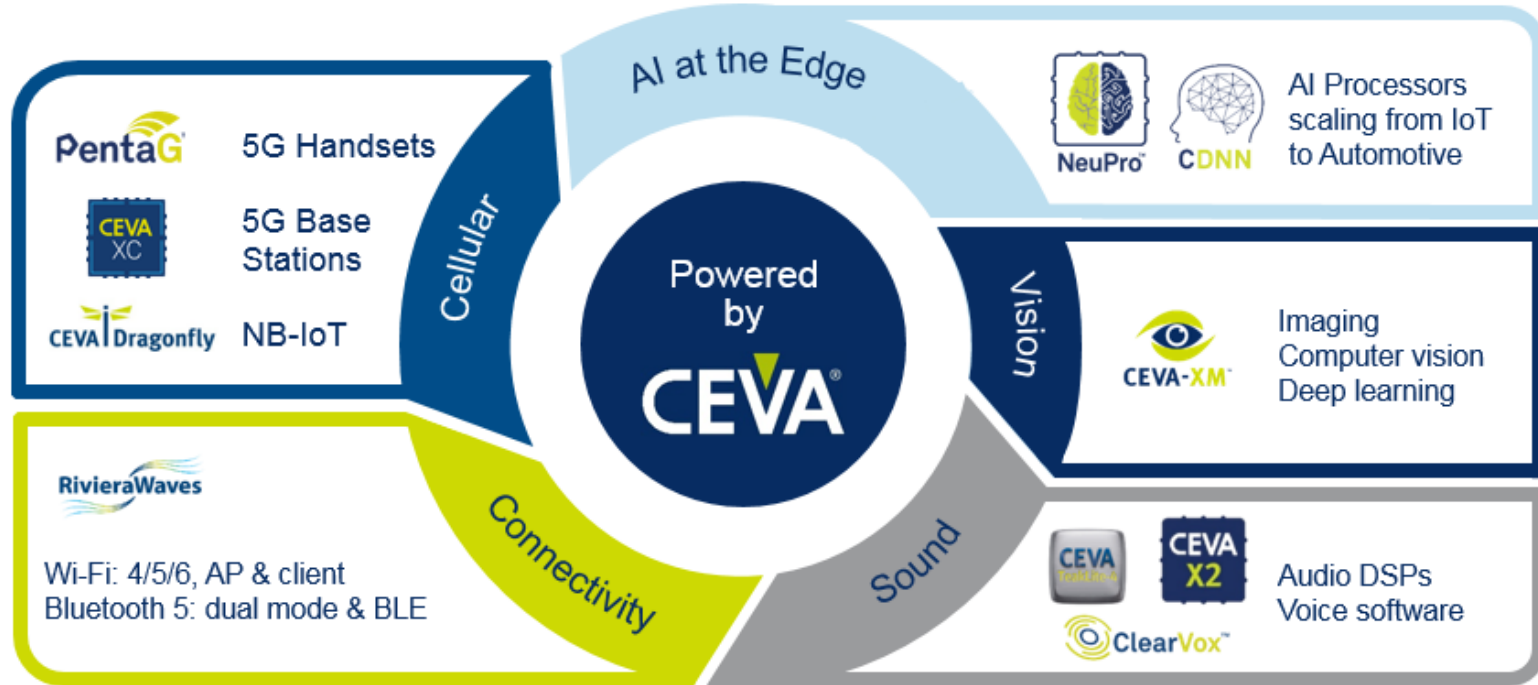
5G device availability (3GPP)



# AI, IoT, and 5G Trigger Disruption and Innovation in Multiple Industry Sectors



CEVA is providing Intelligent Connectivity solutions:



# Thank You

Moshe Sheier, VP Marketing, CEVA



[www.ceva-dsp.com](http://www.ceva-dsp.com)