The Transformation from Imaging to Sensing :

Driving a Market Revolution

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YOLE Développement

Yole's publication portfolio

2021 embedded VISION summit

YEARLY REPORTS

Insight
- Yearly reports
- Market, technology and strategy analysis
- Supply chain changes analysis
- Reverse costing and reverse engineering

Format
- PDF files with analyses
- Excel files with graphics and data

Topics
- Photonics, Imaging & Sensing
- Lighting & Displays
- Power Electronics & Battery
- Compound Semiconductors
- Semiconductor Manufacturing and Packaging
- Computing & Memory

115+ reports per year

QUARTERLY MONITORS

Insight
- Quarterly updated market data and technology trends in units, value and wafer
- Direct access to the analyst

Format
- Excel files with data
- PDF files with analyses graphs and key facts
- Web access (to be available soon)

Topics
- Advanced Packaging
- Application Processor
- DRAM
- NAND
- Compound Semiconductor
- CMOS Image Sensors
- Smartphones

7 monitors quarterly basis

WEEKLY TRACKS

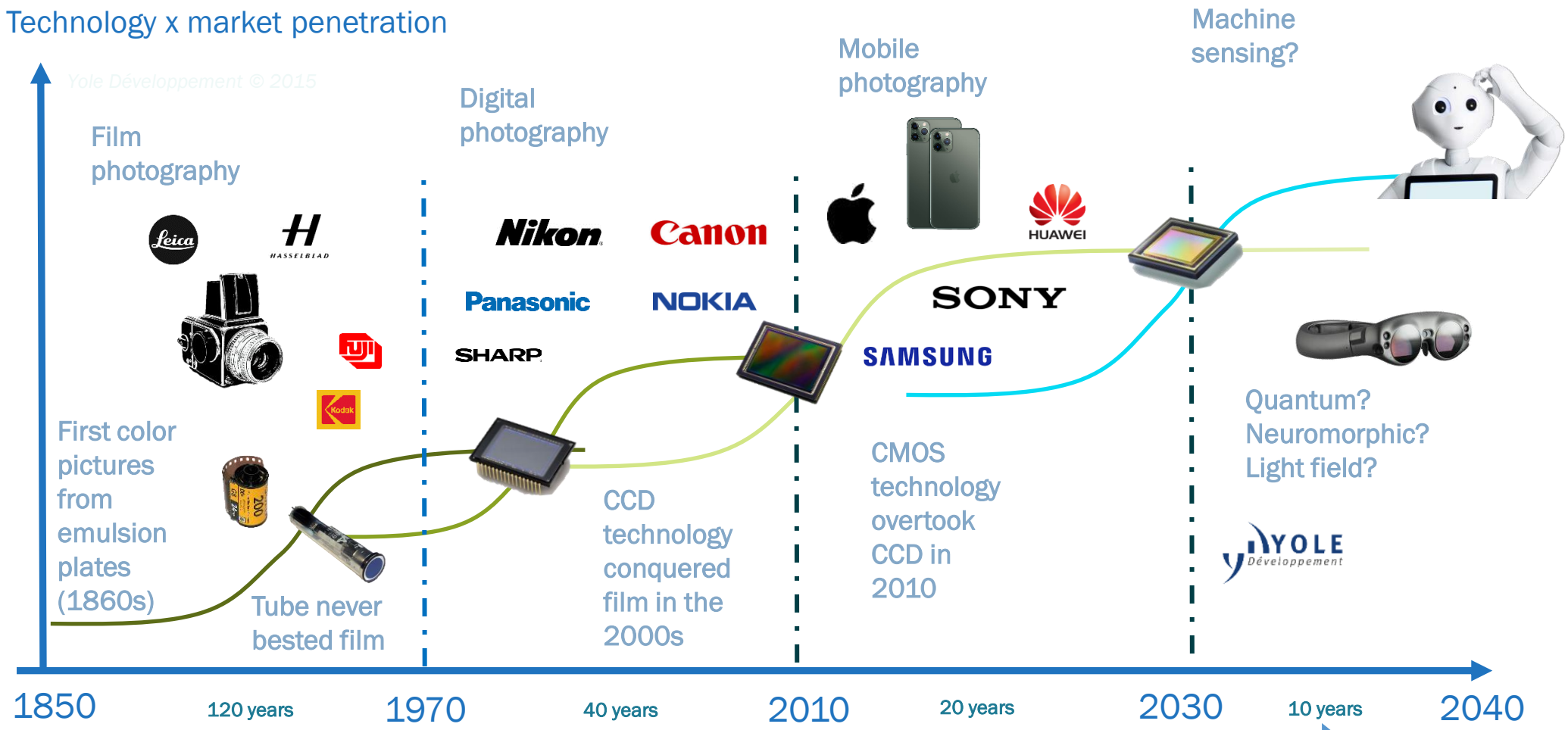
Insight
- Teardowns of phones, smart home, wearables and automotive modules and systems
- Bill-of-Materials
- Block diagrams

Format
- Web access
- PDF and Excel files
- High-resolution photos

Topics
- Consumer: Smartphones, smart home, wearables
- Automotive: Infotainment, ADAS, Telematics

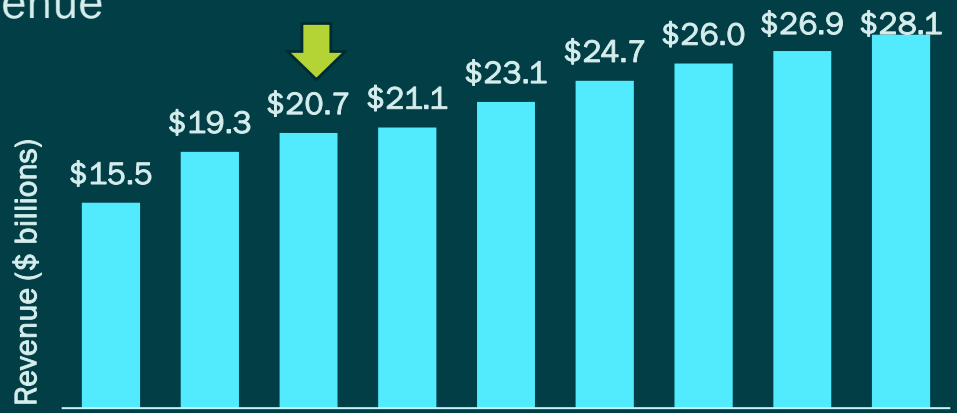
175+ teardowns per year

The triple disruption in photography



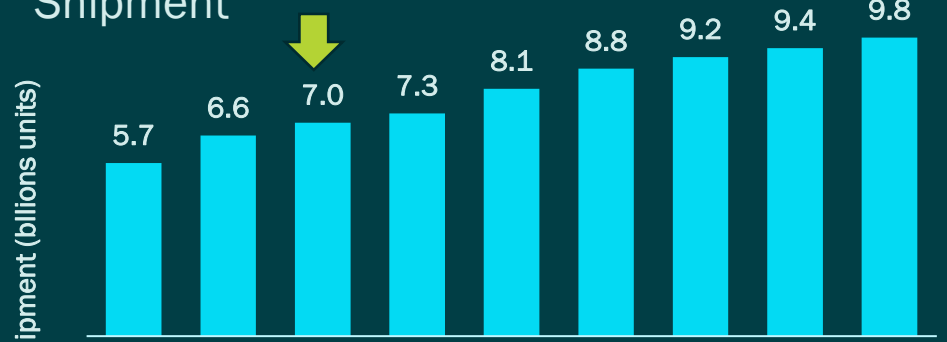
CIS long term dynamics

Revenue



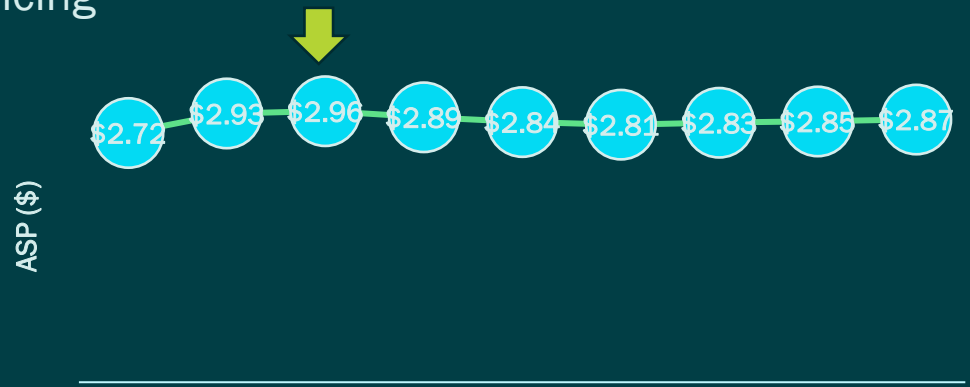
YoY	11%	25%	7%	2%	9%	7%	5%	4%	4%

Shipment



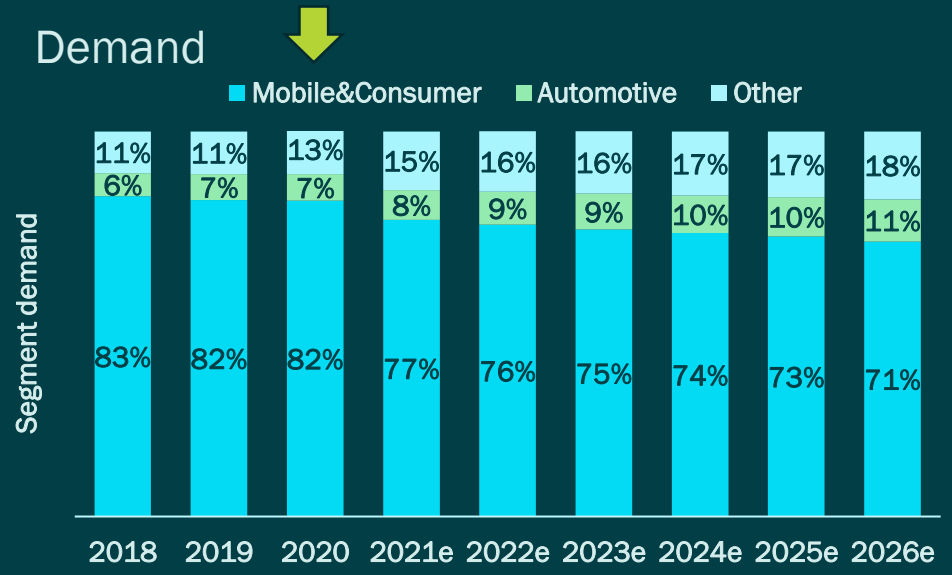
YoY	8%	16%	6%	4%	11%	8%	4%	3%	4%

Pricing



YoY	3%	8%	1%	-2%	-2%	-1%	1%	0%	1%

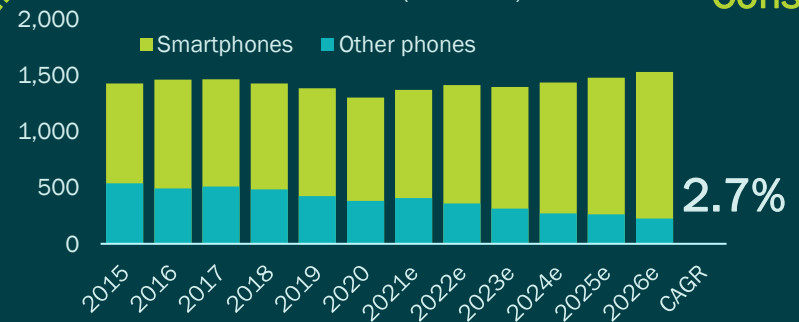
Demand



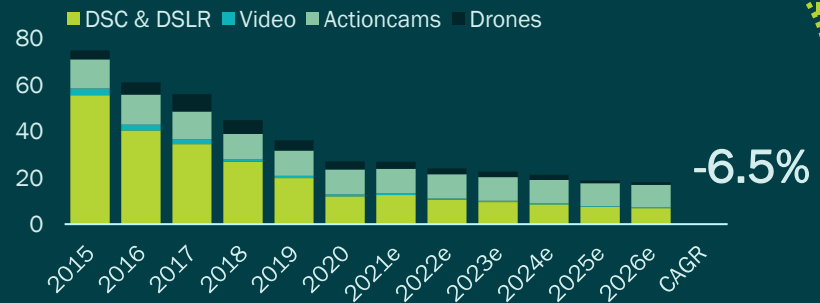
End-system market long term dynamics

Consumer

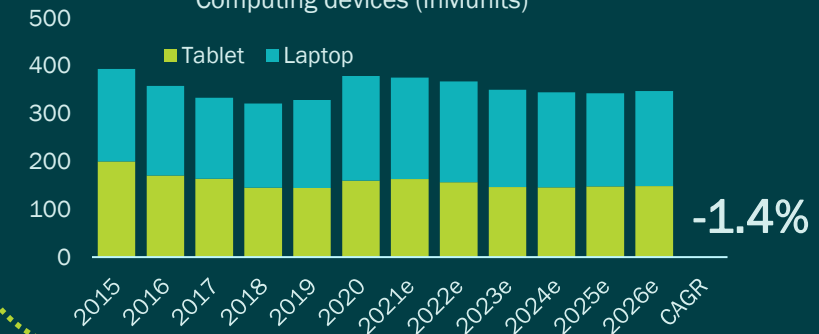
Mobile Handset (inMunits)



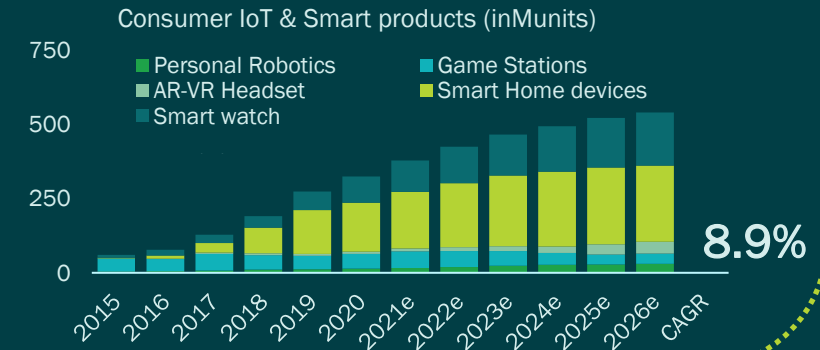
Consumer Photography & Video (inMunits)



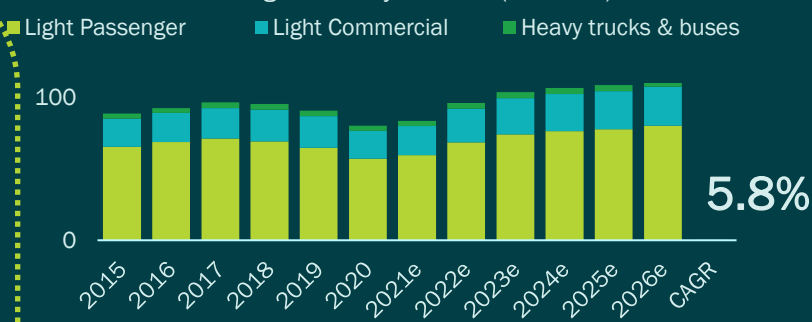
Computing devices (inMunits)



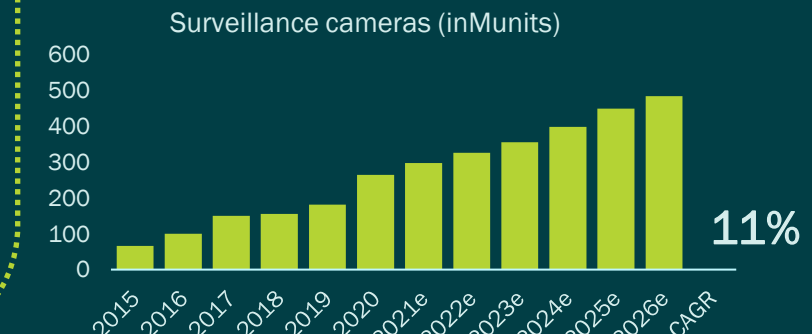
Consumer IoT & Smart products (inMunits)



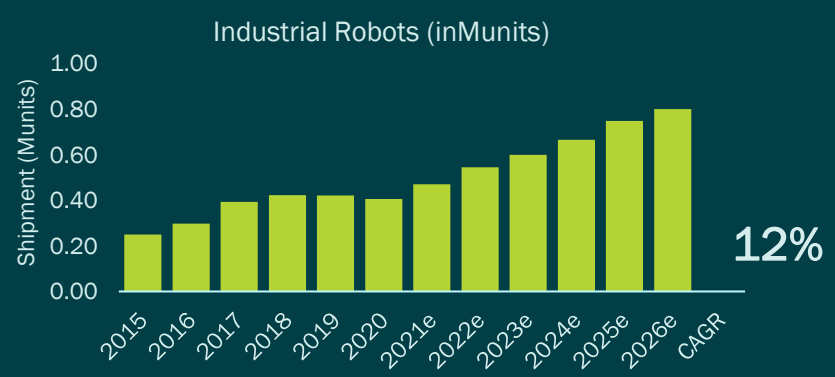
Automotive light & heavy vehicles (inMunits)



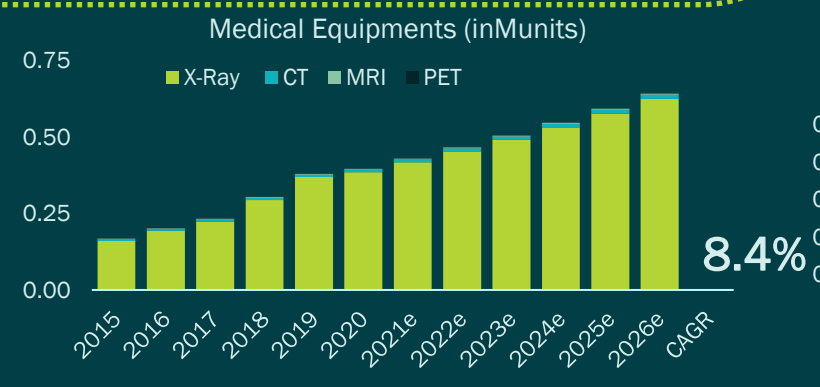
Surveillance cameras (inMunits)



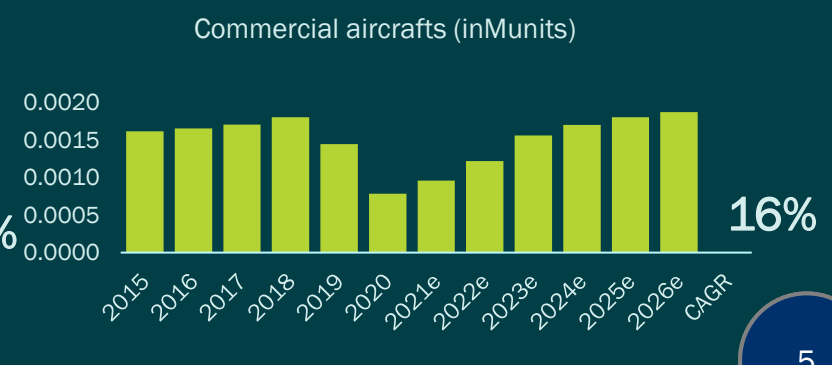
Industrial Robots (inMunits)



Medical Equipments (inMunits)

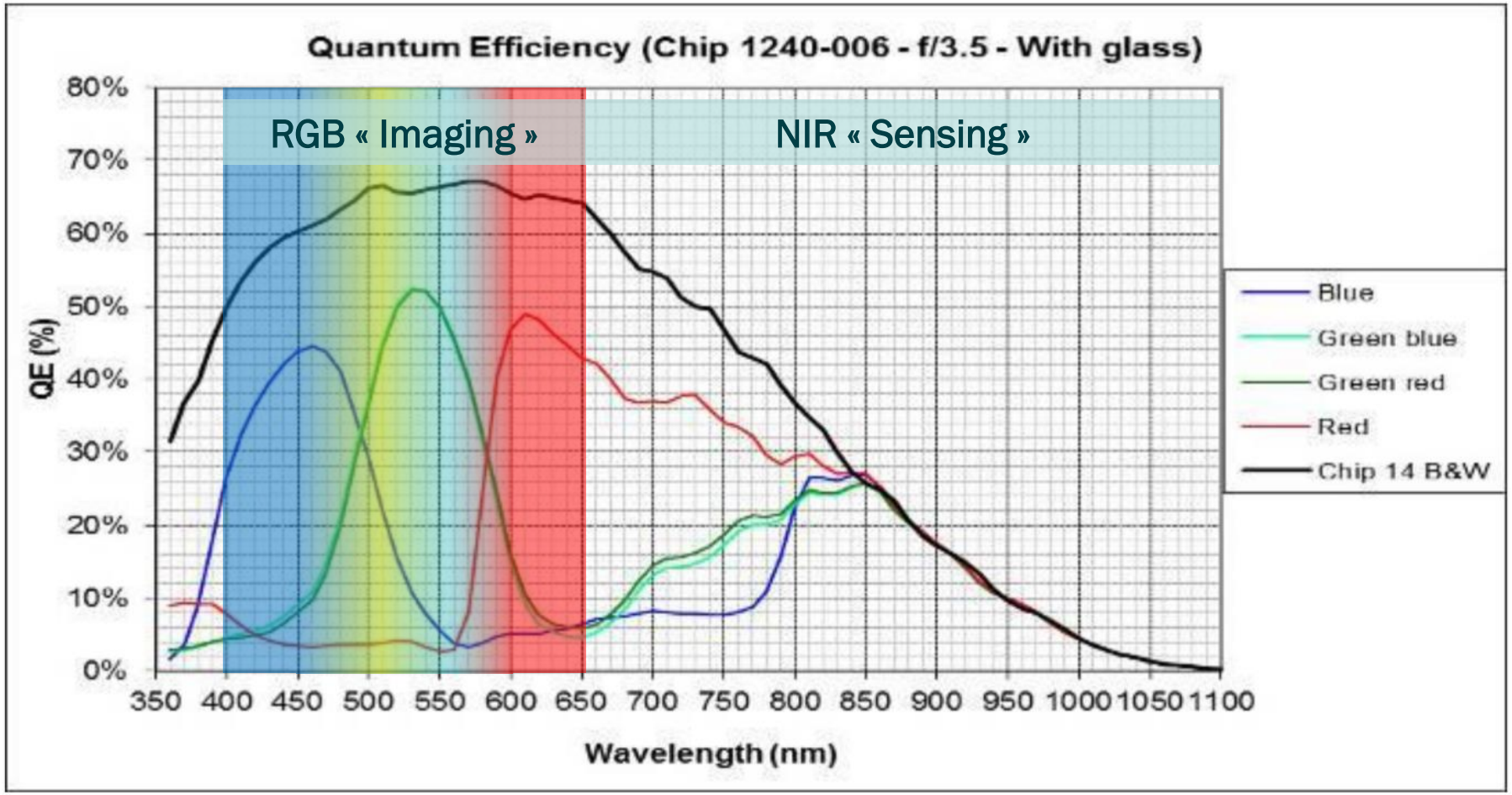


Commercial aircrafts (inMunits)



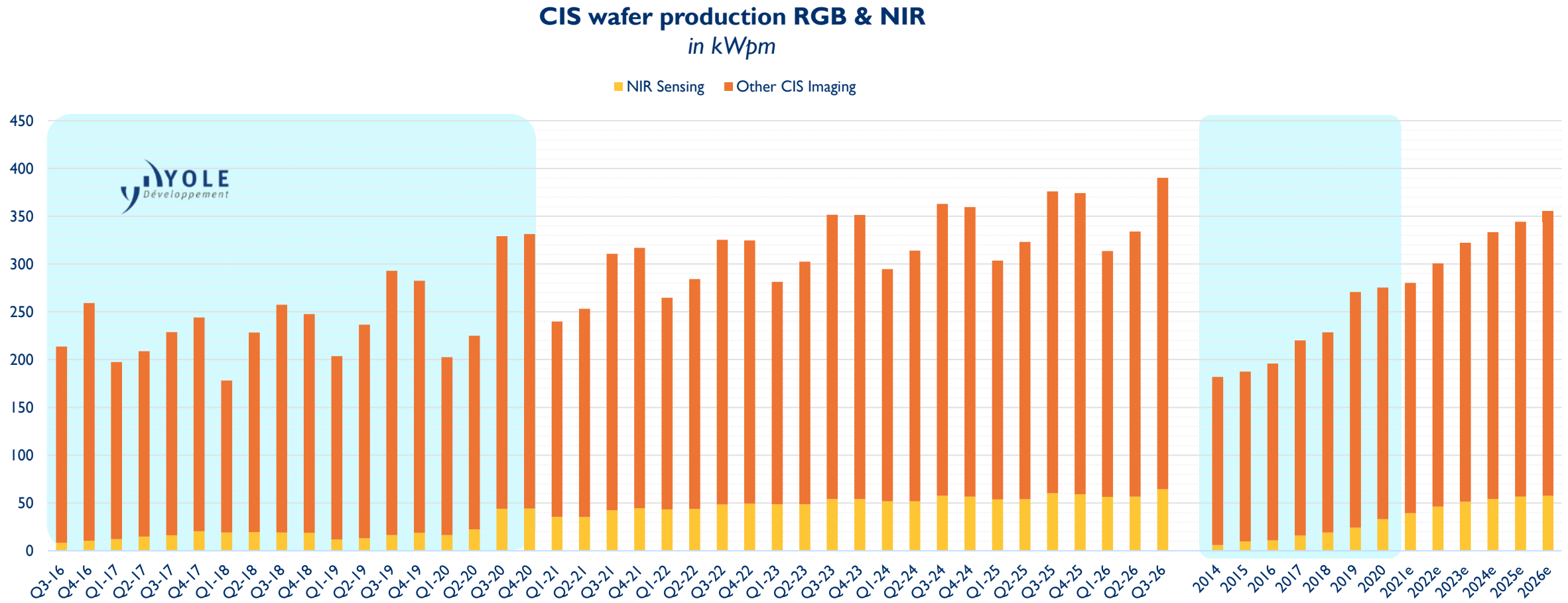
CIS photonic sensitivity RGB vs NIR

Because silicon is sensitive beyond 600nm an IR filter is needed

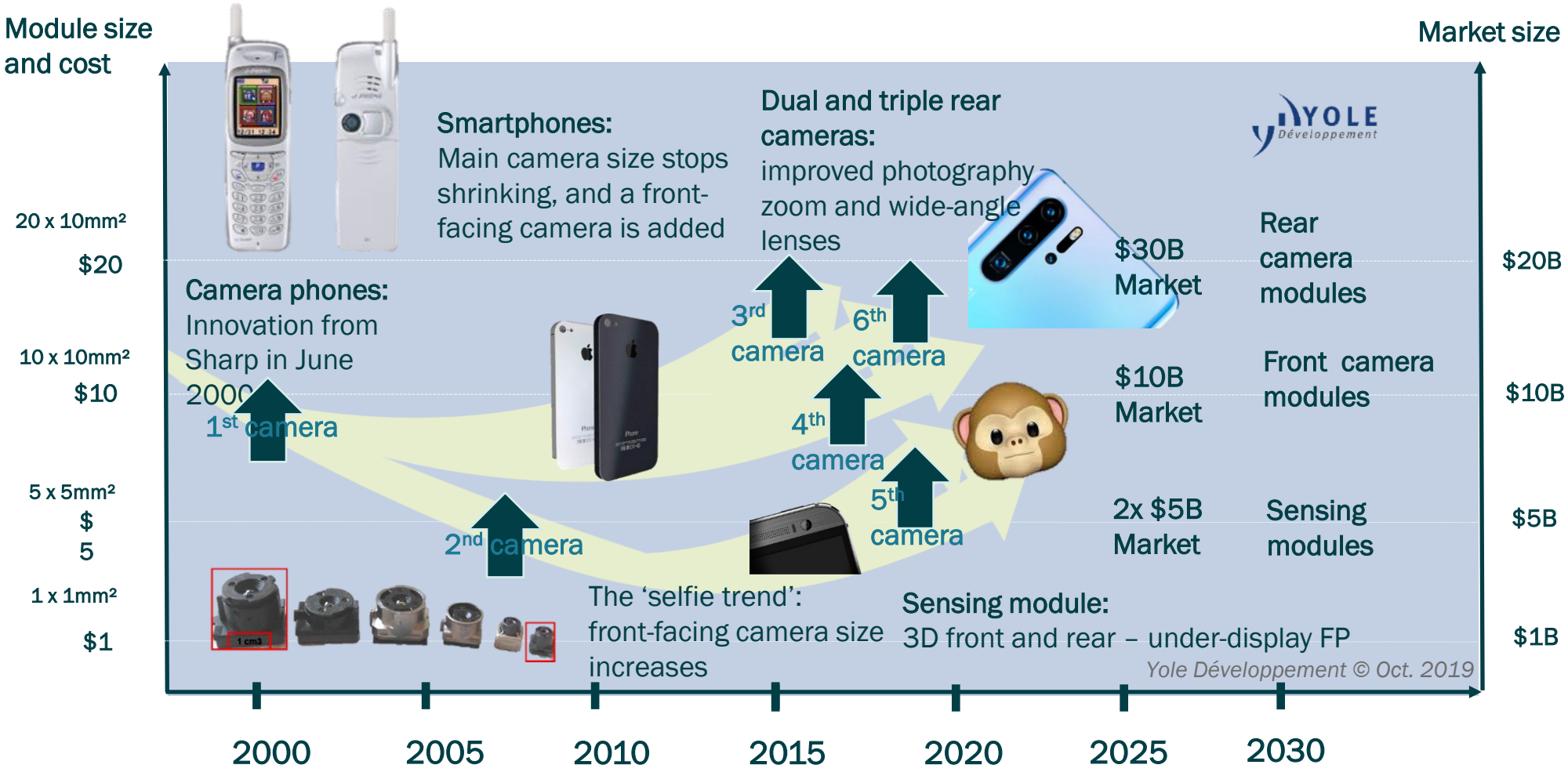


Source : Teledyne e2v

CIS wafer production RGB vs NIR



Proliferation of cameras in mobile phones



Computing market trend

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A technology push to boost computing device sales?

Sensing cameras are making inroads into computing products, ‘Windows Hello’ is finally bringing new functionality to computing cameras.

Enhanced video-calling using eye contact technology is an attractive use-case proposition.

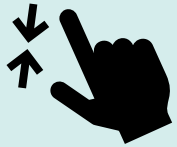
Gesture recognition

LEAP MOTION

SONY

intel

pmd



3D capture

acer ASUS DELL FUJITSU hp lenovo NEC

Courtesy of Google

Courtesy of Apple

Biometry
Eye tracker/face recognition

Fraunhofer

catcheye
Real eye contact in video chats

tobii

Consumer drone application

Advanced drones combine imaging and sensing hardware.

Advanced user experience requires obstacle detection and image-tracking capabilities.

DJI first started the trend in 2017 with the DJI Mavic, quickly followed by Spark and Mavic Air, now is Mavic Air with 3 stereo camera pair.

Stereo vision is mostly used, whereas on the smallest drones Time of flight (ToF) has been preferred.

DJI Mavic 2 — Stereo x2

Skydio 2 — Stereo x4 Trinocular x2

DJI Spark — ToF x1

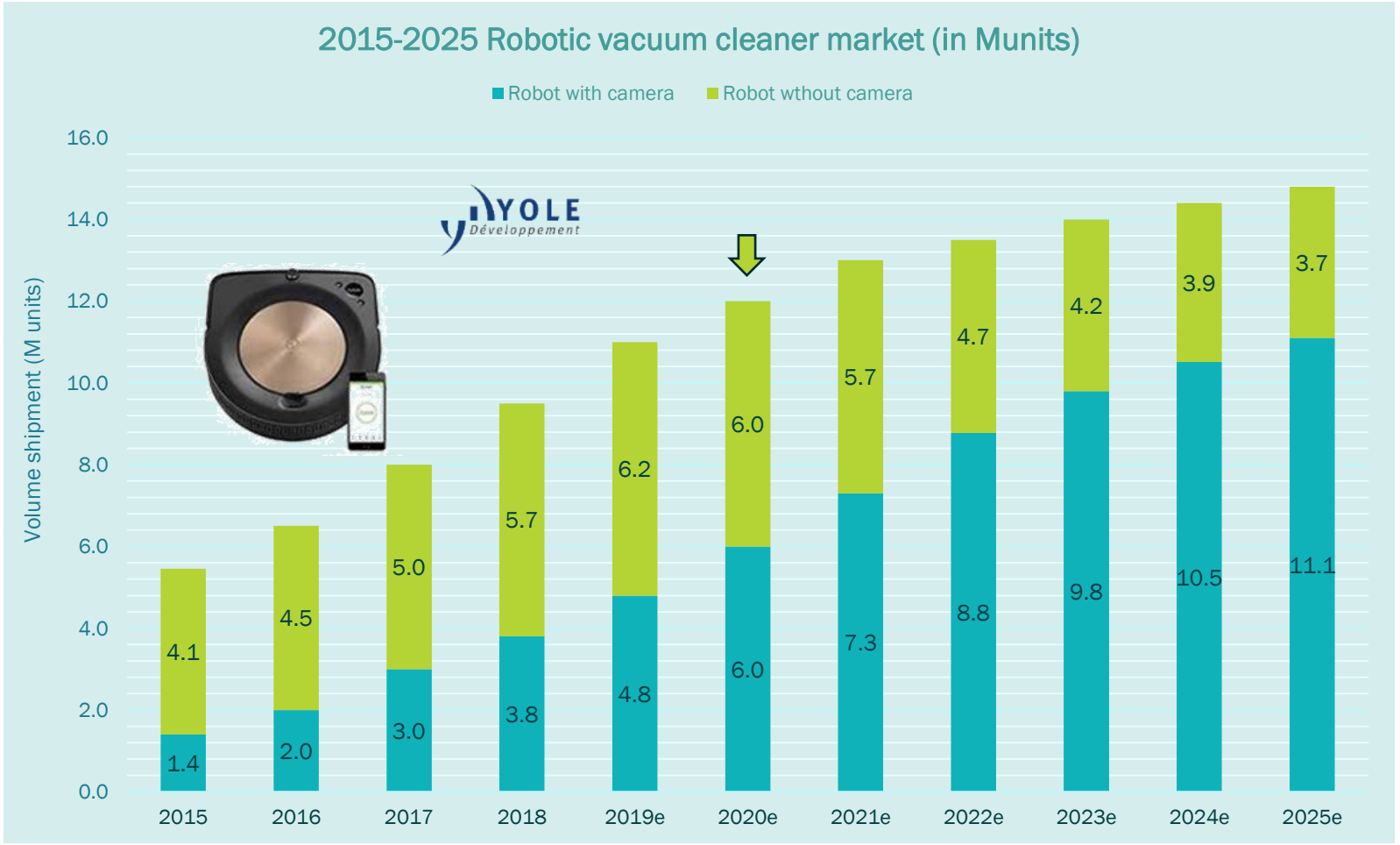
DJI Mavic Air — Stereo x3

Consumer robot application

Vacuum robots are now common-place. What's next?

Robotic vacuum cleaners have created their own niche atop the vacuum cleaner market.

The top players have rolled out products with integrated navigation cameras.



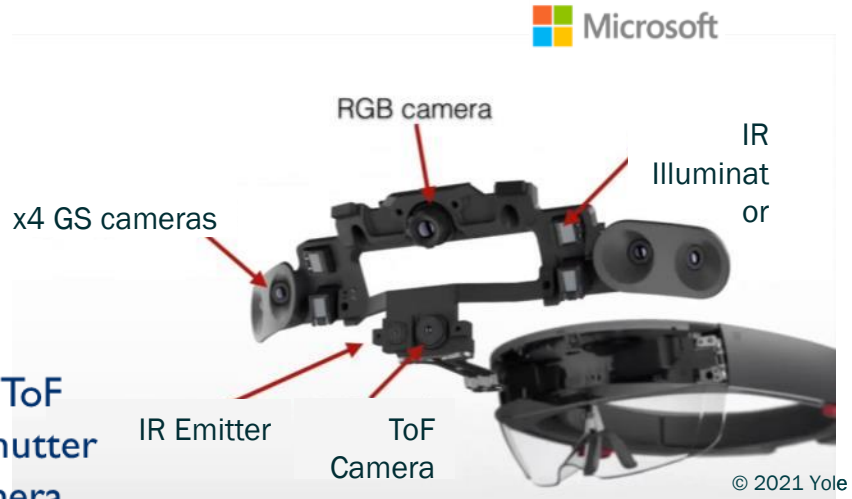
Consumer AR/VR application

ToF or Active stereo cameras are key components of MR, and they can help MR become the most anticipated product in future

Magic leap
x1 forward ToF
x4 Global shutter
no RGB camera

Rokid
x1 HD Camera
x2 Global shutter
6 DoF SLAM

These typical designs have become standard



Microsoft
x1 Forward ToF
x4 Global shutter
x1 RGB camera

ThirdEye X2
x1 13M HD Camera
x2 Wide angle cameras
Thermal sensor

Automotive cameras

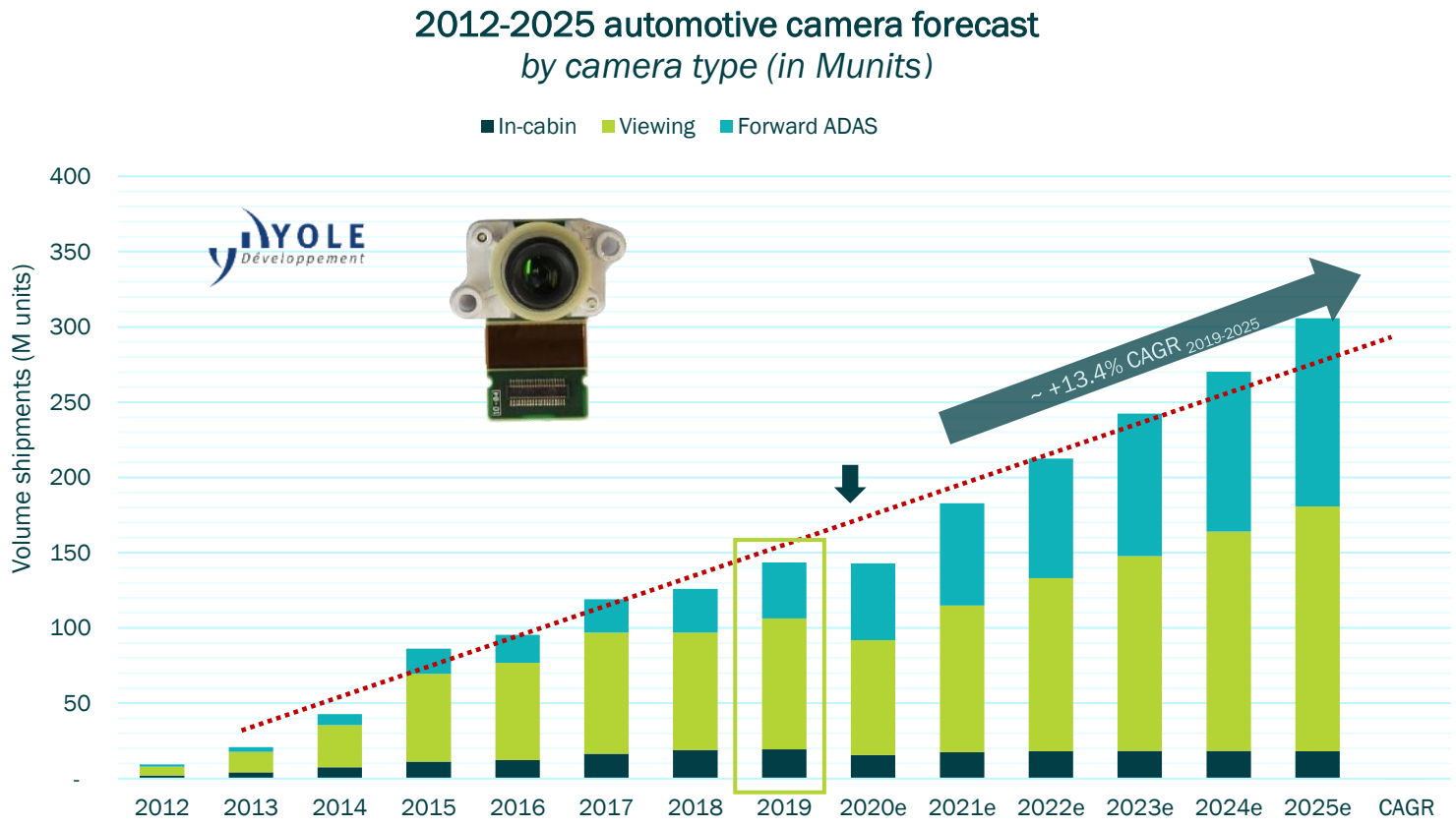
In 2017, automotive cameras first exceeded 100Munits.

In the past, the biggest part of growth was for viewing applications.

Future growth will be higher for ADAS.

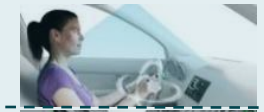
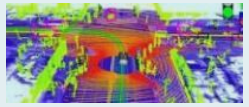
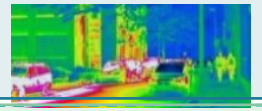
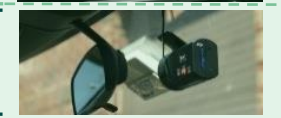
The general trend is a 13.4% CAGR, while ADAS cameras will maintain growth above a 20% CAGR.

Despite the current automotive slump, camera sales should be flat in 2020 and then resume growth.

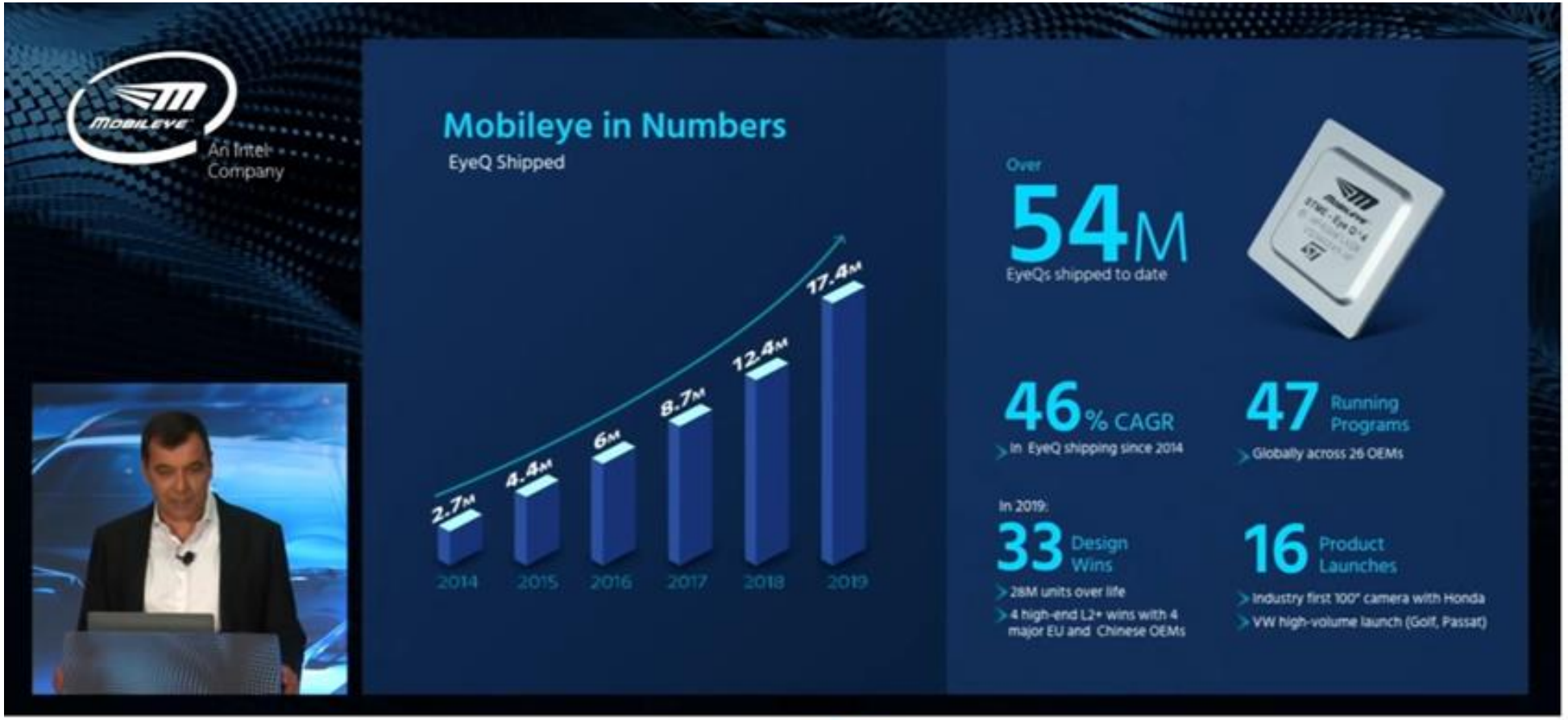


Automotive applications

Nine applications are relevant to automotive imaging.

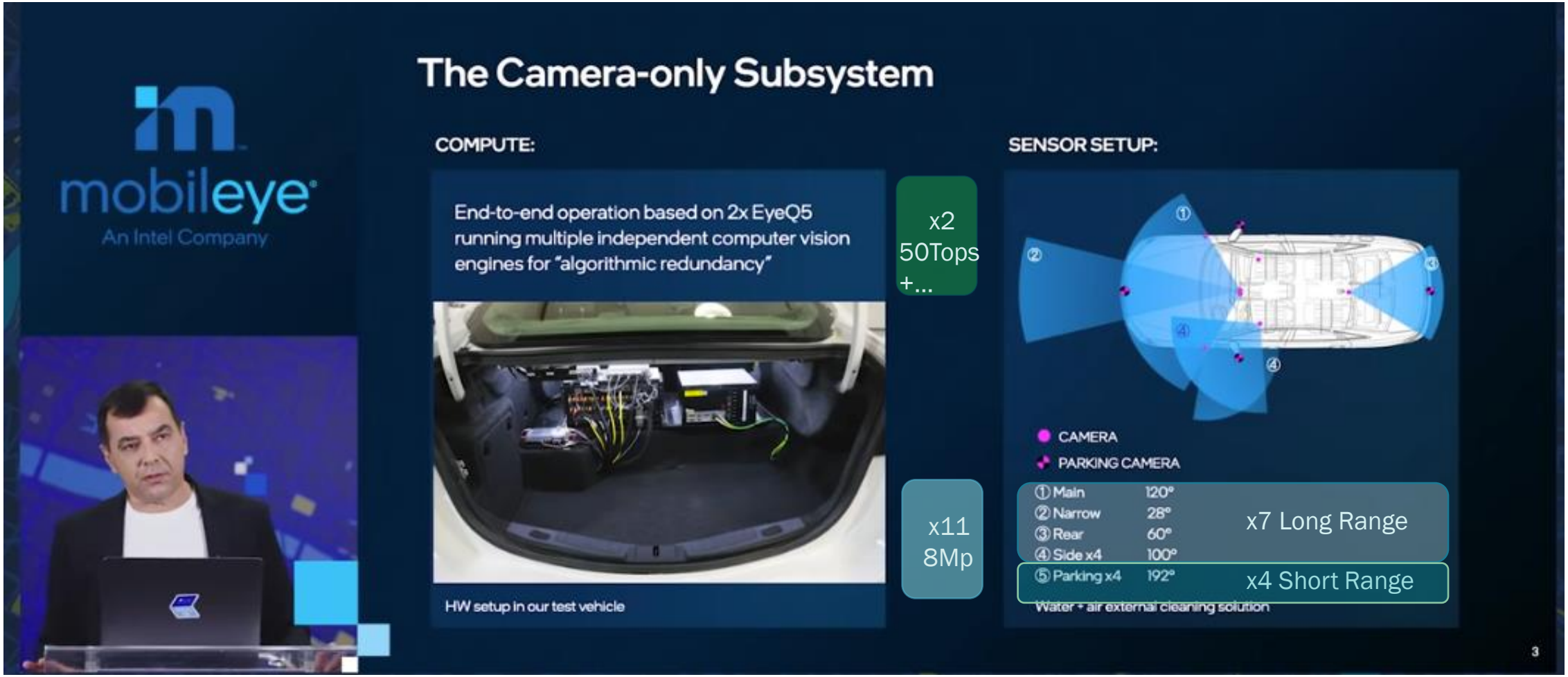
		Device/Application	Technology	
In-cabin		Driver monitoring	Camera	Sensing
		Gesture recognition	3D camera	
		3D perception	3D LiDAR	
ADAS		Forward ADAS	Camera	
		Night vision	Thermal camera	
Viewing		Mirror replacement	Camera	Imaging
		360° surround	Camera	
		Rearview/backup	Camera	
After-market		Dash/blackbox	Camera	

Automotive – Forward ADAS application



With an estiated ASP of $60 per chip, 2019 is the year Mobileye reached $1B in revenues

Automotive - Consumer AV application



Automotive – DMS becomes mandatory

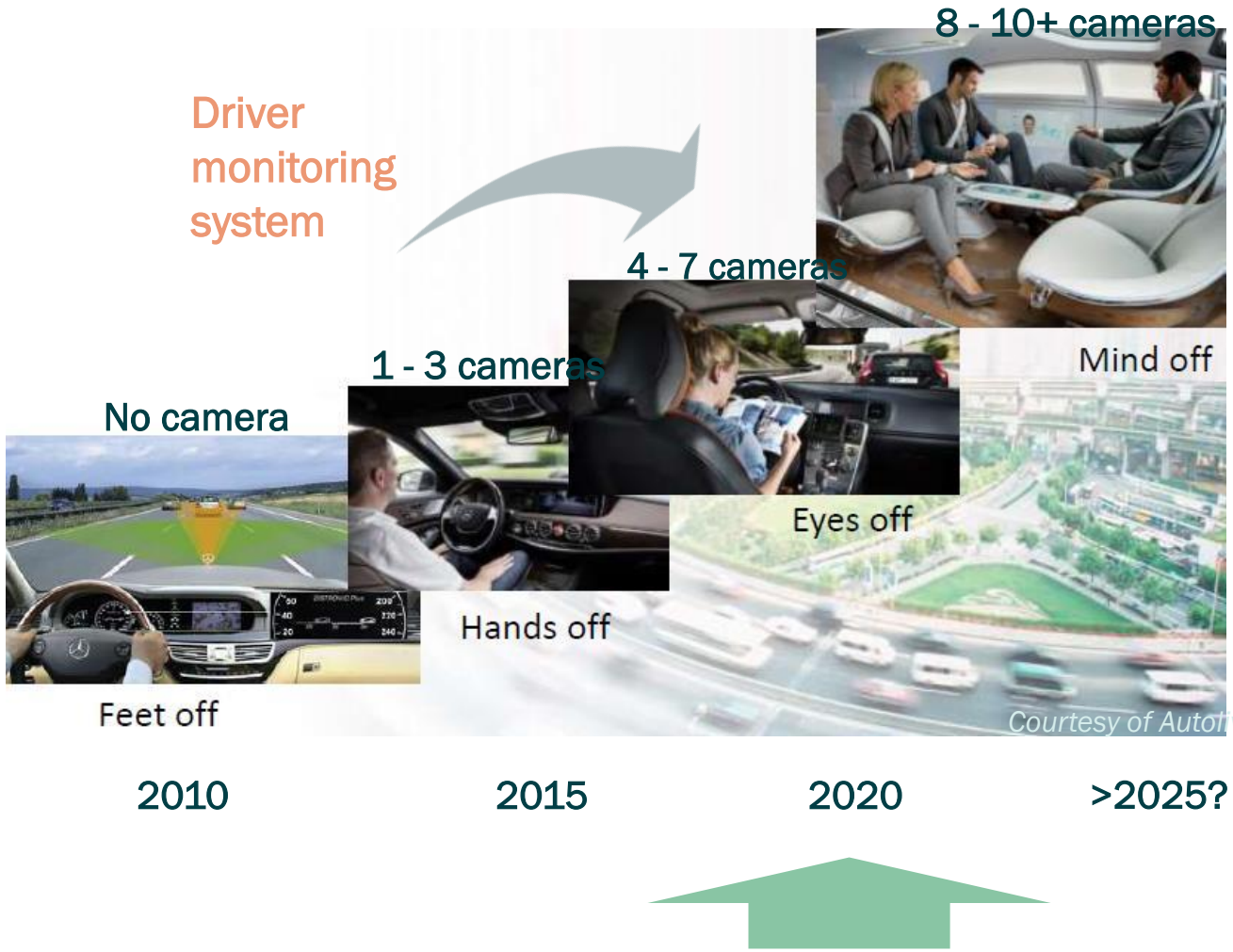
On the road to autonomy, driver monitoring systems (DMS) become mandatory

seeingmachines → GM

SMART EYE → BMW, Audi

XPERI → SUBARU

Euro NCAP 2025 roadmap:
driver monitoring (start-date 2020) is proposed to mitigate the very serious problem of driver distraction and impairment through alcohol, fatigue, etc.
From 2022, priority will be given to Child Presence Detection, which can detect a child left alone in a car and alert the owner and/or emergency services in order to avoid heatstroke fatalities

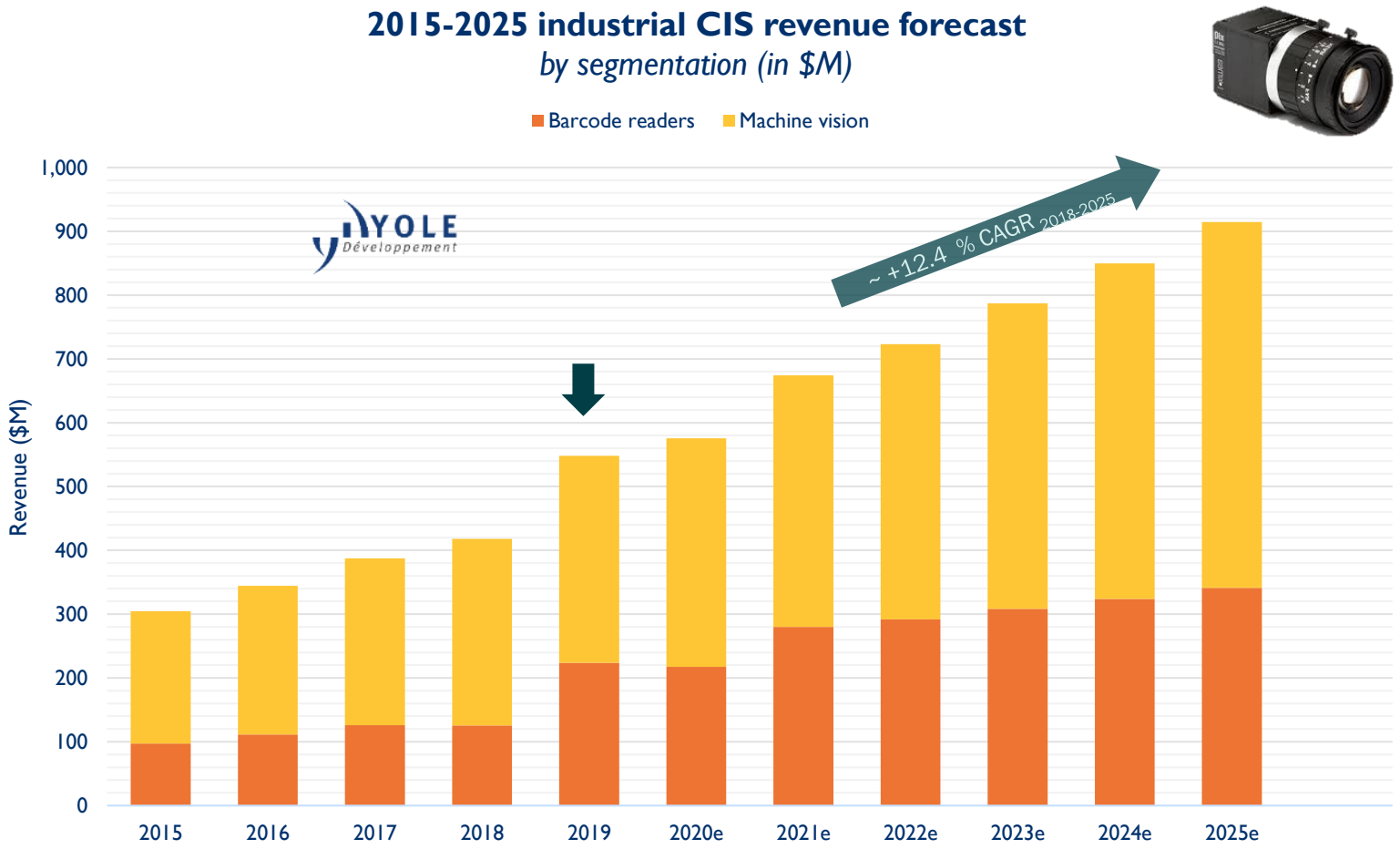


Industrial cameras

Machine Vision is enjoying double digit growth.

Machine Vision (MV) maintains high growth rates due to increasing automation in all industries.

Automated Data Capture (ADC) benefit from the high growth of logistic related matrix code readers



Industrial - Commercial applications

Payment is a key application in commercial such as in retail shop

Easy life with 3D interaction & facial recognition

Many AI-startups enter this market and provides the computing capability to expand the market

Shopping Payment

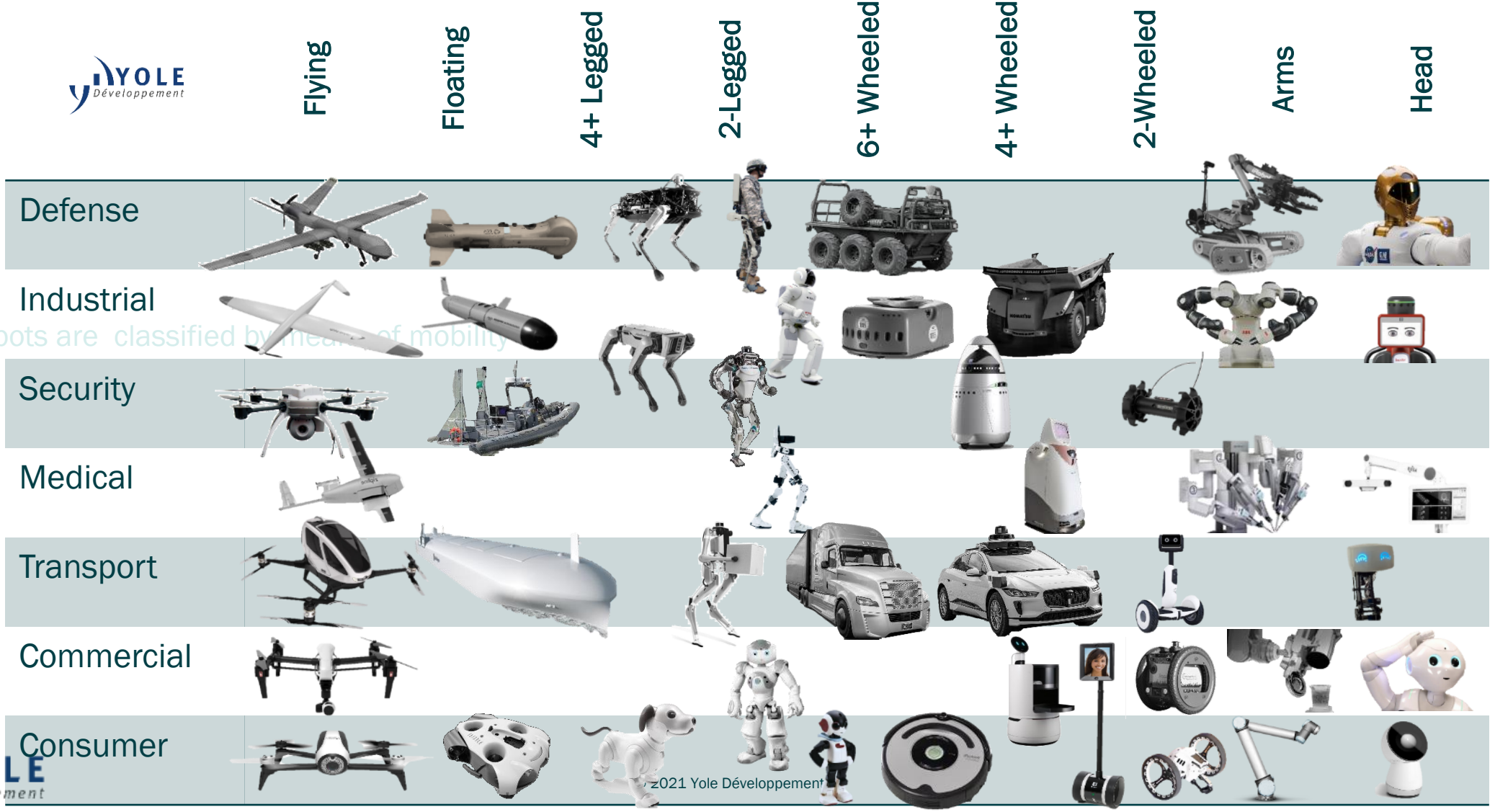
Public Transport Payment

Facial Unlocking

Custom Clearance

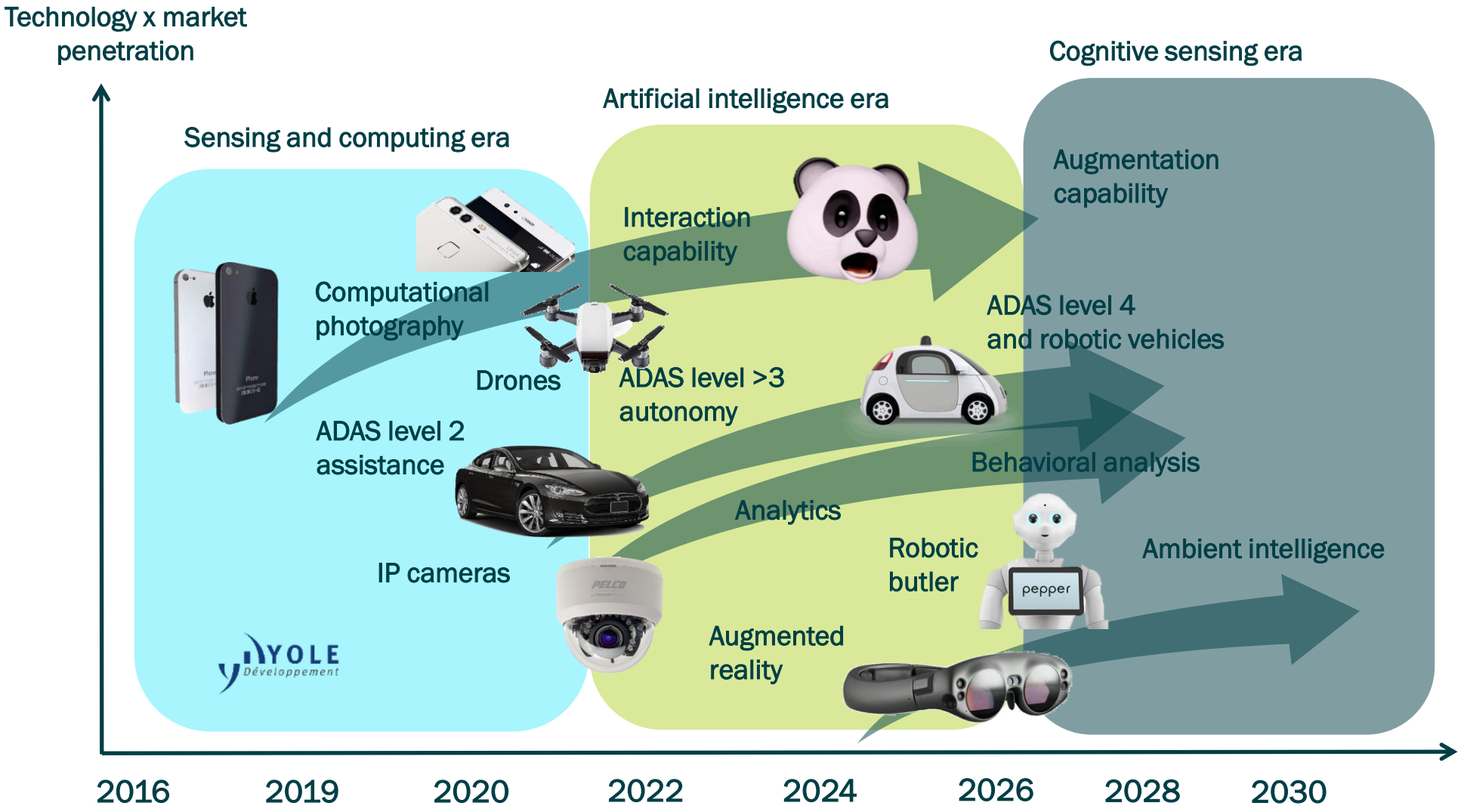
Access Control

Industrial - Robotic applications



Sensing applications – what's next?

The technology shift of the 2020s will be AI-related.



Wrap up

Imaging had 3 major disruptions:

photography, (Film) digital photography (tube / CCD), mobile photography (CIS)

Image sensor (CIS) have reached $20.7B in 2020 and will grow 7.3% CAGR

Image sensors used for Sensing applications represent 10% and will grow 15.7% CAGR

Sensing will be the next paradigm shift, currently supported by several markets :

Mobile	biometrics, 3D face and finger print
Computing	face unlock
Consumer	drone, personal robotics, AR/VR
Automotive	ADAS, in-cabin cameras
Industrial	machine vision, security, automation, robotic AVs

This new sensing paradigm will challenge the current ecosystem, computing will therfore be affected

The next sensing applications : Mobile interaction, ADAS & AVs, Security analytics, Augmented Reality

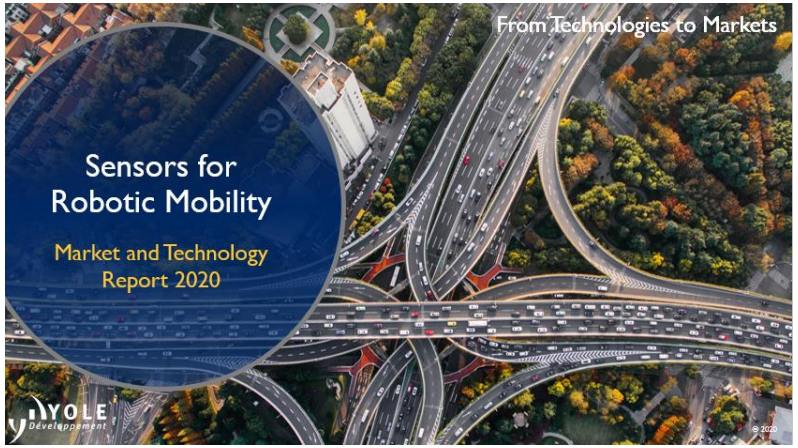
"Disruptive technology should be framed as a marketing challenge, not a technological one."

Clayton M. Christensen
1952-2020

Yole related reports

- Status of the CMOS Image Sensor Industry 2020

- Sensors for Robotic Mobility 2020



- 3D Imaging & Sensing 2020

- Sensors for Robotic Goods Transportation 2021

Thank you

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