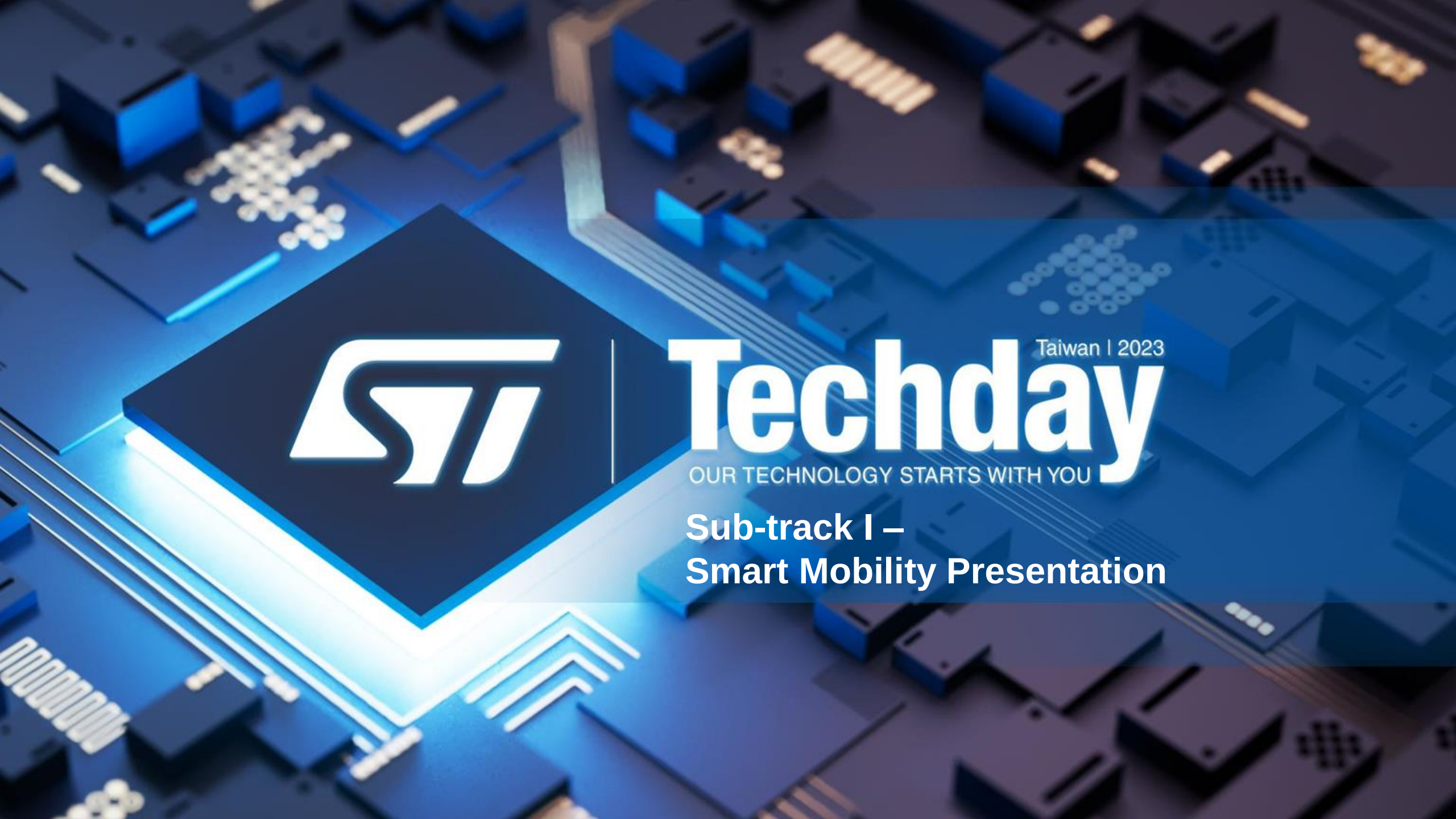
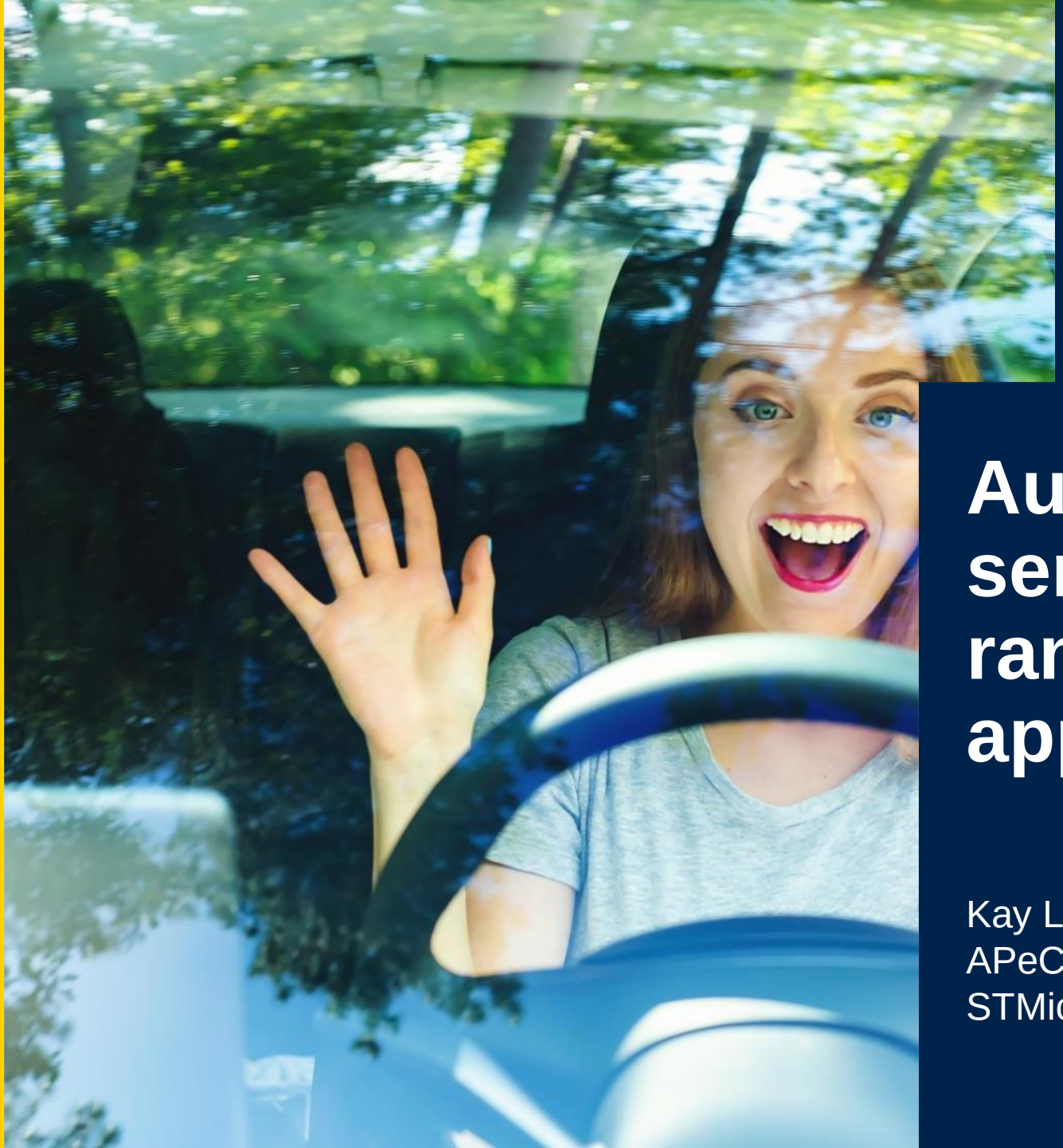


Sub-track I –
Smart Mobility Presentation



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Automotive MEMS sensors for a broad range of automotive applications

Kay LIN
APeC, AMS, MEMS Sub-Group
STMicroelectronics

Smart sensors making our world a better place

Offline Era

2000

A paradigm change in the man-machine interface

MEMS technology: from a concept to a product.

Online Era

2010

Sensor proliferation and connections to the Cloud

Performance improvement and technology fusion.

Onlife Era

2020

The fusion of technology and life

MEMS sensors able to sense, process, and act.

Sustainable Onlife

Sustainable sensorization of the world

MEMS sensors sending only the **meaningful data** to the cloud

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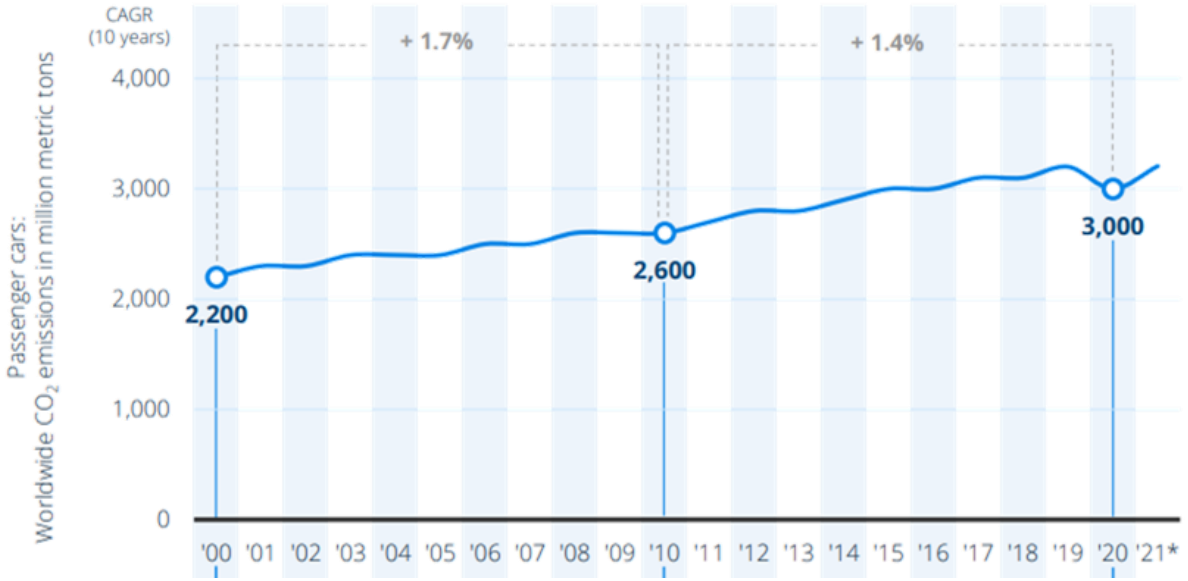
Automotive transformation pillars

In 2020 approximately three billion tons of CO_2 of global emissions are generated by passenger cars

Offline | **Online** | **Sustainable Onlife**



Source: IEA

Combustion engines need to be abandoned

Politics and regulations to support the migration to electricity

Cars will be increasingly automated and autonomous

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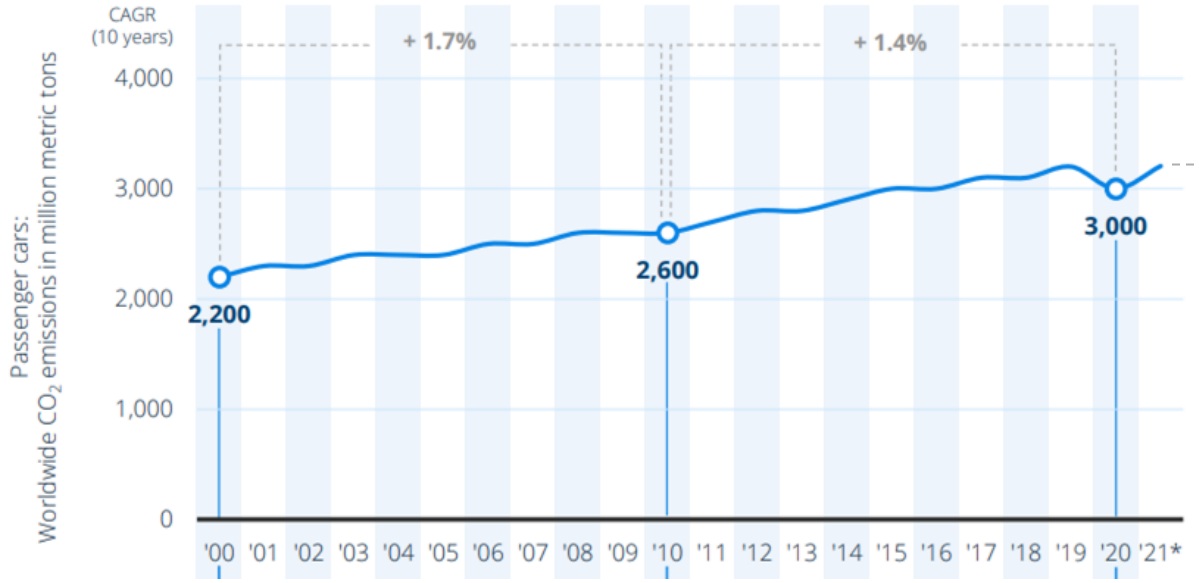
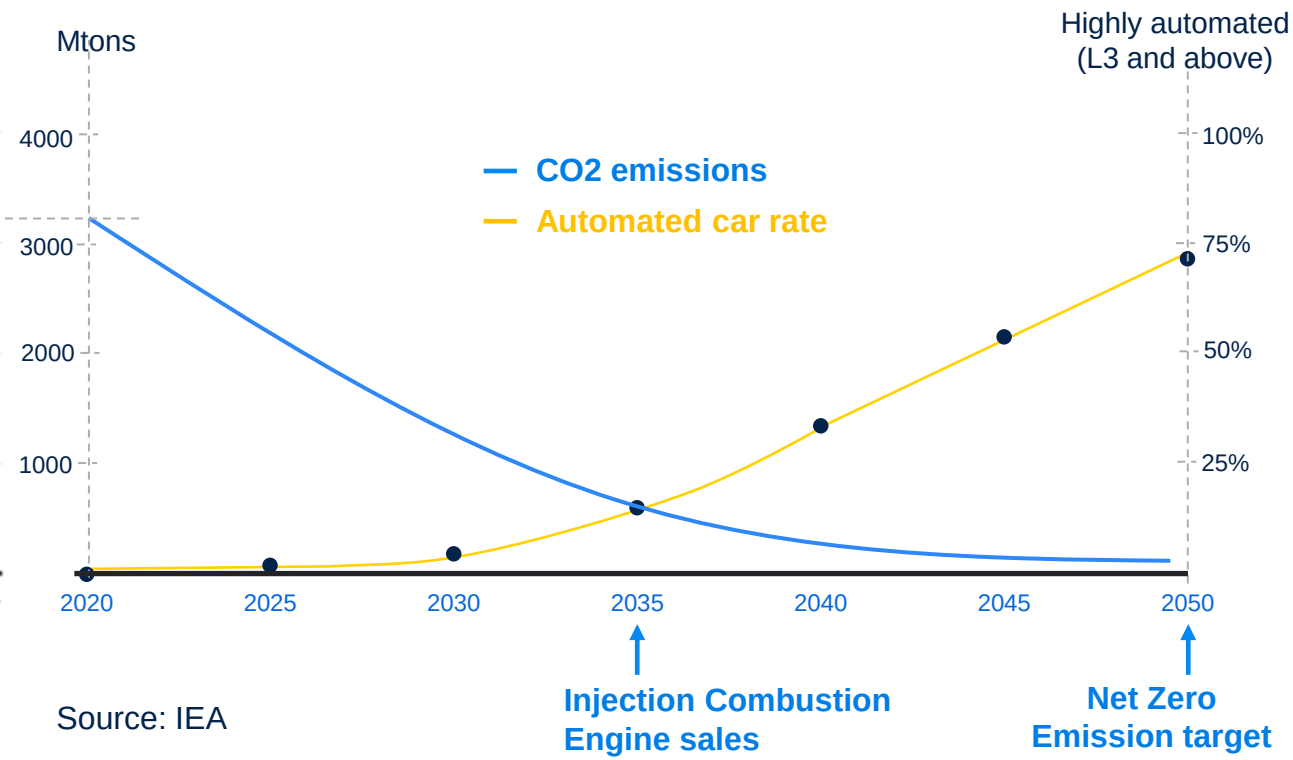
The automotive path to the Net Zero Emission target

ICE sales no longer allowed starting from 2035 (target)
In 2050, more than 70% of vehicles are highly automated

Offline | **Online** | **Sustainable Onlife**





Source: IEA

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Autonomous transportation is energy-intensive

- Sensors’ accuracy and safety standard compliancy (ISO 26262)
- Artificial intelligence to implement complex processing
- Huge amounts of data exchanges to implement vision and localization processing

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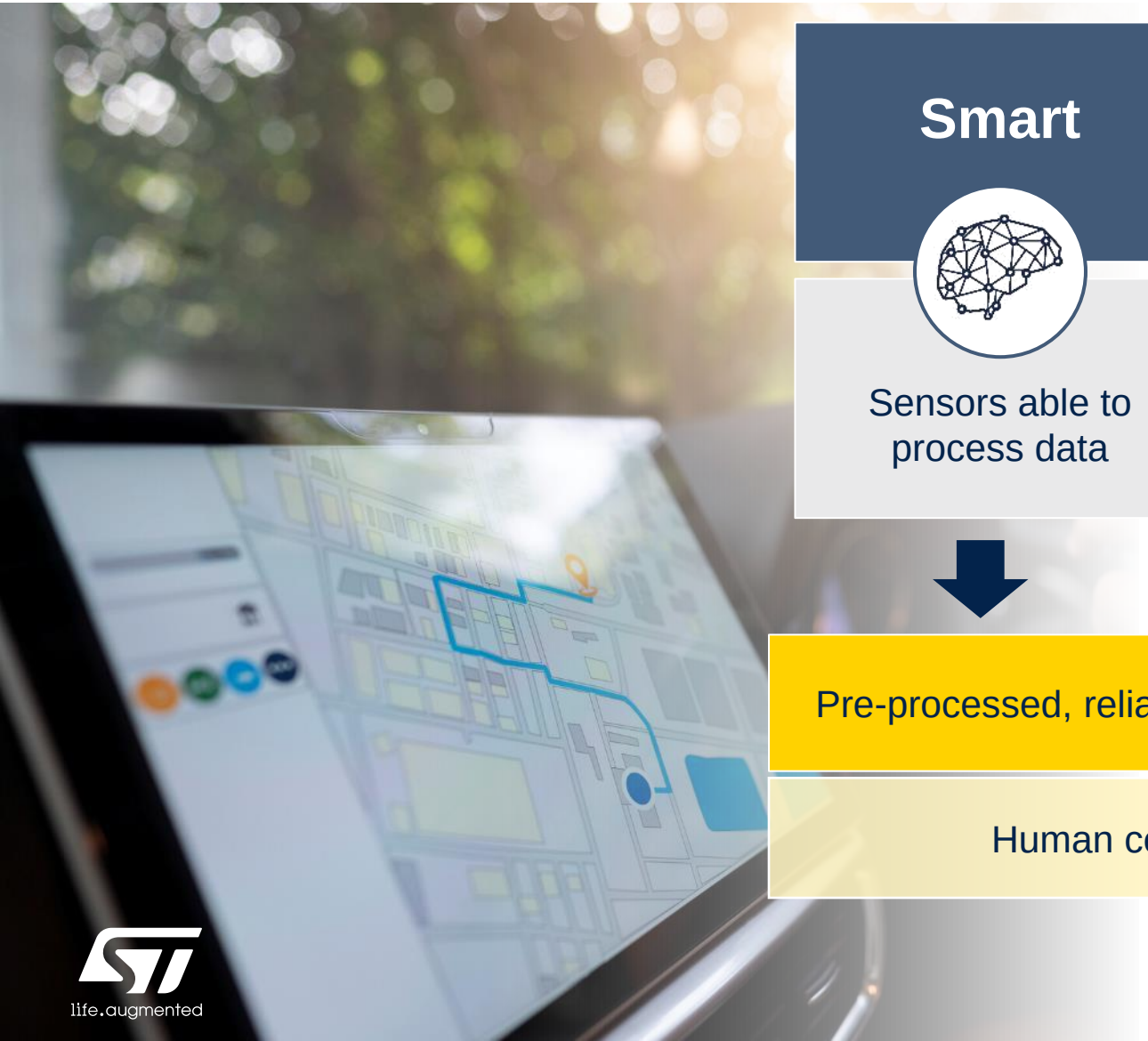
Why ST MEMS sensors?



Smart

Sensors able to process data

Safe

Sensors configured to your needs

Accurate

Sensors providing correct data sets

Pre-processed, reliable, and accurate data are key resources for self-driving cars

Human centered

Sustainable

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Smart

Cars must be capable of taking actions and therefore must be increasingly equipped with AI

Human centricity is achieved if vehicles are capable of imitating human brains

Hard-wired AI implementation with optimized power budgets contributes to sustainability goal

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ADAS – car monitoring

IMU

Artificial intelligence techniques can be used to prevent theft or vandalism when a car is parked. They can also predict a car's status and whereabouts, if it has been towed or stolen.

Product available

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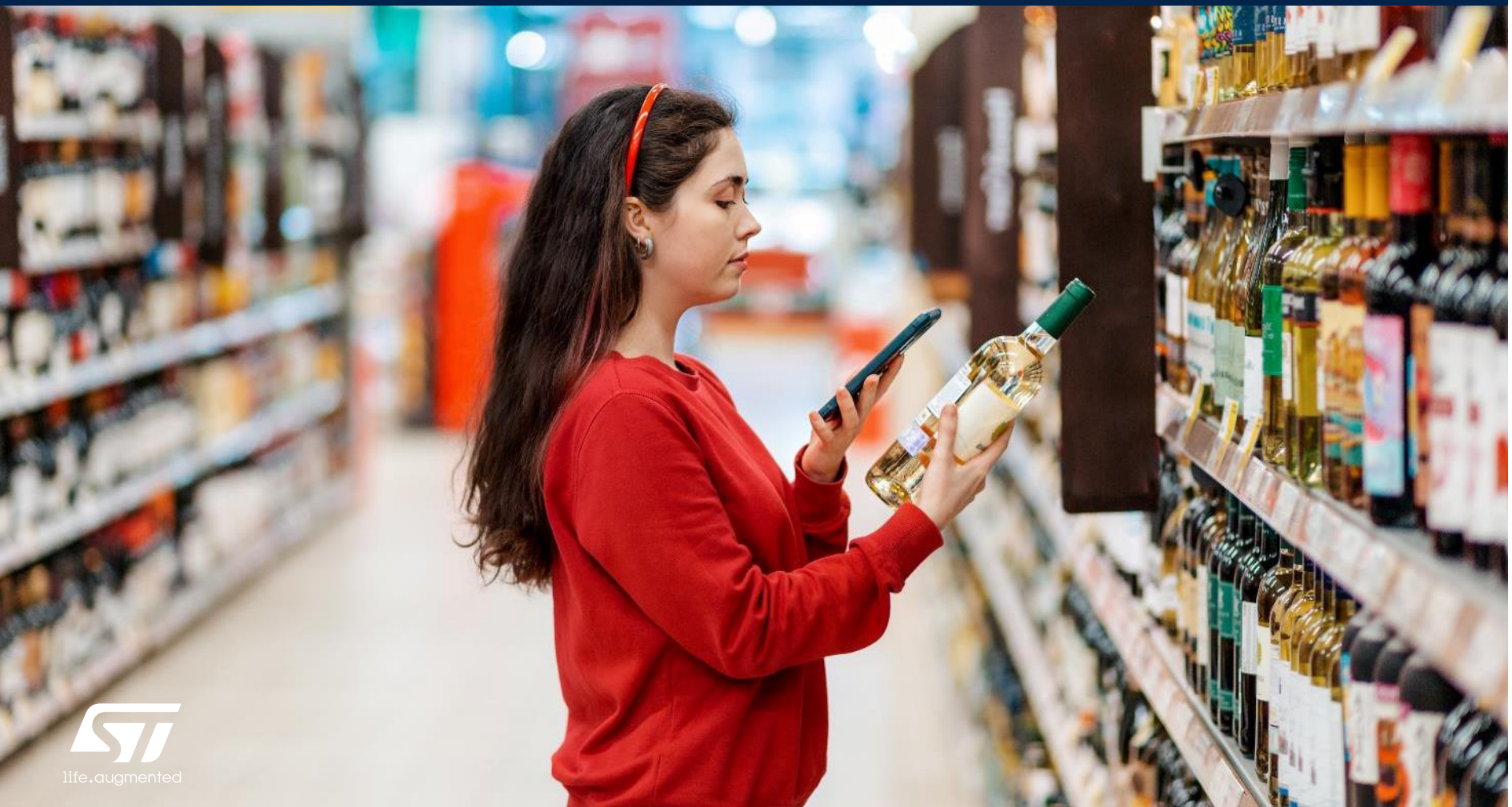
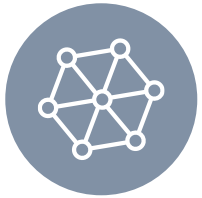
AI monitoring your car integrity

Somebody hits your care while parked at supermarket





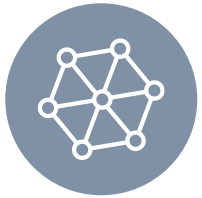
Train

Program

Operate AI

You parked in a no-parking zone

Car is going to be towed while enjoining a dinner with friends



Train

Program

Operate AI

Safe

AVs need more and more electronics to be compliant with the highest safety standards

Human centricity is achieved when the car takes care of passenger safety

Embedded circuits implementing hard-wired FuSa contribute to overall power efficiency

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Accurate precise positioning

IMU	Accelerometer to calculate velocity Gyroscope to calculate rotation ASIL – B compliance	**Product available**

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Digital stabilization

IMU

Camera images can be affected by inclination and vibration, due to steering and road noise. IMU can compensate for any unwanted motion affecting the camera module while driving. Likely ASIL - B

Product available

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New MEMS for L3 and above

IMU

Next-generation smart inertial sensors are based on functional safety ASIL-D and embedded AI

Product under development

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Accurate

Accurate sensing enables highly complex algorithms, which are essential for AVs

Human centricity is achieved if a vehicle is capable of imitating human senses

Accuracy allows energy savings, and reduces the factory calibration resources and time required

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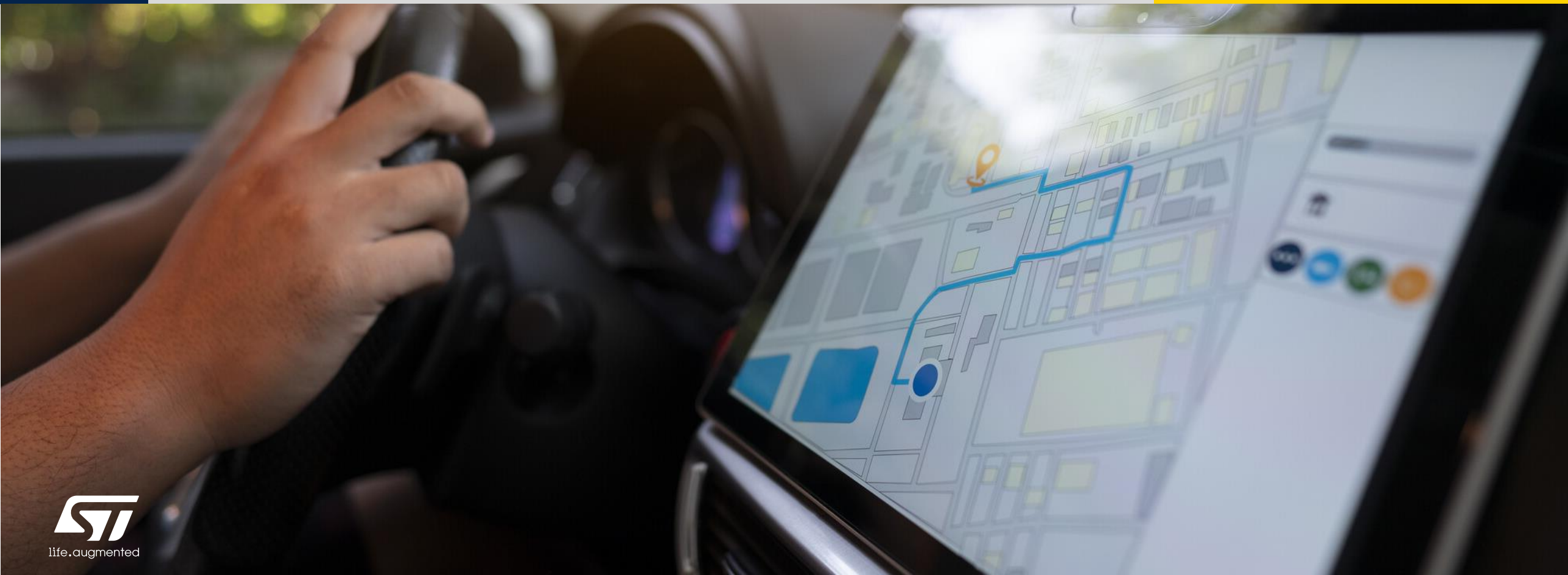
Telematics and infotainment - navigation

IMU	Accelerometer to calculate velocity Gyroscope to calculate rotation for vehicle navigation systems	**Product available**



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Automotive MEMS sensors roadmap

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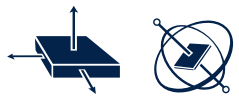
6-axis automotive IMU portfolio

A diversified offer to meet any customer need

ASM330LHH



2.5 x 3 x 0.86 mm

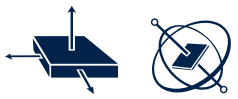
Auto NON-SAFETY 6-axis IMU

- Extended temp. range: **-40 °C to 105 °C**
- High stability

MP

AEC-Q100 Grade 2

ASM330LHHX



2.5 x 3 x 0.86 mm

Auto NON-SAFETY 6-axis IMU with LPM & Machine Learning Core

- Extended temp. range: **-40 °C to 105 °C**
- Low power mode:
  - **Accelerometer 32 µA (typ)**
  - **Combo 520 µA (typ)**
- Embedded **FSM and MLC**

MP

AEC-Q100 Grade 2

With low power mode

With MLC and FSM

ASM330LHB

2.5 x 3 x 0.86 mm

6-axis IMU + SW solution for ASIL-B systems

- Extended temp. range: **-40 °C to 105 °C**
- Low power mode:
  - **Accelerometer 32 µA (typ)**
  - **Combo 520 µA (typ)**
- Embedded **FSM and MLC**
- **Offered with specific library to be compatible for ASIL-B systems**

MP

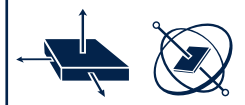
AEC-Q100 Grade 2

With low power mode

With MLC and FSM

With ASIL-B library

ASM330LHBG1



2.5 x 3 x 0.86 mm

6-axis IMU + SW solution for ASIL-B systems

- Extended temp. range: **-40 °C to 125 °C**
- Low power mode:
  - **Accelerometer 32 µA (typ)**
  - **Combo 520 µA (typ)**
- Embedded **FSM and MLC**
- **Offered with specific library to be compatible for ASIL-B systems**

Q4'23

AEC-Q100 Grade 1

With low power mode

With MLC and FSM

With ASIL-B library

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3-axis accelerometers for smart driving

Navigation / TBOX / Antitheft / eCall

AIS328DQ

4 x 4 x 1.8 mm

Ideal for Navigation and Anti-theft

- 3 axis digital
- Extended Top:-40°C +105°C
- QFN Package

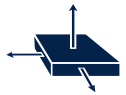
AIS3624DQ

4 x 4 x 1.8 mm

FS: up to 24 g
Specific for e-Call

- 3 axis digital
- **Mid-g range axel: FS: up to 24 g**
- Extended Top:-40°C +105°C
- QFN Package

AIS2IH



2 x 2 x 0.93 mm

High performance & versatility:
Ultra low power & high resolution / high performance modes

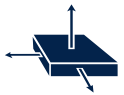
Ideal for Navigation, Anti-theft, TBOX

Focus

- FS: ±2g / ±4g / **±8g / ±16g**
- ODR 1.6 Hz to 1.6 kHz
- **Extended Top: -40°C +115°C**
- **LGA package with wettable flanks**

Passive Keyless Entry (PKE)

AIS2DW12



2 x 2 x 0.93 mm

Ultra low power 3-axis digital accelerometer

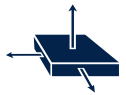
Superior robustness to mechanical shock and drops

Focus

- Cur Cons : 0.67 µA @3 V @1.6Hz
- FS: ±2g / ±4g
- ODR 1.6 Hz to 100 Hz
- **LGA package**

Road Noise Cancelling

AIS25BA



2.5 x 2.5 x 0.86 mm

Audio accelerometer

- **High and flat bandwidth (min 2 kHz)**
- **Low noise (< 2.4 mg_{RMS})**

Focus

- FS ±4g / ±8g
- TDM Time-Division Multiplexing interface

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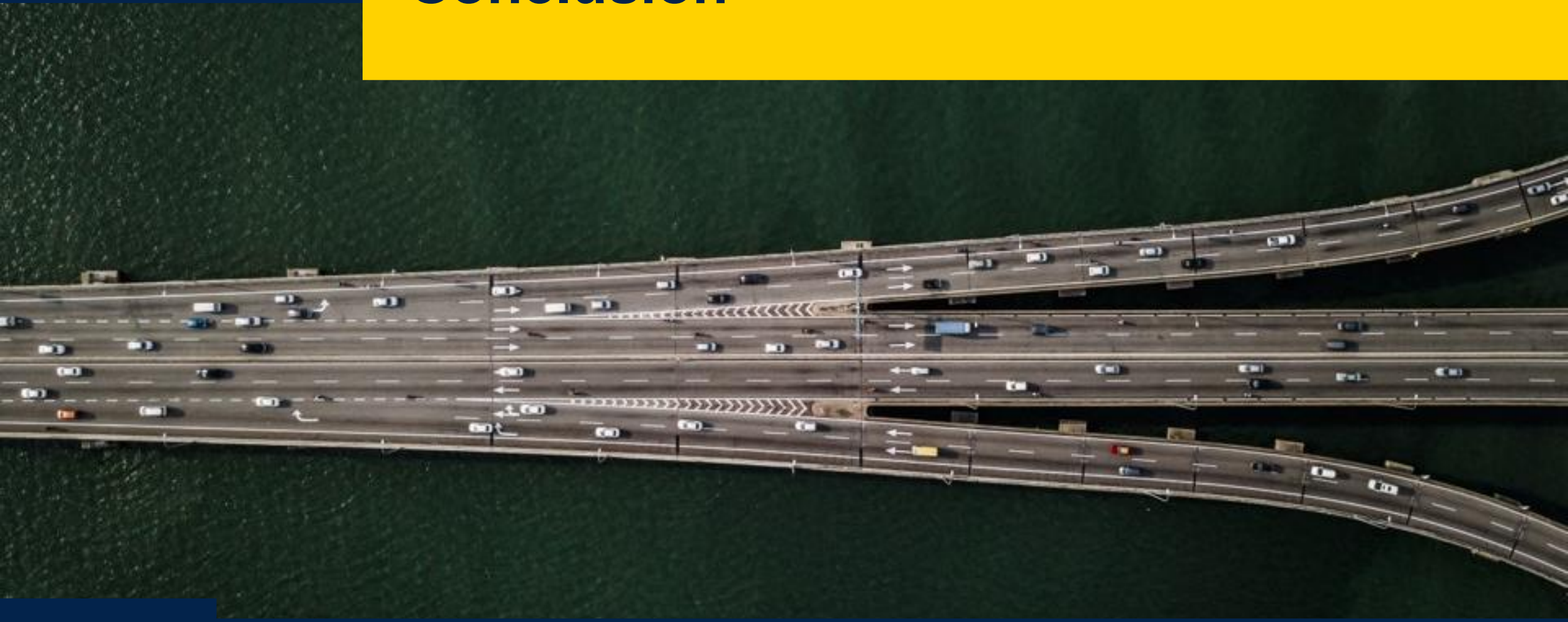
Conclusion



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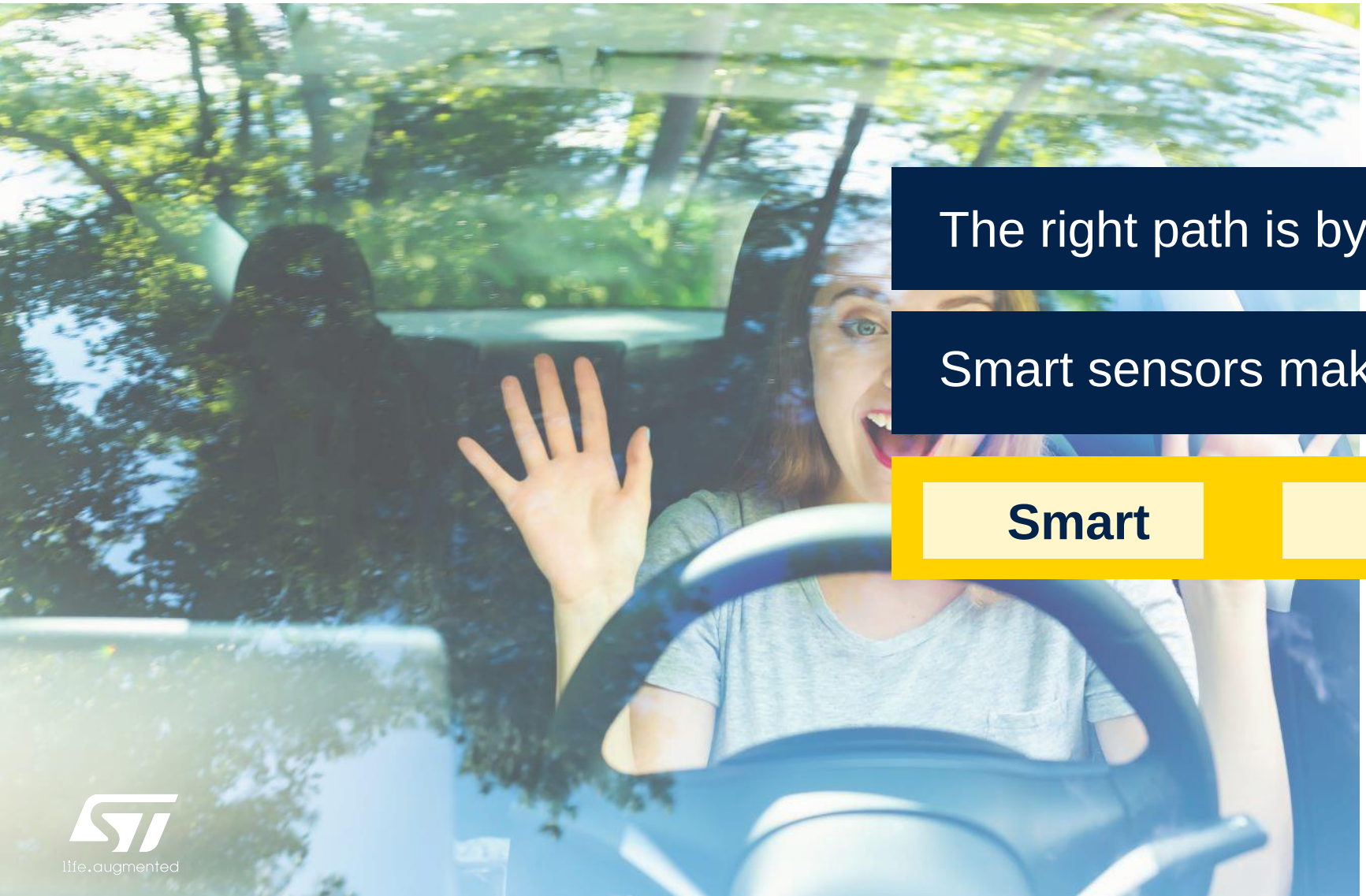
Takeaways



The right path is by no means obvious

Smart sensors make our world a better place

Smart **Safe** **Accurate**

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Our technology starts with You

Find out more at www.st.com/MEMS

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