Self-driving cars: The next revolution

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Smart Driving

The Pillars of the Car of the Future

safer	greener	more connected

digitization and computerization

power and analog

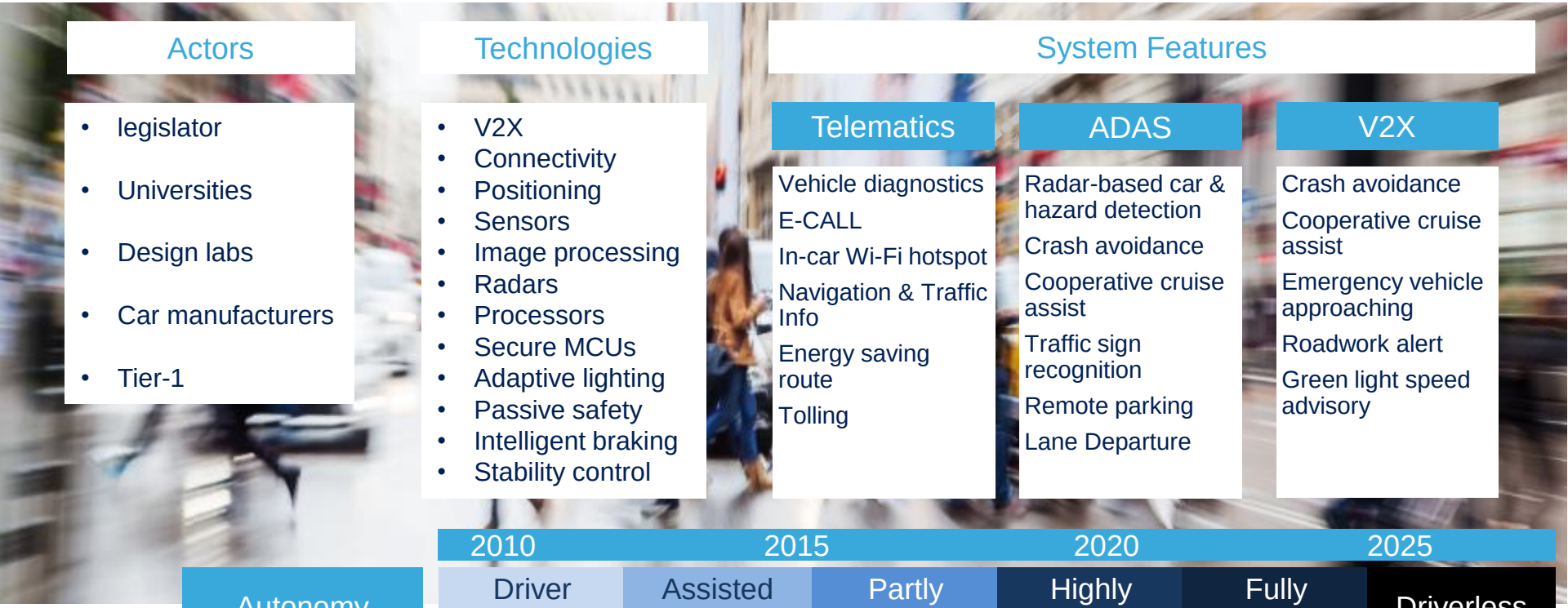
- Autonomous Driving
- Enhanced Vision
- Adaptive Lighting

- Vehicle electrification, EV, HEV
- Engine (ECU) Efficiency
- Eco Navigation
- LED lighting

- Semi & Autonomous driving
- V2X communications
- Smartphone integration
- Embarked Telematics
- Data, video streaming
- Cyber security

Car-Makers Facing Seismic Changes

Supporting our customers building the self-driving car of the future



Actors

- legislator
- Universities
- Design labs
- Car manufacturers
- Tier-1

Technologies

- V2X
- Connectivity
- Positioning
- Sensors
- Image processing
- Radars
- Processors
- Secure MCUs
- Adaptive lighting
- Passive safety
- Intelligent braking
- Stability control

System Features

Telematics	ADAS	V2X
Vehicle diagnostics	Radar-based car & hazard detection	Crash avoidance
E-CALL	Crash avoidance	Cooperative cruise assist
In-car Wi-Fi hotspot	Cooperative cruise assist	Emergency vehicle approaching
Navigation & Traffic Info	Traffic sign recognition	Roadwork alert
Energy saving route	Remote parking	Green light speed advisory
Tolling	Lane Departure	

	2010	2015		2020		2025
Autonomy	Driver Only	Assisted Driving	Partly Automated	Highly Automated	Fully Automated	Driverless
Level	0	1	2	3	4	5

Intelligent & Connected

State-of-the-art of Technology Innovation

Leading edge Electronics toward the self-driving car of the future

Sensors/ MEMS	Embedded Processing	CENTRAL Unit	

• See
• Measure/Evaluate
  • Distance
  • Pressure
  • Temperature
  • Movement
  • Orientation
• Communicate
• Identify Position
	• Distributed Intelligence
	• Improved Security
	• Augmented Safety
	• ISO 26262 Safety
	• Security
		Sensor Fusion MCU	Vision Processing
			Park Pilot
			Real-time high performance

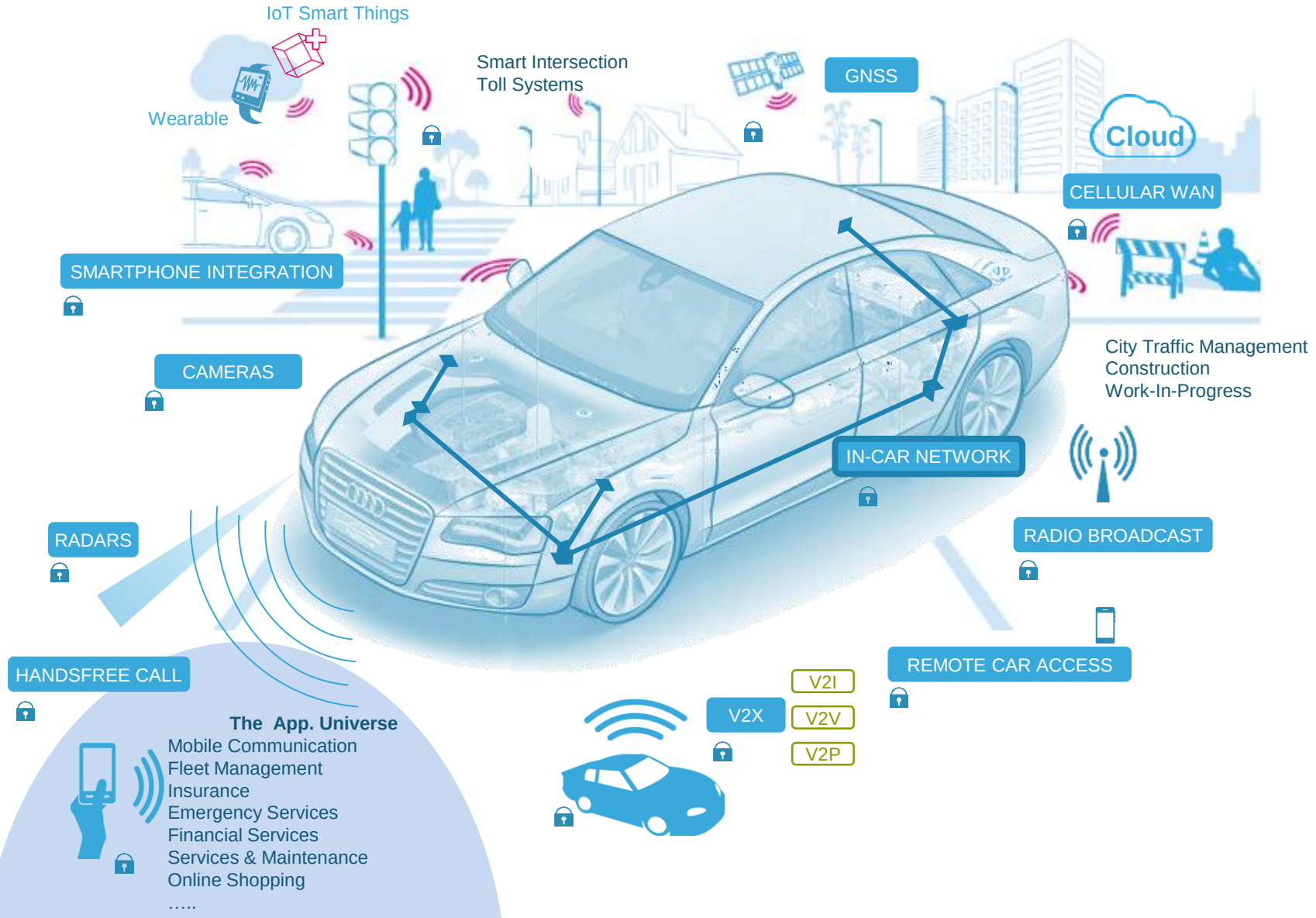
Camera & GPS Sensors Radars, MEMS	SPCxxx, STM32, 8-bit Microcontrollers	Working with the leaders in a win-win market approach ADAS with MOBILEYE – V2X with Autotalks	
SENSE	CONTROL	ANALYSE	COMPUTE

Adding automated driving features

- Estimating Free-space
- Detecting more objects, more precisely
- Reconstructing road profiles
- Monitoring environmental elements
- Fine Sensing of road conditions for automatic suspension, steering adjustment

The Connected Car is a Technology Hub

In a Secure Environment



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Automotive Application Portfolio

ST Offers a Broad Range of Products

PASSIVE SAFETY
- Airbag
- Braking

ACTIVE SAFETY
- Collision Warning/Avoidance
- Stability Control, EPB, ABS

AUTONOMOUS DRIVING
- Driver Assistance / V2X
- Advanced Sensing
- 24 GHz Radar
- 77 GHz Radar

CHASSIS
- Lighting
- Motor Control, Door Zone
- Smart Power for Motor Drivers
- Bulb-Lights and LEDs Drivers
- ViPower Smart Power Switches
- BCM

TELEMATICS
- Smartphone Integration
- Connected Car, WIFI, 5G,
- Telematics Processor
- Positioning solutions

POWERTRAIN
- Energy Efficient
- Low Emission
- Single Core, Multi Core, ISO26262-compliant Micro
- ASSP for EMS (PFI, GDI, diesel), Steering, Transmission

NEW ENERGY
- Electrical vehicle
- Hybrid Alternative Fuels
- Battery Management System

POSITIONING
- Precise Positioning
- Multiple Satellite

INFOTAINMENT
- Audio/ Video Entertainment
- Tuner / Broadcasting
- Multi-Media Processors
- AM/FM DAB tuners
- Audio Power AB, Start-Stop, Multi Ch. Class D
- Satellite Sirius XM receivers

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Safer | Greener | More Connected | Comfort

Smart Driving

Would you recommend the use of human-like capabilities that eliminate the need for human effort and intervention creating a vehicle :

- with sensorial fusion
- with vision and object recognition
- that exhibits automated behavior
- that interacts and communicates with the road, cities, infrastructure
- that is connected to the world

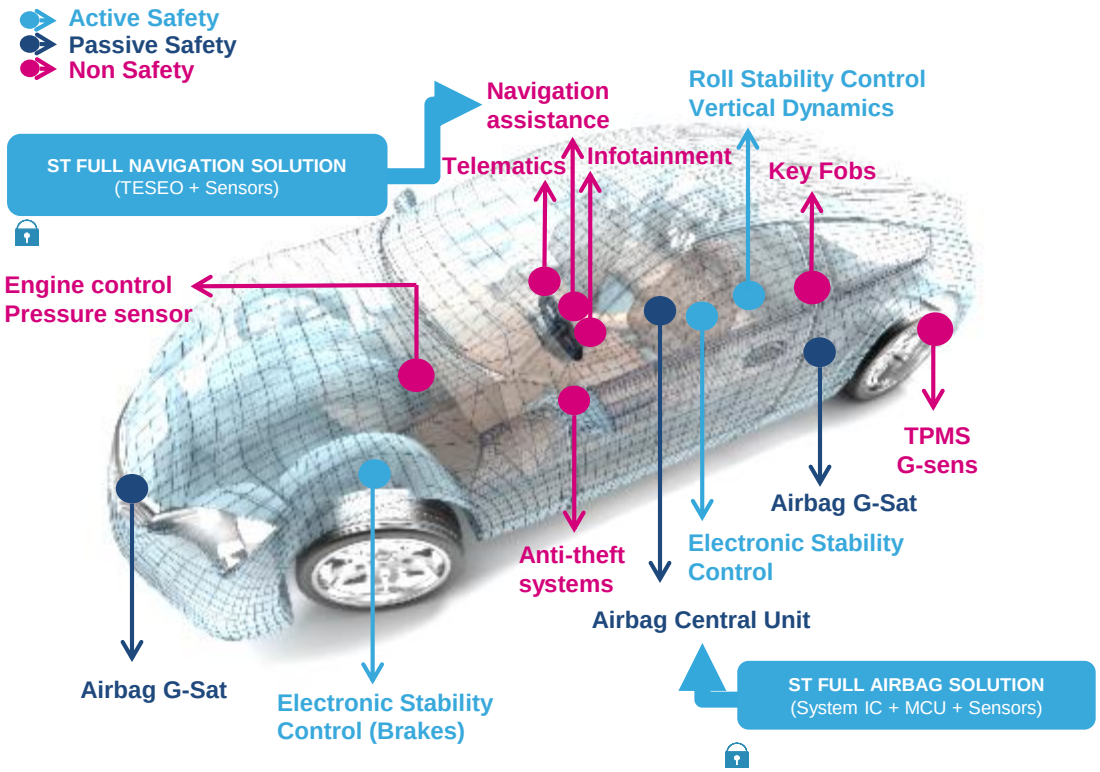
“LIKE” to give your approval

MEMS Sensor Technologies

Bring Life to the intelligent Car

SENSORS

Acoustic/ Video	Motion	Environ-mental
Voice process.	Accelerometer	Humidity
Microphone array	Gyroscope	Temperature
Digital microphone	Magnetometer	Pressure
Camera/ Stabilization	6, 9-axis Inertial	UV index



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Smart Driving : More Connected

ST is making driving more connected

More Connected Driving Technologies

processors (audio, telematics, V2X), tuners, sensors, amplifiers, wireless connectivity

What More Connected Driving Means

- Bringing our personalized entertainment and connected experience into the car environment in a safe and easy to use manner
- Allowing vehicles to communicate with each other (V2V) and to the Infrastructure (V2I)

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Telematics Systems

Multi-Core Processors Embedded Computing

Connected Automotive Software Solutions are changing our driving style ...

- Location Based Services
- Anti-theft
- Insurance
- Cloud Connectivity
- Remote Diagnostics
- Road Tolling
- Geo Localization
- Emergency call
- eHorizon
- Fleet Management
- Vehicle Sharing

ST has a complete range of solutions for Telematics Processors

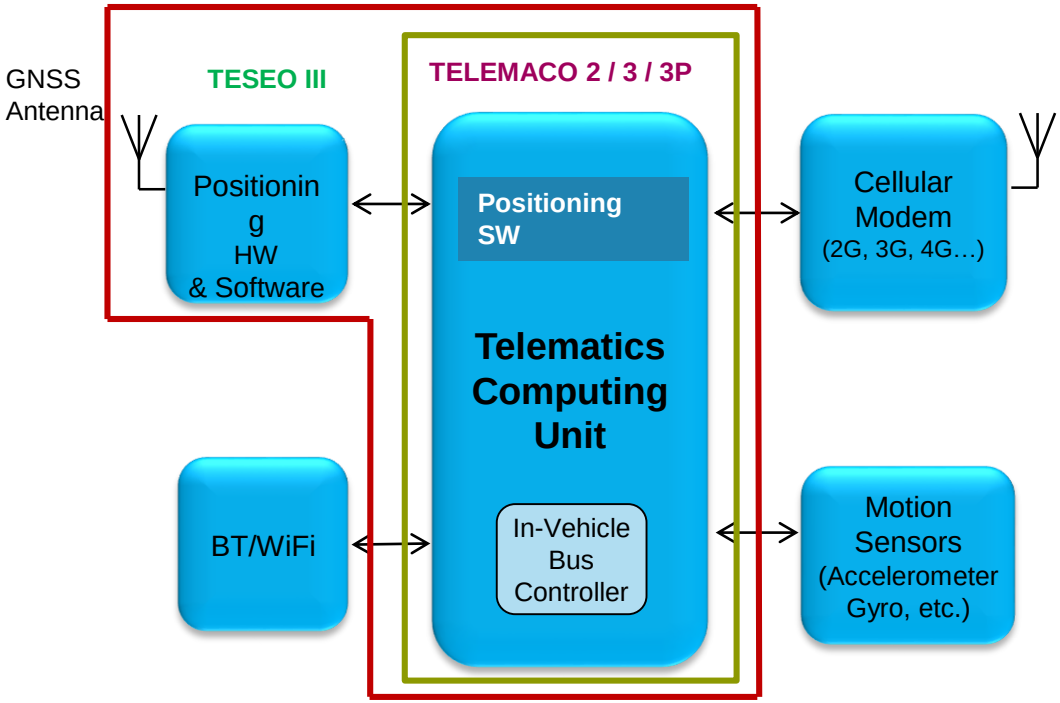
Teseo

Scalable,
Modem Independent,
Rich Set Of Interfaces,
Automotive Grade Qualified

TELEMACO

ST Telematics Architecture

TCU-centric approach



TCU-centric Architecture

Benefits

- Scalability and Independence on Modem Architecture
- Better Immunity against Modem Pricing Strategy
- Smooth Telematics SW Integration
- Computing and Feature-set scalability versus various market requirements

ST offers a class of Processors tailored to TCU-centric Telematics architectures

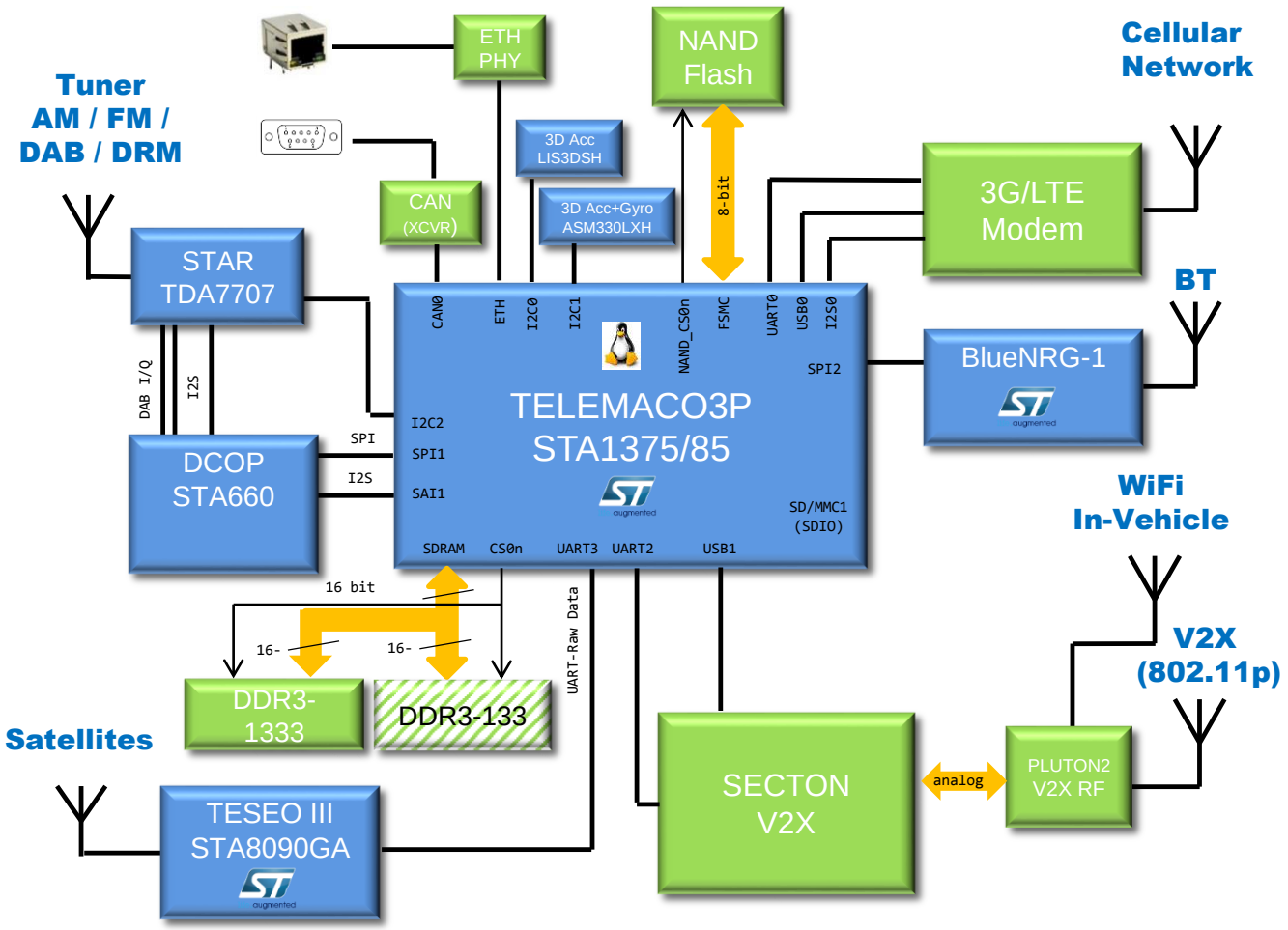
- **Teseo** = entry level TCU-centric processor with integrated positioning
- **Telemaco** = mid/high level TCU-centric processor with hosted positioning

Connectivity Gateway

TELEMACO3P central MCU

TELEMACO3P

- Enhanced Security, Safety and Robustness
- Embedded Hardware Security Module against malware attacks
- Single / Dual Application Cores
- Microcontroller integrated for CAN
- Rich connectivity
- ISO26262 ASIL-B
- AEC Q100 Grade2
- -40°C, + 105°C



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GNSS Precise Positioning

Enabling more safety features for Autonomous Driving

PRECISE POSITIONING

- Lane detection
- Positioning data for V2X sharing
- Collision avoidance
- Autonomous parking
- Autonomous driving
- eCall accident location
- < 1 metre precision

Positioning

ST Performance : The best positioning accuracy on the market

Beidou a key enabler for business in China

GPS+BeiDou simultaneously

STA8090x – Teseo III

Constellations supported
GPS-BeiDou-GLONASS-Galileo-QZSS

Automotive leading consumer market as concrete opportunity

- Road tolling
- Anti-theft
- Emergency call
- Insurance
- Fleet management
- Modules

Pioneer in multi-constellation

- GPS, Galileo, GLONASS, BeiDou, QZSS

State-of-the-Art autonomous & predictive AGNSS

Unique automotive scalable solution

- Stand alone, MCU, host based

Proprietary Dead Reckoning Automotive Way (DRAW) sensor fusion

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ST Automotive Camera System

Camera System Offer for Automotive

High performances 1.3MPix HDR sensor & versatile system-on-chip with advanced and instant **HDR image signal processing**

Compact, low component count & **low energy** automotive camera system

New smart camera system designed to help customers develop secure and **advanced automotive camera applications**

VG6640 1,3MPIX HRD SENSOR
45fps @ full resolution -Ultra Lower power Motion & LED Flicker Mitigation - AEC-Q100 Grade2 - Automotive Safety Integrity Level (ASIL) - Min Die Illumination 1mLux - RGB/RCCC Monochrome variants

STV0991 IMAGING SIGNAL PROCESSOR
Video Analytics Accelerators - Video Compression H.264, JPEG - Low Energy Consuming - Embedded Memory - Graphics Overlay - Lens Optical Correction - ISP HDR 32-bit on-the-fly - Networking Support
ETH-LVDS

Camera System Benefits

Significant reduction of system cost & complexity

Rear View Camera

Overlayer

Top View

Lens Correction

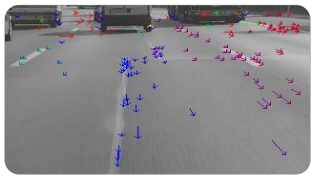
Panoramic View Camera

Image Signal Processing

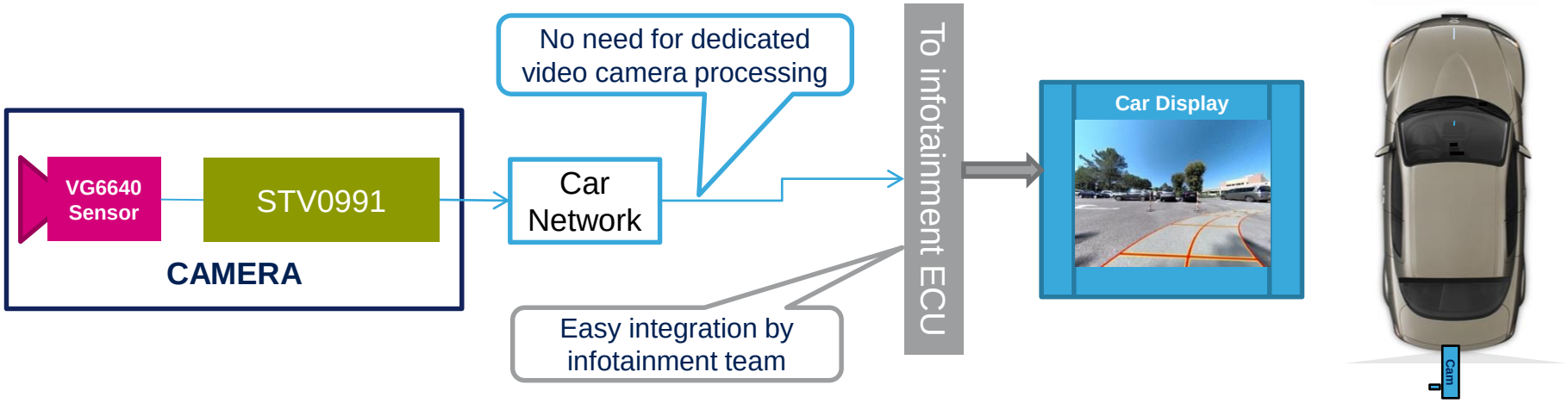
Lane departure

Edge Detection

Motion detection



Optical Flow



- Rear view pre-processing in STV0991 (optical correction, video compression, video analytics support)
- No need of additional video-processing ECUs between STV0991 and Infotainment ECU

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EyeQ4™

4th generation vision processor

Extends EyeQ™ Family Performance, Designed using ST's 28nm FD-SOI Technology

- Long term Roadmaps on key ADAS Technologies
- Machine Vision with Mobileye
- 24GHz and 77GHz RADAR, FD-SOI
- Sensor Fusion SPC5 32-bit MCUs
- Dedicated ADAS Power Management Ics
- Partnerships (public)

4th Generation

- Detection of more objects, more precisely
- More features required for automated driving Free-space Estimation, Road profile Reconstruction
- Monitoring of environmental elements
- Detailed understanding of the road conditions allowing automatic suspension, steering adjustment
- Highly automated vehicles

Radar Systems

Long and Short Range Radar systems

A radar system can use 2 classes of sensors to provide complete coverage

Short-range radar (24GHz)

- Cover almost the entire azimuthal angle and can see all around the car (100° to 360°)
- Distances up to several tens of metres

Long-range radar (77GHz)

- Cover limited angle (±10°) but longer distance (up to 250m)
- Can be used for automatic cruise control

77 GHz

24 GHz

SiGe BiCMOS

- Fully integrated transceiver
- Modular transceiver for multiple channels configurations
- SiGe BiCMOS technology
- Solution for 24Ghz and 77Ghz

V2X

More Safety and New Mobility

- Help to prevent up to 80% of crashes
- Real-world pilots worldwide
- To accelerate road safety innovation
- Lower emissions & energy efficiency through vehicle traffic optimization
- Recently announced trials
- Connected vehicle pilot deployment programs in US Smart Cities (NYC, FL, WY)

Today Social Figures

- 1.3M/year driving fatalities worldwide [1]
- >3B gallons wasted fuel in 2014 in the US, estimated waste increase to 3.8B in 2020 [2]
- Travelers stuck 7B extra-hours in their cars due to traffic congestions [3]

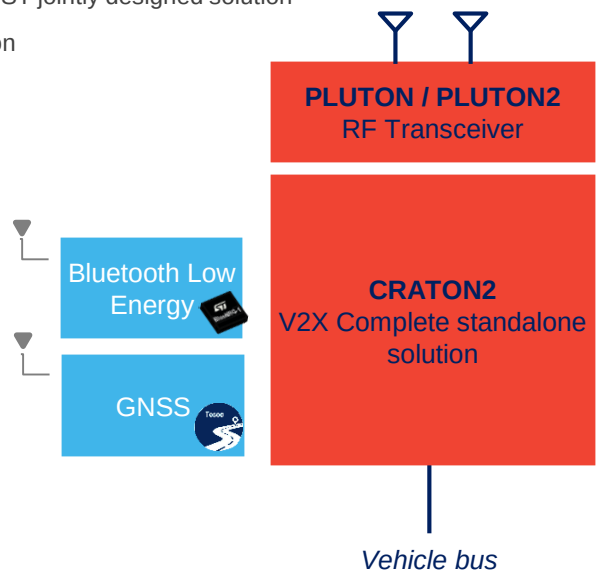
Sources
1. World Health Org
2. Texas A&M Transportation institute
3. US DOT

Flexible V2X solutions fits all needs

Scalable for BOM optimization and development efforts

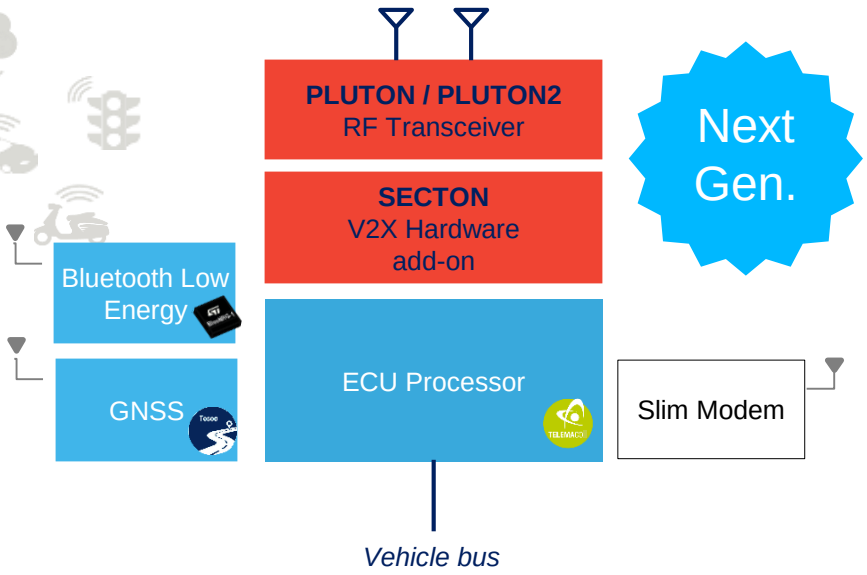
Autotalks-ST jointly designed solution

ST solution



V2X complete **standalone** solution

- ✓ Includes all V2X system blocks
- ✓ Pre-integrated Software
- ✓ Smallest V2X solution footprint



V2X Hardware **add-on** solution

- ✓ Lowest cost V2X hardware add-on
- ✓ Leveraging on existing ECU
- ✓ Simple integration with any host

Autotalks

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Truly Secure | 105°C Operation | Safety Critical | Low Power | Scalable

ST is making Driving More Connected and More Secure

More Secure

Connected car in a connected world	For Cellular & Wireless Communication For In-Vehicle Connectivity For Active Safety, ADAS For Car Infotainment
New Threats	Data manipulation by un-authorized people Service & Network access corruption Device hacking & counterfeiting User data corruption
Increased Security	To guarantee data confidentiality & integrity To protect data transport & storage To secure connectivity networks To ensure platform integrity

More Secure Driving Technologies
Processors (Secure Gateway), Secure Elements

What More Secure Driving Means

- Securing the Vehicle to Infrastructure communications
- Securing internal car networks
- Securing remote user interactions with the vehicle

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Conclusions

The automotive world is going to experience unprecedented changes

Sensors

Radars

Positioning

V2X

- Capabilities in computational power, connectivity, sensor fusion will be key in the electronics platforms of tomorrow's car
- Safety, digitally connectivity and security are accelerating the arrival of autonomous vehicles
- ST is strategically positioned for growth in the key segments of vehicle electrification, Safety and autonomous driving

Super Integrated ASICs

Vision Based Processor

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Thank you!