



Infineon offerings for in-cabin monitoring systems with 60 GHz radar

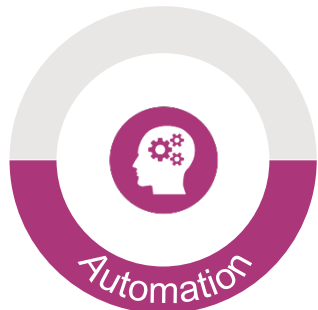
Dr. Sebastian Schams, Head of Product Marketing Radar Sensing
Antonio Monetti, Senior Marketing Director Vehicle Automation & Safety
24 June 2021



ICMS driven by legislation, automation and OEM initiative – 60 GHz radar offers the best price/performance among all technologies



- › Growth of ICMS applications **driven by legislation**:
 - **NCAP** (adaption of CPD from 2023)
 - **Government initiatives** to decrease the number of casualties (left behind child)
 - OEM self-commitments to improve safety of passengers



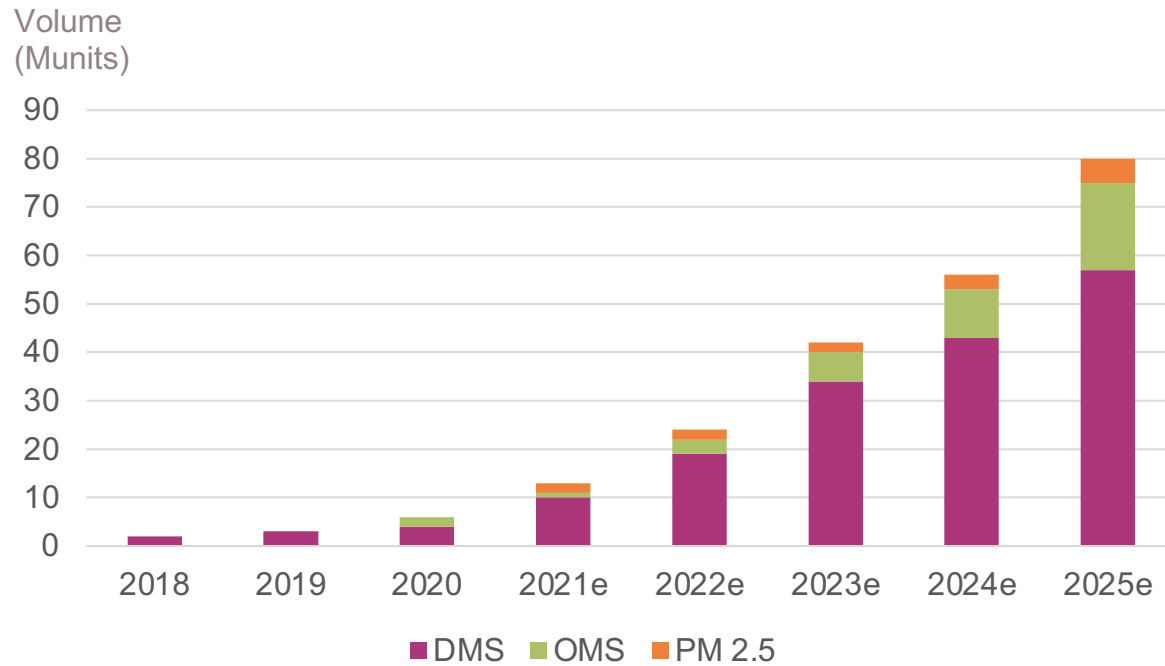
- › ICMS to increase **safety** in highly **automated cars (L2+)**:
 - Monitor **health** condition and **attention** of driver
 - Localization and classification of passengers (airbag activation, seatbelt reminder)



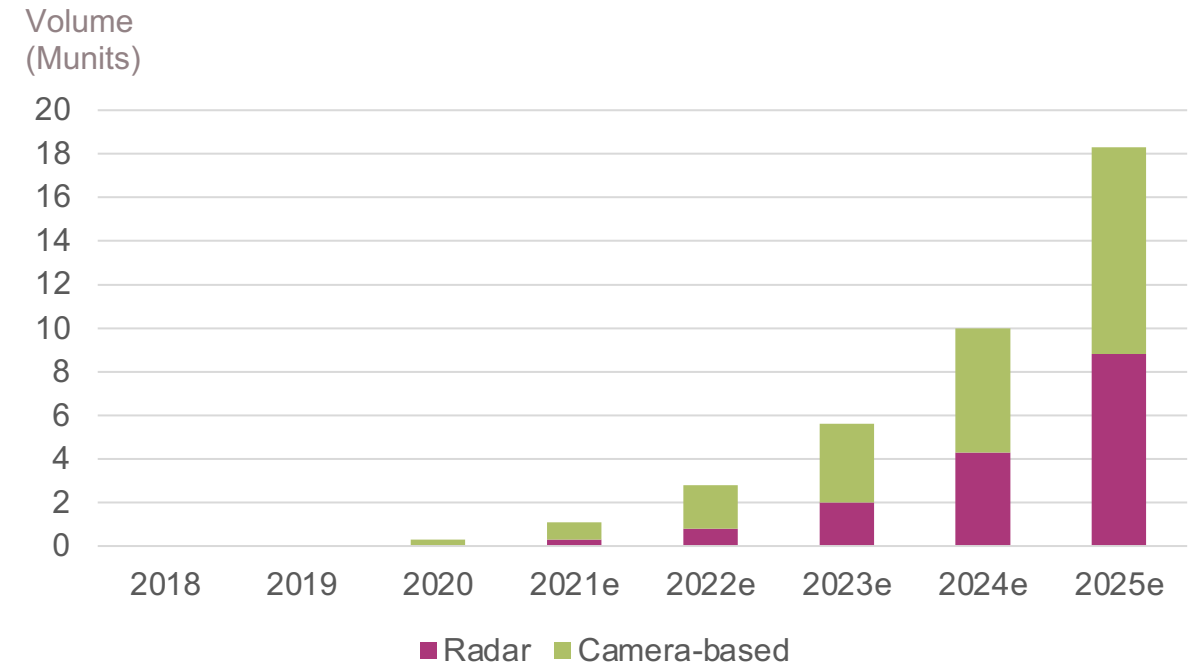
- › **Several technologies** available to realize in cabin monitoring systems
- › **Radar** technology allows **accurate and reliable detection** of passengers and their well-being
- › **60 GHz bandwidth now approved** for ICMS in most regions
- › Radar technology to **enhance existing technologies** (e.g. camera, weight sensor)

ICMS market to grow with a 72% CAGR – Market to be addressed with radar and camera technologies

In-cabin sensing market volume (Munits) – Split by system



Occupant monitoring system market volume (Munits) – Split by technology



The sensor market is booming – 72% CAGR between 2020 and 2025 confirms this trend

OMS market volume to grow from 0.3 Munits in 2020 to 18.3 Munits in 2025 with radar and camera technologies

Regulation and legislation for child safety drive the demand for ICMS over the next years

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | | | | |
|--|---------|-------|-------|------------|------------|--------|-------|-------|------|----------------|
| | EU-NCAP | ANCAP | NHTSA | Latin NCAP | ASEAN NCAP | C-NCAP | JNCAP | KNCAP | USDT | OEM initiative |
| Seat Belt Reminder (SBR) | ● | ● | ● | ● | ● | ● | ● | ● | | |
| Driver Monitoring System (DMS) | ● | ● | ● | | | ● | | | | |
| Child Occupant Presence Detection (COPD) | ● | ● | ● | | ● | | | | ● | ● |

News

› Europe and ASEAN introduce COPD (Child Occupant Presence Detection) in NCAP assessment test.









































































› HOT CAR ACT mandates to equip child safety alert system for new vehicle model in US.




› OEMs commit to automotive rear seat reminder alerts by 2025. Formal agreement



Radar offers the best price/performance among all technologies suitable for ICMS

| Sensor Technology | Accuracy | Robustness | Range | Installation | Power Consumption | Pri- vacy | Cost |
|-------------------|---|--|---|---|---|---|---|
| Weight |   |  |  |    |  | |  |
| Infrared |  |  |  |   |   | |    |
| Ultrasonic |   |   |  |   |    | |   |
| Camera |   |    |   |  |      |  |     |
| Radar |     |     |    |   |     | |     |

Radar sensors used for multiple in-cabin applications



Blind spot detectors

Smart trunk opener

Obstacle detector for tail-gate protection

Door alert for obstacle detection

Child Presence Detection

Driver monitoring for vitals

Gesture sensing/proximity control

Sunroof Opener

Passenger occupancy detection

60 Ghz 24 Ghz

60 GHz radar frequency band approved for ICMS in most regions

| | 24 GHz ISM | 60 GHz UWB | 60 GHz ISM | 77 GHz/79 GHz |
|---------------|------------|------------|------------|---------------|
| Europe / ETSI | ✓ | ✓ | ✓ | ✗ |
| USA / FCC | ✓ | ✓ | ✓ | ✗ |
| China / CCSA | ✓ | ✓ | ✗ | ✗ |
| Korea / NRRA | ✓ | ✓ | ✓ | Missing Info |
| Japan / ARIB | ✓ | ✓ | ✓ | ✓ |



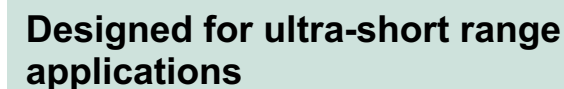
Decision pending



Frequency band released



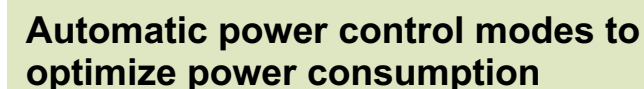
Frequency band not released



- › Optimized for ICMS
- › Automotive qualified components



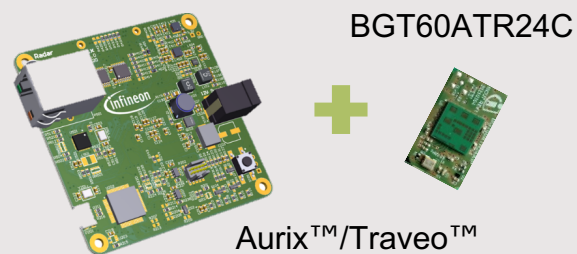
- › MMIC bandwidth of 4 GHz
- › Easy installation for rapid prototyping



- › Very Low Power
- › Max MCU Power: 2 W

Infineon solution is scalable for all ICMS use cases

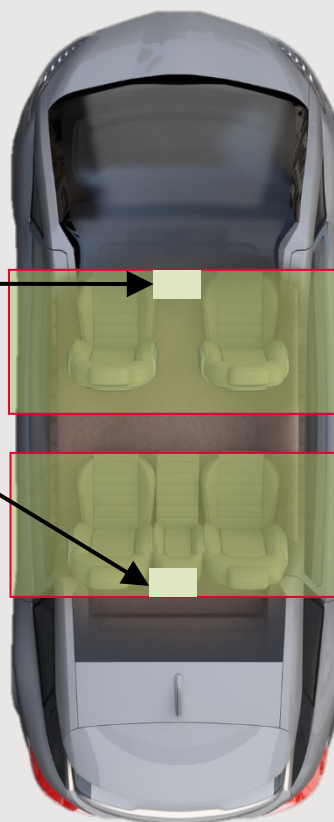
ICMS solution



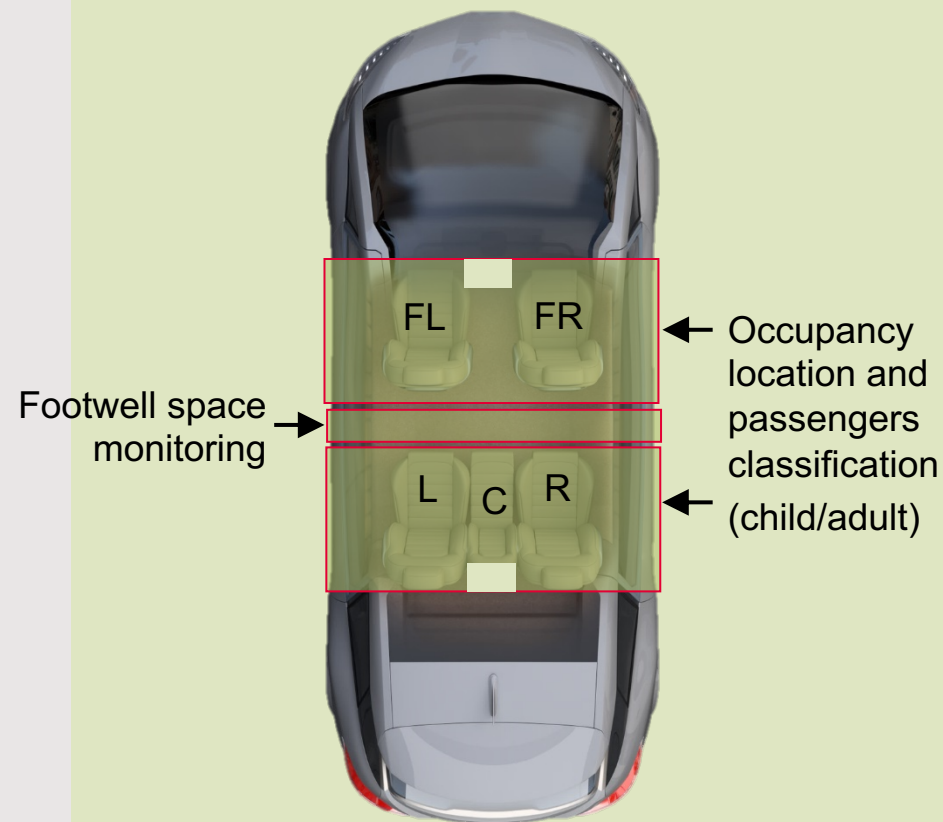
ICMS possible applications

- › Child Presence Detection
- › Occupant location
- › Occupant classification
- › Seat belt reminder
- › Vital sign detection
- › Anti theft
- › ...

Low-End: CPD only



Mid- to High-End: CPD + SBR



AURIX™ TC3xx automotive micro-controller for radar offers software and hardware scalability



| | | |
|---|--|--|
| TC39x A up to 16 MB 6 MB SRAM | | TC39xA 6/4 TC1.6 300 MHz 2xSPU1.0 |
| TC35x A up to 4 MB 2 MB SRAM | TC35xA 3/2 TC1.6 300 MHz 2xSPU1.0 | TC35xA 3/2 TC1.6 300 MHz 2xSPU1.0 |
| TC33x A* up to 2 MB 1 MB SRAM 300 MHz option on request | TC33xA 2/1 TC1.6 200 MHz 1xSPU1.0 | TC33xA 2/1 TC1.6 200 MHz 1xSPU2.0 |
| Memory Package | BGA180 12x12 mm | BGA292 17x17 mm |



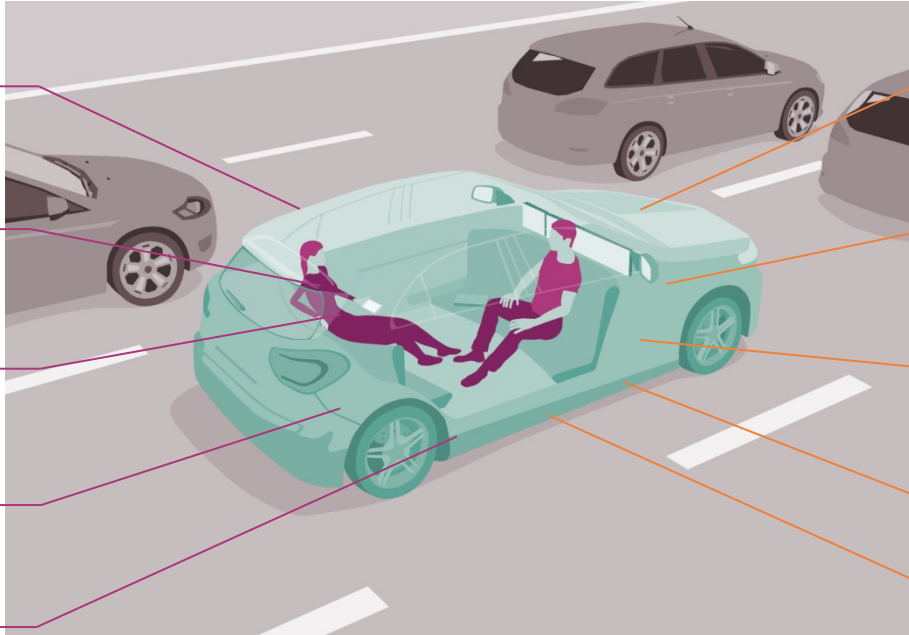
Scalable performance and memory sizes for cost optimized development

Low effort and investment to develop scalable solutions

- › Standard package across portfolio
- › Same safety architecture (ASIL-D)
- › EVITA Full security available across portfolio
- › Pin and software compatible

Infiniteon's partners for 'In-Cabin Sensing' offer a variety of functions to ensure safe travels and to fulfil regulatory standards



| Functions | | Advantages | |
|---------------------------------|--|---------------------------|--|
| Child presence detection(CPD) |  | One sensor solution | |
| Heart rate monitoring | | No privacy concerns | |
| Seat occupancy status detection | | Works day & night | |
| Respiration rate monitoring | | No line of sight required | |
| Classification (Child/Adult) | | Low cost | |
| Our Partners | | | |





bitsensing Inc.

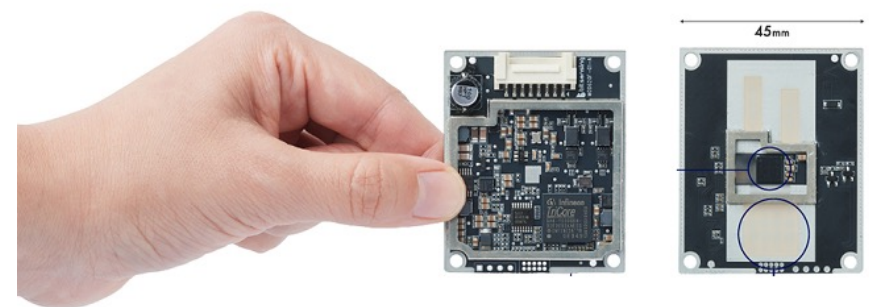
is a Korea based radar expert
developing high performing yet
cost effective radar technology.

Core competencies:

- + Software and Algorithms
- + System solution design and concept

Ultimate Radar Solution
for In-Cabin Sensing

MOD620



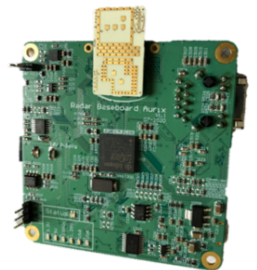
[Watch MOD620 for In-Cabin sensing here](#)

Caaresys

is an Israeli startup that develops vehicle passenger monitoring system based on contactless low emission radio frequency radar

Core competencies:

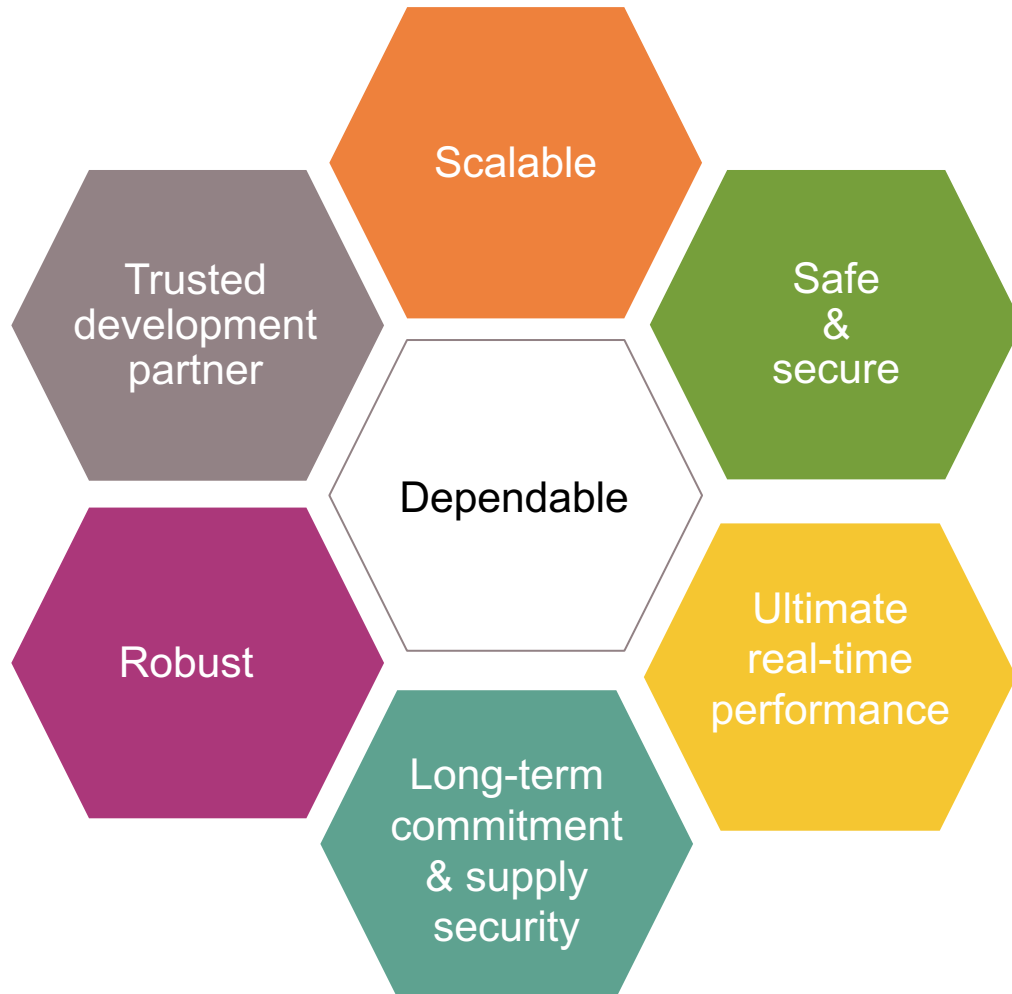
- + Software and Algorithms for cabin occupancy and vital signs monitoring
- + Person status analysis
- + Algorithm and SW based on vital signs data (heart rate and respiration rate)
- + RF & Antenna Design



Hardware expertise from partner will be provided only on request basis but is not the core focus of the company.
End customer should discuss this with Caaresys.

[Respiration rate and heart rate monitoring: watch here](#)

Infineon partners with bitsensing and Caareys to address the growing ICMS market with optimized 60 GHz radar solutions



Advanced 60 GHz MMIC with proven track record and solid roadmap.

Best in class AURIX™ MCU with scalable TC3xx family for Radar implementing safety and security features.

Dependability is **more than a set of technical features** and system properties.

Robustness of an architecture has a strong **fundament in product and engineering quality.**

Technical and commercial scalability is a key advantage in dynamic markets.

Infineon's partners offer an **holistic software solution** to complete the ICMS offering.



Part of your life. Part of tomorrow.

Glossary

| | |
|------------|---|
| CAGR | Compound Average Growth Rate |
| OEM | Original Equipment Manufacturer |
| CPD / COPD | Child (Occupant) Presence Detection |
| SBR | Seat Belt Reminder |
| DMS | Driver Monitoring System |
| ICMS | In-Cabin Monitoring System |
| NCAP | New Car Assessment Program |
| ASIL | Automotive Safety Integrity Level |
| MCU | Micro-Controller Unit |
| MMIC | Monolithic Microwave Integrated Circuit |
| PMIC | Power management Integrated Circuit |
| RF | Radio Frequency |
| ISM | Industrial, Scientific and Medical |
| UWB | Ultra Wide Band |