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Automotive Radars for L4 Automated Driving

Advances, challenges, validation and standardization

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AGENDA

- Radars for L4 automated driving and above

- Sensing demands in different automation levels

- Challenges and limitations of radars

- New radars and solutions

- Standardization requirements and current state

- IEEE SA P3116

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RADARS FOR L4 AUTOMATED DRIVING AND ABOVE

- Sensors to provide 360° perception of the **surrounding** environment

- The need for a **multi-modal** sensor system, including cameras, radars, ...

- Radar's the **most reliable** sensor for L4 and above

  - One-shot distance and speed measurement

  - Least affected by harsh weather conditions

  - Affordable

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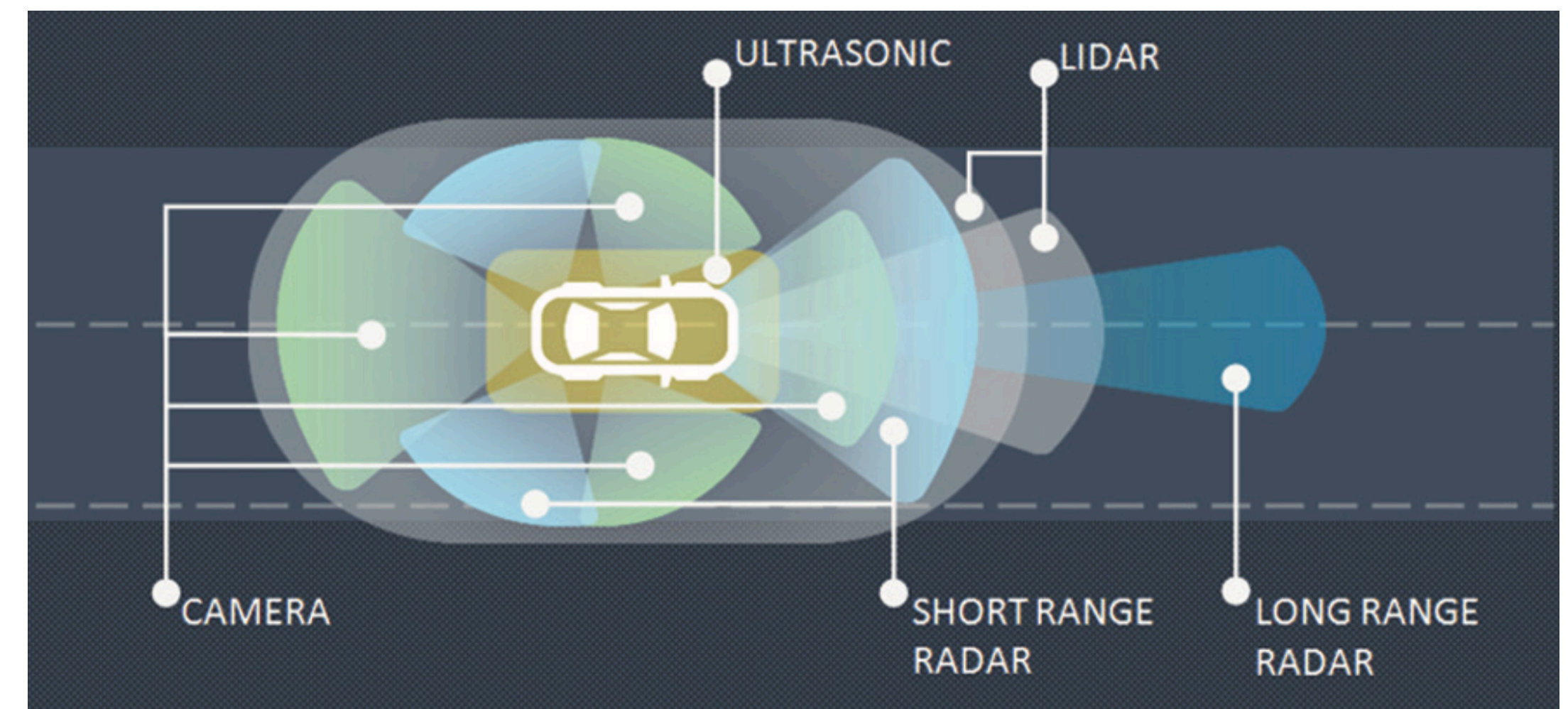
SENSING DEMANDS IN DIFFERENT AUTOMATION LEVELS

0	1	2	3	4	5
NO AUTOMATION	DRIVER ASSISTANCE	PARTIAL AUTOMATION	CONDITIONAL AUTOMATION	HIGH AUTOMATION	FULL AUTOMATION
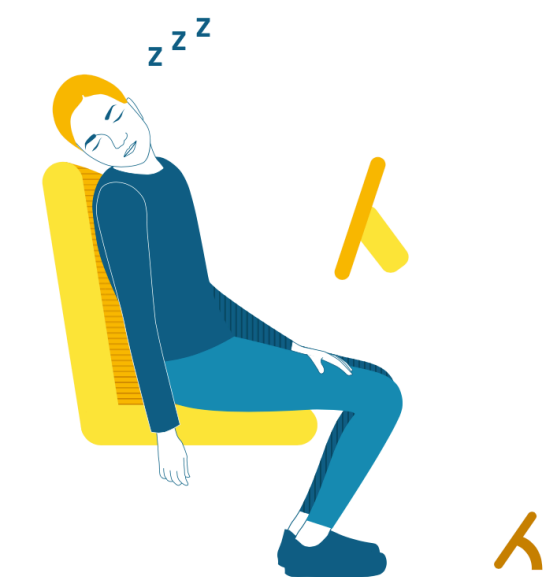
AEB
ACC
CTA (cross traffic alert)

L3+
Traffic jam pilot (TJP)
Valet parking

High-resolution angle and 360° point-cloud

Higher-fidelity perception

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LIMITATIONS AND CHALLENGES OF RADAR TECHNOLOGY

Low angular resolution compared to cameras and Lidars

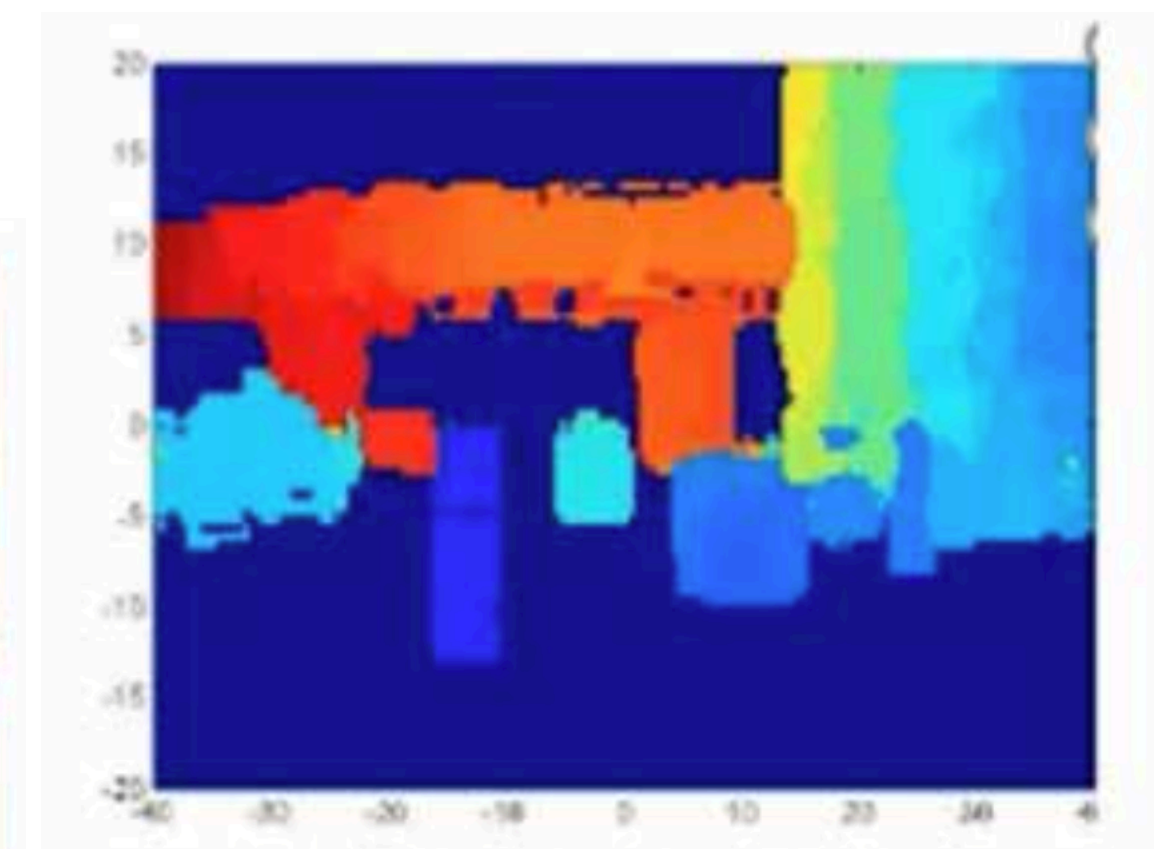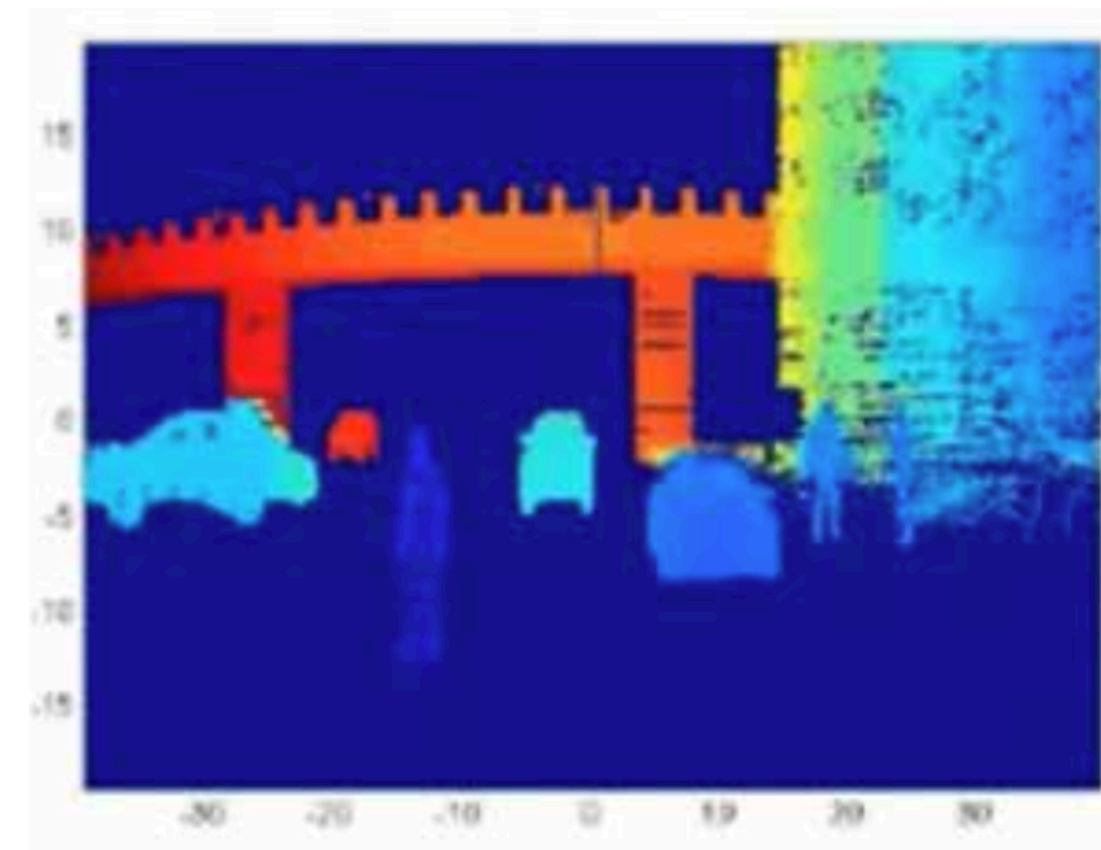**False positive**

Mutual **interference**

New radars with improved resolution, and more reliable data, called Imaging radars!

High-resolution radar

Lidar

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METHODS TO IMPROVE RADAR RESOLUTION

Cascade radars

Multiple radar chipsets are used to achieve virtual arrays with large number of channels.
Chipsets are from NXP, Infineon, TI, …

Antenna/ Meta-materials

Analog beam forming being made more accessible with new antenna technologies.

Many transceivers

Using a large number of transmit and receive channels e.g. 24TX/12RX improves angular resolution.

Signal models & Processing

New signals such as PMCW instead of FMCW, or multi-band signals, or AI-based processing methods for target recognitions and classification.

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RADAR STANDARDS LANDSCAPE

- Frequency band, radiated power and out of band emissions

- Test targets for various road users such as pedestrian, motorcycle, cyclist and 3D passenger car, testing of overall performance of functions

- Test scenarios, NCAP, IAMTS, ASAM and SAE

- Standard draft on testing methods for automotive mm-Wave radar and measuring radar metrics using reference targets, by CATARC

ETSI EN 302 264, ETSI TR 102 263, ETSI TR 103 593, Rec. ITU-R M.2057-1, Draft T/CAAMTBXX-2019

RADAR STANDARDIZATION NEEDS

- Automotive radar performance for different automation levels

- Traffic scenario and functional application of radar sensor

- Interference analysis and mitigation methods
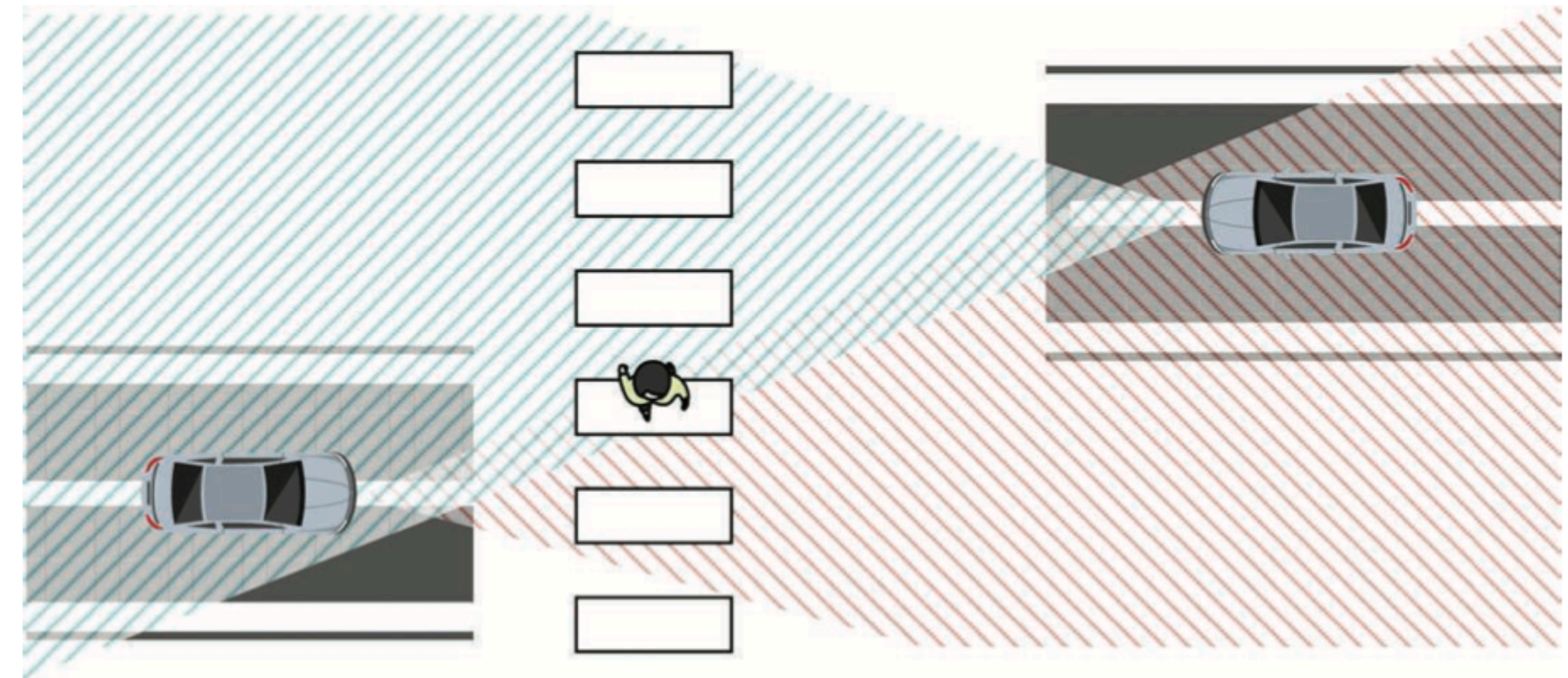
- One radar in two applications:
  - Cross Traffic Alert
  - Blind Spot Detection

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TESTING AUTOMOTIVE RADARS

- Testing and evaluation of radars within standard metrics

- Testing requirements for L4 and above

  - Multiple targets with arbitrary trajectory

  - Agile angle perception

  - Short and long distance emulation in same scenario

  - Wide RCS dynamic range for VRU scenario

  - Adaptable to various scenarios and use-cases

- Radar target simulation technologies

- Time domain emulation

  - NI

  - Keysight

  - Rhode and Schwarz

  - dSpace

  - Keycom

- Frequency domain emulation

  - Uniquesec

  - Ulm University

NEW IEEE SA AUTOMOTIVE RADAR STANDARD: P3116

- Automotive radars performance metrics and testing methods for Advanced Driver Assistance Systems (ADAS) and Automated Driving System (ADS) applications

- P3116 WG kick-off meeting date: **7th December 2021, 8:00 EST (14:00 CET)**

- Register at https://sagroups.ieee.org/3116/

- **Join us in assuring safety of future radars**

P3116: WORKING GROUP FUTURE MEETINGS

- Establishment of WG officers: vice-chair and secretary

- Sub-groups

- Development of outline for automotive radar standard draft

- Monthly meetings

  - Next WG meeting: **First week of Feb 2022 (7th Feb)**

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