# ADAS
# Sensor Fusion

辅助驾驶　传感器融合

# ADAS introduction

- Advanced Driver Assistance System

- provide support for driver by

  - warning (visual, audible, haptical signal)

  - engage in control

- reduce consequence of accident

- prevent traffic accidents

- in (near) future, facilitate fully autonomous driving

# ADAS systems by usage

- Human Machine Interface

- Safety Telematics Systems

- Vehicle Surrounding Sensors

- Active Safety Sensors

- Passive Safety Systems

# Human Machine Interface

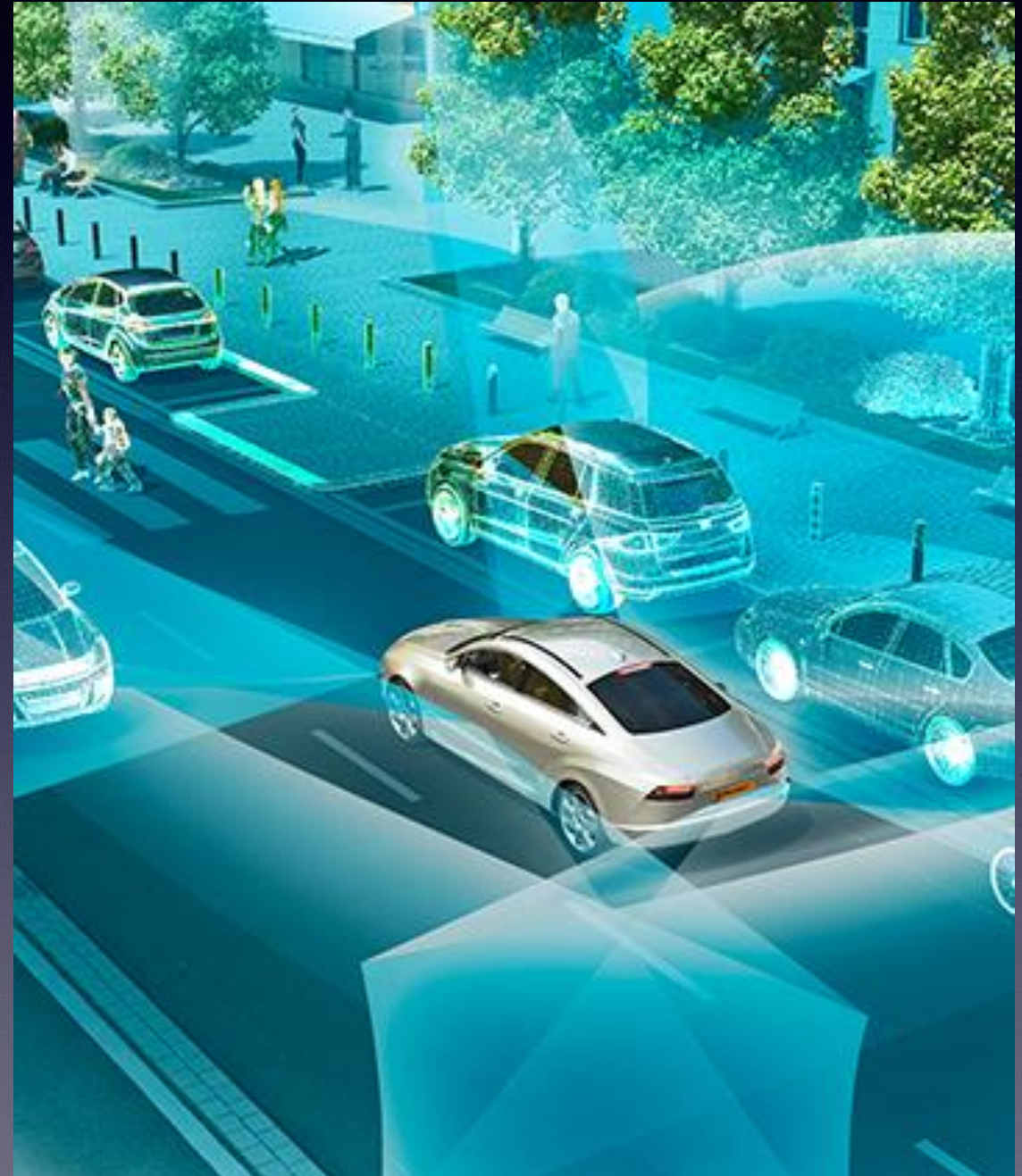- reduce driver distraction, concentrate on driving
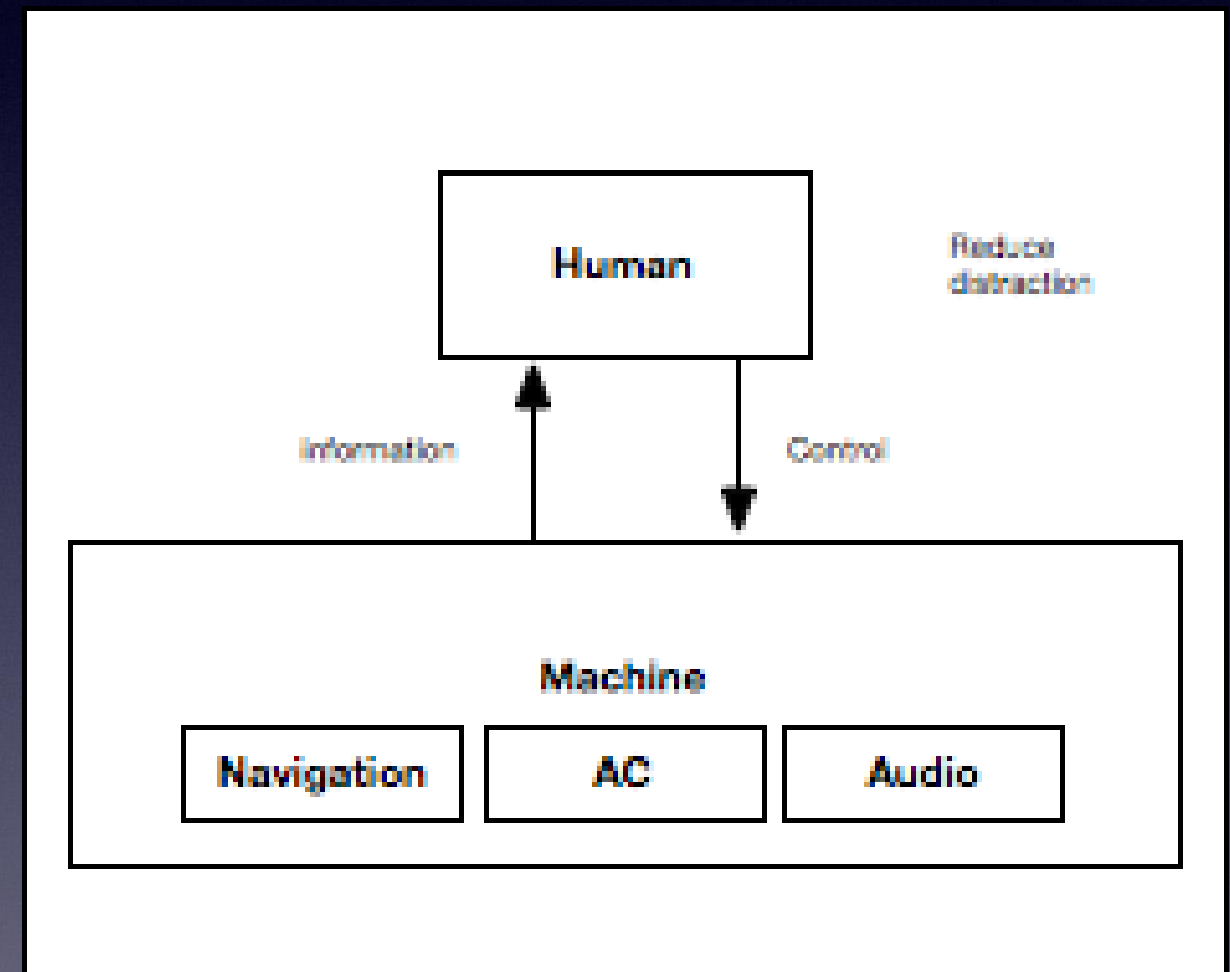
# Safety Telematics System

- car-to-car

- car-to-environment

- dynamic navigation based on live traffic

- comfort and safety

# Vehicle Surrounding Sensors

- Obstacles, vehicles

- potential collision warning

- parking assistance

- lance change assistance

# Active Safety Sensors

- take control in dangerous situation

- Electronic Stability Control

- Brake Assist (BA/EBA)

# Passive Safety Systems

- act after accident

- reduce consequence

- prevent injuries

- Airbag

- pressure sensor bumper

# ADAS Development

- Since 70s, Anti-lock Braking System (ABS)

- Proprioceptive Sensors (behavior of vehicle)

- Exteroceptive Sensors (ultrasonic, radar, lidar, infrared, vision)

- Sensor networks, multi-sensory platforms

# ADAS Application Examples

- Blind Spot Detection (BSD)

- Rear Cross Traffic Alert (RCTA)

- Intelligent Headlamp Control (IHC)

- Traffic Sign Assist (TSA)

- Lane Departure Warning (LDW)

- Emergency Brake Assist (EBA) and pre-crash

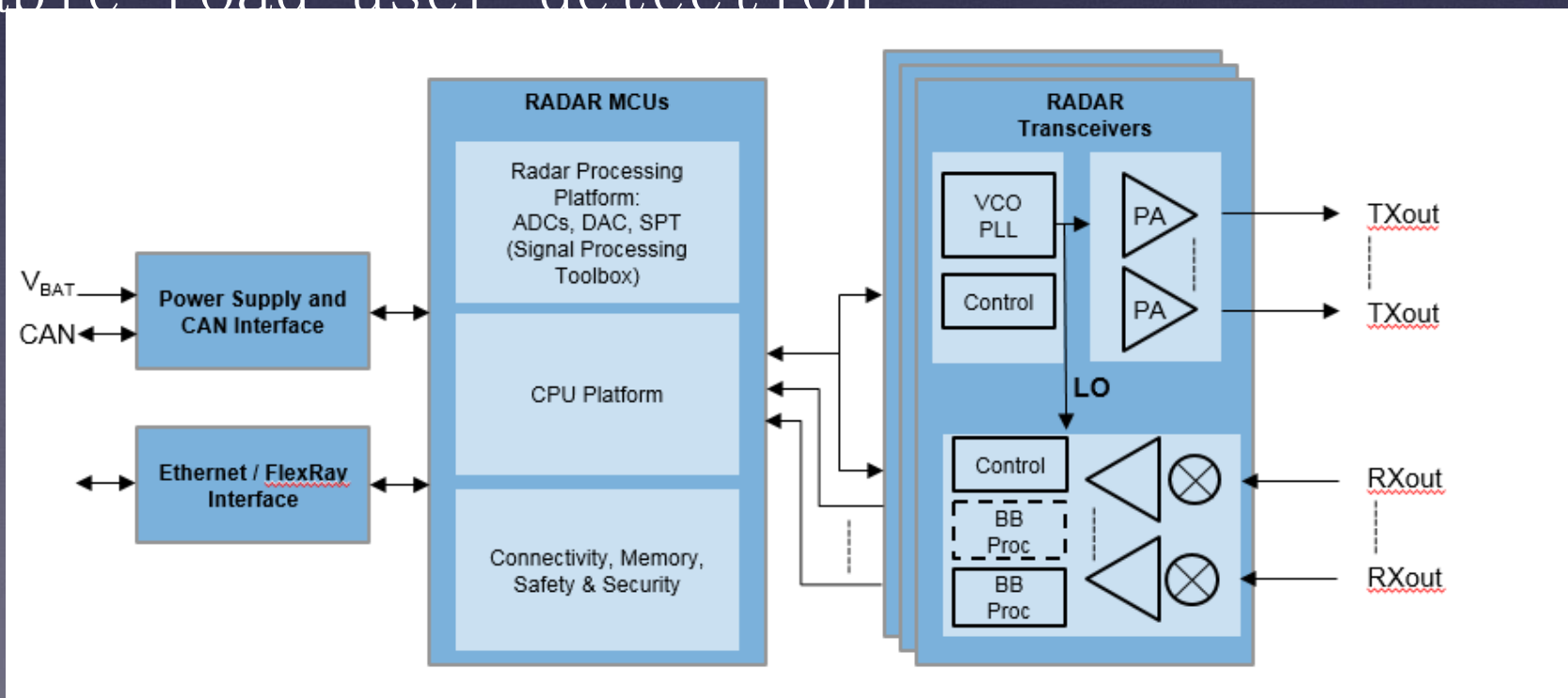- Adaptive Cruise Control w. Stop & Go

# ADAS Sensors
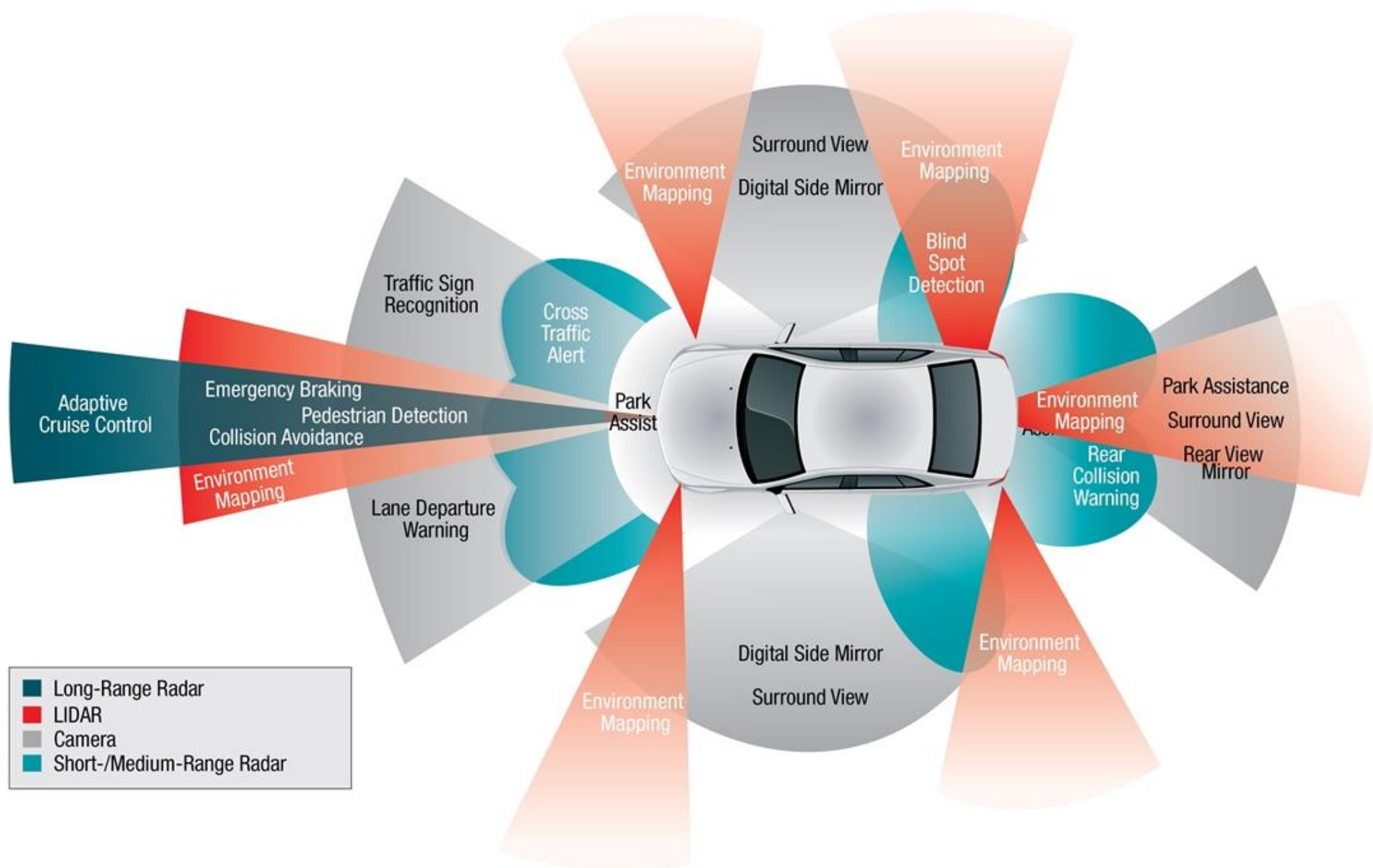
# Freescale

- basic-rear

- smart-rear

- surround-view-cameras
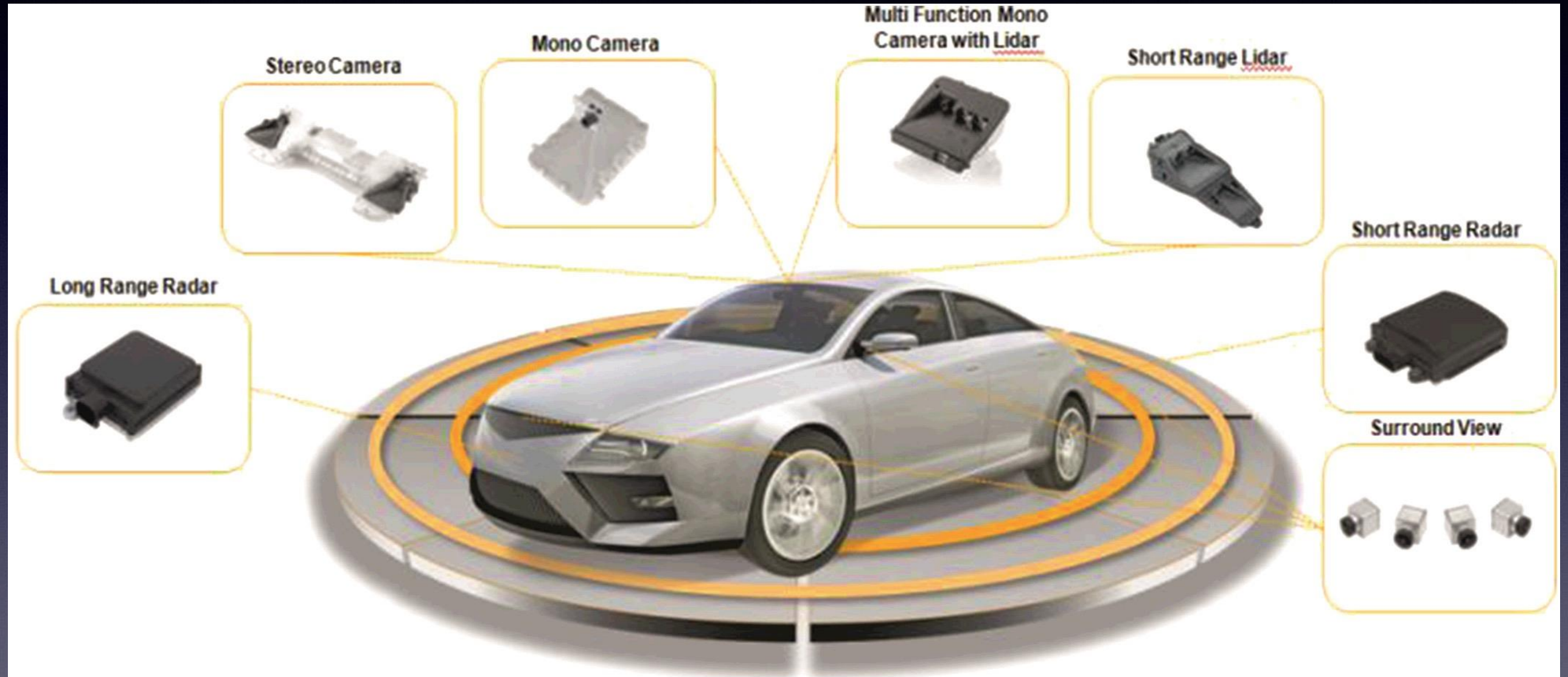
- 77GHz radar system

# NXP

- Collision detection, warning and mitigation
- Collision avoidance
- Blind spot monitoring / blind spot detection
- Lane change assistance and lane departure warning system
- Rear cross-traffic alerts
- Vulnerable road user detection

# Texas Instruments

- [ADAS Applications Processor TDA2x System-on-Chip](#) Oct 2013

# Continental



AutoUniMo project

# Short Range Radar (SRR)

- Pulse Compression Modulation, EM wave 24GHz

- Mount: 4 on bumpers, 2 front 2 rear

- detects objects, measures relative distance and velocity,
  angular coordinates

- field view +/- 75 degree, up to 50m

- position of object {x,y} resolution up to 0.1m

- velocity up to 35m/s, resolution 0.2,0,25m/s

- used for BSD, RCTA

- Via: CAN bus

# Radar Sensor – LRR

- Long Range Radar (RRR)

- operating frequency: 77 GHz

- range up to 250 m

- Used in EBA, ACC

# Multi Function Camera

- Mount: next to rearview mirror

- Mono or stereo

- range up to 90 m, 44 degree (6mm) field of view limited

- 640x496 x8b color depth x40ms

- detects vehicle contours, lane marking, headlight

- Used for: IHC, LDW, TSA

- Via: CAN

# Surround View Camera

- fisheye camera

- small form factor

- 3D 360 degree view

- augmented reality

- Used for: BSD, auto-parking, lane change

# LiDAR

- Short Range Lidar (SRL)

- mount: rear-view mirror

- measure range 1~10m (front), 3x lasers

- night and day

- sensitive to weather and ambient light

- view of 27 degree (h) 11 degree (v)

- accuracy 0.1m
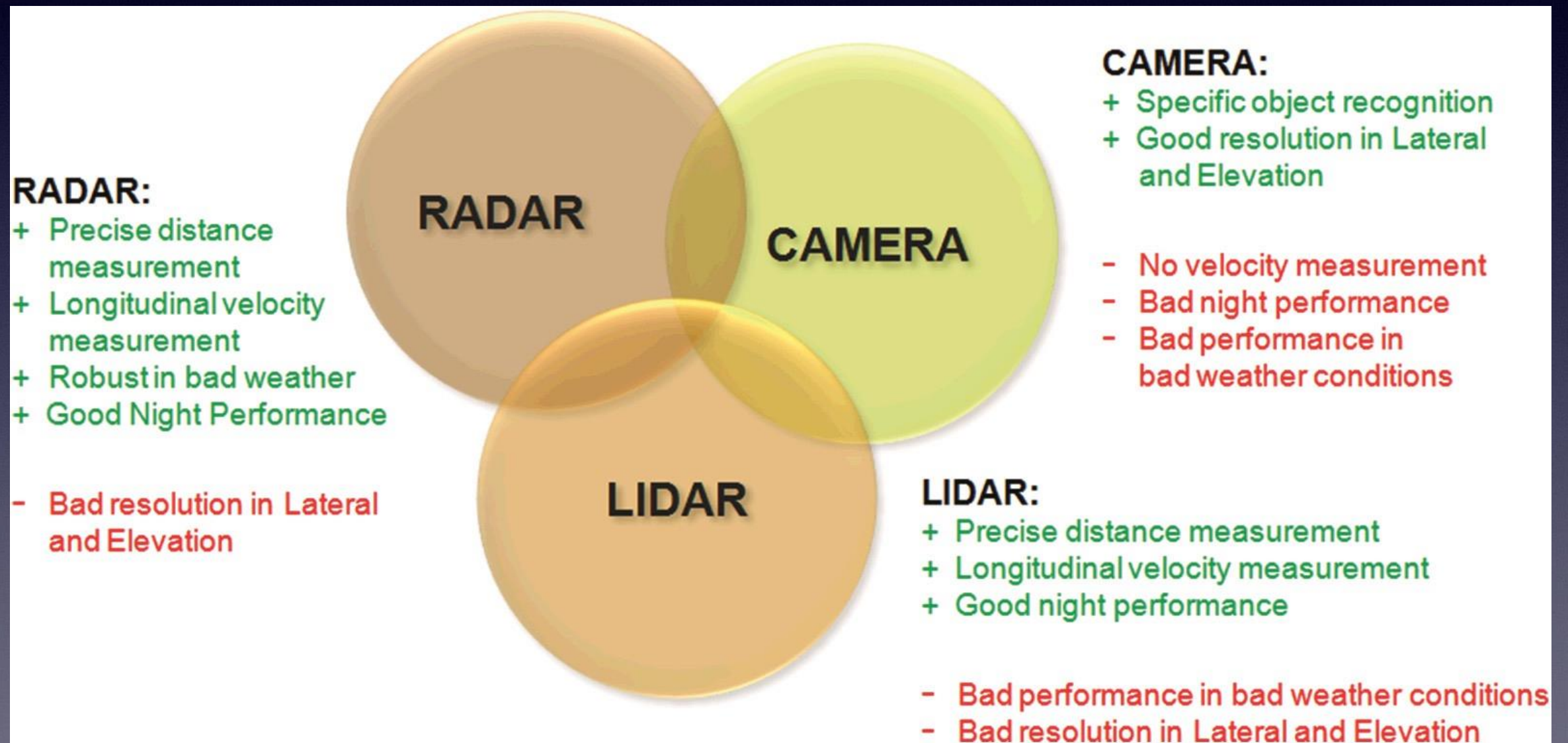
- Used for: EBA

- High-Speed-CAN bus

# Multi Function LiDAR

- infrared + camera

- Used for EBA, LDW, IHC, TSA

- much smaller range

- CMOS imager 1024x605

# Sensor Fusion

- Multi-Function Lidar, infrared + camera

- Stereo-vision camera

- "As yet, no unified architecture has been determined for the automobile industry."

# Sensor Fusion



**RADAR:**
+ Precise distance measurement
+ Longitudinal velocity measurement
+ Robust in bad weather
+ Good Night Performance

− Bad resolution in Lateral and Elevation

**CAMERA:**
+ Specific object recognition
+ Good resolution in Lateral and Elevation

− No velocity measurement
− Bad night performance
− Bad performance in bad weather conditions

**LIDAR:**
+ Precise distance measurement
+ Longitudinal velocity measurement
+ Good night performance

− Bad performance in bad weather conditions
− Bad resolution in Lateral and Elevation

# Backup

- 2x front SRR, 2x rear SRR, SRL, MFC