AUTONOMOUS VEHICLE SYSTEMS AND A CONNECTED FUTURE

IoT Summit – RWW 2018

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SYSTEMS AND APPLICATIONS
INFOTAINMENT AND DRIVER ASSISTANCE
LEVELS OF AUTONOMATION IN CARS

Level 0-2
Human driver performs part of the dynamic driving task

Level 3-5
Automated driving system performs the entire dynamic driving task

SAE standard J3016
MEGATRENDS IN THE AUTOMOTIVE ARENA

Seamlessly Connected Mobility Experience

ADAS Towards Self-Driving

Energy Efficiency

One hour per day in the vehicle
Enjoying Life

1.3M global road fatalities every year
Saving Lives

US mandates 163 grams / mile and 54.5 MPG by 2025
Reducing CO₂
REDUCING ROAD FATALITIES

Safety crucial for self-driving car

Safety, quality & reliability at the heart of automotive engineering

Trusted technology and functional safety track-record essential

Safety system adoption accelerated by mandates & NCAP ratings

ADAS needed to reverse recent increase in fatality rate (texting)
Drones – Unmanned Aerial Vehicles

- A remotely controlled flying robot.
- Drones fly autonomously through software-controlled flight plans that are embedded in their systems, working in conjunction with GPS.
- Most often associated with the military but has many other applications.

- Search & Rescue
- Surveillance
- Traffic Monitoring
- Weather Monitoring
- Firefighting
DRONE APPLICATIONS

Drones could allow businesses to deliver goods directly to consumers without having to send them to a store or distribution center.
Cost effective UAV Logistics require state of the art technologies:

- **Security**: Registration, authentication
- **Autonomy**: Radar, V2X communication, Vision, Sensor fusion, IR, high accuracy positioning
- **Safety**: Geofencing, limp home, Safe operational
- **Privacy**: Video encryption, privacy preserving video analysis
Market Drivers: NCAP and Automation
Towards a 360° view by Sensor Fusion

NCAP Roadmap

NCAP

L1: Partial Assistance
ACC
L2: Partial Automation
AEB
Junction Assist
Emergency Steer Assist

2010
2016
2018
2020
>2025

Autonomous Driving

Platooning
Smart Navigation (Vehicle deciding on routes)
Traffic Jam Assist (Semi Autonomous steering)
Automated vehicle (taking complete control of navigation, transmission, steering, braking & parking)

L3: Conditional Automation
L4: Highly Autonomous

Parking (Autonomous parallel parking)
Co-operative cruise control

Adapted from Frost & Sullivan analysis.
• Proliferation of Radar-based Safety:
  - SRR Radar for "Entry-level" NCAP for low-end models and corner radar for NCAP 2020

• Emergence of L3/L4 Autonomous Support:
  - Need for "surround-sense" USRR/SRR radar satellite modules

• Small module size for flexible deployment
  - new deployment scenarios in doors, etc driving small size requirements
Advanced Radar

• High Resolution Radar
  ▪ Sometimes called Imaging Radar
  ▪ Some techniques use Synthetic Aperture Radar
    - Integrate information as the vehicle moves to improve overall “view” of the environment

• Use many transmit antennas and many receive antennas
  ▪ Create large amounts of complimentary data
  ▪ Perform calculations to effectively increase the resolution of the radar
    - Claims as low as 1.2° of angular resolution
Application Context for Radar Systems

- **TOMORROW**
  - MULTI-MODE MRR/SRR
  - NCAP Lateral Assist, Evasive Steering, Highway Pilot

- **TODAY**
  - NEXT GEN LDC/LTA
  - Low Resolution Radar
  - Adaptive Cruise Control
  - Automatic Emergency Braking
  - Forward Collision Warning

- **TOMORROW**
  - LONG RANGE HIGH RESOLUTION RADAR
  - Adaptive Cruise Control
  - Automatic Emergency Braking
  - Forward Collision Warning

- **TOMORROW**
  - MULTI-MODE MRR/SRR
  - Junction Assist, Cross Traffic, Evasive Steering
V2X extends sensing beyond own vehicle & beyond line of sight

Motorcycle approaching / „do not pass!“

Roadworks beyond line-of-sight

Platooning / cooperative driving
5m gap @ 80km/h based on 802.11p low latency

Emergency vehicle around corner

802.11p required for
Safety-critical V2X features:

Low Latency, Secure &
Beyond-line-of-sight

Providing additional safety data earlier than any other sensor can „see“
WAVE/G5 Dedicated Short Range Communications (DSRC*)

- Ad-hoc, 2-way network
- Regulated spectrum for ITS
- 7 free channels
- Low latency (<50ms)
- 360°, Range up to 2km
- Data rates from 6-27Mbps
- Signed messages using Public Key Infrastructure

* EU: DSRC describes road-tolling at 5.8 GHz, and not 802.11p
Security for V2X communications

- **Digital signature:**
  - For authentication (sender identity, content integrity)
  - And non-repudiation (no plausible deniability)

- **Based on:**
  - Public-key crypto: two keys, one is private (secret), other public (non-secret)
  - Hash function → unique identifier for message

- **ETSI (EU) and IEEE (US) standards mandate ECDSA**
  - RSA signatures too long (bandwidth limitation)
  - Comparable security strength: RSA 3072b ~ ECC 256b ~ AES 128b
Privacy for V2X communication

Pseudo-identities

- A vehicle can be tracked if it always uses the same unique identifiers
- A vehicle therefore uses multiple pseudo-identities
  - each with limited lifetime
- Pseudo-identities are switched regularly (engine start, every X minutes,...)

All identifiers are derived from the pseudo-identity and changed simultaneously
Rinspeed Etos Concept Car

https://www.youtube.com/watch?v=mIENynRwZGw
SECURE CONNECTIONS FOR A SMARTER WORLD