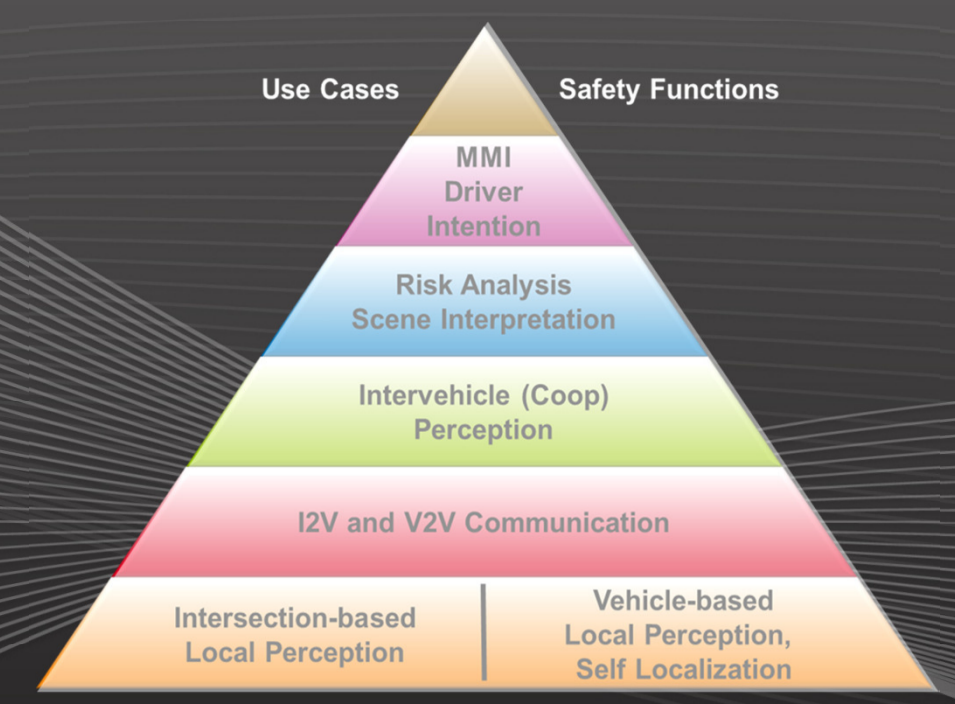


# Cooperative Perception Building Blocks



## Bottom-up Representation of Ko-PER Building Blocks to achieve virtually complete dynamic compilation of traffic environment

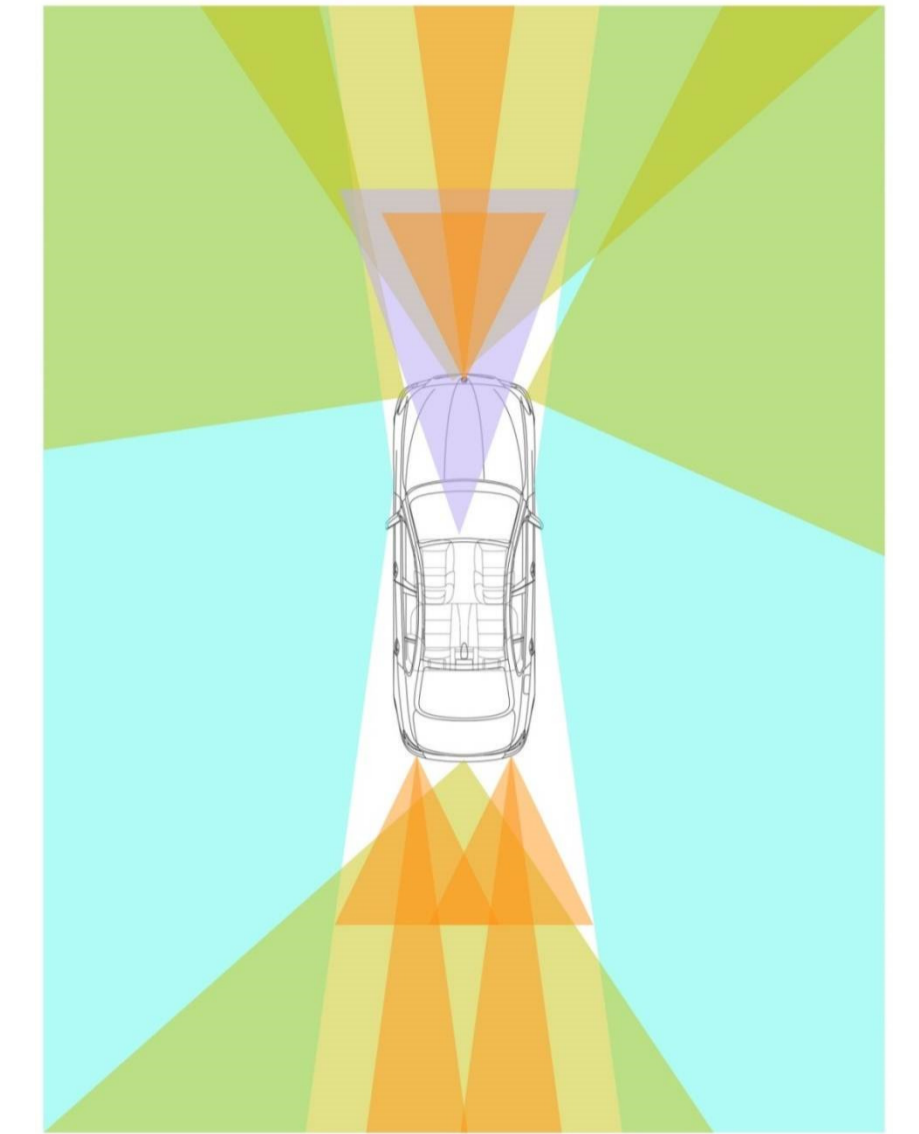
### Perception Network: Intersection

- 8 standard VGA cameras
- 14 multi-layer laser scanners
- 2 high-resolution cameras for the detection, tracking and classification of trucks, cars, two-wheelers and pedestrians



### In-Vehicle Perception

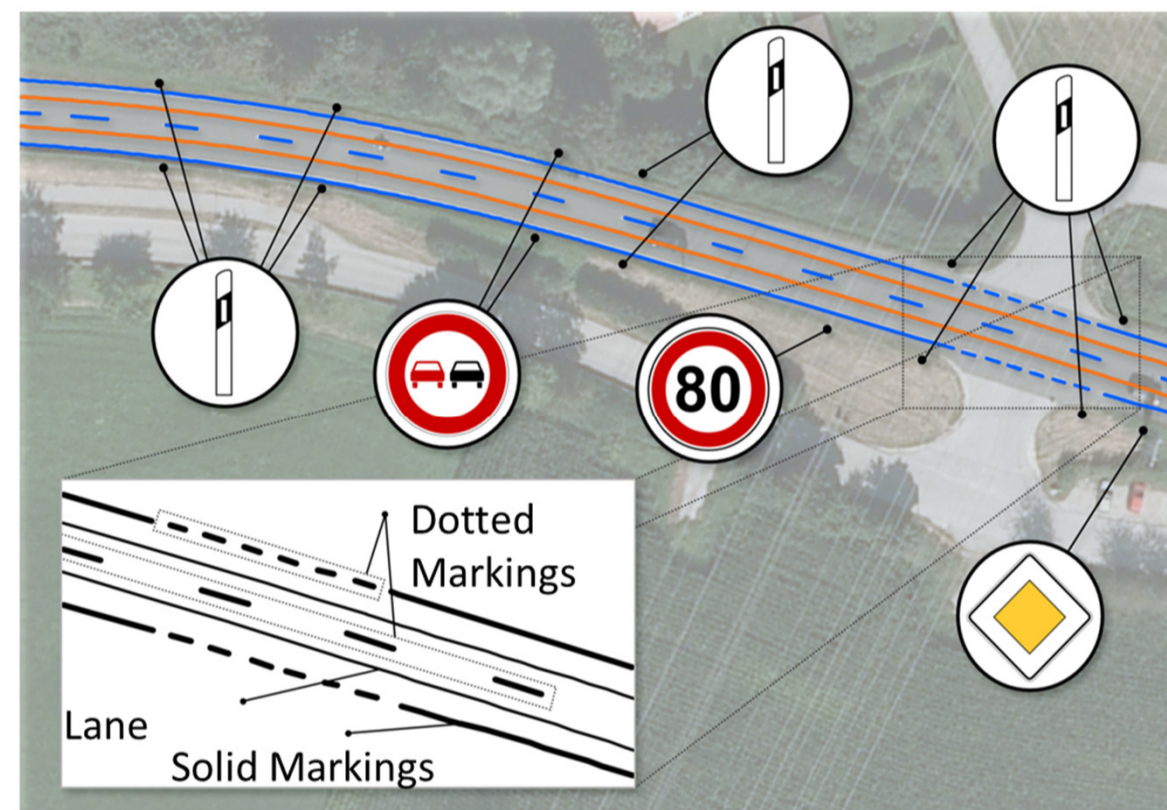
- Start with signal processing of various sensors
- Employ sensor data correlation and association
- Conduct multi-object sensor data fusion and tracking including object classification



### High-Precision Self-Localization

based on various approaches:

- Tightly coupled GPS/GNSS
- Laser scanner & land marks
- Video cameras, high precision digital maps and land marks
- Cooperative GPS/GNSS
- Fusion of localization results



### I2V- and V2V-Communication

- Use sim<sup>TD</sup> CCU hard- & firmware and existing messages e.g. intersection MAP & SPaT (Signal Phase and Timing)
- Compose and implement various new Ko-PER specific message types:
  - CPM (Cooperative Perception Message)
  - CLM (Cooperative Localization Message)
  - Various DEN messages, *i. e.* SLD, SVC, PED/CYC/BIC

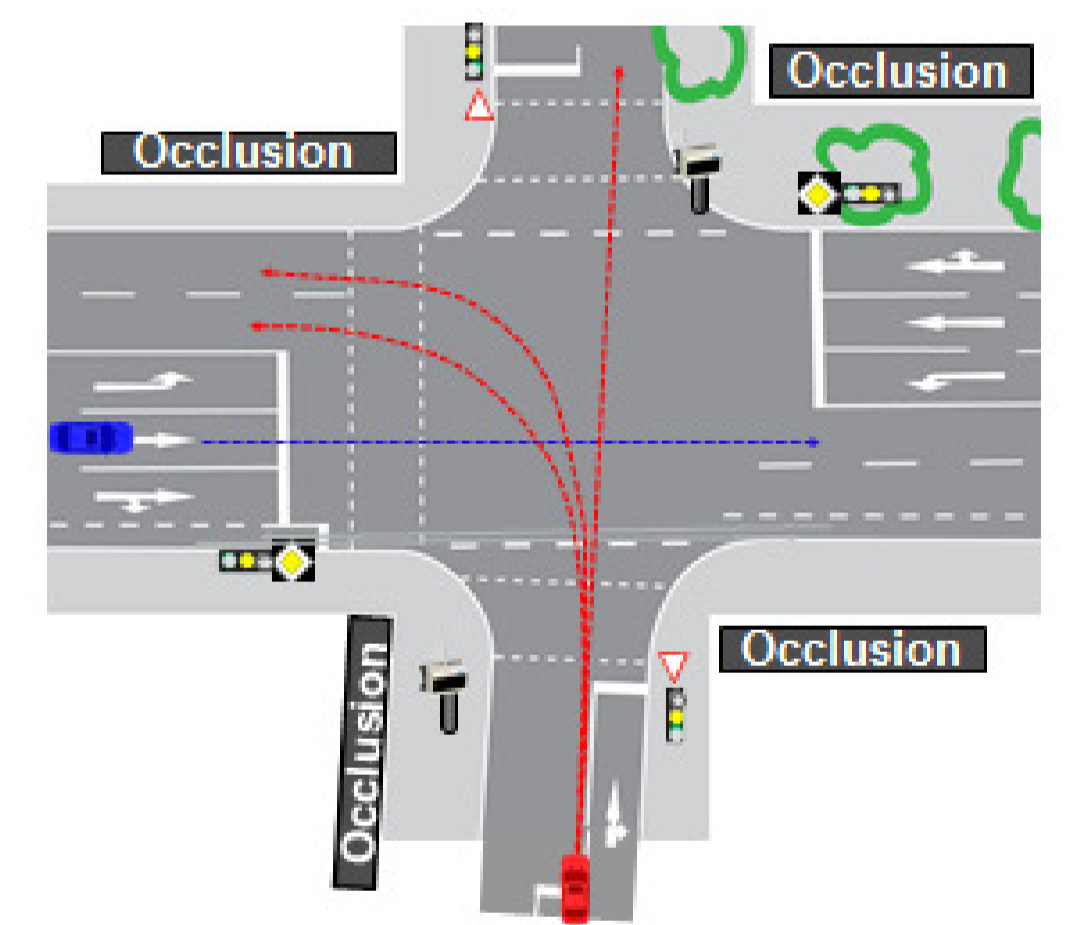
### Cooperative Perception and Inter-Vehicle Sensor Data Fusion

Master the following challenges:

- Cope with transmission delays and drop-outs
- Correctly handle inaccuracies of global timestamps and of positions in global coordinate systems
- Achieve correct data correlation and association
- Accomplish inter-vehicle sensor data fusion via Cooperative Perception Messages and various DENMs

### Situation Analysis

- Correctly handle perception uncertainties and inaccuracies
- Understand the traffic situation
- Analyze and predict intentions of traffic participants
- Infer hazardous traffic situations
- Timely *inform* the driver of potential / emerging hazards

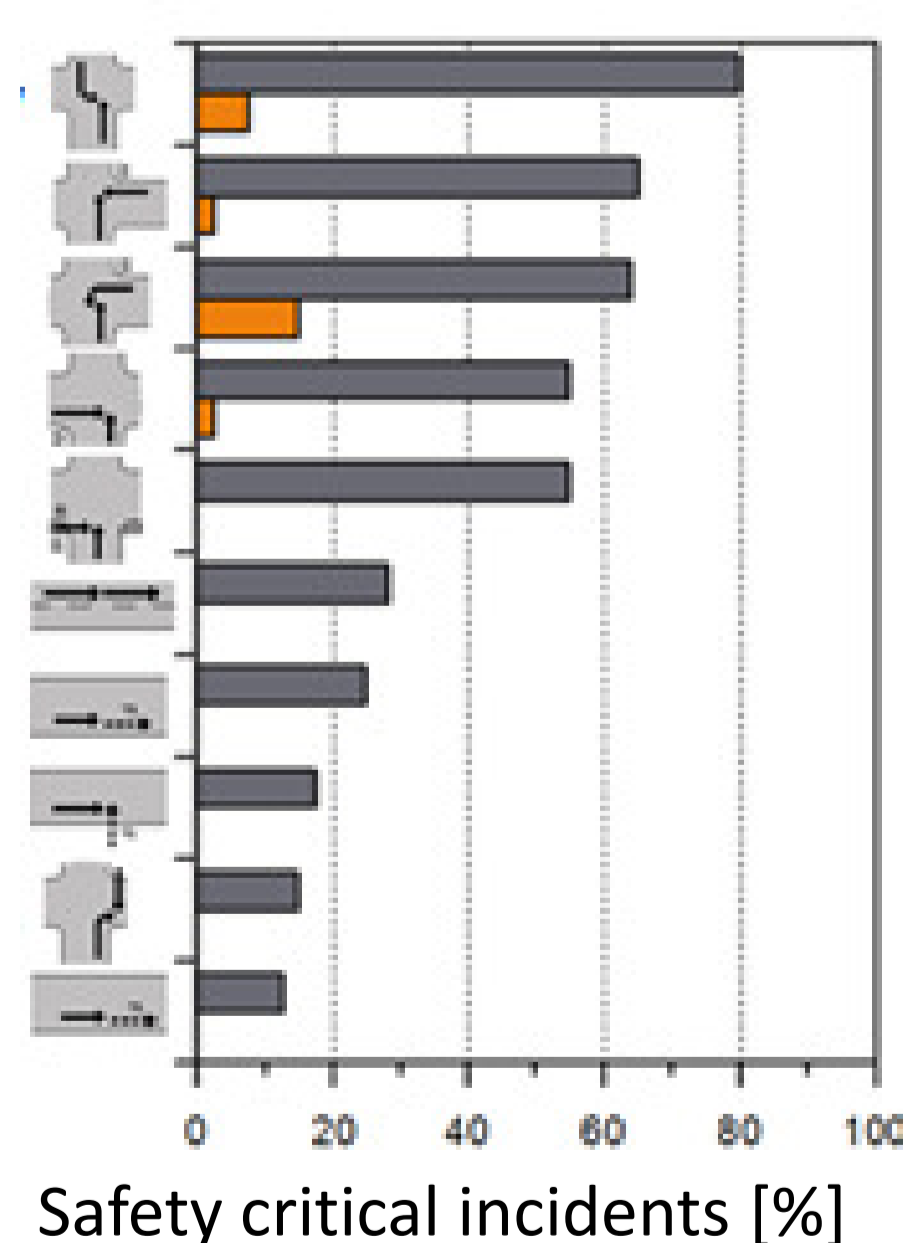


### HMI Approach

Timely advisory information

- prevents emergency reactions
- helps to prevent false alarms
- decisively de-escalates critical situations

Without driver information   
Including driver information



### Preventive Safety Functions

Utilize suitable displays (e.g. HUD) to advise driver

