European Global Navigation Satellite Systems Agency

PRoPART
Precise and Robust Positioning for Automated Road Transports

European Global Navigation Satellite Systems Agency

HORIZON 2020

VEHICLE PLATFORM AND APPLICATION

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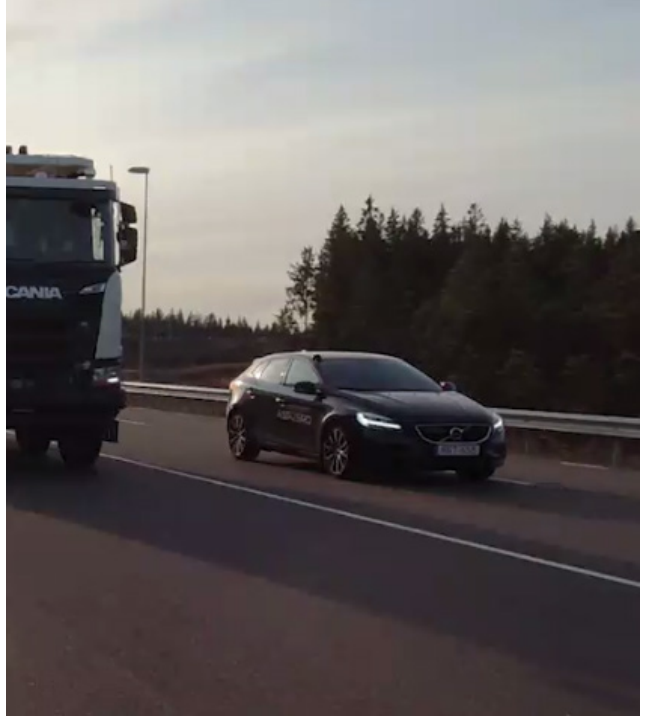
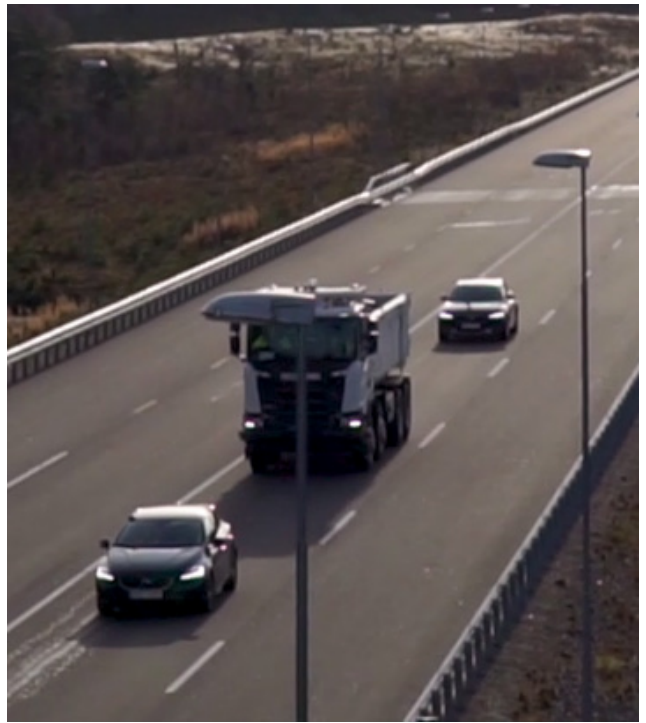
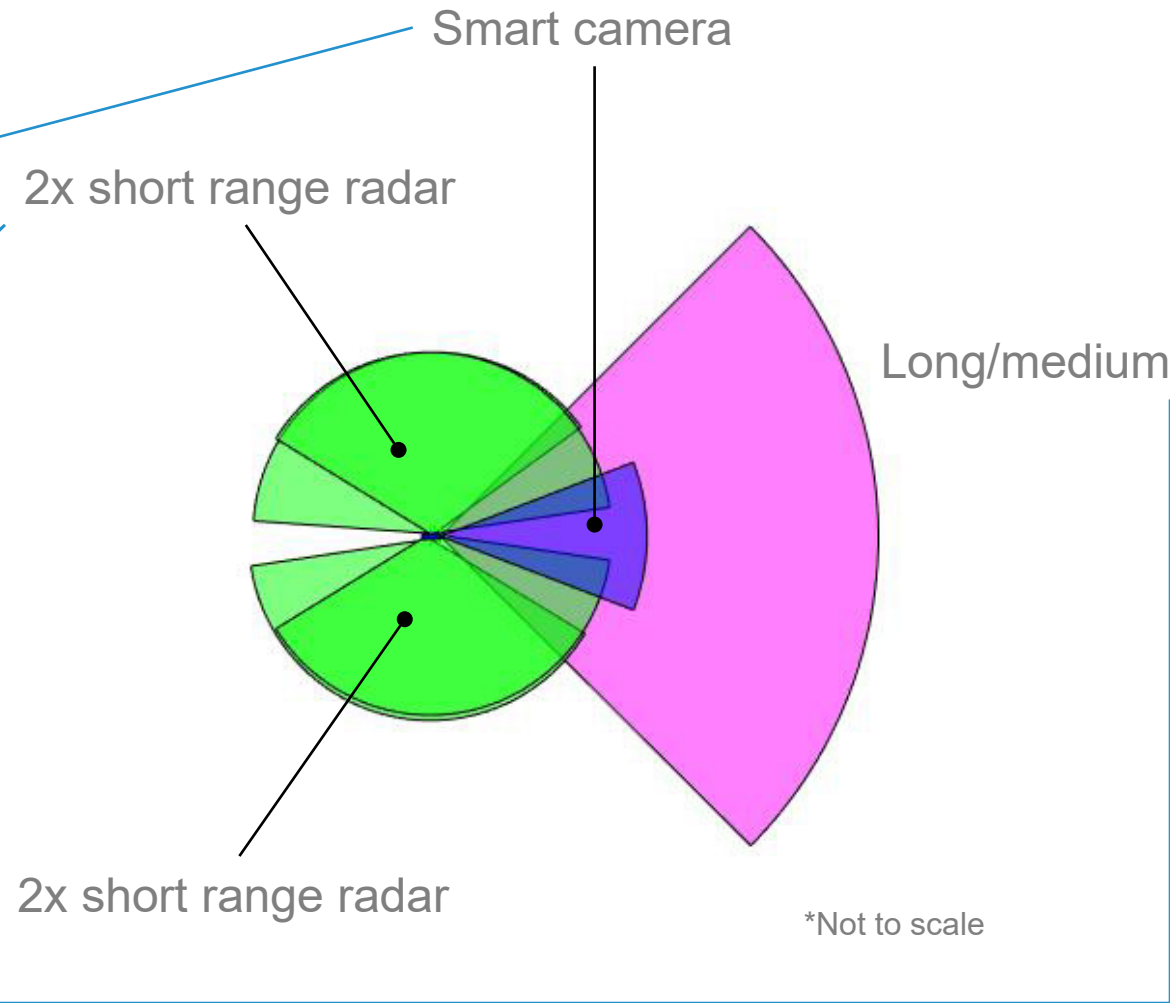




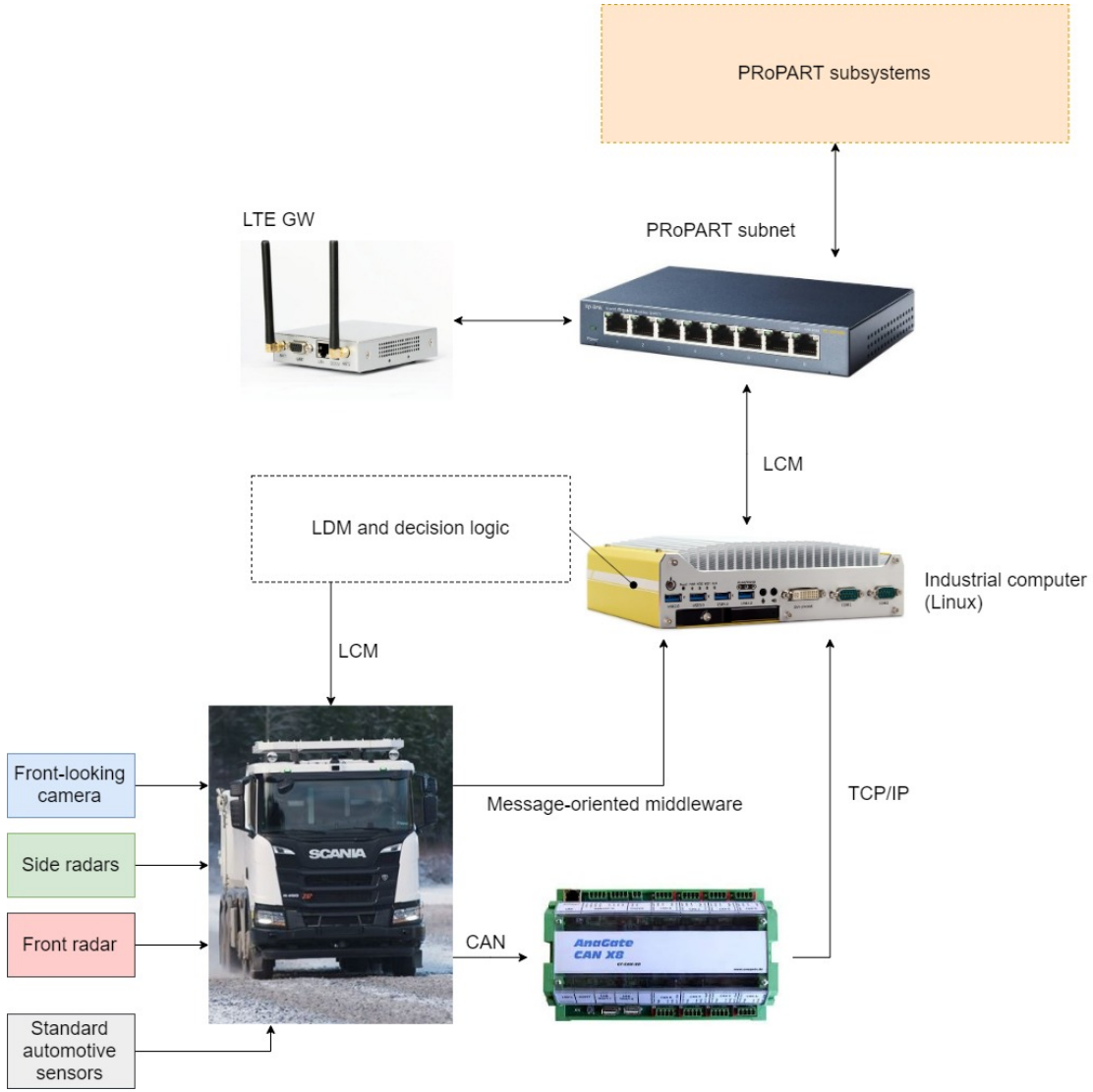
Topics

- PRoPART sensor setup
- Overview of onboard setup
- Vehicle adaptations
- Precise and robust positioning from the OEM perspective
- Collective perception
- Vehicle applications

PRoPART sensor setup



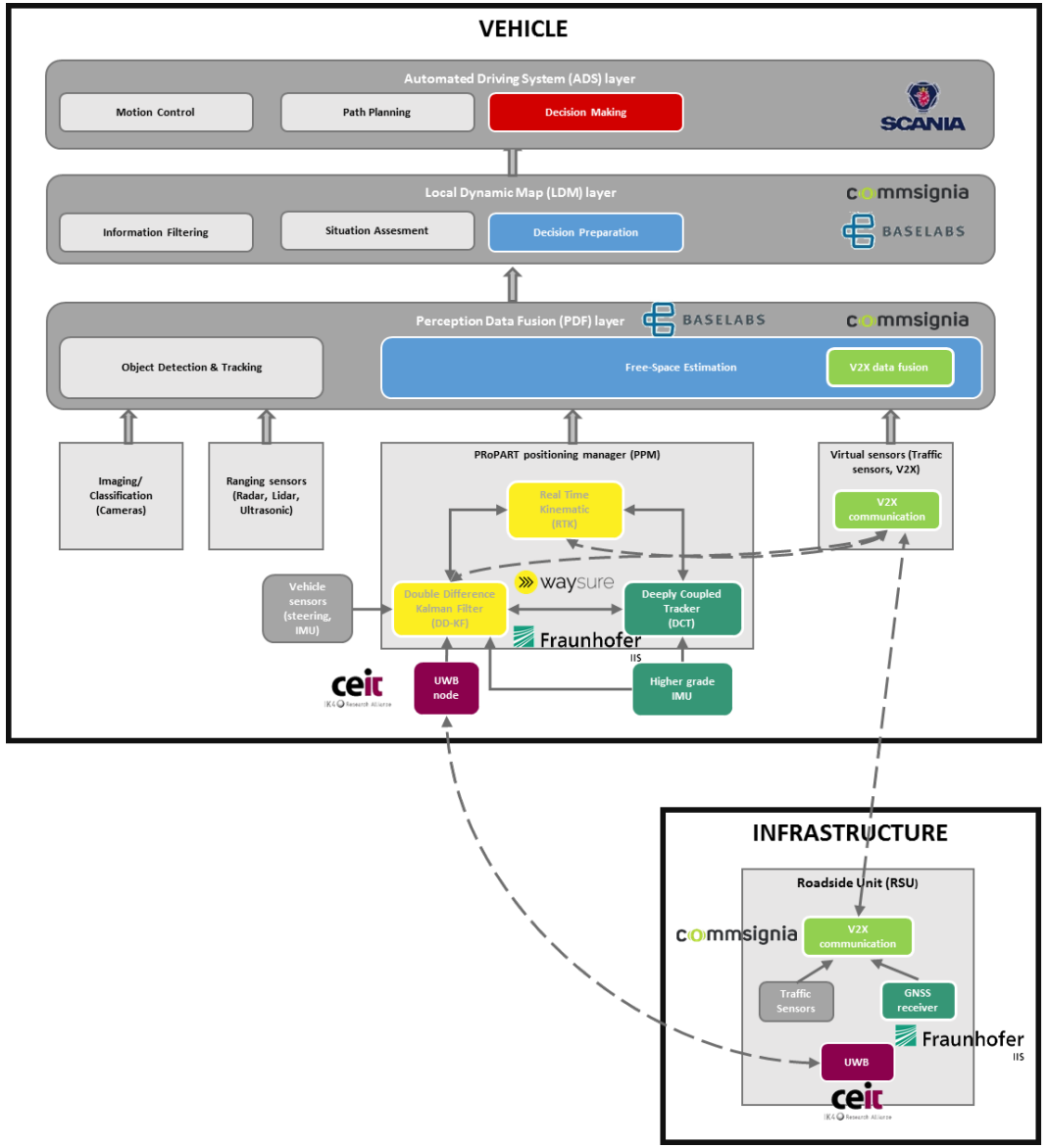
Overview of onboard setup



- Vehicle signals
  - Perception sensors:
    - Front-looking camera
    - Front-looking radar
    - Side-looking radars
  - Vehicular sensors:
    - High-resolution odometry
    - Drive shaft direction of rotation

Vehicle adaptations

- Scania's proprietary sensor fusion and high-level perception stack has been **disabled**
  - Perception and lane "availability" handled by PRoPART's **local dynamic map layer**
- When the **local dynamic map layer indicates that it's safe to change lane**, the truck will:
  - Update its desired target pose
  - Re-plan the trajectory
  - Execute the resulting plan
- Disclaimer:
  - The application is **not based on the most recent developments** of Scania's autonomous vehicle system
  - The vehicle is **running in degraded mode** with otherwise needed modules deactivated



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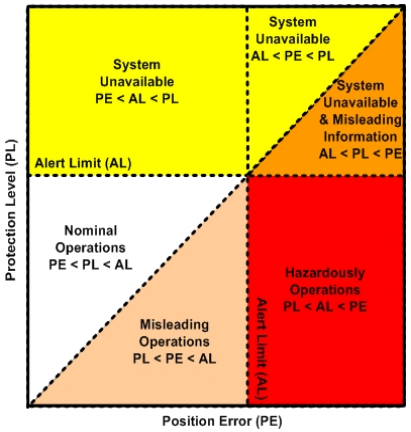
Precise and robust positioning

- Positioning is a basic enabler for automated and autonomous vehicles
- Both **global positioning** and **dead reckoning** systems
- Needs and challenges in navigation:
  - Robust and tamper proof
    - e.g. OS-NMA
  - Precision estimates for PRoPART scenarios
    - Position error: ~2dm (laterally)
    - Integrity risk: $\sim 10^{-12}$
  - Precision in general
    - Limited errors:
      - Orientation [rad]
      - Velocity [m/s]
    - Drifting errors:
      - Position error drift [m/s]
      - Orientation error drift [rad/s]



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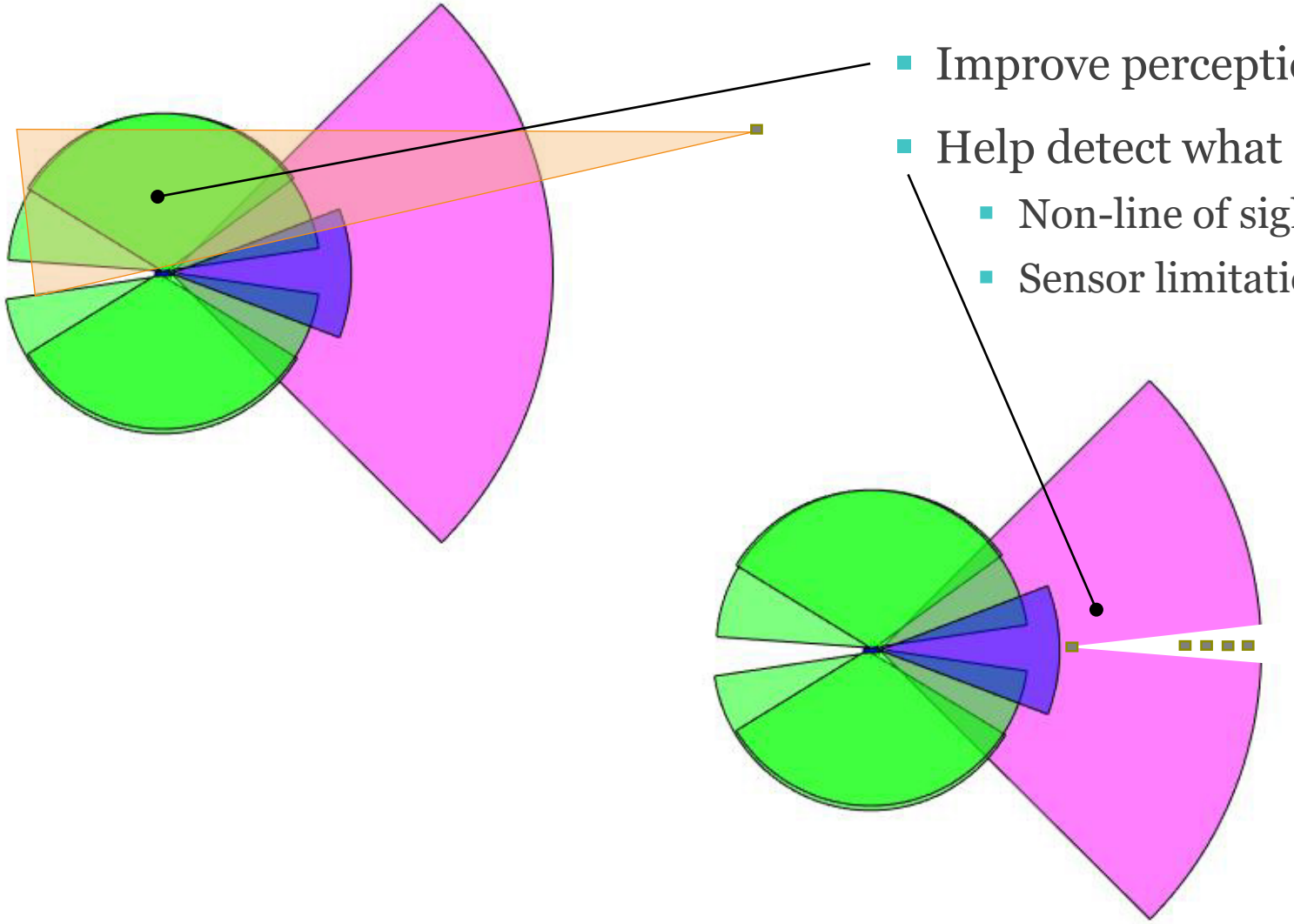
Precise and robust positioning contd.

- Needs and challenges in navigation:
  - Redundancy
    - …in the critical dimensions/directions
    - …in types of errors (e.g. drifting errors, limited errors)
    - …in expected availability (e.g. tunnels, cities, mines)
  - Requirements different than for passenger cars
    - Changing platforms
    - Complex and non-rigid dynamics
      - e.g. multiple trailers
    - Cab moves relative to chassis

Precise and robust positioning contd.

- Harsh conditions
  - Vibrations
  - Temperature
  - Power supply
  - Dirt, salt, water, moisture, etc.
  - Electromagnetic interference
- Scalability and cost

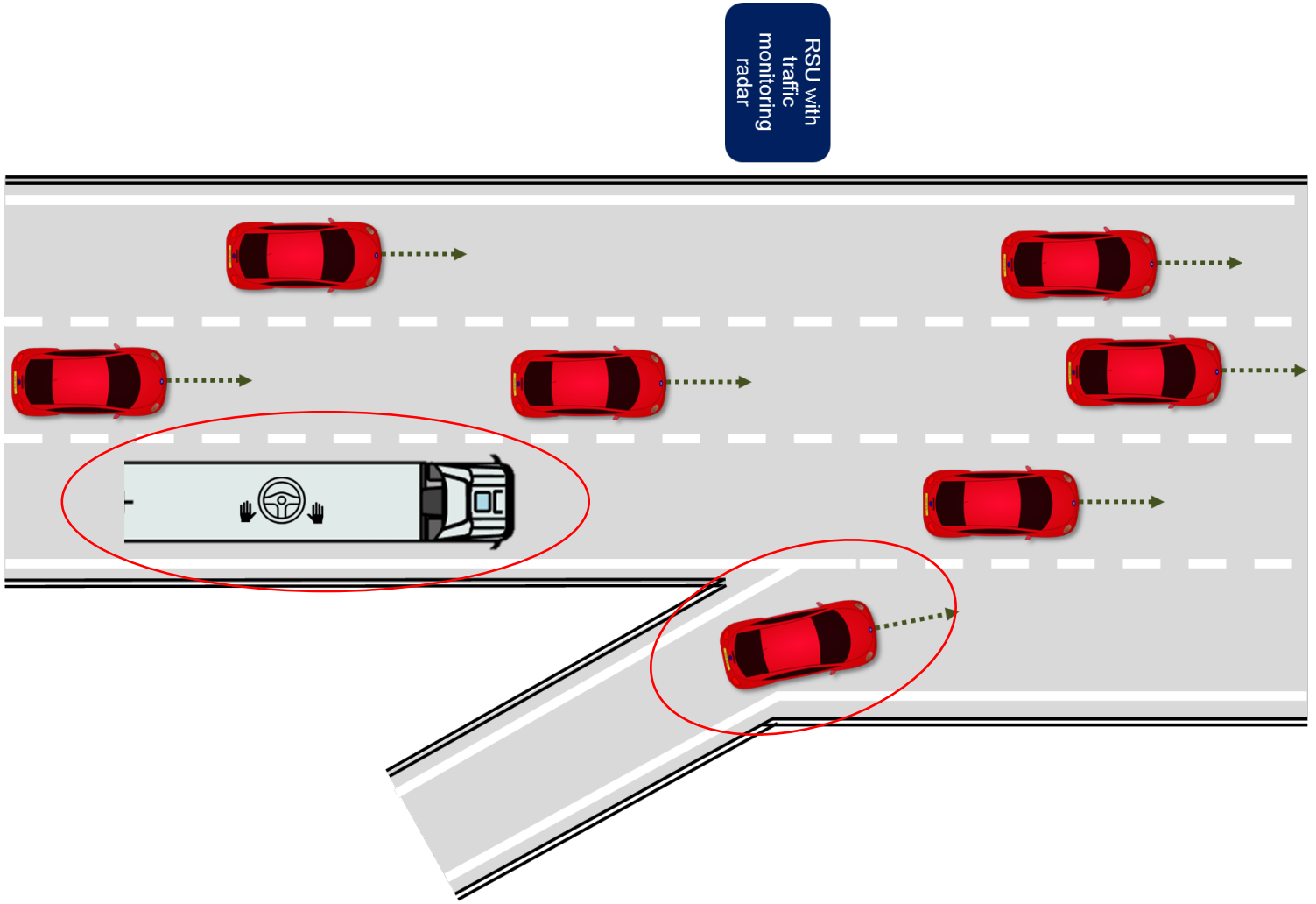
Collective perception



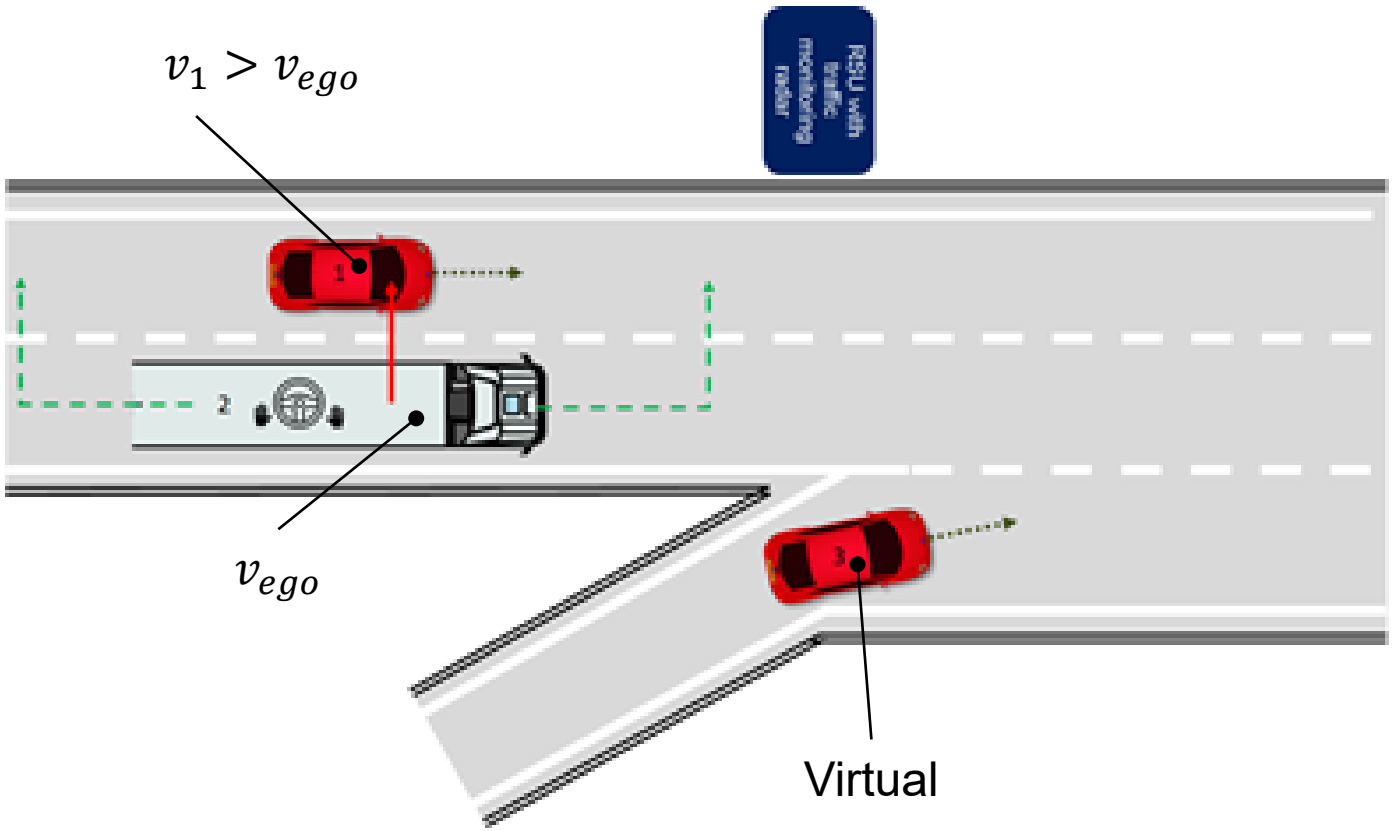
- Improve perception confidence
- Help detect what the vehicle can't see, e.g.
  - Non-line of sight
  - Sensor limitations

- Positioning and reliable and authenticated communication key to use the collective perception information

Use case



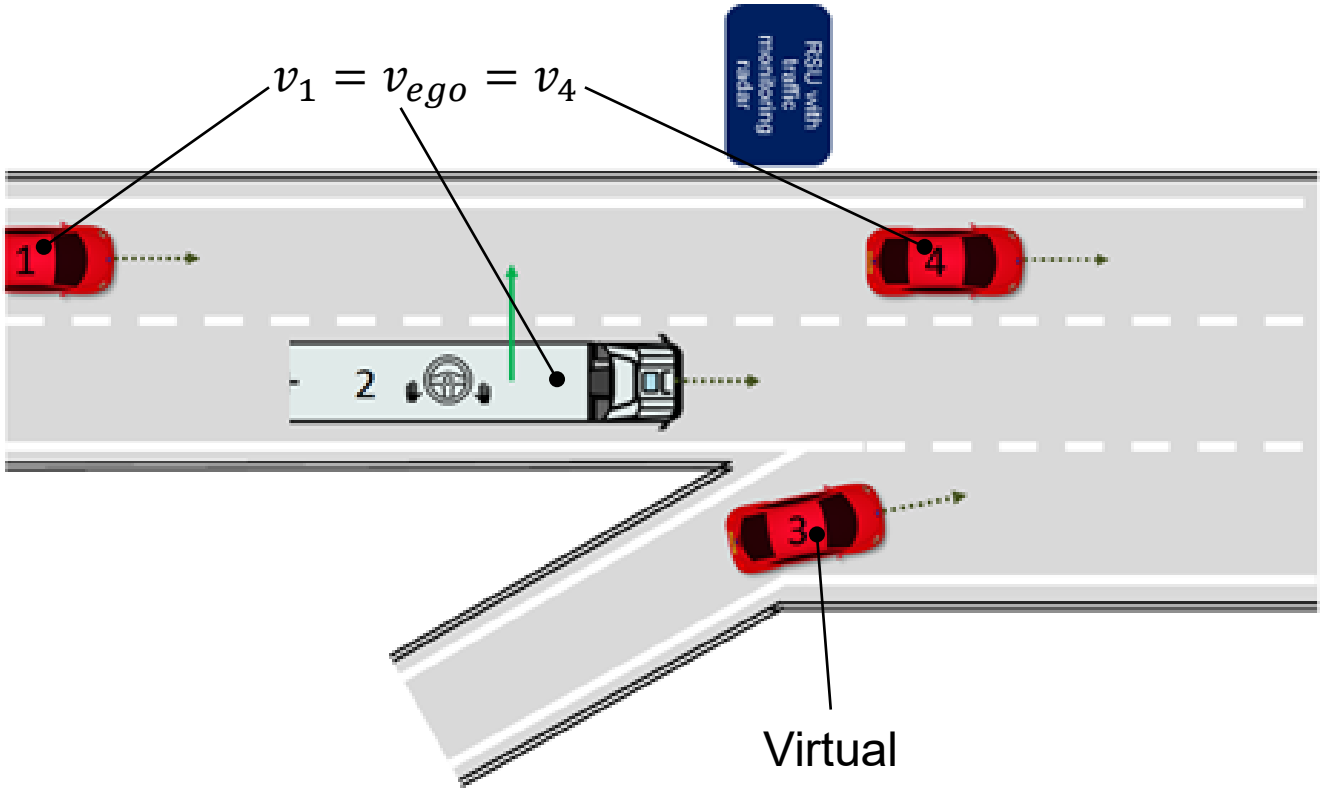
Scenario C



Demonstrates the systems' ability to robustly identify a *blocking* or *interfering* obstacle car

- The system shall **initially conclude that the lane change cannot be performed**
- When the obstacle car has built up enough distance, the system shall **identify the space as free** and inform the automated driving system that a safe lane change is possible

Scenario A



Demonstrates the systems' ability to **robustly identify free space** between obstacles and **suggest safe maneuvers** in the presence of obstacles

- The system shall conclude that the separation between and speed of the obstacle cars allows for a safe lane change maneuver

Questions?