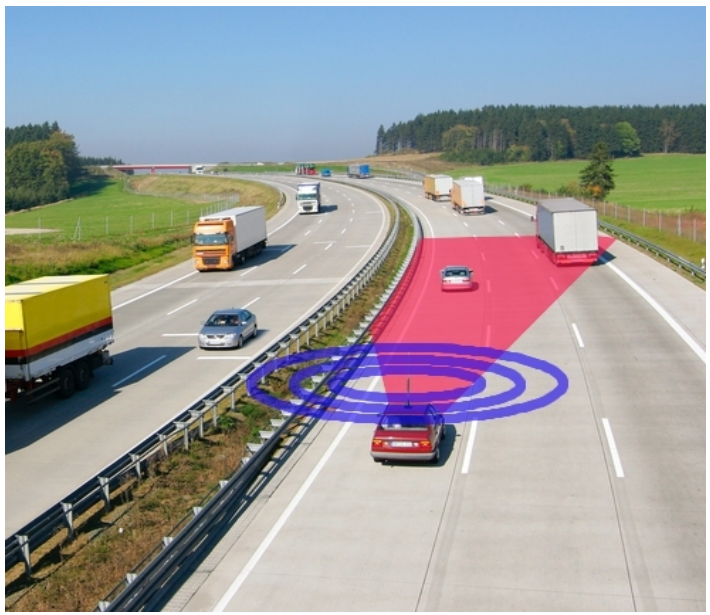
Vehicles as Sensors for Cooperative Systems



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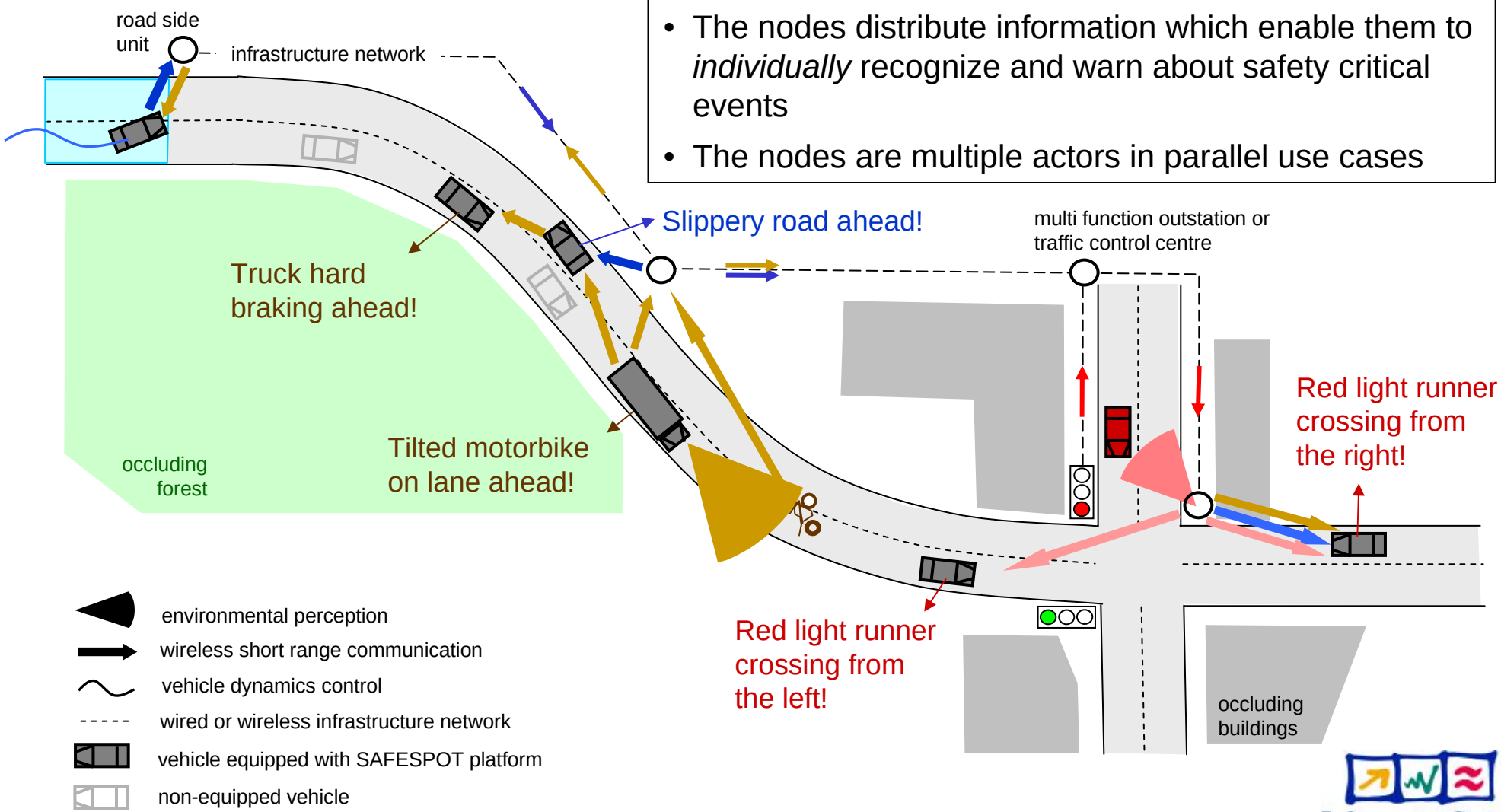
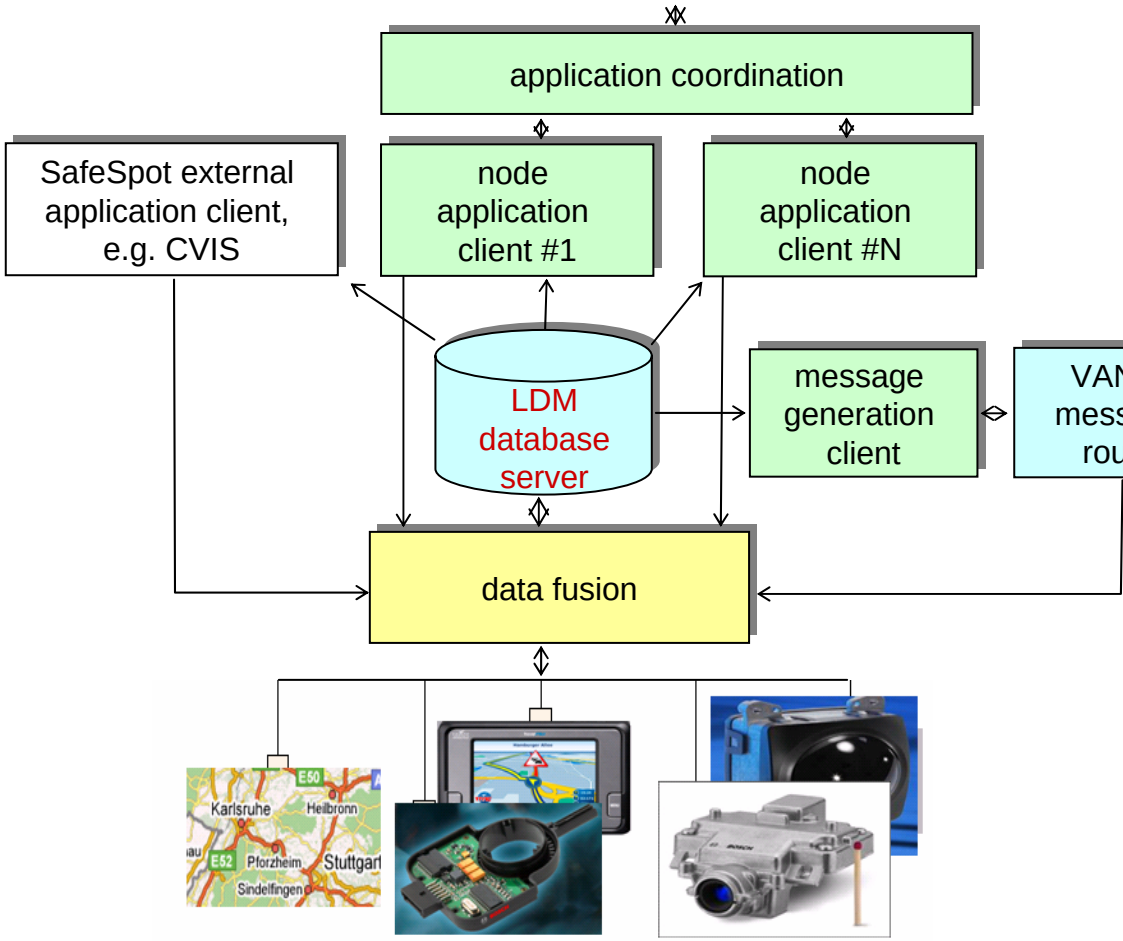
Cooperative SAFESPOT Networks

Decentralised Approach:

- The nodes distribute information which enable them to *individually* recognize and warn about safety critical events
- The nodes are multiple actors in parallel use cases

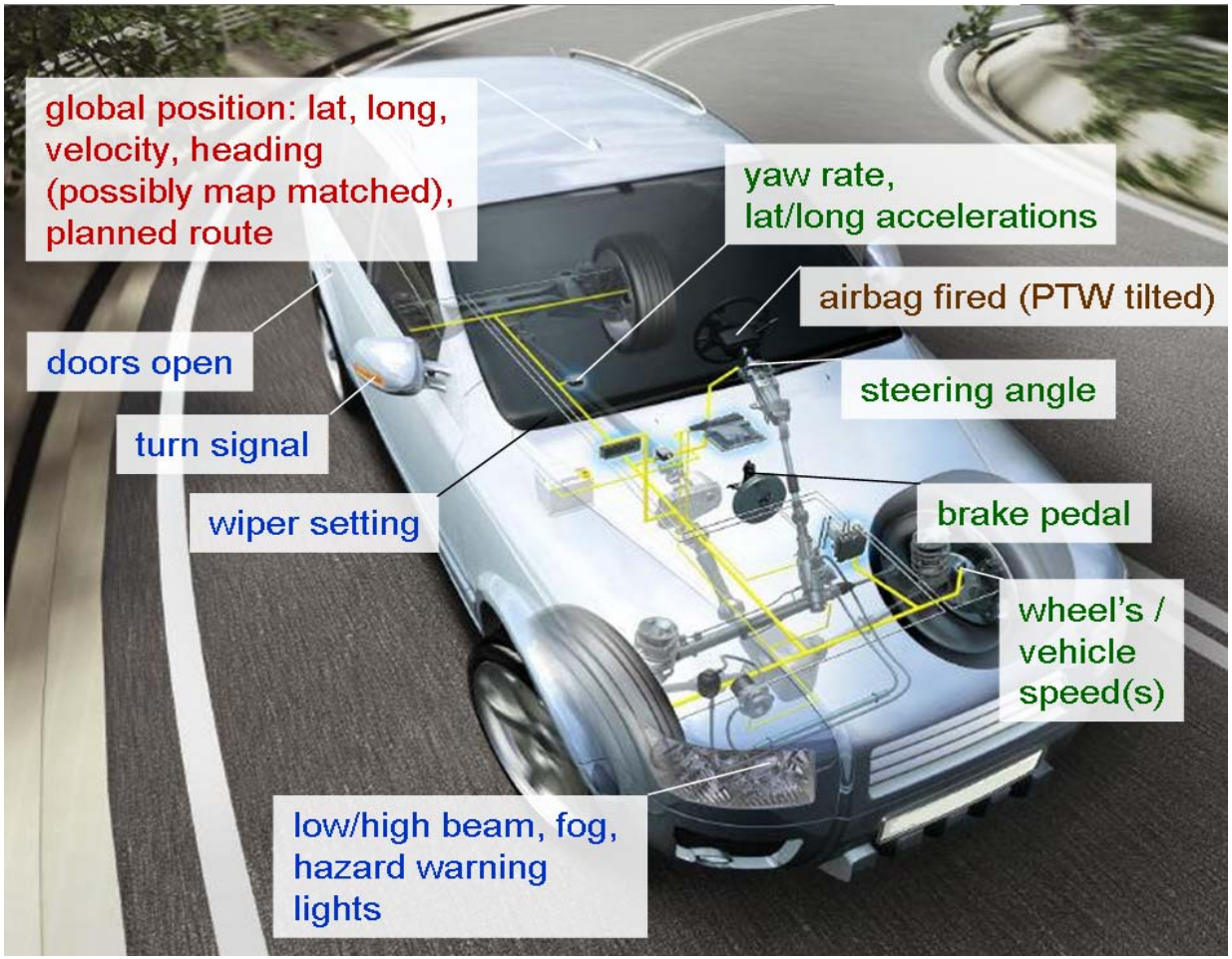


Centralised Node Architecture



- Client-server architecture in each node
- Single interface for platform users / clients: Local Dynamic Map (LDM) database server
- **All node input flows through data fusion to LDM**
- LDM content includes **platform state and environment model**
- A node's involvement in parallel use cases with unknown current actor roles necessitates **common message generation rules for all nodes** (vehicle and infrastructure)

Moving Platform's State

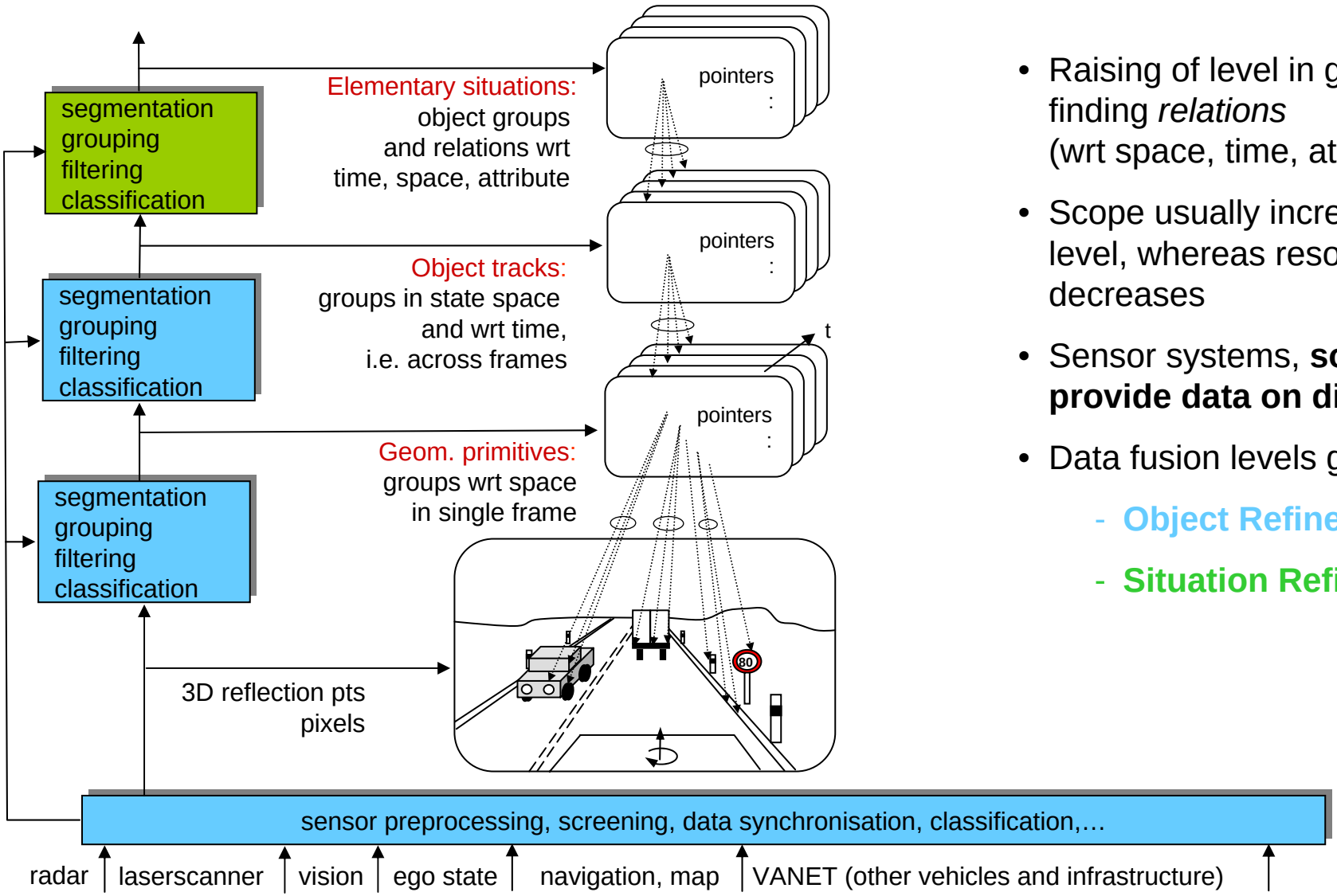


- **In-vehicle data sources** for platform state
  - Vehicle dynamics systems
  - Body management
  - Occupant safety systems
  - Navigation systems
- **External sensors**: camera, laser scanner, radar etc.
- **Communication**: Safespot messages (+ external applications)

- Vehicle positioning will be improved wrt GPS alone by new technologies (SP3)

- LDM database will store and provide (filtered and fused) state data to clients

Multi-layered Environment Representations

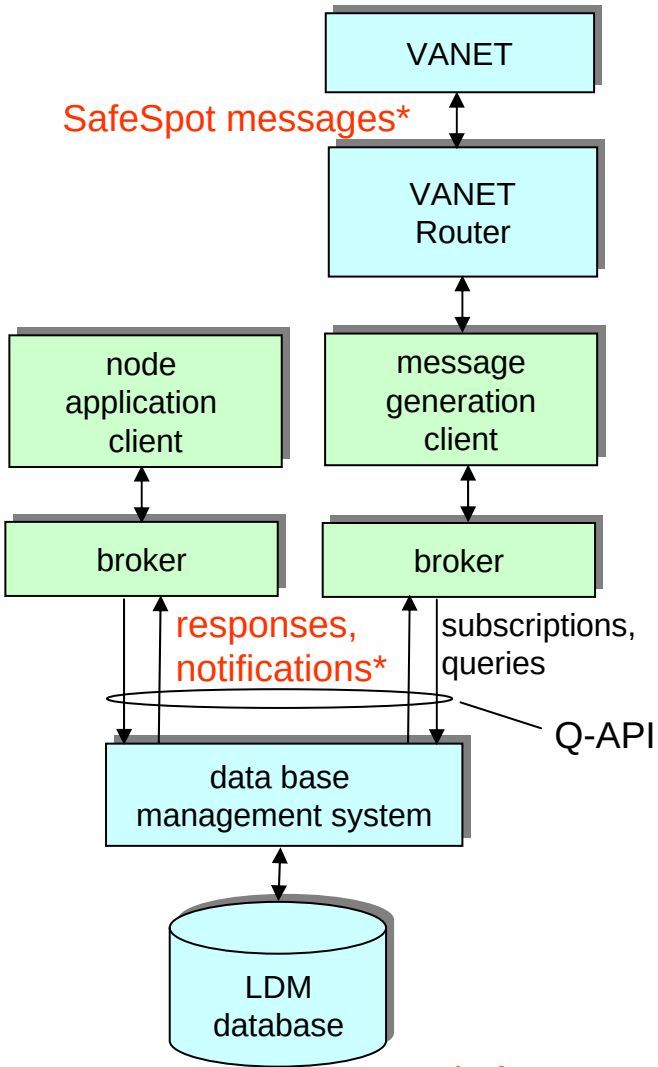


- Raising of level in general by finding *relations* (wrt space, time, attributes)
- Scope usually increases with level, whereas resolution decreases
- Sensor systems, **sources often provide data on different levels**
- Data fusion levels grouped in
  - **Object Refinement**
  - **Situation Refinement**

Data Fusion

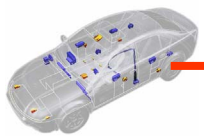
- Reconstruct the traffic scenario around the vehicle thanks to the data collected from several sources of information (on-board sensors and communication)
- **Object Refinement**:
  - spatial properties: position, orientation, velocity
  - attributes: identification, classification.
- **Situation Refinement**: relationships between objects, e.g. lane association
- Affects and is affected by LDM object modelling and application interface
- Results are stored in LDM

Local Dynamic Map



- LDM is more than just a storage device
- Unique representation of environment – not copy of other LDMs
- Moving "**horizon**" of static information, e.g. road network, landmarks
- **Dynamic** contents governed by Data Fusion process
- Does not only provide data, but **access functions** for data projection, selection, filtering, join, grouping, sorting, etc.
- **Event-triggered notification** can provide extra functionality

Hardware Architecture



Powertrain/body networks (e.g. CAN)

ENP network (e.g. private CAN)

GPS & NAV (e.g. RS232 or CAN)

Ethernet 10/100BASE-T

OEM Gateway

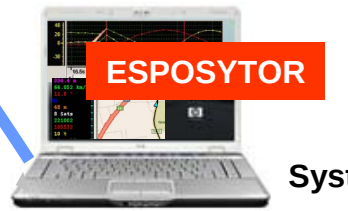
Positioning PC *

Ethernet Switch

Main PC (DF, LDM)

Applications PC *

VANET PC *



System monitor

* may be incorporated into Main PC based on algorithmic complexity or in PTW

Summary

- **SAFESPOT's cooperative ad-hoc networks will be *decentralized***
  - nodes *individually* recognise and warn
  - nodes are multiple actors in parallel use cases
- **Platform architecture will be *centralized***
  - database server: local dynamic map (LDM)
  - clients: node's individual applications & common message generation
- **Applications' situation recognition emerges by finding relations between objects in the LDM**
  - platforms support this by serving queries and subscriptions to notifications
- **Platform will not just be a mobile sensor but a mobile server of multi-level environmental information**