



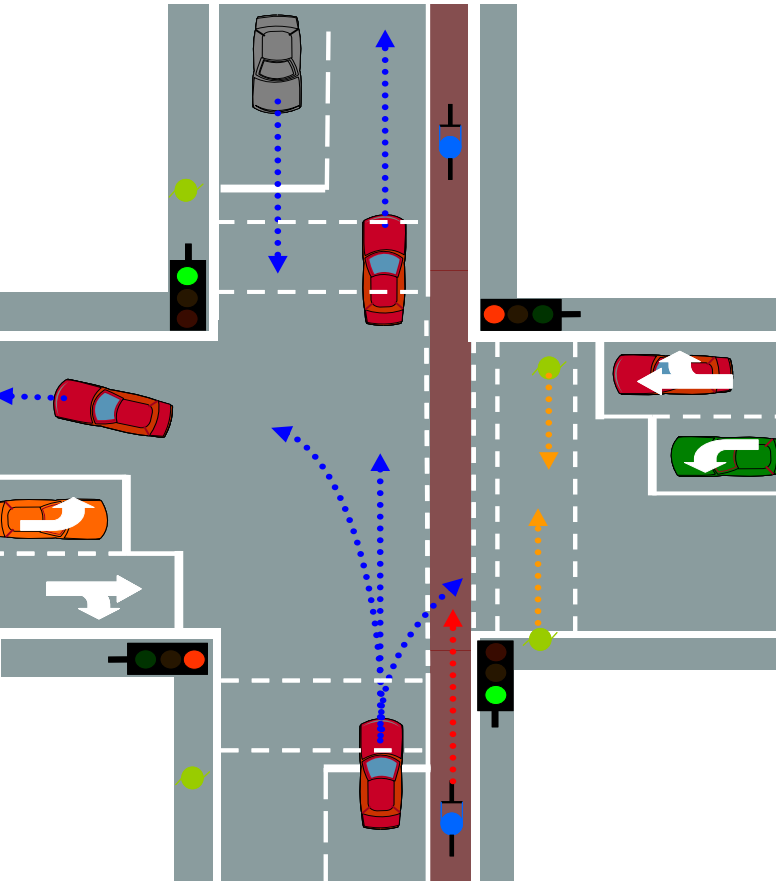
Local Dynamic Map – Future of Navigation Map

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Towards the Vision of Zero Accident



Situation Awareness requires:

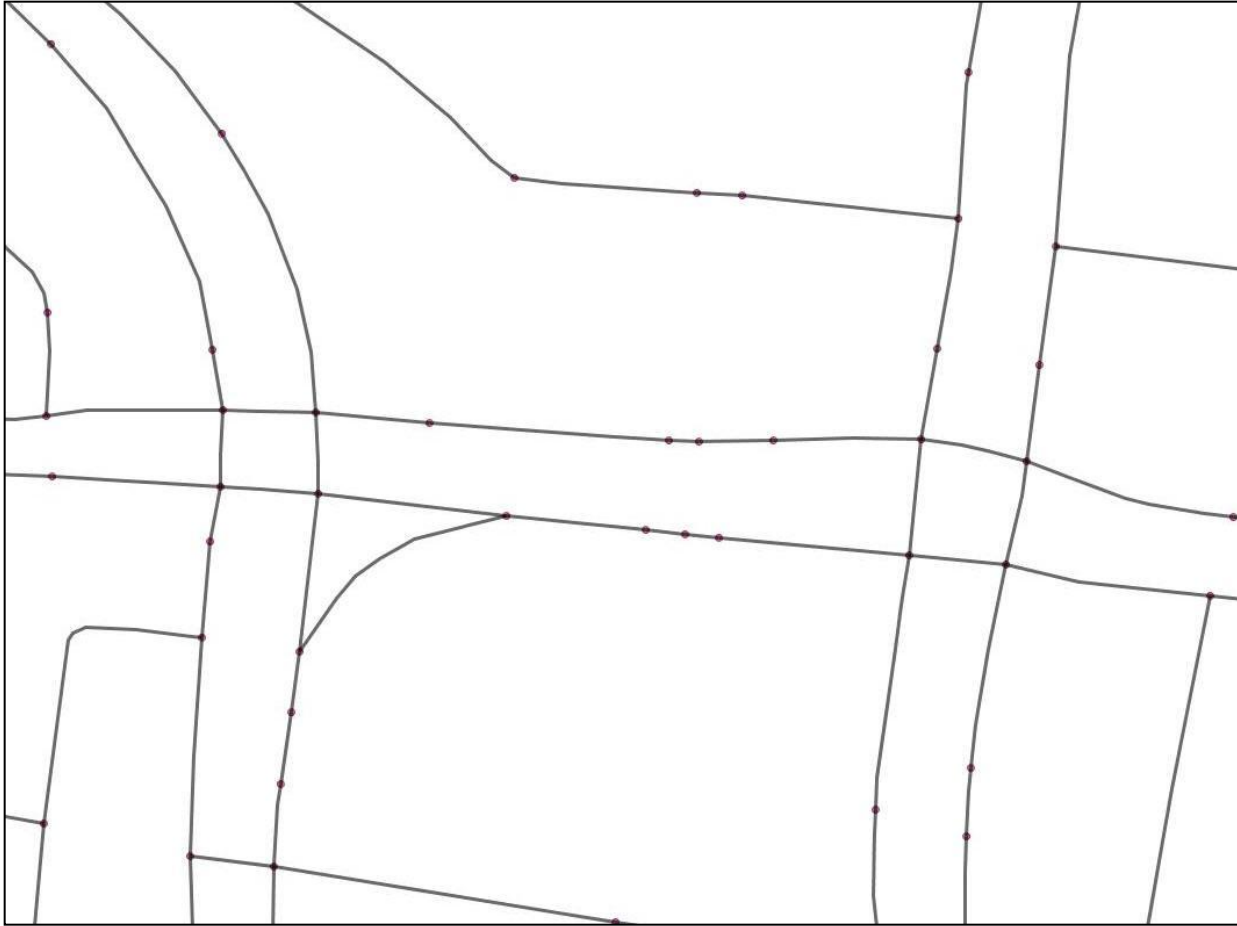
- Lane level accurate positions
- Valid traffic rules, static & dynamic traffic signs per lane
- Flexible relation finding between static map and dynamic object data (spatial and topological)
- Low system latencies (<0.5 seconds)

Challenging scenarios with major impact on accident statistics

Red: N.a. using standard technologies

SafeSpot Approach – Local Dynamic Map (1/3)

Conventional Map for Navigation



- Road center lines
- Links
- Junctions
- number of lanes
- Optimized for navigation

SafeSpot Approach – Local Dynamic Map (2/3)

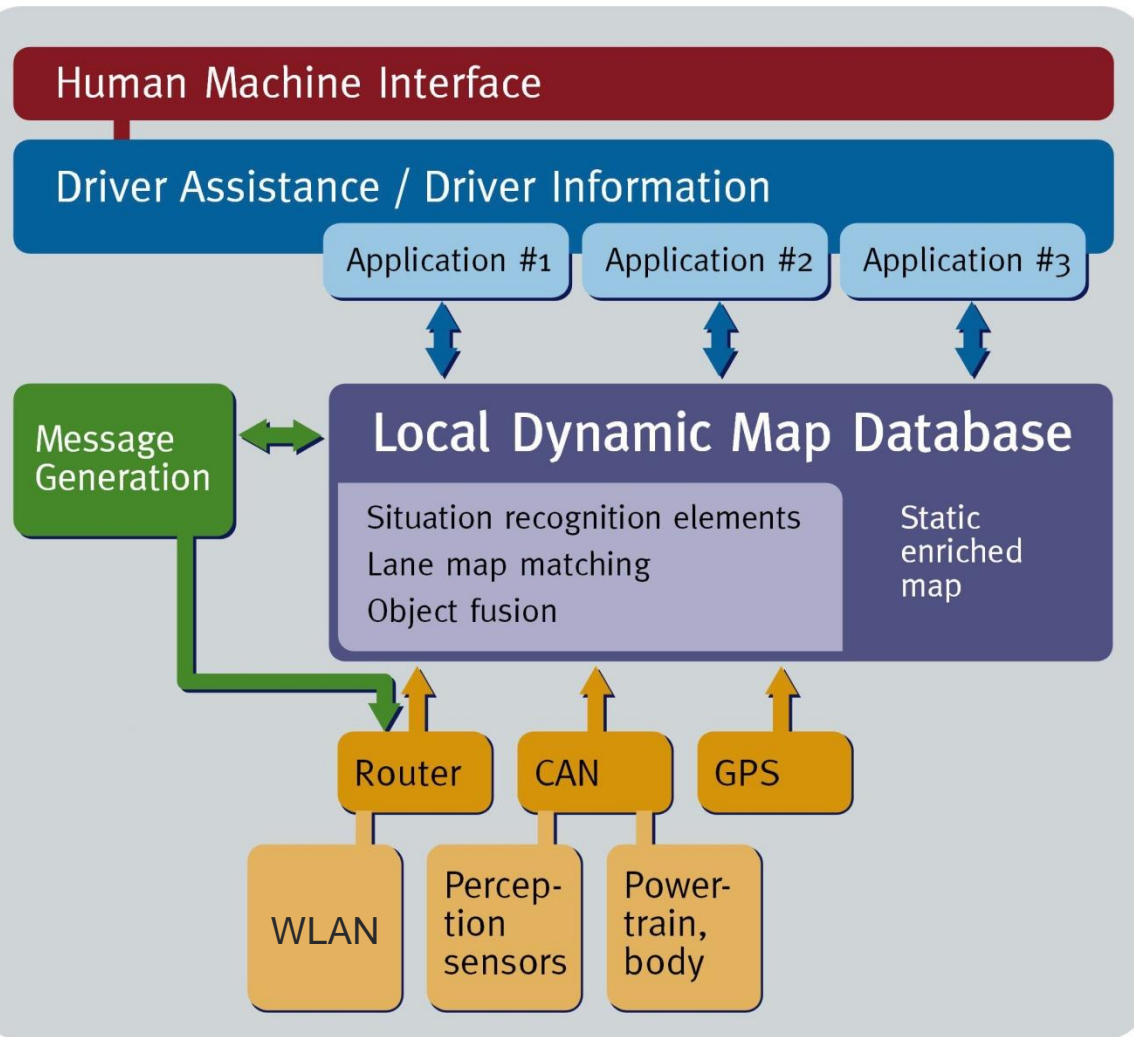
Extended Static Layer



Enhanced with:

- Lane dividers
- Lane markings
- Reference tracks
- Landmarks
- Traffic lights
- Light poles
- Building facades
- Curbs
- ...

SafeSpot System Architecture for Vehicles



- Sensor inputs fused in Data Fusion Component
- LDM realised based on a database
- LDM encapsulates sensor inputs from applications
- Applications run as LDM clients
- LDM supports spatial queries

LDM Services and API

Level-1*

Transactions

add(objectName, attributes, values)
remove(objectName, condition)
update(objectName, attributeList, valueList, condition)
query(objectNames, attributes, condition)

Geometry

Test

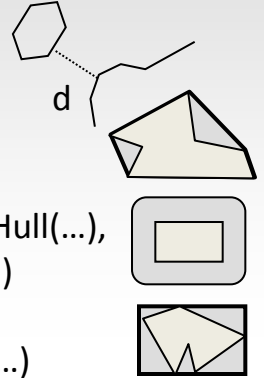
contains(objectNames, condition), equals(...), intersects(...)

Measure

area(objectName, condition), length(...),
distance(objectNames, condition)

Create

difference(objectNames, condition), convexHull(...),
geomUnion(...), intersection(...), boundary(...)
buffer(objectName, condition, distance)
centroid(objectName, condition), envelope(...)



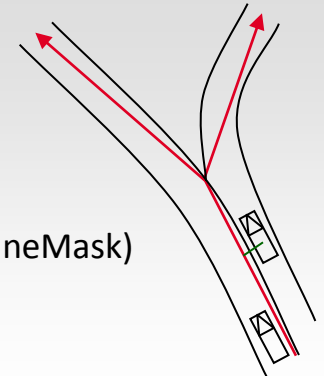
Level-2*

Road Elements

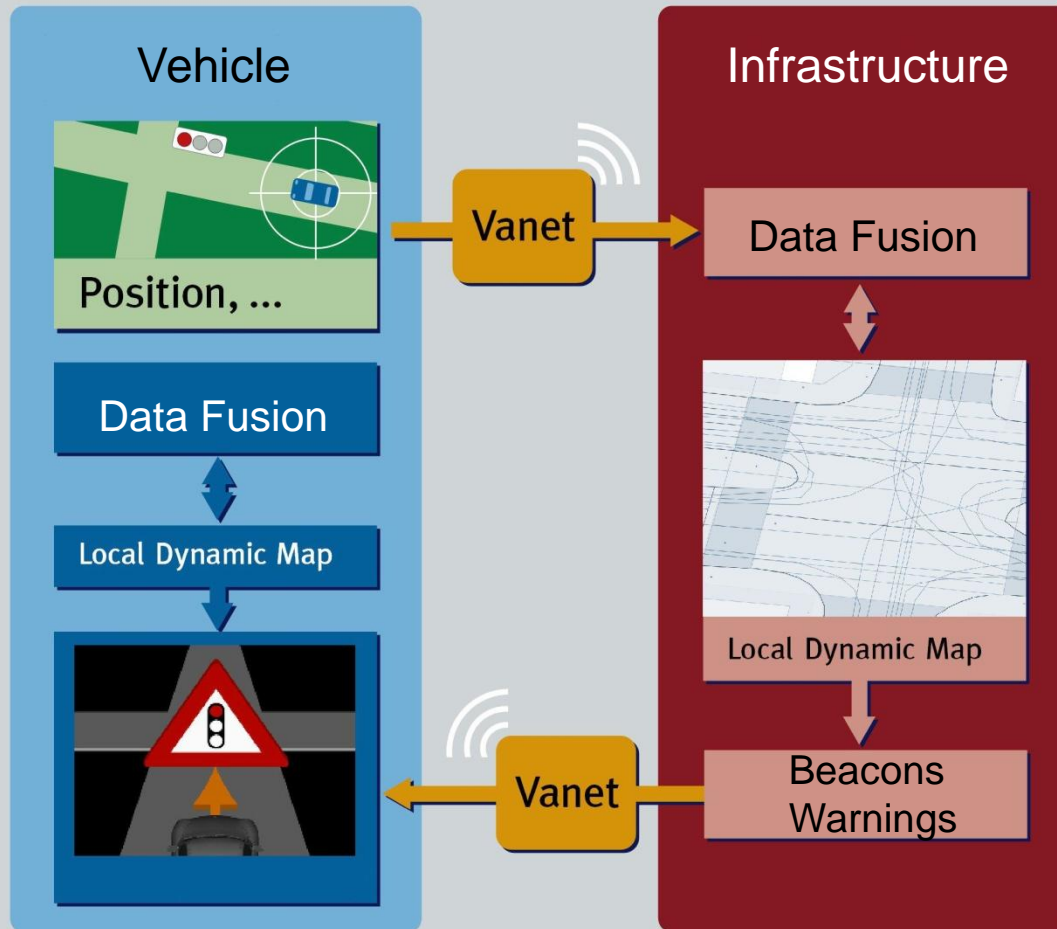
getRoadElement(motorVehicleId)
getNextRoadElements
(roadElementId, drivingDirection, vehicleTypes, illegal)
getPreviousRoadElements(...)
getRoadElementTree(roadElementId, drivingDirection,
vehicleTypes, distance, illegal)

Vehicles and Features

getVehiclesOnRoadElement
(roadElementId, offset, lanesMask)
getLanesForRoadElement
(roadElementId, drivingDirection, laneMask)
getLandmarks(Point2D, radius)
getCurbs(Point2D, radius)



LDM in SafeSpot – Vehicle and Infrastructure



- Applied in both vehicles and road side units
- Unique database schema as LDM structure
- API serves both's needs
- Implemented by both map providers – TeleAtlas and Navteq

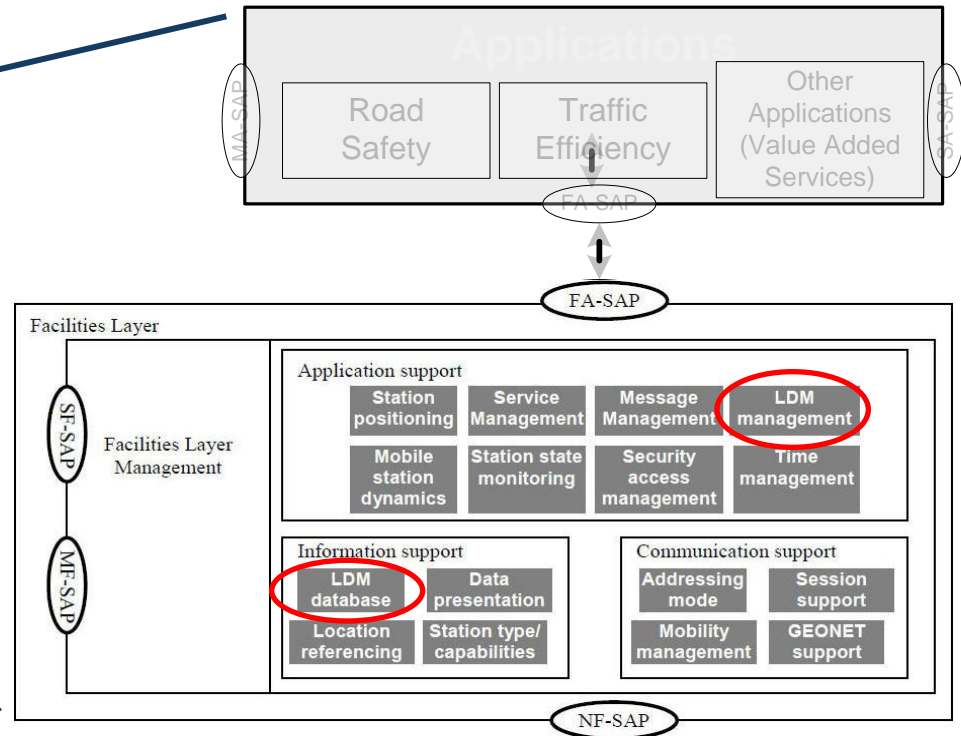
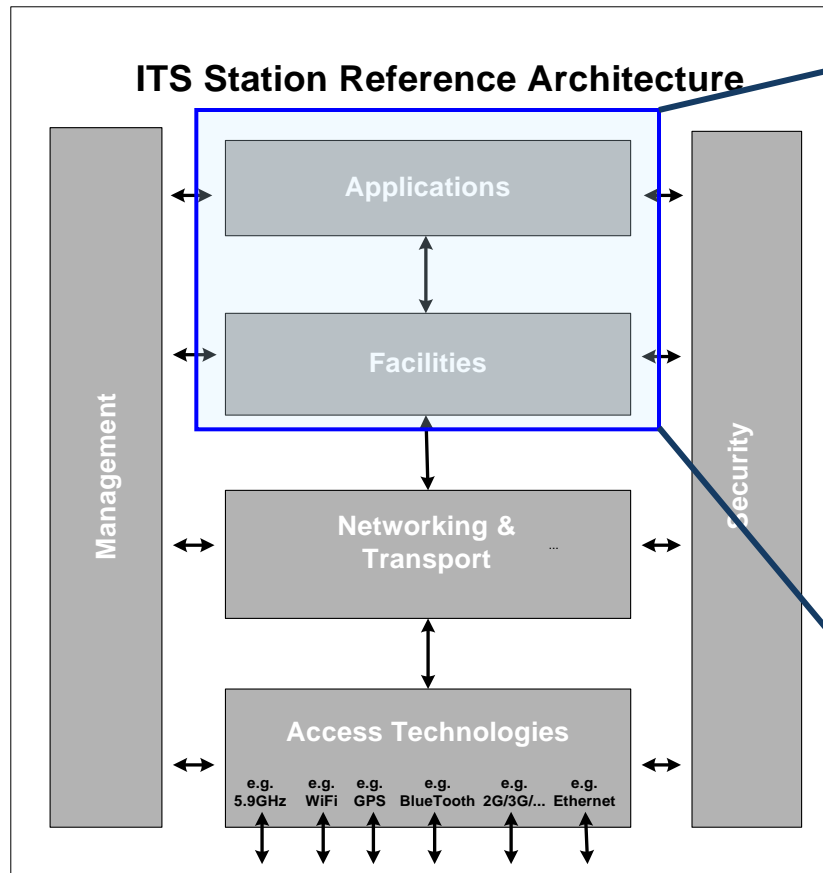
LDM-Use in SafeSpot – Vehicle and Infrastructure



SafeSpot Approach – Local Dynamic Map

- Conventional map enhanced with more lane informations
- LDM contains landmarks for improved positioning
- Additionally dynamic infos are content in the LDM
- Information ranges from vehicle states to road surface condition
- SafeSpot: LDM implemented based on a spatial database
- Client-Server-Architecture allows concurrent access to the LDM
- Intelligent spatial queries facilitate better understanding of object relations => situation awareness

LDM Arrival in ETSI via COMeSafety



Sources:

- [1] [COMeSafety](http://www.comesafety.org), *European ITS Communication Architecture, Overall Framework - Proof of Concept Implementation*, vers. 2.0, see www.comesafety.org
- [2] [ETSI](http://www.etsi.org) Technical Report TR 102 638 v1.1.1: *Intelligent Transportation Systems (ITS): Vehicular Communications: Basic Set of Applications: Definitions*

cooperative

Conference 2010

mobility