

An orange abstract graphic consisting of multiple overlapping, curved lines that form a complex, organic shape, resembling a stylized flower or a network structure. It is positioned on the left side of the top half of the slide.

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Communication for cooperative perception

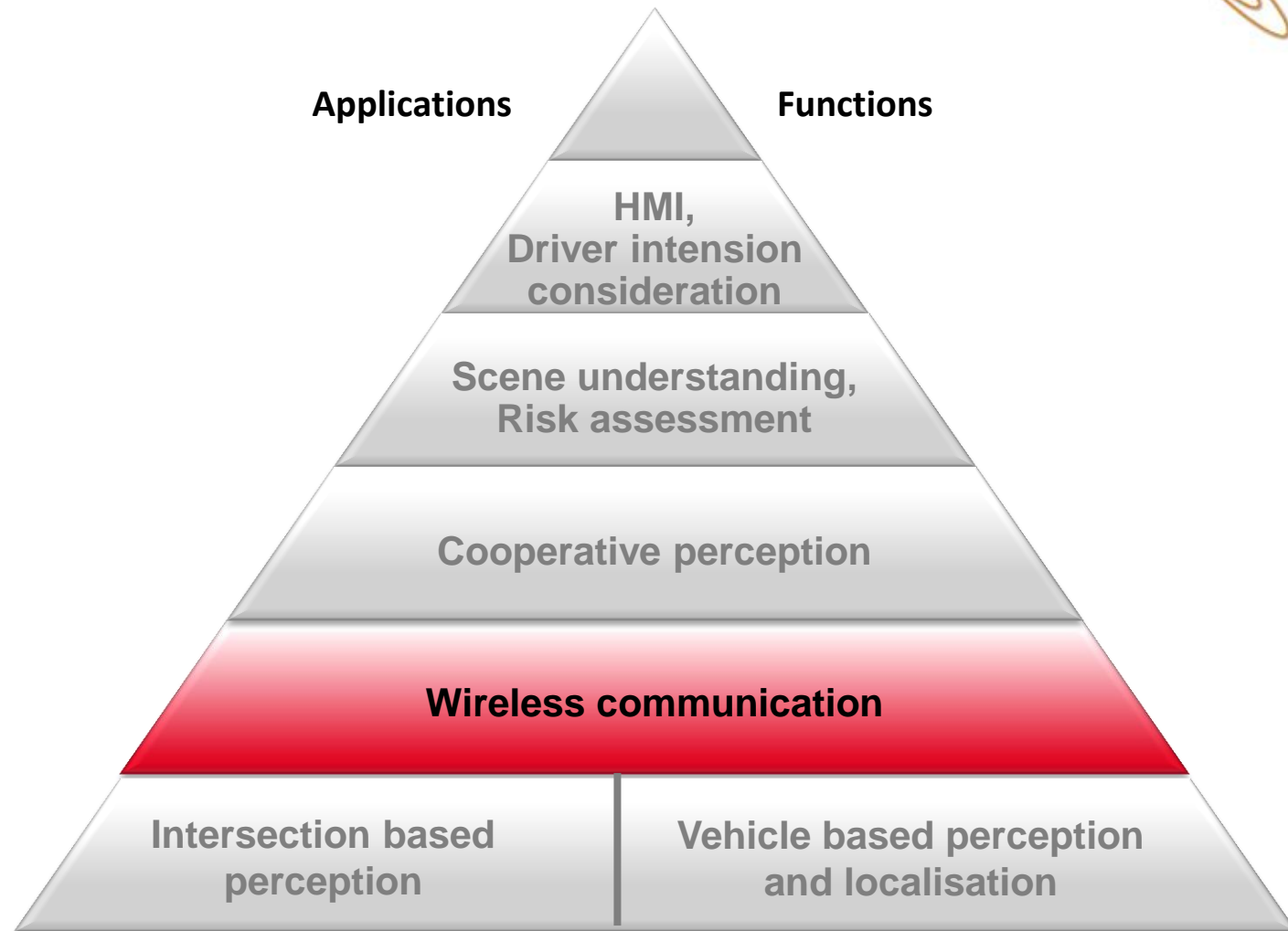
Informationsaustausch zur kooperativen Perzeption

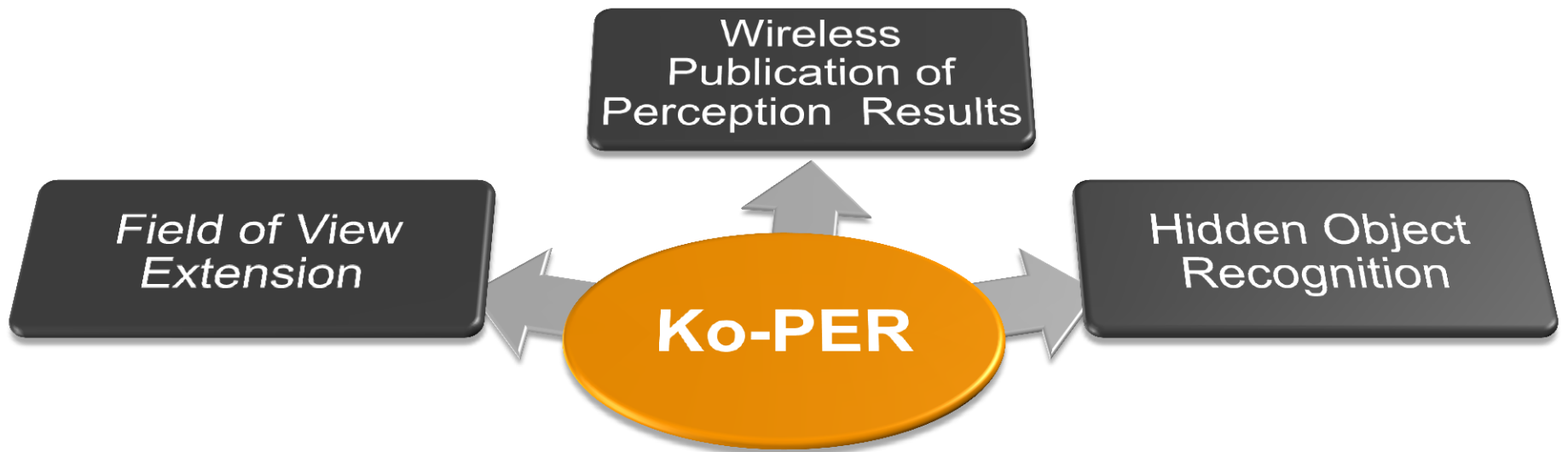
Sven Kopetzki
Delphi Deutschland GmbH

Supported by:

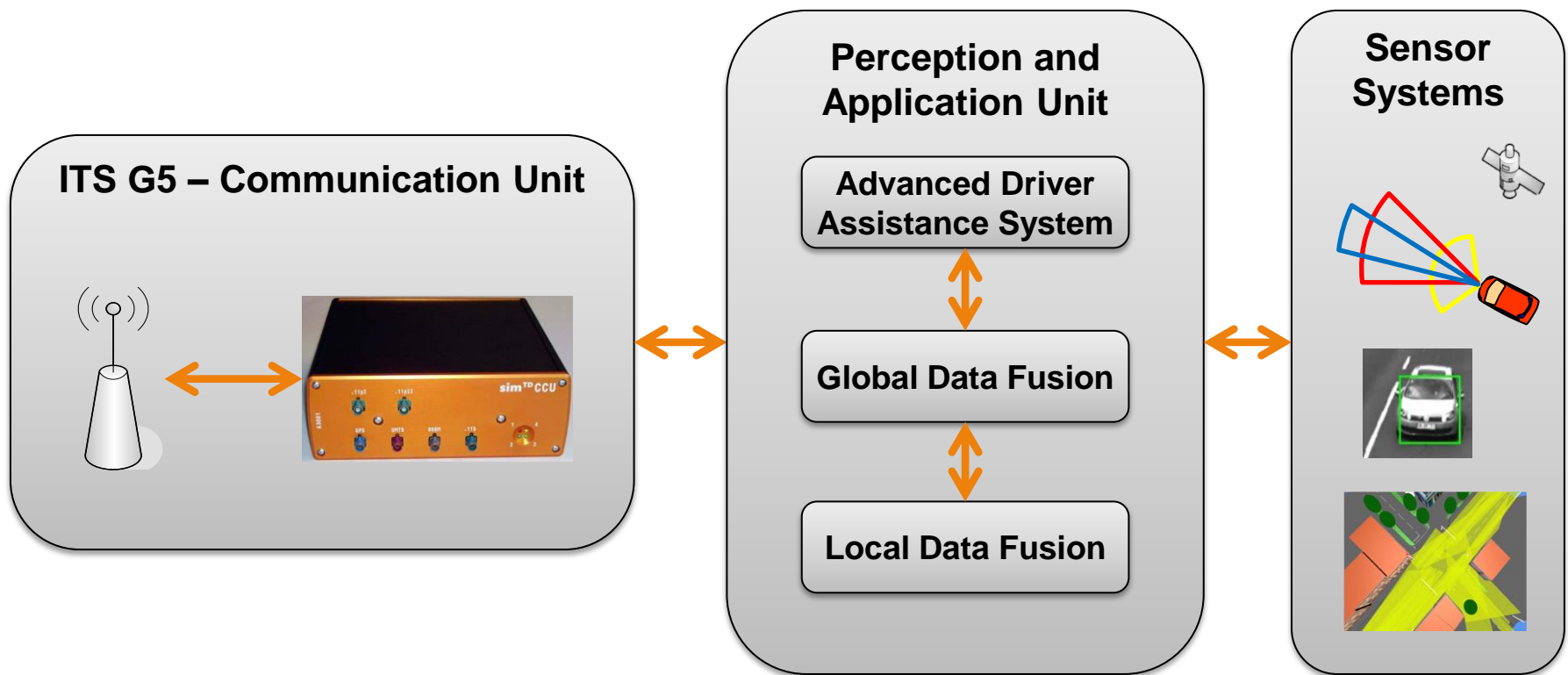


on the basis of a decision
by the German Bundestag





Ko-PER System Architecture



Vehicle

- Vehicle State Information (CAM – Cooperative Awareness Message)
- Event Information Decentralized Environmental Notification Message (DENM)

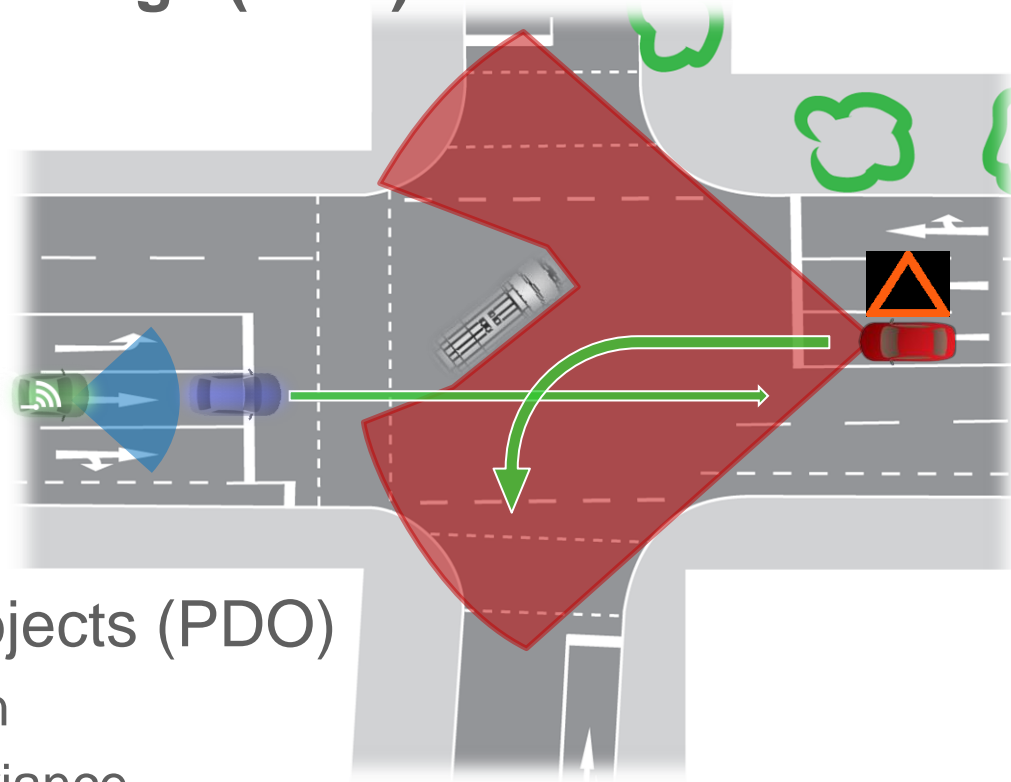
Intersection

- Intersection Geometry and Topology (MAP)
- Traffic Light Information (SPaT – Signal Phase and Timing)



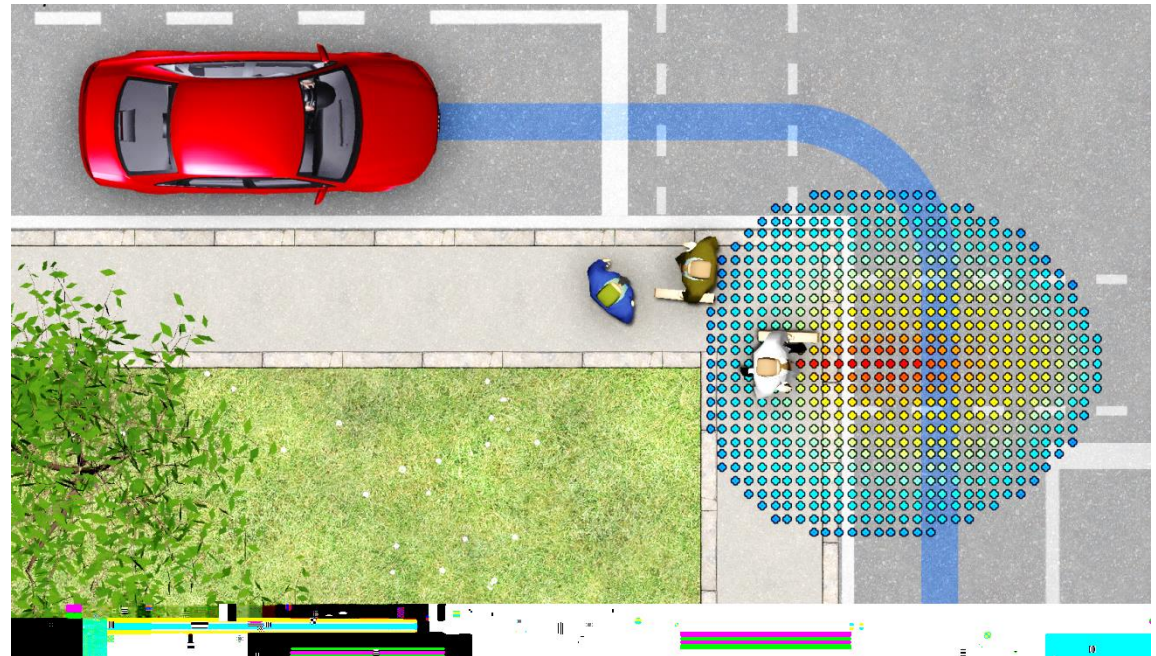
Cooperative Perception Message (CPM)

- Ego Information (EIS)
 - Global Position
 - 3D-Orientation
 - Vehicle Dynamics & Covariance
 - Field of View (FoV)
- Perceived Dynamic Objects (PDO)
 - Object Class & Dimension
 - Object Dynamics & Covariance



Support Safety in Longitudinal Traffic & Cooperatively Protect Vulnerable Road Users

- Sudden Velocity Change (SVC)
- Sudden Lateral Displacement (SLD)
- Surprise Behavior of Pedestrians & Two-Wheelers (PED&BIC&CYC)

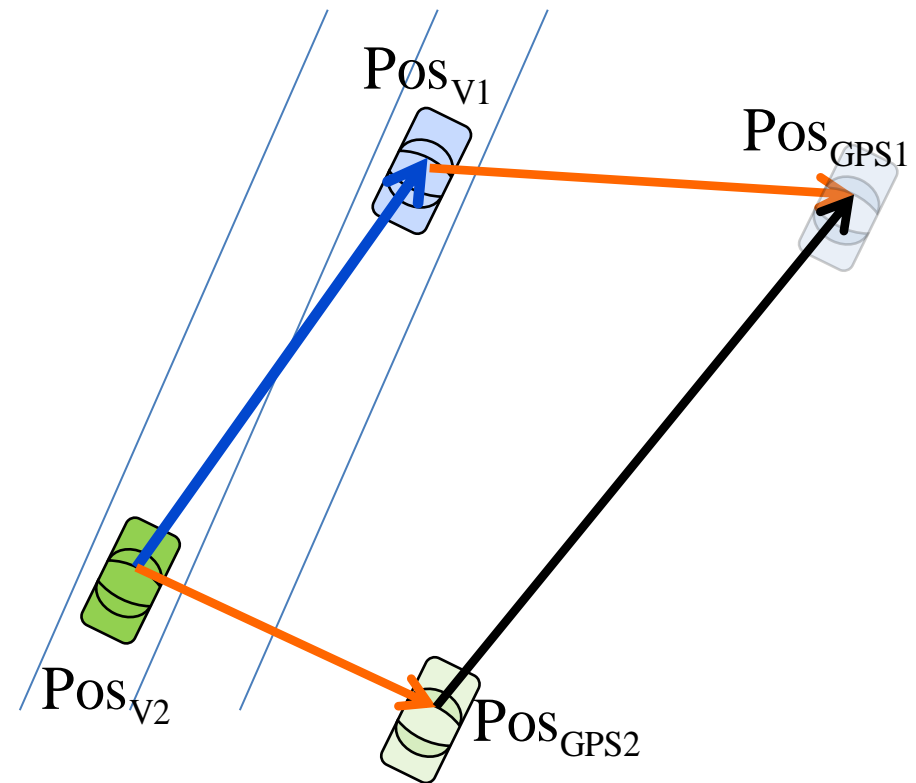
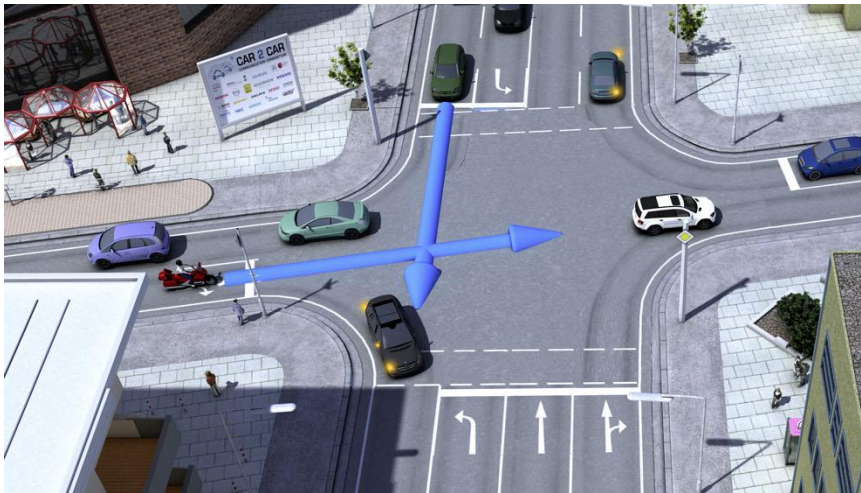


Advanced Ko-PER Messages

Cooperative Positioning

Cooperative Localization Message (CLM)

- Satellite Raw Data
- Vehicle Dynamics
- Lever Arms



Definition neuer Nachrichtentypen

Ko-PER

Cooperative Perception Message (CPM)

Ego Information Structure (EIS)

Perceived Dynamic Objects (PDO)

Perceived Static Objects (PSO)

Advanced Ko-PER DENM

Protection of Vulnerable Road Users

Cooperative Localization Message (CLM)

Cooperative Localization Data



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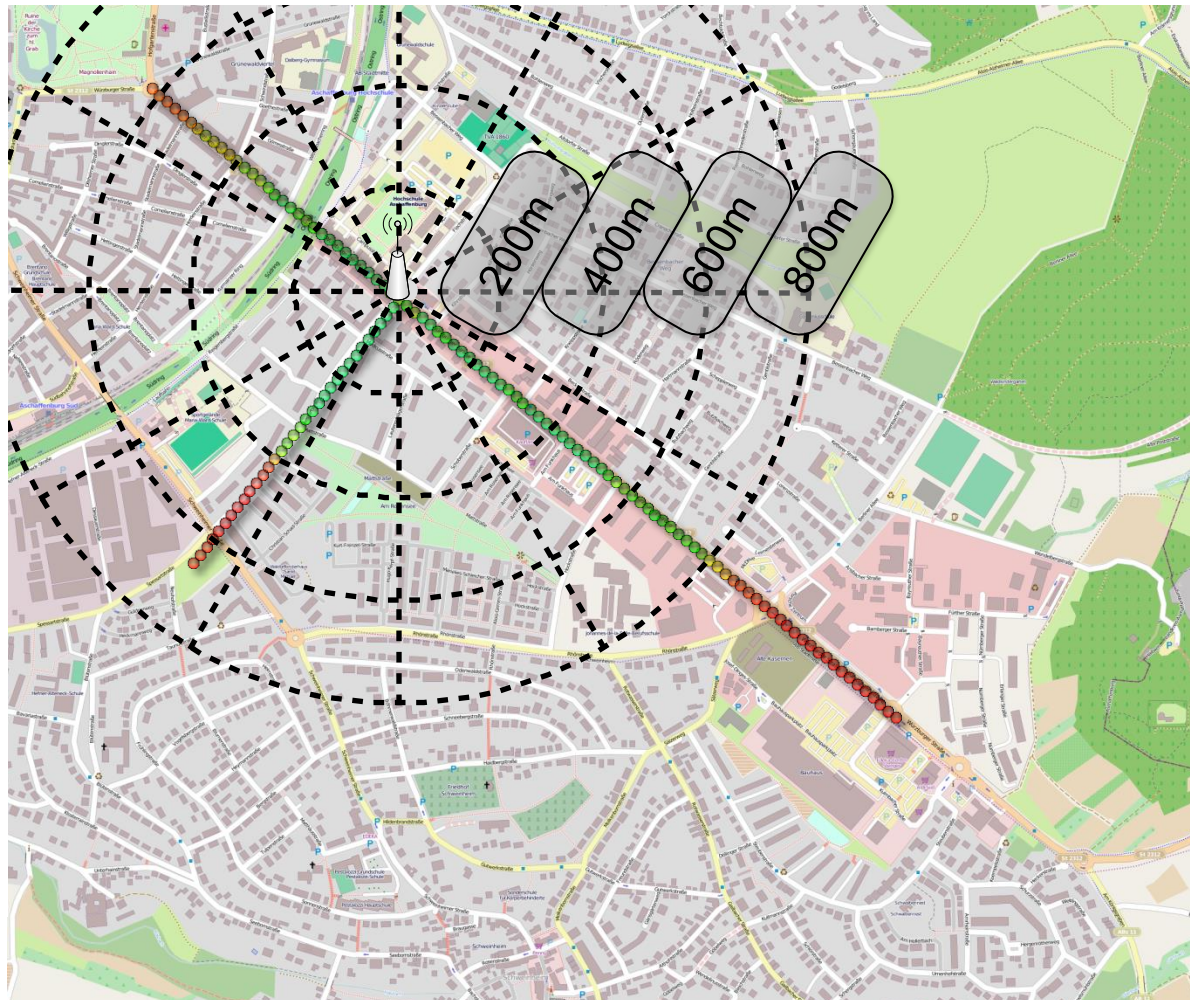
Cooperative Awareness Message (CAM)

Decentralized Environmental Notification Message (DENM)

Road & Intersection Topology (MAP)

Signal Phase and Timing (SPaT)

Communication Distance at Ko-PER Test Intersection



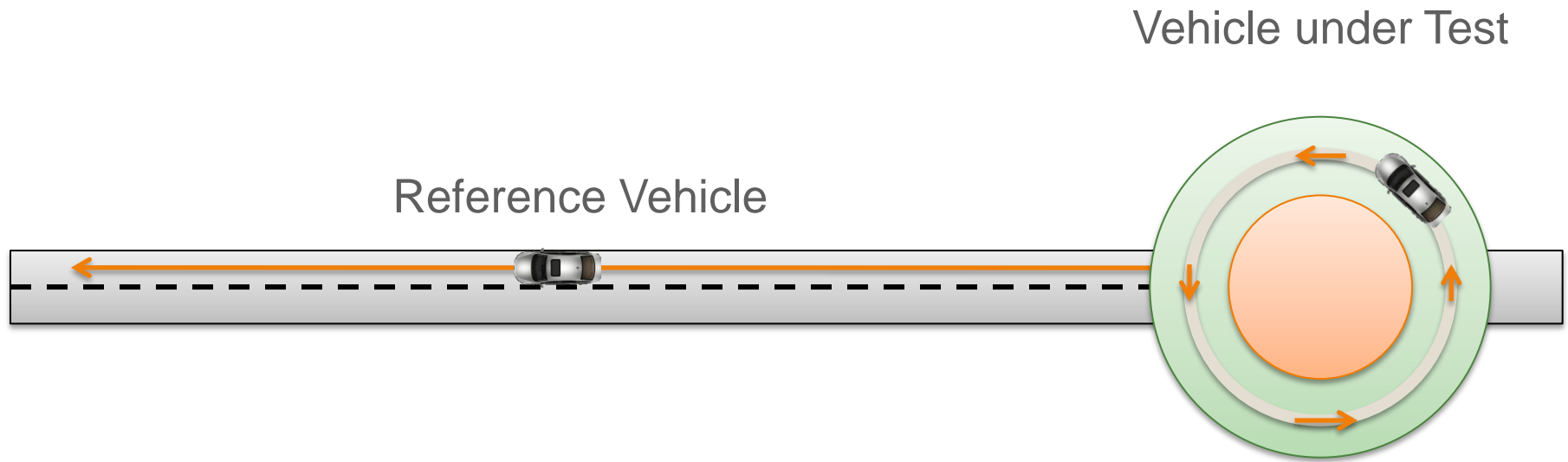
Communication range between ITS roadside station (ITS equipped intersection in Aschaffenburg) and ITS vehicle stations (Ko-PER vehicles)

Packet Error Ratio (PER)

- green: PER < 10%
- orange: 10% < PER < 50%
- red: 50% < PER

- Reliable communication distance of over 400m enables various infrastructure-to-vehicle safety applications

ITS-G5 Communication Pattern Test Scenario

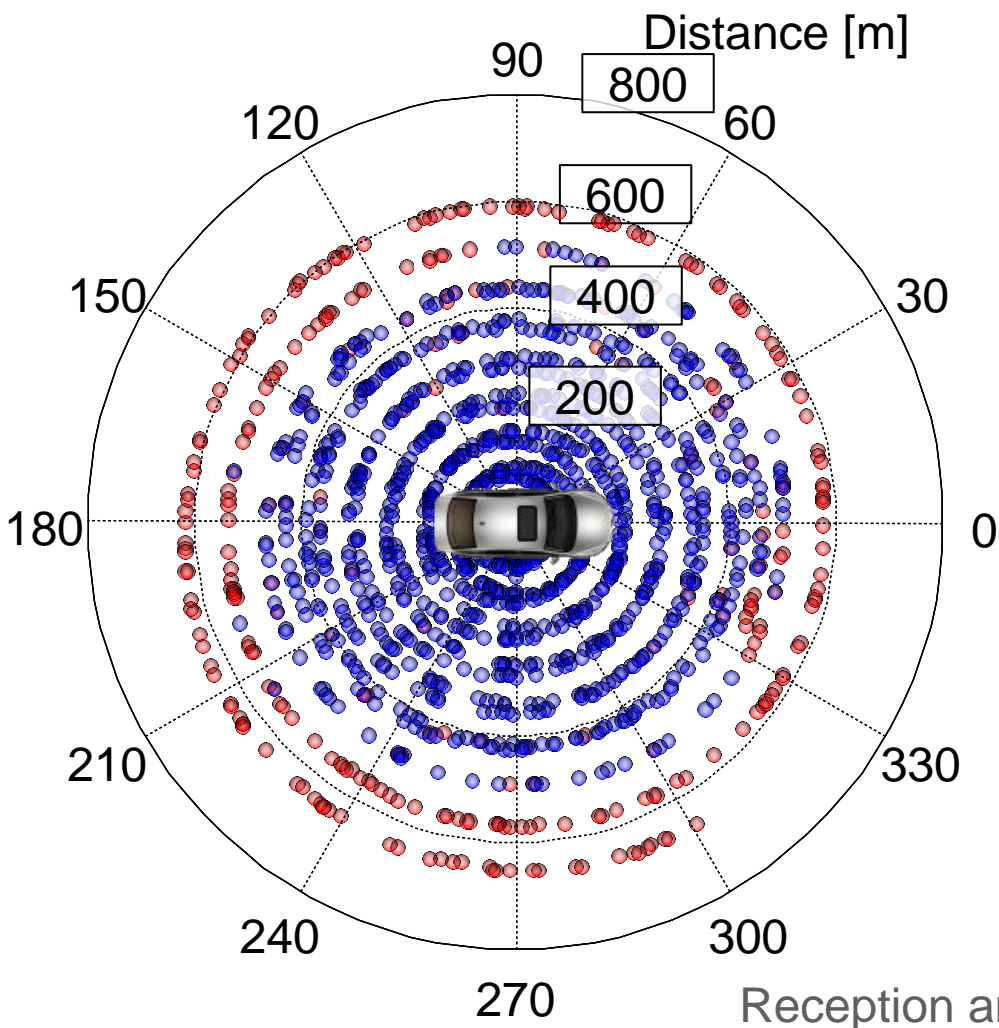


Test Message: Cooperative Perception Message

ITS-G5 Communication Pattern Result



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Sample communication pattern between two ITS vehicle stations (Ko-PER cars).

- blue: successful transmission
- red: lost packet

- Omni-directional radiation pattern
- Reliable communication distance of over 400m enables various vehicle-to-vehicle applications.
- Test Message: Cooperative Perception Message

Communication Working Group

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ulm university

universität

uulm

DAIMLER

BMW Group
Forschung und Technik



Continental



DELPHI