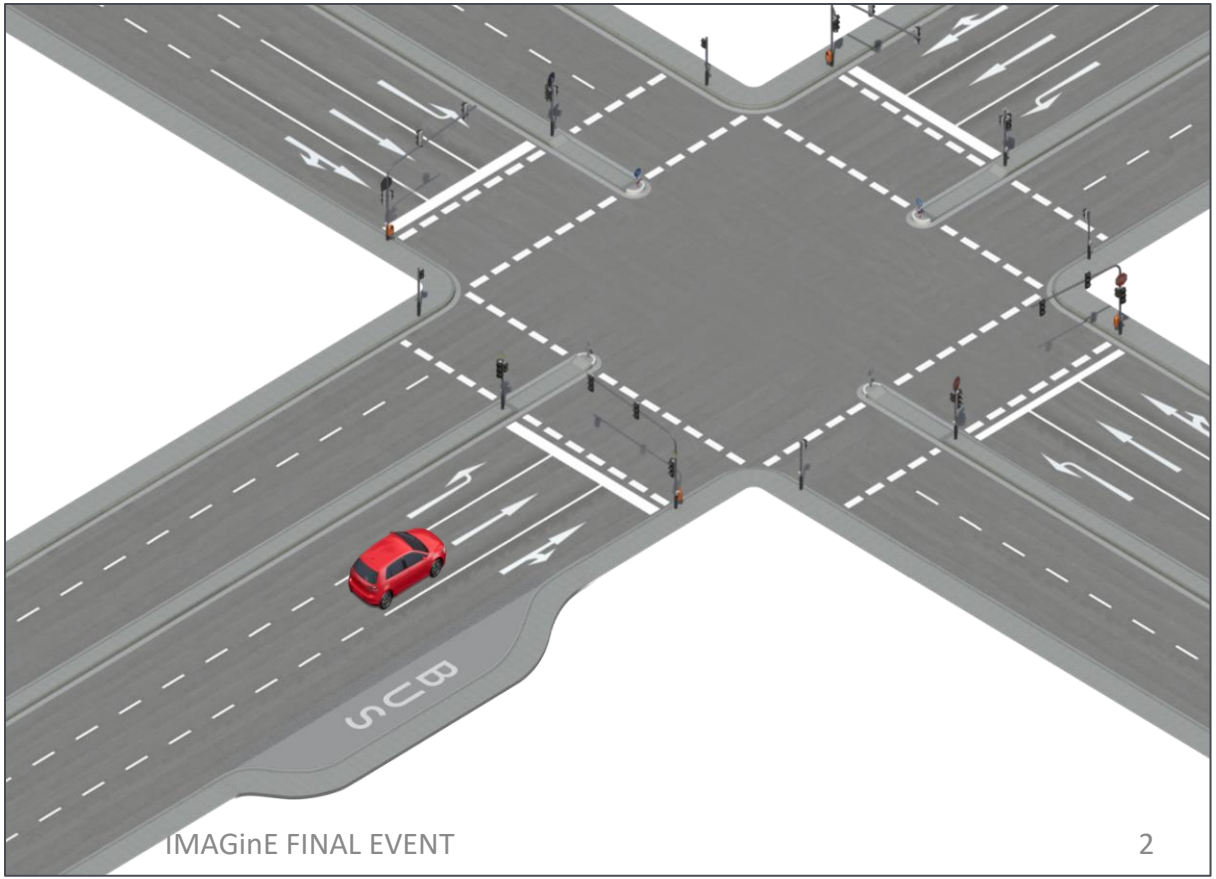
Dr. Stefan Gläser, Volkswagen

12 MAY 22

FINAL EVENT

The Cooperative Environment Model

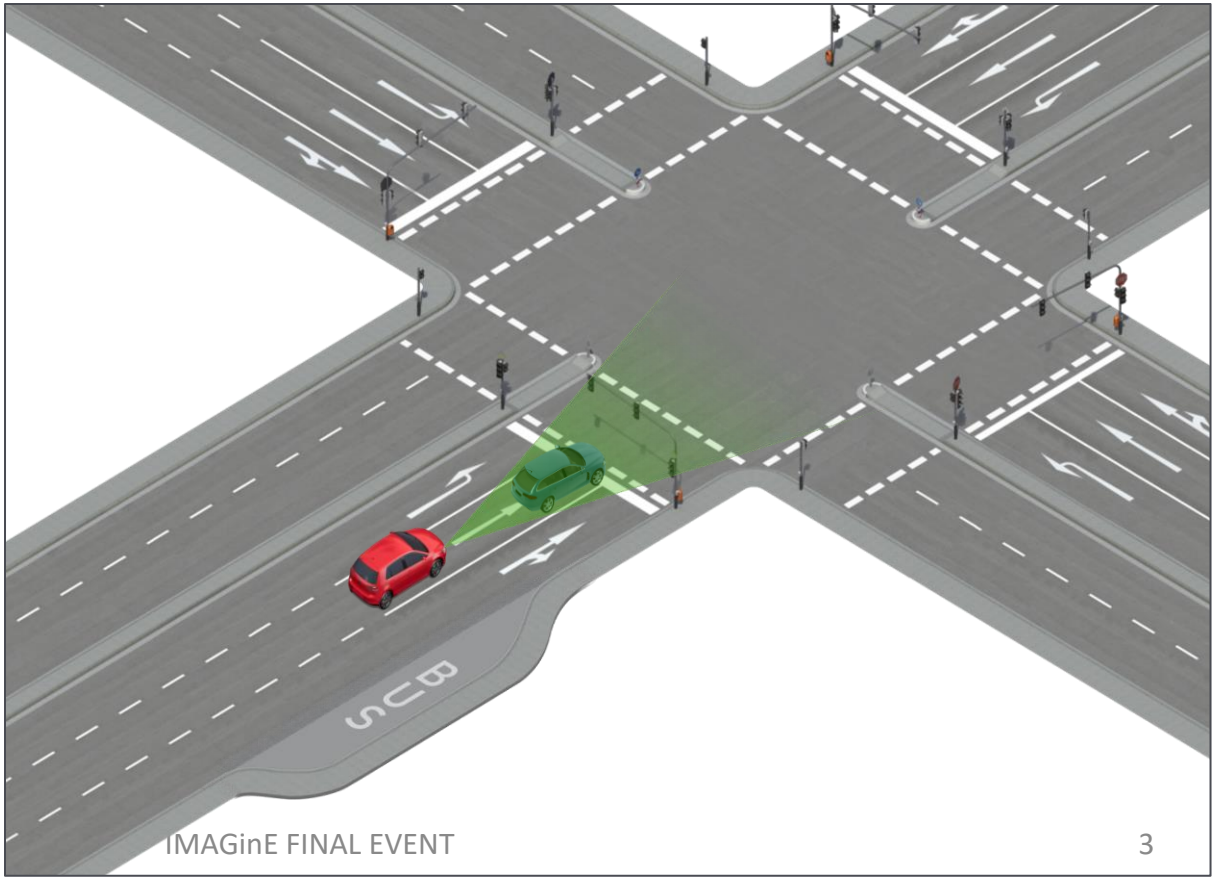
Perception of the Environment



Perception of the Environment

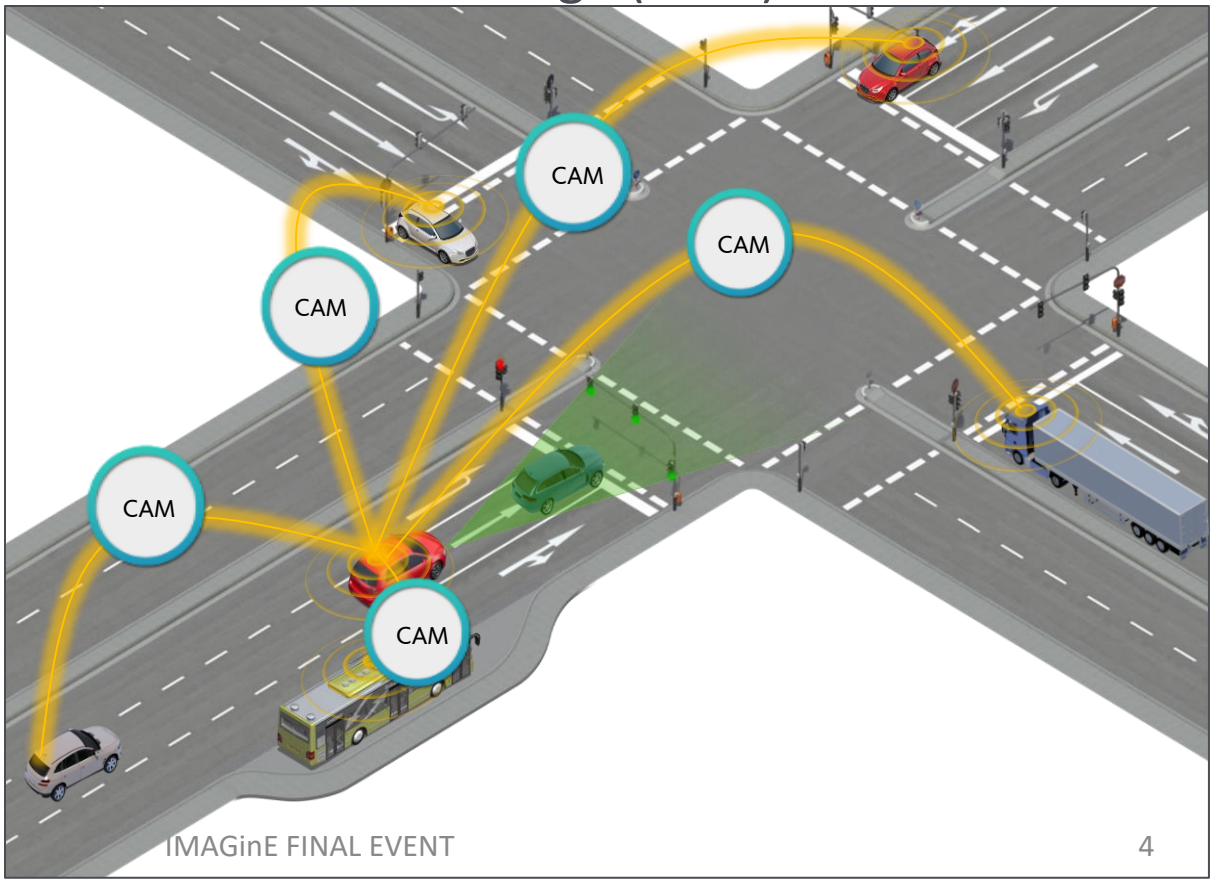
Today: Local Perception Sensors

- Local Perception Sensors to detects nearby vehicles



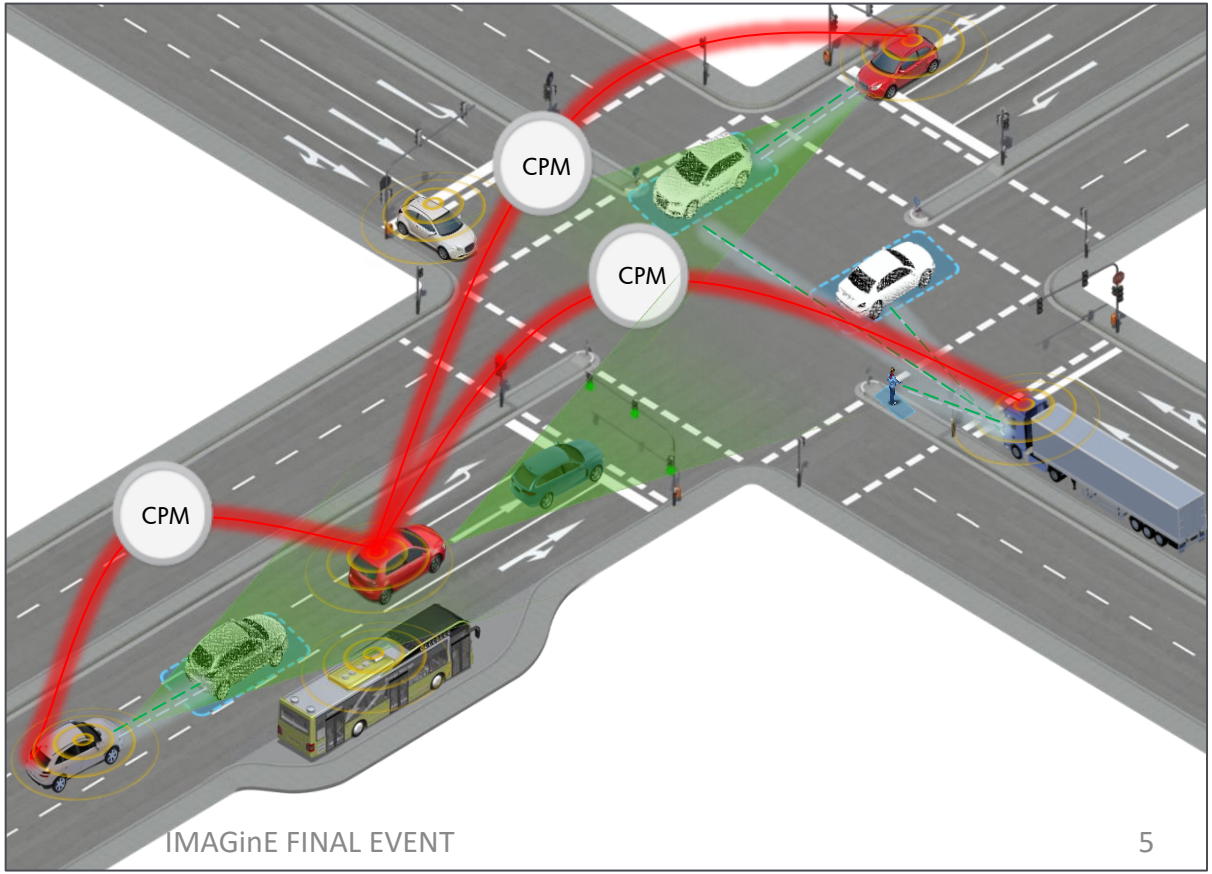
Perception of the Environment
with IMAGinE: Cooperative Awareness Message (CAM)

- Local Perception Sensors to detects nearby vehicles
- CAM to transmit „here I am“-information



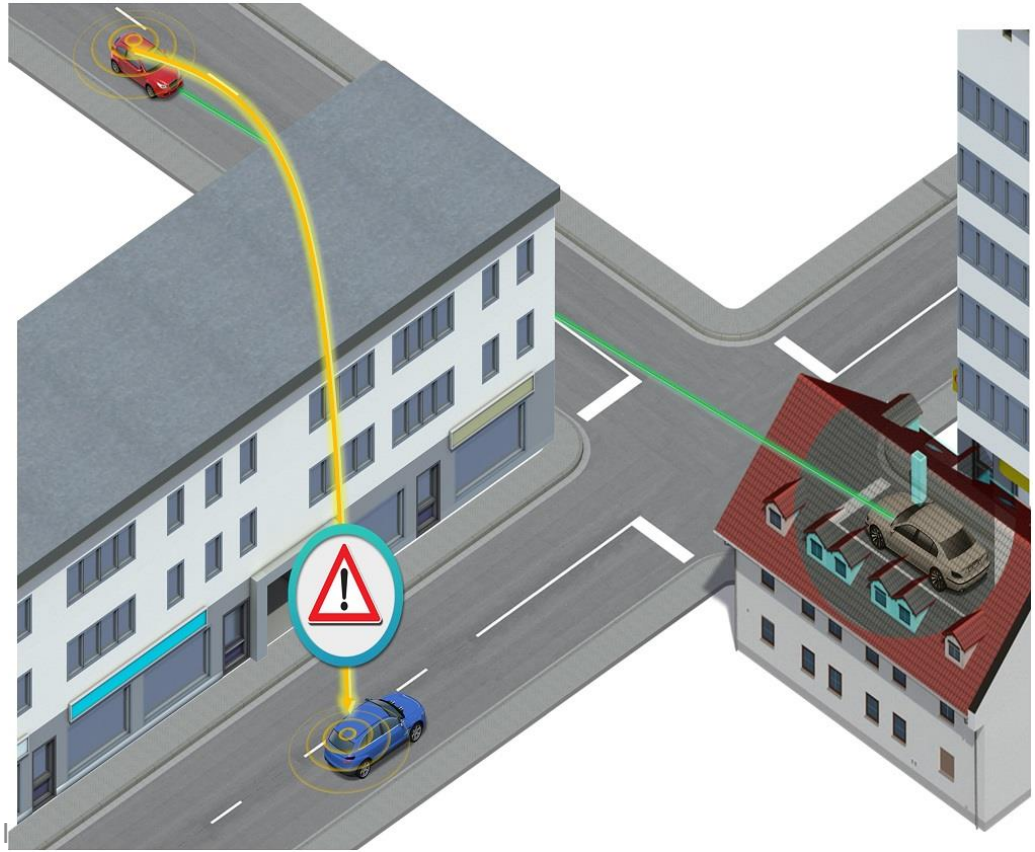
Perception of the Environment
with IMAGinE: Collective Perception Message (CPM)

- Local Perception Sensors to detects nearby vehicles
- CAM to transmit „here I am“-information
- CPM to inform other vehicles about self-detected objects



The Cooperative Awarenes Message (CPM)
with IMAGinE: „Seeing with the eyes of the others“

- blue car approaching the crossing
- hidden (or unequipped) grey car from right
- red car detects grey car with own sensors
- red car distributes information via V2X
- blue car receives this information and is now aware of the hidden grey car.



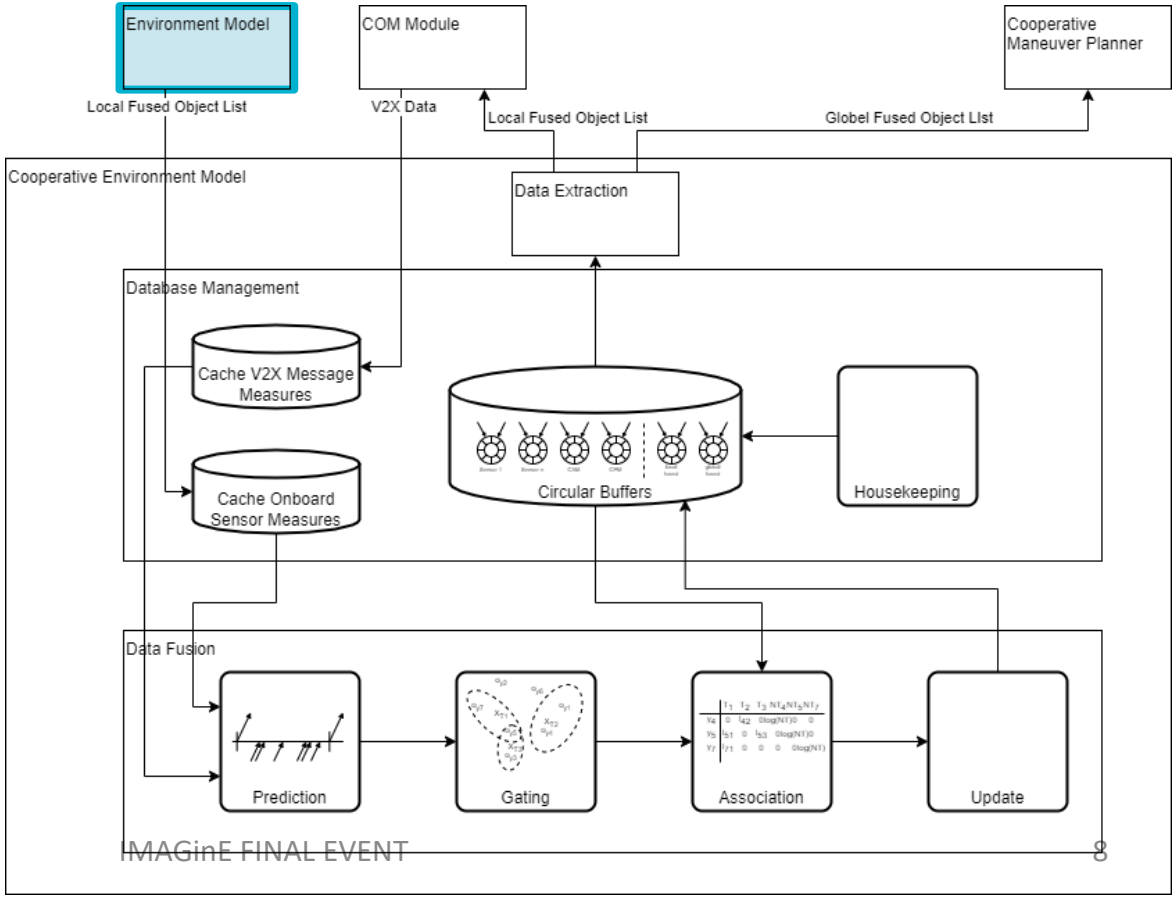
The Cooperative Environment Model

Mode of Operation

Button zum
Draufklicken, damit
der Mini-Film zum
Umfeldmodell
abgespielt wird

The Cooperative Environment Model

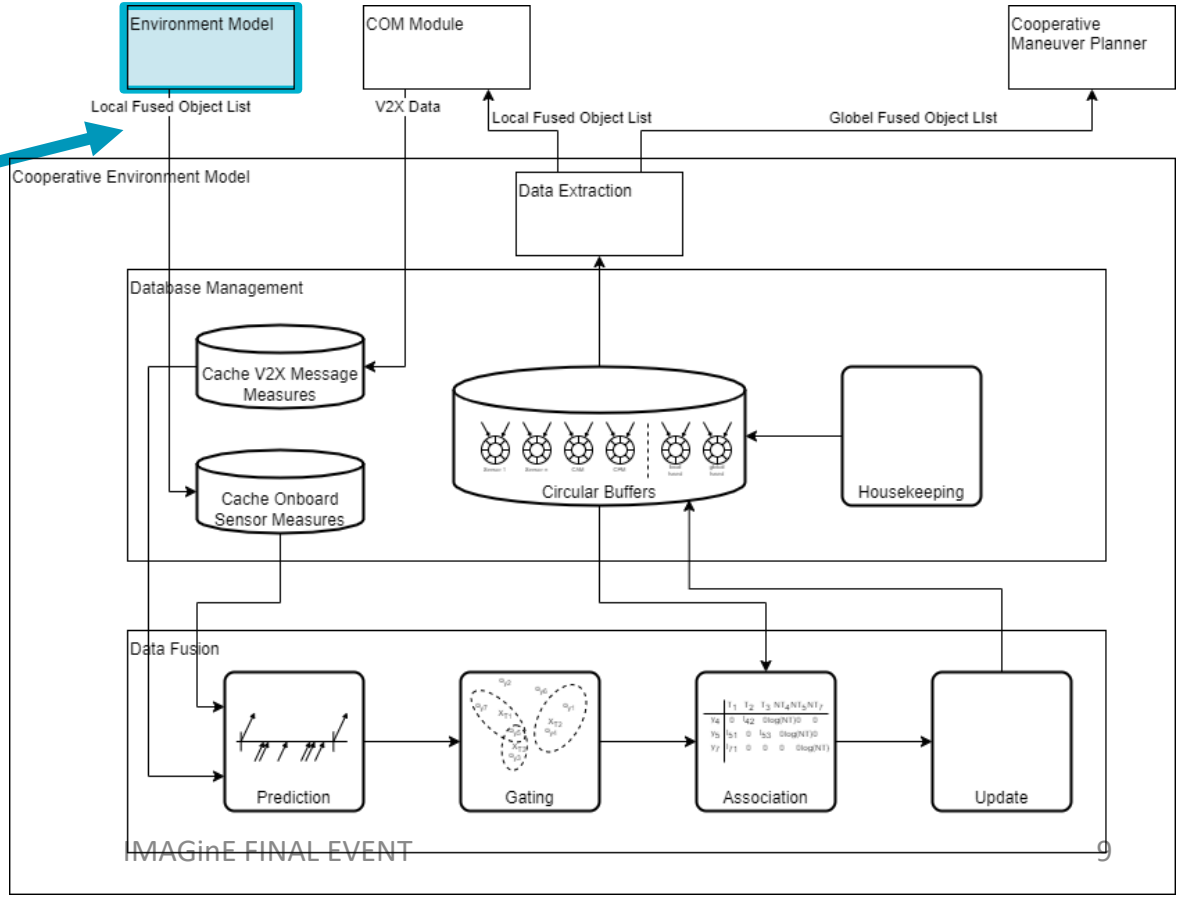
Internal Architecture and Workflow



The Cooperative Environment Model

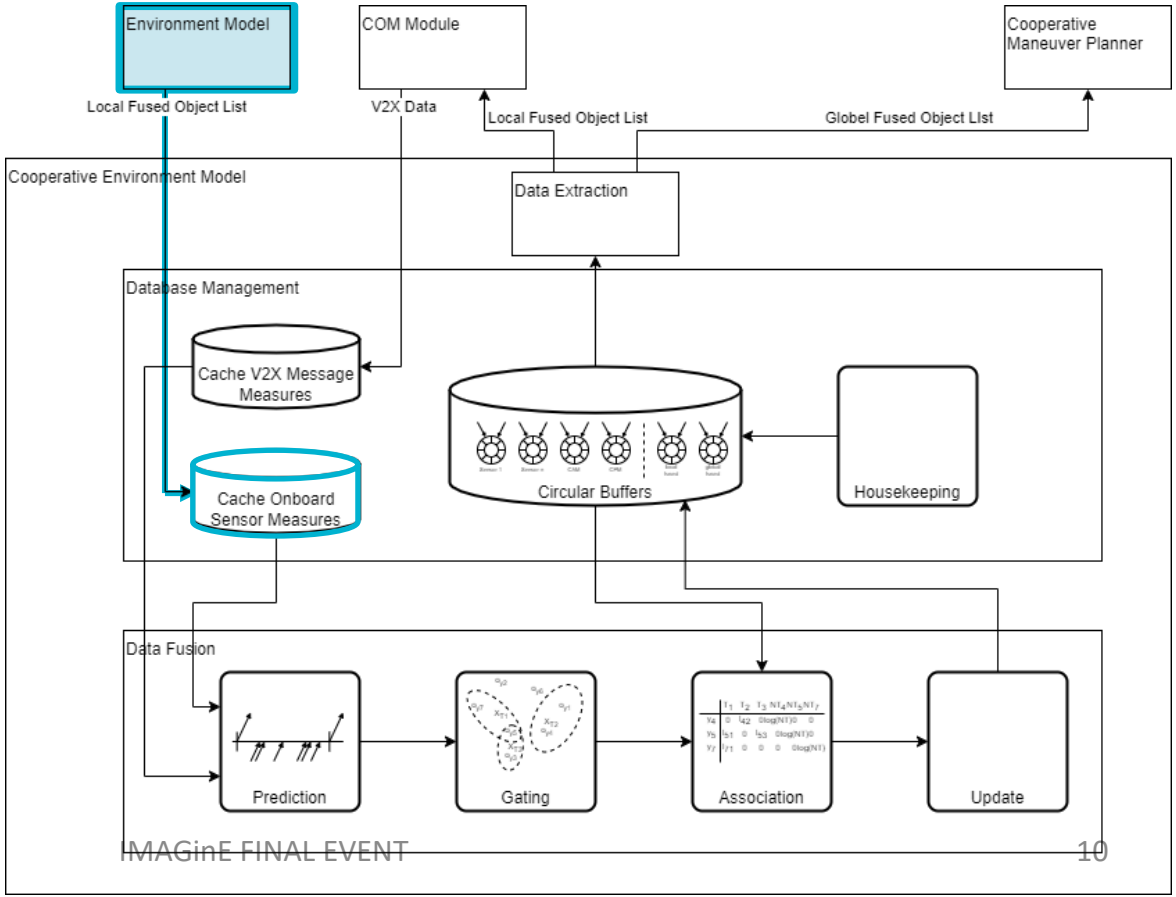
Internal Architecture and Workflow

receives Object List
from Local Perception Sensors
→ Local Object List



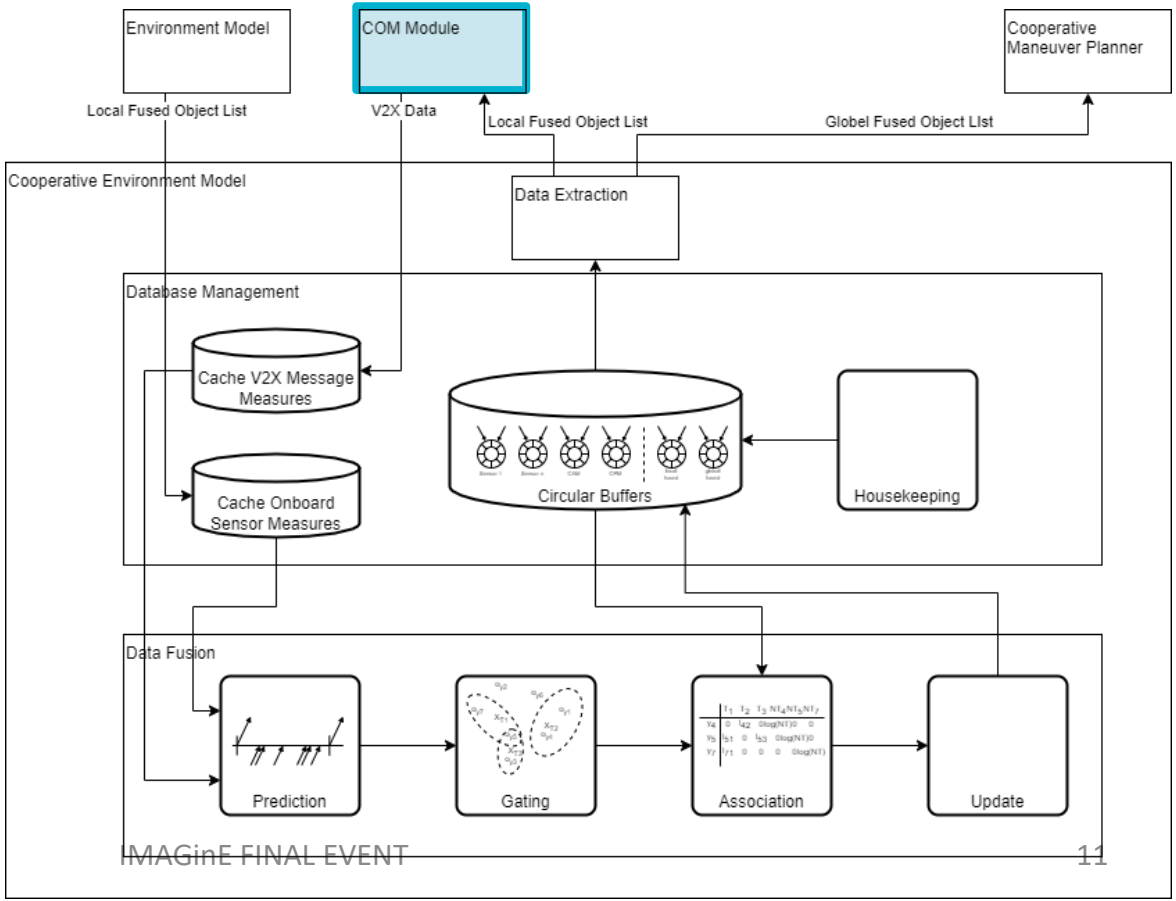
The Cooperative Environment Model

Internal Architecture and Workflow



The Cooperative Environment Model

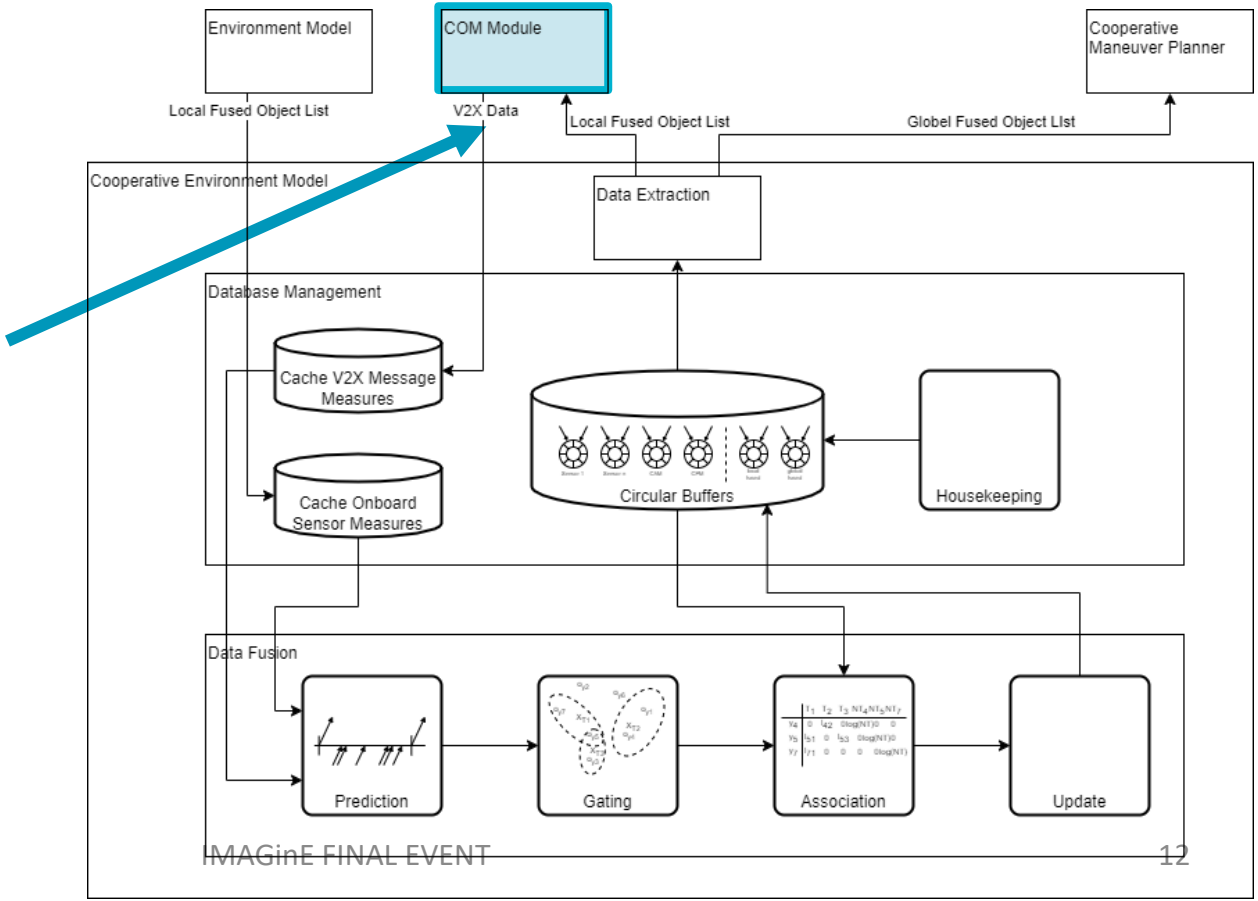
Internal Architecture and Workflow



The Cooperative Environment Model

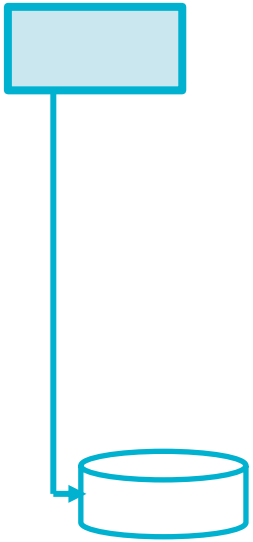
Internal Architecture and Workflow

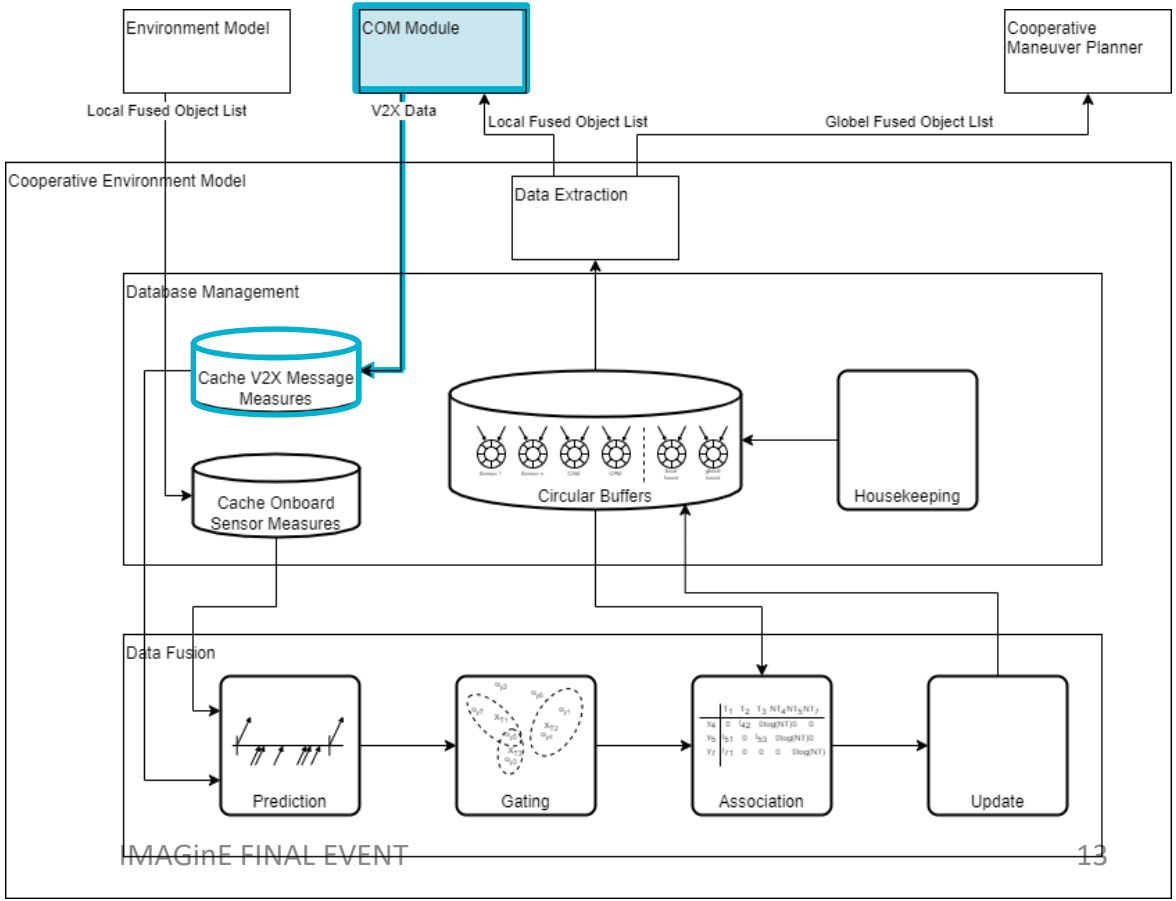
receives Object List from
V2X Messages
→ V2X Object List



The Cooperative Environment Model

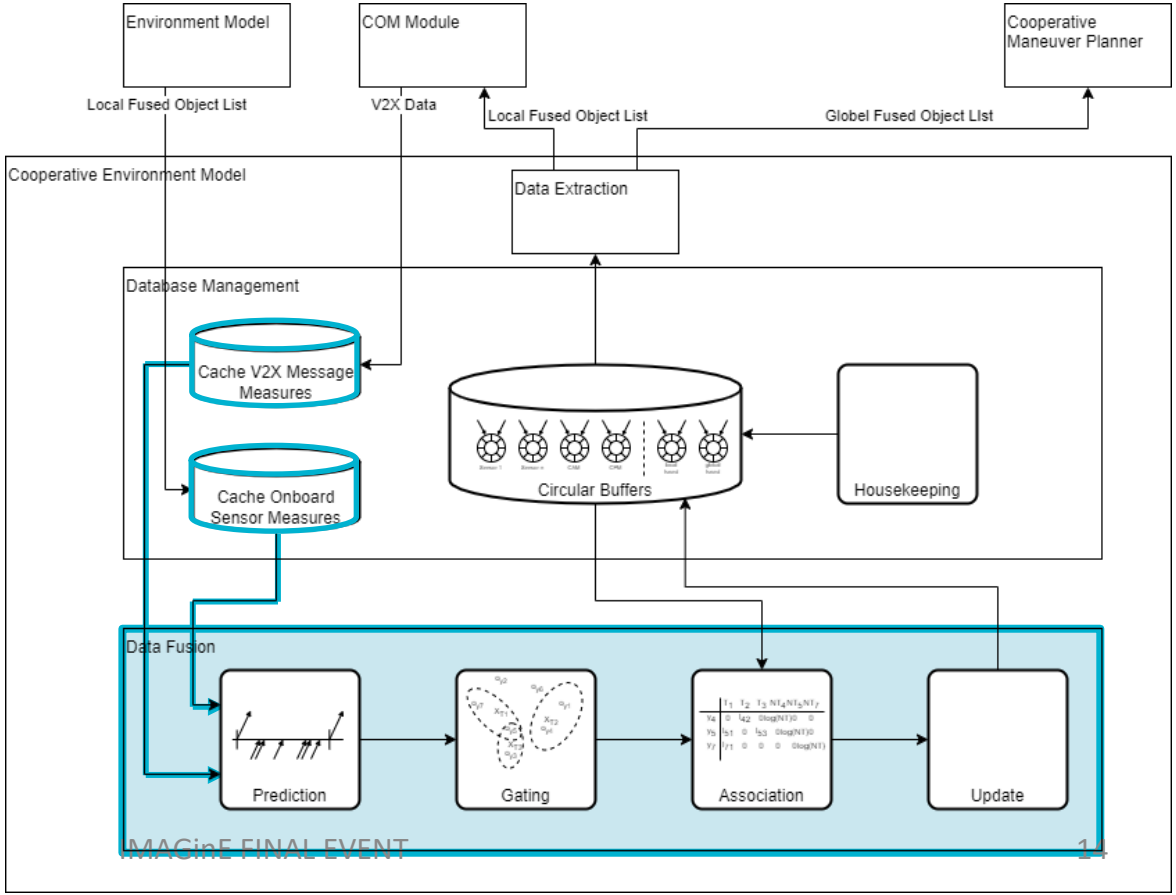
Internal Architecture and Workflow





The Cooperative Environment Model

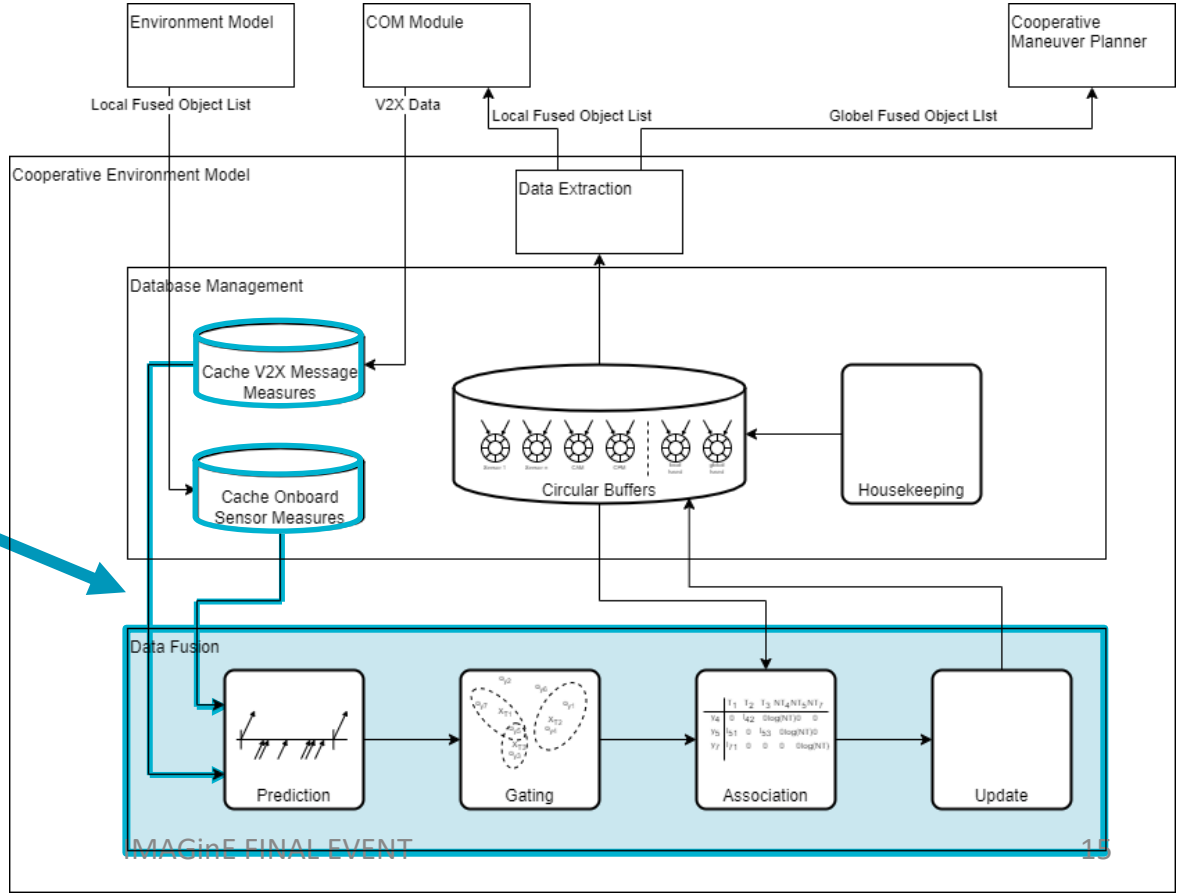
Internal Architecture and Workflow



The Cooperative Environment Model

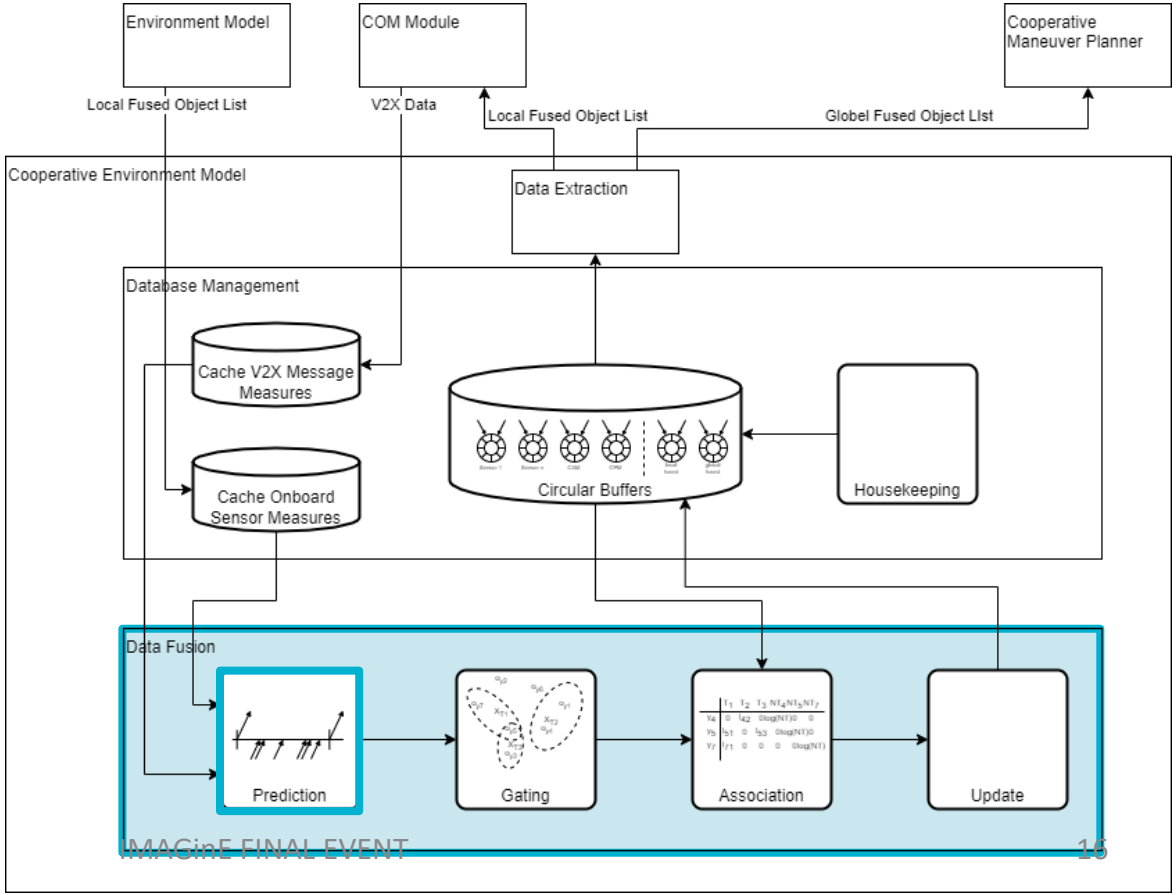
Internal Architecture and Workflow

fuses Objects from Local and V2X Object List
→ Global Object List



The Cooperative Environment Model

Internal Architecture and Workflow



fuses Objects from Local and V2X Object List
→ Global Object List

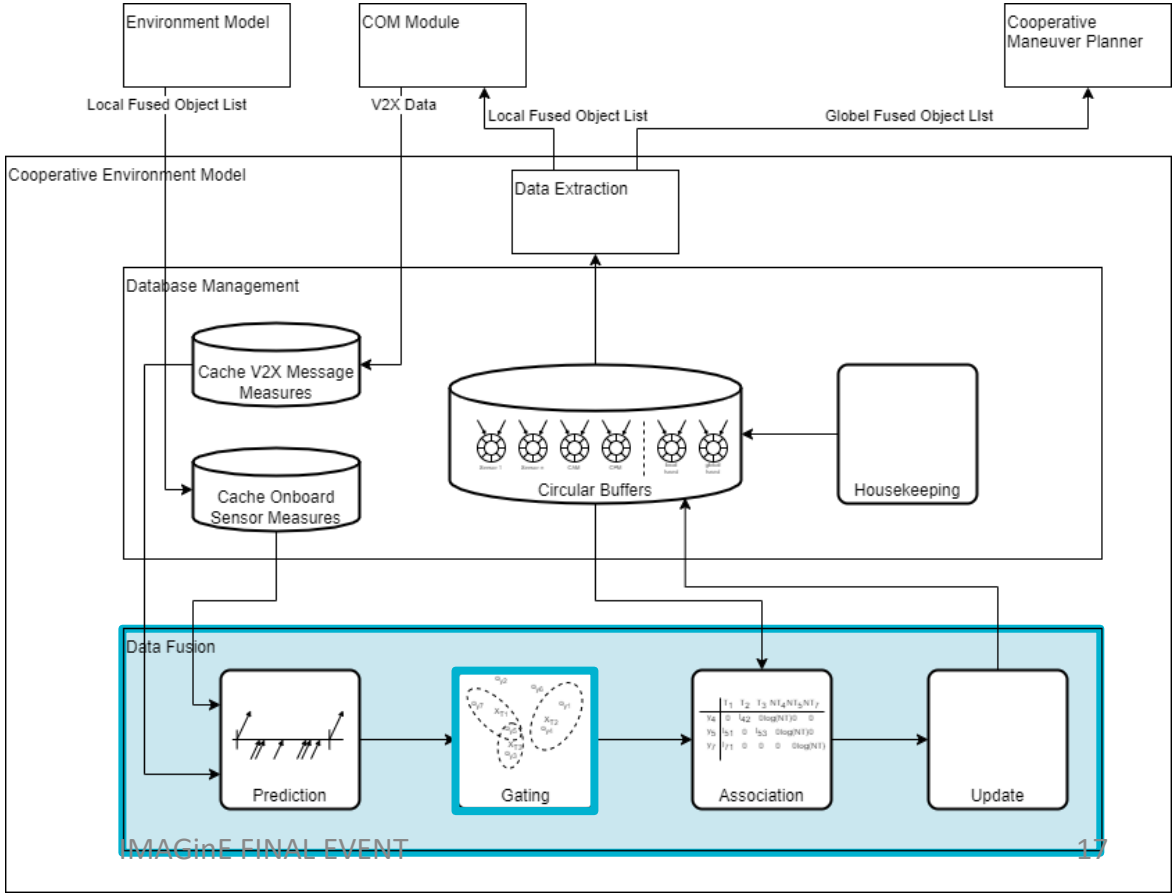
<u>Prediction</u>

incoming signals with different actualization rates

→ need for prediction to time frame of outgoing signals

The Cooperative Environment Model

Internal Architecture and Workflow



fuses Objects from Local and V2X Object List
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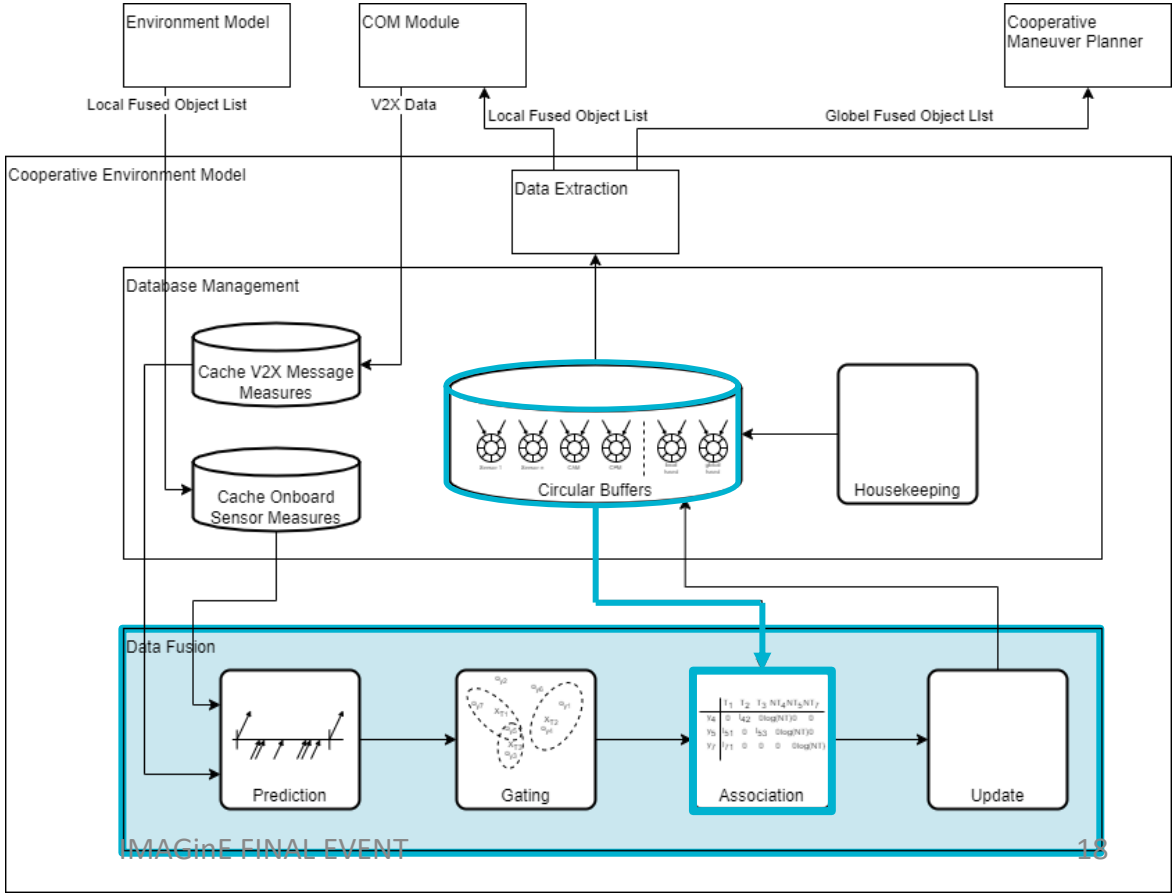
<u>Gating</u>

frist step for associating new measures to existing tracks

The Cooperative Environment Model

Internal Architecture and Workflow



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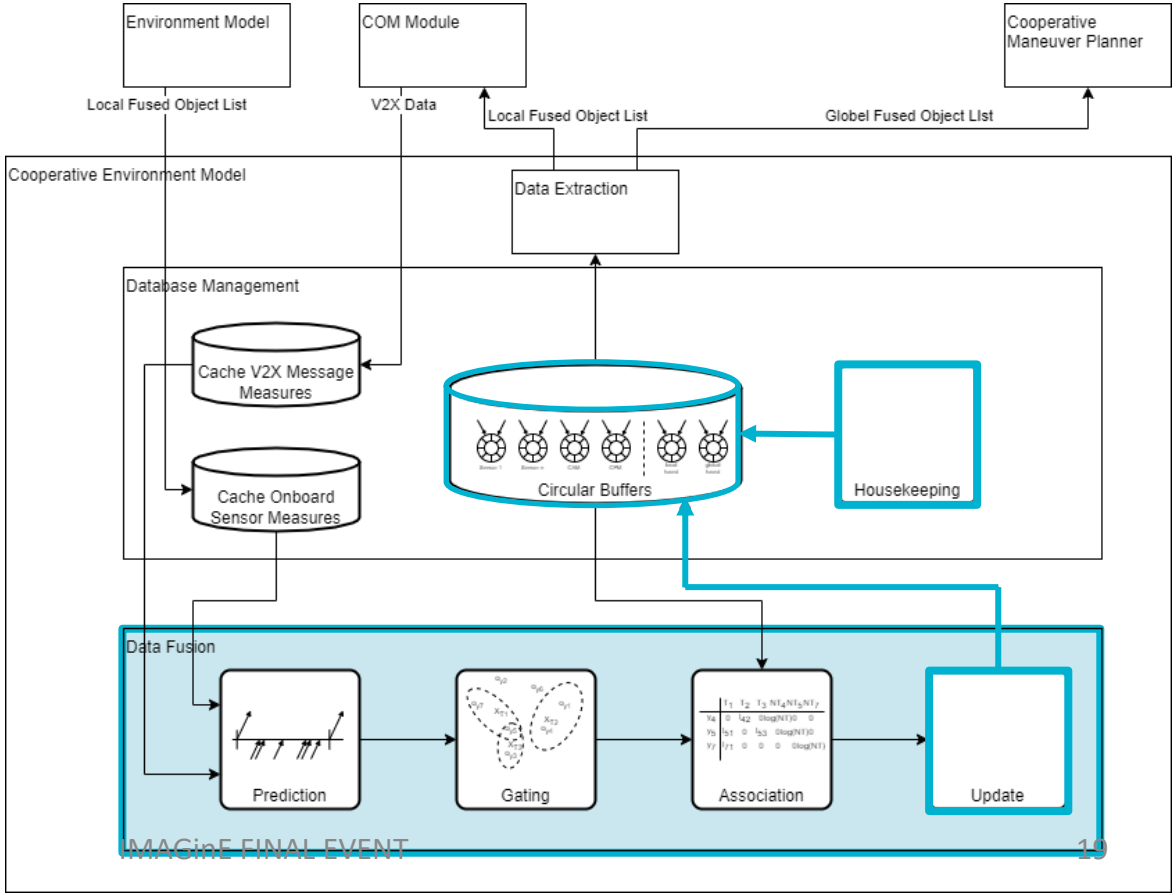
<u>Association</u>

further step for association using dedicated algorithm

The Cooperative Environment Model

Internal Architecture and Workflow



fuses Objects from Local and V2X Object List
→ Global Object List

<u>Update / Housekeeping</u>

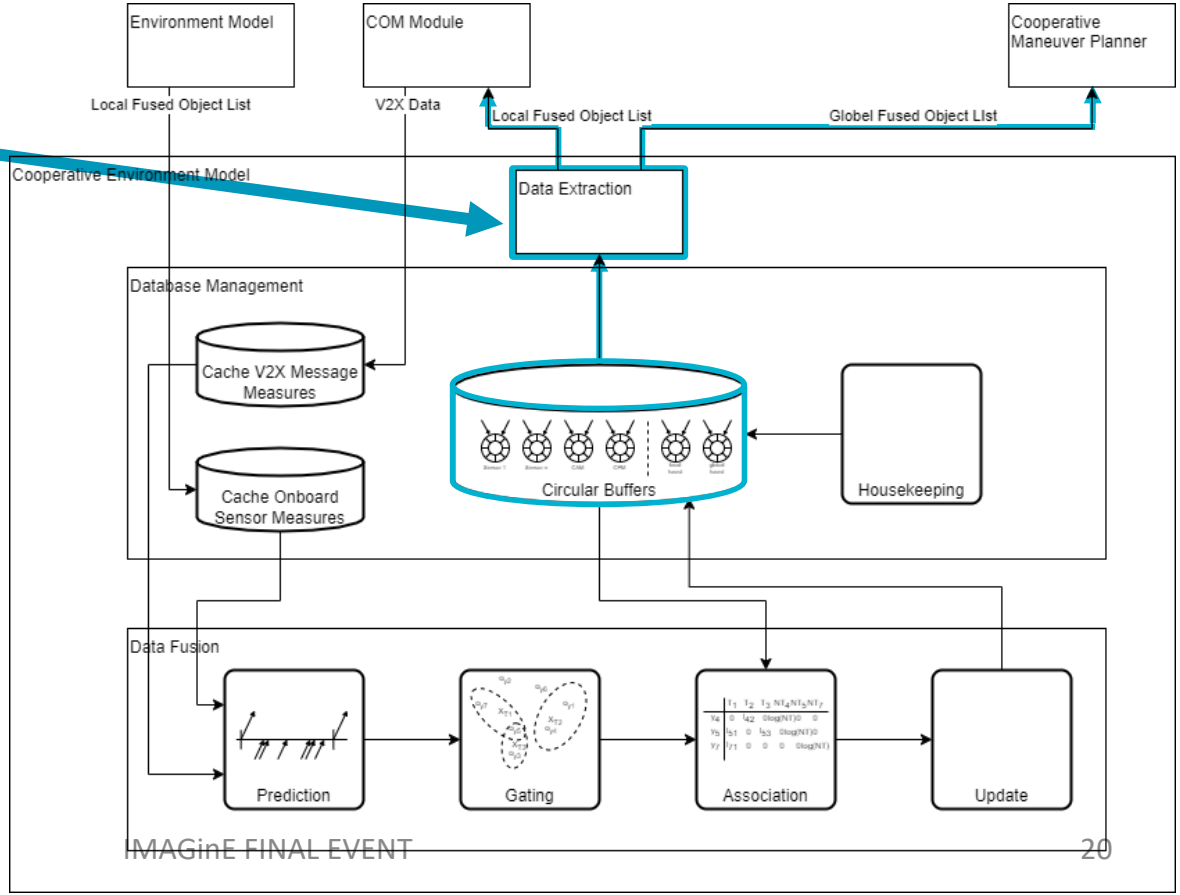
actualization of track list

The Cooperative Environment Model

Internal Architecture and Workflow

provide Object Lists for:

- CPM Messages
- Cooperative Maneuver Planner



The Cooperative Environment Model

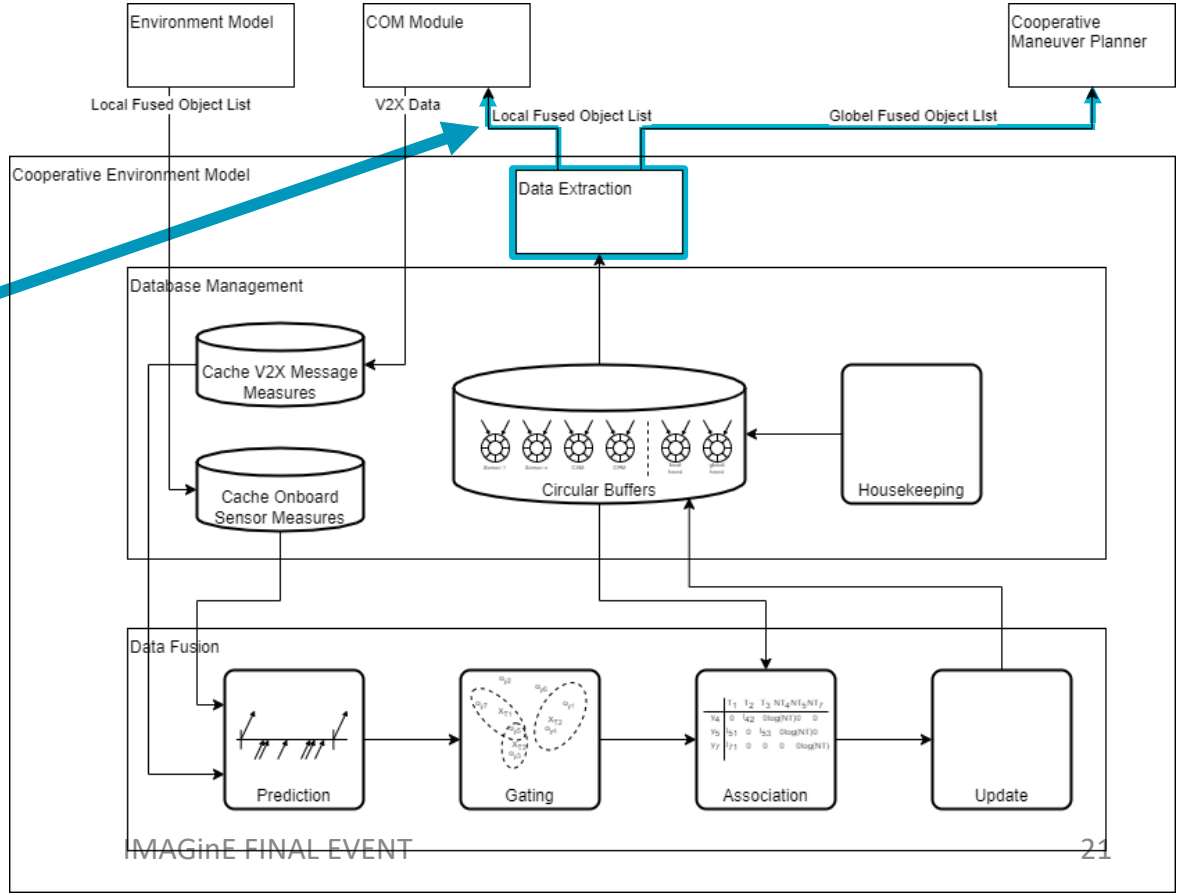
Internal Architecture and Workflow

provide Object Lists for:

- CPM Messages
- Cooperative Maneuver Planner

<u>Local Fused Object List</u>

sending out only objects detected by Ego itself to avoid filter cascades



The Cooperative Environment Model

Internal Architecture and Workflow

provide Object Lists for:

- CPM Messages
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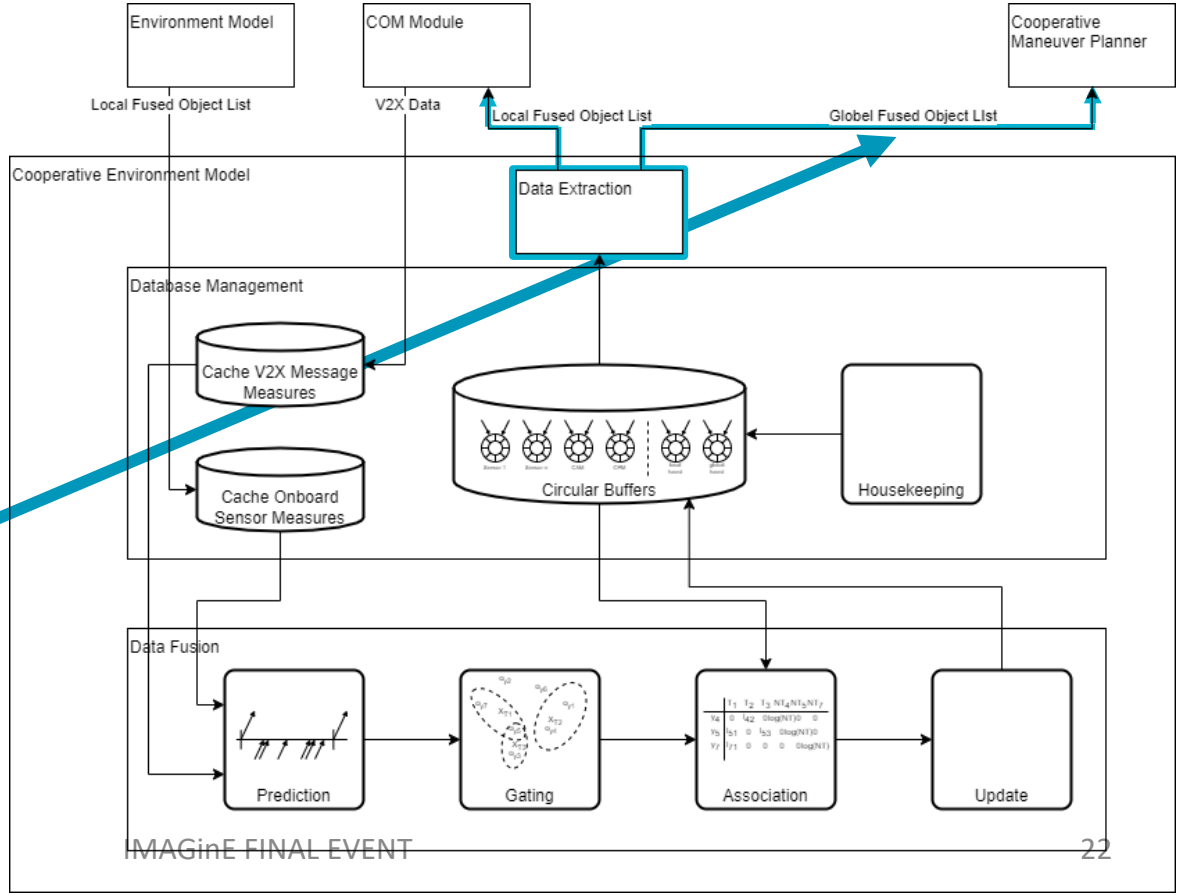
<u>Local Fused Object List</u>

sending out only objects detected by Ego itself to avoid filter cascades

<u>Global Fused Object List</u>

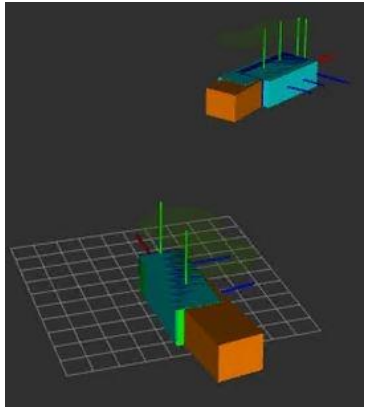
using all objects of the CEM* for internal applications, e. g. CMP**



*CEM: Cooperative Environment Model
**CPM: Cooperative Maneuver Planner

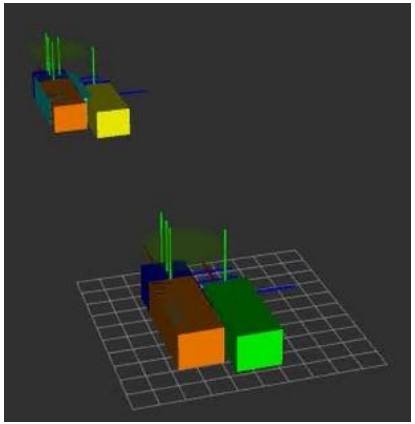
The Cooperative Environment Model

Simulative Validation



Legend

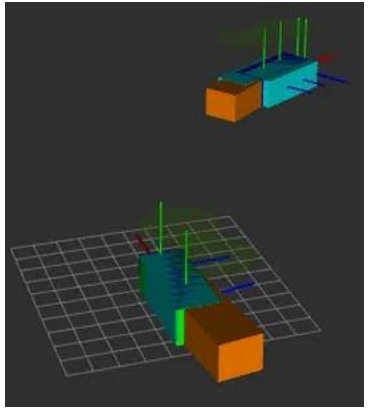
- green: Observing Vehicle (EGO)
- blue: Sensorics of EGO
- yellow: CAM-Objekt (V2X)
- orange: CPM-Objekt (V2X)
- cyan: Global Fusion (Sensors + V2X)



The Cooperative Environment Model

Simulative Validation

- Simulation: „ideal“ Environment
  → „ideal“ Environment Model



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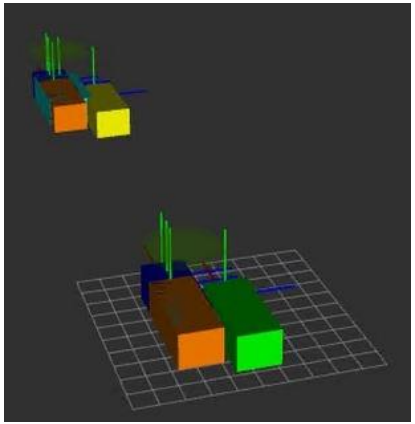

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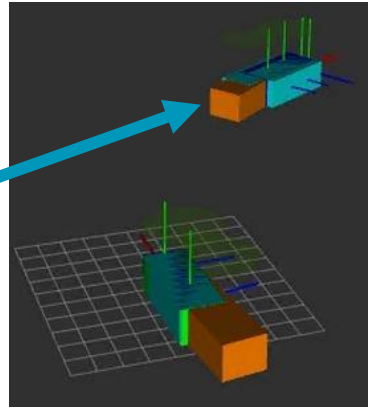
Simulative Validation

- Simulation: „ideal“ Environment
  → „ideal“ Environment Model
- **correct** lag in V2X Positioning



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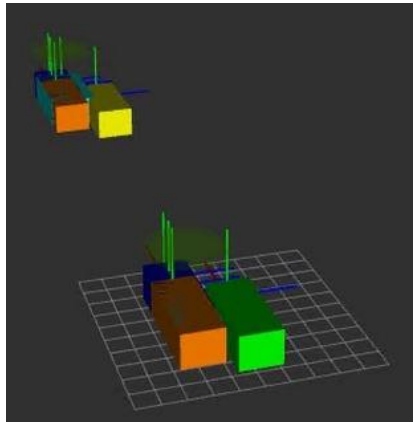

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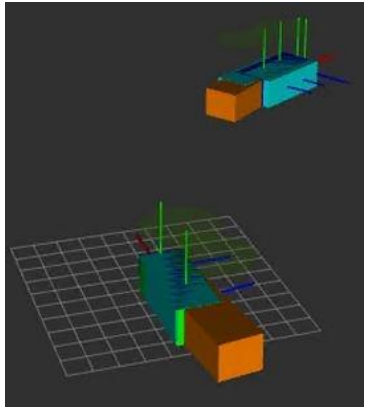

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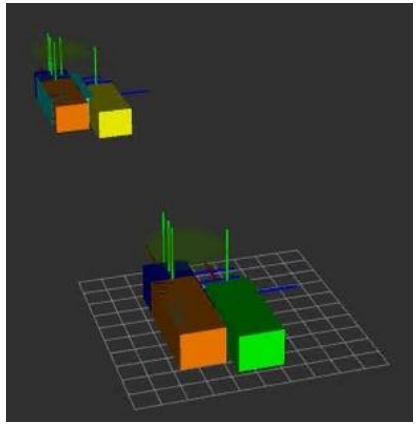
- Position Offset in Local Sensors
  → **correct** Position Offset in Env. Model



The Cooperative Environment Model

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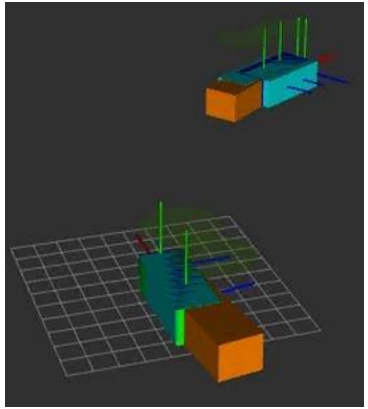

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- Position Offset in Local Sensors
  → **correct** Position Offset in Env. Model
  large Position Offset
  → **incorrect** Generation of extra Object