



Future Mobility

Trilateral Conference

St. Valentin, 20.04.2023, M. Taubenreuther



IAV – your strong Engineering-Partner



Software Systems & Connectivity

- Optimized E2E-Software-Architectures and Integration
- Automotive Software Engineering and Digital Life Cycle Management



Vehicle Solutions & Autonomous Driving

- AD-Function, Architecture und Integration
- Integrated E/E-Functions and Vehicle Platforms
- Intelligent chassis solution



Future Powertrain

- Electrified propulsion systems
- Alternative and classical powertrain solution



Solutions & Products

- Non-Automotive solution for: Energy- and Agro-Systems
- IAV Product management



More than 25 location worldwide



Almost 40 years experience



More than 7.500 employees

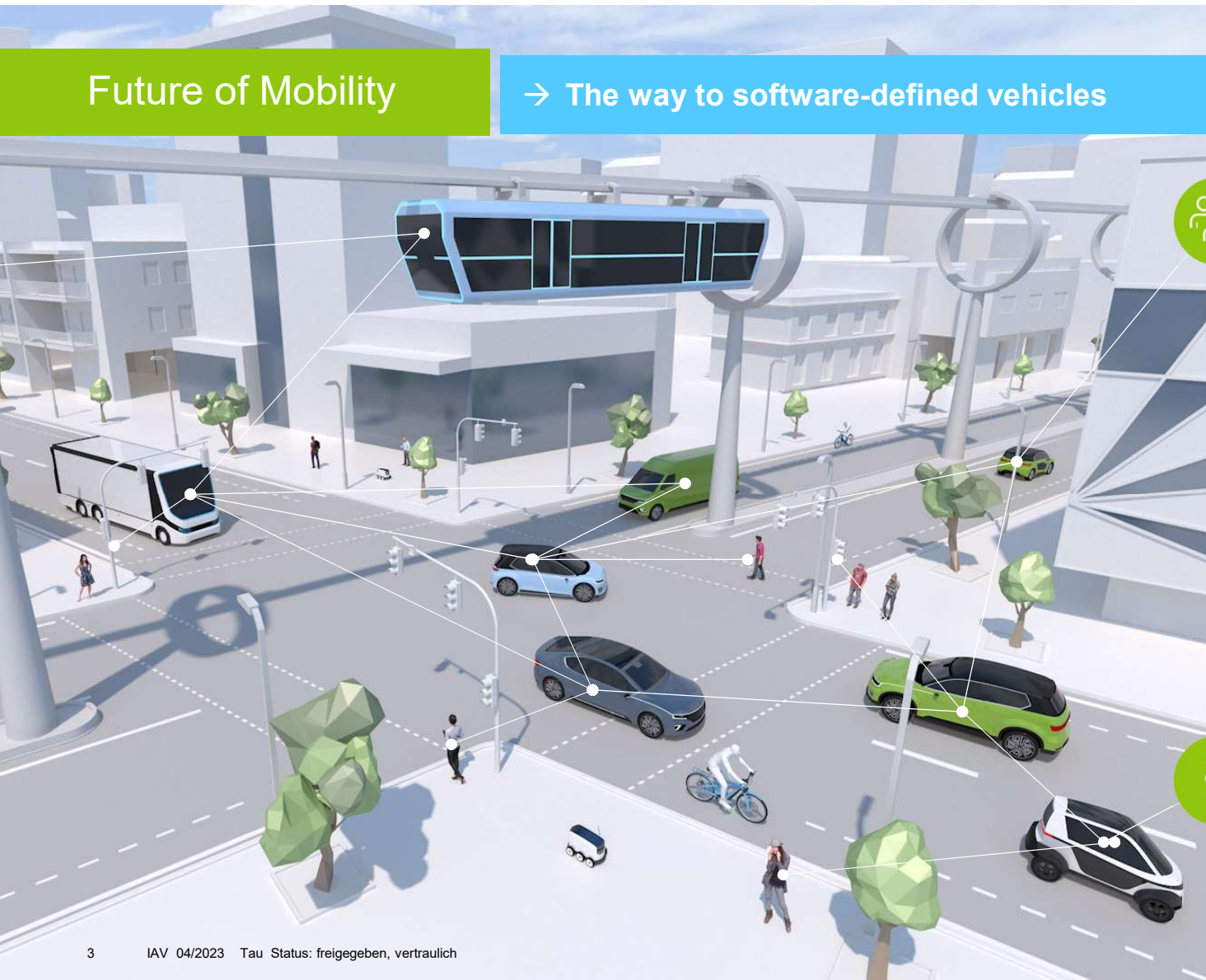


More than 890 Mio. Euro turnover

→ Responsibility for full service contracts – we move ideas & concepts into series production level !

Future of Mobility

→ The way to software-defined vehicles



Market & Customer

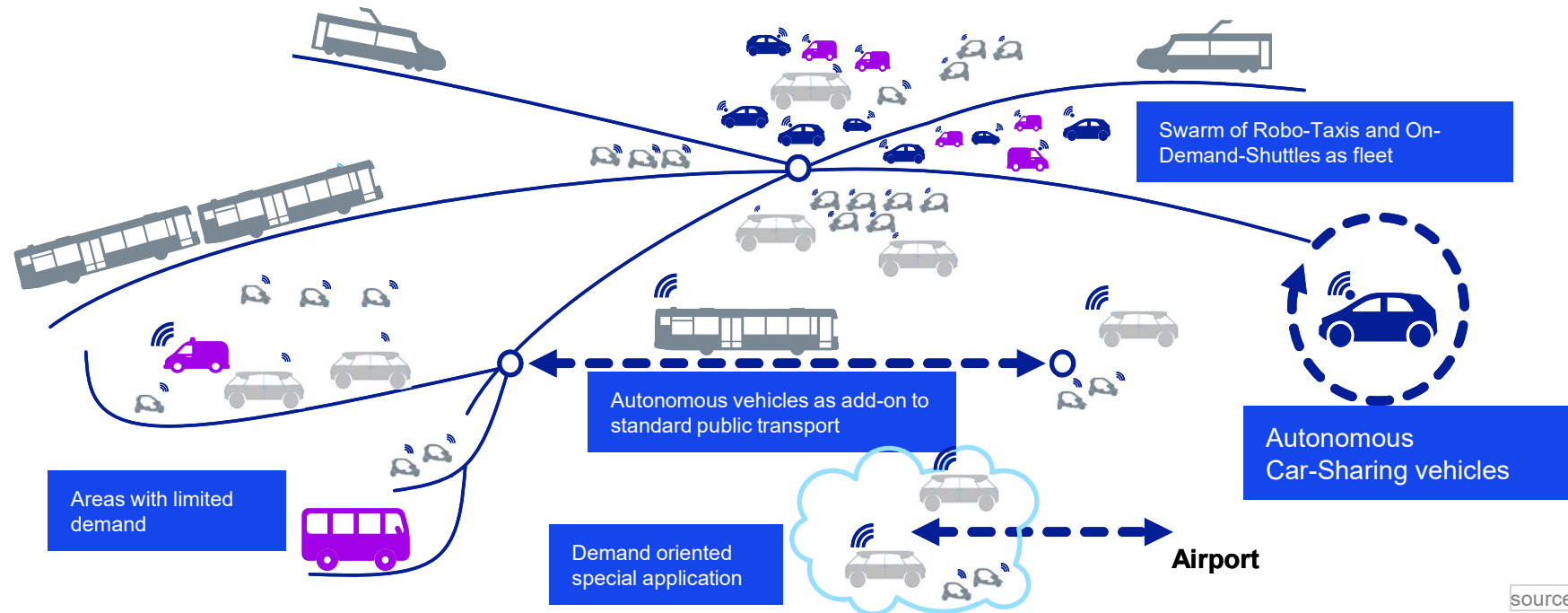
- 100 % connected
- Automated Driving
- Safety, Privacy and Security
- Vehicle as element of IOT world
- Digital services and new business models
- Personalization and Identification
- On-Board-Entertainment
- Mobile offices
- Connected Smart Home

Norms & Standards

- ISO (Functional Safety)
- UNECE (SUMS, CSMS)

Vision

Deployment of **optimized** transport systems, supported by autonomous vehicles.



- The future of mobility: connected, cooperative and technology-open
- The entire mobility eco-system is much more than just vehicle development and deployment

Now it is time, to set the right way ...

... key factors for successful autonomous operation !

Reduction

- Less individual traffic
- Less complexity for drivers and passengers



Attractiveness

- Value add for safety and comfort
- through on-Demand service

Automation

- in defined/confined areas
- supported by robust communication links

Profitability

- By flexible control elements
- By configurable drive concepts adjusted to application

Acceptance

- the staff
- the customer
- the environment

Mission: Automated Driving for Public Transport and Logistics



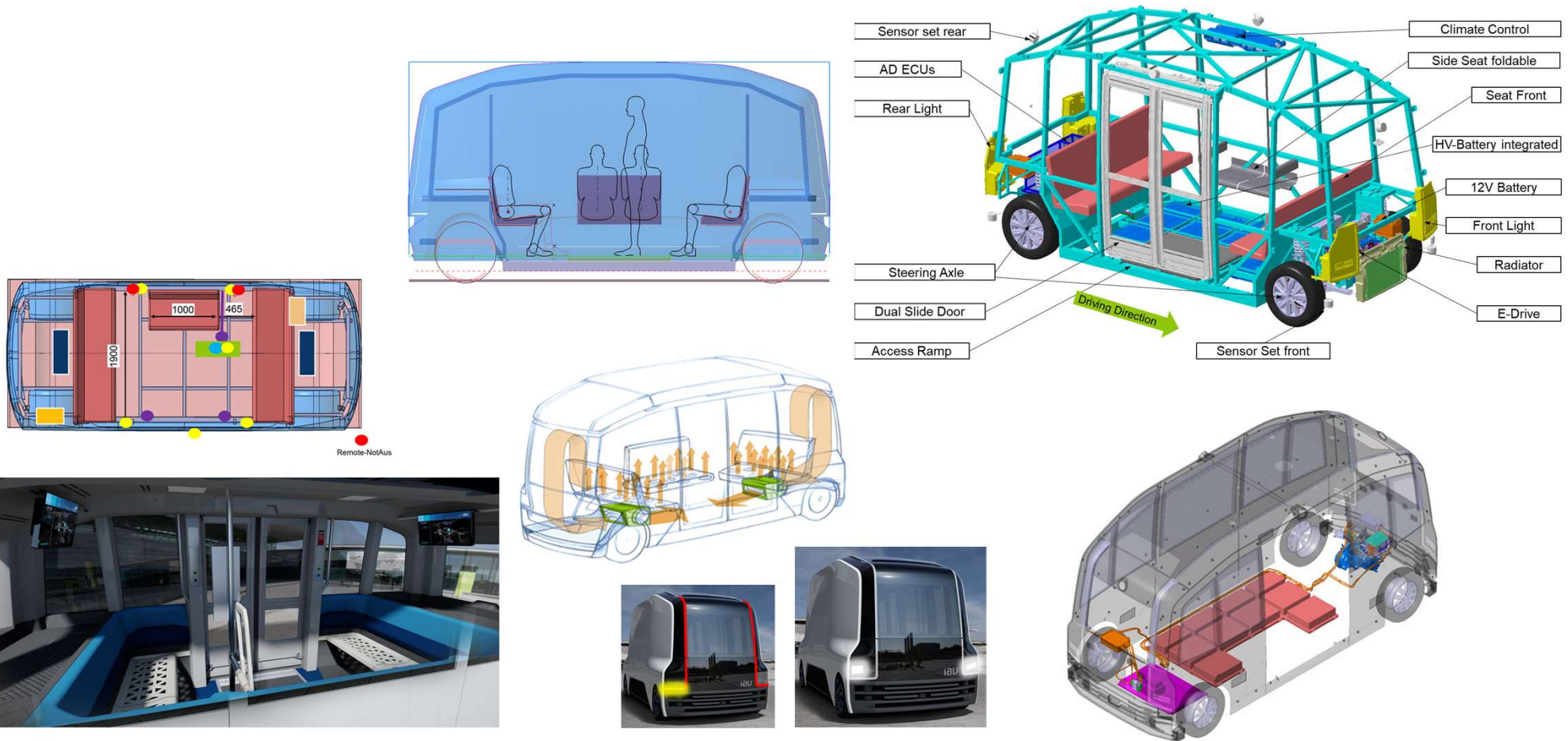
Goals

- Flexibility
- Availability
- Optimized Costs
- Optimized Utilization of roadside infrastructure

Areas of application

- Urban
 - Metro / Tram / Local area distribution
 - Hub-Hub-Logistics
- Sub-urban areas
 - Area coverage with public transport offer
 - Link to main transport routes

Vehicle development topics beyond typical passenger cars

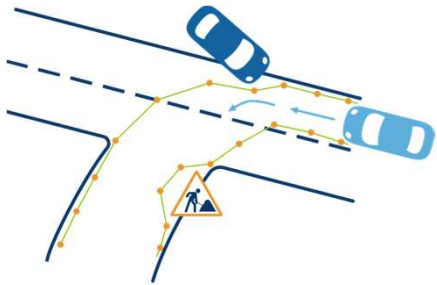


Automated Driving (AD) System

Sense

Perception

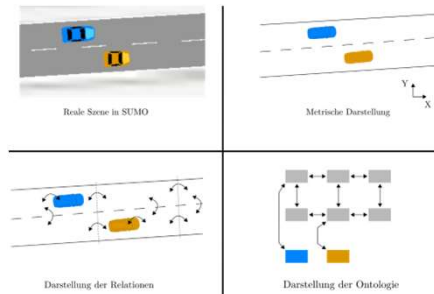
- Acquisition
- Association
- Fusion
- Enrichment of environmental data



Lanes, objects, host vehicle data, ...

Situation interpretation

- Situation classification and representation
- Prediction
- Intention detection

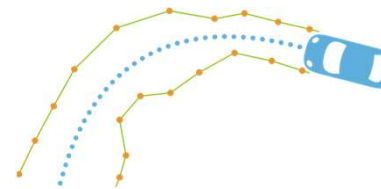


Situation model

Plan

Maneuver and motion planning

- Derivation of current vehicle mission and planning of its realization

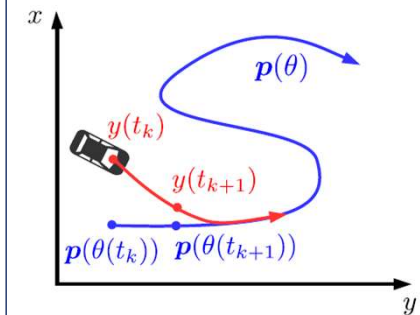


Driving path with velocity profile

Act

Control

- Realization of planned vehicle mission

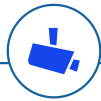


Steering wheel angle, desired velocity, ...

IAV Mover – Technical Highlights



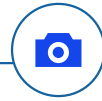
10 Lidar-Sensors



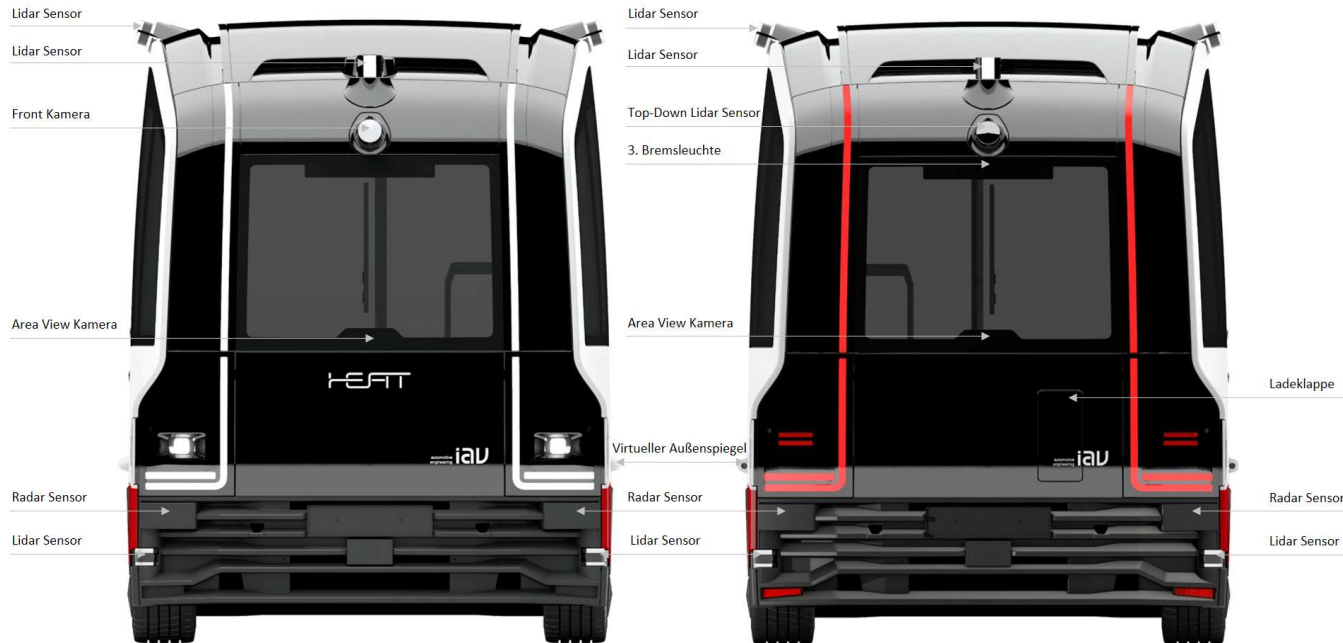
4 Area View-Cameras



8 Radar-Sensors



1 Multifunktion-Camera



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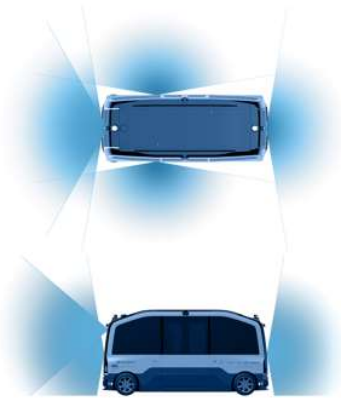
Safety
ISO26262 developed systems for longitudinal and lateral control

!

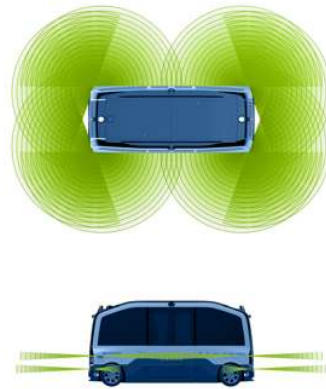
Manual control device: Dynamic take-over capability over the full operational speed range

IAV Mover – Sensor concept and data fusion

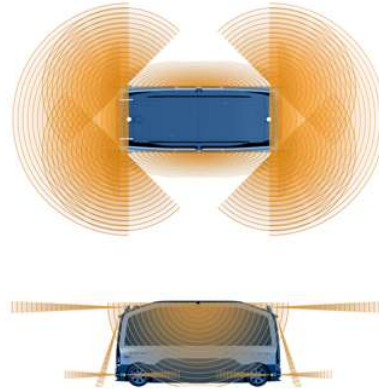
Camera



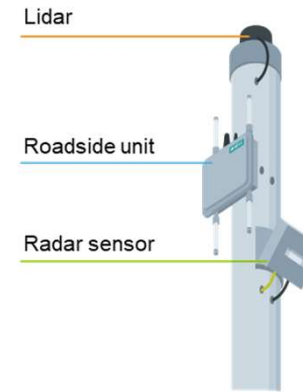
Radar



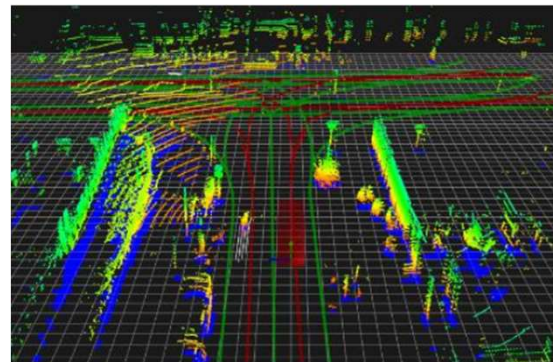
LiDAR



Roadside unit



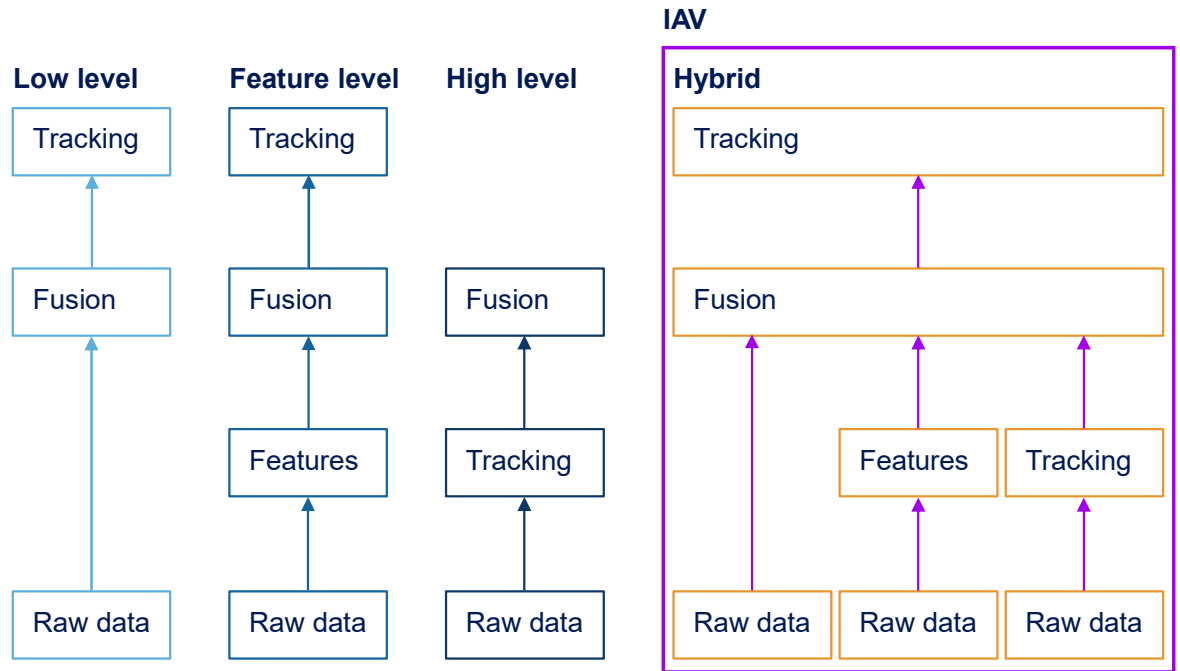
Backend Services



- External HD-map
- Redundant & diversified sensor principles
- Intelligent infrastructure at critical areas
- Combination of Onboard- and Infrastructure-Signals and traffic signals
- Reliable situation interpretation in dynamic urban driving scenarios

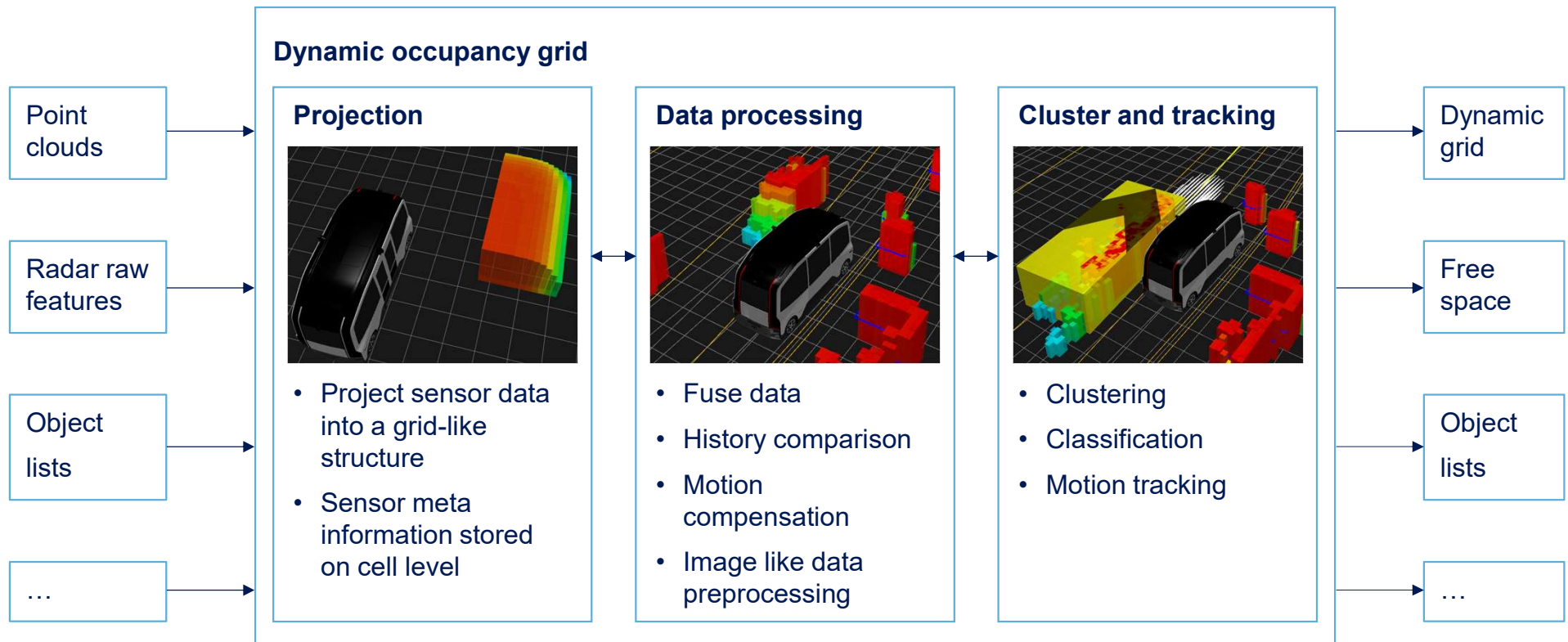


IAV's Sensor Fusion Concept

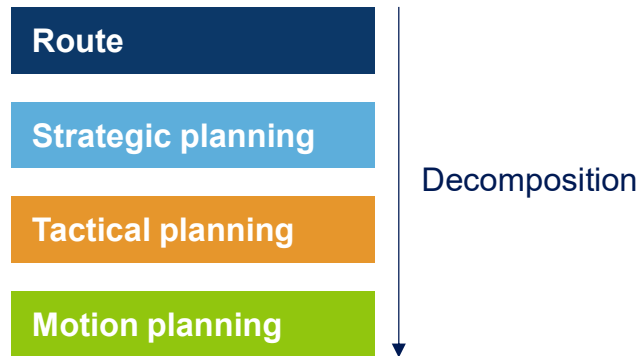


→ IAV's Dynamic Grid Fusion approach in comparison to standard solutions

IAV's Dynamic Grid Fusion



Maneuver Planning



Strategic

- Complete route
- Low dynamic

Tactical

- Complex maneuver (e.g., turn left)
- Medium dynamic

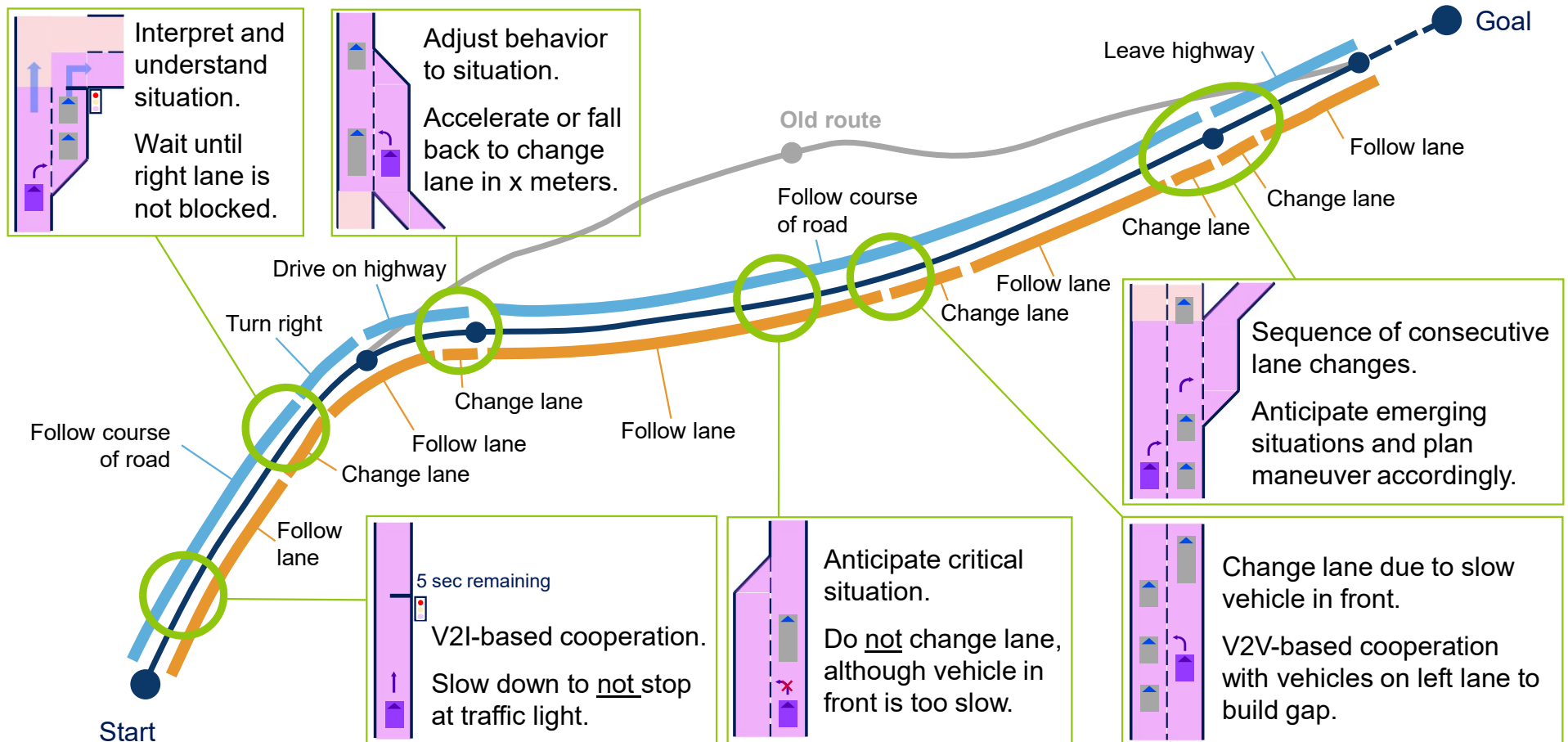
Motion

- Basic maneuver (e.g., follow lane)
- High dynamic

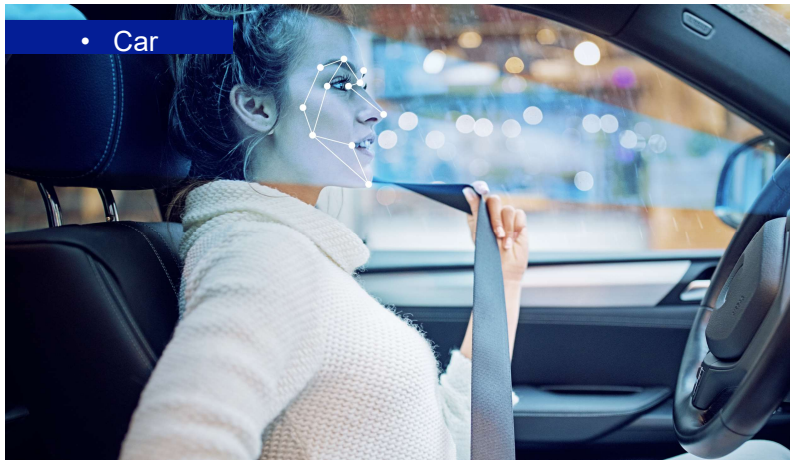
- Maneuver Planning is central functionality for:
 - Seamless automated driving
 - From a given route to the very basic driving behaviors
 - Anticipatory driving
 - To avoid critical situations, increase comfort and facilitate more human like driving
 - Cooperative driving
 - Based on V2X to handle more complex situations
 - Intelligent automated driving (level 2+ to level 5)
 - Gradual decomposition of route into sub-tasks
- Different planning horizons and decision dynamics:
 - Strategic
 - Tactical
 - Motion

→ Enabling vehicles to think.

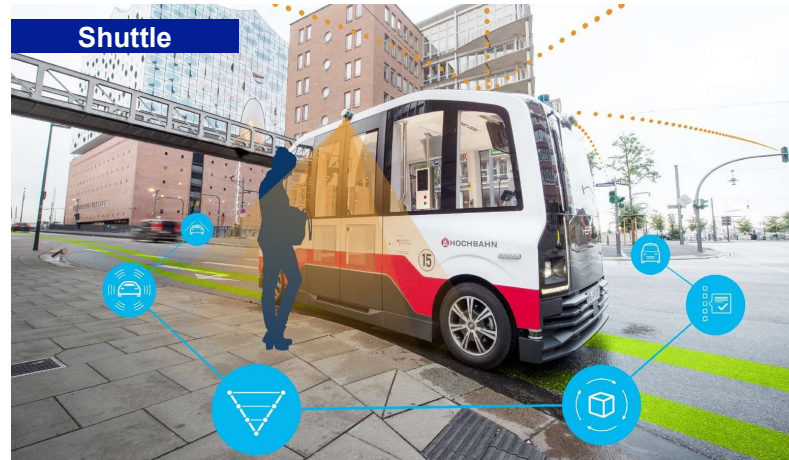
Situation-Aware Maneuver Planning



Cabin Sensing for cars, movers & transportation



• Car



Shuttle



Transportation

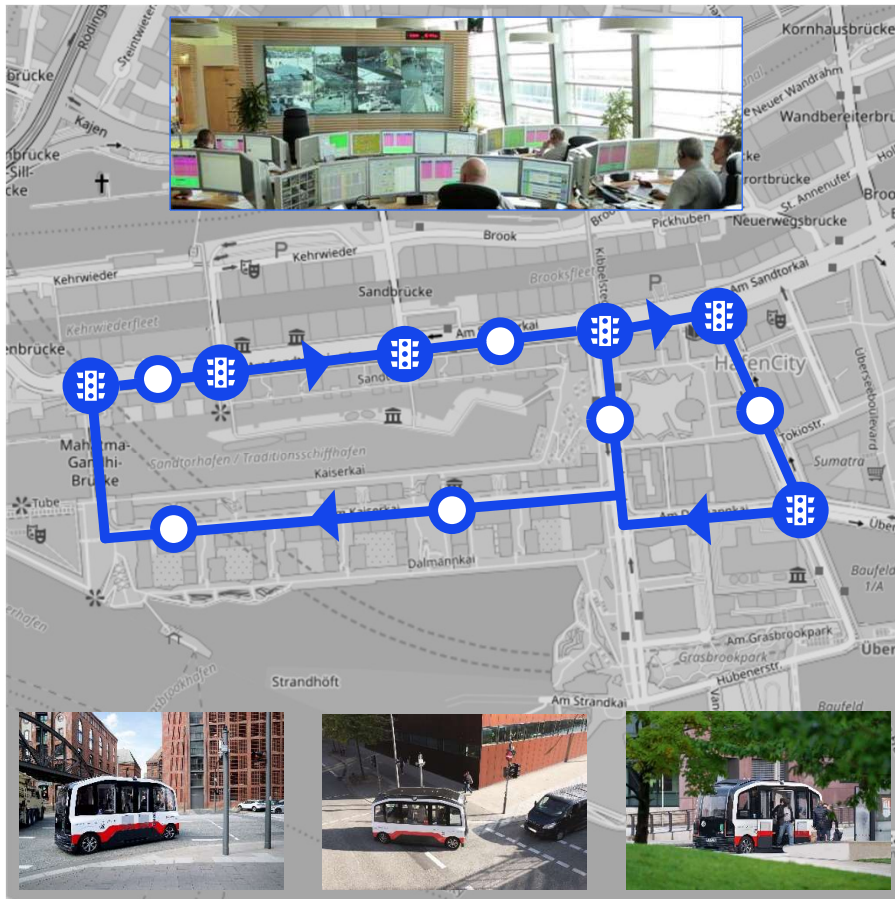
– Cabin sensing with increasing importance, accelerated by introduced laws and regulation → enabler for multiple functions

- General Safety Regulation (GSR)
- Guobiao Standard (GB/T China)
- European New Car Assessment Programme (EuroNCAP)

– New sensor technologies widen the spectrum of feature application

Functions				
Personen- & Gegenstandsidentifizierung	✓	✓		⚙️
Sitzschlüsselverriegelung		✓		⚙️
Videoüberwachung & „Social“ Media		✓		
Zustellstatusüberwachung & Fahrererkennung		✓		
Sicherheitsfoto		✓		⚙️
Bedienungsoberflächenverfolgung	✓	1/3		
Handlungsprotokollverfolgung	✓	1/3		
Handlungsprotokollverfolgung	1/3	1/3		
Sichterkennung	✓	(1/3)		
Stimmenerkennung	✓			
Geolokalisierung				⚙️
Personenverfolgung			⚙️	⚙️
Videoüberwachung	⚙️	⚙️	⚙️	⚙️
Videoüberwachung / Ereignisprotokolle	⚙️		⚙️	⚙️

Reference project HEAT – Fully operational in 2020/2021

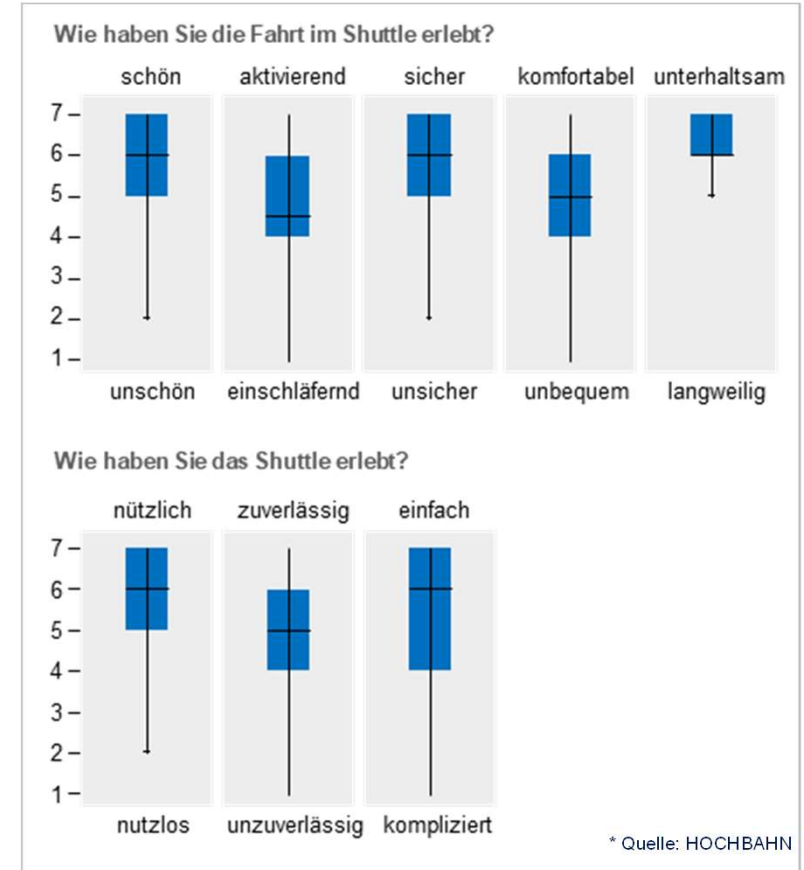
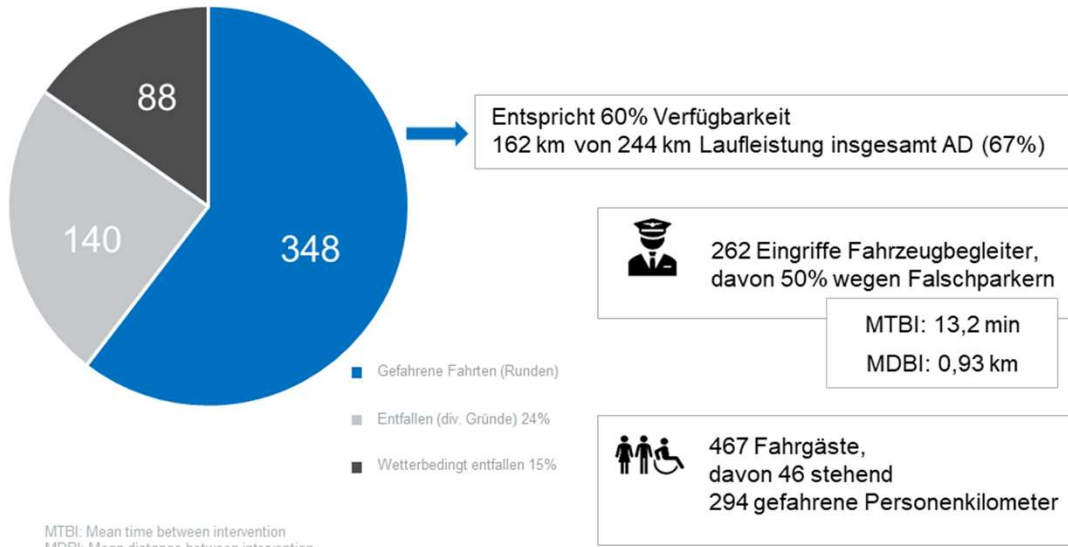


- 10 Local infrastructure installation at critical areas
- Autonomous driving solution (vehicle, E/E and SW)
- Central control center by HOCHBAHN
- The operation:
 - Fully integrated services of all subsystems
 - Shuttle with dynamic driving in urban area and public road without any restriction or ODD adaptation
 - 1,8 ..2,3 km distance with complex scenarios
 - Shuttle operation is directed [strategic plan] directly from control center

- Partners:
 - SIEMENS**
 - HOCHBAHN**
 - hy SOLUTIONS** Innovative Antriebe für Hamburg
 - Hamburg**
 - IKEM**
 - Deutsches Zentrum DLR für Luft- und Raumfahrt



Survey results from early 2020 operation [3 weeks continuous]



- Dynamic driving adaptation and take-over for obstacles
- Improvements for data fusion of vehicle and infrastructure information for increased driving performance

Intelligent to your destination



Using automated & connected driving functions for future-proof mobility solutions



Backend Services & Control Centre



Safety & Reliability in Development & Operation



Intelligent Infrastructure



Dynamic Driving Functions



Adaptive Cooperative Traffic Control





Look forward ...

Robustness of automated driving & Approval & Homologation of products

Digitization & Provisioning of available data

Maintenance (SLA) for digitized data & services

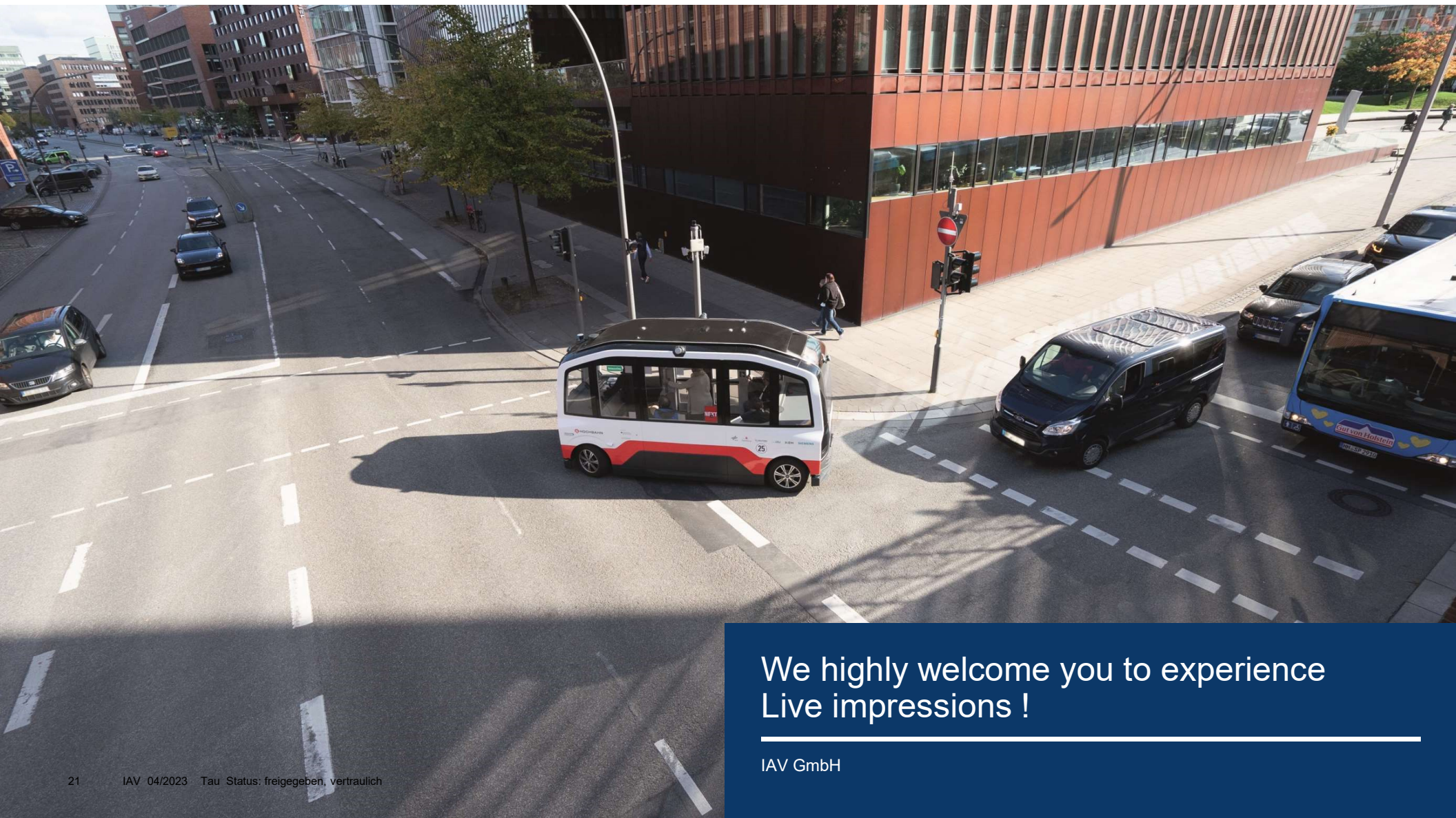
Rollout/Extension of infrastructure incl. operation model ?

Connectivity of all road users

→ Focus towards deployment in regular operation

→ Start in defined/confined application (Pilot Areas)

→ Introduction of operational autonomous systems on public roads in 2025 ?



We highly welcome you to experience
Live impressions !

IAV GmbH

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