Siemens Mobility Operating System: Empowering Cities

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Agenda

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1 Smart city vision

2 Current mobility challenges and trends in cities

3 Our Solution: Siemens Mobility Operating System

4 Functions, features and use cases

5 Technological approach

Smart city vision – Improve quality of life by leveraging digital technologies in three major areas

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Smart Facilities
Efficient and safe

Smart Energies
Renewable and decentralized

Smart Mobility
Electric and intermodal

Smart city vision – Unlock potentials for a safer, cleaner and more efficient city

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30 – 300
lives saved each year in a city of 5 million

8 – 15%
lower disease burden

15 – 30
minutes less in daily commute

30 – 40%
fewer crime incidents

25 – 80
liters of water saved per person per day

20 – 35%
faster emergency response times

What are the trends and challenges cities are facing with regard to mobility?

Selected challenges and trends with regards to mobility

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Congestion and safety

Environmental issues

Painful (intermodal) travel

Uncoordinated micro mobility services

Autonomous and connected vehicles

Increasing amount of mobility data

Increasing city air traffic

More and connected travelers

Cities have to keep balance between mobility demand, environment and safety

Our answer …

The Siemens Mobility Operating System – “MobilityOS”

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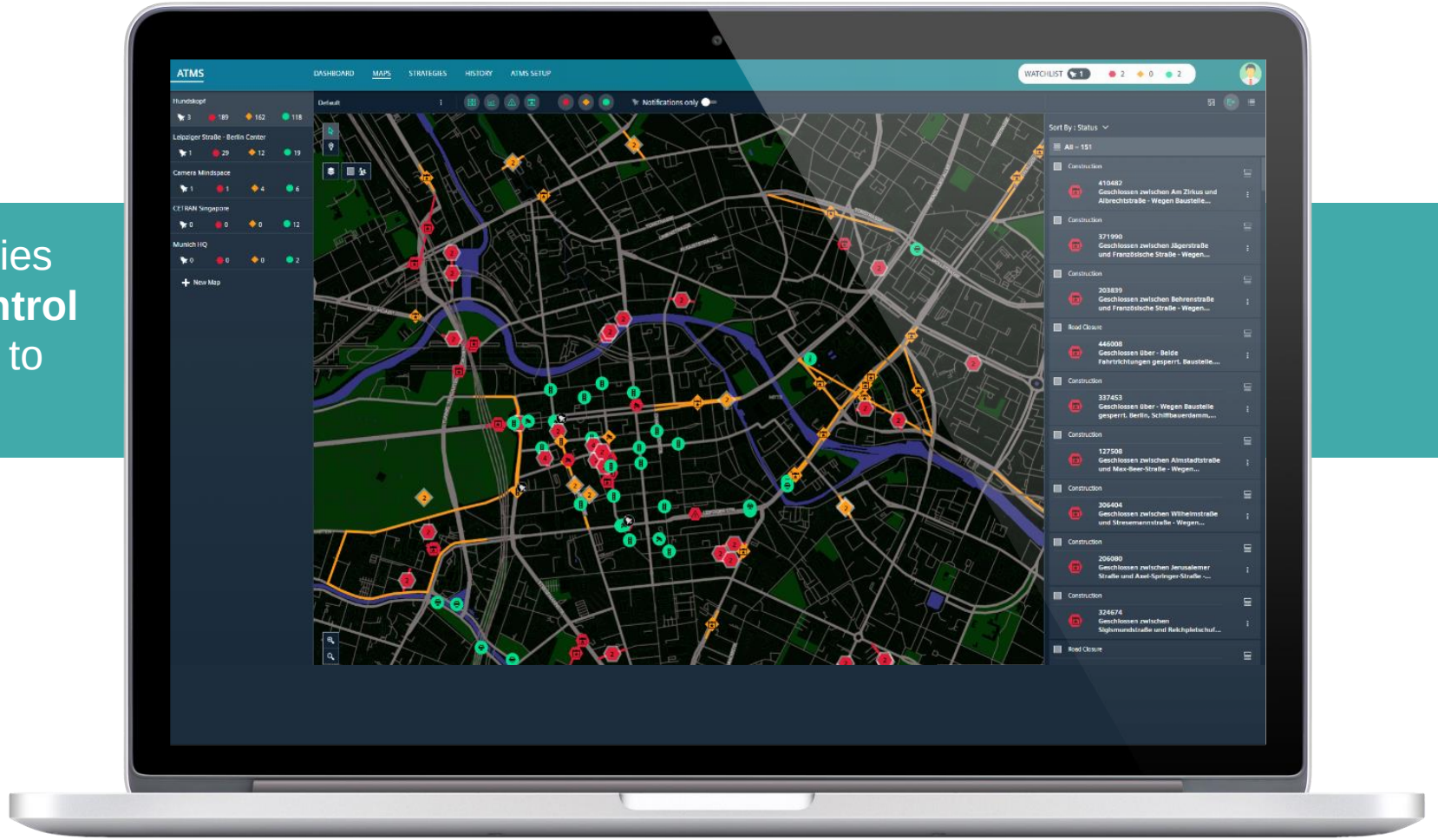
It is a **system of systems** for cities and authorities to **gain back control** over the mobility ecosystem and to manage it holistically



The Siemens Mobility Operating System

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Enable higher automation in traffic and mobility management

Set the rules and gain control over all mobility providers

Improve safety, efficiency and air quality

Enhance individual travel across the whole city

Fast response on irregularities and incidents

Overall mobility monitoring and management

The Siemens Mobility Operating System

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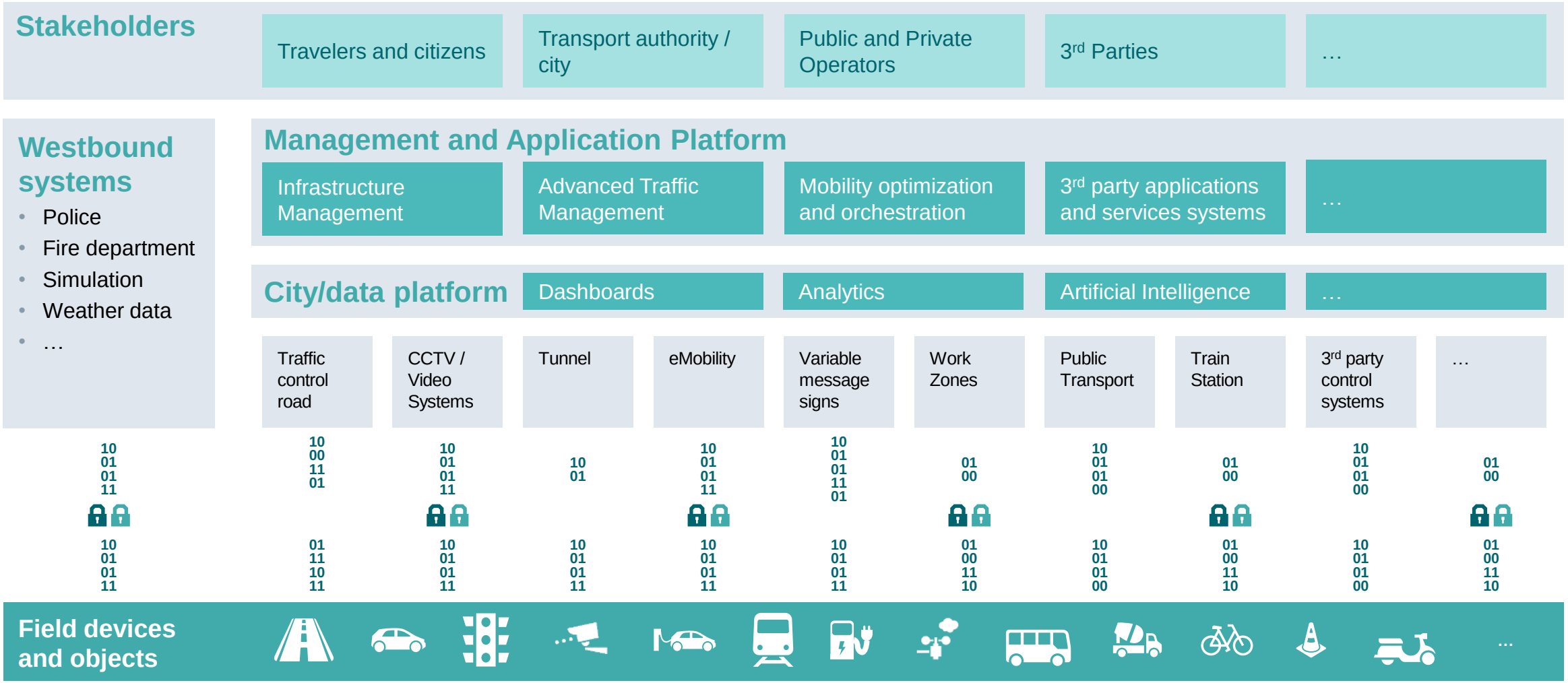

Functions (1/3) – Monitoring

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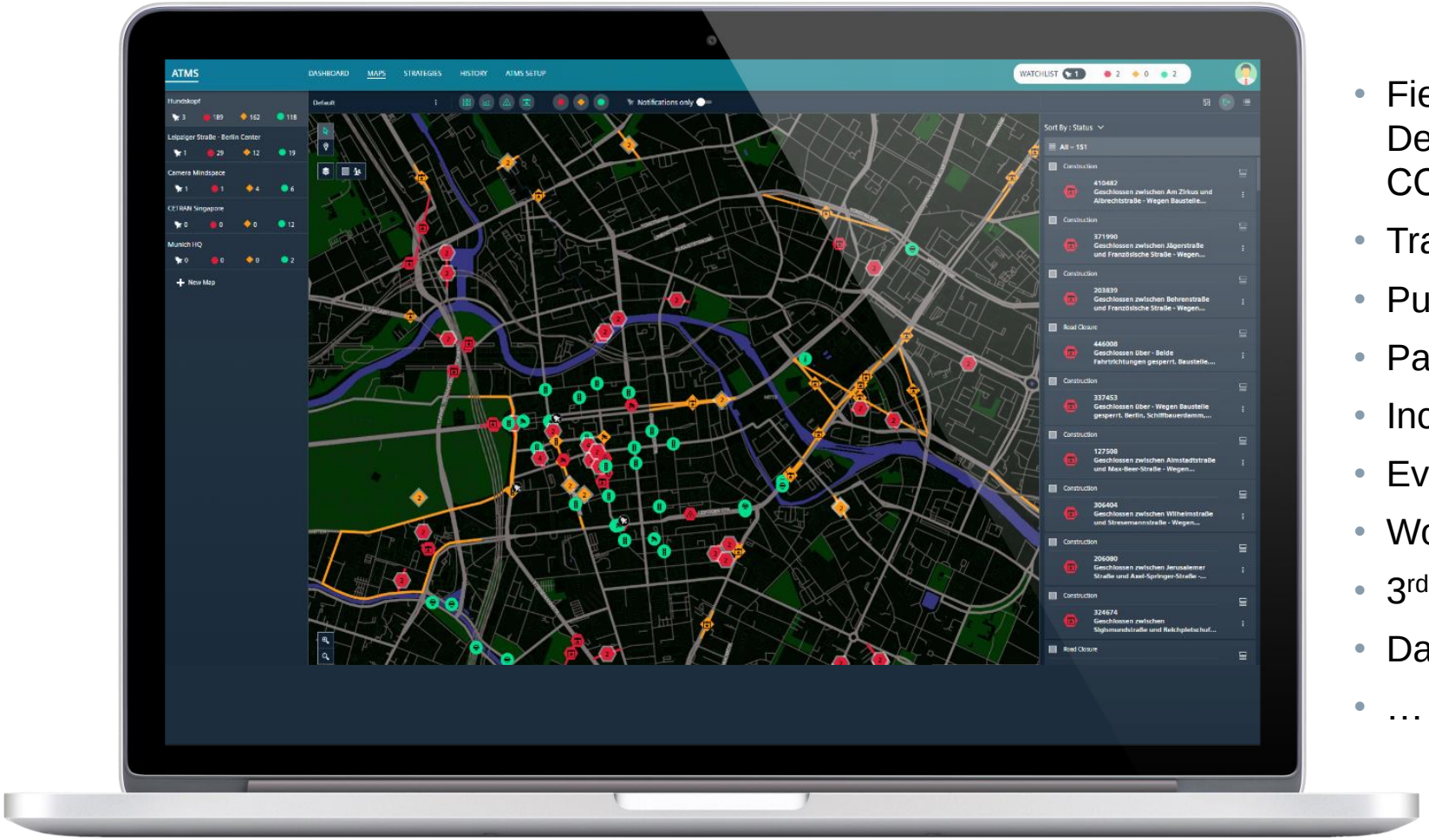
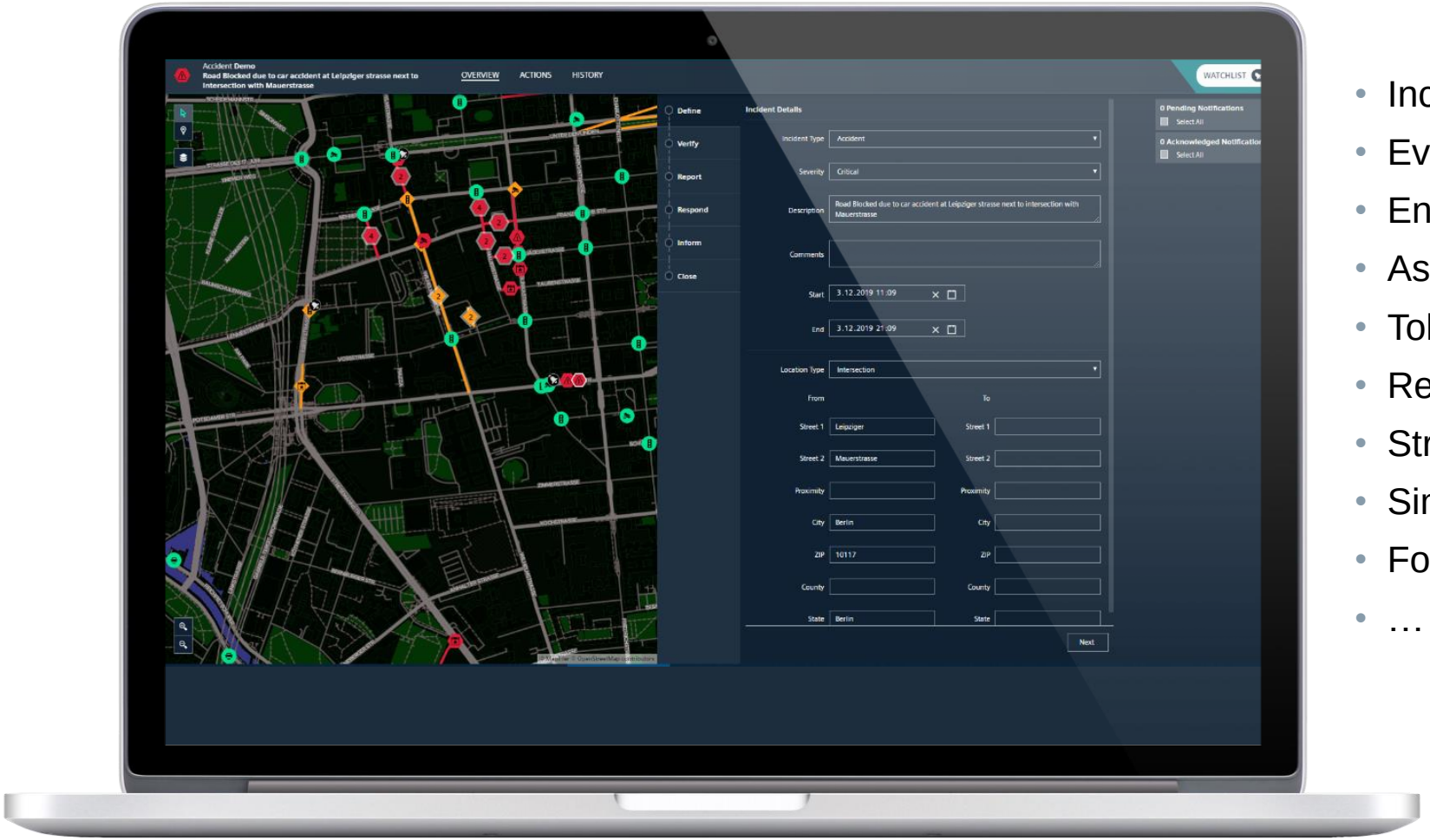


- Field Devices, e.g. Traffic Controller, Detection, Sensors, Weather Data, CCTV …
- Traffic Status
- Public Transport Status
- Patronage
- Incidents
- Events
- Work Zones
- 3rd Party Systems
- Dashboards
- …

Functions (2/3) – Operational Management



- Incident Management
- Event Management
- Environmental Traffic Management
- Asset Management
- Toll and Fare Management
- Response Plan Creation
- Strategy Management
- Simulation
- Forecasting
- …

Functions (3/3) – Governance Management

- Rule Setting (e.g., Speed Zone)
- Enforcement
- Irregularity Management
- Workflow Management
- Traffic Demand Management
- Demand Responsive Transport
- Mobility as a Service
- Use Case Engine
- Simulation
- Information Management (Email / Social Media…)
- …

Elements of the MobilityOS

The user …

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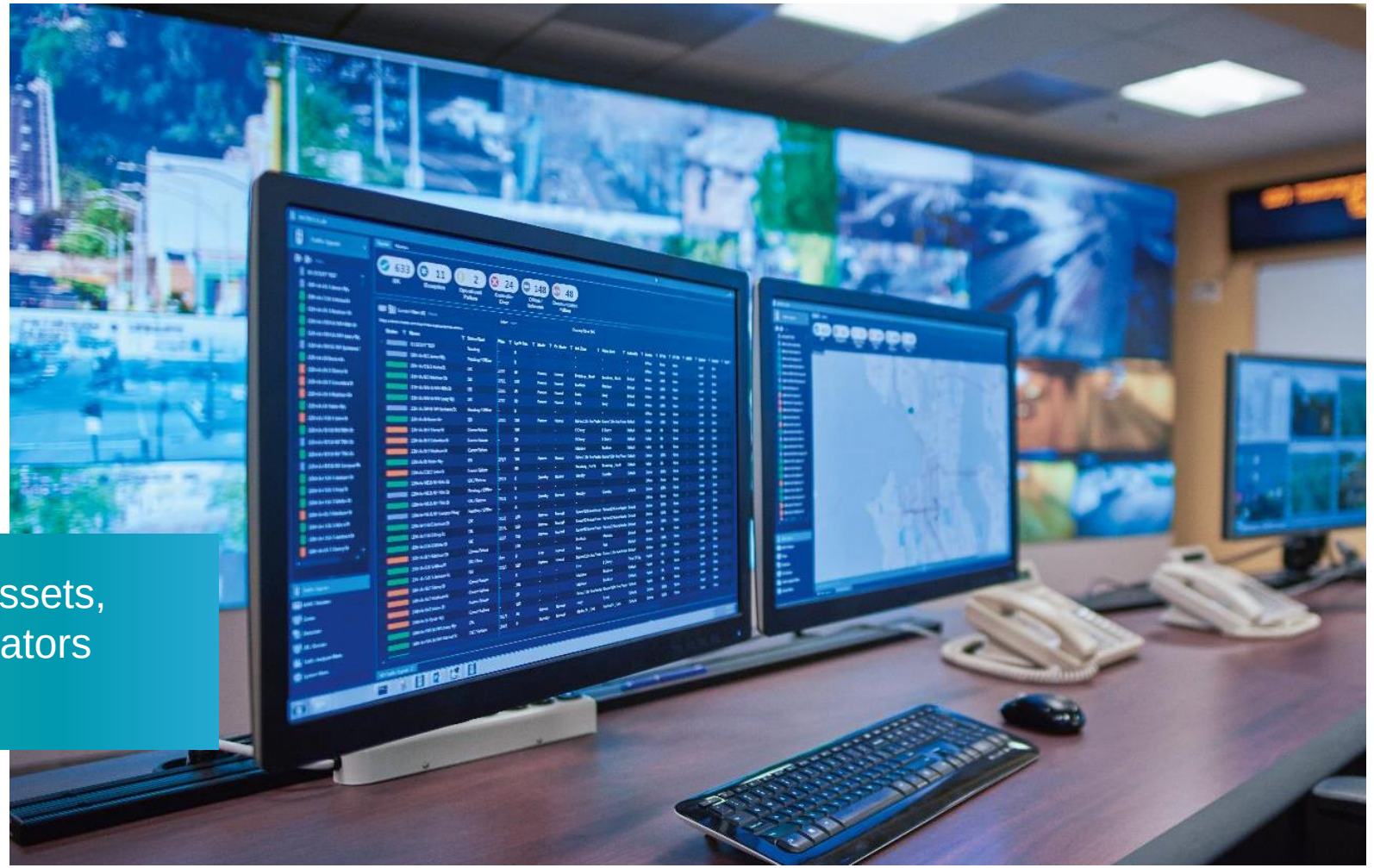
…is a **operator from a City / DoT** or (on behalf of the authority) a private company.

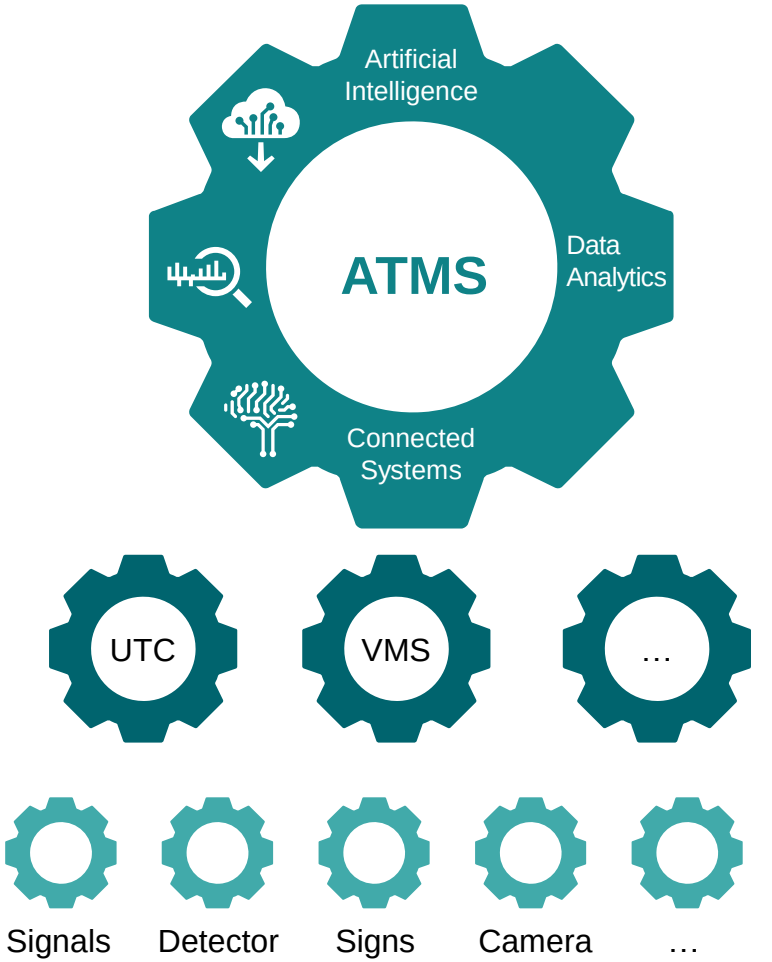
His goal is to **holistically orchestrate mobility** on a Government-to-Business / Consumer approach (G – to – B and C).

He is a **Multimodal Mobility Operator**.



We enable Authorities to manage assets, traffic, mobility, public / private operators and consumers / travelers

Advanced Traffic Management System sits in the center….



Management layer

(Sub-) system/ control layer

Field devices layer

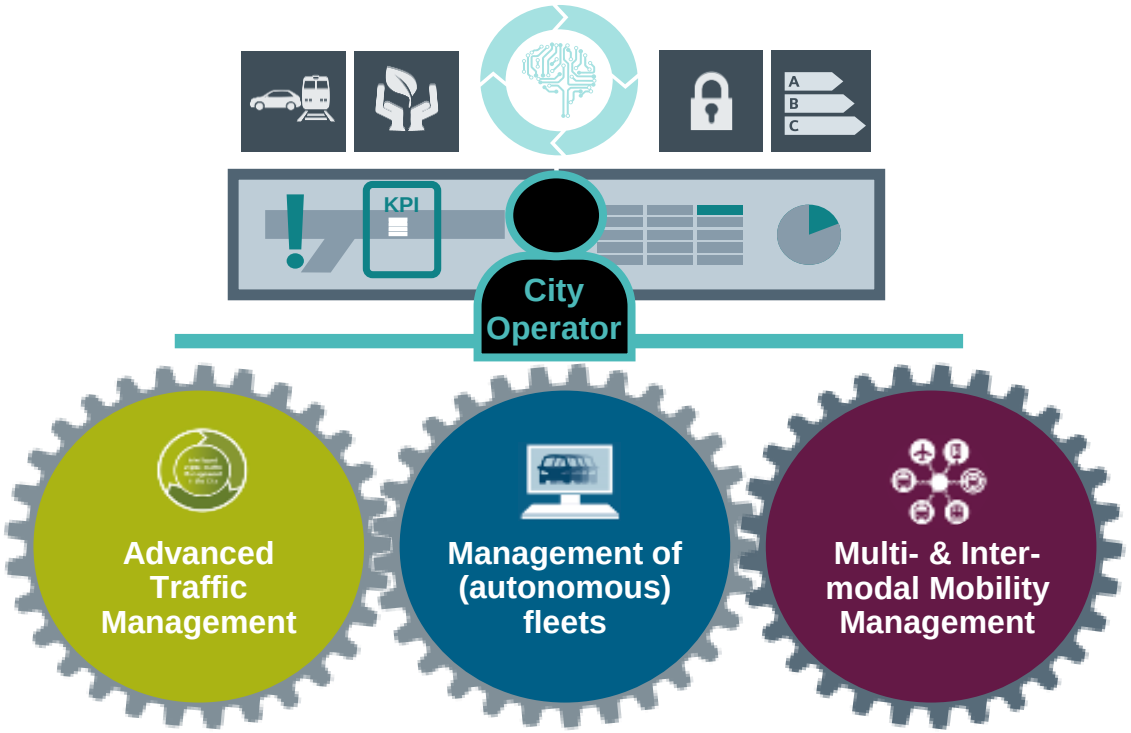
- Comprehensive overview
- Aggregated information of selected functions of subsystems
- Combination of information and creation of new insights
- Advanced applications
- Decision support and decision taking
- Action triggers
- …

- One subsystem for each field devices type
- Detailed management of field devices with
- …

- **Collectors:** Traffic and environment data, video/image stream
  Actors: Information visualization, traffic lights
- …

UTC: Urban Traffic Control I VMS: Variable Message Signs

….and is enhanced by fleet management and multi- and intermodal mobility management



System connection

- Take control over your city's transportation and mobility environment
- Define KPI's and rules
- Manage demand and supply
- Enable seamless intermodal connection
- Optimize first and last mile
- Reduce congestion and pollution
- Achieve energy and safety targets
- Ensure information flow
- ….

Basis – Open data model with data platform

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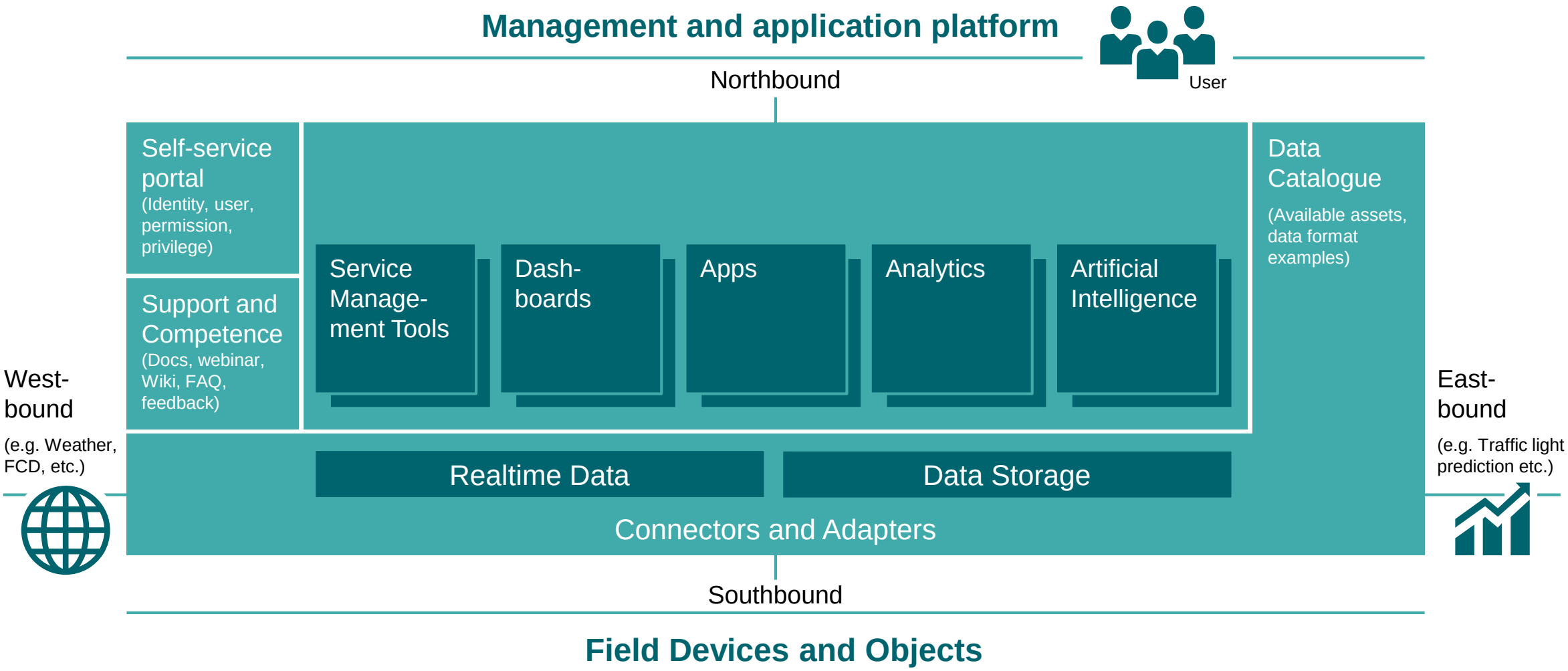

Simulation & Forecasting – a key element for effectiveness and efficiency

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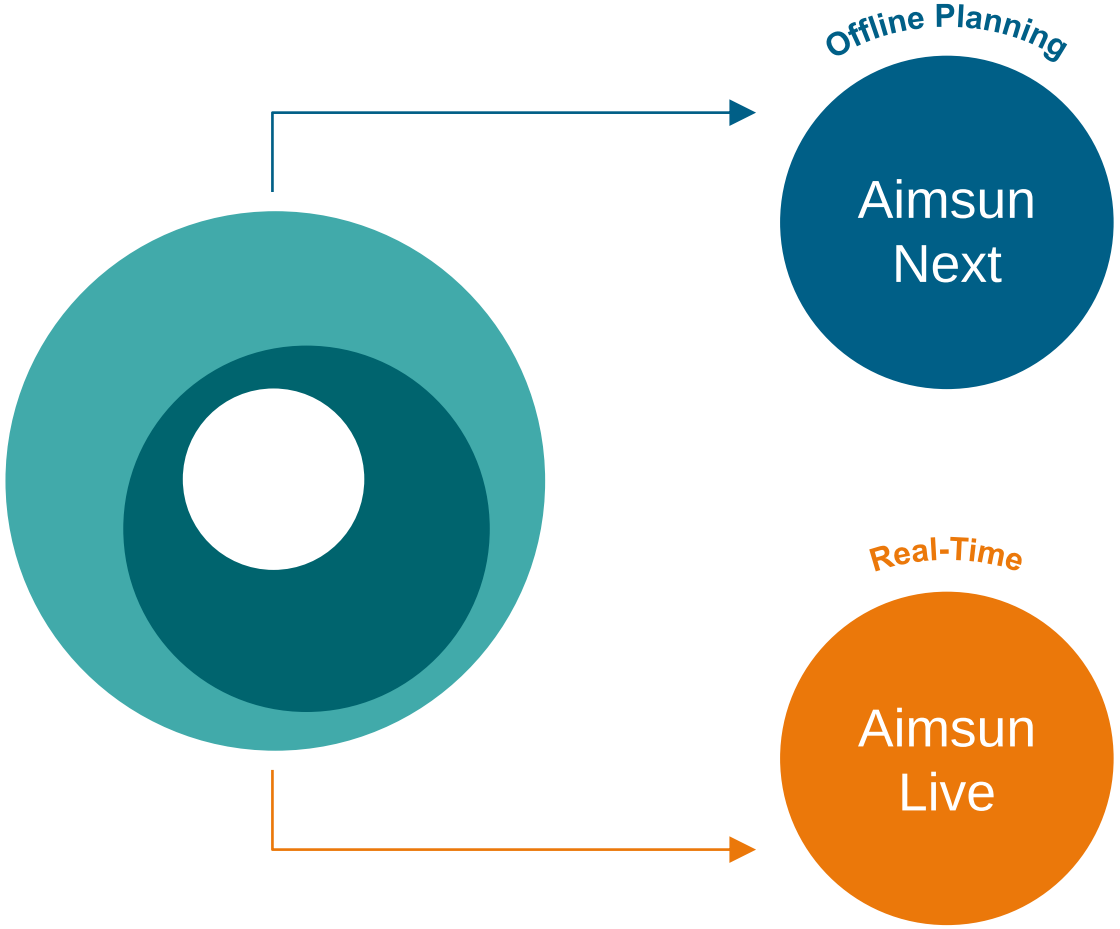

What is the impact of a…

… road user charge

… bus bay

… capacity increase

… higher frequency

What would happen in 60 minutes from now if I …

… try to avoid emissions with a green wave

… raise the charge

… close the right lane

… do nothing

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MobilityOS use cases

Use case 1: Train breaks down five stations before the airport – Provide solution with minimum delay for passenger

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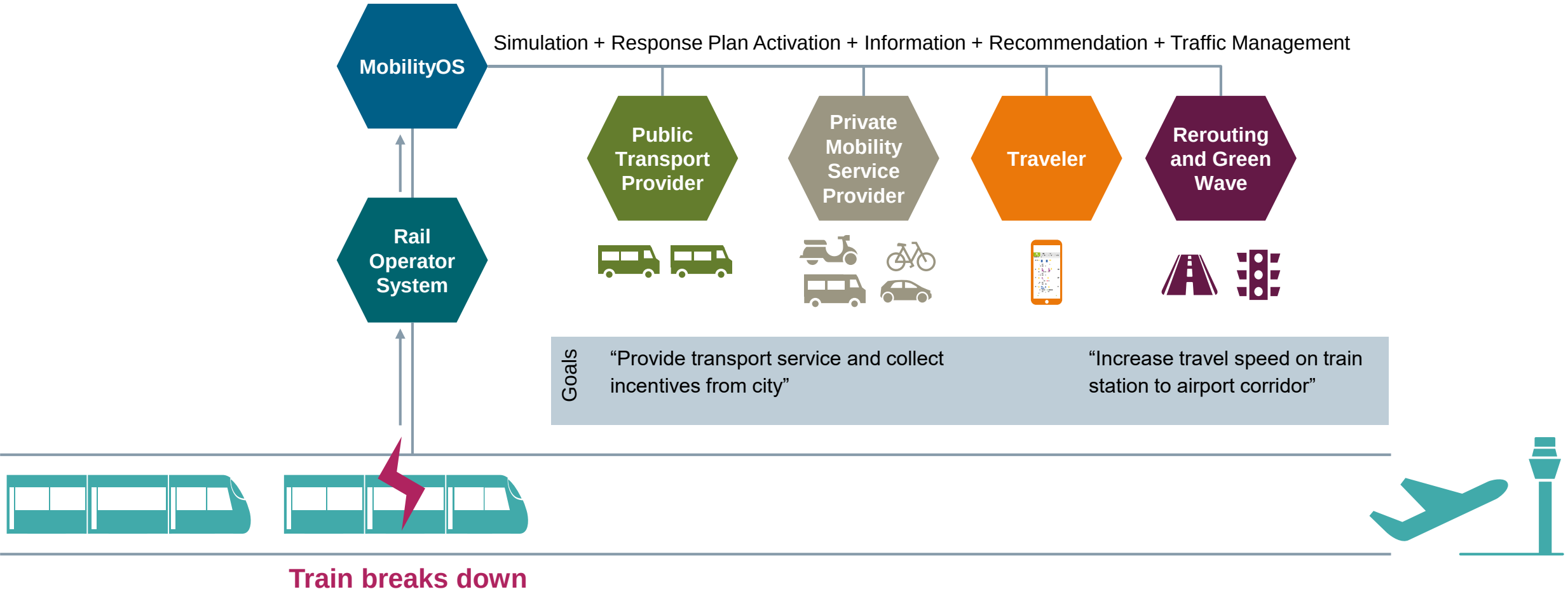

Use case 2: Emission reduction in city traffic

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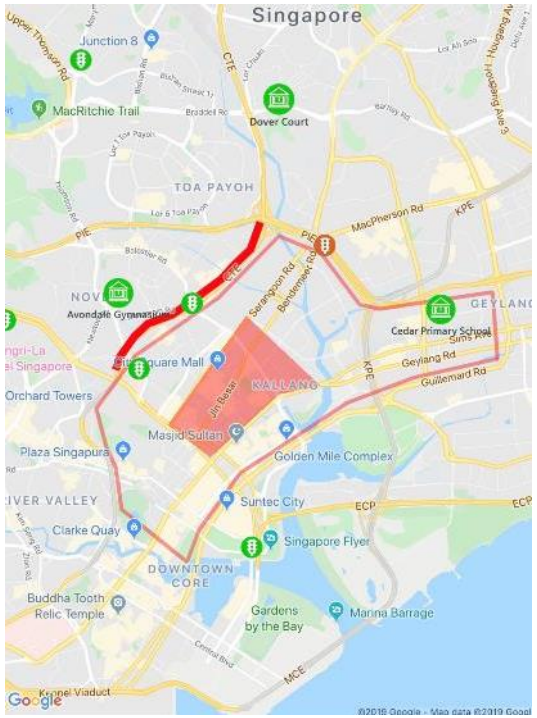
Cities' challenges are increasing – Pollution in city centers on the rise

- **Rush hour** traffic **adds unnecessary emissions** and **cities pollution increases**
- **High pollution levels** are **detrimental**
- **Demand** for **emission cuts, better air quality and decarbonization rising quickly**
- **City** therefore **wants to/needs to**
  1. **Minimize CO_2** and **particle pollution**
  2. **Provide safe** and **convenient journey**
- **Existing models do not** assess real-time **vehicle mix** – no prediction how changes in traffic flow affect fuel use and emissions

MobilityOS enables cities to reduce traffic emissions



Exemplary functionalities: Predict – Simulate – Steer traffic

1. **Predict emission hot-beds and timing peaks** using historic data
2. **Provide info** on **fuel consumption** and **emissions** from **real-time vehicle mix** on the road (from buses to e-scooters)
3. **Simulate** optimal **emission reduction** options using **dynamic routing, traffic-light optimization** and **smart parking**
4. **Restrict individual car access,** activate **dynamic road tolling,** adjust **PT fare prices** and **incentivize electric MaaS providers** (e.g., eBike, eScooters)
5. **Actively inform travelers** about **route options** incl. impact (cost & environment)

Use case 3: Incident management

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Major disruptions in the transport network require a rapid response

- Fast detection (e.g. automatic incident detection via cameras or detectors)
- Simulation & prognosis evaluate different action alternatives
- Implement the most efficient measures and strategies to reduce the impact
- Efficient coordination with other stake-holders to handle the incident (e.g. police, road services, fire brigade)

Use case 3: Incident management – Automated notifications and recommendations

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Your journey to the office takes 20 minutes longer today.

Take the public transport to be faster.

Traveler

Mobility Service Manager

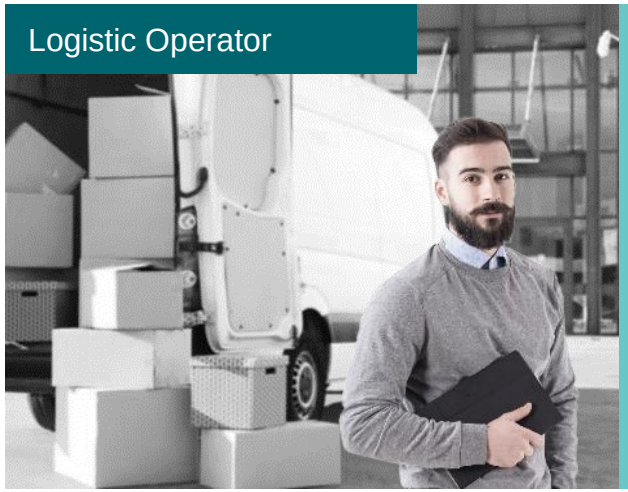
Blockade on Oxford St.: High traffic load

Deactivate rental of vehicles within a radius of 600 m.

Blockade on Oxford St.

Please divert lines 181, 203, 244 via Liverpool Street.

Public Transport



Logistic Operator

Blockade on Oxford St.

Within this area deliver your goods with cargo bikes

Use case 4: Mobility service provider regulation

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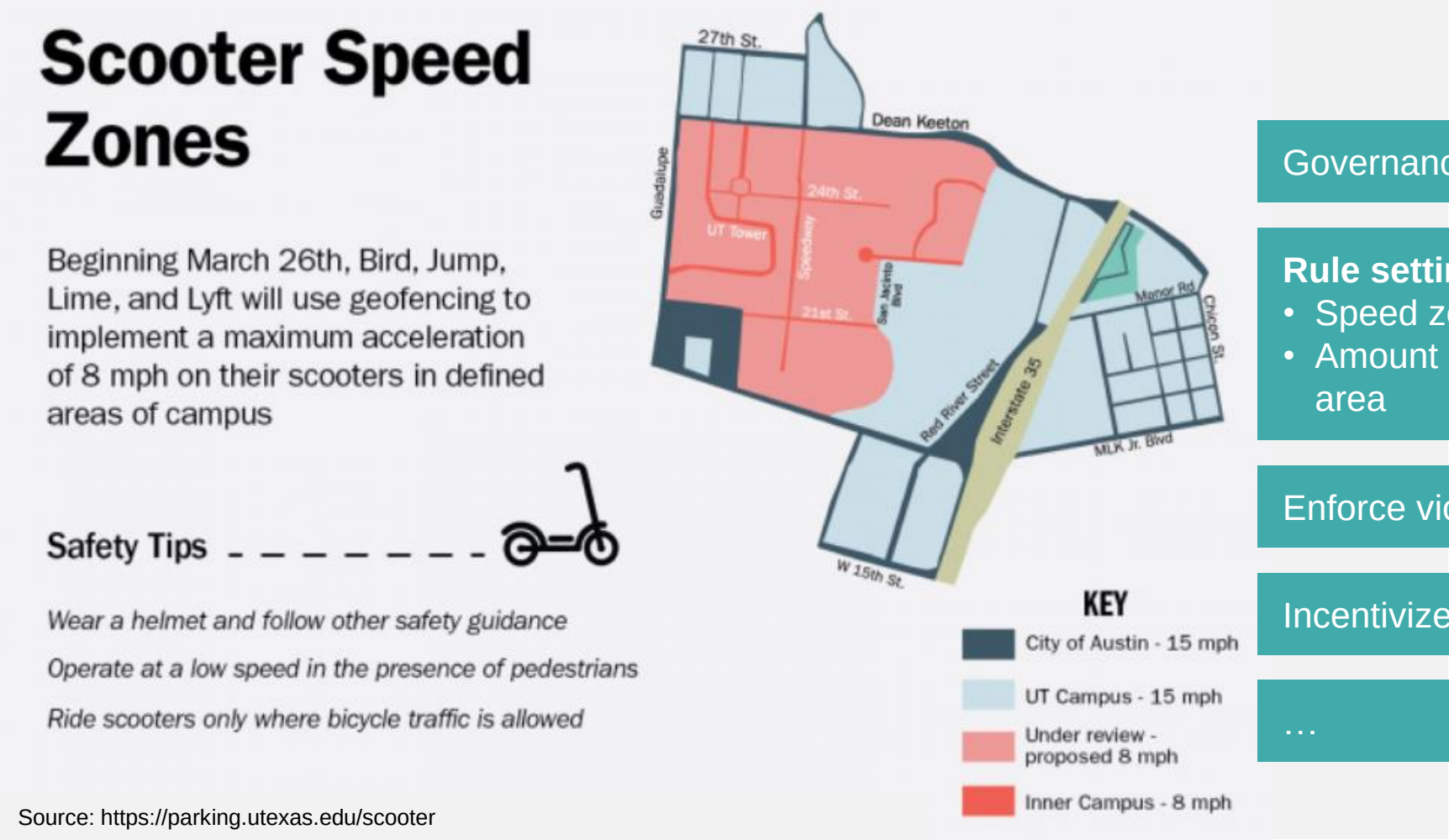

Source: https://parking.utexas.edu/scooter

- Governance
- **Rule setting e.g.**
  - Speed zone
  - Amount of devices within a specific area
- Enforce violations
- Incentivize positive behavior
- …

Use case 5: Safety zone

Establish dynamic safe zones e.g.
- Elementary school
- Hospitals
- Shopping center
- …

Set rules for activation / deactivation

Limit access for specific fleets (e.g., car sharing, trucks)

Enforcement via video / ANPR systems and/or live data from operators

Use case 6: User behavior incentivization

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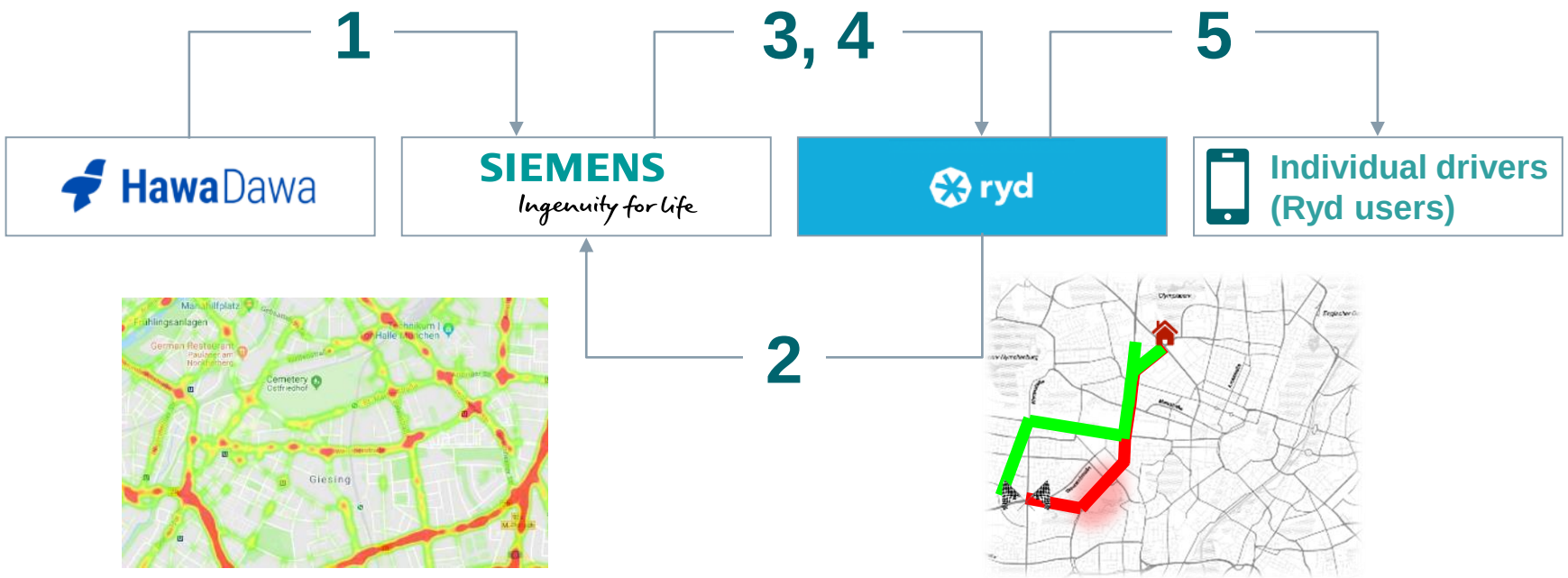

1 Pollution forecast

2 Anonymized historical trip data

3 Predict individual routes

4 Provide more ecofriendly alternative

5 Incentivize alternate route

Pollution hotspot Typical route Alternate eco-route

Use case 7: Demand Responsive Transport (DRT)

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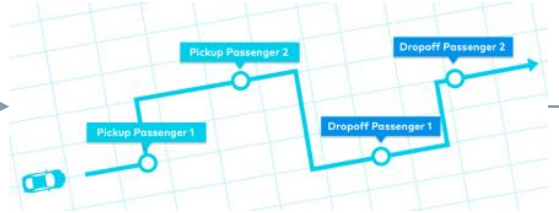
DRT Platform



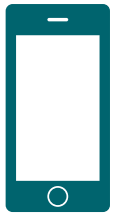
DRT is attractive and cost saving offer for passengers

Adapts dynamically to demand with flexible routes and schedules

Ride Sharing is efficient for providers

Digital technologies automate and optimize fleet mgmt. and operations

Traveler App



Driver App

Flexible management of fleets will lead to

1. Planning
2. Demand analytics
3. DRT technology
4. Intermodal traffic management

Use case 8: Freeways and their interfaces

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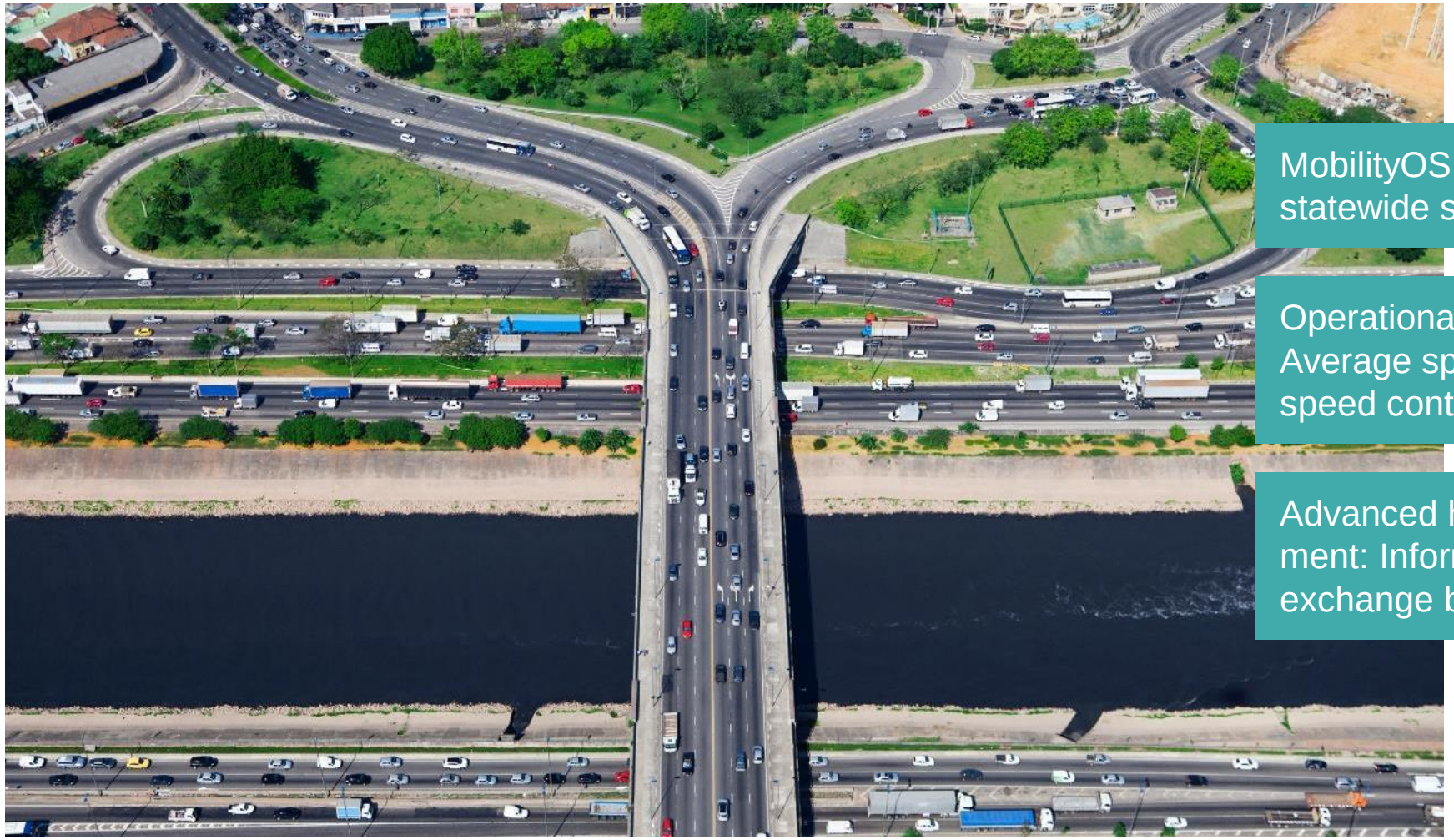

MobilityOS for highways as overarching statewide system

Operational highway management: Average speed, weather condition, speed control, prioritized lanes, etc.

Advanced highway corridor management: Information and strategy exchange between cities and highways

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Design Principles

Design Principles

- **Cloud and on-premise deployment**
- No special hardware needed
- **Modern microservice-based architecture**
- Easily extendable
- Scalable
- No vendor lock-in
- **Integrations easily possible through innovative adapter concept**
- Web / Tablet / Smart Phone access possible
- **Configurable workflows**
- …

Cloud based deployment

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Benefits

Cost/Time effective solution:
No additional hardware and server investments/efforts and maintenance required

Scalability: Dynamic adaption of infrastructure resources depending on the current needs

- Virtual machines
- Storage
- Performance

Increased collaboration

Disaster recovery

Microservices

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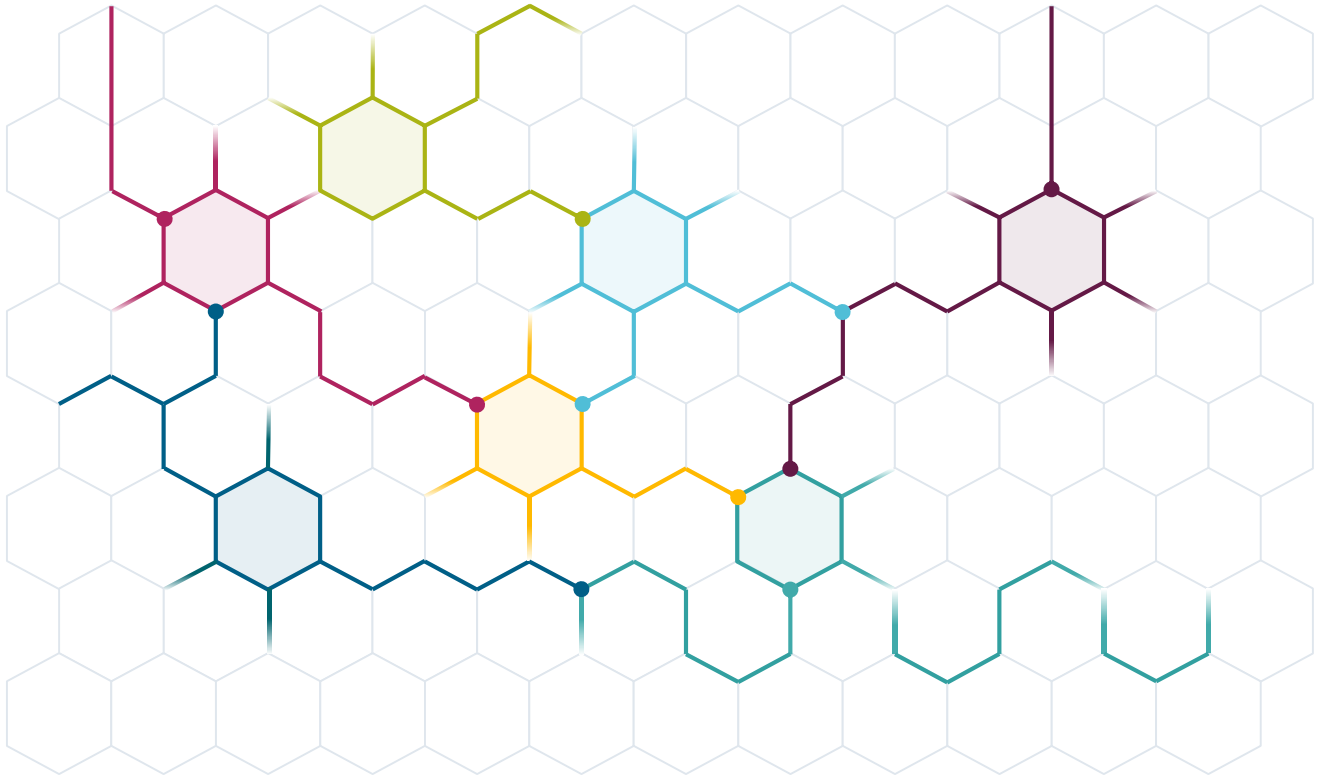


Benefits

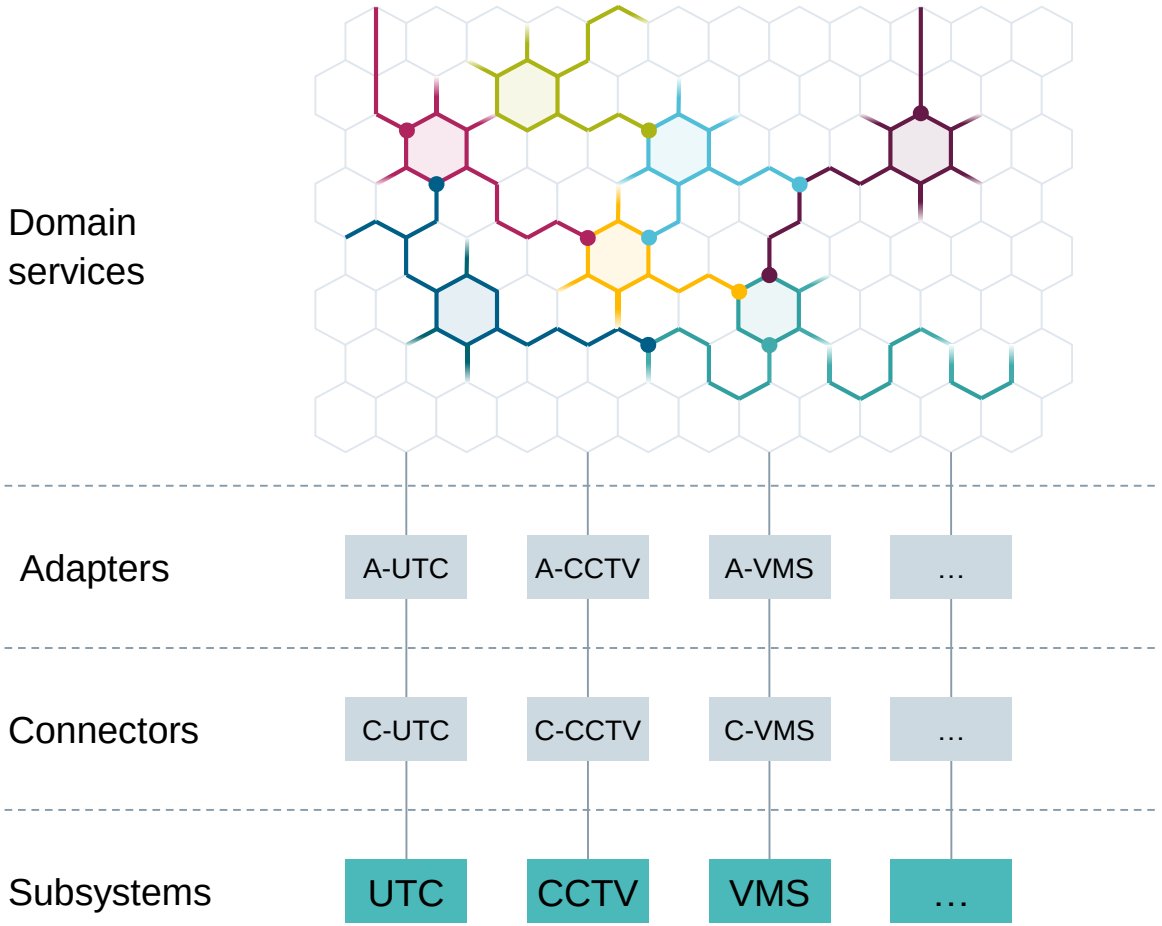
Resilience

- Independent Services: Failure in one service does not impact other services
- Services are at least available twice

Scalability

- New subsystem can be additionally integrated into the system and operated without affecting the operation of the other services
- Easier Management: It's easier to manage services when they're split up into smaller, easily developable functionality modules

Easier integration of subsystems



Benefits

- Easier and time effective integration of the subsystems from third-party
- Using adapters to convert and process subsystem data to internal model
- Using connectors to implement the data exchange
- Continuous delivery of technology features to the traffic management system, for example
  - C2X integration
  - Autonomous vehicles
  - Demand Responsive Transport integration

UTC: Urban Traffic Control I CCTV: Closed Circuit Television I VMS: Variable Message Signs I C2X: Car to Infrastructure Communication

Configurable workflow in various use-cases

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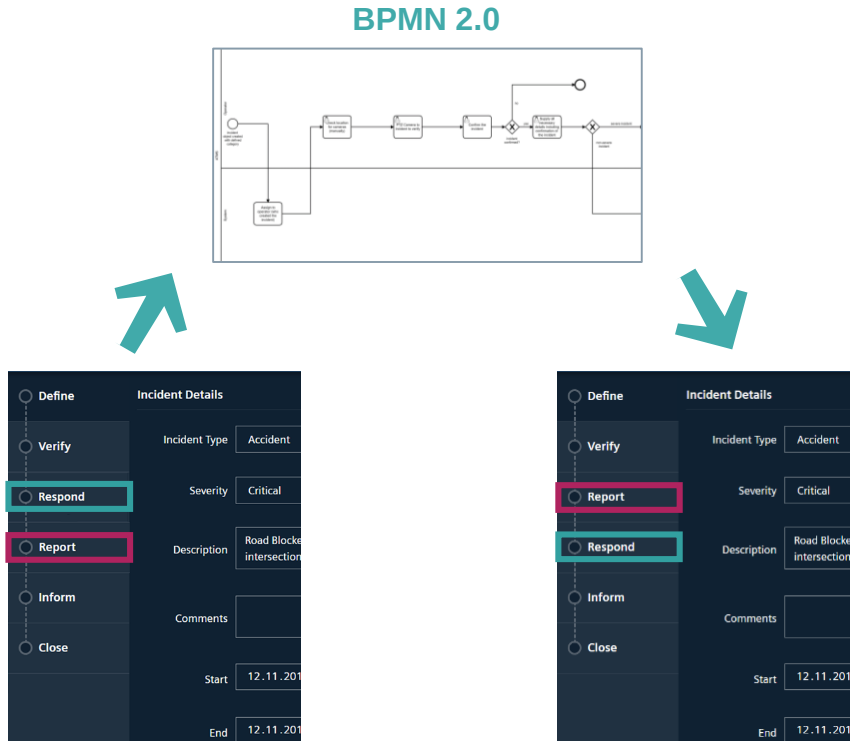
Features and Benefits

- Operator workflows are organized via business processes using **BPMN 2.0** standard
- Intuitive design and notation of workflows
- Workflow is easily configurable according to the client's specific requirements by the client himself
- It allows process deployment into an engine in the backend
- Short time from idea/process change to execution
- Fast testing and continuous improvements



BPMN: Business Process Model and Notation

Outlook – One solution for all dimensions of city's mobility

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City air

Ground

Underground

Siemens Mobility Operating System changes the whole mobility of a city by creating an ecosystem for all relevant stakeholders.