Siemens Mobility Operating System: Empowering Cities
Max Eichhorn, Head of the Mobility Operating System
Agenda

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

- **Smart Energies**
  - Renewable and decentralized

- **Smart Facilities**
  - Efficient and safe

- **Smart Mobility**
  - Electric and intermodal
Smart city vision – Unlock potentials for a safer, cleaner and more efficient city

- 30 – 300 lives saved each year in a city of 5 million
- 8 – 15% lower disease burden
- 30 – 40% fewer crime incidents
- 15 – 30 minutes less in daily commute
- 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

- 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”

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

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

Goals
# The Siemens Mobility Operating System

## Stakeholders
- Travelers and citizens
- Transport authority / city
- Public and Private Operators
- 3rd Parties
- ...

## Westbound systems
- Police
- Fire department
- Simulation
- Weather data
- ...

## Management and Application Platform
**Infrastructure Management**
- Advanced Traffic Management
- Mobility optimization and orchestration
- 3rd party applications and services systems
- ...

## City/data platform
**City/data platform**
- Dashboards
- Analytics
- Artificial Intelligence
- ...

### Field devices and objects
- Traffic control road
- CCTV / Video Systems
- Tunnel
- eMobility
- Variable message signs
- Work Zones
- Public Transport
- Train Station
- 3rd party control systems
- ...

### Management and Application Platform
- **Infrastructure Management**
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- **Mobility optimization and orchestration**
- **3rd party applications and services systems**

### City/data platform
- **Traffic control road**
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- **Variable message signs**
- **Work Zones**
- **Public Transport**
- **Train Station**
- **3rd party control systems**
Functions (1/3) – Monitoring

- 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 …

…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....

- 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
  - ...

Artificial Intelligence

Data Analytics

UTC

VMS

…

(Sub-) system/control layer

Field devices layer

Management layer

Signals

Detector

Signs

Camera

…

UTC: Urban Traffic Control I VMS: Variable Message Signs

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 CES Press Event
....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

Management and application platform

Self-service portal (Identity, user, permission, privilege)
Support and Competence (Docs, webinar, Wiki, FAQ, feedback)

Service Management Tools
Dashboards
Apps
Analytics
Artificial Intelligence

Realtime Data
Data Storage

Connectors and Adapters

Northbound

Data Catalogue (Available assets, data format examples)

Westbound (e.g. Weather, FCD, etc.)

Eastbound (e.g. Traffic light prediction etc.)

Field Devices and Objects
Simulation & Forecasting – a key element for effectiveness and efficiency

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
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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MobilityOS

Simulation + Response Plan Activation + Information + Recommendation + Traffic Management

Rail Operator System

Public Transport Provider

Private Mobility Service Provider

Traveler

Rerouting and Green Wave

Goals

- “Provide transport service and collect incentives from city”
- “Increase travel speed on train station to airport corridor”

Train breaks down

“Provide transport service and collect incentives from city”

“Increase travel speed on train station to airport corridor”

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Use case 2: Emission reduction in city traffic

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 CO₂ 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

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 stakeholders to handle the incident (e.g. police, road services, fire brigade)
Use case 3: Incident management – Automated notifications and recommendations

Blockade on Oxford St.: High traffic load

Deactivate rental of vehicles within a radius of 600 m.

Your journey to the office takes 20 minutes longer today.

Take the public transport to be faster.

Blockade on Oxford St.

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

Blockade on Oxford St.

Within this area deliver your goods with cargo bikes.

Traveler

Mobility Service Manager

Public Transport

Logistic Operator
Use case 4: Mobility service provider regulation

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

ANPR: Automatic Number Plate Recognition
Use case 6: User behavior incentivization

1. Pollution forecast
2. Anonymized historical trip data
3. Predict individual routes
4. Provide more ecofriendly alternative
5. Incentivize alternate route

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Pollution hotspot  | Typical route  | Alternate eco-route
Use case 7: Demand Responsive Transport (DRT)

DRT Platform

- DRT is attractive and cost saving offer for passengers
- Adapts dynamically to demand with flexible routes and schedules

Traveler App

- Ride Sharing is efficient for providers
- Digital technologies automate and optimize fleet mgmt. and operations

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

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
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

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

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

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

City air

Ground

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