Graz FH Joanneum I Innovationen in der Fahrzeugtechnik I Oktober 12, 2015

Future of Urban Mobility – Electrification, Automation, Digitalization

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Agenda

- **Megatrends: A global perspective on urban mobility**
- **Digitalization of urban mobility: Project examples, incl. lessons learned**
- **Summary and outlook**

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We are in the urban millennium

Globalization

Demogr. Change

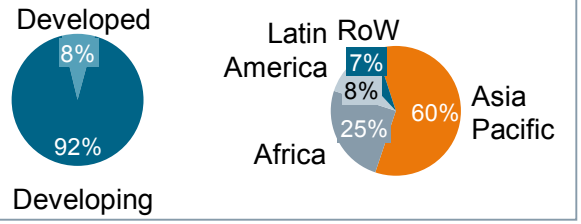
Urbanization

Climate Change

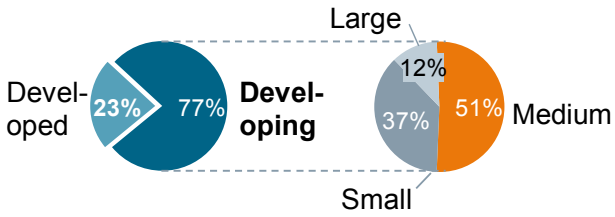
Digitalization

	2010	By 2030
Popu-lation	~50% of the world's population lives in cities	Urban population will grow from 3.5 billion to ~4.7 billion, mainly in developing countries
Economy	~50% of global GDP is produced in 600 cities; Top 100 cities with 38% of the global total	77% of global GDP growth will be generated by middleweight cities in emerging markets
Energy and CO_2	Cities account for two-thirds of the world's energy consumption and up to 70% of its CO2 emissions	Energy consumption pattern is dependent on city and industry structure

Urban popul. growth by 2030, by type/region



Urban GDP growth by 2025, by type



World energy consumption, by sector

End-use sector	2005 (in %)	2015 (in %)
Commercial	14	13
Industrial	8	7
Residential	51	54
Transportation	27	26

Sources: UN DESA 2014: World Urbanization Prospects; McKinsey 2011: Urban World

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Example:
Urban development of Jakarta and Delhi 1975-2010

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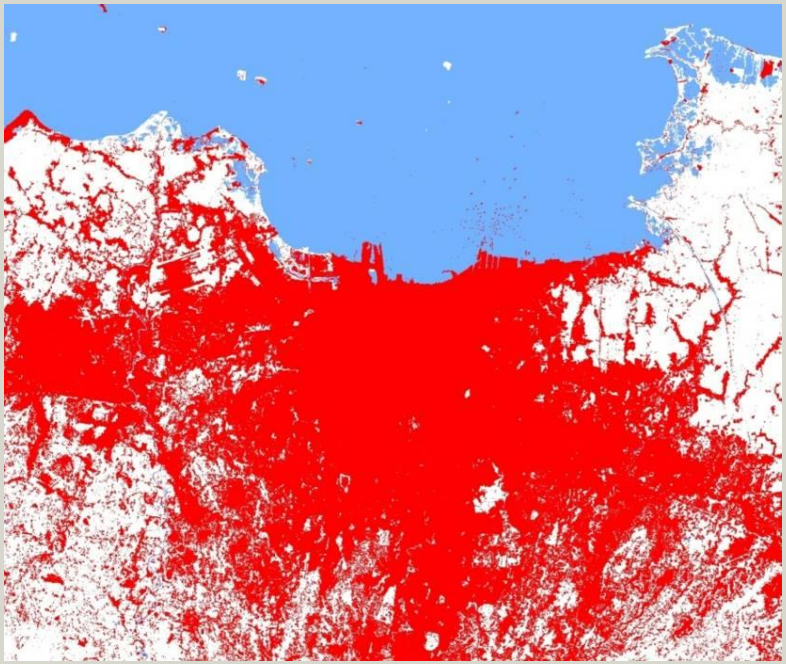
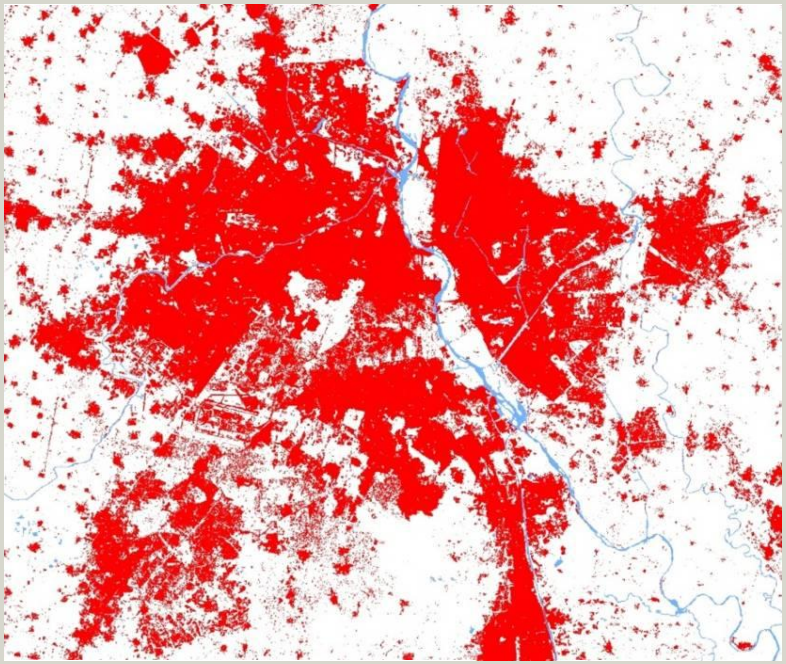
Jakarta 2010

9.2 million



Delhi 2010

22.2 million



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Urban mobility is No. 1 priority of city decision makers, with strong overall growth until 2050

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Fundamental requirements

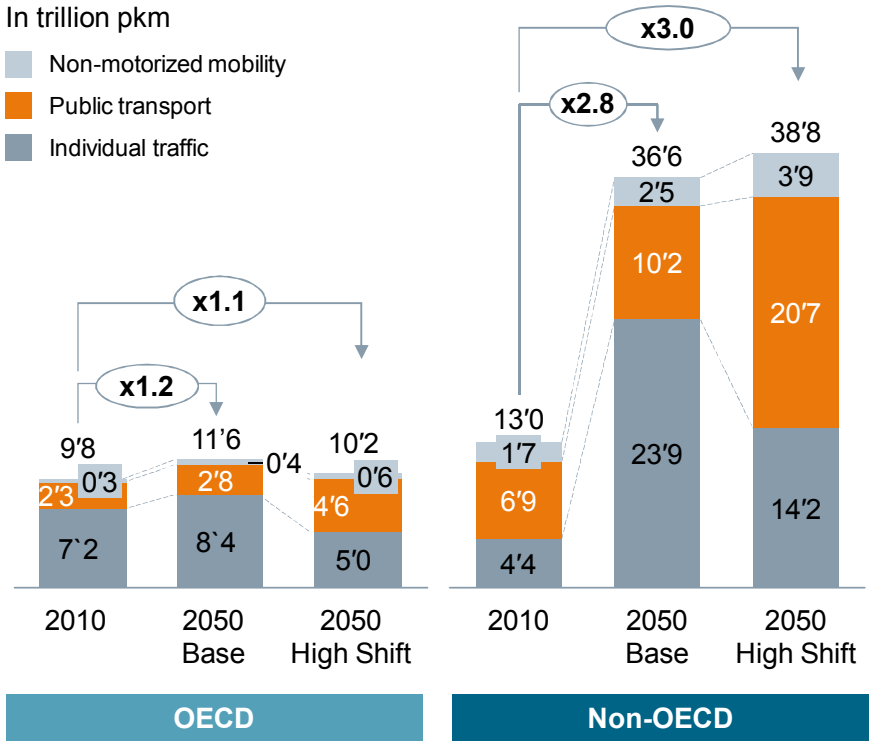
Efficient transportation of people and goods

Reliable and efficient supply of energy

Low emissions, water usage and waste

Comfort, quality of life and security

Demand growth in urban mobility, by mode



Key trends

- **Significant overall demand growth** until 2050 (x2,2) mainly non-OECD driven
- **Highest growth:** India (x3.7), Africa (x3.3), China (x2.8)
- **Base Scenario:**
  - Strong growth of individual traffic (x2.7), only modest growth (x1.4) of public transp.
  - Very high risk of gridlock: Congestion, energy/emissions
- **High Shift Scenario:**
  - Disproportional increase of public transport (x2.7), in both OECD and Non-OECD cities
  - Non-linear development, upsurge from 2020 onwards

* Sources: ITDP/UC Davies 2014: A global high shift scenario, Siemens analysis

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Clear trend towards public transport, with a high degree of electrification and automation

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Drivers

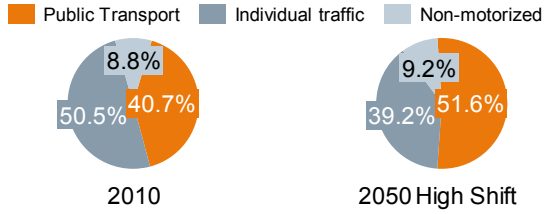
- Demand growth
- Mobility cost
- City-relevant policies
- Technological development

Modal Shift

Clear market share wins for public transport in urban areas

- Overall significant increase of public transport share by 10.9 basis points
- Modal shift as key lever to cope with capacity and energy demand growth

Development of urban modal split

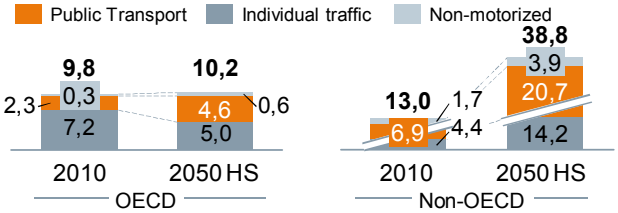


OECD/ Non-OECD

Further modal shift in OECD countries and slight increase in Non-OECD countries

- OECD: Significant growth (24% to 45%) of public transport modal share
- Non-OECD: Slight increase of public transport with strong absolute growth

Urban modal split OECD/Non-OECD

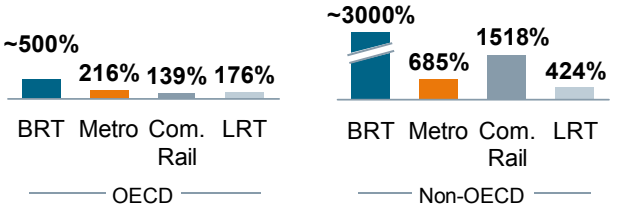


Public Transport

Bus Rapid Transit and Urban Rail (Metro, LRT, Com. Rail) with highest growth rates

- BRT, Metro, Commuter Rail and LRT are outpacing the urban bus and minibus modes
- Strong BRT growth, with significant potential for electrification and automation

"Top 4" PT modes with highest growth rates



Sources: ITDP/UC Davies 2014: A global high shift scenario; Analysis based on "trillion pkm travelled"

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Besides shift to public transport with a growing share of urban rail, efficiency and innovation in individual traffic will be key

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Drivers

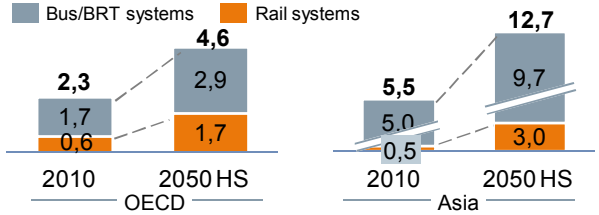
- Demand growth
- \+
- Mobility cost
- \+
- City-relevant policies
- \+
- Technological development

Rail-bound systems

Urban Rail (Metro, LRT, Commuter Rail) is winning market share against bus systems

- Bus/BRT still as leading public transport mode, but urban rail is winning market share
- Comparable development path in all Non-OECD countries/regions, but for Africa

Development of urban bus/urban rail split

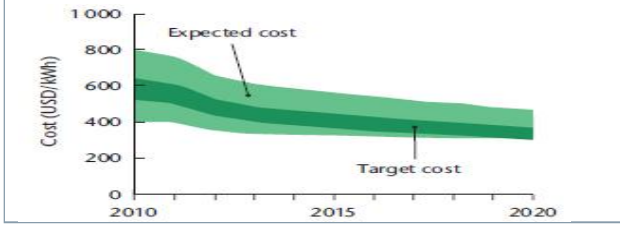


Individual Traffic

High efficiency improvements needed to manage absolute growth in individual traffic

- Individual vehicle efficiency (incl. alternative fuels/drive systems)
- Efficient management of road network/ intelligent traffic systems

Battery costs through 2020

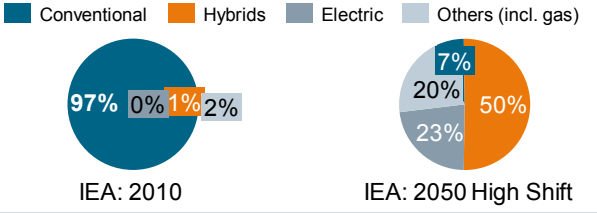


Alternative fuels/drives

Urban area as focal point for new fuels/ drive systems, particularly electromobility

- From mainly conventional fuels to a more diversified energy system for urban mobility
- Urban areas as well suited environment for electric mobility (and natural gas)

New sales of cars & light duty vehicles/year



Sources: ITDP/UC Davies 2014: A global high shift scenario; Analysis based on "trillion pkm travelled"; IEA 2012: Energy Technology Perspectives

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Typical development path of urban mobility, based on an increasing degree of electrification, automation and digitalization

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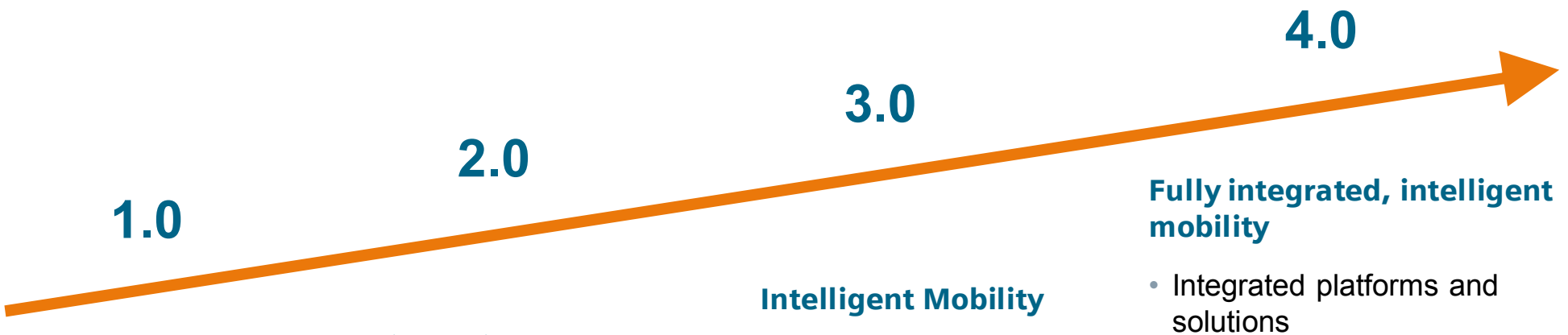

Basic "Brick&steel" Mobility

- Road and rail tracks
- Public transport systems
- Mobility hubs

(Semi-) Auto-mated Mobility

- Operational control systems for road and rail traffic
- Rail automation with focus on safety and security

Intelligent Mobility

- Fully automated train control system
- Urban traffic manage-ment center
- Personalizes services and information
- Environmental friendly fuels and drives

Fully integrated, intelligent mobility

- Integrated platforms and solutions
- End-user centricity, on-demand services
- Real-time, smart data based optimization and incident handling across modes
- Integration of mobility with energy and building systems to smart city solutions

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Example Stockholm: An European lighthouse of sustainable and smart urban mobility

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- **Small, but very well integrated public transport network:** Only 7% of commuters using private vehicles
- **High density of city combined with excellent walking and cycling lanes**: 68% of people cycle or walk to work
- **Very effective connection of suburbs and peripheral areas:** 75% of rush-our travels into city center by public transport
- **"Real-time Information"** for travelers with regard to arrival times for buses and trains
- Income from **city tolling/tax** re-invested into **new mobility technologies:** Use of cars reduced by 20%
- **Continuous "green" innovations**: e.g. adaptive traffic management, buses with alternative/electric fuels (50% by 2011, 100% by 2015), eCar policies

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Siemens Mobility: Addressing the future of urban mobility with an integrated portfolio and consulting & solution design competencies

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Consulting & innov. solution design

- **Smart and sustainable city/mobility studies**, e.g. for London, Singapore, Vienna, Helsinki, Shanghai
- **Business and technology advisory**, including strategic design and piloting of innovative mobility technologies/ solutions with key clients and partners

Integrated technology solution portfolio

- **Electrification:** Rail-bound urban transport, electrification solutions for rail and eBus systems (electric/hybrid) , eCar technologies
- **Automation:** Automation of urban and interurban rail-based transport systems, intelligent road traffic systems
- **Digitalization:** Software and IT solutions for managing rail and road transport, Business analytics and data-driven service optimization, embedded software/systems for electrification and automation

Consult → **Design** → **Build** → **Operate** → **Maintain**

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Digitalization as key value driver for operator and end user, based on integration into overall system approach: Rhein-Ruhr-Express

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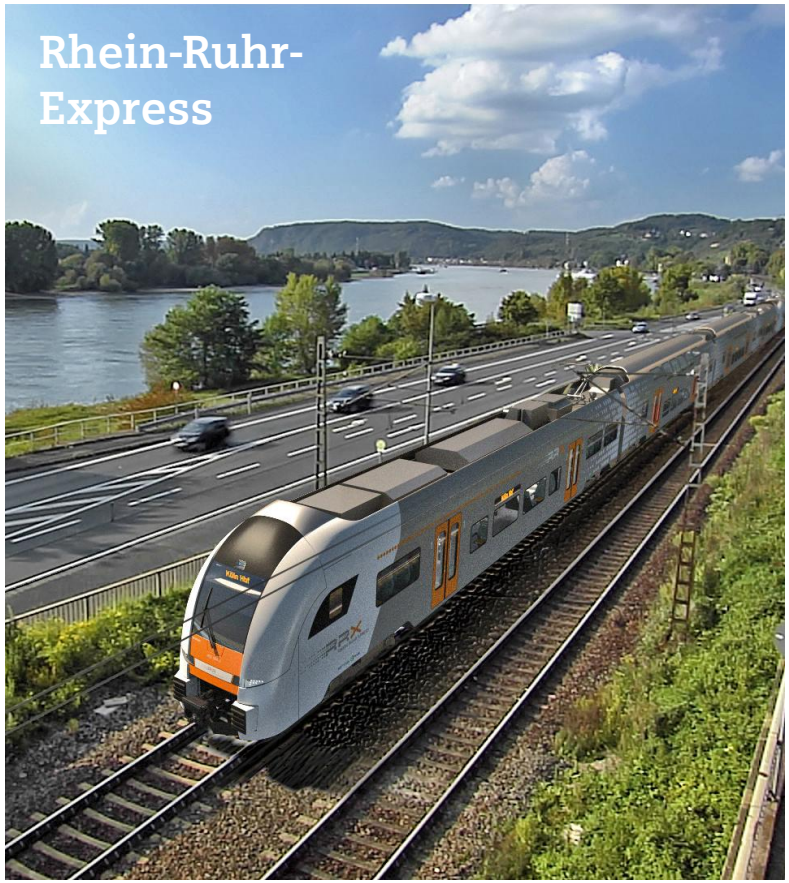

Digitally enhanced electrification and automation components
– Tailor made train setup based on optimized lifecycle costs (train, service and energy)

→ **Best asset utilization**

Digital services
– Smart data analytics for vehicle service
– Preventive up to predictive maintenance
– Bogie remote diagnosis

→ **Guaranteed availability**

Vertical software/IT solutions
– Internet on board (WiFi)
– Passenger Information System
– Security for passengers (CCTV)

→ **Enhanced passenger experience**

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It`s about end-to-end mobility of people and good, not of vehicles: Intermodal Mobility Platform Berlin

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- **Public urban transport**
- **Individual Mobility**
  - eCars and eBikes
  - Car Sharing solutions
- **Additional services**
  - Access to parking
  - Other public services

- **Intermodal urban mobility platform**
  - One customer interface with single sign-on
  - Smart phone or smart card based
  - Real-time Info, reservation, ticke-ting, billing across all modes/offers
- **Value drivers**
  - Easy to deal with
  - Additional value-add for all players

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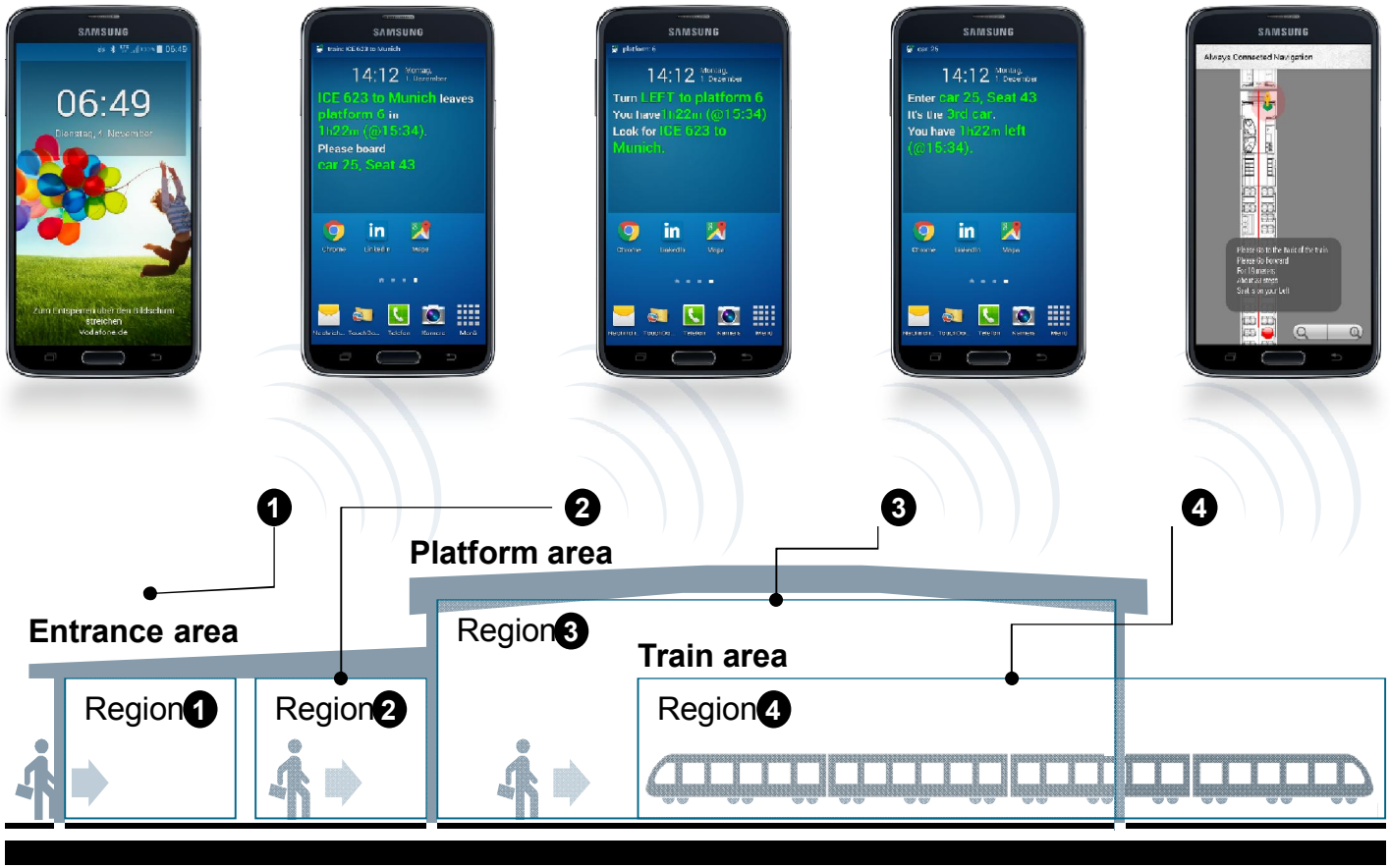
Proximity-based, personalized and real-time information will become key success factors: Passenger flow solution Dubai (metro, tram, bus)



Backend
- Maps ID to place
- Provides content and services
- Analyses streams

Beacon
- Sends a unique ID

Smartphone of the passenger

- **Traveller:** Relevant, context-related information, when needed
- **Operator:** Automated real-time passenger data
- **Shops/retail:** Personalized, Location based offerings

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From separate to multi-functional and integrated smart mobility/city solutions: Smart parking solution Berlin

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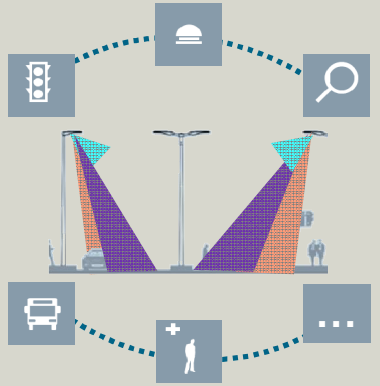
- **Smart Parking** system based on overhead radar sensor detection and integration into end-user and operator mobility platform
- **From separate** (sensor, communi-cation, power) **to multi-purpose sensor networks**:
  - Smart lighting, parking,
  - Traffic control, security
  - Emmisions
  - WIFI, etc.



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Demand management and new business models, enabled by real time information and smart analytics: Fast lane Tel Aviv

Length 13 km, around 6,000 cars per day

System calculates the toll dynamically according to the traffic situation

Guaranteed speed of 70 km/h on fast lane

Co-financing of free shuttle buses to the city center; toll free for vehicles >3 passengers

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Summary and outlook

- **Urban Mobility as Nr. 1 priority** for sustainable urban development and competitiveness, with significant, specific challenges in developed and developing countries
- **Electrification, automation and digitalization** as key technological improvement levers to develop from Mobility 2.0/3.0 towards Mobility 4.0
- **Digitalization with strong potentials** both for efficiency and revenue improvements in the mobility industry - but need for combining the physical and virtual worlds to realize value-add
- **Key success factors:** Effective digitalization eco-system, addressing all digitalization levers, integrated IT platforms, vertical process expertise, adaption of innovation processes and new business models, management of data security issues
- **Development path for mobility industry:** Build upon existing strength (domain expertise, system and operations know-how) while both endogenously learning and exogenously integrating good-practices from the new economy (end-user/process focus, speed, new business models)

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