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Overview of Intelligent Transport

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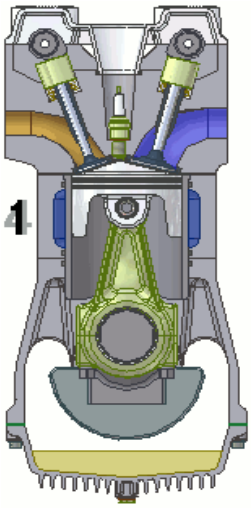
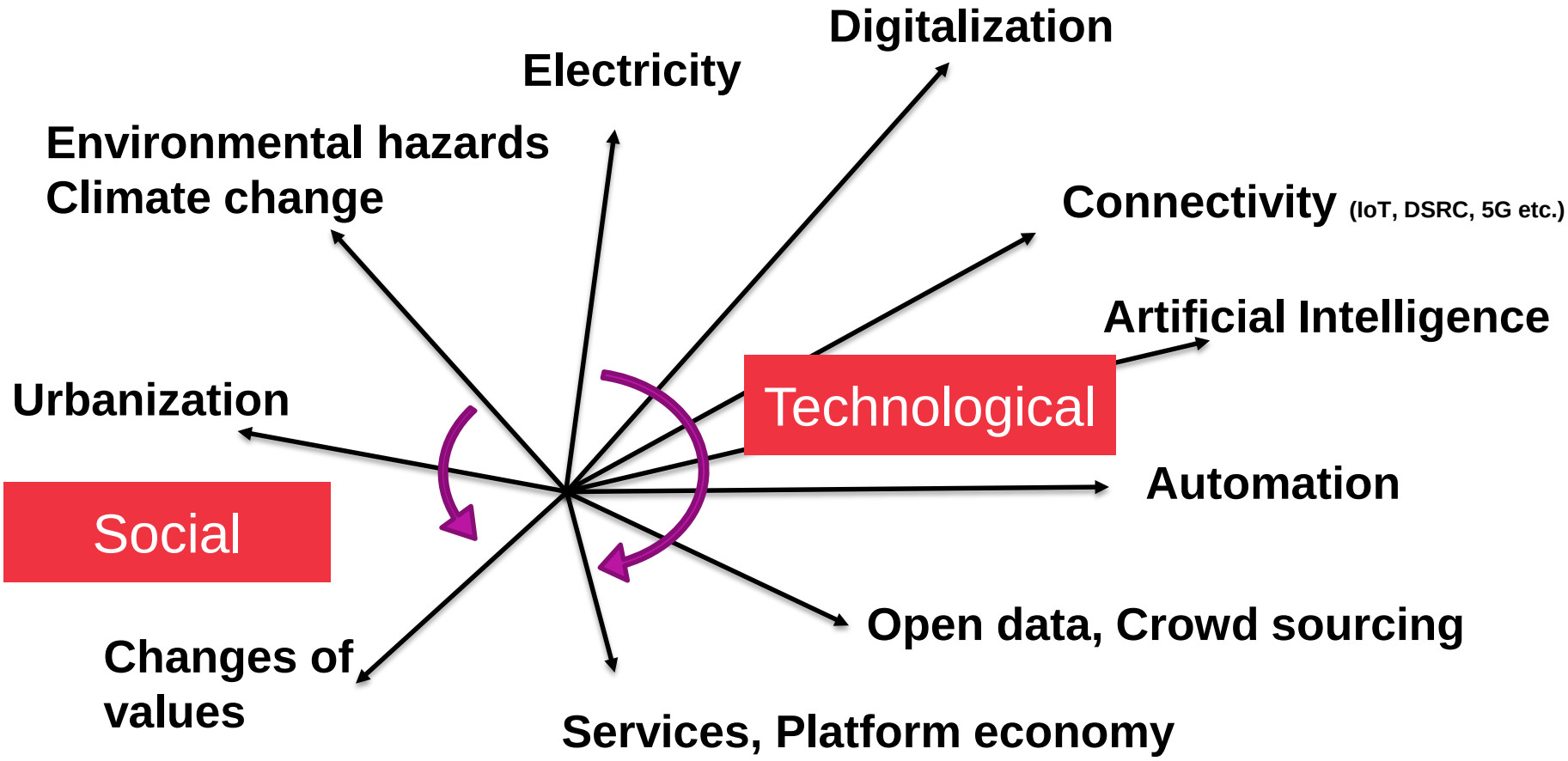
Overview of Transport System Evolution

The recent development can be characterized by increased number and power of vehicles

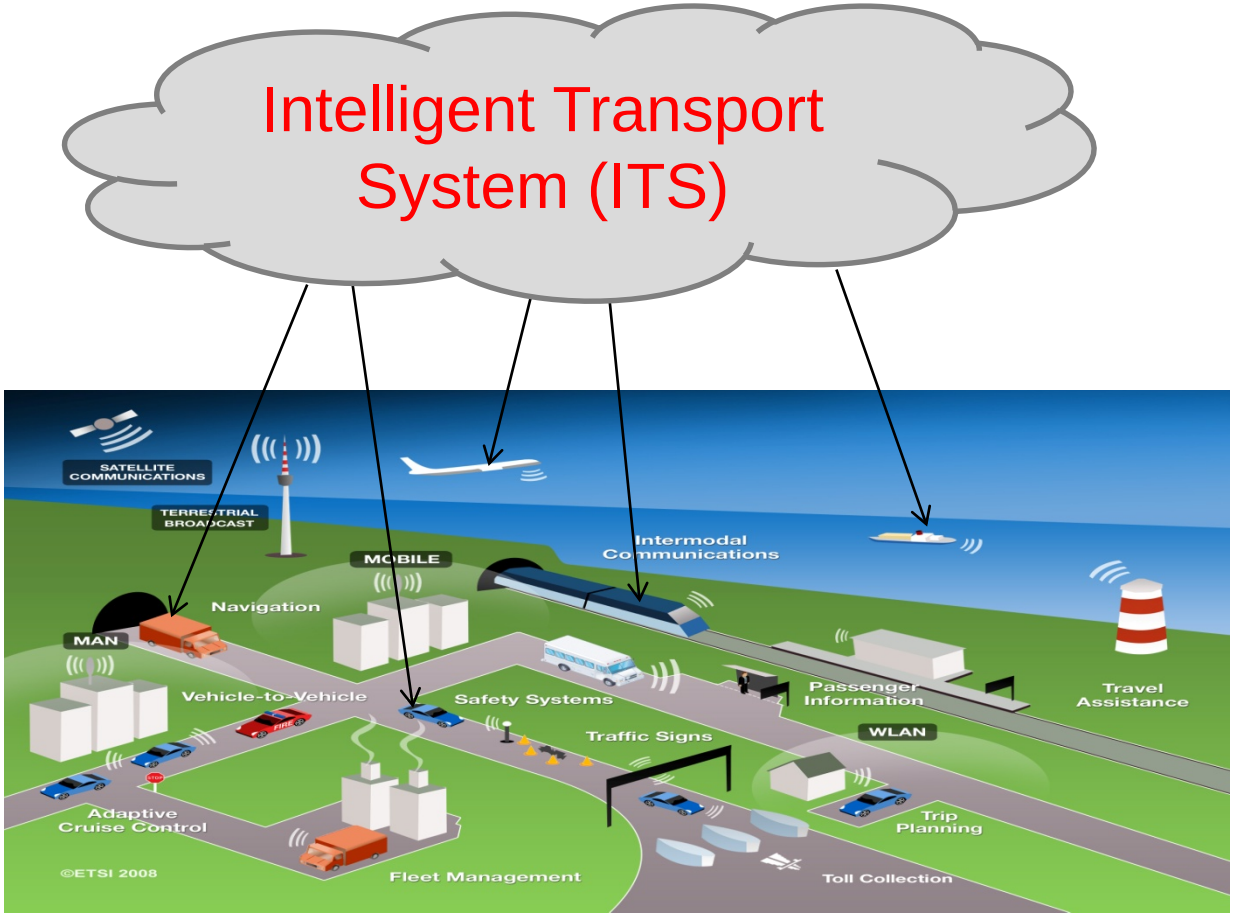
- 1900- Internal combustion engine
- 1920- First traffic signals
- 1950- Private cars becoming more common
- 1970- The first boom of transportation engineering
- 1990- Intelligent transport introduced
- 2000- First services of intelligent transport
- 2010- Electric and hybrid vehicles emerging to the market
- 2020- Established smart mobility services
- 2030- Vehicle automation in significant scale



Transport Disruption Landscape



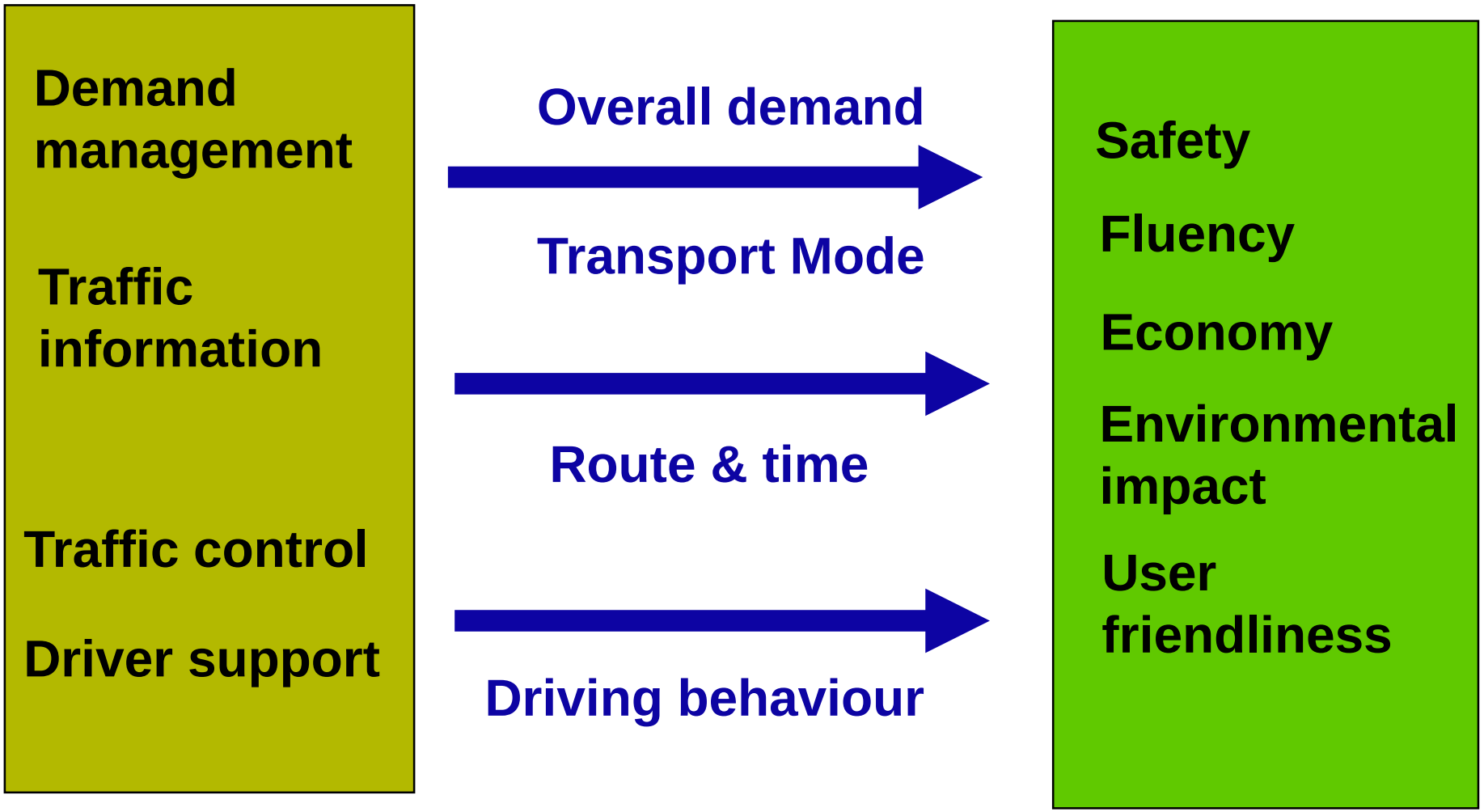
A New Dimension of the Transport System



Do We Need Intelligent Transport ?

- **Safety:**
  - The number of traffic accidents is still very high
  - Within EU 1,7 million people injured per year, cost ca. 2% of GDP
- **Fluency:**
  - Too much traffic jams
  - Within EU the costs of traffic congestion, cost ca.1% of GDP
- **Energy:**
  - Low energy efficiency in transport
  - Use of fossil fuels is not sustainable
- **Environmental impact**
  - Pollution of air in dense cities
  - Accelerating the climate change

Multiple Objectives



User preferences

- Safe traveling
- Fluent, fast and comfortable traveling
- Level of service, especially in disruptions
- Management of trip chains
- Easy planning of trips
- Reliable estimation of travel time and cost
- Easy payment, reasonable pricing

Objectives of the society

- Balancing of demand and supply
- Broadening the use of transport modes
- Cost efficiency, raising funding for transport
- Improving energy efficiency
- Reducing emissions, improving air quality
- Use of ITS as part of everyday life
- Facilitating remote work
- Improving the urban structures

Services

More Flexible Services

Old structures

Timetabled traffic
Separate payment systems
Few real time information services

New structures and models

Profiling - segmentation
Consumer behavior & motivations

Mobile ordering

Demand responsive public transportaton

Smart traffic control

Reittiopas
Helsingin seudun liikenne

Real-time traffic information

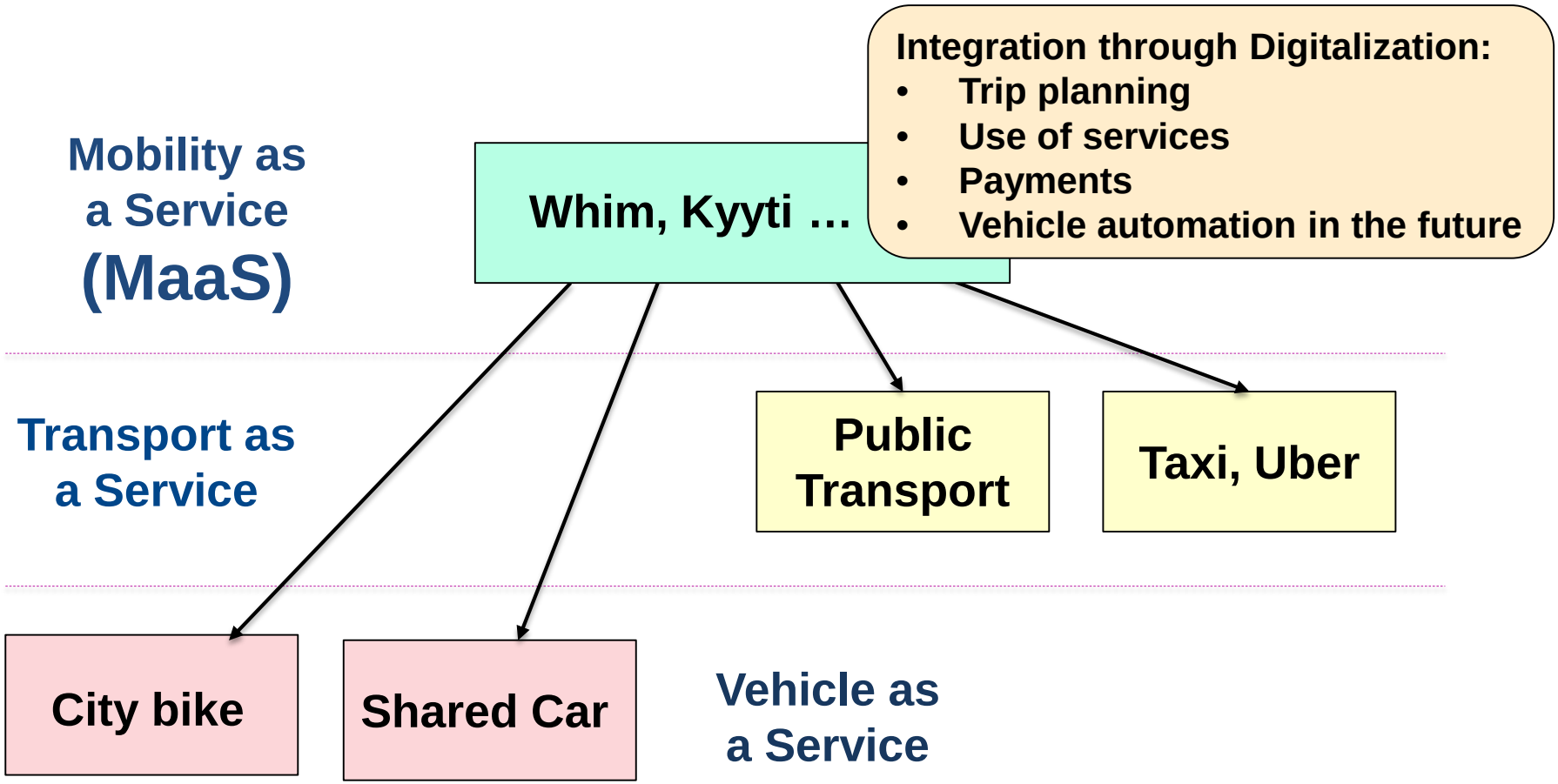
Route planners

Payment systems

Public transportation

Shared vehicles

Integrating the Mobility Services



Service providers aspects

- Viability, business logics
- Cost savings, efficiency
- Administration and regulation
    - Privacy protection
    - Standardization
- Public or private services
    - Public private partnership (PPP-model)
    - Basic services and added value services

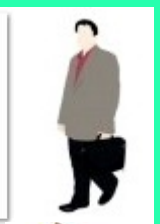
Technology

Technology and the Traffic Processes

ITS Tech-nology

- Travellers
- Services & Applications
- Algorithms & Communications
- Software & Hardware
- Vehicles
- Infrastructure

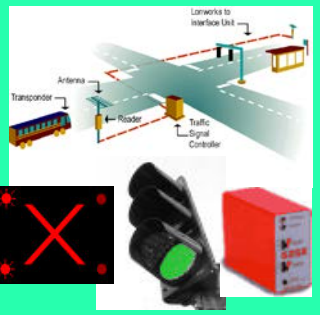
Mobility



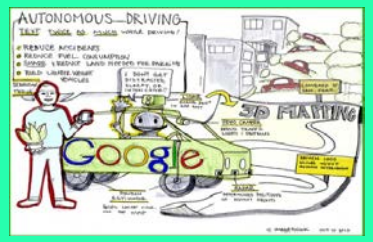

Traffic



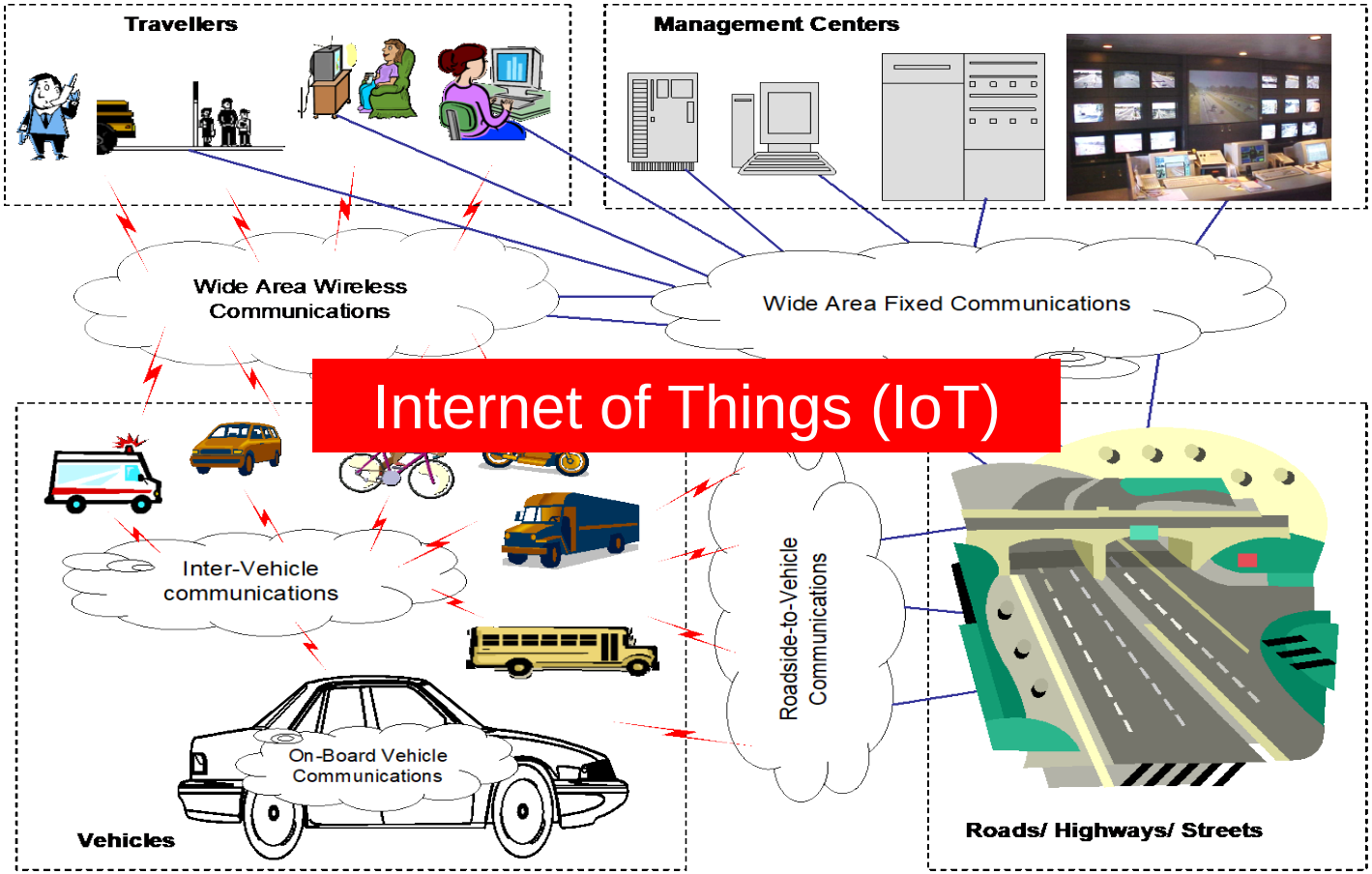


Vehicle

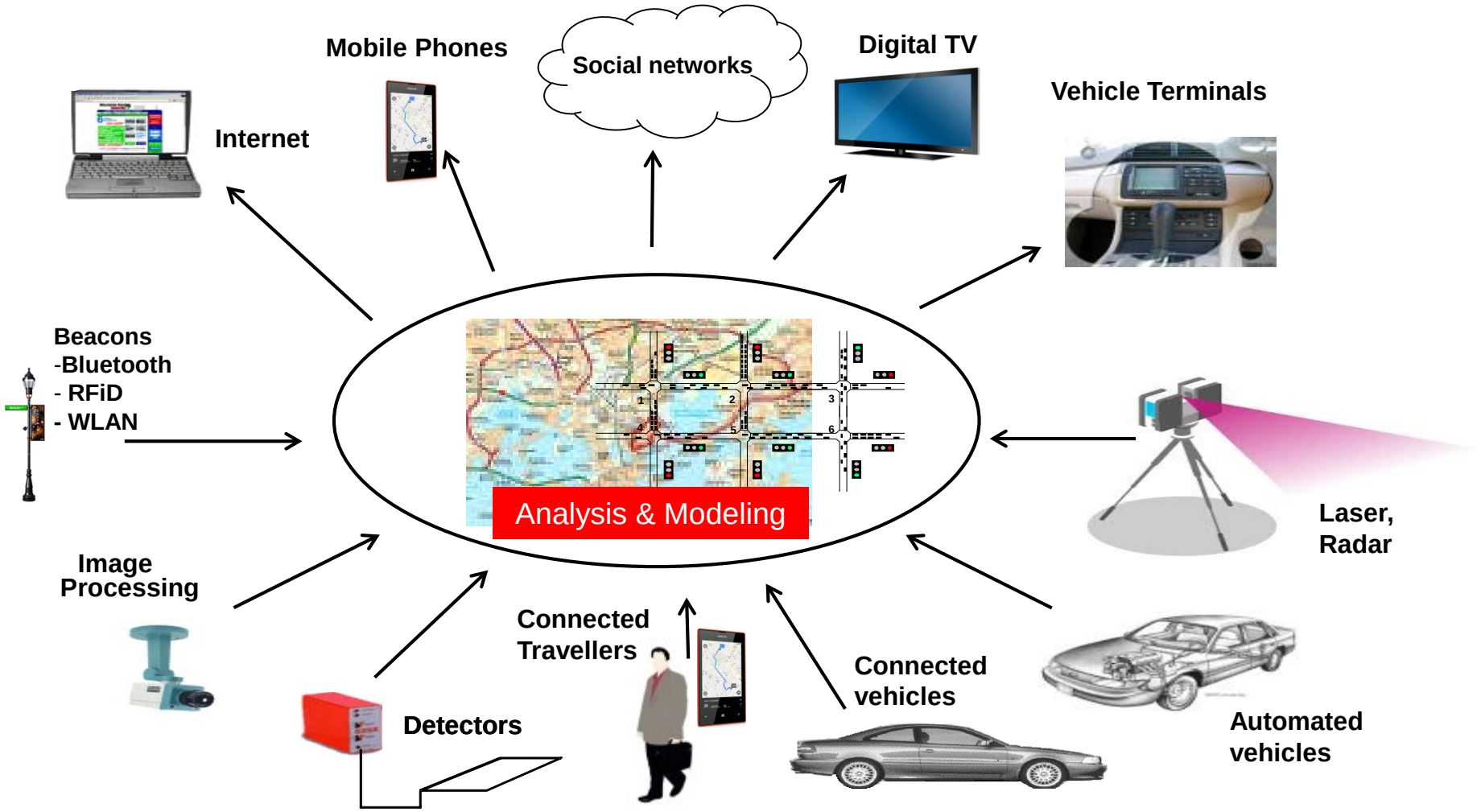


Networked Transport System



Collecting the Big Data



Evolution of the Information Technology

- **Data collection**
- Sensors, positioning, recognition, remote sensing
- **Communication**
- Internet, local area networks (LAN)
- Wireless local area networks (WLAN)
- Mobile networks (2-5G)
- Short range communication (DSRC, RFiD, Bluetooth, NFC)
- Digital radio ja television (DAB & DVB)
- **Hardware**
- Increasing computing power
- Reduced size, cost and power consumption
- Mobile devices, embedded systems, cloud/edge/fog computing
- **Processing of the data**
- Data bases, data models, GIS, BIM, HD-maps
- Sensor-fusion, image processing, statistical analysis, modeling, simulation
- Data mining, Soft-computing, artificial intelligence, deep learning

Intelligence

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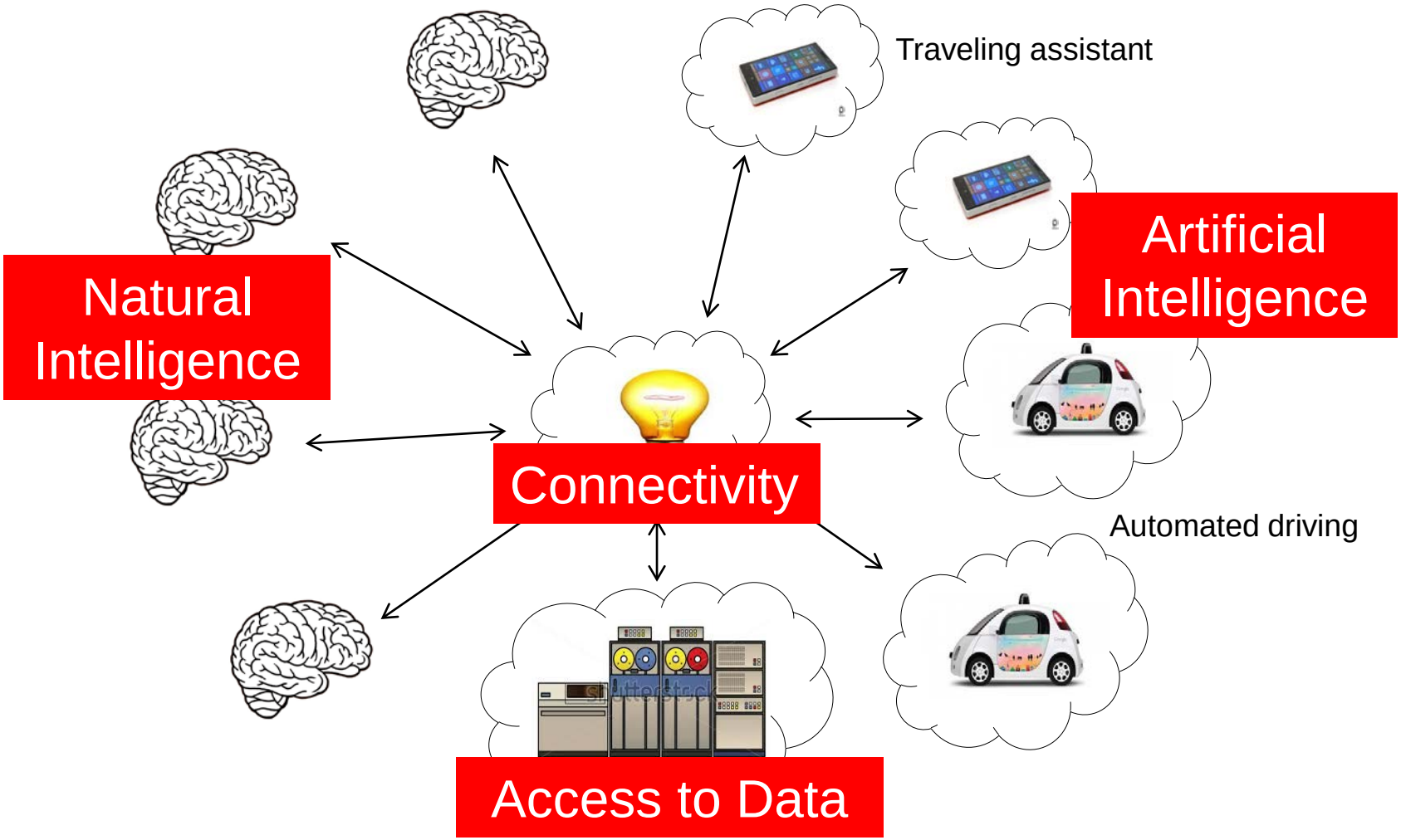
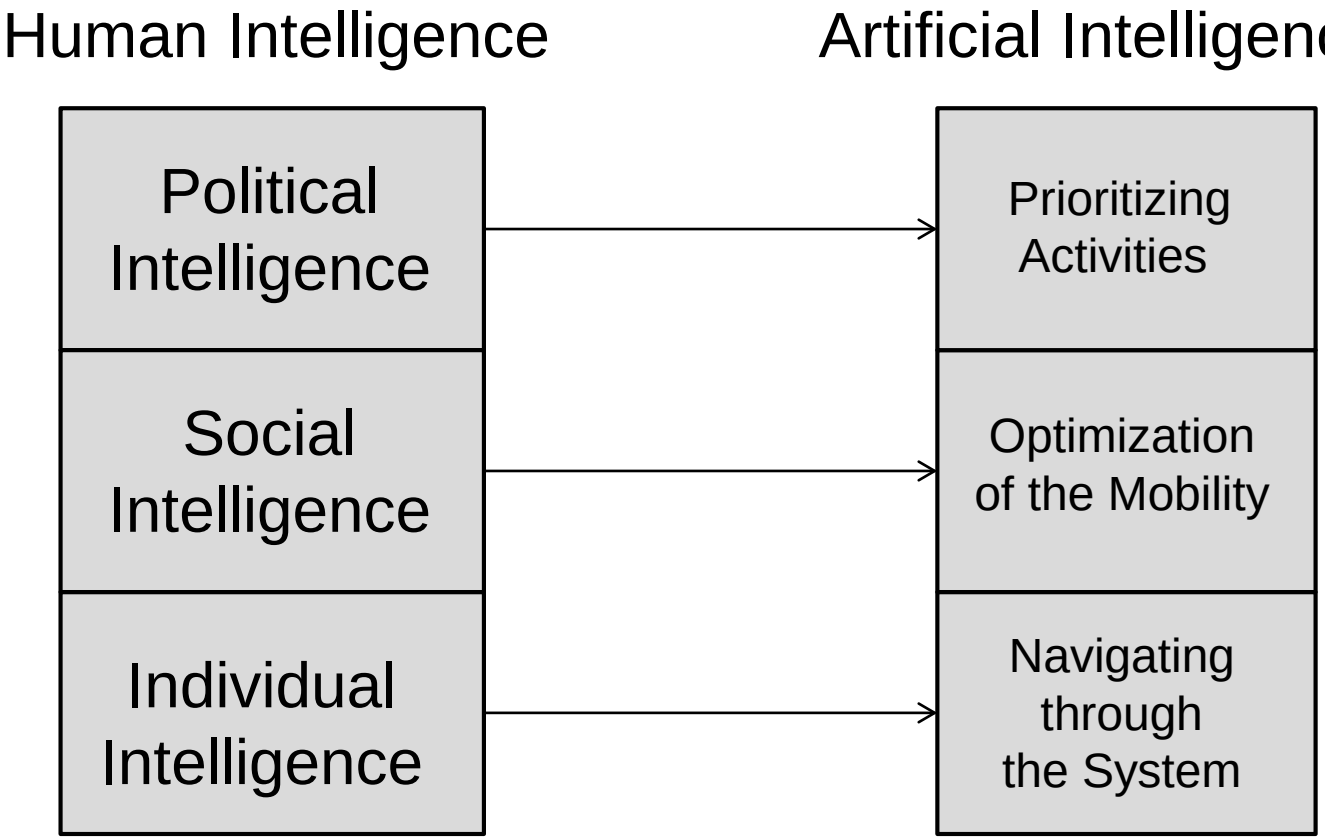
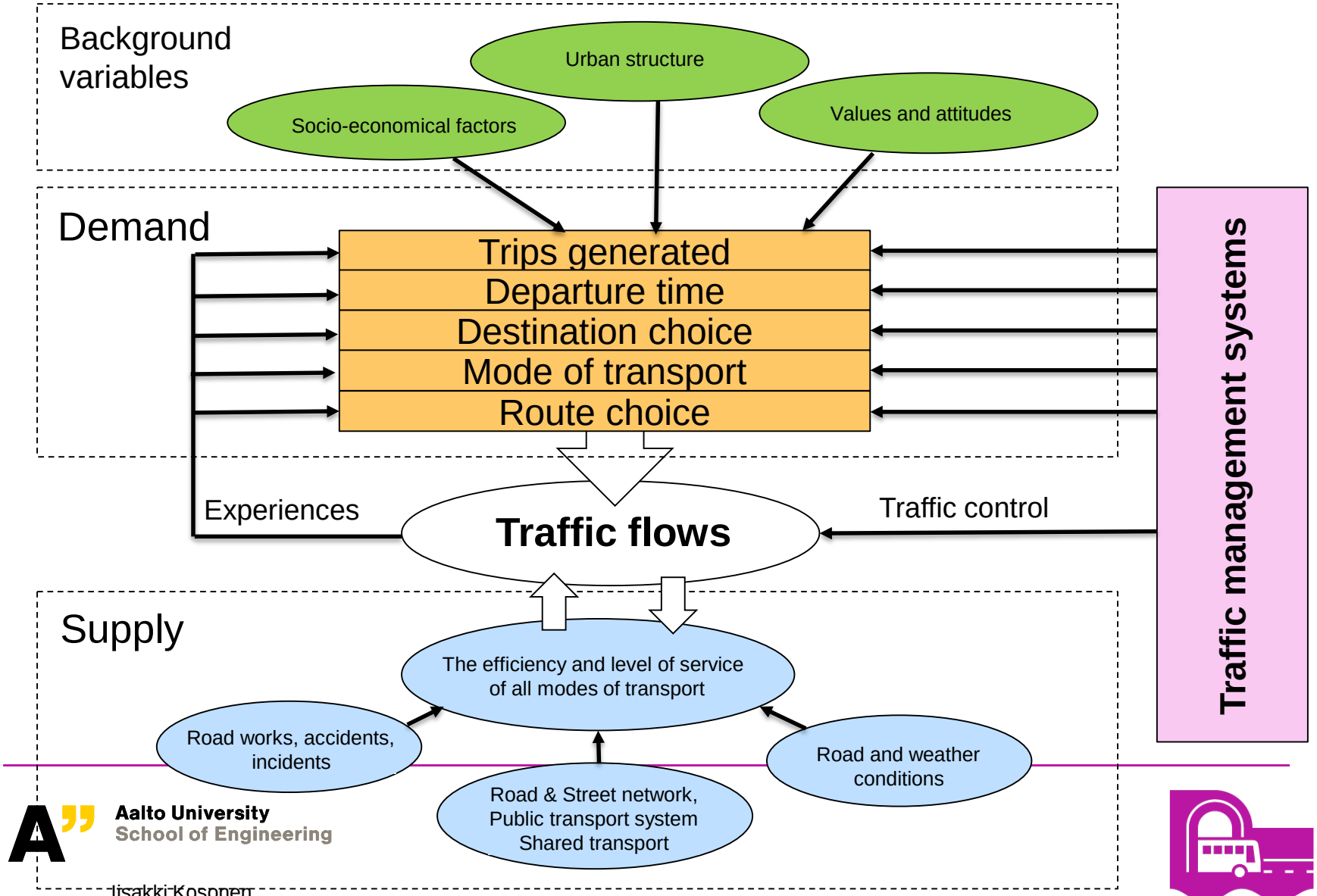
Emerging Intelligence



Human Intelligence vs. Artificial Intelligence



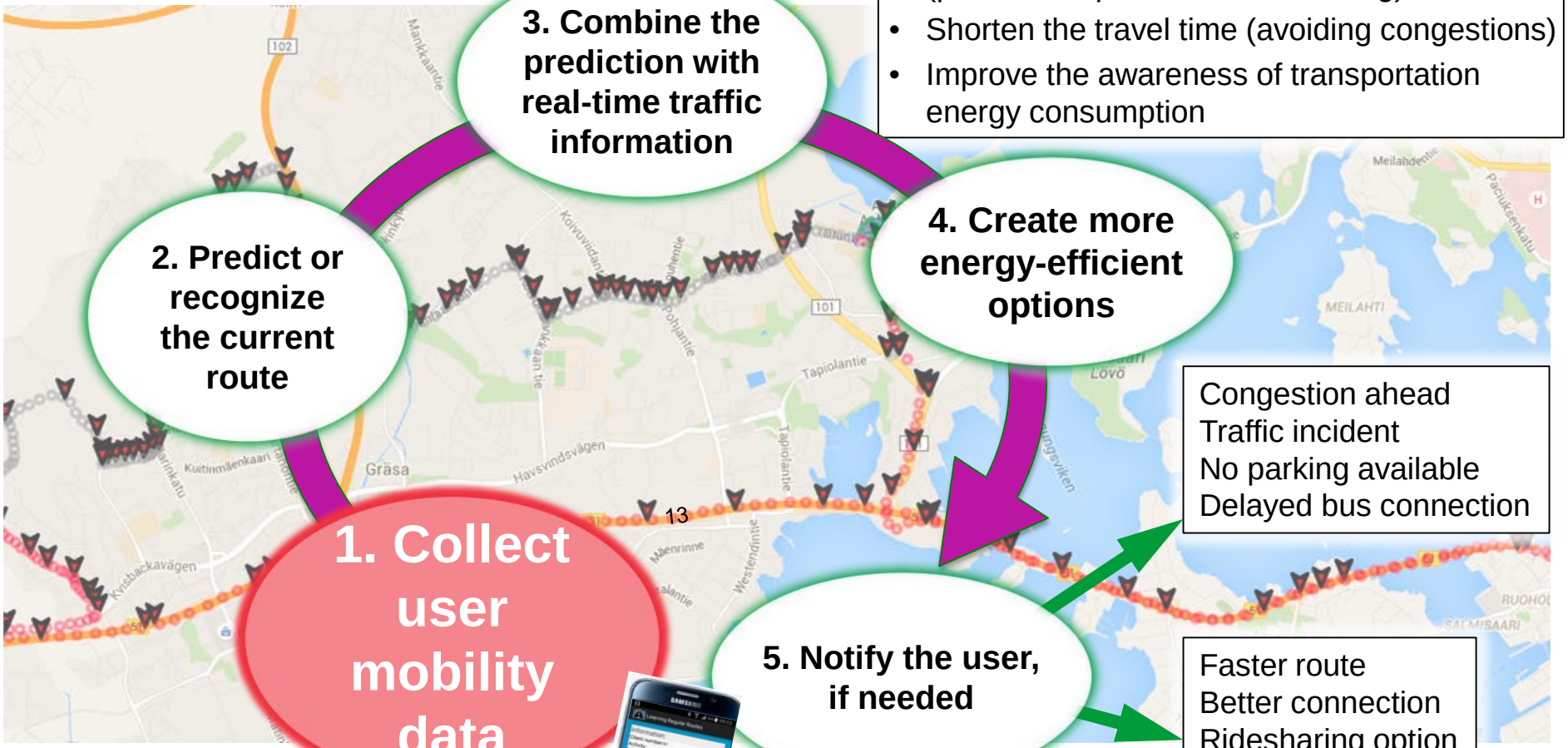
Balancing the Demand vs. Supply



Assisting Traveling

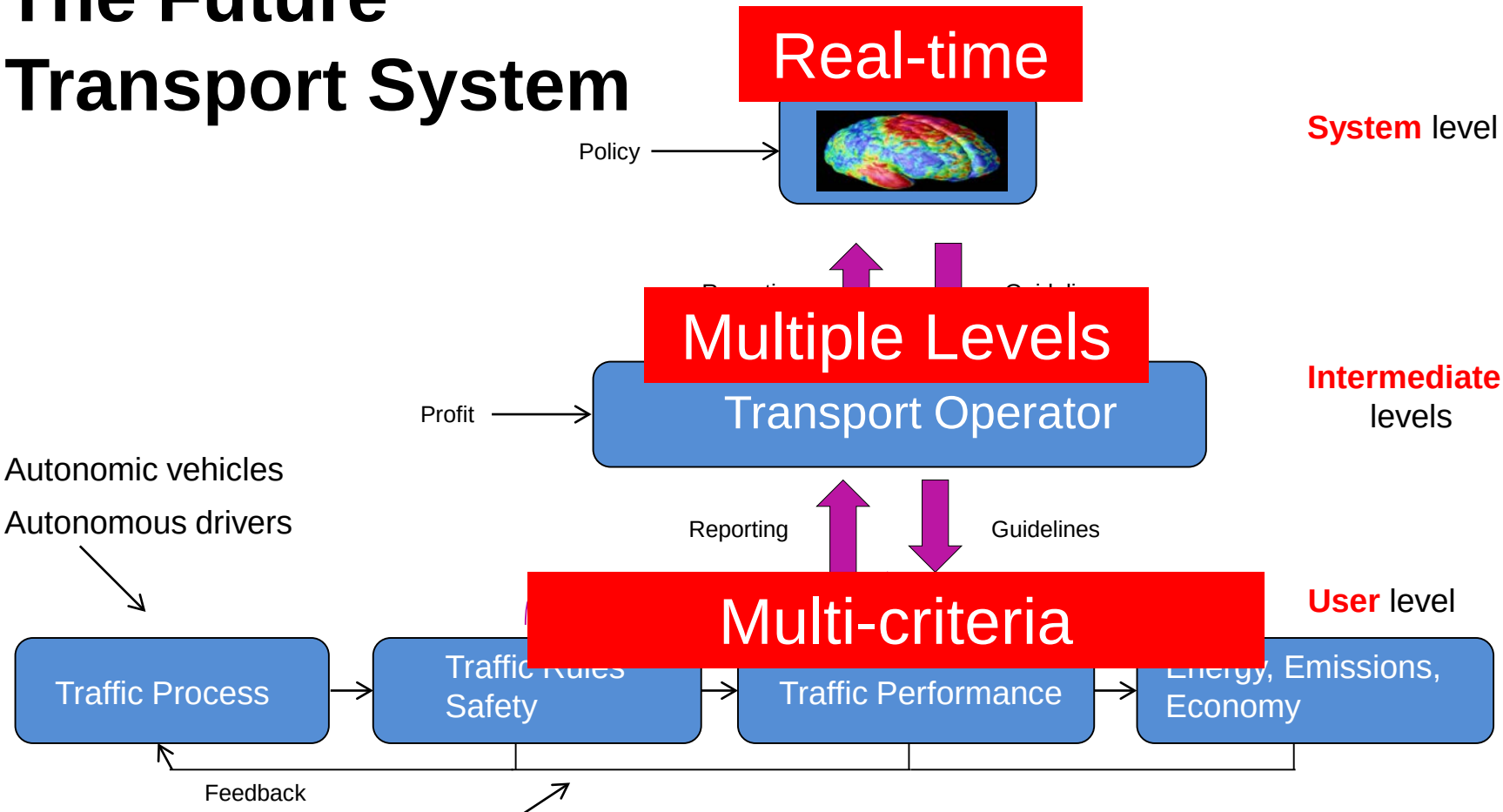
TrafficSense mobile service

- Facilitate the use of shared transportation (public transportation, ride sharing)
- Shorten the travel time (avoiding congestions)
- Improve the awareness of transportation energy consumption



Optimizing the Transport System

The Future Transport System



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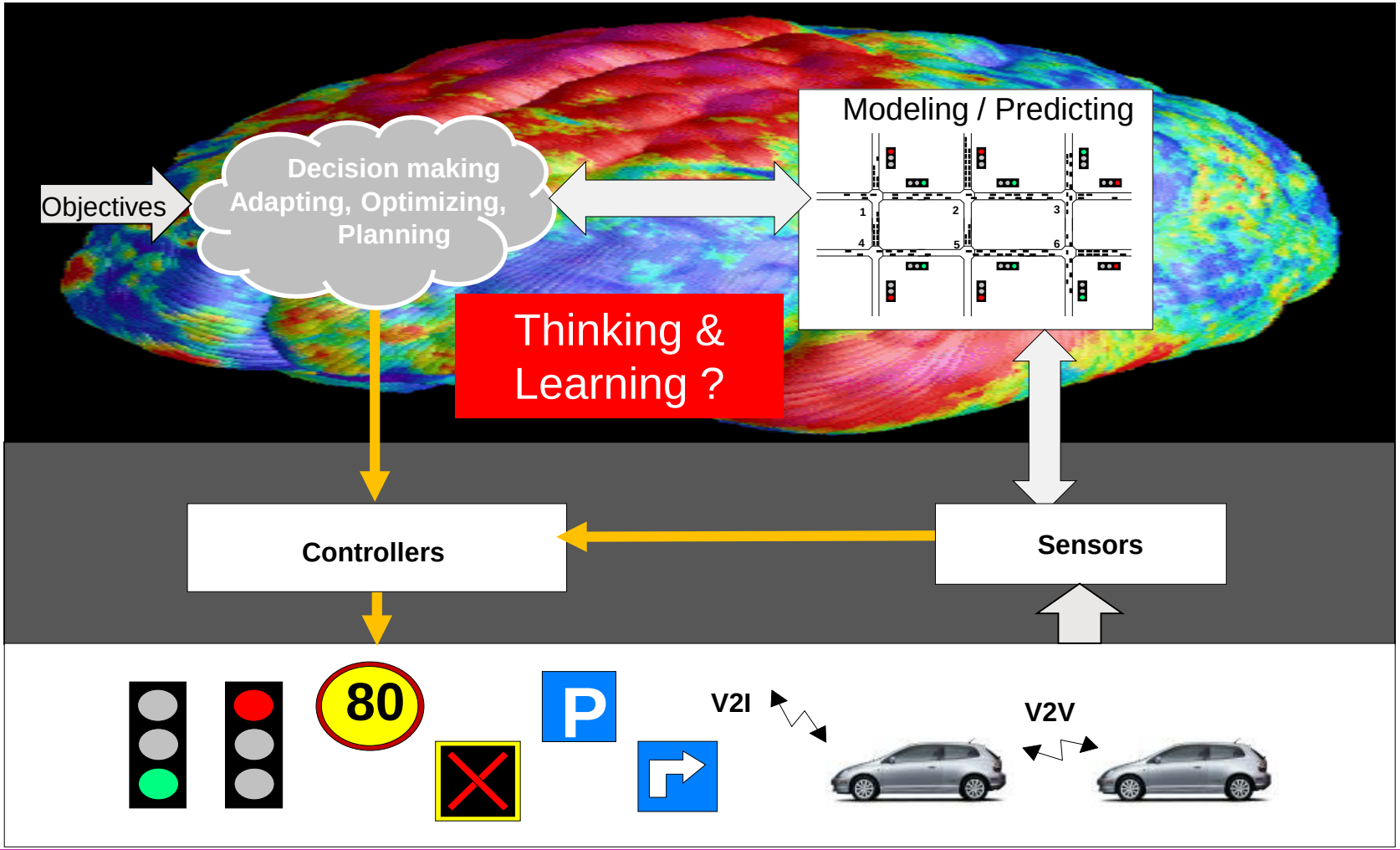
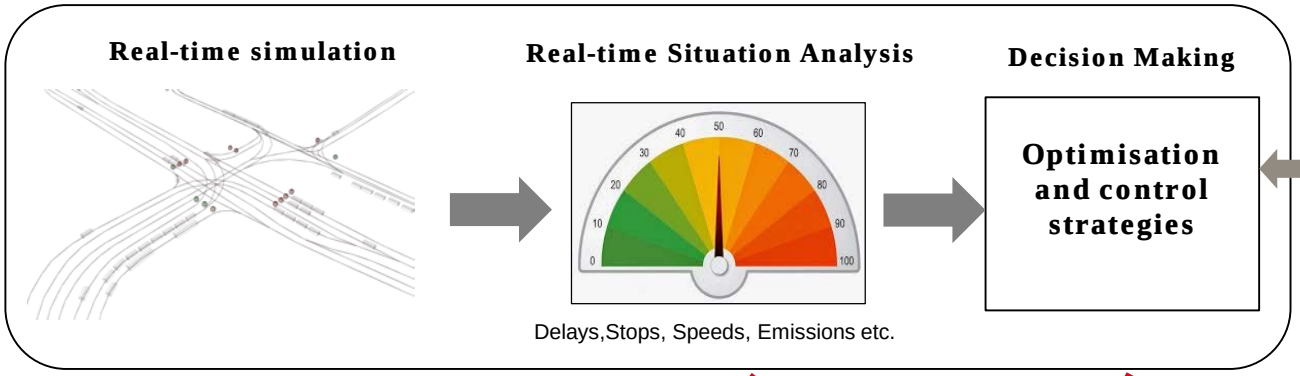
Improving Traffic Management



Smart Infrastructures

5G
IoT



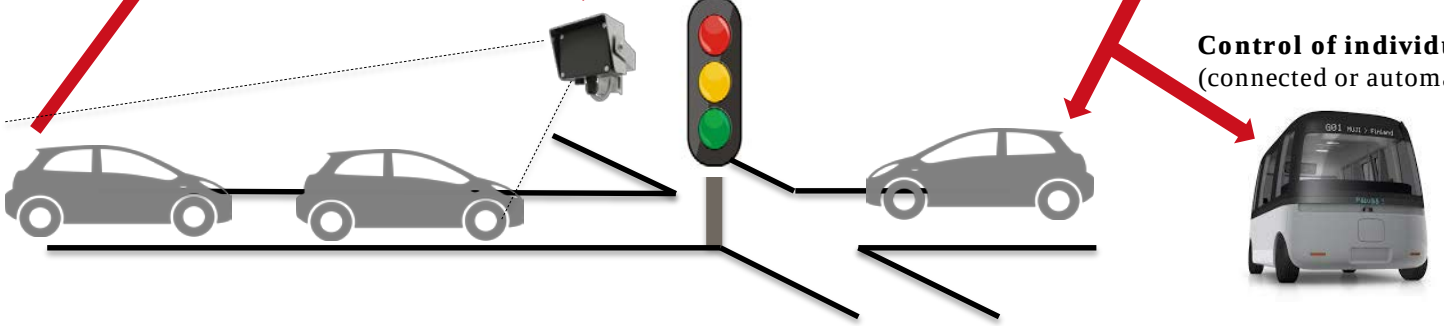
ata of individual vehicles
onnected or automated)

Data of vehicle groups
(sensor, radars, cameras)

Control of vehicle groups
(through traffic signals)

Alerts to pedestrians and other users
(via smartphones or other devices)

Control of individual vehicles
(connected or automated)



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Critical: 5G or cable required

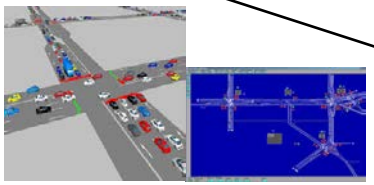
Non-critical:

Planning

Supporting Planning

Public sector

Smart Policy



Planning support systems

Smart City
Intelligent Transport

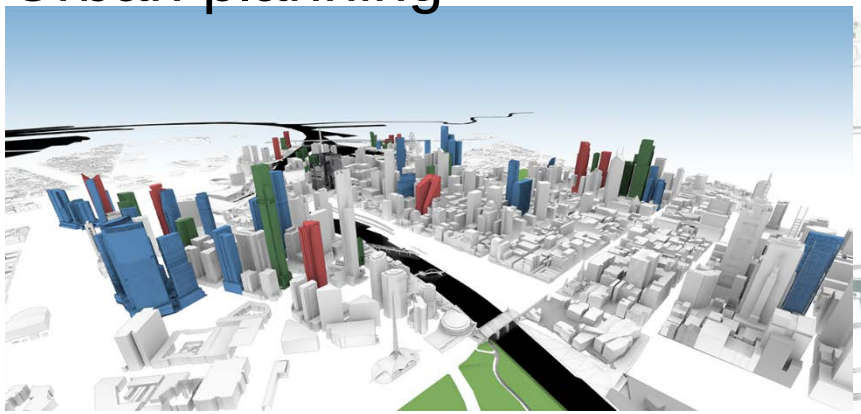
Emerging Business Models

Technological
Evolution

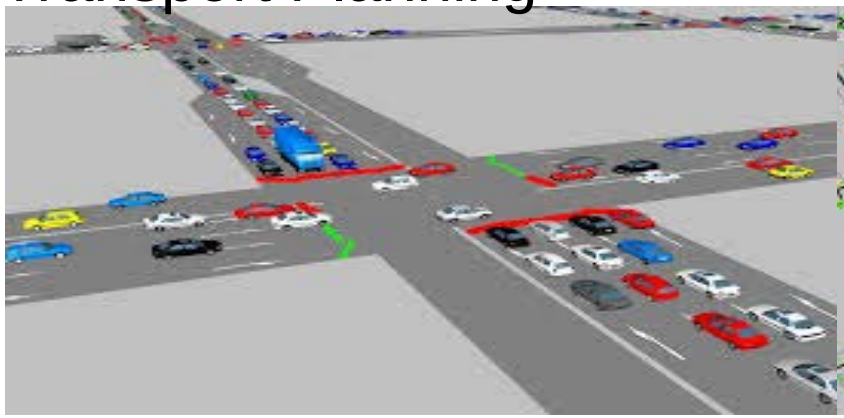
Private sector

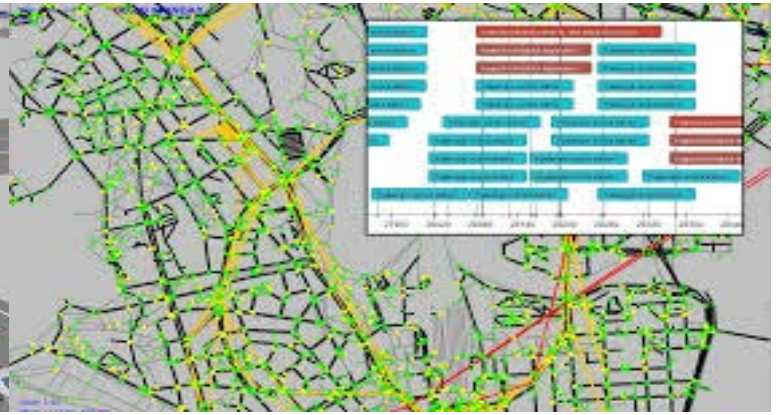
Simulation and Modeling Tools

Urban planning

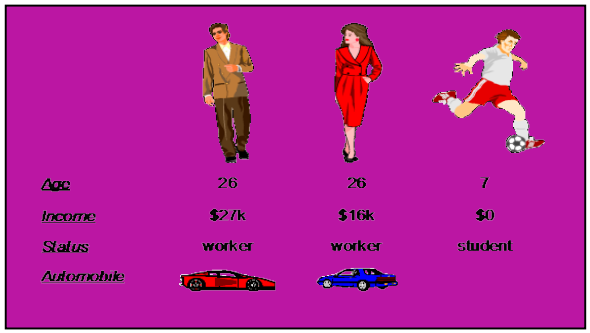


Transport Planning

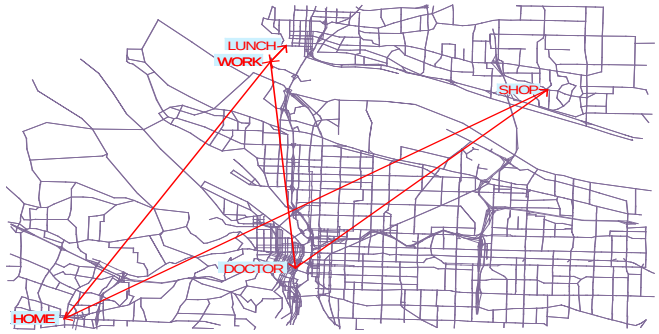




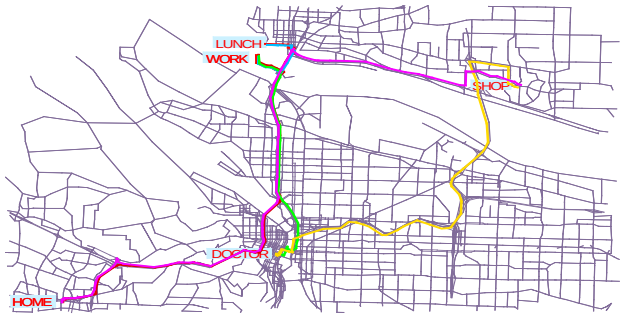
Activity-based Modeling



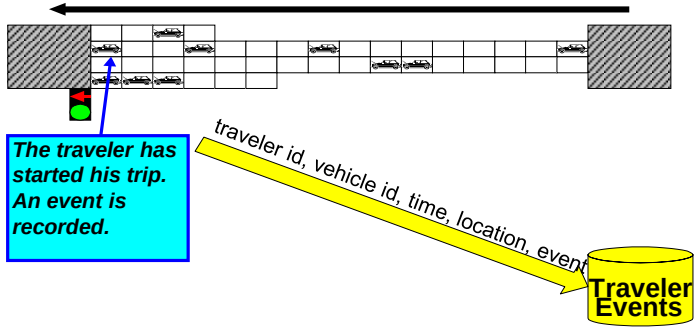
SYNTHETIC POPULATION



ACTIVITIES



PLANS: ROUTES AND MODES



SIMULATION OF FLOWS AND EVENTS

Automation

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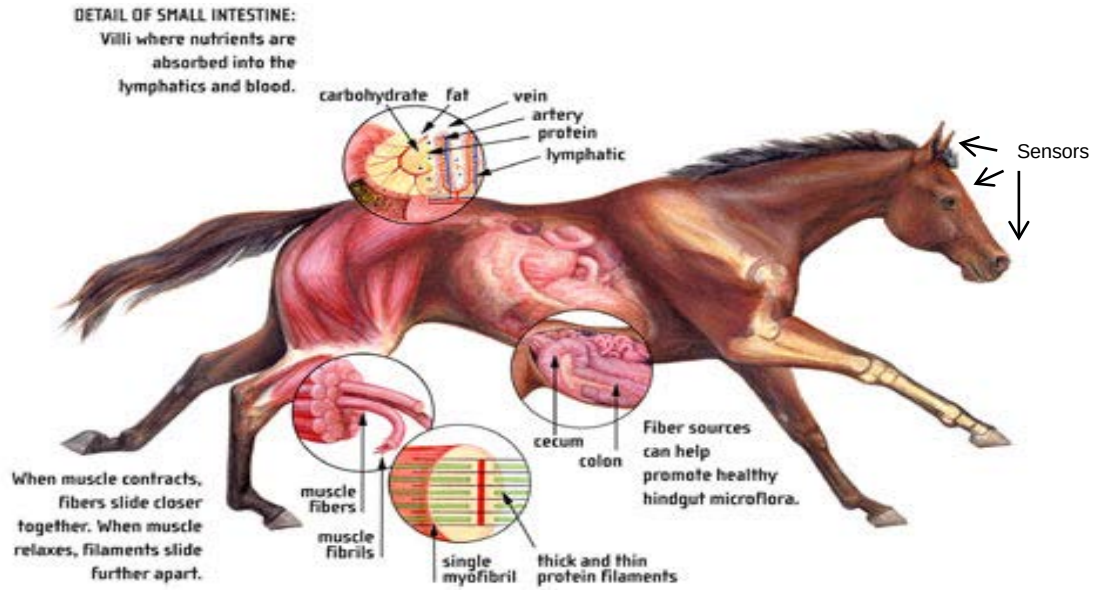
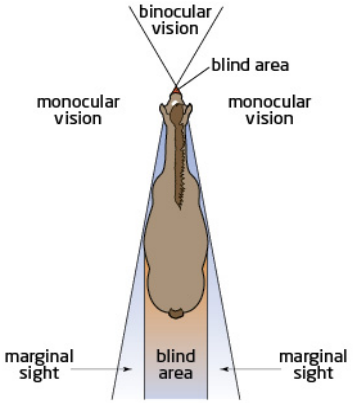
What is autonomous vehicle ?

- Takes independently care of all functions related to maneuvering the vehicles
- Various sorts of intelligence:
  - Sensory: ability to make relevant findings from the raw data streams
  - Motoric: takes care of details of movements
  - Interactive: understand the signals of the driver, giving response
  - Learning: environment, traffic conditions, driver preferences
- Is there such a vehicle ?

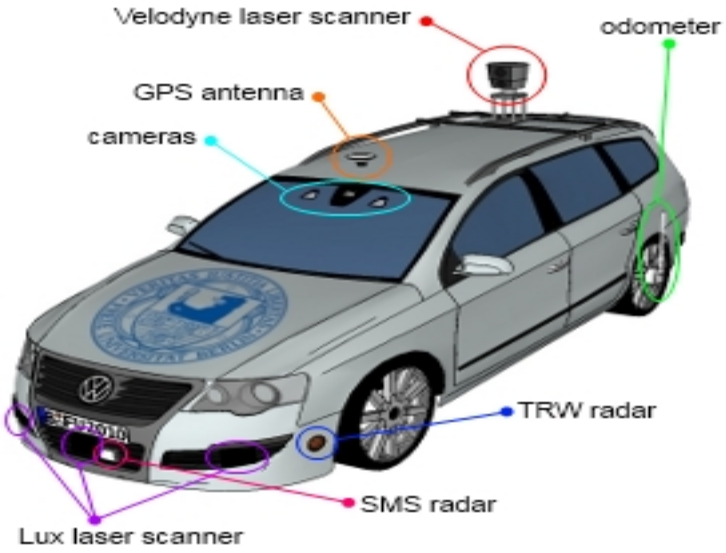
Autonomous vehicle, model. 4000 BC

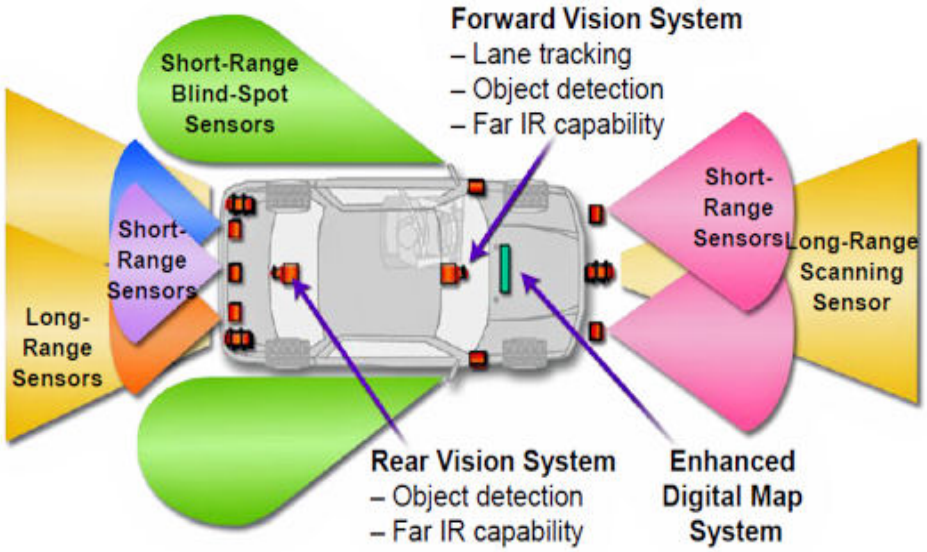




•Autonomic features: yielding obstacles, returning to home etc...
•Sensors: stereo vision, hearing, smelling, position, equilibrium, temperature …
• Motoric: capable of moving is very difficult terrain
• Fuel: Multifuel, bioenergy, very good energy efficiency
• Emissions: recyclable waste only

Automated vehicle Model 2019 A.D.

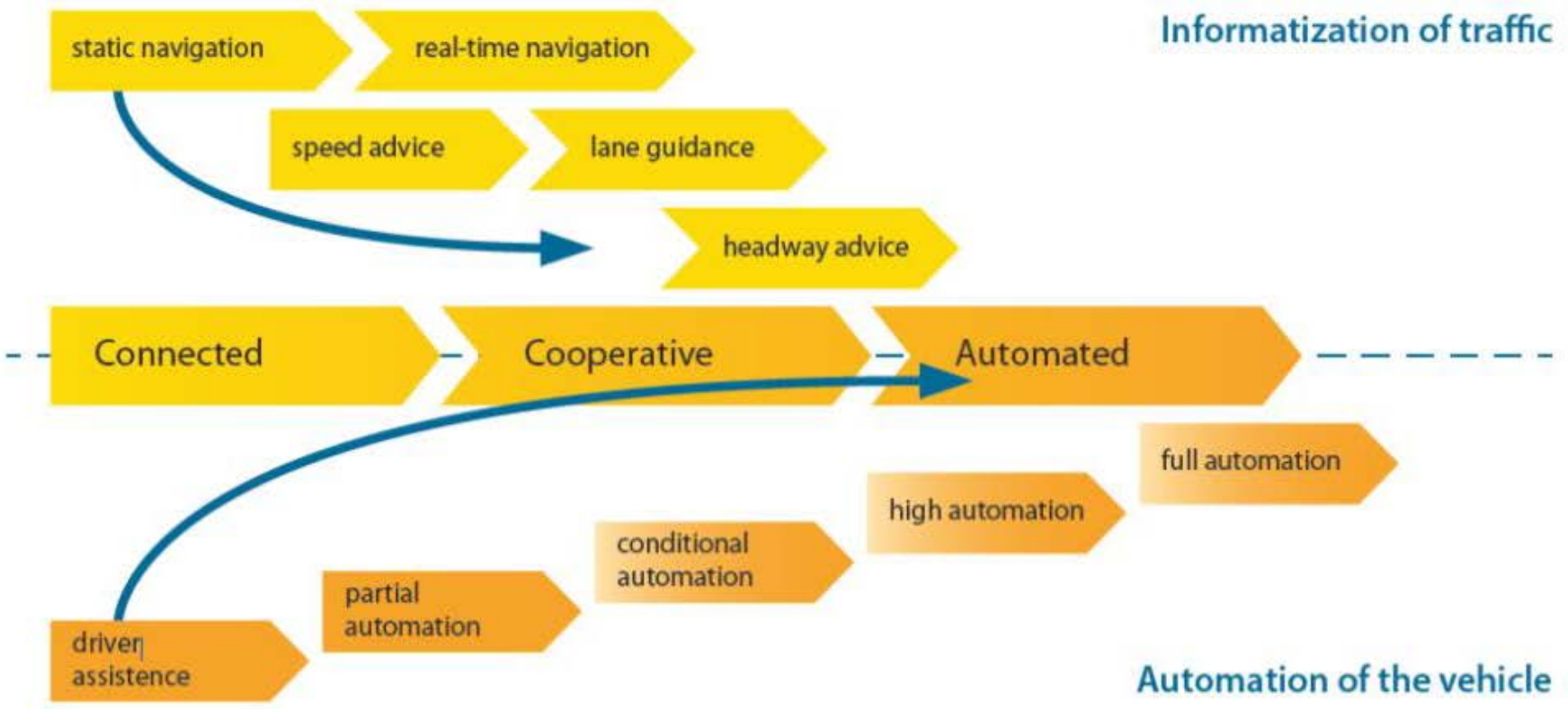




Last-mile Services

- Transit oriented vehicle automation
- Robot buses can support the public transport
- Frequent service rate (like metro)
- Fixed route or flexible
- Door-to-door for disabled travelers
- Campus traffic (universities, hospitals …)
- Remote control for unexpected situations

A Possible Path Towards Automation

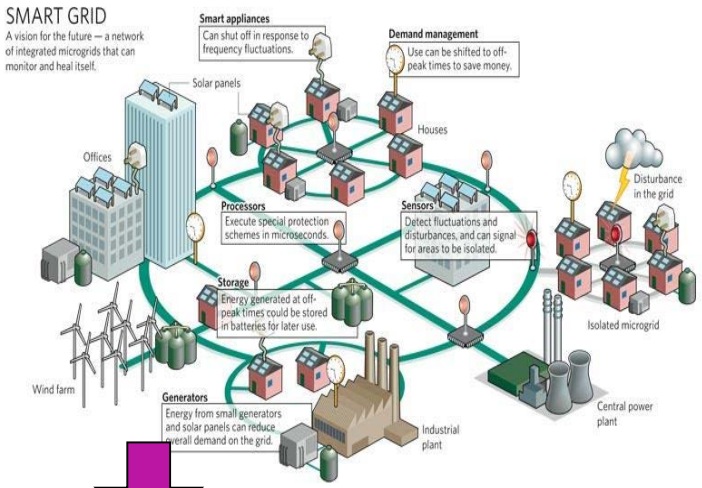


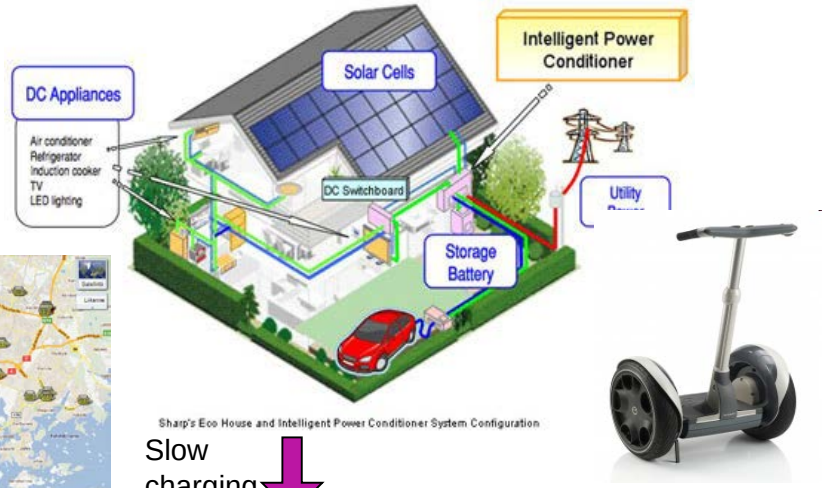
Energy

Energy Efficiency - Towards Low Power Technology

Towards electric mobility

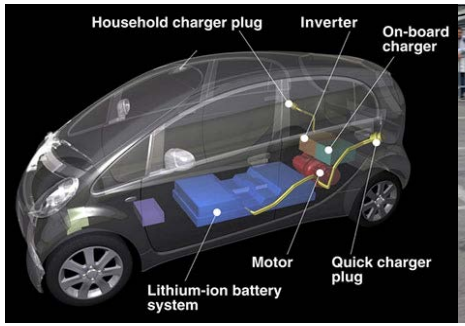
Optimization of production, distribution and energy efficiency





Slow charging

Fast charging



Electric car

Compact city vehicle

Electrically assisted bicycle

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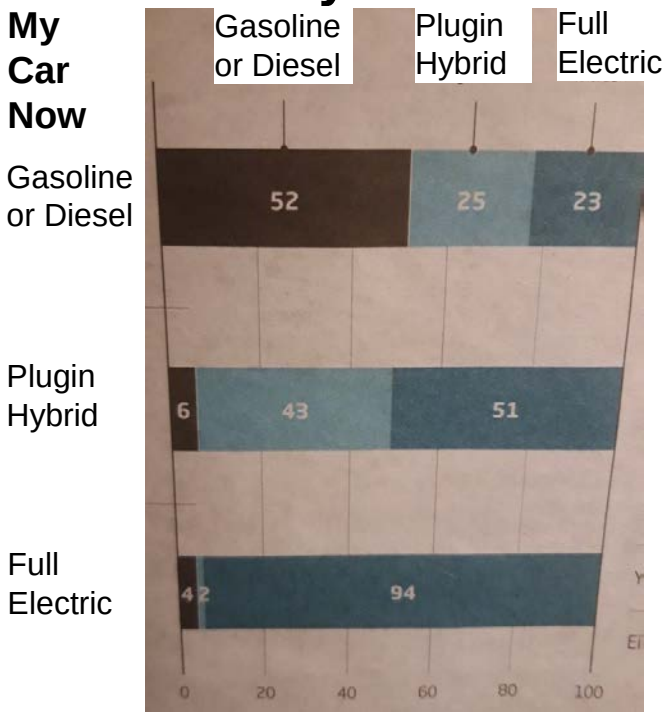
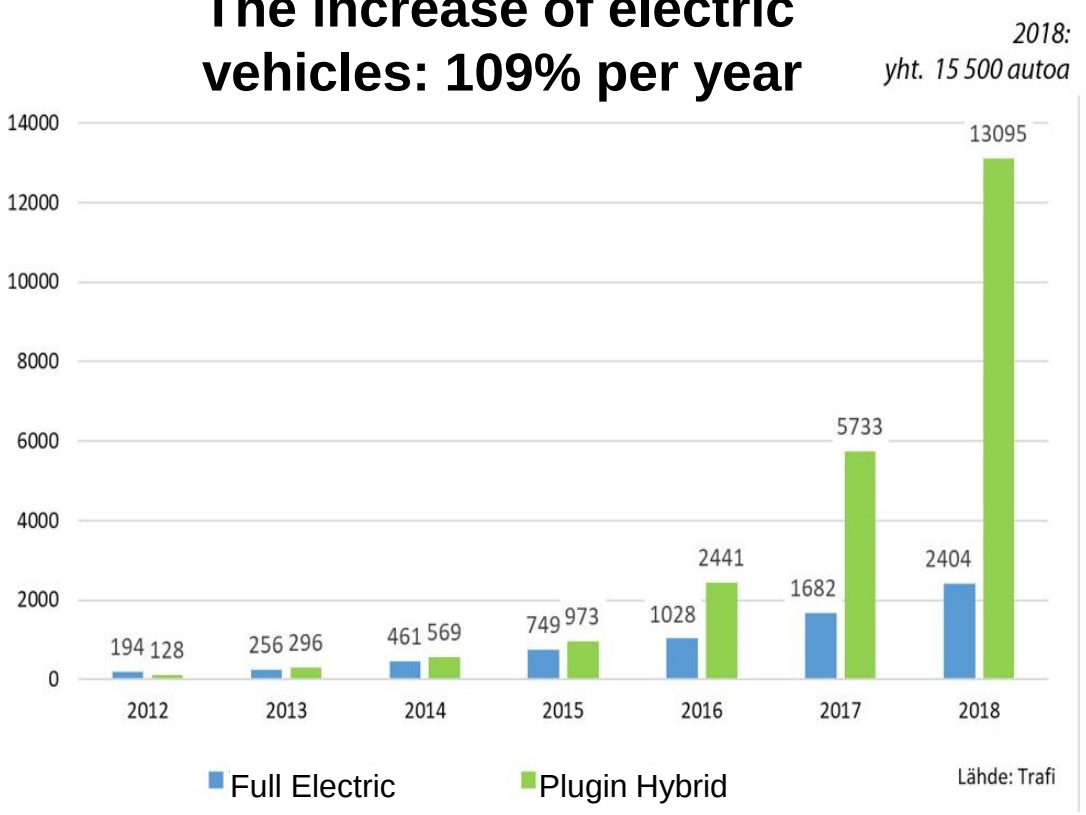
SIMBe & eSINi – projects: http://sahkoinenliikenne.fi/esini-project/

The Change is Ongoing Now

What's your nexr car ?



The increase of electric vehicles: 109% per year



Innovations on Very Low Energy Mobility

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Architectures and Ecosystems

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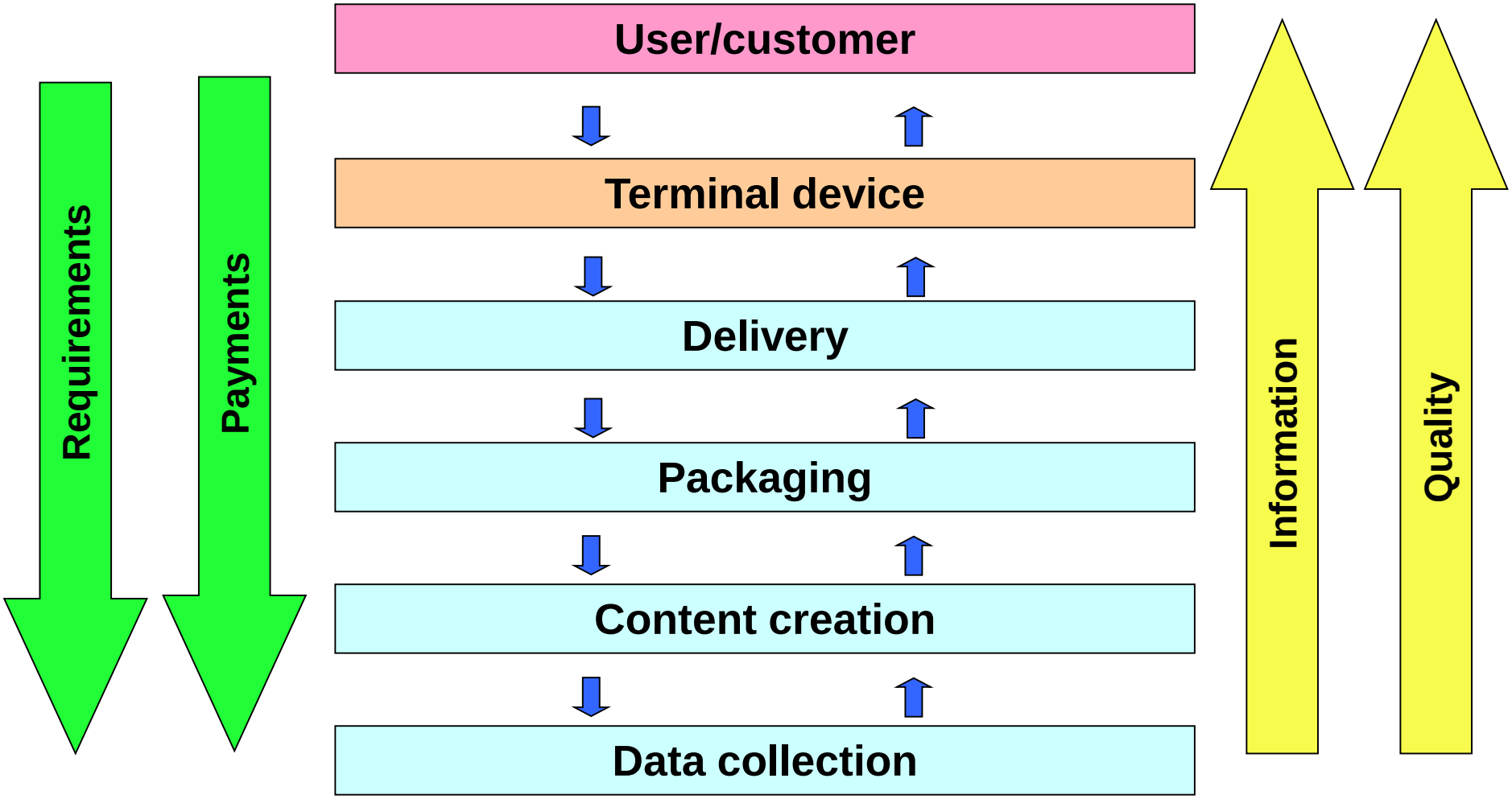
Service Chain



Enablers

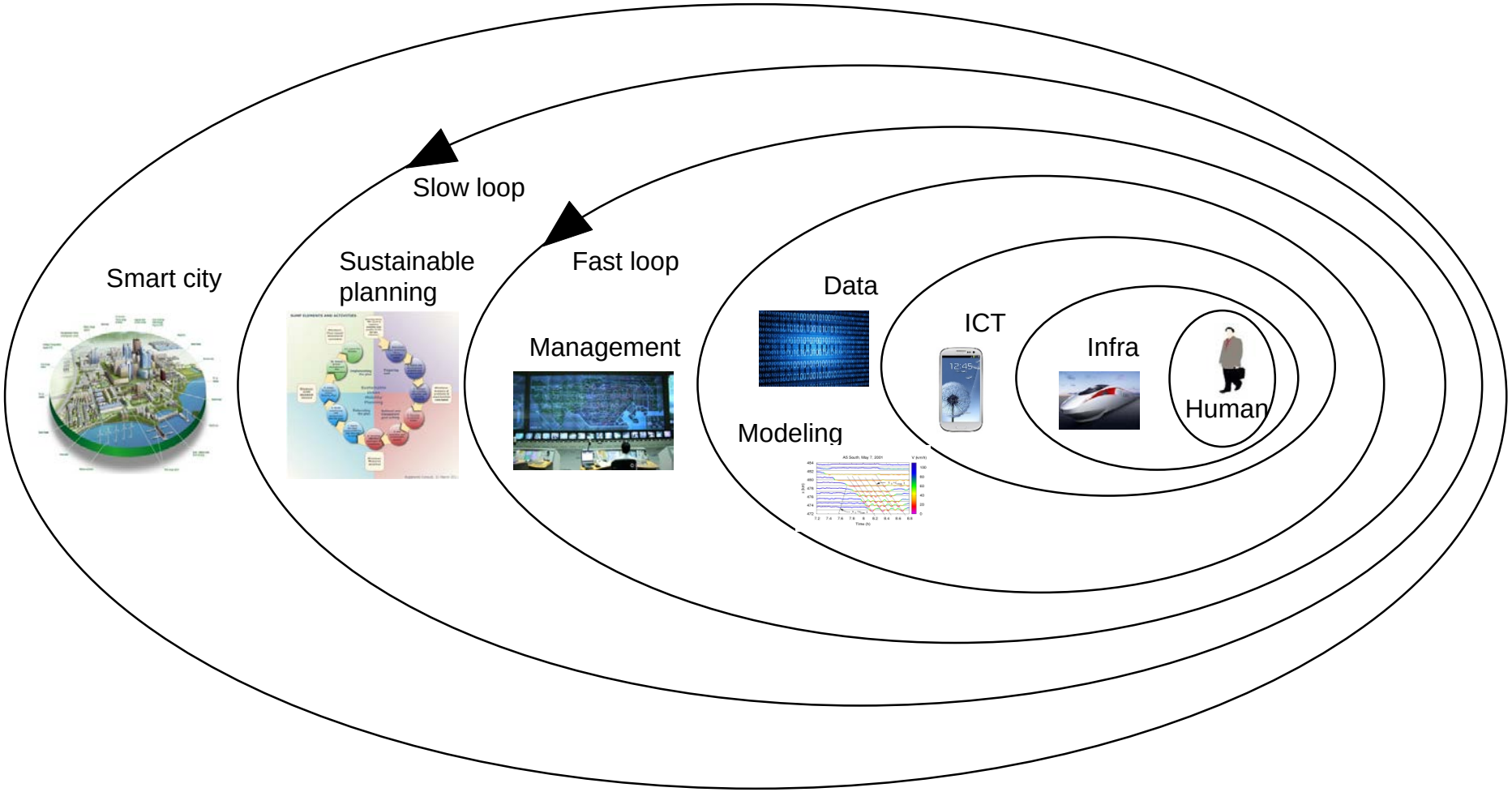
- **Guidelines**
  - Regulation, administration
  - Open architectures
  - Standardization
- **Resources**
  - Cloud services
    - *Capacity for storage and computing*
  - Communications
    - *Radio frequencies for wireless communication*
  - Data bases

    Raw sensor data, refined data

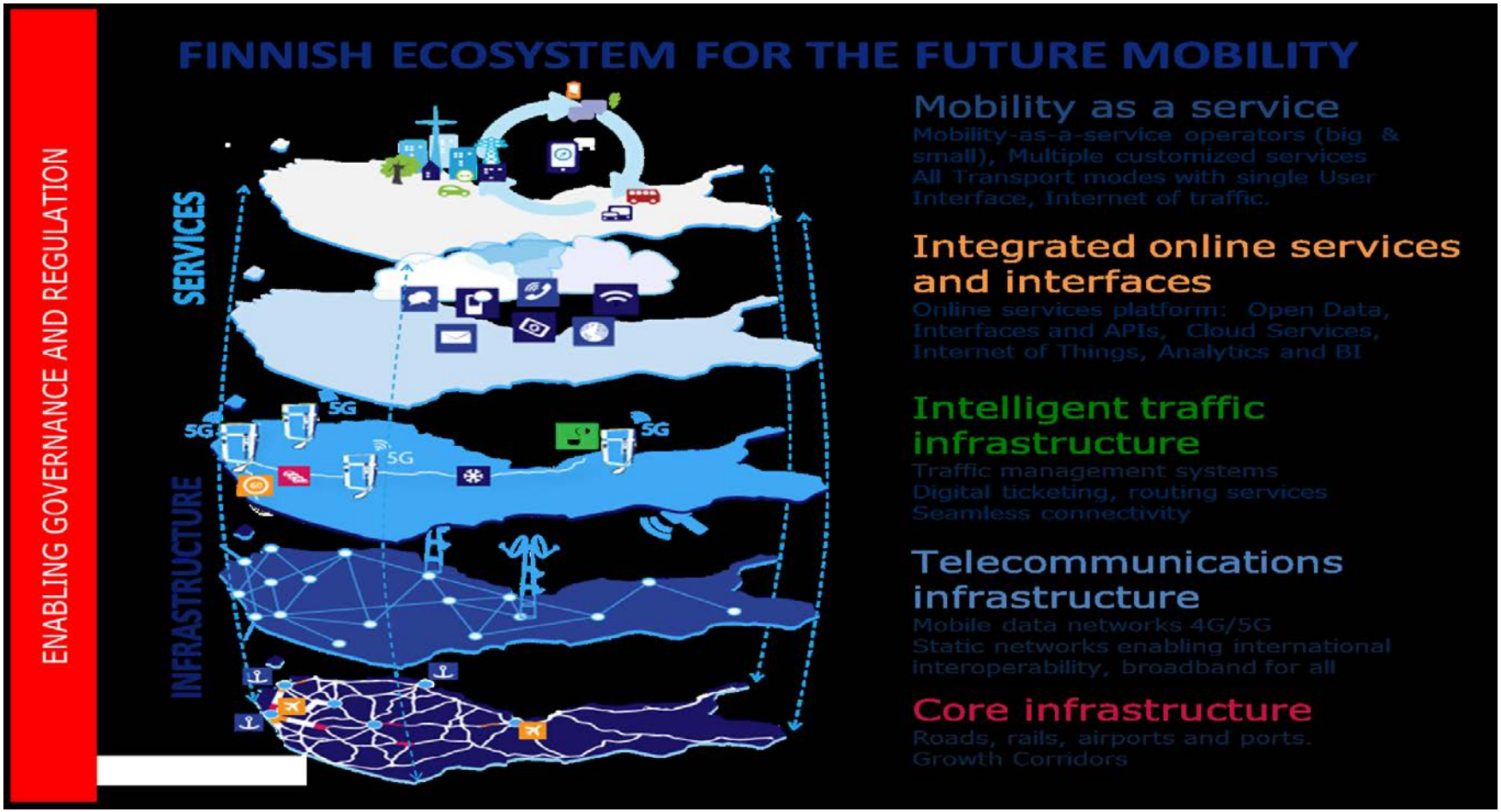
Openness

- **Open hardware**
  - PC/ARM ...
- **Open API:s (Application Programming Interface)**
  - Operating systems
  - Access to data
- **Open software**
- **Open data formats**
  - HTML, XML, JSON ...
- **Open data**
  - Files, data bases, real-time data

Operating System of Transportation



The Finnish Ecosystem



Challenges

The present state of the ITS ?

- New services emerging with increasing speed
- Heterogenous collection of various systems are not able to co-operate with each other
- There is no common platform for ITS
- The business logics is unsettled
- ITS is solving individual tasks, but there is a little intelligence the operation of the transport system as a whole

Business Logics in ITS

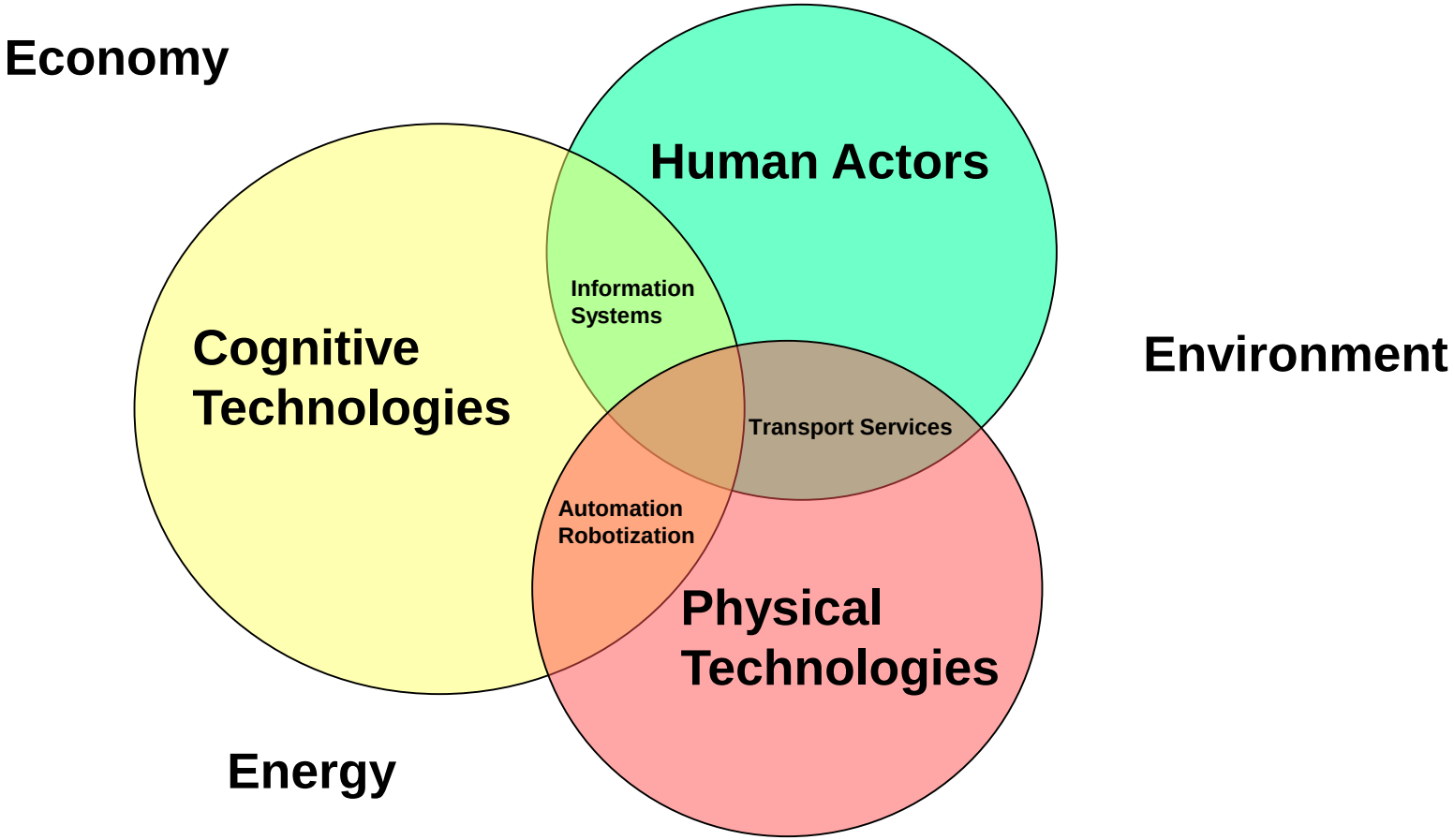
How to make business profitable ?

- Who should be paying whom in the service chain ?
- The share between public and private partners
- Some possible options:
  - Free services with taxpayers money
  - Subsidizing services with taxpayers money
  - Packaging services to vehicle price
  - Pricing per transaction
  - Service packets, monthly price
  - Credit schemes

Future directions

- Real-time traffic and traveler data will be collected
- Data is accumulating and getting more detailed
- Improved mobility, traffic management and transport planning can be achieved by analyzing the ”big data”
- Vehicles and travelers are connected all the time
- Transport will be more service-oriented, with multiple size of vehicles available
- Vehicle automation takes place gradually

The Future ?


Economy
Human Actors
Information Systems
Cognitive Technologies
Environment
Transport Services
Automation Robotization
Physical Technologies
Energy

Thank you !

Let’s discuss