Intelligent Transport System

Theoretical part

Why does a system intelligent?

What is intelligent system?

- Telematics – telecommunications + informatics
- Infocommunication (ICT), information provision (data processing)
- On-line (dynamic) systems
- Smart solutions
- Sensor technologies
- Control technologies, traffic management …

Definitions (no clear definition):

EU:

ITS are advanced applications which without embodying intelligence as such aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated and „smarter" use of transport networks

ETSI – European Telecommunications Standard Institute:

ITS include telematics and all types of communications in vehicles, between vehicles (e.g. car-to-car), and between vehicles and fixed locations (e.g. car-to-infrastructure). However, ITS are not restricted to road transport – they also include the use of information and communication technologies (ICT) for rail, water and air transport, including navigation systems.

Definitions (no clear definition):

US Department of Transportation:

ITS improves transportation safety and mobility and enhances American productivity through the integration of advanced communication technologies into transportation infrastructure and vehicles. ITS encompass a broad range of wireless and wire line communications-based information and electronics technologies.

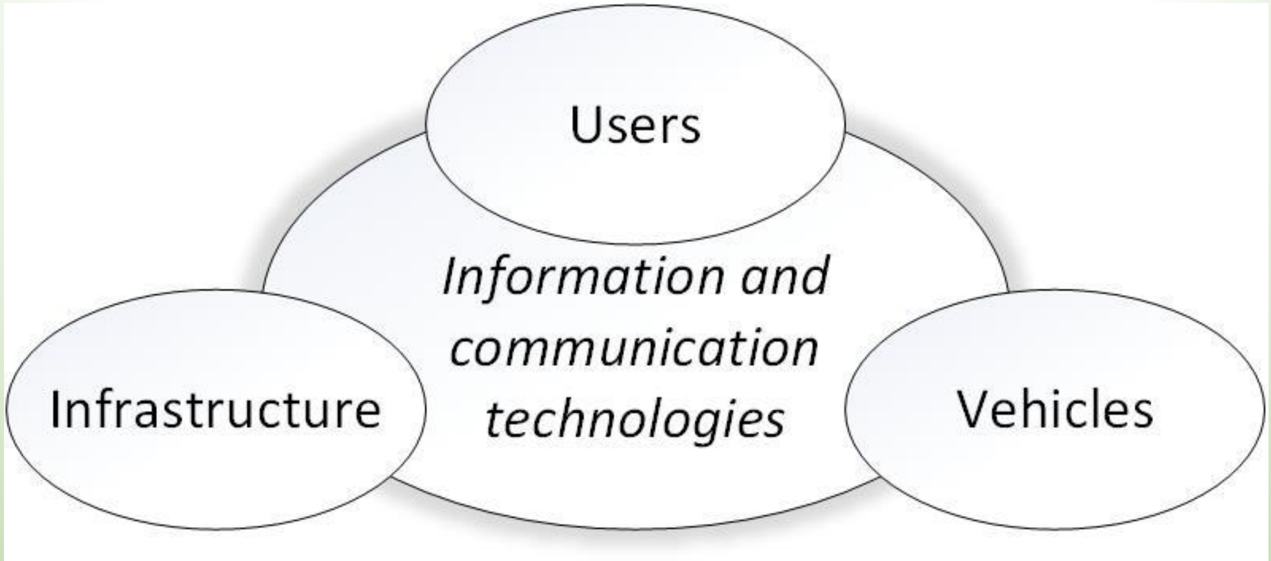
ITS Japan:

ITS offers a fundamental solution to various issues concerning transportation, which includes traffic accidents, congestion and environmental pollution. ITS deals with these issues through advanced communications and road technologies. ITS receive and transmit information on humans, roads and automobiles.

Definitions (no clear definition):

Summerized (my opinion):

ITS is the integrated application of advanced technologies using electronics, computers, communications, and advanced sensors. These applications provide users (travellers, drivers, operators) important information while improving the safety and efficiency of the transportation system and makes it more environmental friendly.



History of ITS (road transport) I.

Mechanical cruise control in a car (1958) – comfort

ARI (Autofahrer Rundfunk Information) (1974-2008) – radio based information system

PATH (Partners for Advanced Transit and Highways), USA started in 1986 – congestion handling – vehicle platoon

IVHS (Intelligent Vehicle Highway System) (early 90’s) –

- Advanced Traffic Management System
- Advanced Traveller Information System
- Advanced Vehicle Control System
- Advanced Public Transportation System

Super Smart Vehicle Systems in Japan in the 80’s with electronic toll collection

Energy saving systems (after turning of the century) – truck platooning

History of ITS (road transport) II.

PROMETHEUS project in Europe (1985) – joint research activity of European automobile industry – improvement of traffic safety and traffic management

- Driving task (driver assistant functions)
- Navigation

ERTICO, ITS America, ITS Japan, ITS Hungary

ITS congresses (Word wilde, by continents)

Challenge of ITS

- Infrastructure based development is close to end
- Demand for mobility is increasing

The goal is

- To make safer the transportation and
- Decrease the travel time on the network

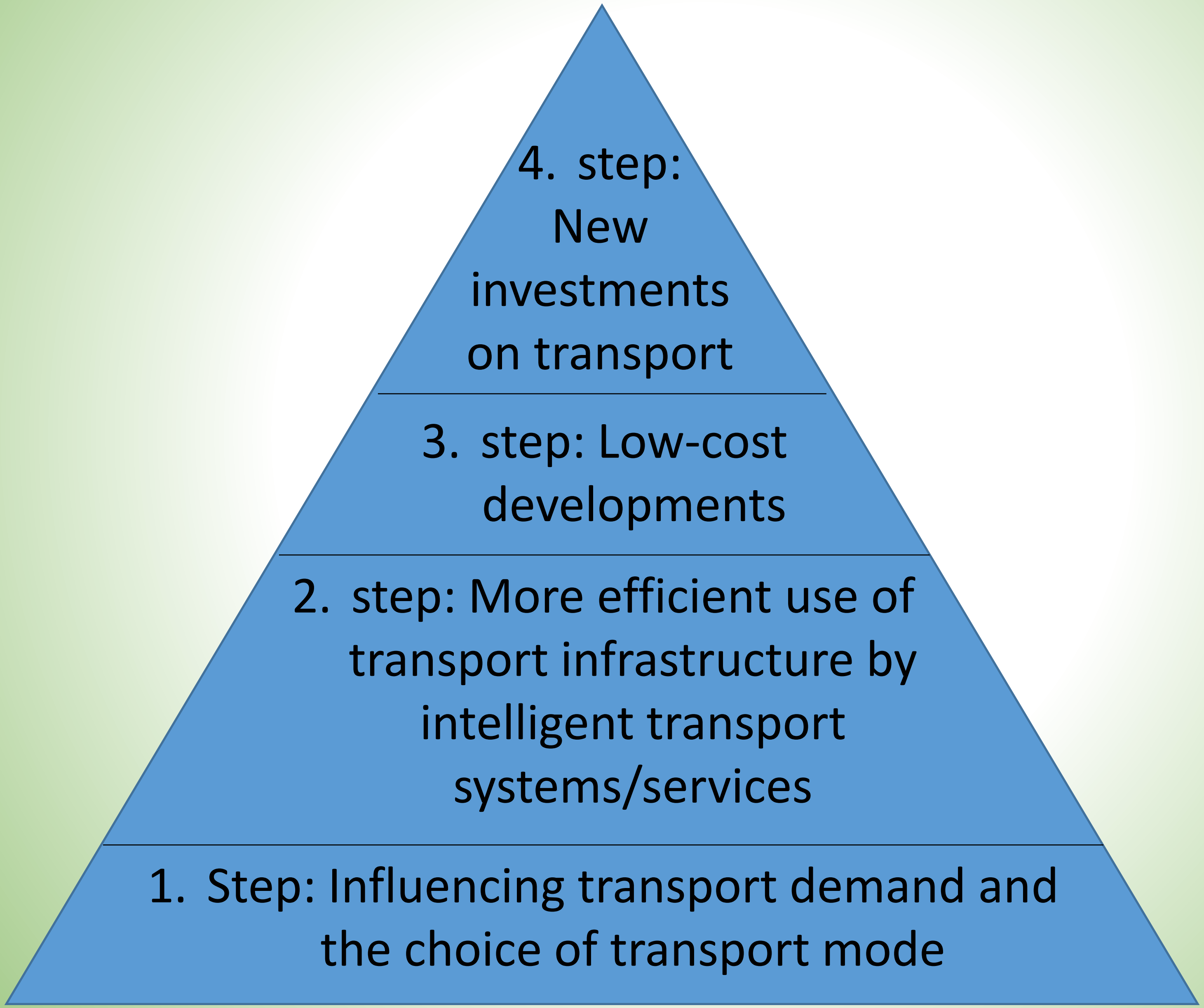
The soulution is ITS

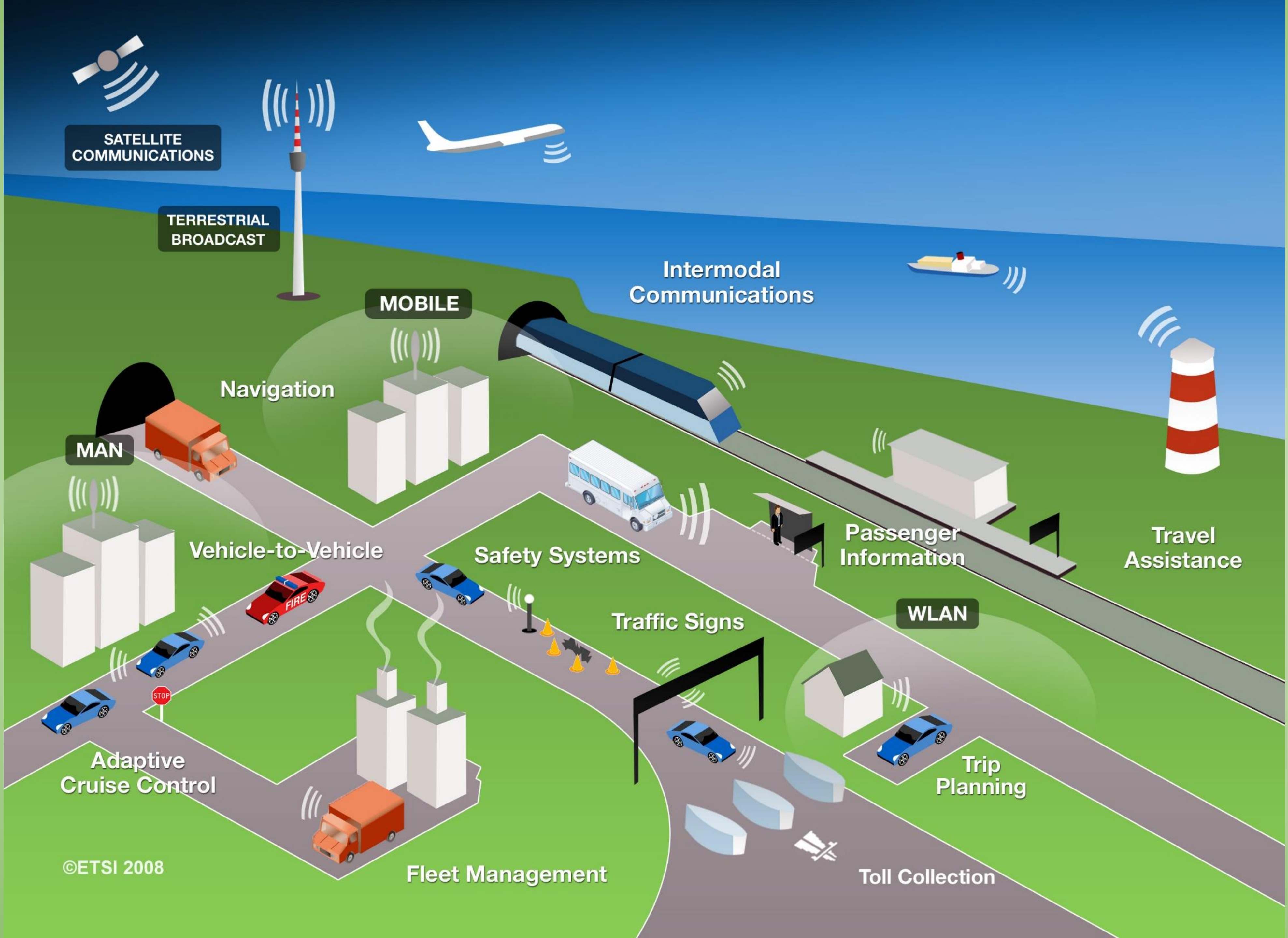
- Security and safety
- Traffic management (traffic flow, avoiding congestion)
- Transport economy (division of labour – passenger and freight transport)
- Transport planning
- Protection of the environment
- Influencing transport demand

German example – Highway information system

- Decreased number of accidents (-30%) – fatal accidents by 50%
- Decreased fuel consumption (-20%)
- Decreased pollution of environment
  - CO (-20%)
  - NO_2 (-15%)
  - CO_2 (-40%)
- Decreased travel time (-25%)

Pyramid principle to manage transport problems




SATELLITE COMMUNICATIONS
TERRESTRIAL BROADCAST
MOBILE
Intermodal Communications
Navigation
MAN
Vehicle-to-Vehicle
Safety Systems
Passenger Information
Travel Assistance
WLAN
Traffic Signs
Adaptive Cruise Control
Trip Planning
Fleet Management
Toll Collection
FIRE
STOP
©ETSI 2008

2010/40/EU directive

On the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport

1st priority area

Optimal use of road, traffic and travel data

Priority actions:

a) the provision of EU-wide multimodal travel information services
b) the provision of EU-wide real-time traffic information services
c) data and procedures for the provision, where possible, of road safety related minimum universal traffic information free of charge to users

2010/40/EU directive

2nd priority area

Continuity of traffic and freight management ITS services

3rd priority area

ITS road safety and security applications

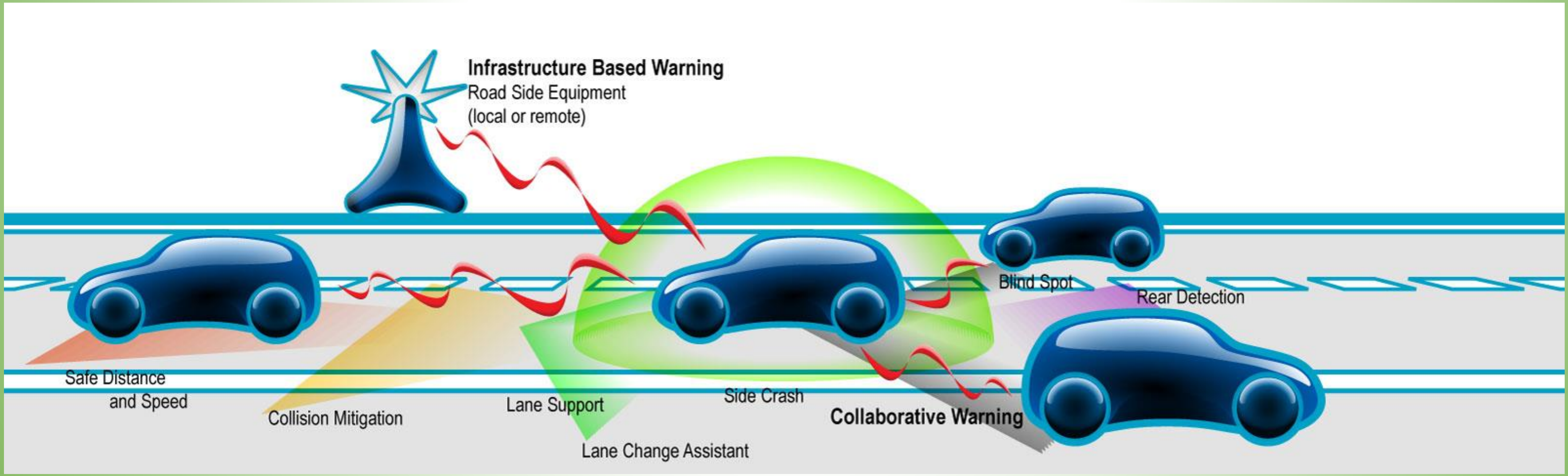
Priority actions:

a) the harmonised provision for an interoperable EU-wide eCall
b) the provision of information services for safe and secure parking places for trucks and commercial vehicles
c) the provision of reservation services for safe and secure parking places for trucks and commercial vehicles

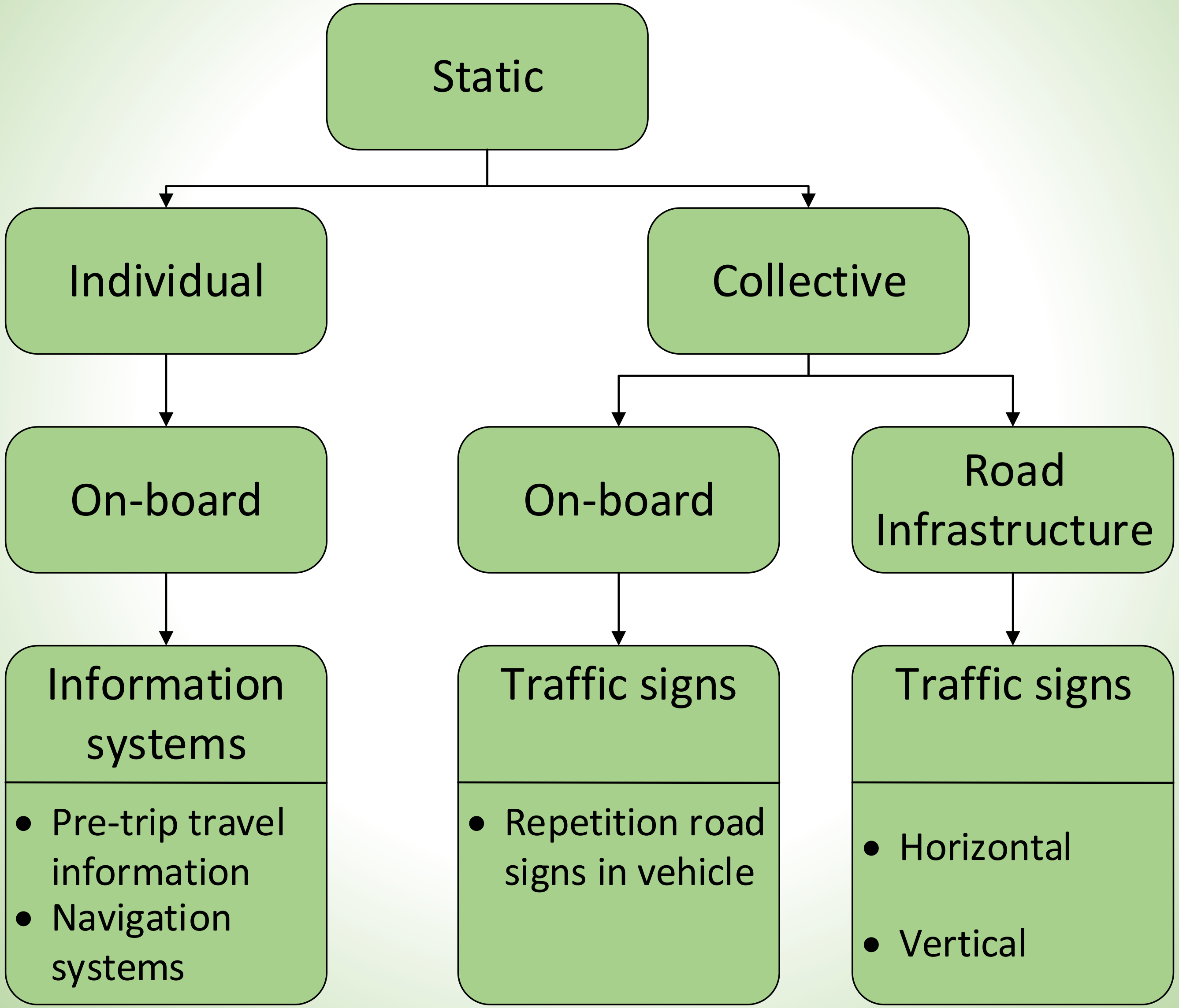
2010/40/EU directive

4th priority area

Linking the vehicle with the transport infrastructure



Classification of ITS systems (based on information services)



Static, collective, on-board systems

- Based on magnetic field (Comguard)
- Based on GPS (problem is VMS)
  - On-board database (updating necessary)
  - Central database (Internet connection necessary)
- Road sign recognition cameras (visibility problems – weather, vegetation)
- I2V technologies

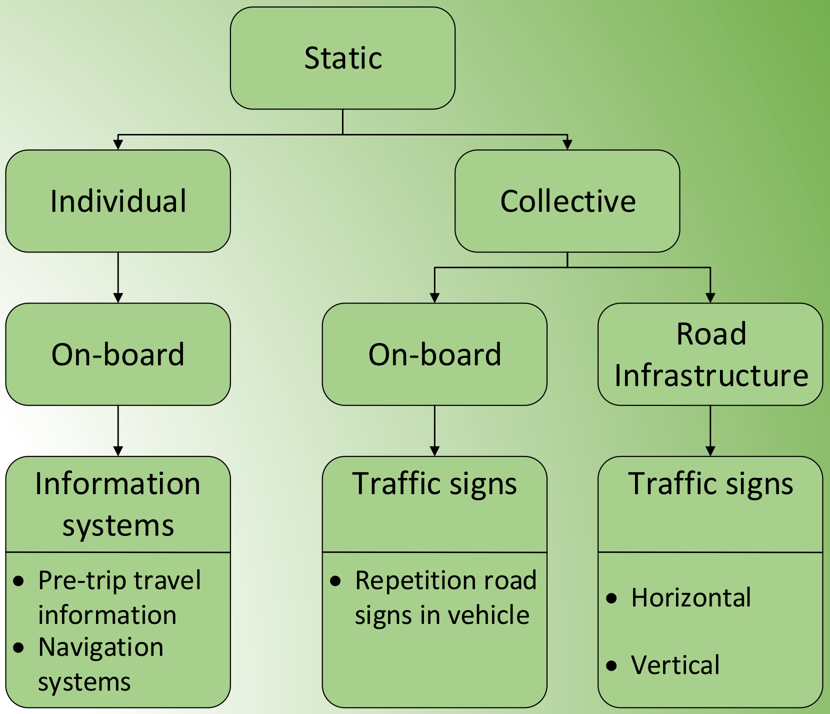
Static, collective, road infrastructure systems

- Horizontal – road marks
- Vertical – road signs

Static, individual, on-board systems

- Pre-trip travel information systems
- Navigation systems

Pre-trip travel information systems



- Map (matching postal address and a point of a map)
- Public transport timetable
- Shortest route calculation and recommendation
  - Distance based (private transport)
  - Time based (public transport)
- Objects on the map (transport, touristic …) with information, searching

Daily routine or single case (e.g. tourists)

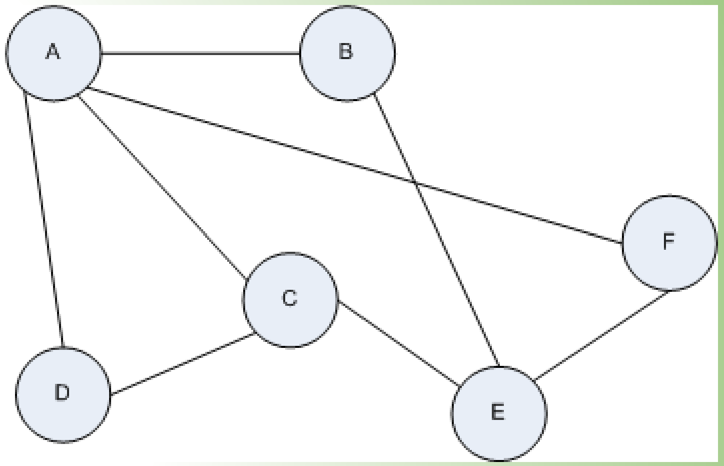
Transport experts (transport objects)

Specific user groups (logistics companies, disabled travellers, blind people …)

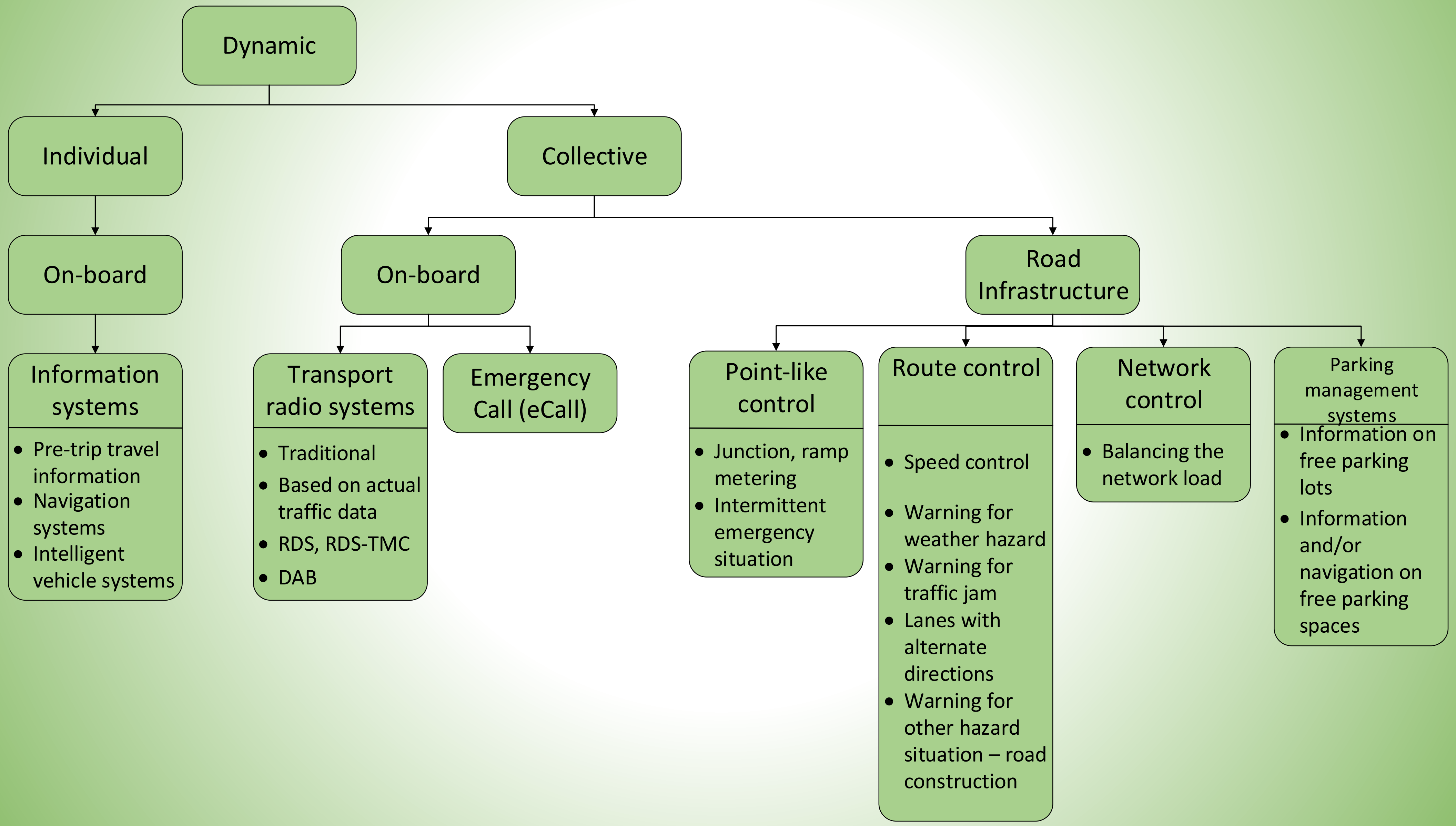
Pre-trip travel information systems

Graph theory (mapping the real network)

- Public transport (dual system)
- Private transport



Classification of ITS systems (based on information services)



Tasks of dynamic ITS systems I.

- Increasing traffic safety in case of high traffic load or/and in intermittent emergency situation
- Decreasing:
  - Loss of travel time
  - Extra energy use
  - Air pollutions
  - Noise pollutions
- Maximize the available capacity of the existing road network. Time-varying directions of the transport lanes to achieve better capacity utilisation.
- Improving traffic flow without any construction intervention in junctions or on routes

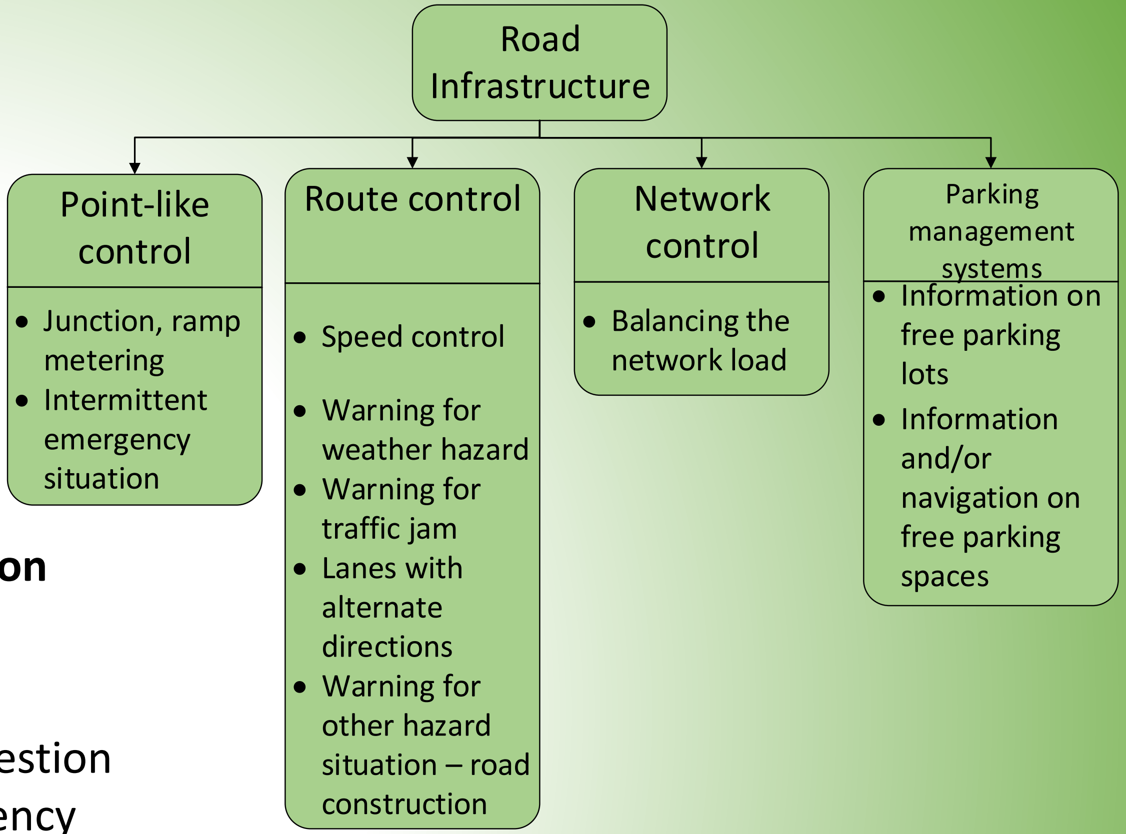
Tasks of dynamic ITS systems II.

- Decreasing traffic volume on congested road network, e.g. giving suggestions for alternative routes
- Shorten parking space searching time by giving information on
  - Parking facility
  - Free parking space

Integrated systems are the solutions:

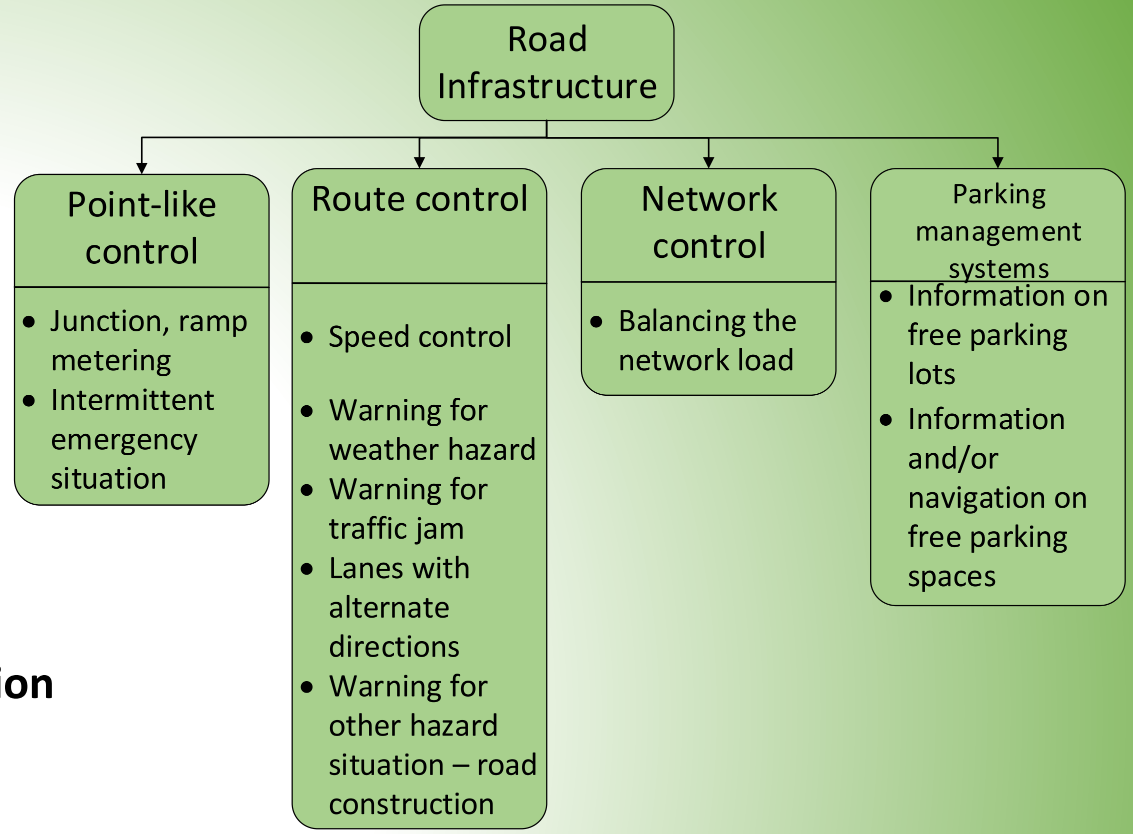
- Collect information about traffic, weather conditions and other information (e.g. construction on the road)
- Evaluation of these information
- Information service to drivers at the right place and time (about safe speed and emergency situations)

Dynamic, collective, road infrastucture systems I.



Objective	Target Value	Network element	Intervention
Increasing traffic safety	Number of accidents and accidents severtity	Route	Speed control Warning for congestion and other emergency situation (accident, weather)
Increasing efficacity	Sum of waiting time	Junction	Traffic-dependent signallic traffic control
	Sum of travel time/cost	Route	Speed control Time-varying directions of the transport lanes
		Network	Alternative route recommendation

Dynamic, collective, road infrastructure systems II.



Objective	Target Value	Network element	Intervention
Environmental protection	Emission, imission	All	Speed control Emission control Prohibition of truck traffic
Cooperation between transport modes	Modal split	All	Park and Ride systems Priority systems for public transport

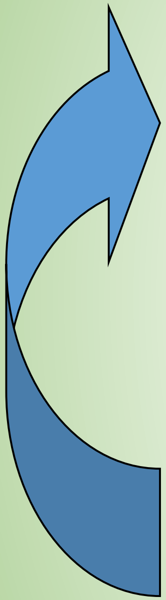
Dynamic, collective, road infrastucture systems – Network control

Objectives:

- Decreasing traffic volume on congested road network (alternative routes – same capacity utilization rate)
- Decreasing loss of travel time and energy consumption
- Increasing traffic safety
- Elimination of existing and prognosed traffic jams
- Environmental protection

Dynamic, collective, road infrastucture systems – Network control

Information loop:



- Data collection
- Data storage, data processing (traffic forecast)
- Recommendations based on strategy of traffic management
- Forwarding information
- Reaction monitoring

Dynamic, collective, road infrastucture systems – Route control

- Harmonizing the traffic flow with speed control at high traffic loads
- Increasing traffic safety in hazard situations (traffic jam, accident, road construction, weather hazard – fog, heavy rain, strong wind, icing)

Variable message signs are the most commonly used to displyay route control information.

Requirements:

- Visibility
- Recognizability
- Clarity

Dynamic, collective, road infrastucture systems – Route control

Types of VMS

- Mechanically operated
  - Prizm (3 signs)
  - Rotating flat (2 signs)
  - Blind (max. 25 signs)
  - Rotating lamellas (infinite)
- Operated with lighting technology
  - Led (infinite)
  - Bulb
    - Separate control (infinite)
    - Combined control (15 signs)
  - Internal illumination (1 sign)

Dynamic, collective, road infrastucture systems – Route control

Principles of VMS

Text:

- Predetermined (not free text)
- Short and clear
- No abbreviation
- Multilingual
- Monolingual + „!" – No
- Non-traffic information for traffic safety

Image:

- Internationally accepted pictograms
- Road signs (visualisation is same as on signboard)

Text + Image:

- Text and Image coherence

Dynamic, collective, road infrastucture systems – Route control

Best example: Highway control

Data collection: inductive loops, cameras, meteorological station

Objectives:

- Harmonized traffic flow
- Avoiding congestion
- Warning for accident hazards
- Warning for weather hazards

Based on data the software suggests signs and dispatcher approves or refuses – **not an automated system**

Dynamic, collective, road infrastucture systems – Highway control

Dynamic, collective, road infrastucture systems – Highway control

Dynamic, collective, road infrastucture systems – Highway control

Dynamic, collective, road infrastucture systems – Highway control

Dynamic, collective, road infrastucture systems – Highway control

Meteorological station

- Temperature (air, pavement)
- Humidity
- Rainfall intensity
- Snow height
- Visual range
- Wind force, wind direction, wind gust
- Freezing point, icing

Dynamic, collective, road infrastucture systems – Highway control

Expected travel time display

Dynamic, collective, road infrastucture systems – Point-like control

Objectives:

- Improving traffic flow in a junction and improving traffic safety
- Better capacity utilisation ratio

A **ramp meter**, **ramp** signal or **metering** light is usually a basic traffic light or a two-section signal (red and green only, no yellow) light together with a signal controller that regulates the flow of traffic entering highways according to current traffic conditions.

Dynamic, collective, road infrastucture systems – Point-like control

Dynamic speed control at a pedestrian crossing

Dynamic, collective, road infrastucture systems – Point-like control

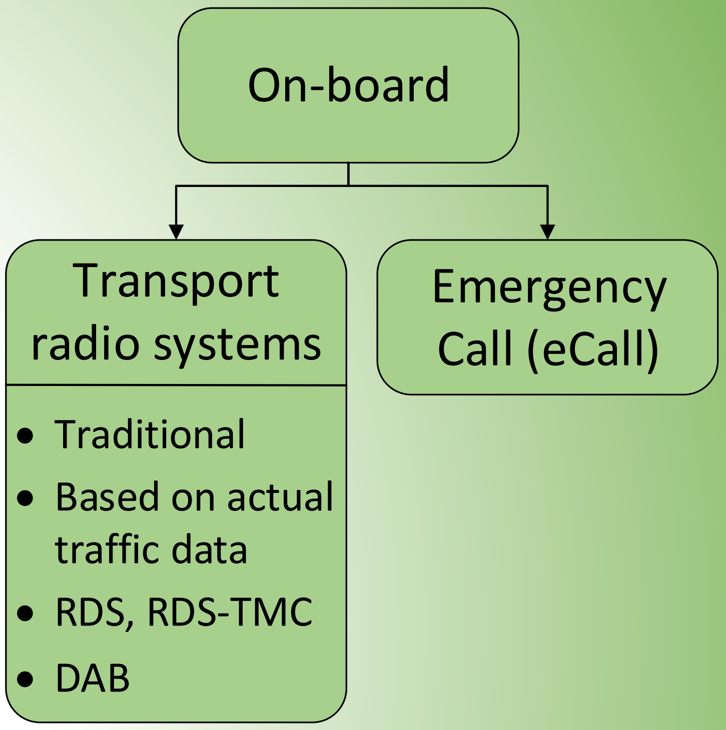
Dynamic, collective, road infrastucture systems – Parking management

Objectives:

Shorten parking place search

- Information on free parking lots
- Information on free parking spaces (advanced system: navigation to free parking spaces), and reservation

Dynamic, collective, on-board systems



Transport radio systems

- Traditional radio systems (developments: automated switch on; for a given region)
- Based on actual traffic data (interrupted broadcast, on a special frequency, for a given region, unknown reason)
- RDS (automated switch-over)
- RDS-TMC (traffic measurements, no interruption, encoding-decoding, information storage, language, for a given region)
- DAB (images, moving pictures)

Dynamic, collective, on-board systems

Transport radio systems – RDS receiver

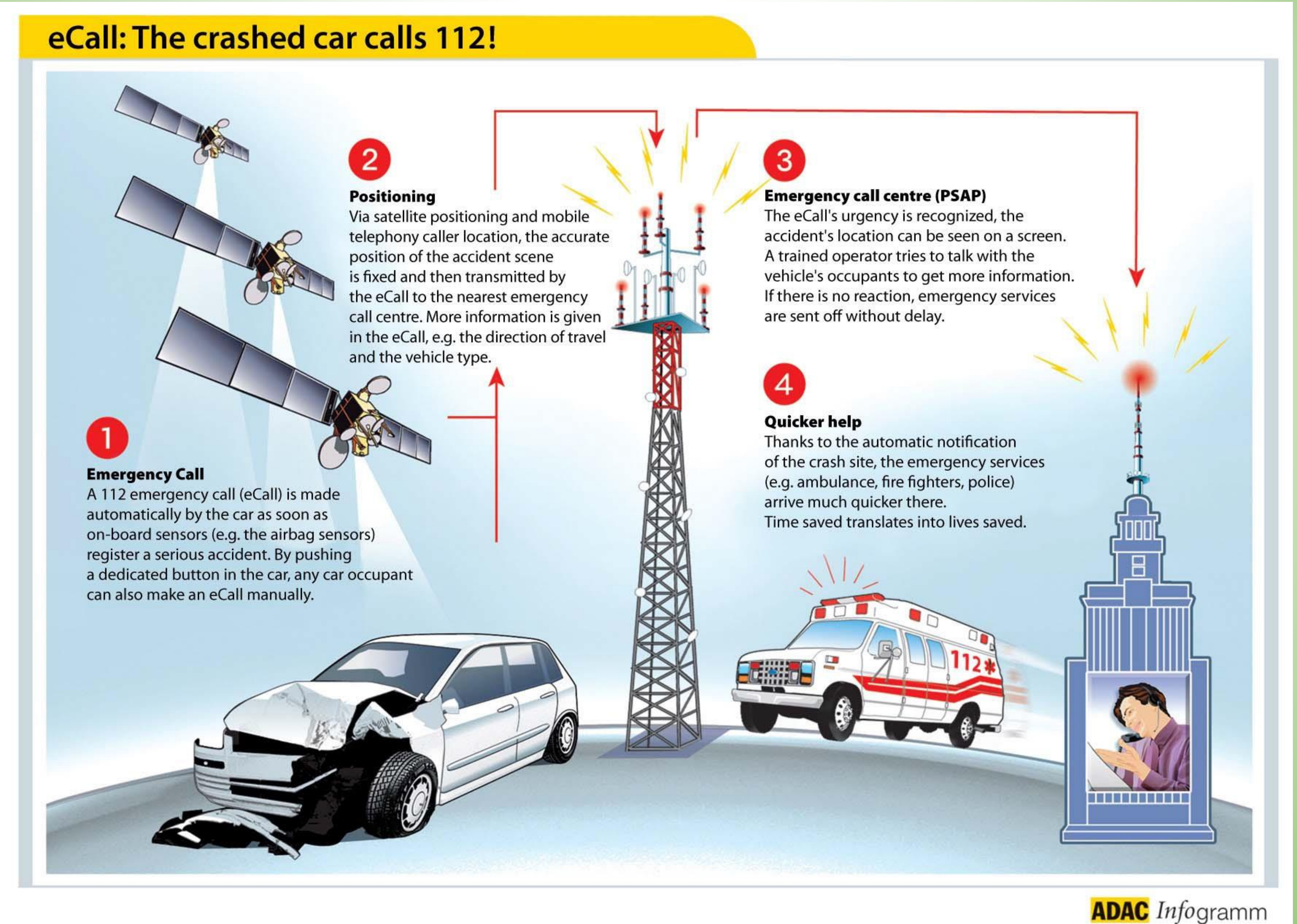
Dynamic, collective, on-board systems

eCall

- An emergency call to nearby vehicles
- An emergency call to an emergency center (112)
  - Deceleration
  - Airbag deployment
  - The maximum tensioning force of the seat belts
  - GPS position

Dynamic, collective, on-board systems

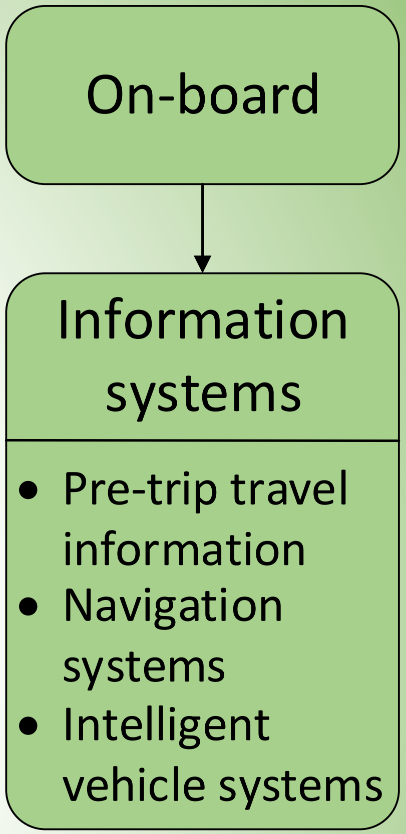
eCall



Dynamic, individual, on-board systems

Functions:

- Information service
- Positioning
- Route suggestion, navigation
- Communication
- Taking over driving tasks



Dynamic, individual, on-board systems

Pre-trip information systems:

- Information service
- Influencing travel behaviour

Static data:

- Network
- Distance, expected travel time
- Parking
- Public transport

Dynamic data:

- Traffic disturbances
- Parking
- Weather conditions
- Public transport

Dynamic, individual, on-board systems

Pre-trip information systems based on data collection:

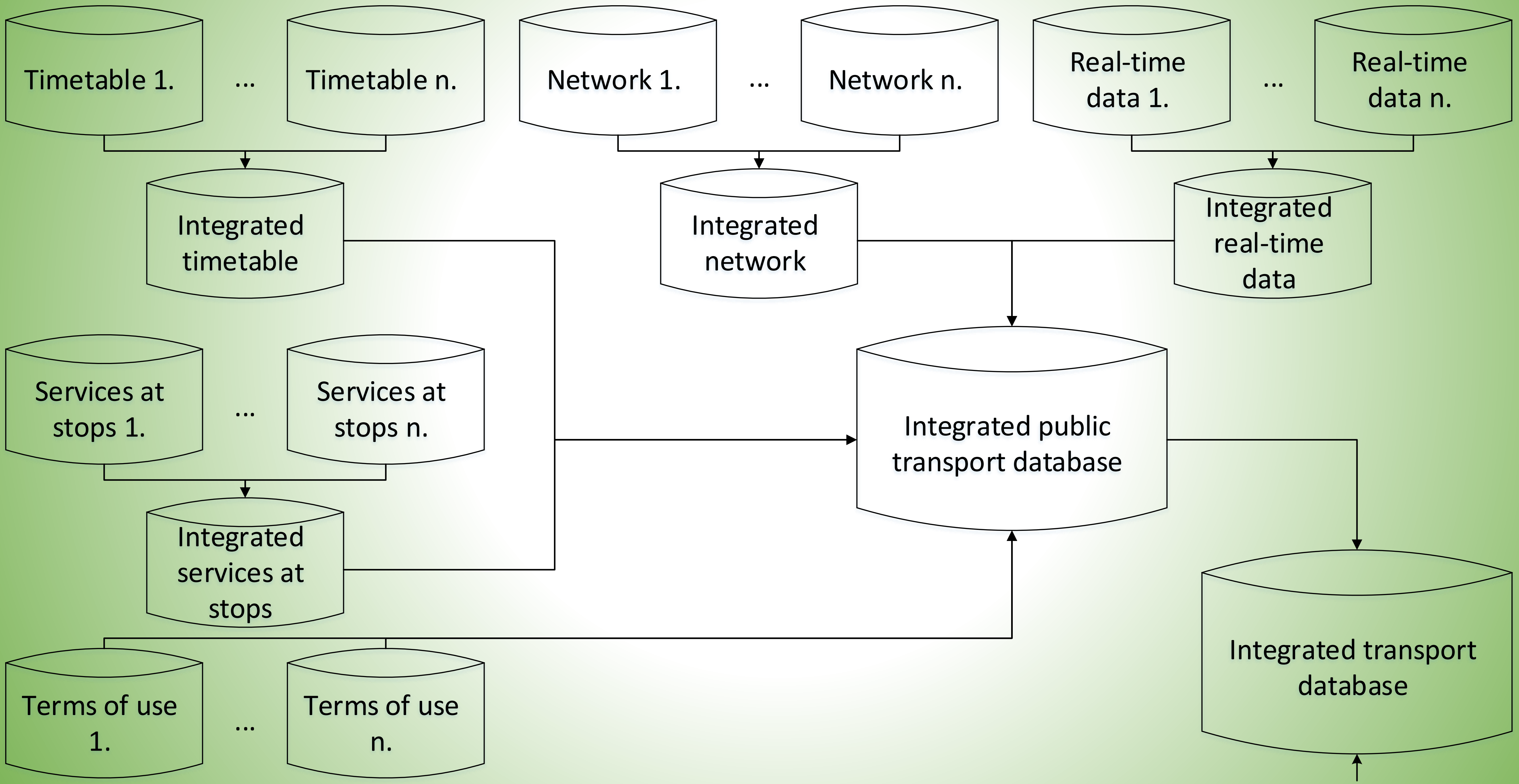
- The data itself often not clear for travellers (e.g. traffic volume – vehicle unit/hour)
- Information provision based on analyzing traffic data
- It is advisable to suggest recommendations to traveler (based on the information)

maps.google.com

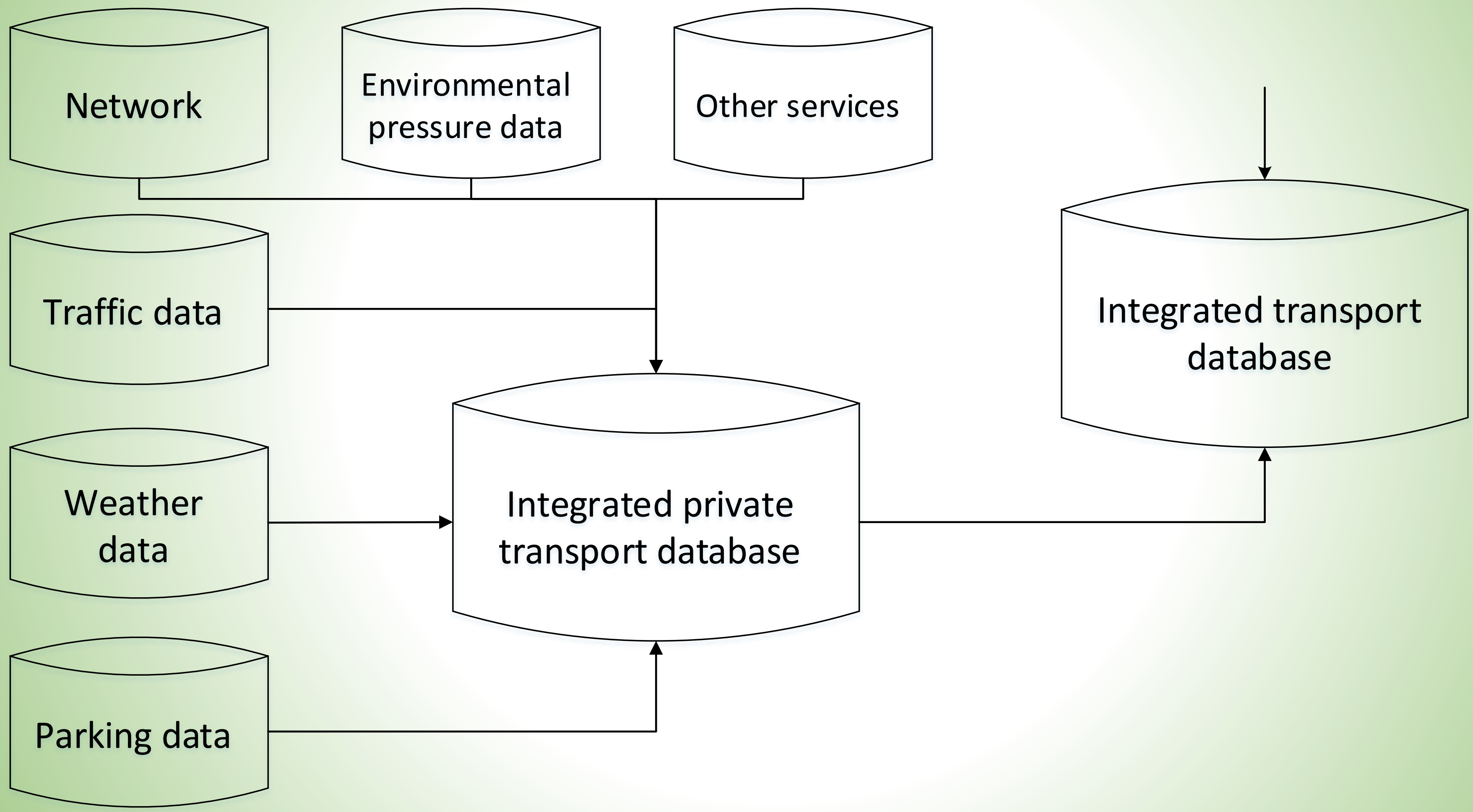
mobile applications (e.g. Waze – with navigation)

web cameras (utinform.hu/webkamerak)

Pre-trip travel information systems (public transport)

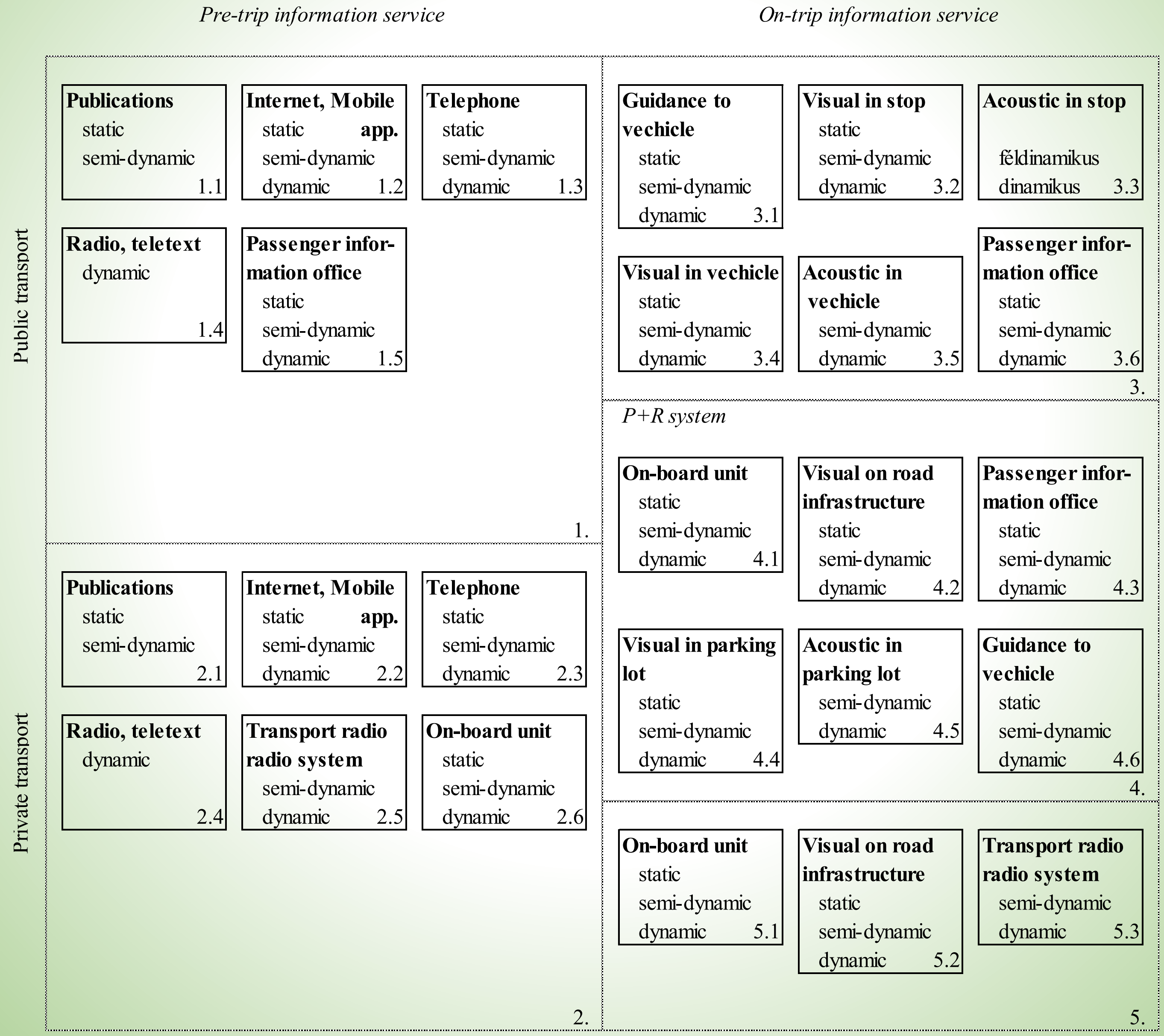


Pre-trip travel information systems (private transport)



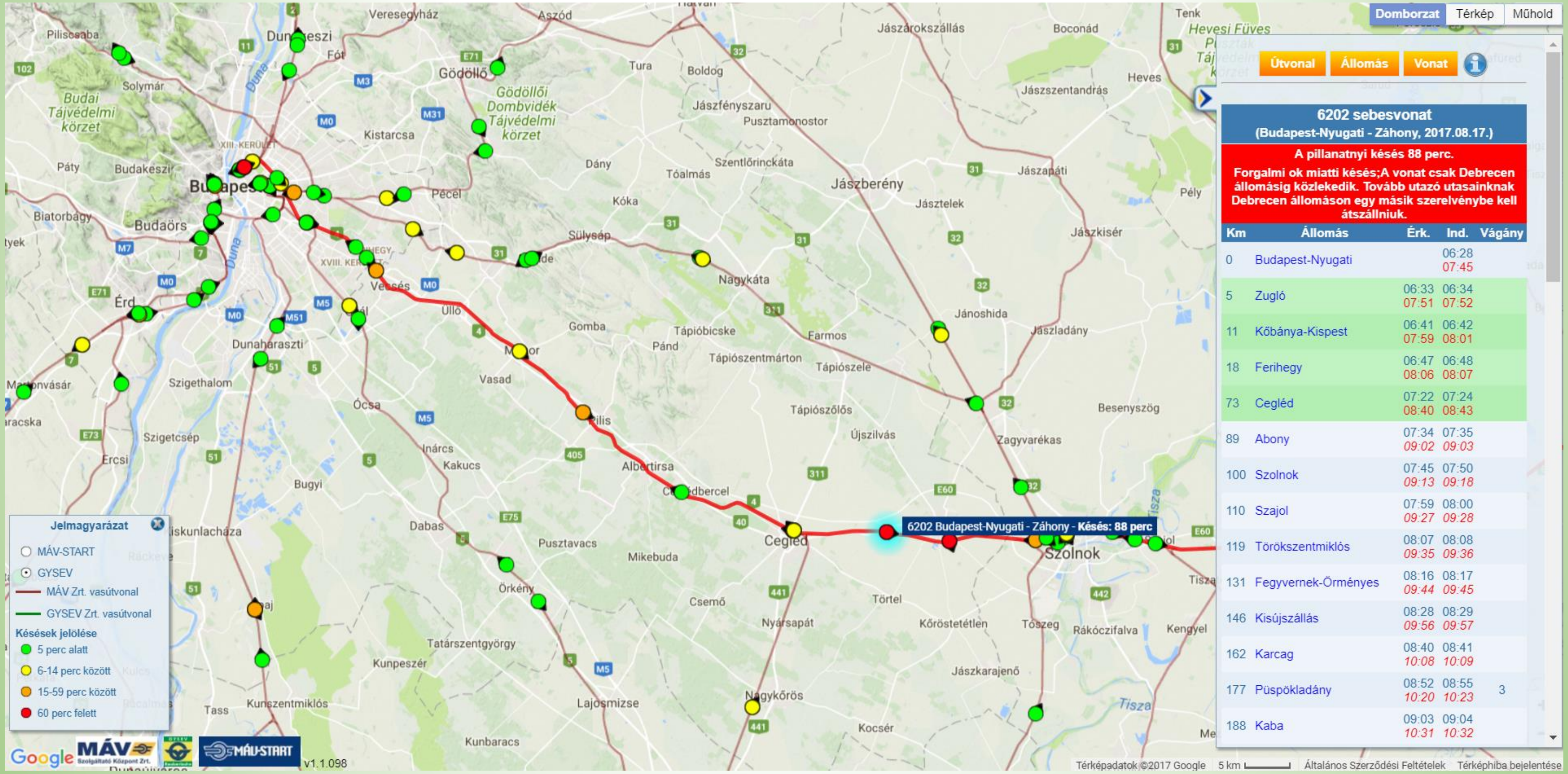
Pre-trip travel information systems

Modes of information services



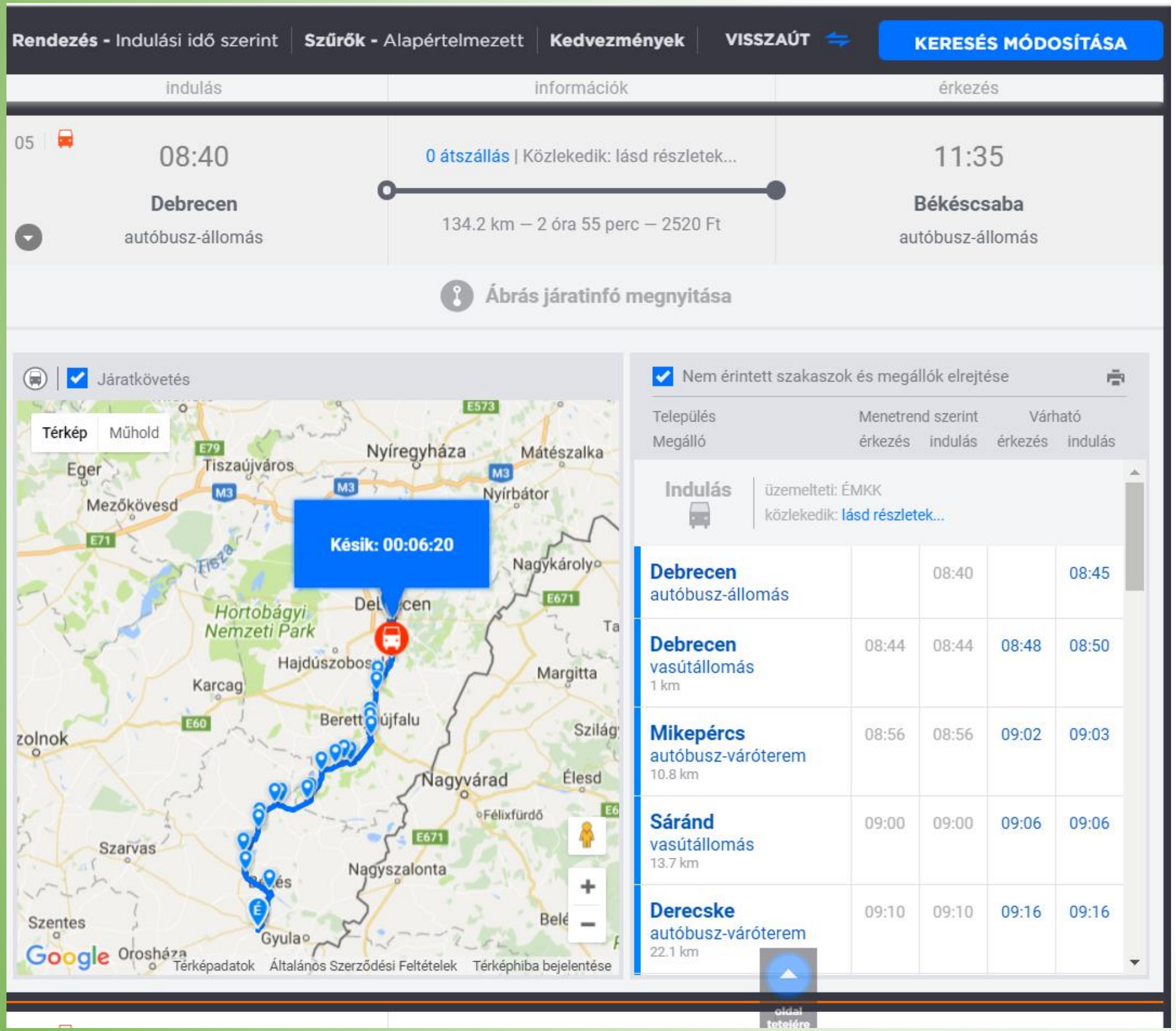
Pre-trip travel information systems

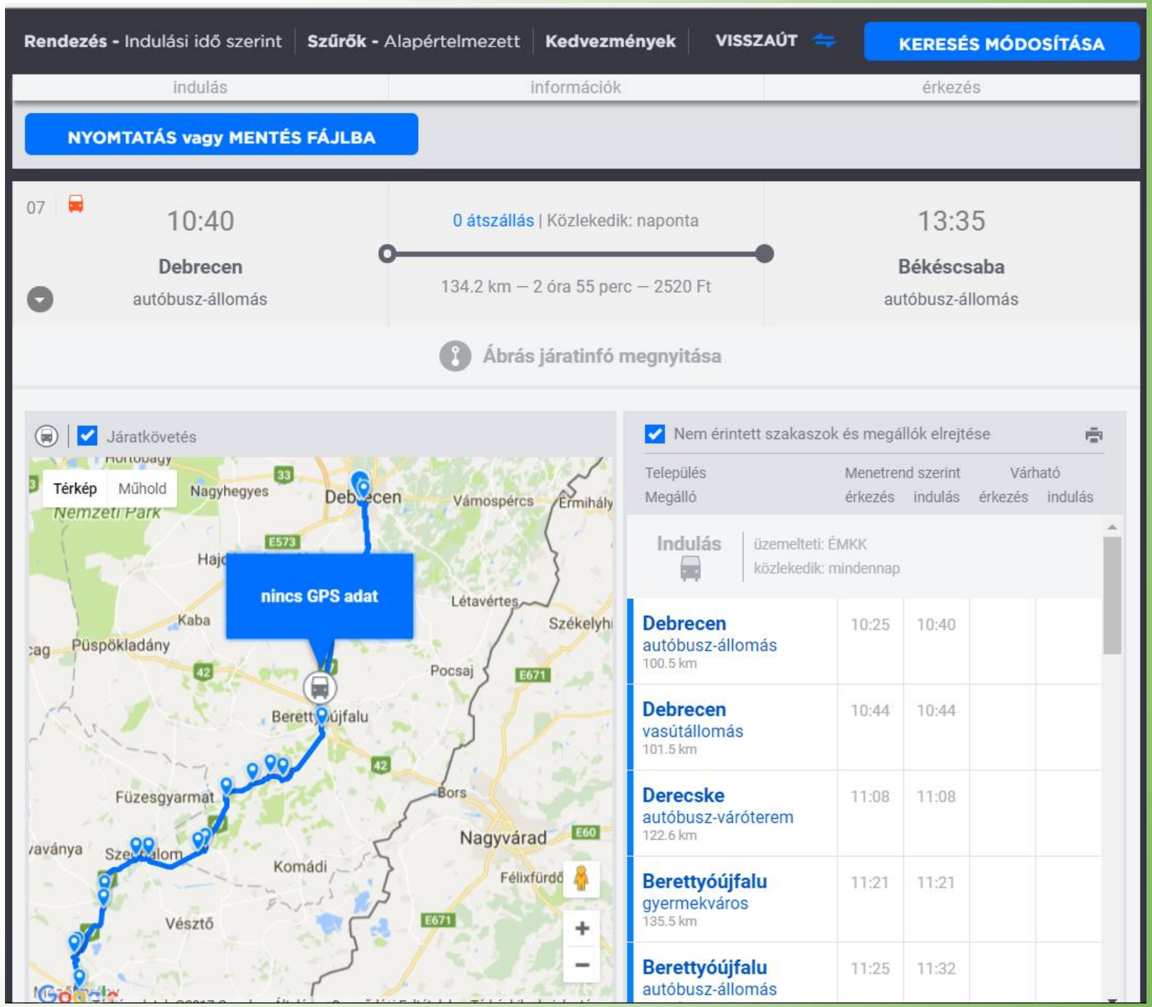
Dynamic information about train status



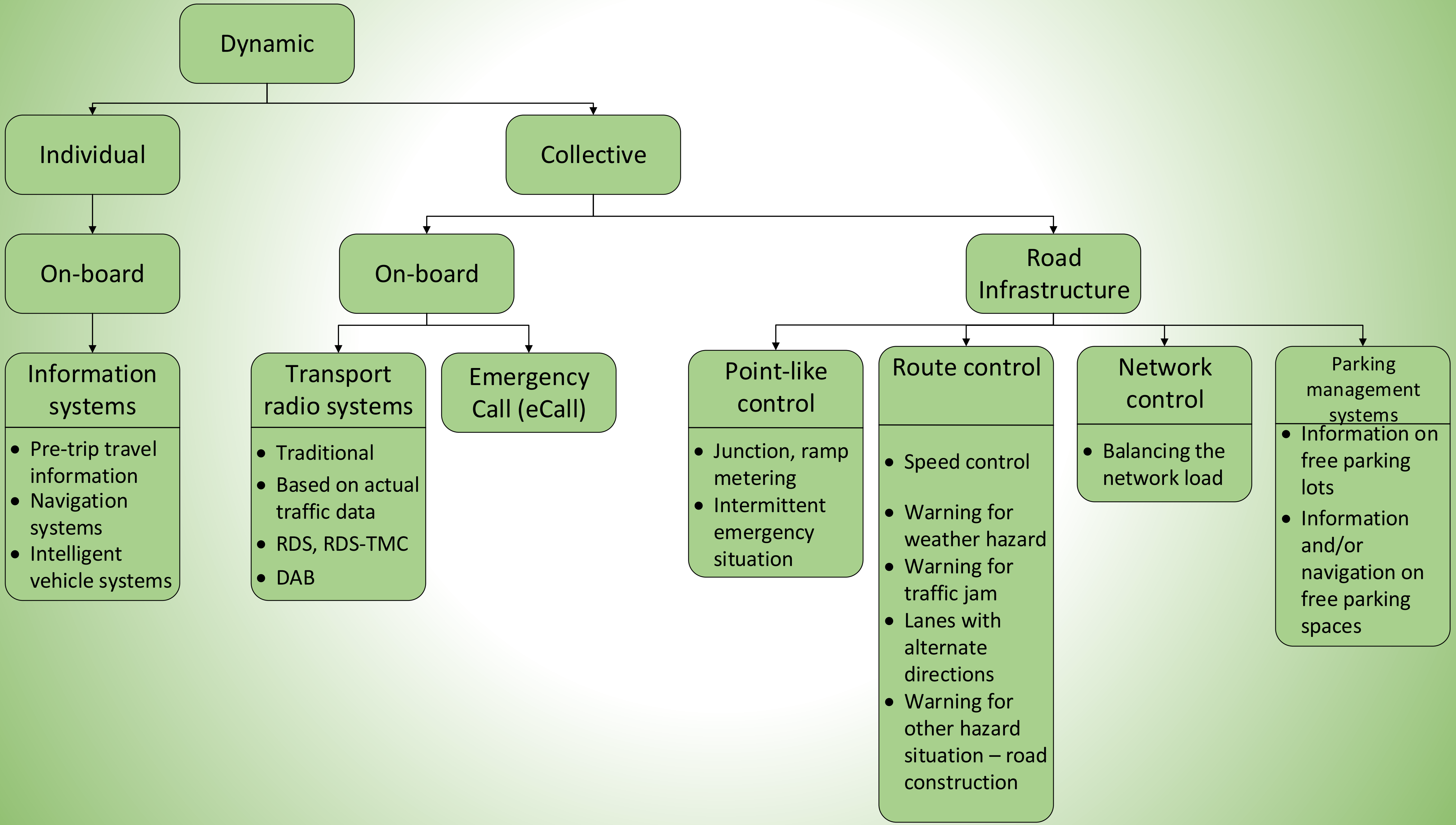
Pre-trip travel information systems

Dynamic information about journey planning





Classification of ITS systems (based on information services)



Dynamic, individual, on-board systems

Navigation systems

- Positioning
- Route recommendation
- Navigation
- Information service

Mobile application - Waze

Dynamic, individual, on-board systems

Data for Navigation systems:

- Static
  - Network data
  - Archived, historic data (traffic volume is used to be)
  - Long-term road construction
  - Route recommendations
- Dynamic
  - Traffic disturbances
  - Road environment (weather)
  - Floating car data (speed, travel time)
  - Route recommendations

Dynamic, individual, on-board systems

Classification of Navigation systems:

- Nature of information
  - Static
  - Dynamic
- Mode of communication
  - One-way
  - Two-way
  - Bimodal
- Route decision
  - In vehicle
  - In a center
- Optimization criterion
  - User
  - System

Dynamic, individual, on-board systems

Intelligent vehicle systems

Shipping, aviation, track-based modes

Objectives

- Increase transport safety (guidance in hazard situations)
- Travel comfort (making easier driving tasks, reduce stress)

RESPONSIBILITY!!

Dynamic, individual, on-board systems

Intelligent vehicle systems

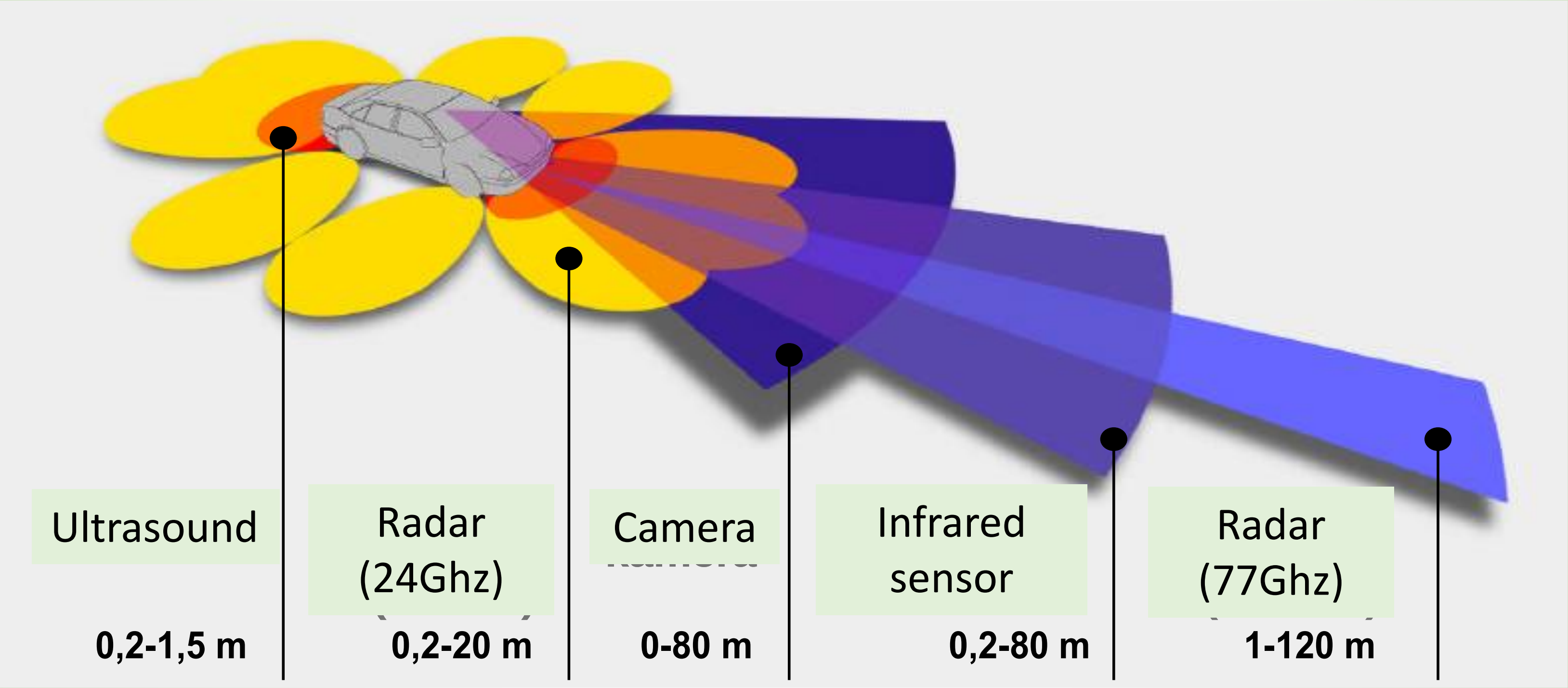
Levels of driving support

- Giving information and possibly suggestion of the recommended driving behaviour (speed recommendation, warning to weather)
- Previous + intervention in driving process in critical (hazard) situation (keep distance)
- At the driver's request some driving functions are taken over by the vehicle (cruise control – adaptive or cooperative adaptive, parking support system e.t.c)
- Fully automatic driving (self driving)

Level0	Name	Narrative definition	Execution of steering and acceleration/deceleration	Monitoring of driving environment	Fallback performance of dynamic driving task	System capability (driving modes)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning of intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task	System	Human driver	Human driver	Some driving modes
Automated driving system („system”) monitors the driving environment						
3	Conditional Automation	the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene	System	System	Human driver	Some driving modes
4	High Automation	the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task even if a human driver does not respond appropriately to a request to intervene	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a humand driver	System	System	System	All driving modes

Dynamic, individual, on-board systems

Intelligent vehicle systems



Human detection

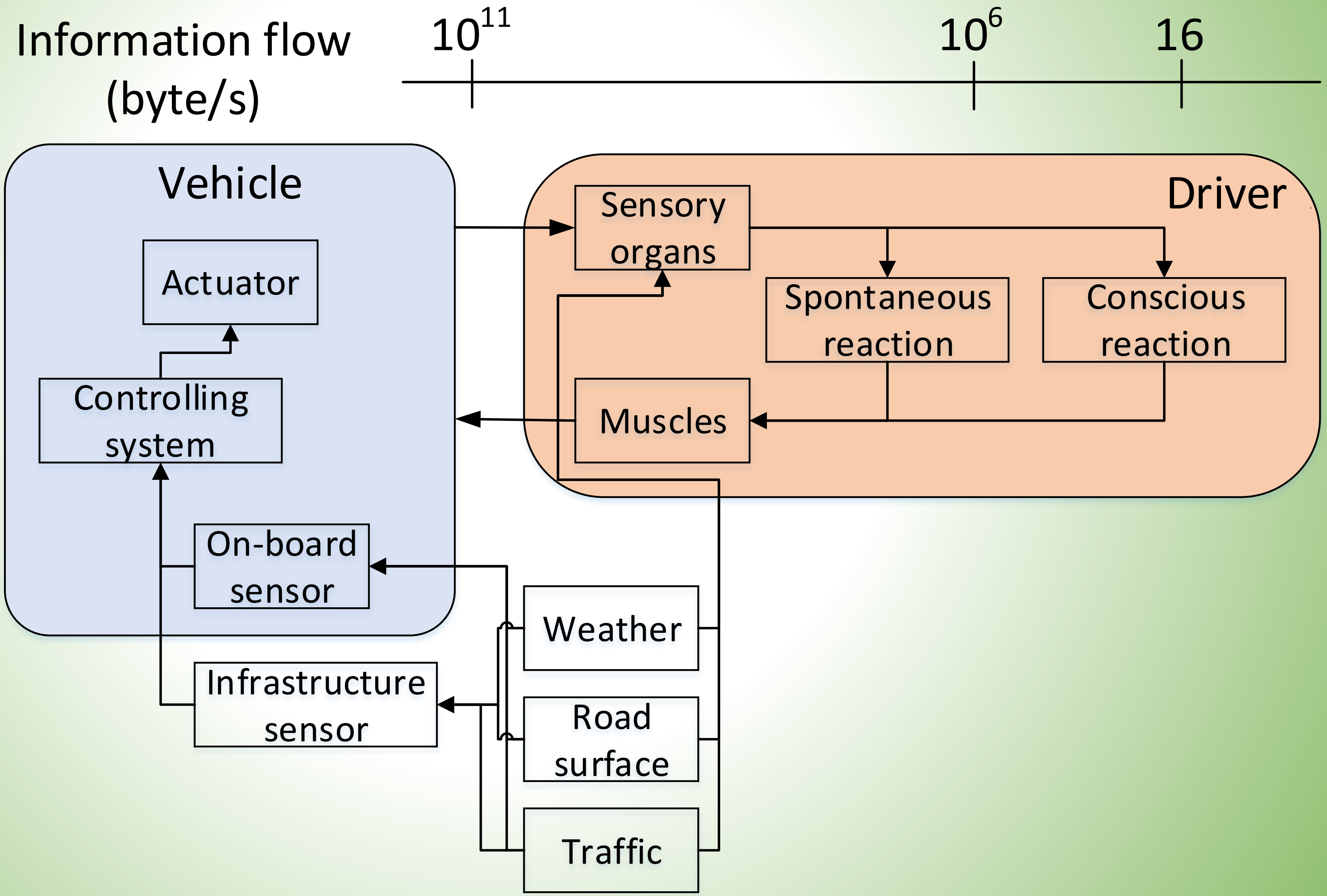
Back-up radar
Parking assistance

Lane assist
Object classification

Obstacle detection
Adaptive cruise control

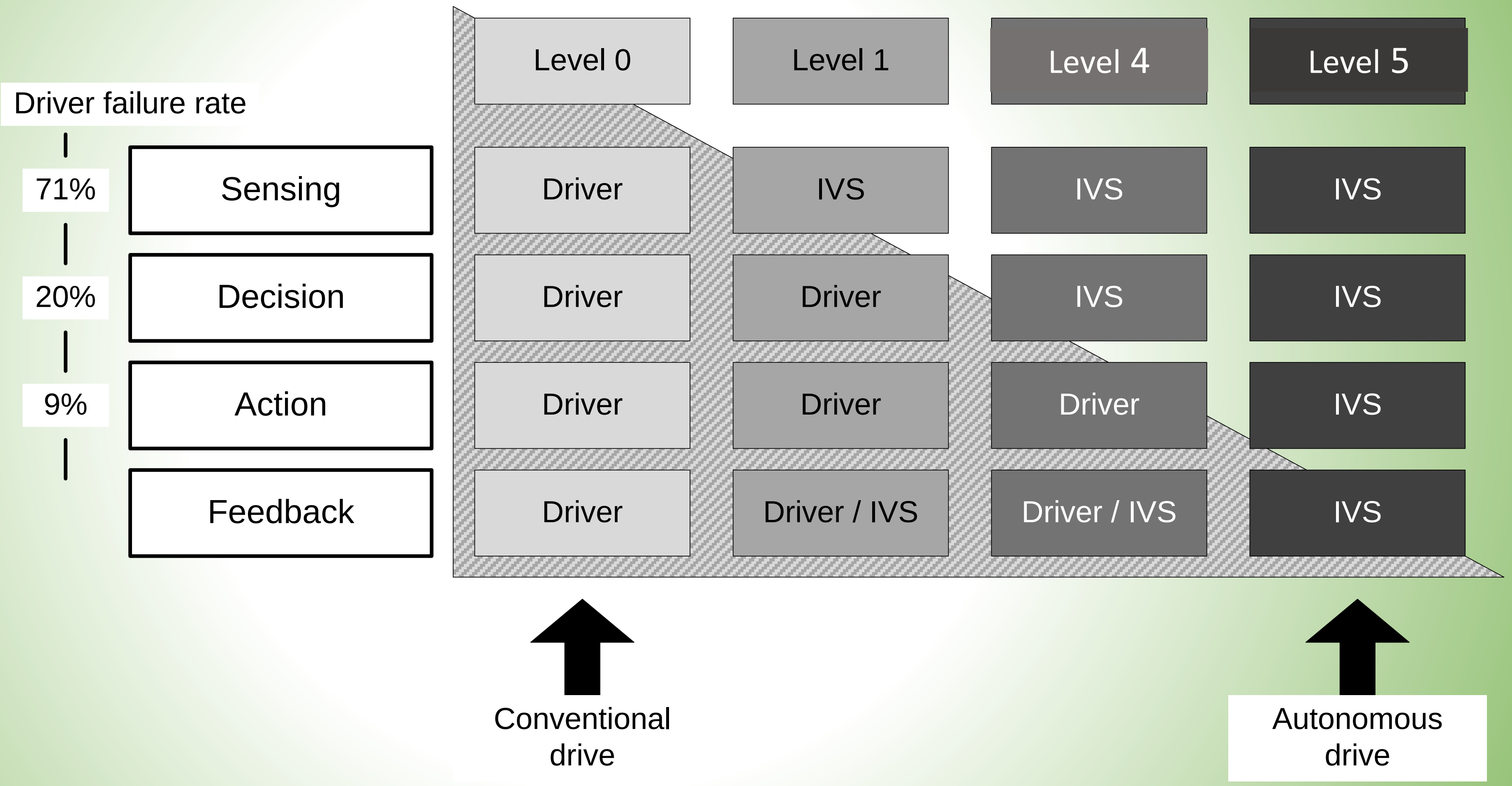
Dynamic, individual, on-board systems

Intelligent vehicle systems



Dynamic, individual, on-board systems

Intelligent vehicle systems

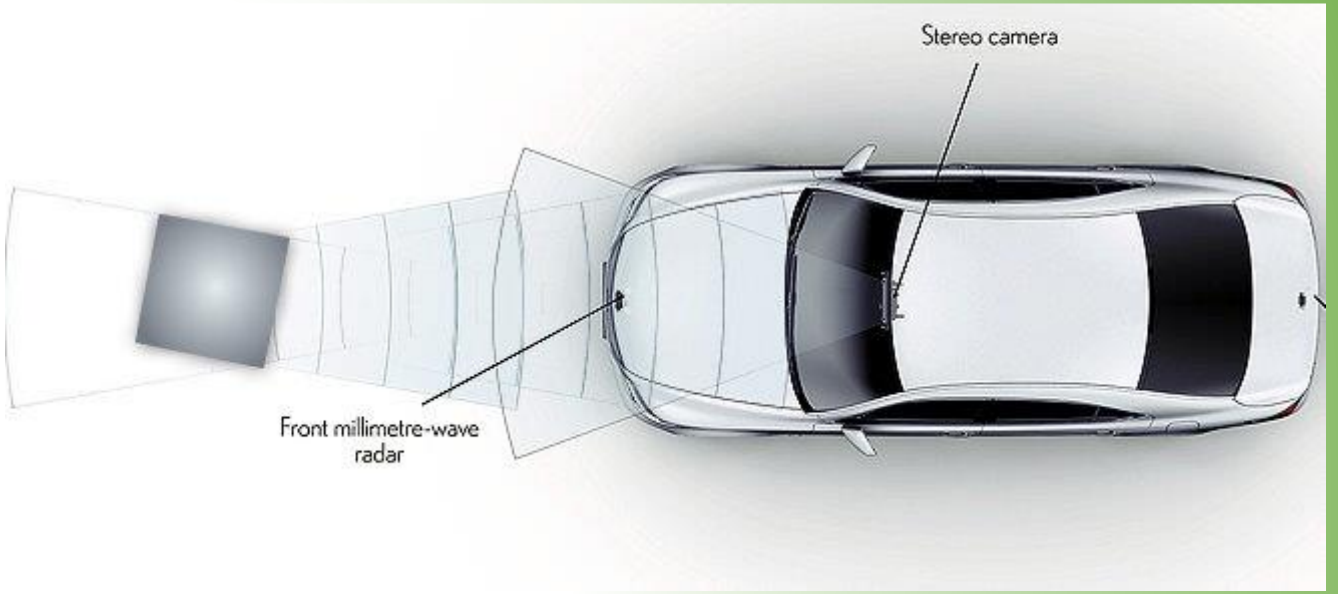


Dynamic, individual, on-board systems

Intelligent vehicle systems

Obstacle **D**etection **S**ystem

https://www.youtube.com/watch?v=osLzVqhtI-Y



Drowsy **D**river **W**arning
https://www.youtube.com/watch?v=OaPsl84ecrg

Dynamic, individual, on-board systems

Intelligent vehicle systems

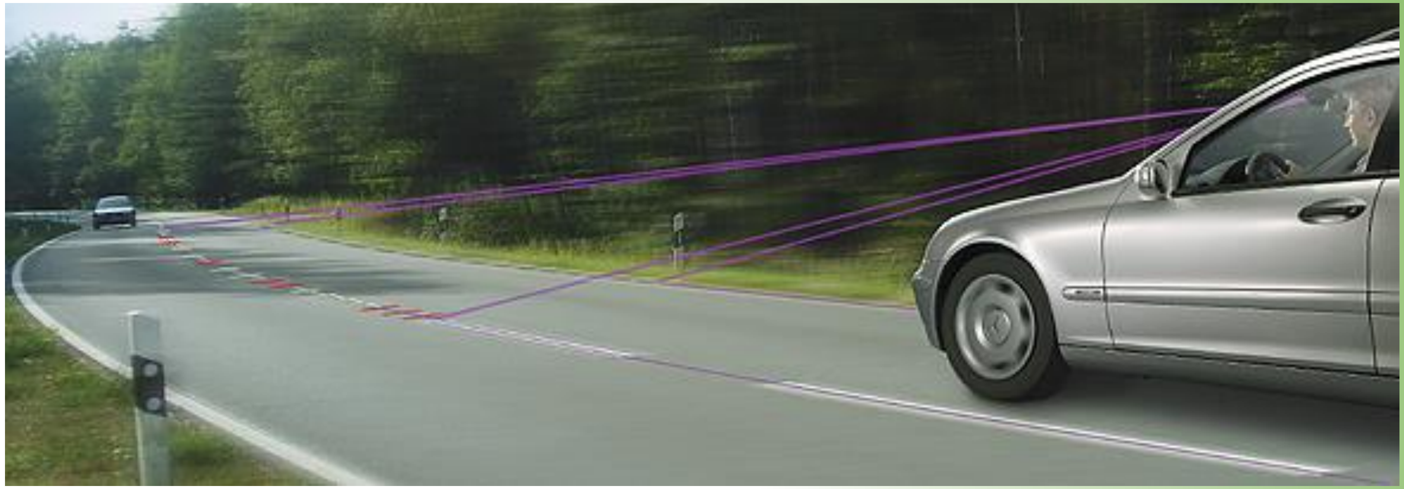
Adaptive **C**ruise **C**ontrol

https://www.youtube.com/watch?v=r8G0n5LeJo0

Intelligent **S**peed **C**ontrol

https://www.youtube.com/watch?v=jI7tnoQaSyA

Dynamic, individual, on-board systems



Intelligent vehicle systems

Lane **K**eeping **S**ystem

https://www.youtube.com/watch?v=QmAMO1tyhdk

Intersection **C**ollision **W**arning

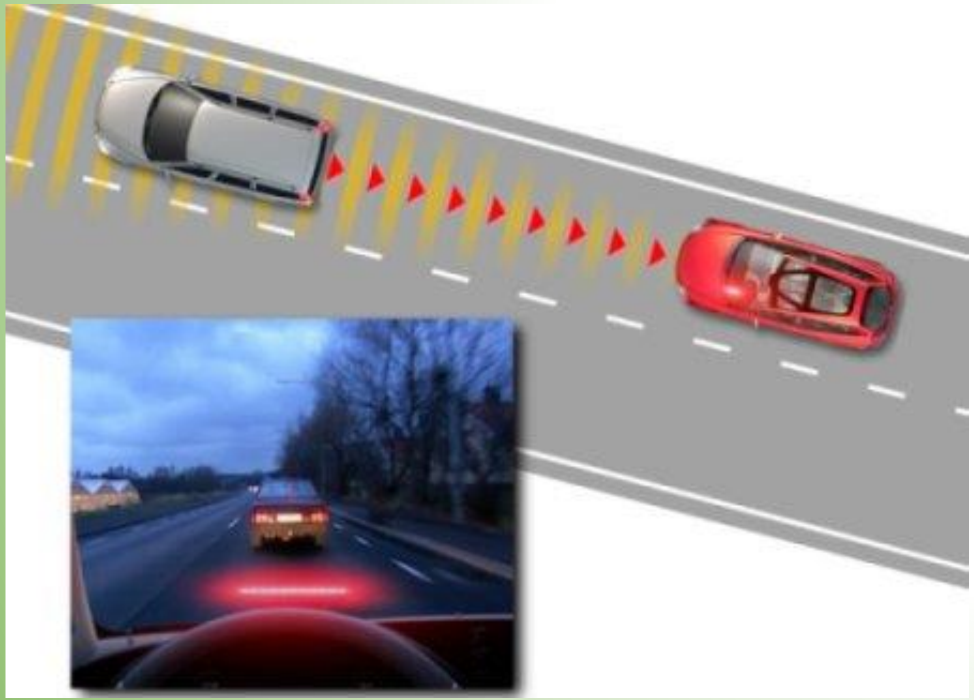
https://www.youtube.com/watch?v=nfMOKSDMtPM

Dynamic, individual, on-board systems

Intelligent vehicle systems

Lane **C**hanging **A**ssistant

https://www.youtube.com/watch?v=sX0BXmv90G0



Collision **W**arning (front, rear)

https://www.youtube.com/watch?v=rYckJqp4XTc

Dynamic, individual, on-board systems

Intelligent vehicle systems

Traffic **J**am **A**ssistant

http://www.youtube.com/watch?feature=player_embedded&v=MZ3s_cdk_yE

https://www.youtube.com/watch?v=MRqlqc1ztr0

Parking **A**ssistant

Intelligent vehicle systems

1st-3rd level of driving support is prioritized by car manufacturer (responsibility)

Fully automatic driving is the future (10 years)

Nowadays on motorways fully automatic driving is available (cruise control, lane keeping system, adaptive distance keeping) – In 1999, in Japan

Conventional and automatic cars are together on roads

In early 2010’s estimation:
Fully automatic driving by 2018

Intelligent vehicle systems

Tasks of fully automatic driving

- Prevents collision with obstacles
- Prevents slipping in the bend
- Keeps in the lane
- Prevents collision with transverse traffic
- Prevents collision with left turning traffic
- Prevents collision with passing pedestrian traffic

Classification of ITS systems (based on transport modes)

Private transport in urban areas

Coordinated traffic lights (green wave)

Parking management

Toll zone controll

Traffic control, incident detection, information system

Alternating use of lanes

Classification of ITS systems (based on transport modes)

Private transport out of towns

Traffic management

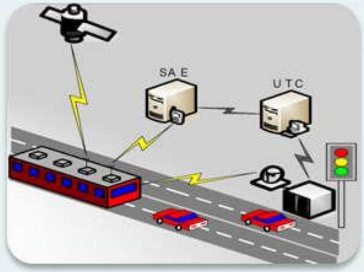
Electronic toll system

Traffic control, incident detection, information system

Tunnel traffic control

Classification of ITS systems (based on transport modes)

Public transport



Fleet management, preference for public transport

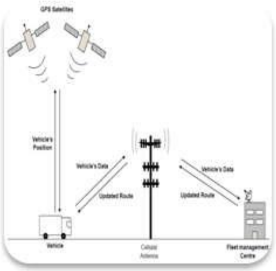
Passenger information service

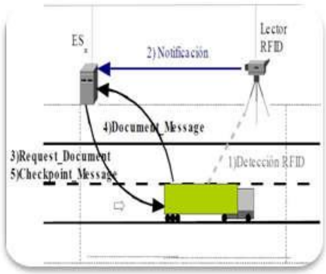
Electronic ticket system

Co-modality, intermodality, garanteed public transport transfer

Classification of ITS systems (based on transport modes)

Freight transport





Fleet manage-ment

Goods identification and tracking

Digital tachograph, OBU

Controlling loading and unloading

Dangerous goods control system

Mobility management

Integration of several ITS solutions in a mobility management center

Objectives

- Increasing efficacity
- Increasing traffic safety
- Protecting environment
- Data collection and information service related to transport
- Coordination among different travel modes (intermodality)
- Preventing travel disturbances, elimination of existing disturbances, improving traffic flow
- Maximizing capacity utilisation
- Decongest routes (alternative route suggestion)

Mobility management

VMZ Berlin (www.vmzberlin.com/en, vizberlin.de)

www.kozut.bkkinfo.hu

www.uj.utvonalterv.hu

www.maps.google.hu

www.vonatinfo.mav-start.hu

Mobile applications (Waze, vonatinfo)

Mobility management

Information service

- Actual, planned and predicted information
- Information based on individual demand and position
- Influencing decision process

Management

- More transport modes, transport chain
- Optimizing private and public transport
- Parking management

Mobility management

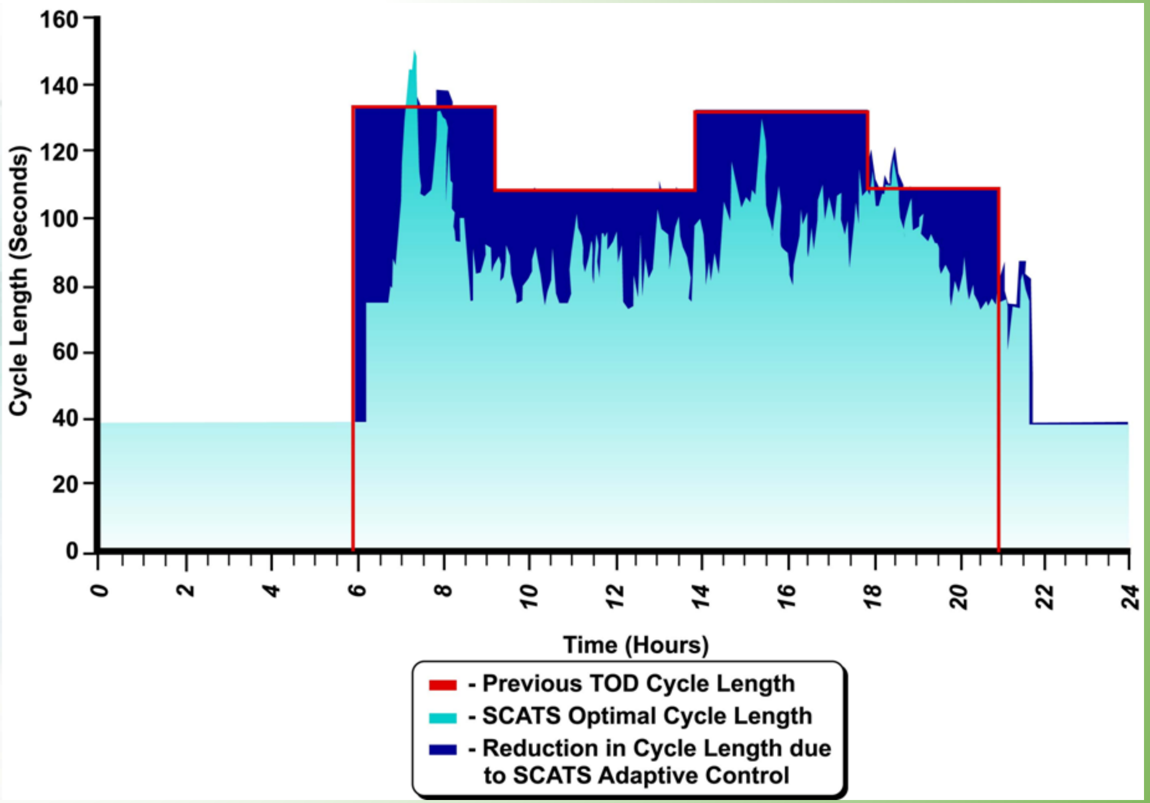
Private transport:	Public transport:
- Traffic control (traffic lights) - Parking management - Information service (actual traffic situation, weather) - Route planning - Traffic prediction	- Fleet management, control - Preference for public transport (priority) - Information service (actual timetable, actual traffic situation) - Journey planning

P+R parking management

Mobility management

SCATS – Sydney Coordinated Adaptive Traffic System

- Management and control of junctions with traffic lights
- In 120 cities world wide
- Inductive loops and CCTV cameras
- Priority to public transport
- Travel time prediction based on historic data



Mobility management

SCATS – Sydney Coordinated Adaptive Traffic System

Private transport:	Public transport:
- Traffic control (traffic lights)	- Fleet management, control
- Parking management	- Preference for public transport (priority)
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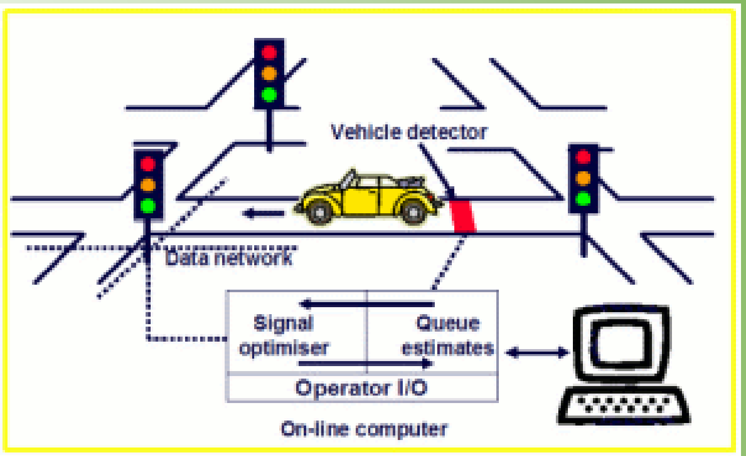
- Traffic prediction	

P+R parking management

Mobility management

SCOOT – Split Cycle Offset Optimisation Technique



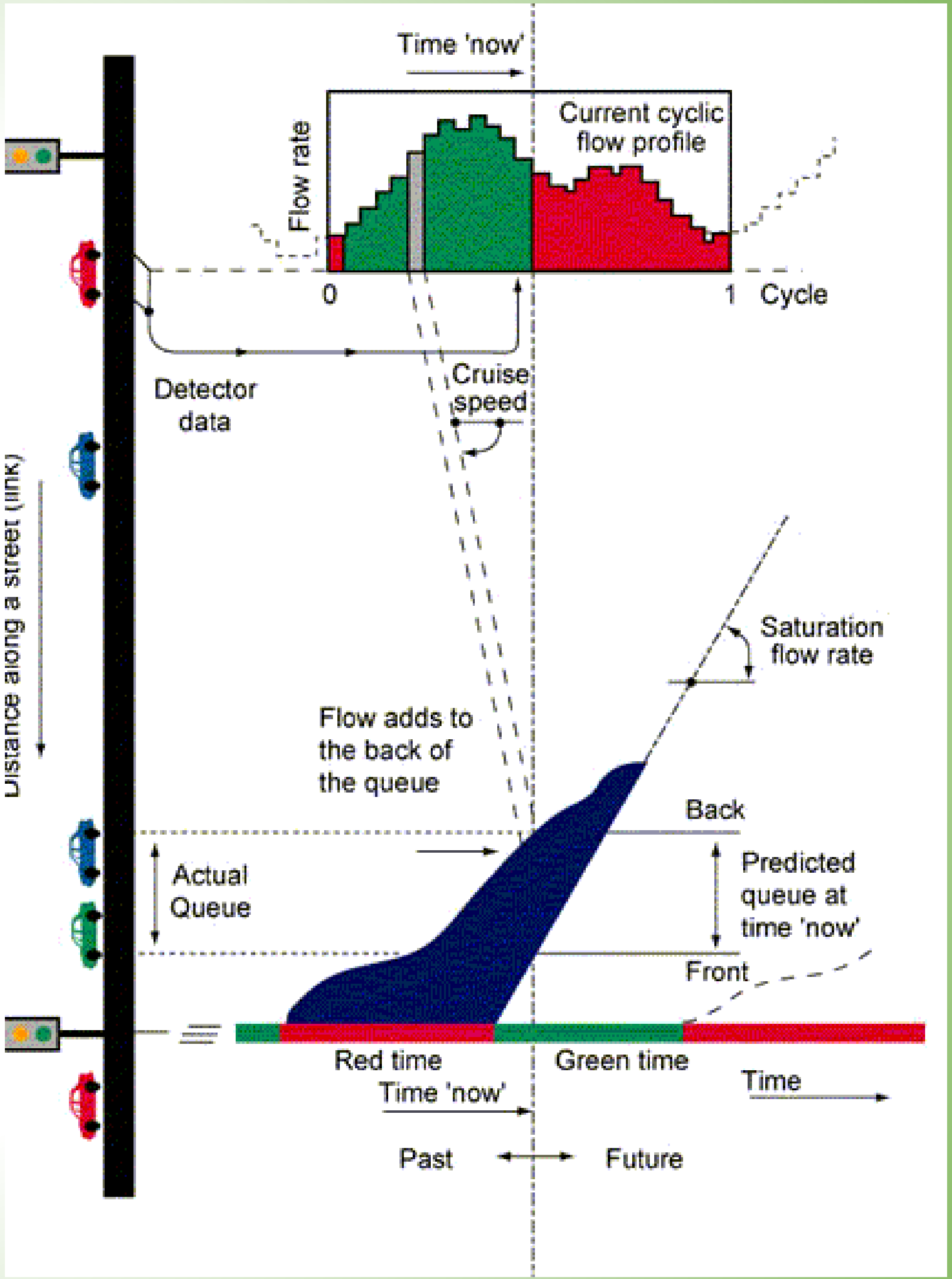
- Monitoring and coordination of junctions with traffic lights
- Priority to public transport
- Incident management

- Time loss decreasing by 20%
- In more than 200 cities, in 14 countries

Mobility management

SCOOT – Split Cycle Offset Optimisation Technique

- Optimization based on vehicle detection
- Cycle length calculation every 5 minutes
- Signalling time calculation in every cycle



Mobility management

SCOOT – Split Cycle Offset Optimisation Technique

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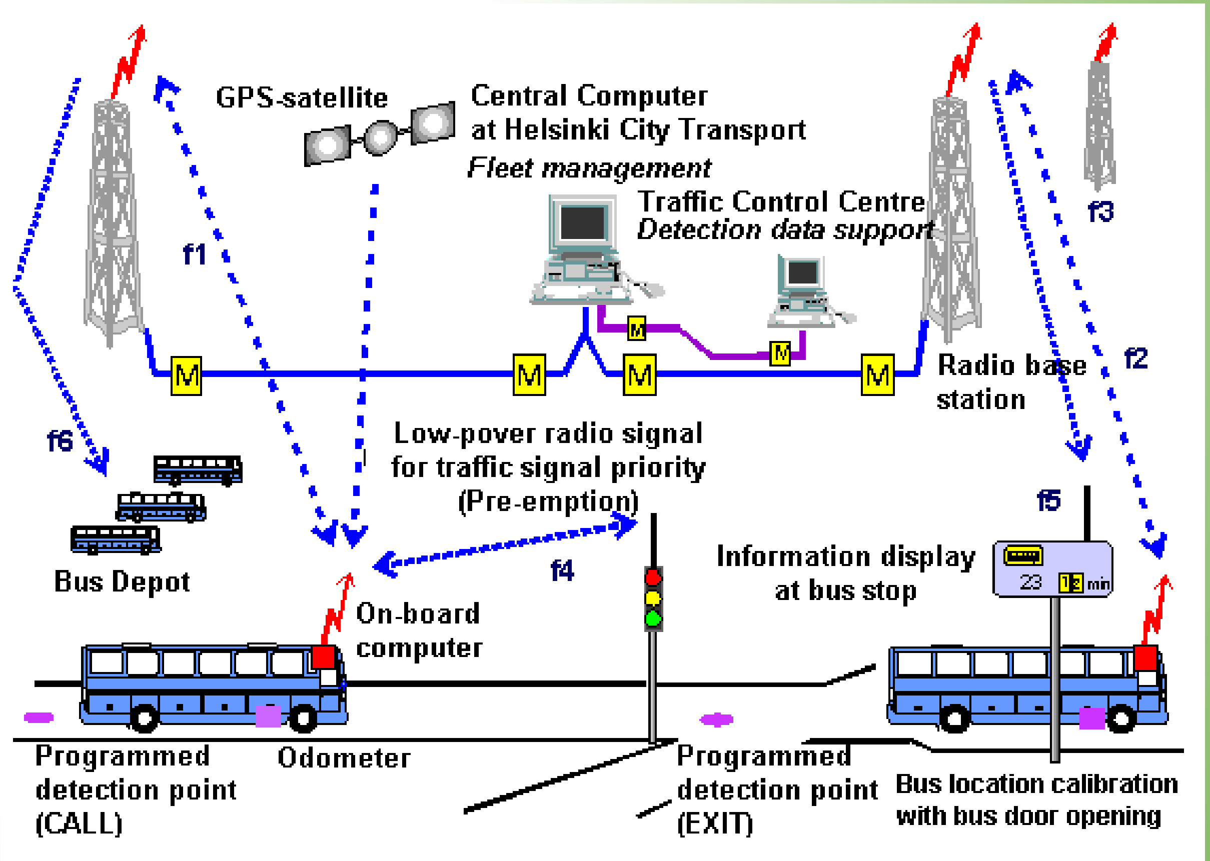
P+R parking management

Mobility management

Helsinki - HelUTC

- Management and control of junctions with traffic lights
- Parking management
- Public transport management
- Priority to public transport
- Tunnel control



Mobility management

Helsinki - HelUTC

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P+R parking management

Mobility management

Berlin - VMZ

Private transport:

- Traffic control (traffic lights)
- Parking management
- Information service (actual traffic situation, weather)
- Route planning
- Traffic prediction

Public transport:

- Fleet management, control
- Preference for public transport (priority)
- Information service (actual timetable, actual traffic situation)
- Journey planning

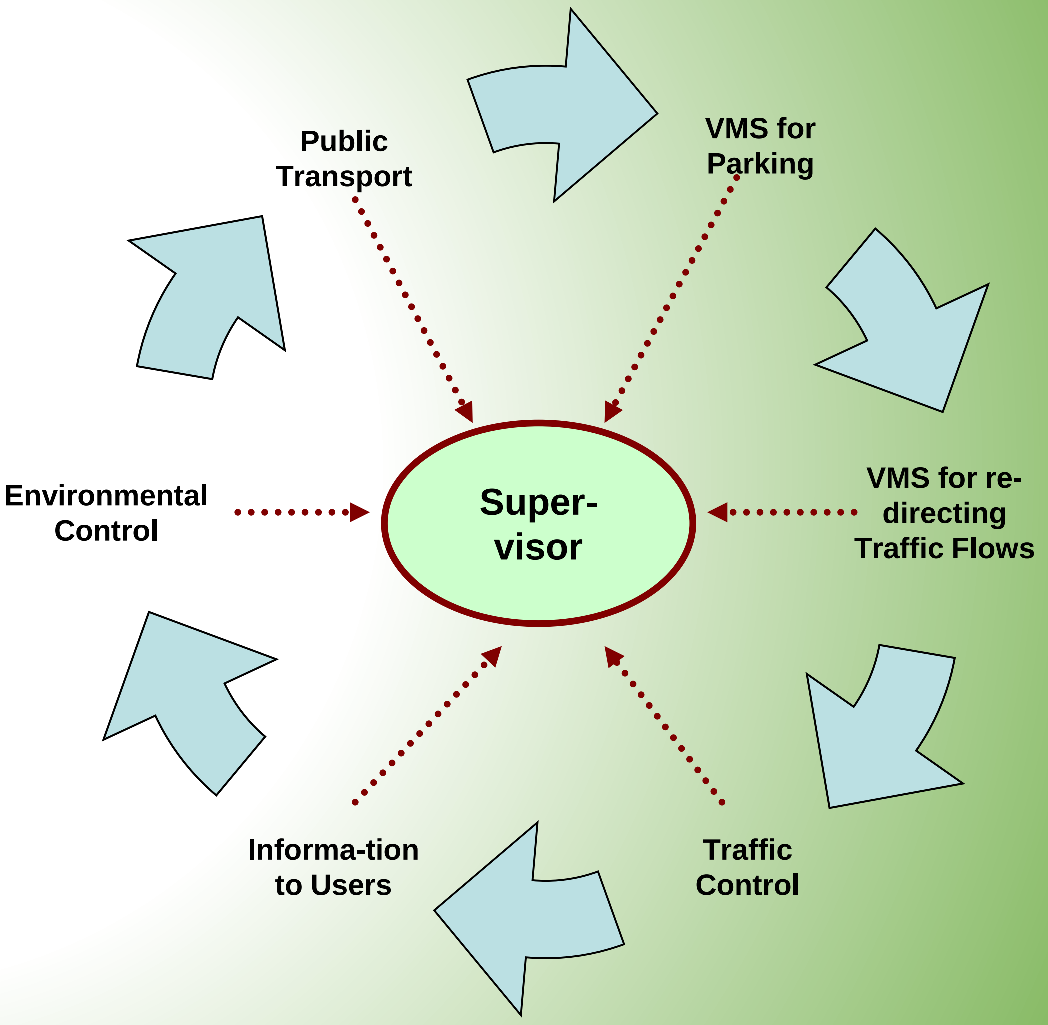
P+R parking management

Mobility management

Torino – 5T

Telematic Technologies for Transports and Traffic in Turin

- Traffic management
- Public transport management
- Priority to public transport
- Parking management
- Environmental control
- Automatic toll collection



Mobility management

Torino – 5T

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P+R parking management

Mobility management

Hogia system

- Public transport operation and management
- Planning timetable
- Electronic ticket system
- Passenger information system (Journey planning), real-time data
  - Internet
  - SMS
  - Mobile application

Mobility management

Berlin - VMZ

Private transport:	Public transport:
- Traffic control (traffic lights) - Parking management - Information service (actual traffic situation, weather) - Route planning - Traffic prediction	- Fleet management, control - Preference for public transport (priority) - Information service (actual timetable, actual traffic situation) - Journey planning

P+R parking management

Electronic Toll Collection

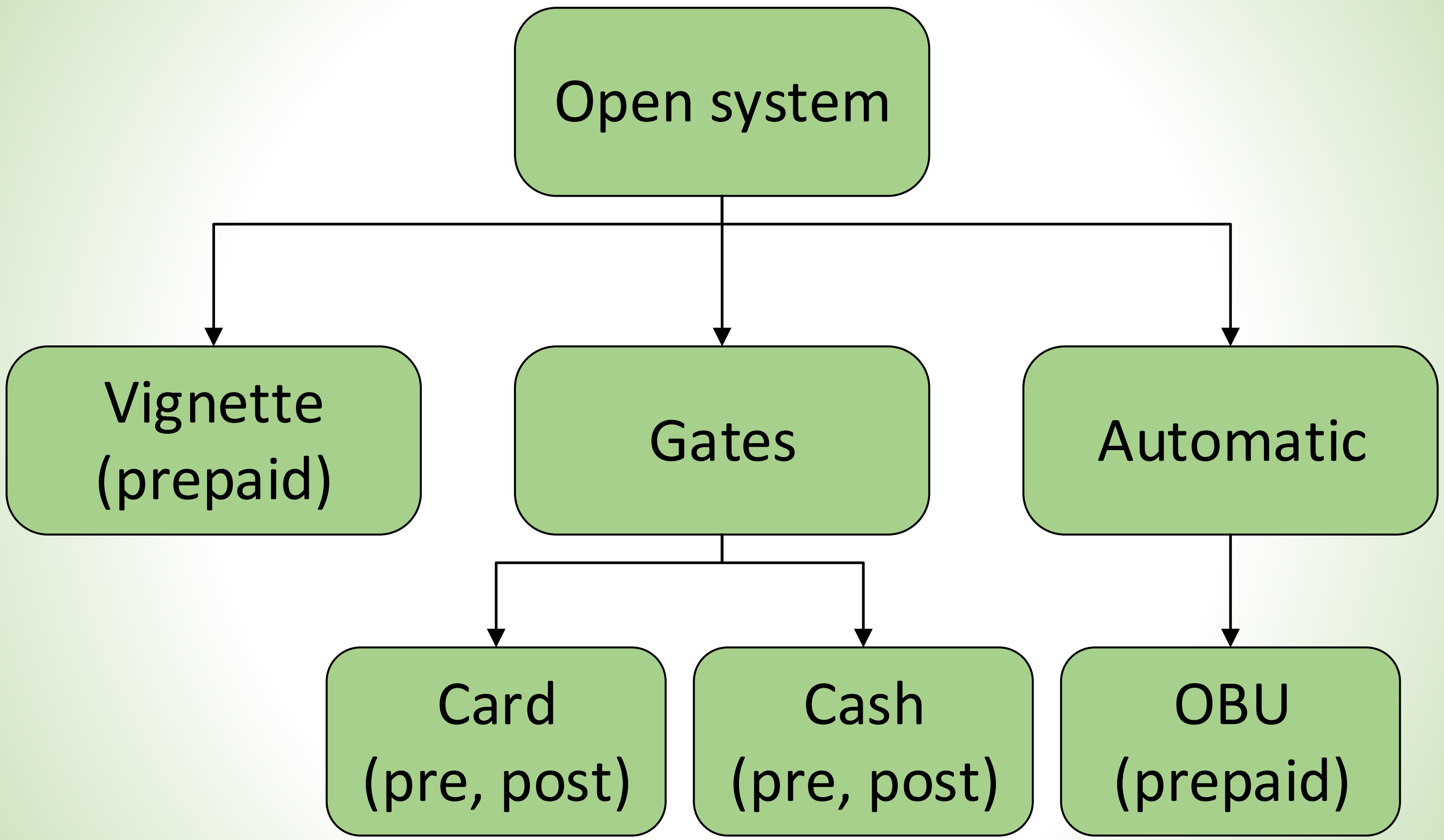
- Open system (fixed amount)
- Closed system (performance-based – distance or time)

Equipments (laser scanner – vehicle category, camera, infra light, radio communication – if neccessary, OBU – active, passive, GPS)

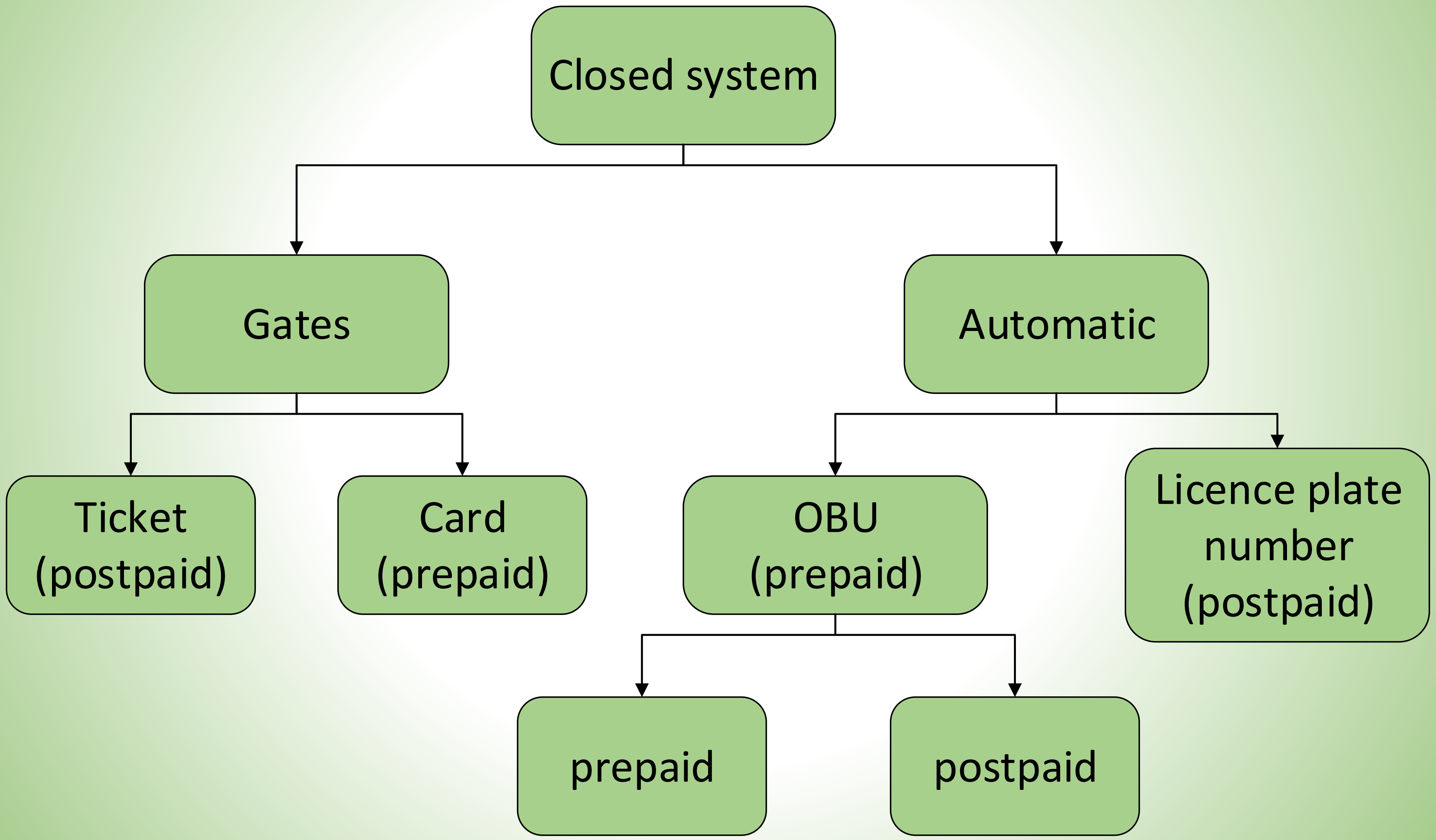
Payment

- Prepaid
- Postpaid

Electronic Toll Collection



Electronic Toll Collection



Electronic Toll Collection

Requirements for an automatic toll collection system

- Collecting and checking without disturbing traffic
- Availability at any kind of traffic (or other) condition – multilanes, traffic jam, extreme speed
- Extreme weather conditions
- Flexible toll structure (vehicle categories)
- Technical reliability and availability
- Protecting personal information
- Interoperability

Electronic Toll Collection

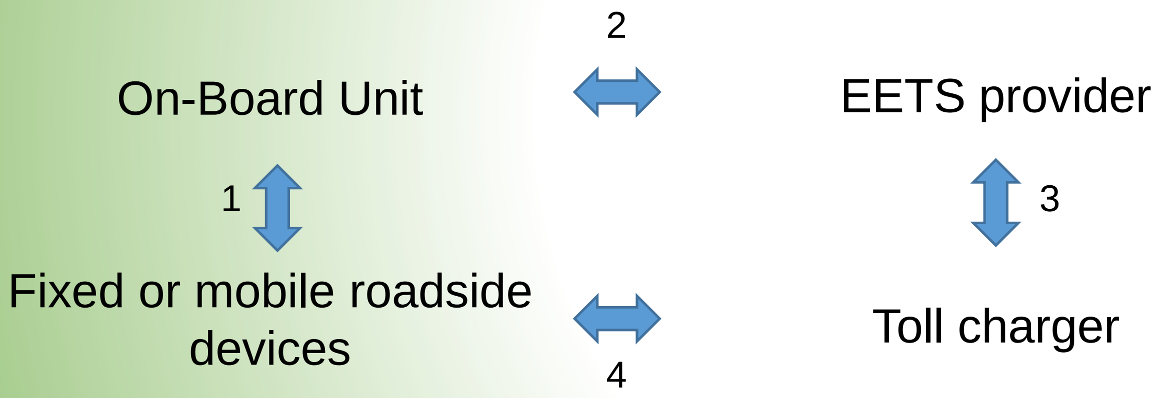
Road infrastructura can be:

- Active – DSRC – Dedicated Short Range Communication (microwave or infrared)
- Passive („virtual" toll gate), toll collection in the vehicle (GPS-GSM)

Electronic Toll Collection

European Electronic Toll System (EETS)

- Interoperability (5.8 GHz microwave dataexchange, stellite positioning, mobile communication)



EETS specify directives for communication 1 and 3; 2 and 4 „internal issue”

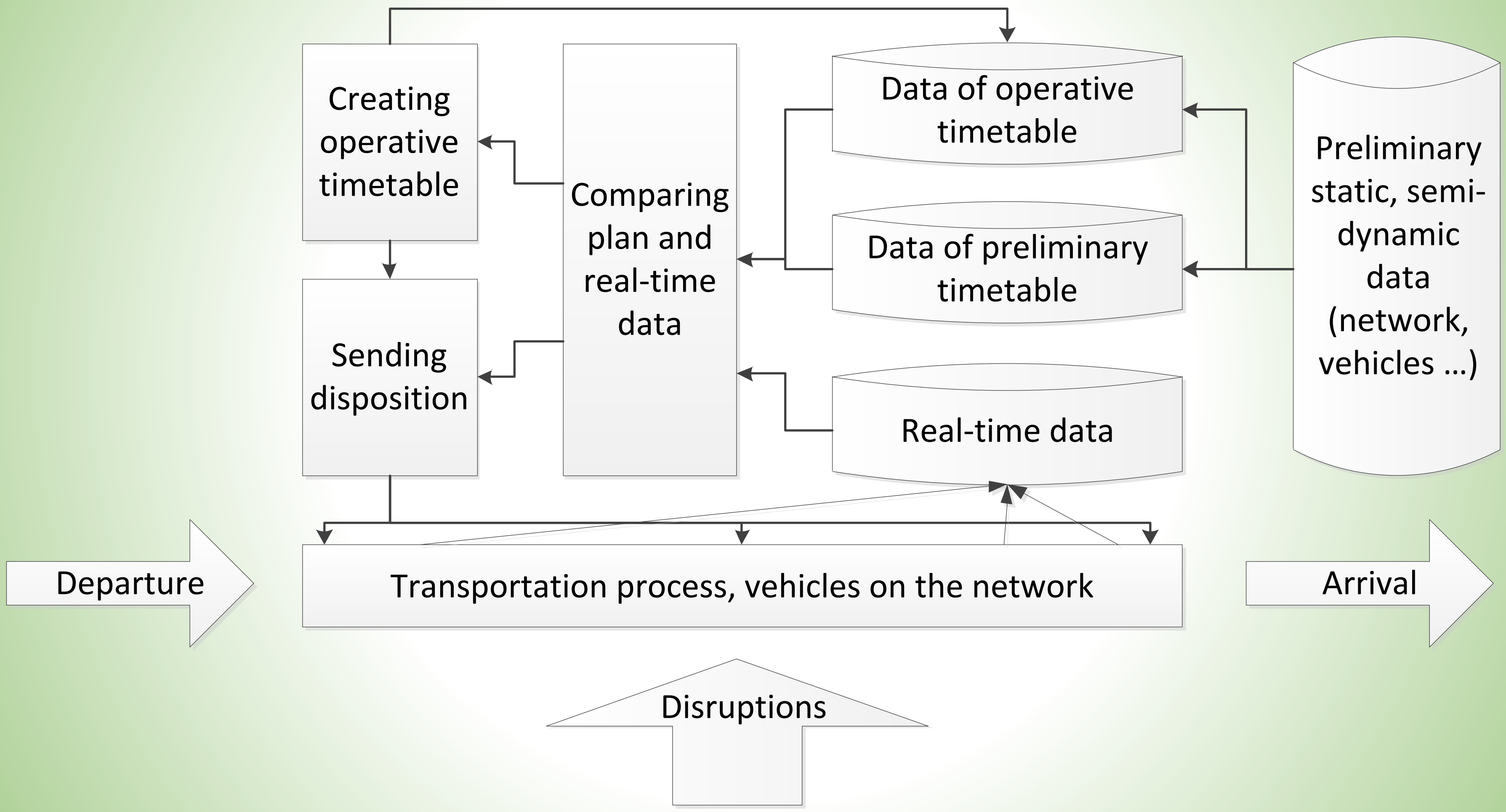
1. DSRC tranzaction, if there is a fixed roadside device; Eligibility check
2. Parameters of vehicles, charging data, GSM communication (GPS)
3. Charging data, blacklist
4. Eligibility check

Electronic Ticketing system (Public Transport)

Benefits of chipcards

- More accurate information about reduced fares
- Fast and easy use of vehicles
- Interoperability among different services
- More and accurate information about journeys and passengers
- Automatic ticket validation, introduction of ticket types, that meet demands
- Protection against abuse
- Easy to buy tickets
- Electronic wallet

Control of Public transport



Control of Public transport

System requirements:

- Control at the end stations (without staff – departures, arrivals, passenger information)
- Control on vehicle routes
- Communication between drivers and dispatchers
- Information process and control in the centers
- Priority for public transportation at traffic lights
- Passenger information service
- Real time information about public transport connections

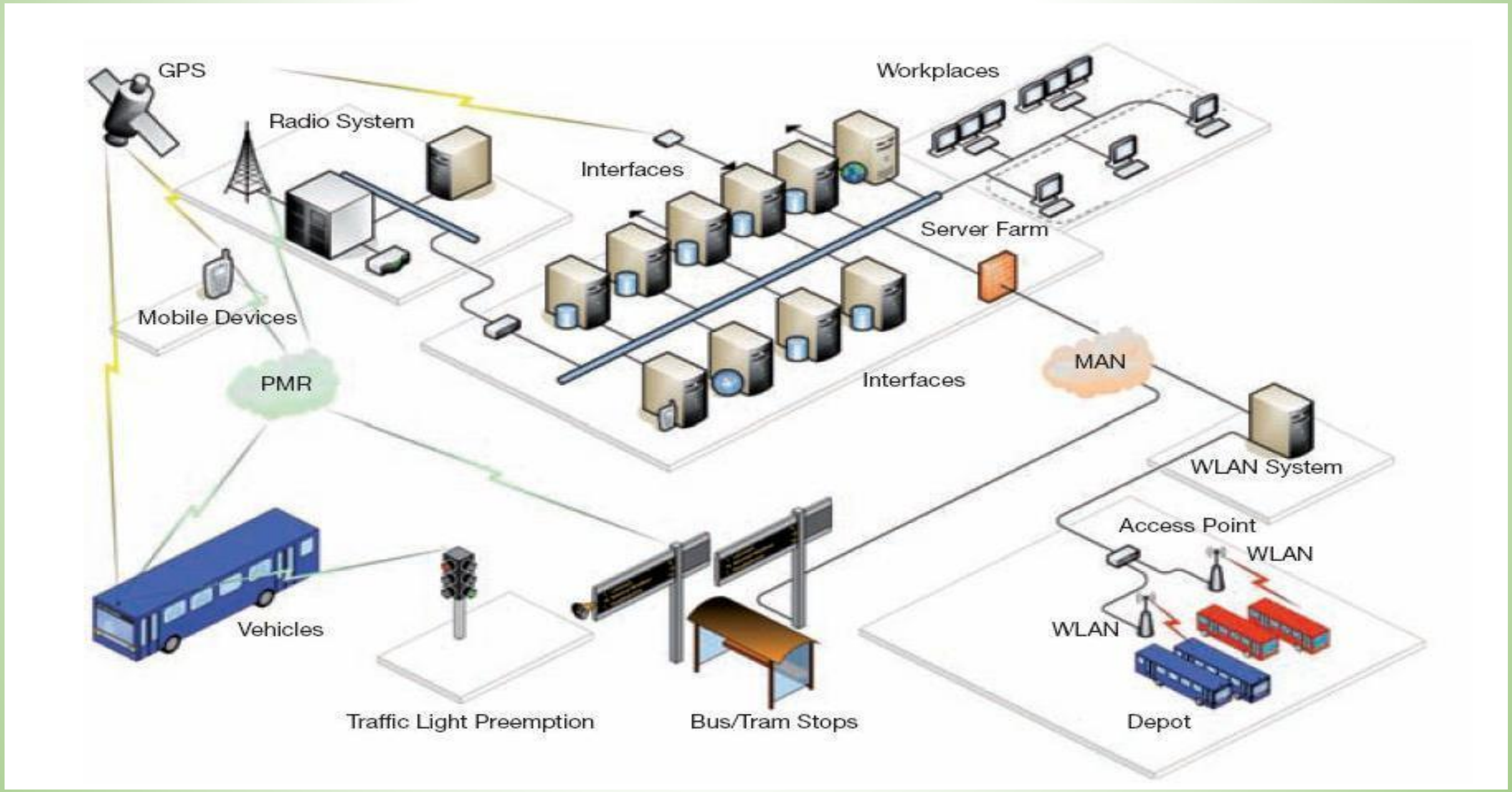
Control of Public transport

Vehicle positioning:

- Vehicle tracking systems based on cyclical query, without satellites
  - Physical (markers, wheel turn-round counter)
  - Logical (door opening, wheel turn-round counter)
  - Mixed
- Vehicle tracking with Global Positioning System (moving object – occuracy, receiving equipment)
- Vehicle tracking based on incident-driven, without satellites
  - Markers
  - Identification appliance

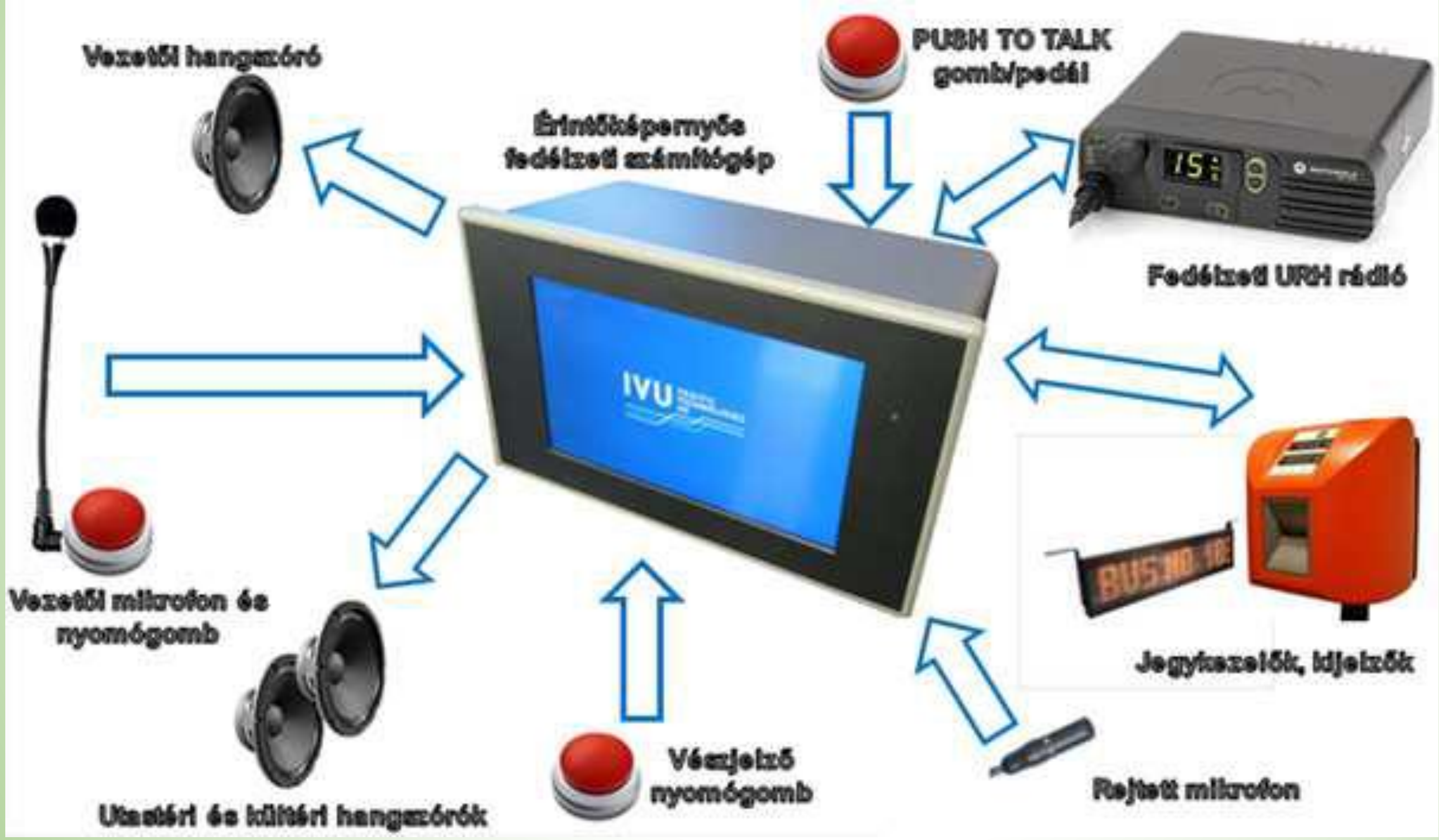
Control of Public transport

FUTÁR system:



Control of Public transport

FUTÁR system:



Demand responsive transport

Grouping travel demand:

- Car sharing, car pooling
- Traditional public transport
- Demand responsive transport

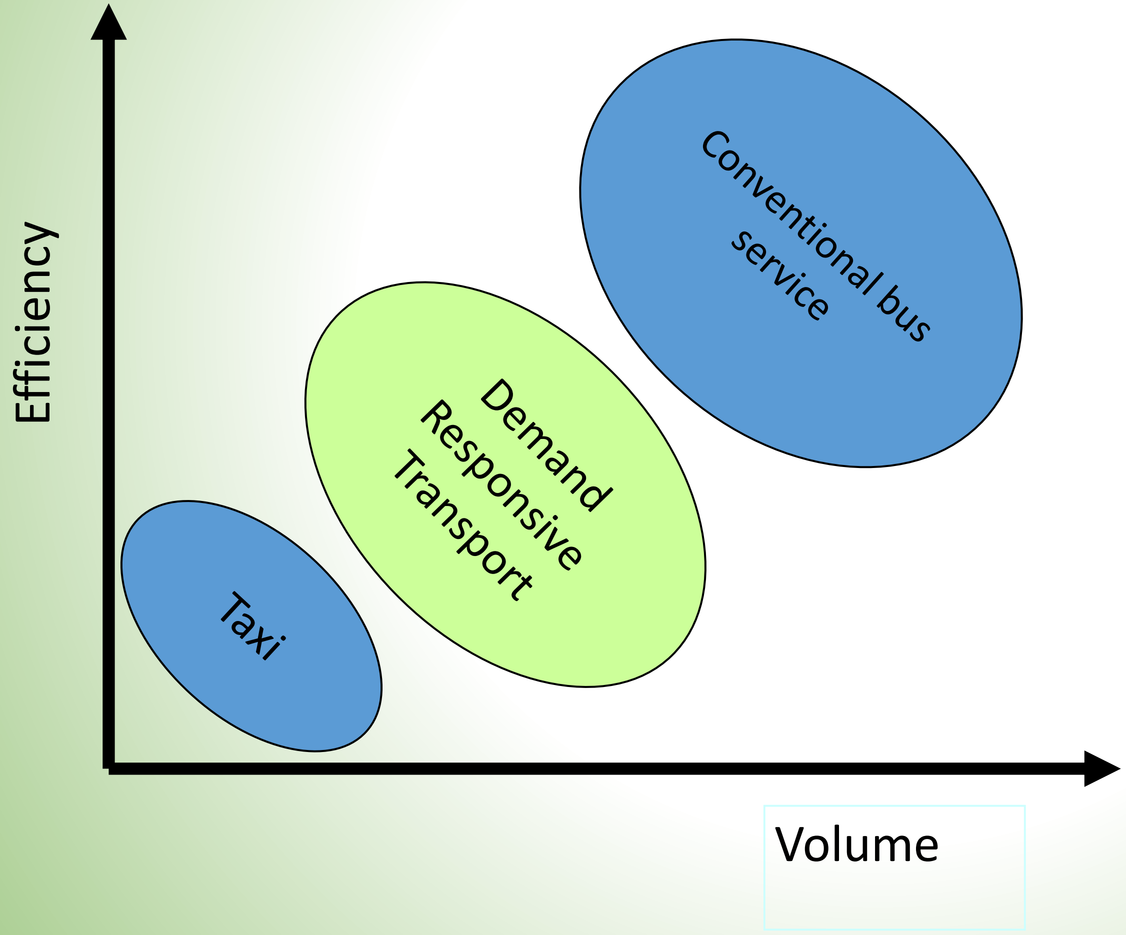
Features of DRT:

- Travel demand notification individually
- Spatial and temporal plan of vehicle journeys
- Combination of travel demand (more passengers in one vehicle)

Demand responsive transport

- DRT – Demand Responsive Transport
- FTS – Flexible Transport System
- FCT – Flexible Collective Transport
- Paratransit
- Jitney
- Rufbus – Rapid Urban Flexible

Demand responsive transport



Demand responsive transport

Application possibilities:

- Low travel demand, short travel distances
- Low population density, peripheral areas
- Low travel demand period (evenings, week-ends)
- Service for disabled persons

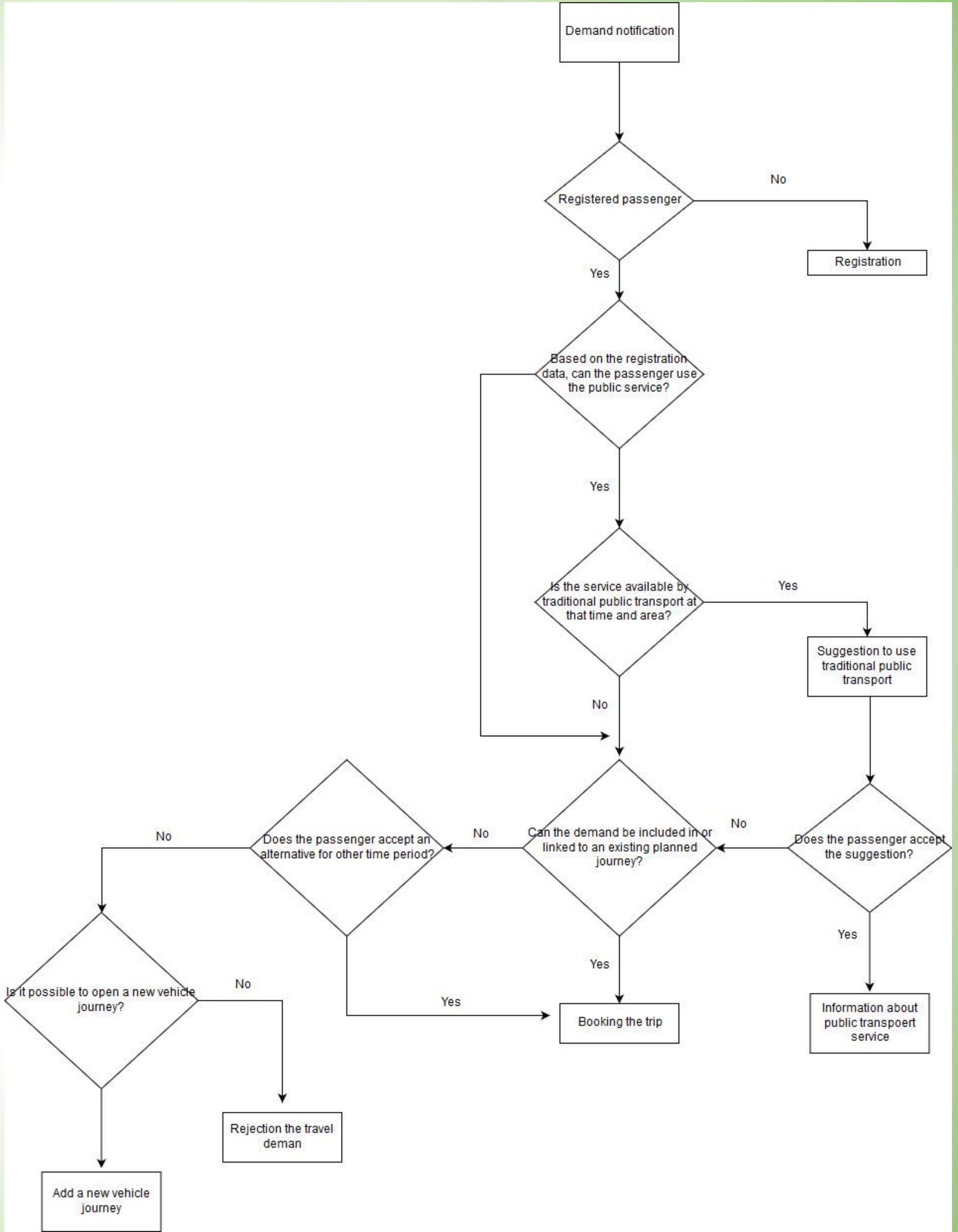
Covering more travel demand (capacity utilisation, complementary travel demand in time and space)

Demand responsive transport

Process of DRT:

- Notification of a demand (phone call, via Internet, mobile application): personal data of passenger, origin and destination point, time window, special demands (e.g. disable person)
- Optimization – vehicle journey planning (conditions: fleet, network, time window, efficiacity – efficiency)
- Disposition to driver (route, passenger boarding points, list of passengers with spatial and temporal data)
- Administration

Demand responsive transport



Demand responsive transport

Better spatial service

Demand responsive transport

Connection to public transport
- Supplementary
- Replacement
- Other

Rout flexibility
- Fixed
- Semi flexible
- Flexible

Flexibility in time
- Fixed
- Partly changing
- Flexible

Notification of demand
- One-step
- Two-step

Financial performance
- Self-financed
- Same as PuT
- More than PuT

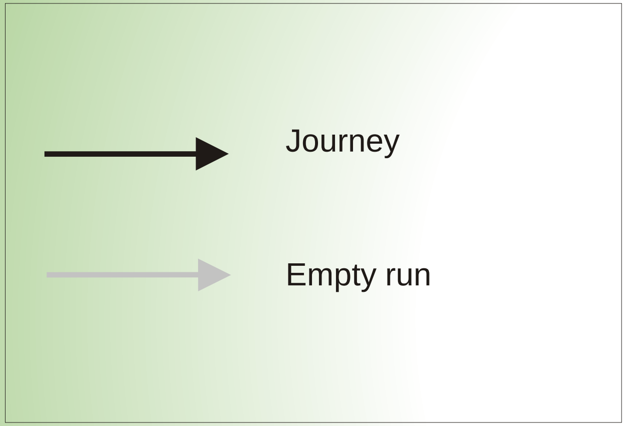
Spatial distribution of demamds
- 1 destination
- Some dest.
- Dispersed

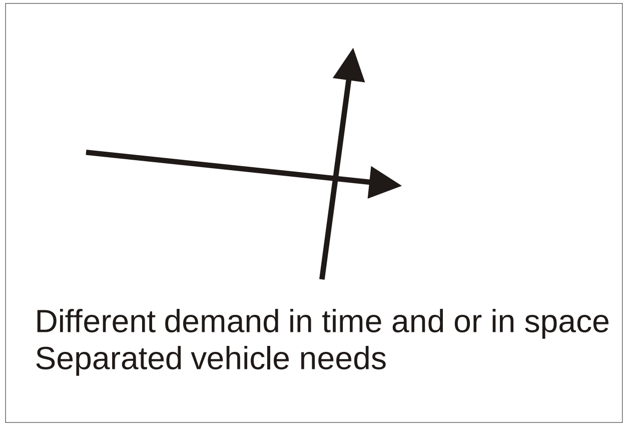
Accessibility
- Open
- Semi Open
- Closed

Market driver
- Business
- Public service

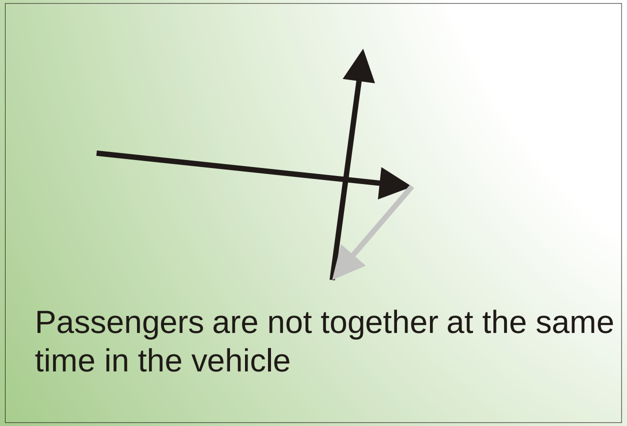
Demand responsive transport

Combination of journeys:

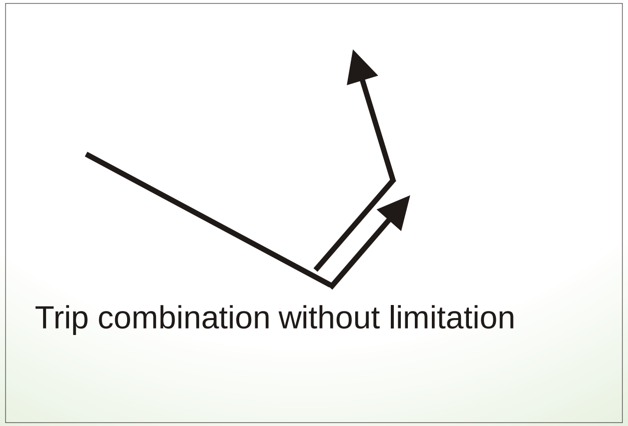




Separated trips



Chained trips



Interlaced trips

Demand responsive transport

Budapest example

- Supplementary of conventional public transport
- Semi fexible rout
- Fixed departures times
- One-step notification
- Opec accessibility.
- Midibus
- Financial performance same as PuT.
- Public service (not business based)