SoberIT
Software Business and Engineering Institute

Innovation in Public Services

METROPOL - Demand Driven Public Transportation

ICTEC Course, 5.5.2008

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(SoberIT)

Content of a Lecture

- Background
  - PT as a Public Service
  - Public Service and Service Innovations
  - PT Characteristics
  - Need for New Innovations in PT
- Metropol-project
  - Multidisciplinary and the role of ICT
  - DRT Characteristics (Lauri ja Teemu)
  - Modelling (Tuukka ja Lauri)
  - Potential Effects

PT as a Public Service

- Passenger Transport Act
  - Passenger Transport for a fee is illegal without the Transport Licence → Regulated business
  - Public transport licence, Taxi transport licence or Fixed-Route Transport licence
- Act on Public Procurement
- Proposal for a EC Regulation (Palvelusopimusasetus)
- Subsidised service
  - YTV-area subsidy ratio about 44 %

Functions of the public bodies

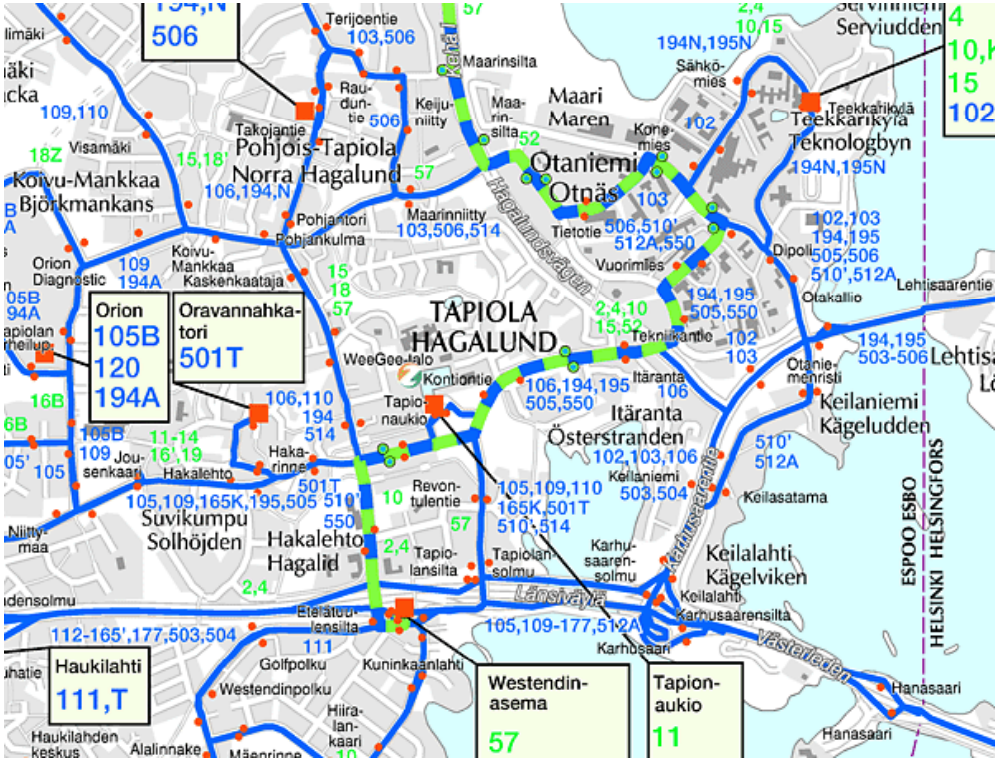
- Planning and procuring
- Promoting
- Providing travel information
- Developing and maintaining the ticketing and travel card system
- Organising the ticket control
- Conducting traffic surveys

Tendering process

- Public bodies
  - set the routes, the timetables and the service requirements
  - define the vehicle types and quality standards
- Contracts from 2 to 5 years
- Objective evaluation criteria (YTV)
  - 87% of the marks are for the cost
  - 11% for properties of the specified bus fleet
  - 2% for having a certified quality system

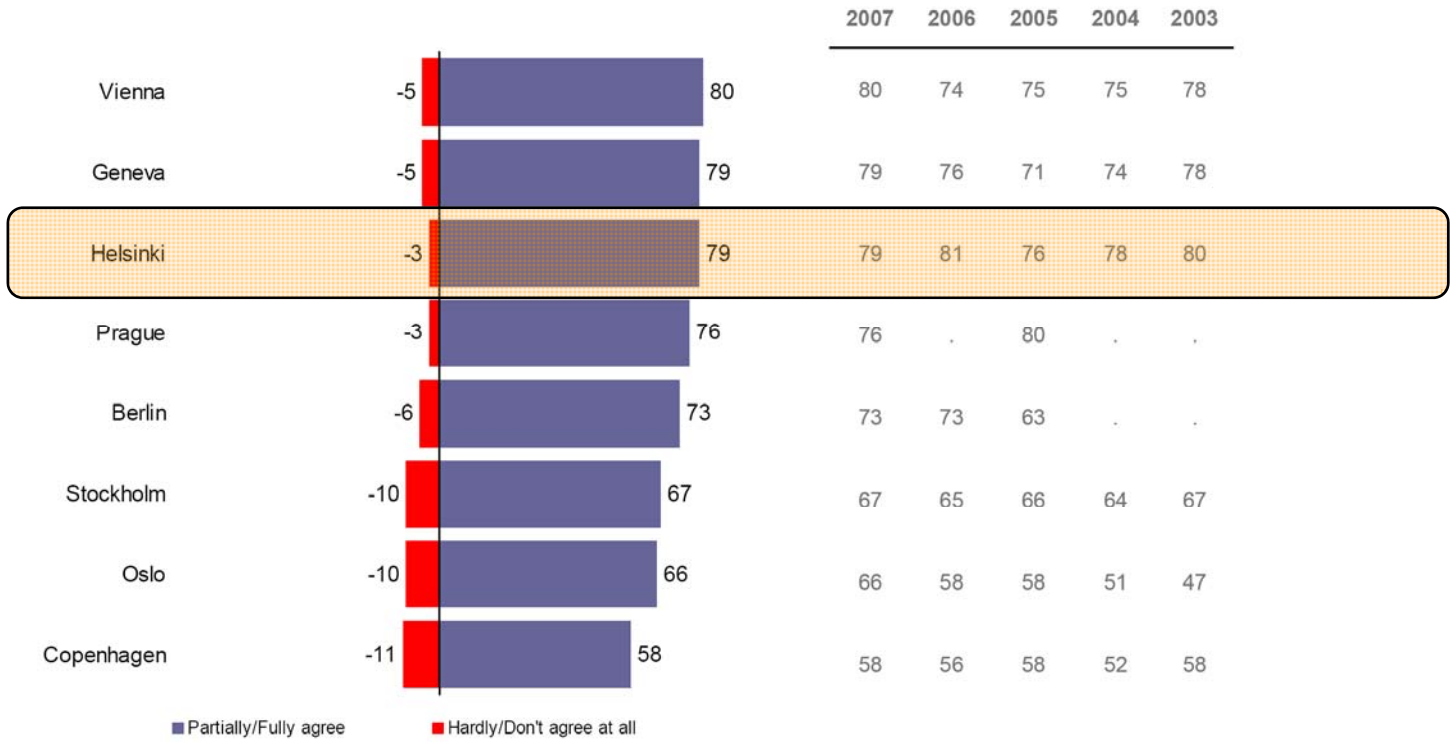
PT in numbers

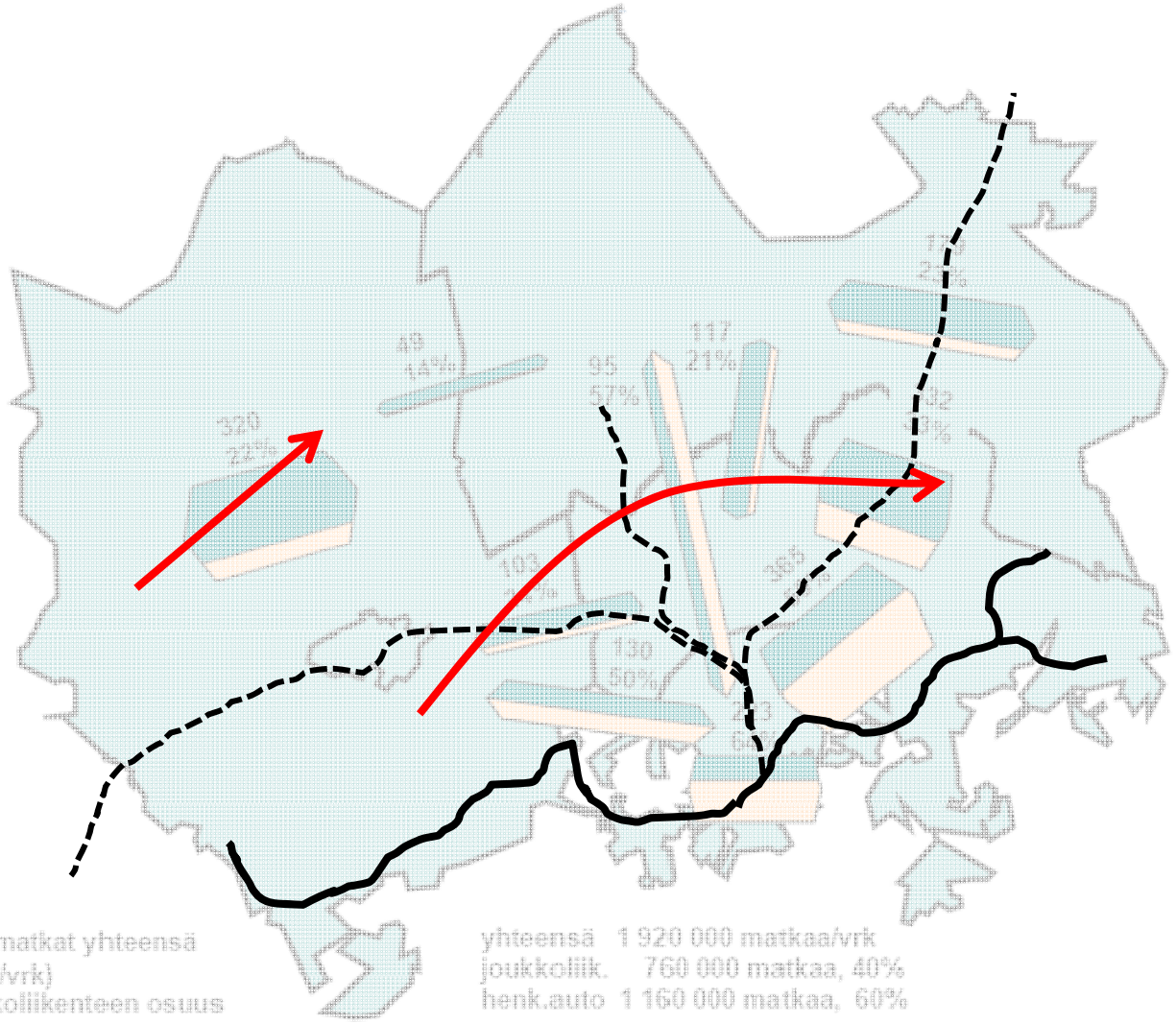
- Bus lines
  - Regional ~100
  - Helsinki 107
  - Espoo 40
  - Vantaa 33
- Metro
- 11 Tramlines
- 15 Regional Train lines
- 2 Ferries to Suomenlinna



People are satisfied with PT in general

How satisfied are you with public transport in general (BEST 2007 research)?:




ylempi luku matkat yhteensä
(1000 matkaa/vrk)
%-luku joukkoliikenteen osuus
yhteensä 1 920 000 matkaa/vrk
joukkoliik. 760 000 matkaa, 40%
henk.auto 1 160 000 matkaa, 60%

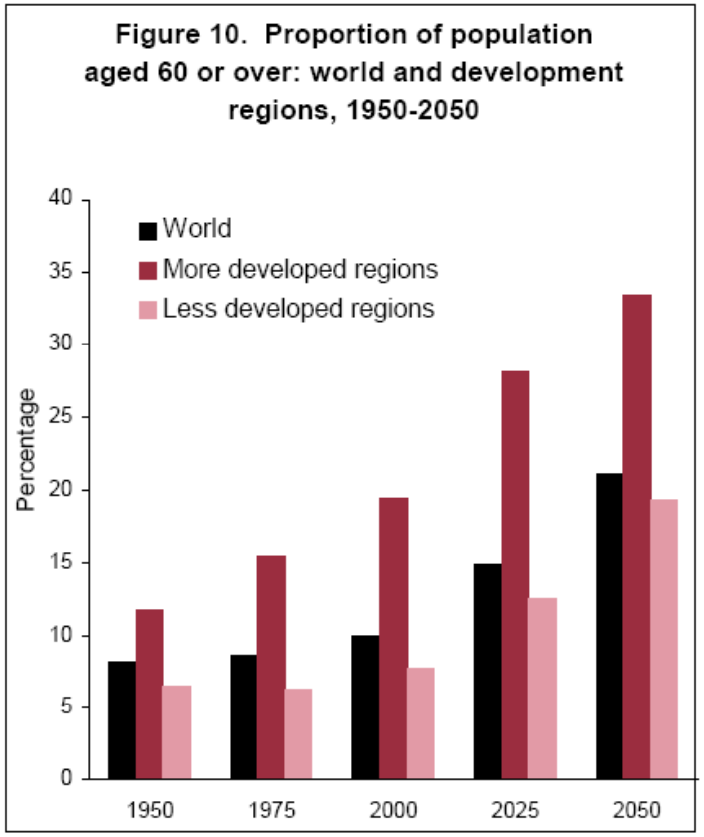
Need for new Service Innovations?

Public Services and Service Innovations

- Legislation and bureaucracy prevent new innovations
- New ideas need to be pushed ahead and marketed strongly
- Development in ICT could help promoting new innovations in Public Sector

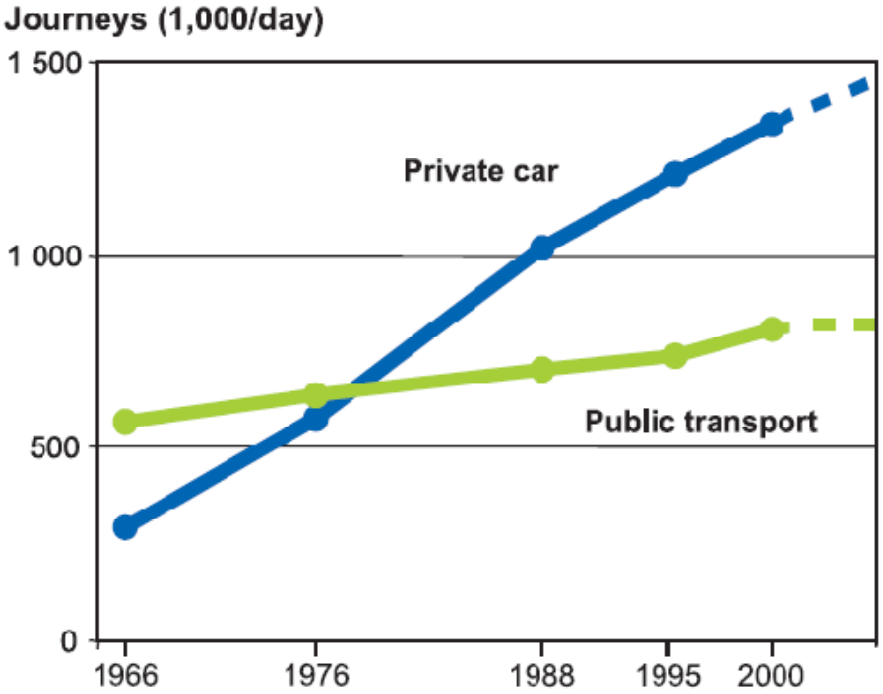
- Demand Responsive Transport (DRT) is in the gray area

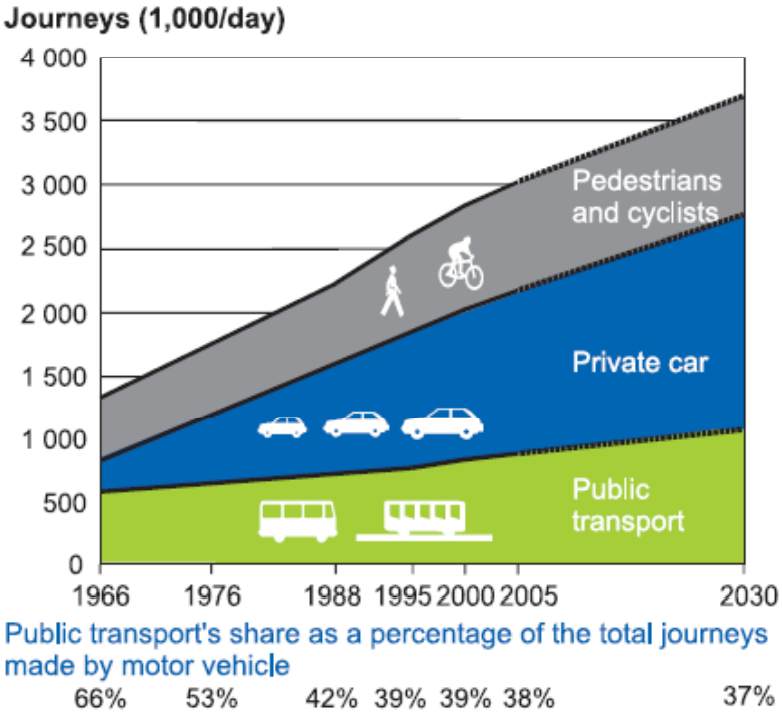
Population is ageing



SOURCE: World Population Ageing: 1950-2050, UN

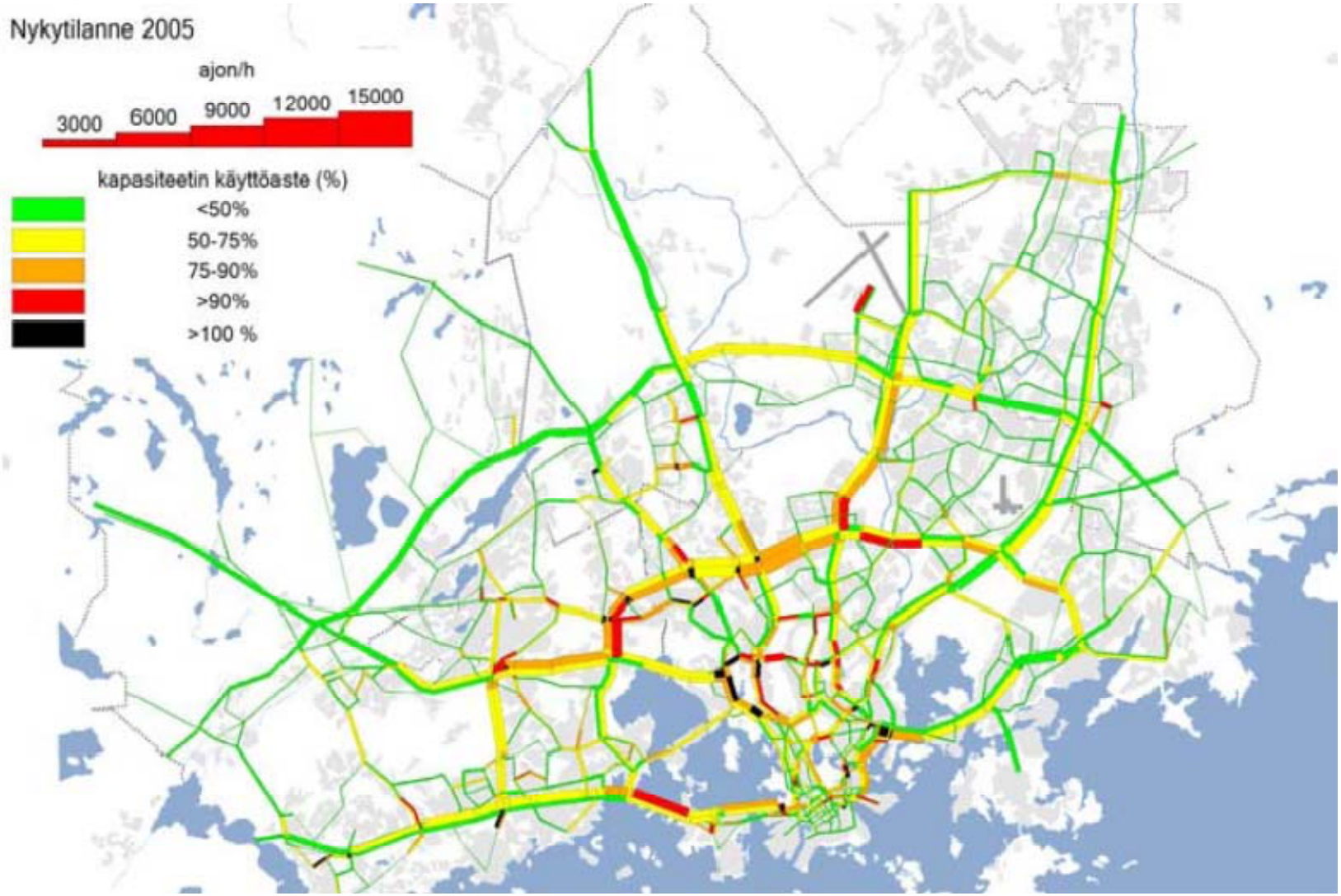
Trend of Public Transport in HMA





SOURCE: Helsinki Metropolitan Area Transport System Plan PLJ 2007

Traffic Congestion will be reality



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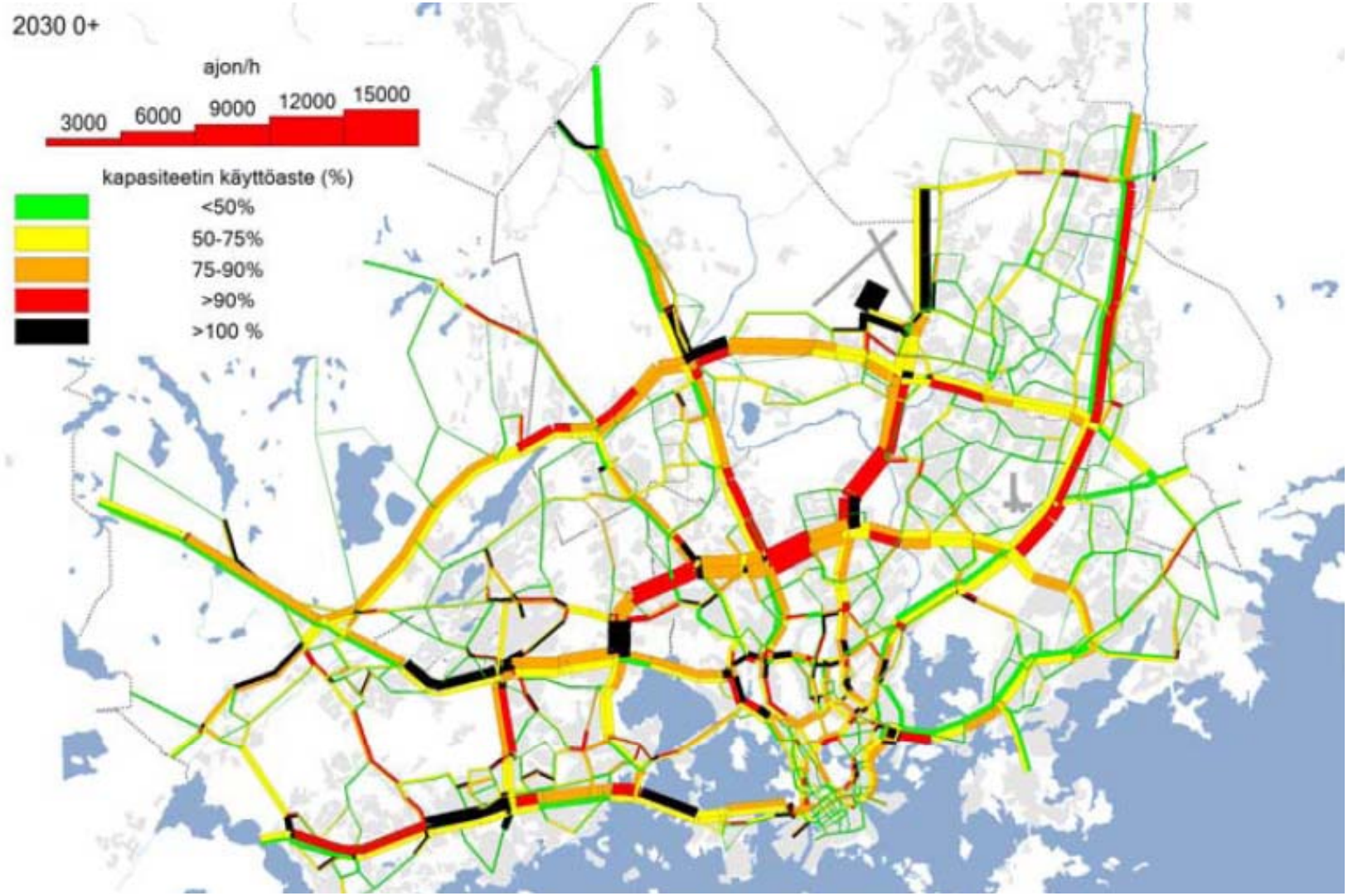
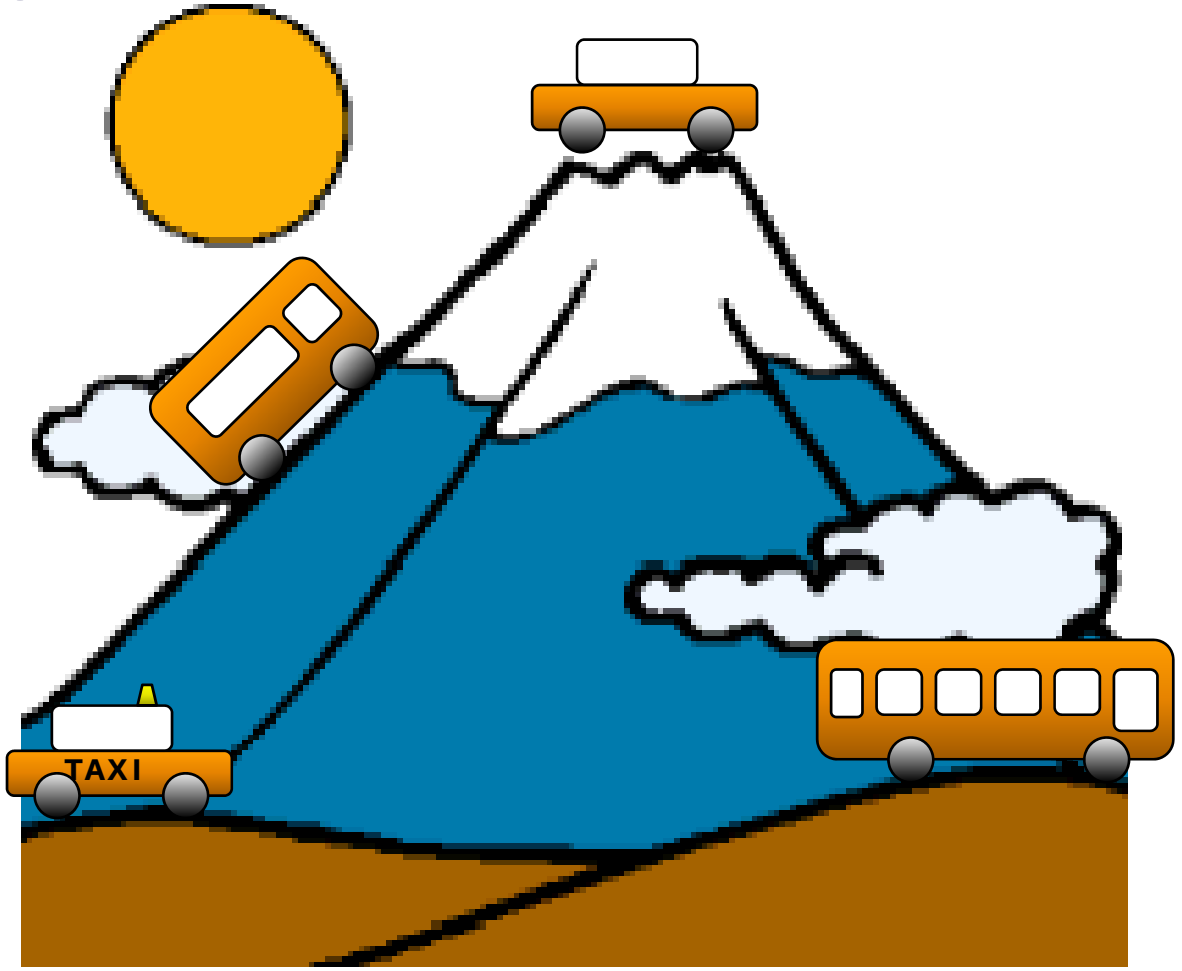


What to do?



METROPOL-project

- METROPOL is a research project at the Helsinki University of Technology dealing with Demand Responsive Transport in a Metropolitan areas.
- Premiss of the project
  - The System is flexible based on the Customer needs
  - Large number of vehicles
  - Large transport demand
  - Real-time requests are allowed → Close to real-time demand responsiveness
  - Open for all System

Goals of METROPOL

- Is Metropolitan area DRT with project premises **viable** and **where** and **when?**
- How well can we match service commitments given to customers and vehicle capacity in real-time
- How can we complement current transport system with a new flexible component

Multidisciplinary Project

- Project located in
  - Department of Computer Science and Engineering
  - Software Business and Engineering Laboratory
- Doctoral Thesis to Transportation
- Doctoral Thesis to Mathematics
- Masters Thesis to Mathematics
- Masters Thesis to Computer Science

Statistics

- Helsinki area rough numbers
- 3 000 000 trips / day
  - 1 000 000 private car
  - 1 000 000 public transport
  - 1 000 000 bicycle and pedestrian traffic
- Average trip lengths
  - 8 km private car
  - 9 km public transport
  - 2 km bicycle and pedestrian traffic

Demand responsive transit example

- Vehicle capacity = 10 persons
- Vehicle speed = 40 km / h
- Stop duration = 30 s
- 35 stops per hour / vehicle (17.5 min)
- Effective vehicle speed

$$v_{eff} = \frac{(1h - stop\_time/hour) \times v_{vehicle}}{1h} = 28km/h$$

- Average filling degree = 50%

Performance

- Trips by private car per hour = 1 000 000 / 24 = 40 000 which means 320 000 km
- Passenger kilometers served per hour =
  0.5 x 10 x 28 x number of vehicles
- Average number of vehicles required =
  320 000 / (0.5 x 10 x 28) = 2300
- Peak hour traffic = 10% daily trips which means
  (100 000 * 8) / (0.5 x 10 x 28) = 5700 vehicles are required to replace private cars

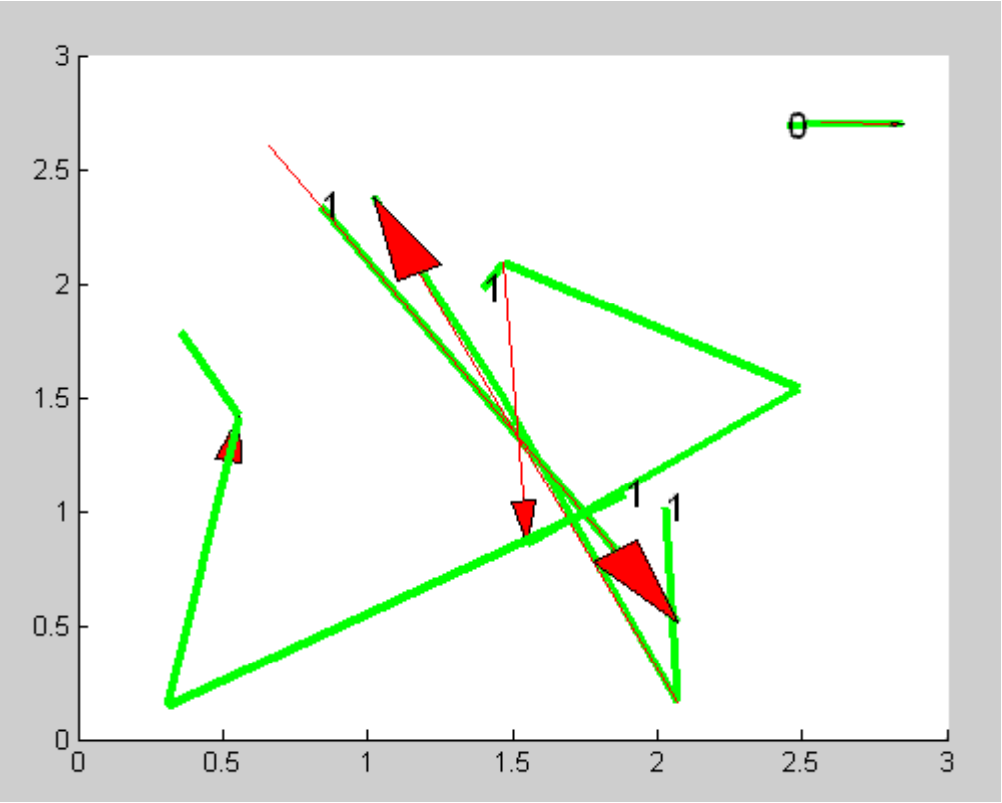
Results

- Average number of persons in private cars = 1.3
- Operating private cars: 40000 / 1.3 = 30000 cars per hour
- DRT: 2300 vehicles => reduction of 93%
- Conclusion: DRT is potentially very efficient!

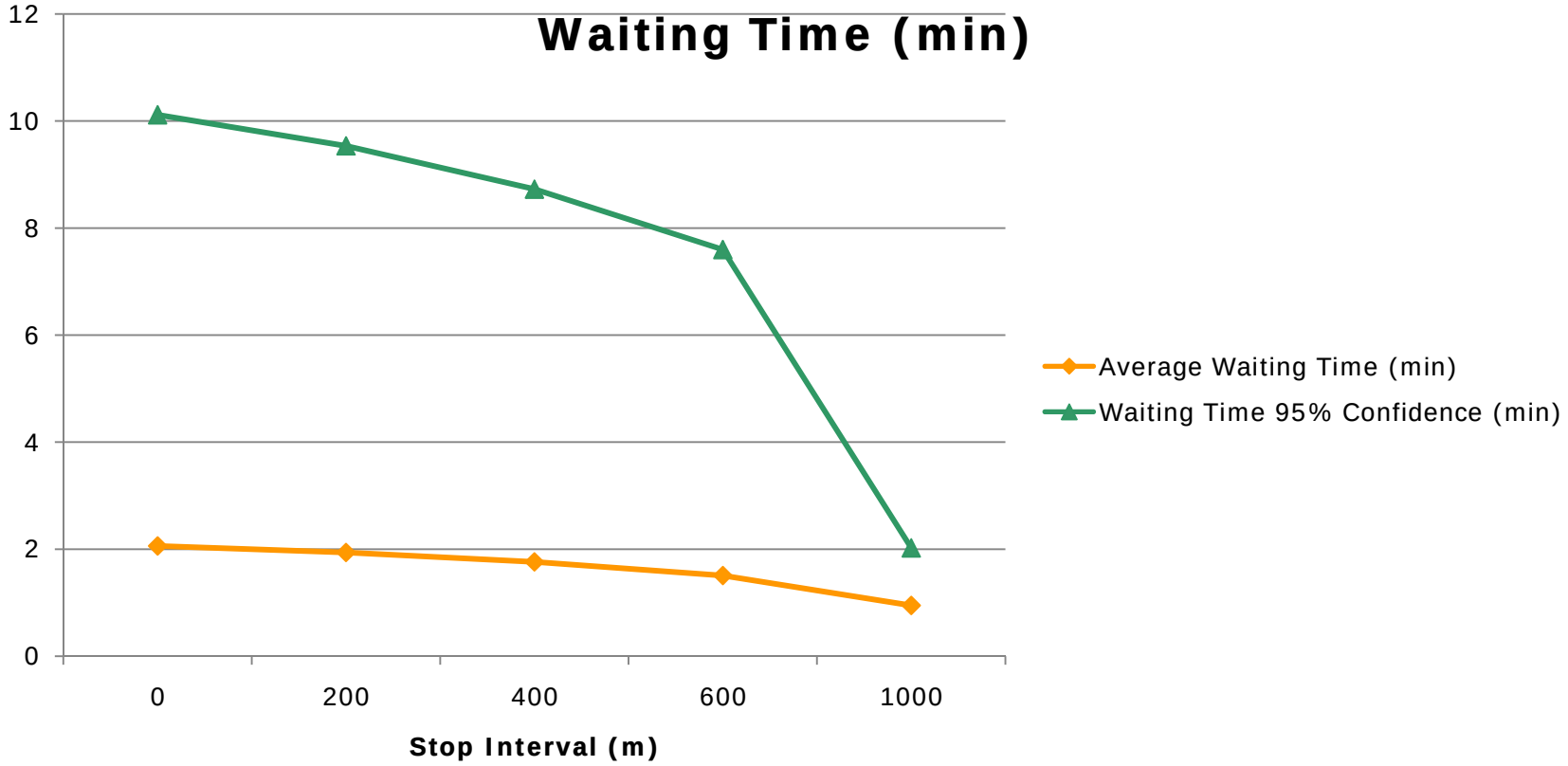
Modelling DRT services

- It is possible to investigate interesting DRT schemes by mathematical modelling
  - Queuing theory
  - Graph theory
  - Stochastic analysis
  - Simulation models
- Some variables/parameters of interest for a DRT scheme:
  - System: Cost of service, efficiency
  - Passenger service: waiting time, ride time, reliability

An example of simulation model



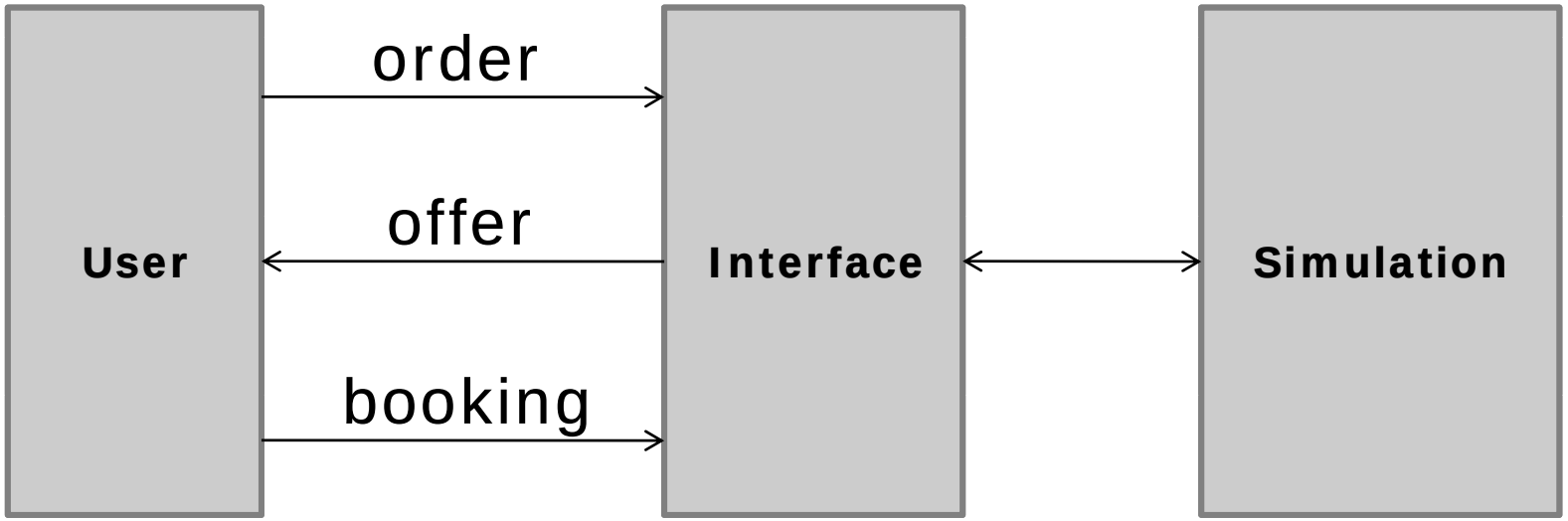
Example of results from the simulation model



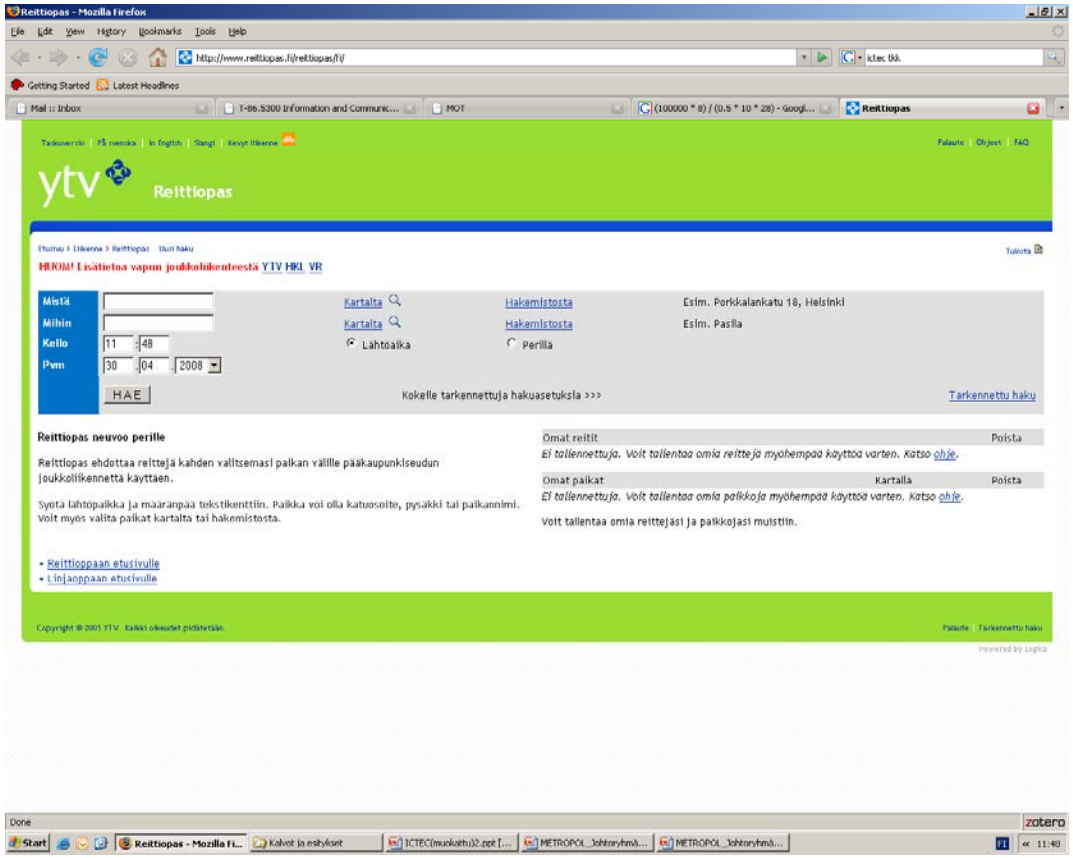
What is mathematical modelling good for?

- Investigation of future DRT schemes that cannot be currently implemented due to present legal and technological restrictions
- Evaluating the potential of interesting DRT schemes with low cost
- Investigation of underlying relationships relevant to any DRT scheme
- Optimization of subsystem performance (where possible)
- Aid in design of DRT systems
- Analysis of demand data (interesting patterns...)

Service modeling



Interface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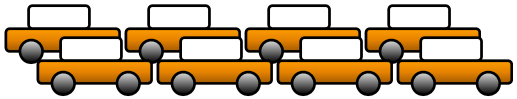
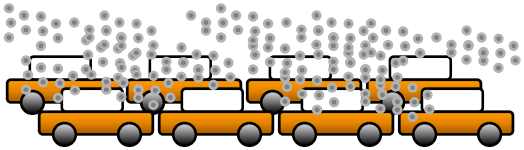
Potential Effects

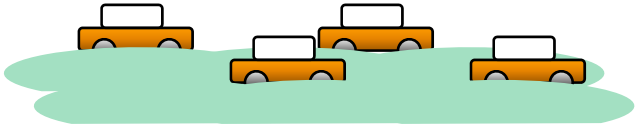
EU Area:
Year 2000: 1 % of GDP
Year 2020: 2 % of GDP



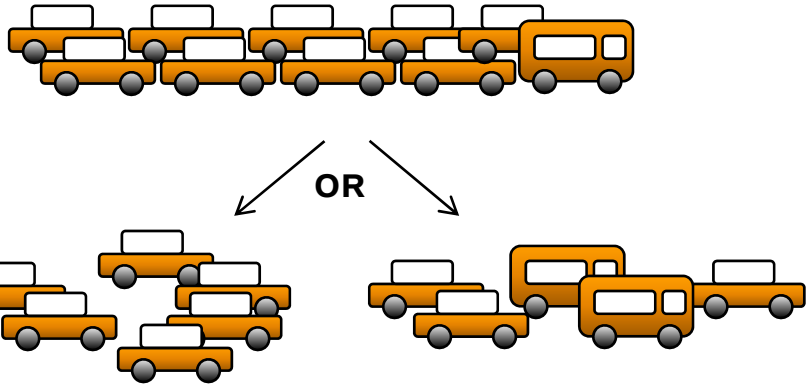
RIP 40-100 000/Year



Climate Change



New Infrastructure?




How to make it happen?
Think big!
Think innovatively!