Czech Technical University in Prague

Faculty of Transportation Sciences

Department of Control Engineering and Telematics

Laboratory Of Telematics

ITS Architecture, Standards and Pilot Projects

Prof. Dr. Ing. Miroslav Svítek
Head of Department
Vice-Dean

Prague, Czech Republic

Prague - Czech Republic

Content

T.E.A.M.
telematics
economy
architecture
management

Introduction

ITS Architecture Theory

- Methodology of ITS Architecture Creation
- User Requirements and System Parameters Definition
- Synchronization in time, parameter, protocol, etc.
- Design Methodology based on ITS architecture
- Physical realization of ITS subsystems
- Use Case Subsystem - On-board Unit (OBU)
- Economical Analysis of ITS Architecture Benefits

Involvement of the Czech Republic into GALILEO

- Information System for Monitoring and Control of Dangerous Goods Transport with help of GNSS (Galileo)
- Monitoring of Transport Means on Airport Surface

Other ITS Projects

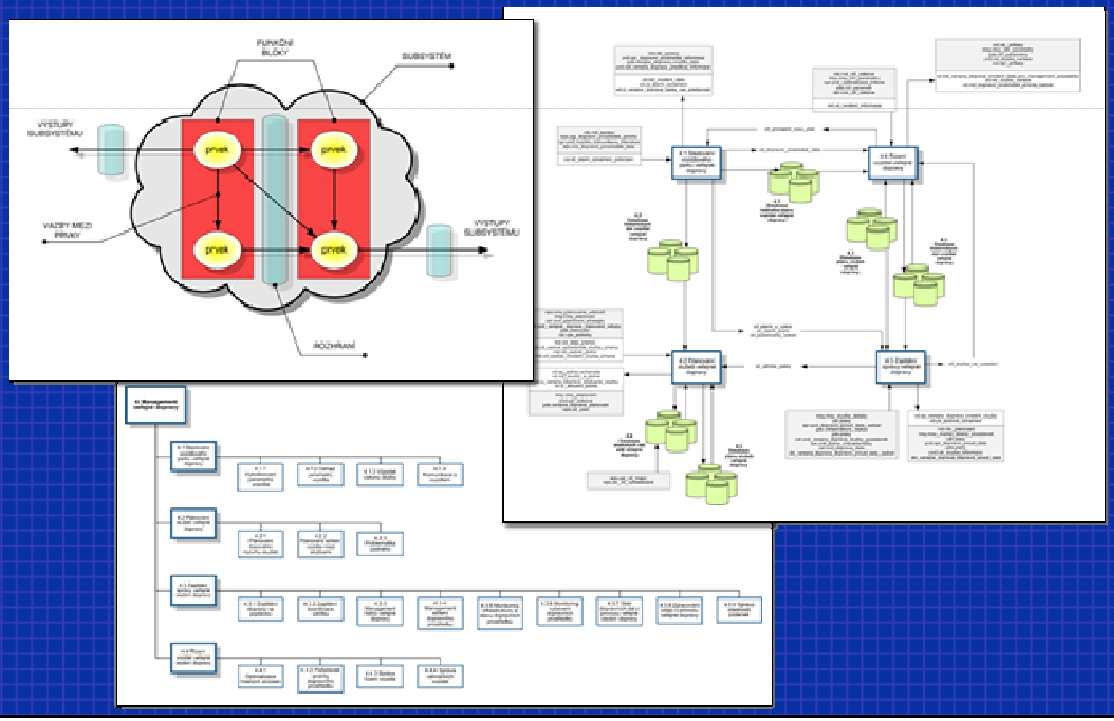
- RDS/TMC Pilot Project
- Development of Telematic Services with help of SKODA Portal
- On-line navigation systems, other telematics services

Conclusion - products, results

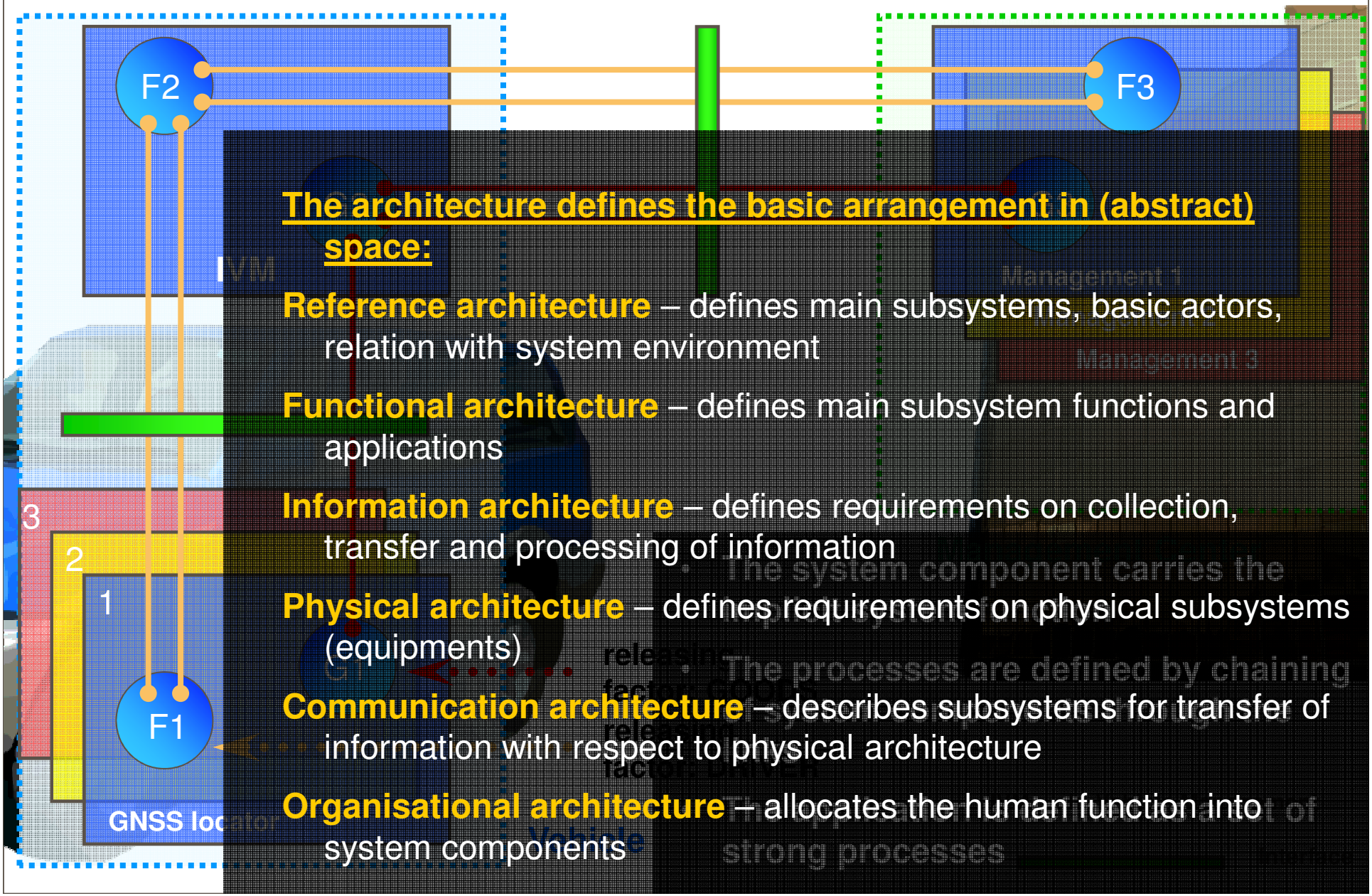
Project supported by Ministry of Transport of the Czech Republic

ITS architecture of the Czech Republic

- is solved within the project „ITS in transport-telecommunication conditions of the Czech Republic (**802-210-108)** supported by Ministry of Transport
- comes from KAREN, FRAME, ACTIF projects
- time schedule 2001 - 2005



ITS architecture – process analysis



The architecture defines the basic arrangement in (abstract) space:

Reference architecture – defines main subsystems, basic actors, relation with system environment

Functional architecture – defines main subsystem functions and applications

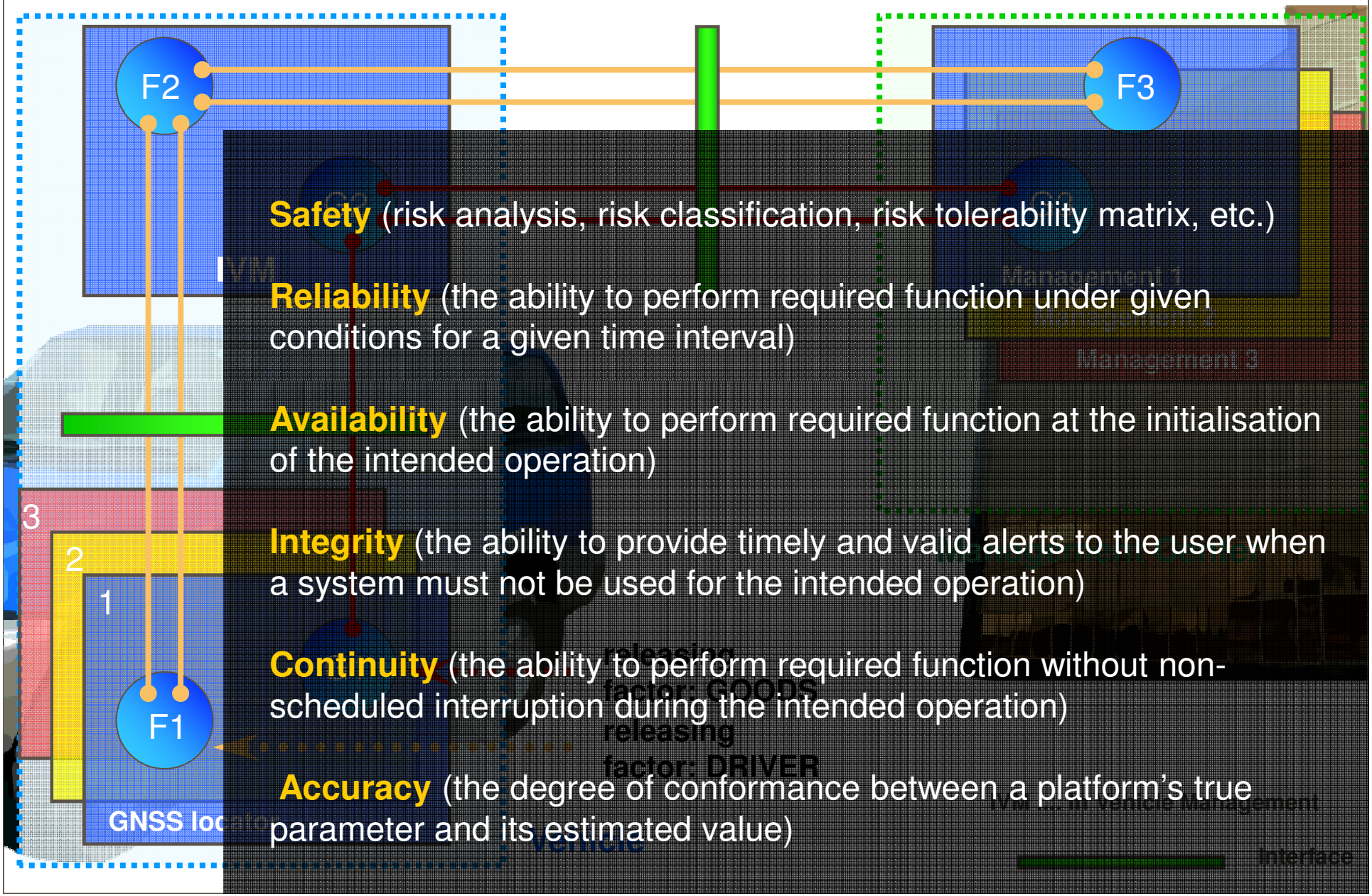
Information architecture – defines requirements on collection, transfer and processing of information

Physical architecture – defines requirements on physical subsystems (equipments)

Communication architecture – describes subsystems for transfer of information with respect to physical architecture

Organisational architecture – allocates the human function into system components

ITS architecture – process analysis



Safety (risk analysis, risk classification, risk tolerability matrix, etc.)

Reliability (the ability to perform required function under given conditions for a given time interval)

Availability (the ability to perform required function at the initialisation of the intended operation)

Integrity (the ability to provide timely and valid alerts to the user when a system must not be used for the intended operation)

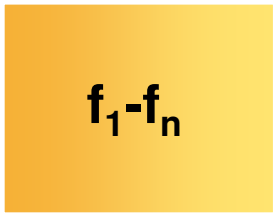
Continuity (the ability to perform required function without non-scheduled interruption during the intended operation)

Accuracy (the degree of conformance between a platform's true parameter and its estimated value)

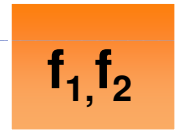
Methodology of ITS system design

Design of ITS components (OBU, telecommunication environment, processing center, local components - call centers, etc.)

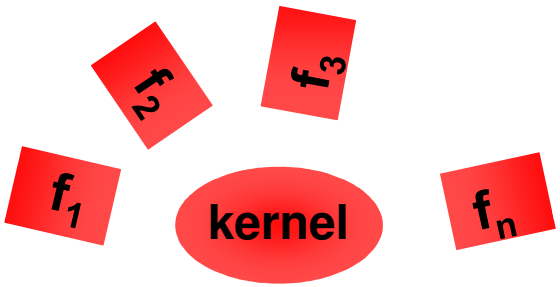
universal components



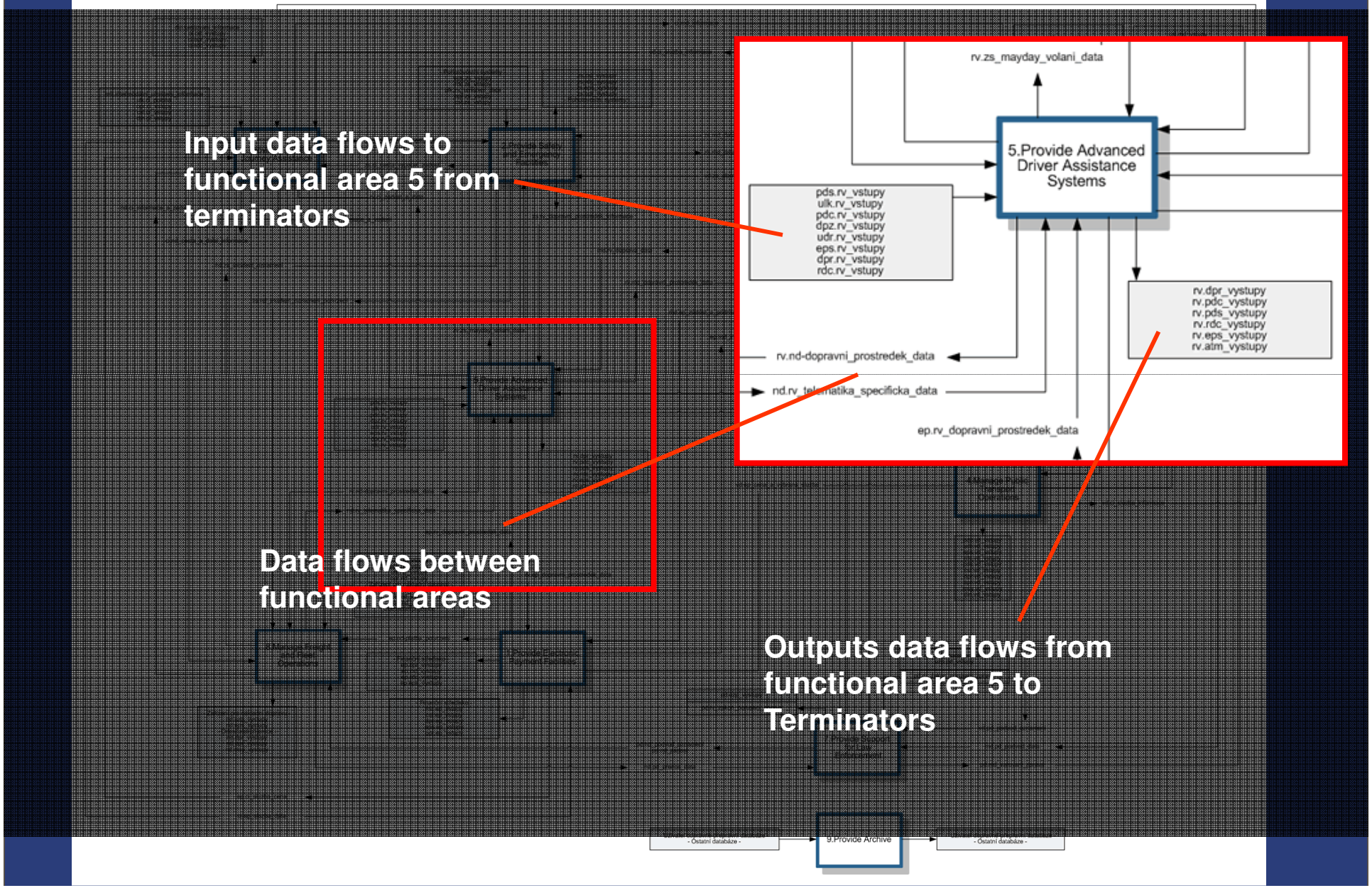
several component



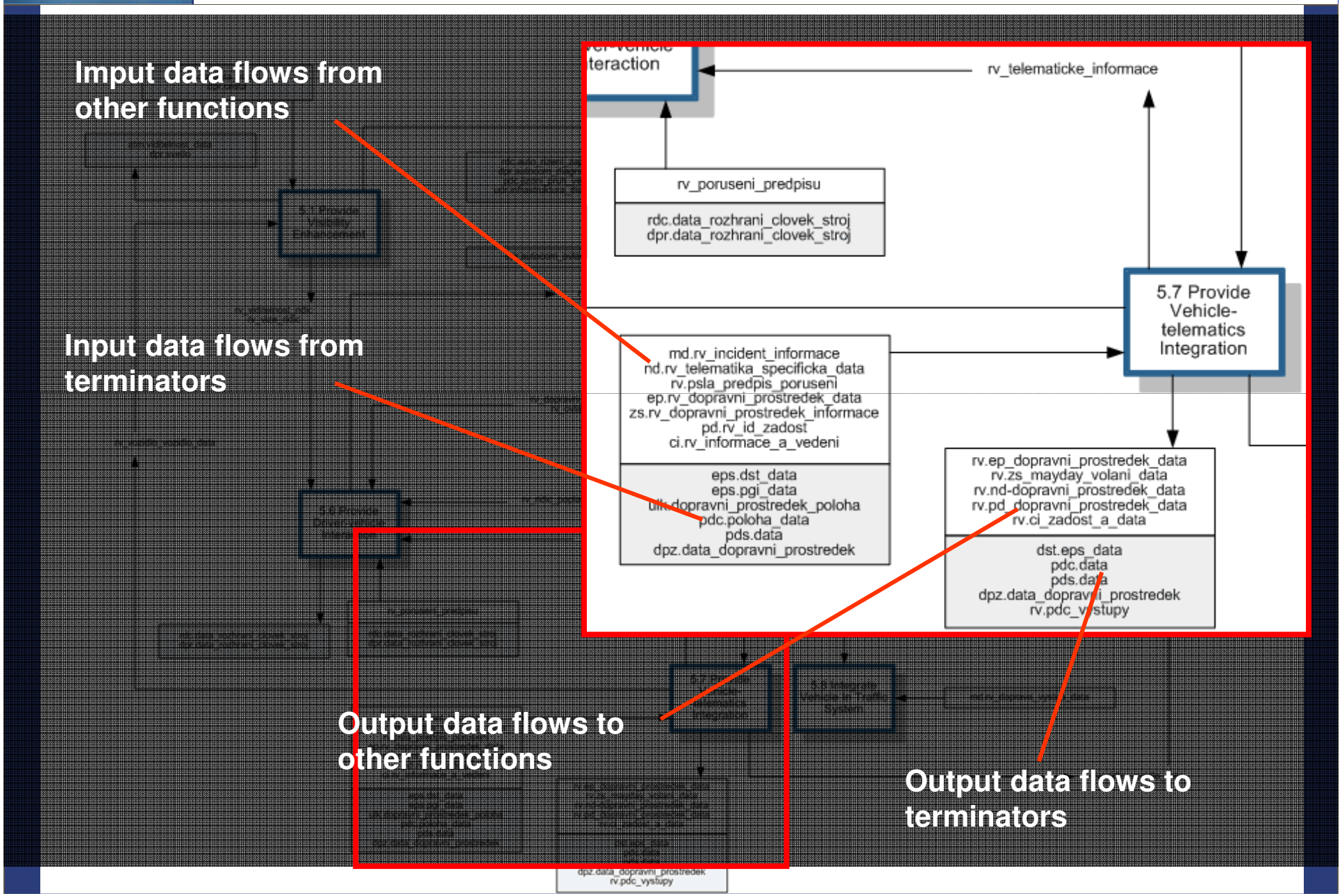
modular components



ITS architecture – Information data flow



ITS architecture – Information data flow



ITS architecture – physical architecture

Centre subsystems

- Mainterance Management System
- Parking Management System
- Public Transport Management System
- Tool Administration System
- Trafic Management System
- Travel Coordination System
- Archived Data Management System
- Commercial Vehicle Administration System
- Emergency Management System
- Feet Management System
- Freight Management System
- Information Service Provider System
- Law Enforcement System

Communication interface

Travellers subsystems

- Kiosk Systems
- Personal Device system

Vehicles subsystems

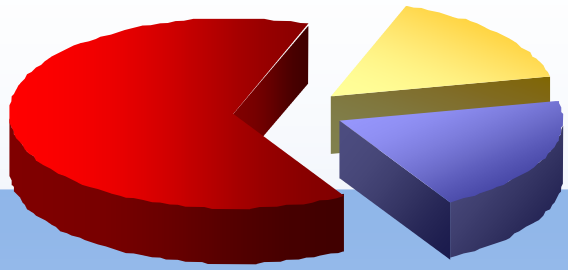
- Commercial Vehicle System
- Emergency Vehicle System
- Freight Equipment System
- Maintenance Vehicle System
- Public Transport Vehicle System
- Personal Vehicle System

Infrastructure subsystems

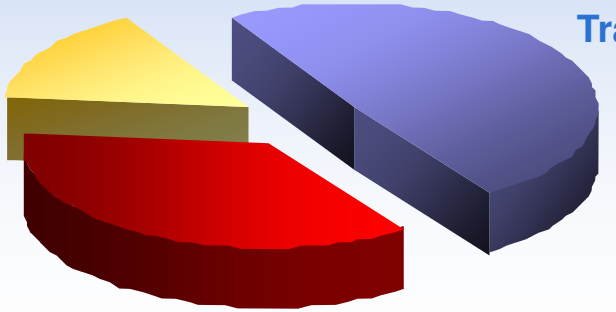
- Commercial Vehicle Check System
- Tool Collection System
- Parking Facilities System
- Roadway System

Economical Analysis of ITS Architecture

Telematics system with designed architecture



Telematics system without designed architecture

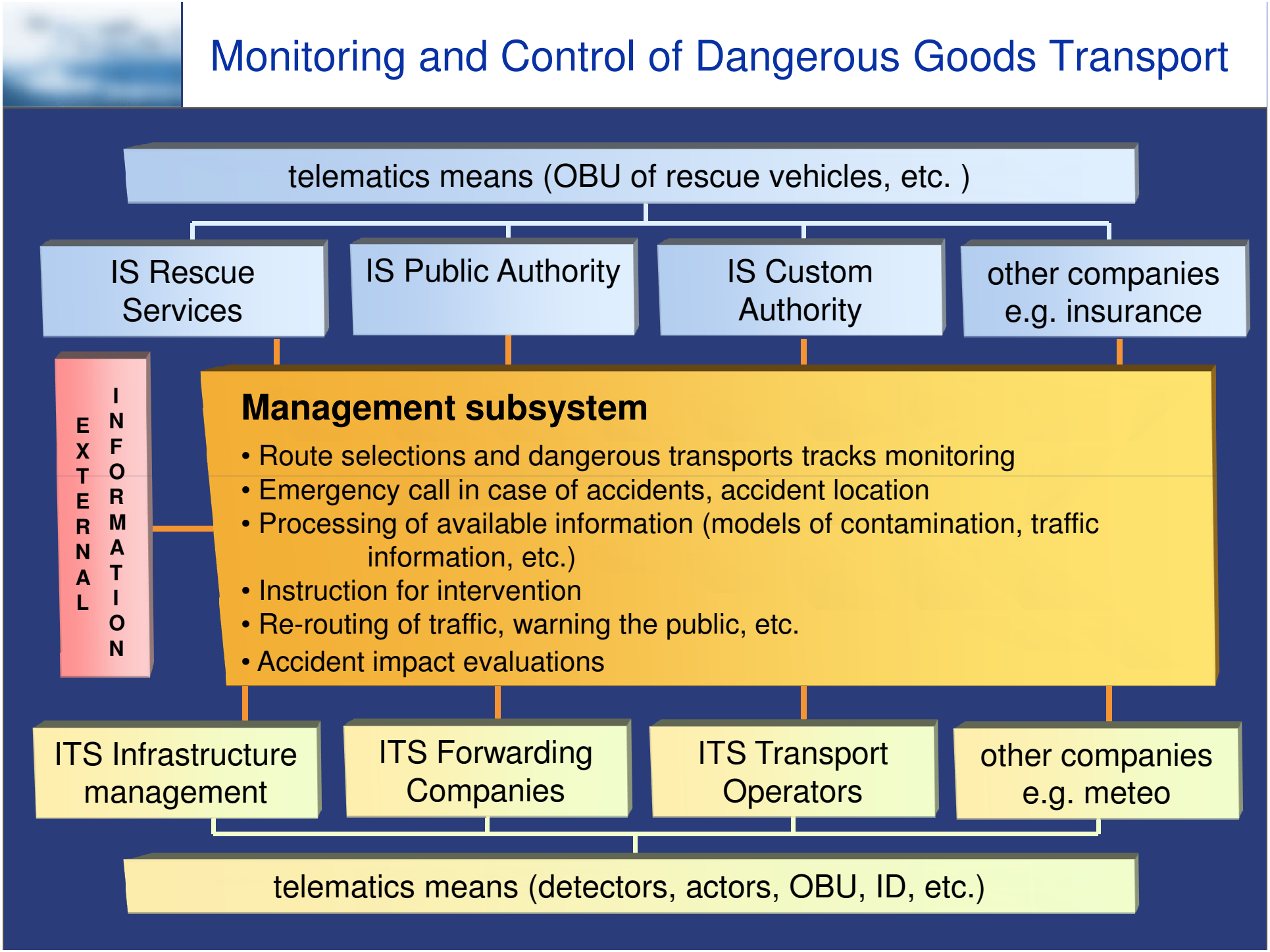


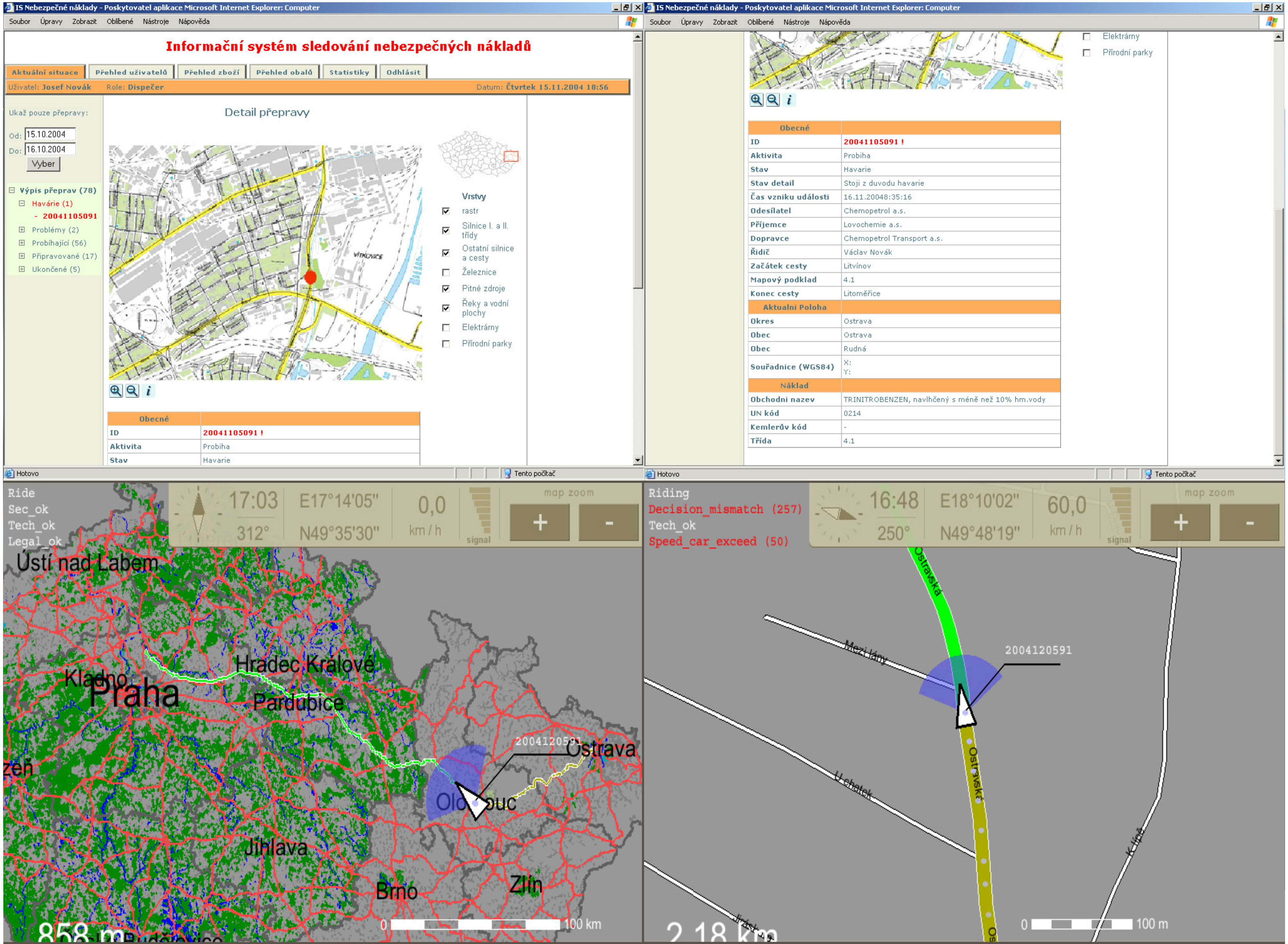
Projects supported by Ministry of Transport of the Czech Republic

Information system for monitoring and control of dangerous goods

- is one of the pilot applications prepared within project „Involvement of the Czech Republic into Galileo Project“ (**802-210-112)** supported by Ministry of Transport
- is pilot application of using the ITS architecture for practical design of selected telematics application
- time schedule
  2001 - 2006

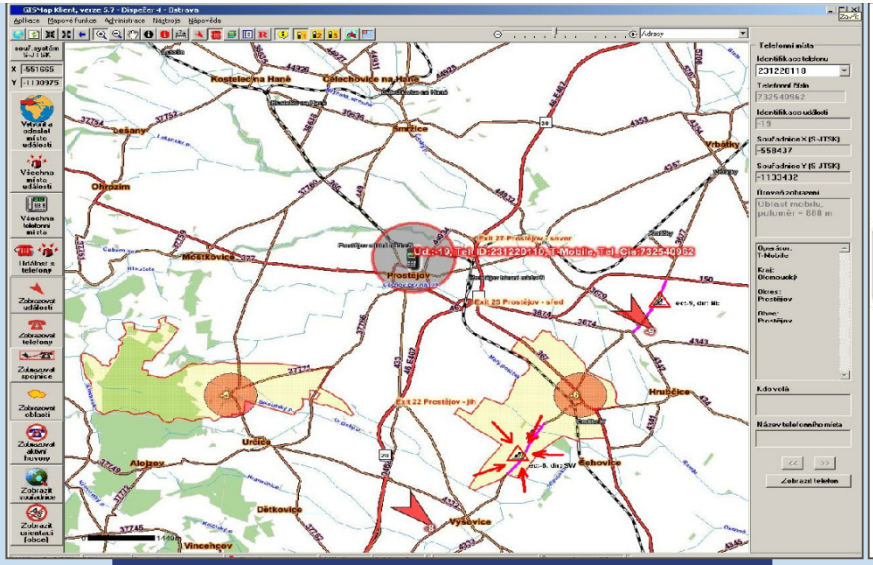
Monitoring and Control of Dangerous Goods Transport



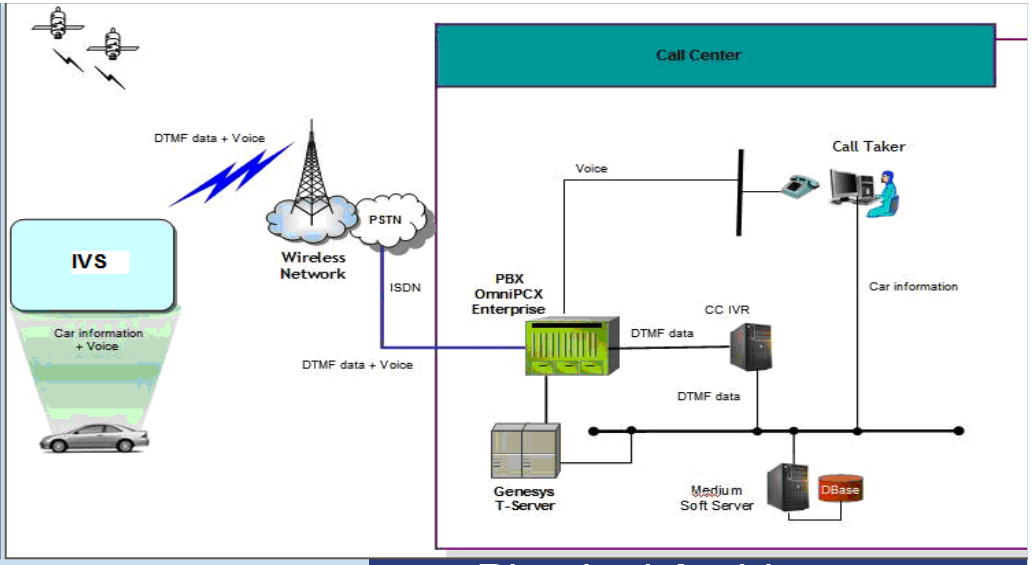

IS Nebezpečné náklady - Poskytovatel aplikace Microsoft Internet Explorer: Computer
Soubor Úpravy Zobrazit Oblíbené Nástroje Nápověda
Informační systém sledování nebezpečných nákladů
Aktuální situace
Přehled uživatelů
Přehled zboží
Přehled obalů
Statistiky
Odhlásit
Uživatel: Josef Novák
Role: Dispečer
Datum: Čtvrtek 15.11.2004 18:56
Ukaž pouze přepravy:
Od: 15.10.2004
Do: 16.10.2004
Vyber
Výpis přeprav (78)
Havárie (1)
- 20041105091
Problémy (2)
Probíhající (56)
Připravované (17)
Ukončené (5)
Detail přepravy
Vrstvy
rastr
Silnice I. a II. třídy
Ostatní silnice a cesty
Železnice
Pitné zdroje
Řeky a vodní plochy
Elektrárny
Přírodní parky
Obecné
ID
20041105091 !
Aktivita
Probiha
Stav
Havarie
Stav detail
Stoji z duvodu havarie
Čas vzniku události
16.11.20048:35:16
Odesílatel
Chemopetrol a.s.
Příjemce
Lovochemie a.s.
Dopravce
Chemopetrol Transport a.s.
Řidič
Václav Novák
Začátek cesty
Litvínov
Mapový podklad
4.1
Konec cesty
Litoměřice
Aktualni Poloha
Okres
Ostrava
Obec
Ostrava
Obec
Rudná
Souřadnice (WGS84)
X:
Y:
Náklad
Obchodni nazev
TRINITROBENZEN, navlhčený s méně než 10% hm.vody
UN kód
0214
Kemlerův kód
-
Třída
4.1
Hotovo
Tento počítač
Ride
Sec_ok
Tech_ok
Legal_ok
17:03
312°
E17°14'05"
N49°35'30"
0,0
km / h
signal
map zoom
+
-
Ústí nad Labem
Kladno
Praha
Hradec Kralové
Pardubice
2004120591
Ostrava
Olomouc
Jihlava
Brno
Zlín
0
100 km
858 m
Riding
Decision_mismatch (257)
Tech_ok
Speed_car_exceed (50)
16:48
250°
E18°10'02"
N49°48'19"
60,0
km / h
Ostravská
Mezi lány
U chatek
K lipě
2004120591
2.18 km

Projects overview - e-call pilot implementations

- eCall Service - Pilot Operation
  - Pilot project funded by Ministry of Transport
  - Project led by Telefónica O2
  - Objectives
    - Develop, implement and test the environment for the eCall service as an extension of real E112 system
    - Collect data related to the MSD throughput via mobile and fixed telecommunication infrastructure
    - Compare the localization information provided by mobile operator with the GPS

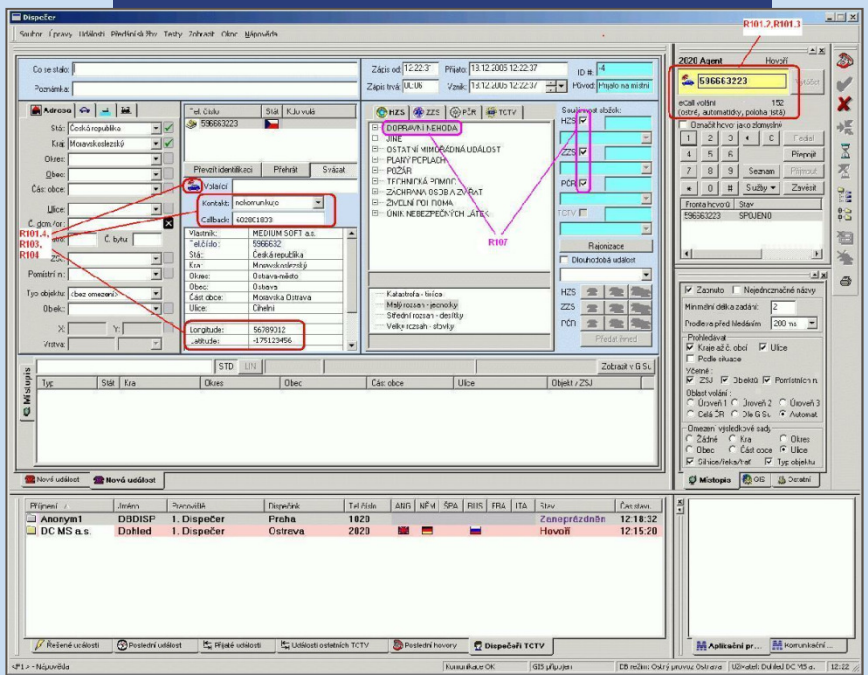


GIS View

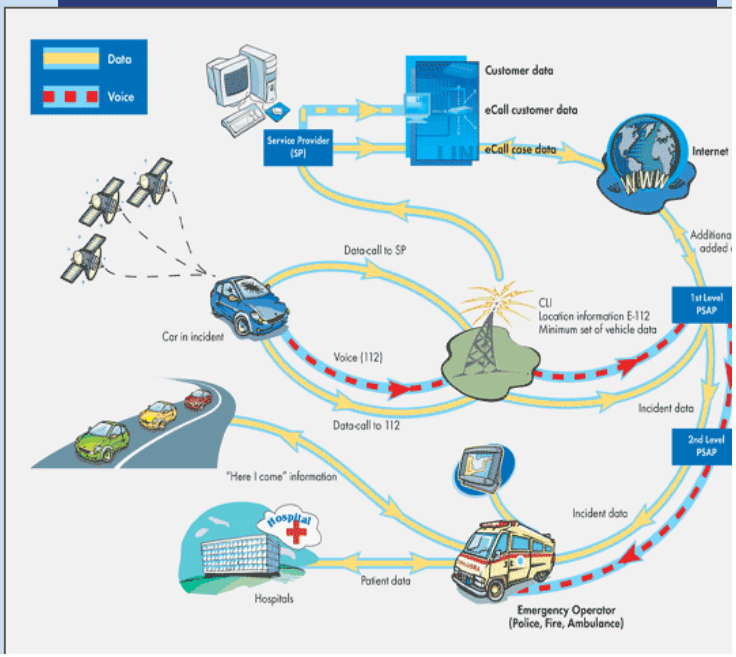


Physical Architecture

PSAP Terminal



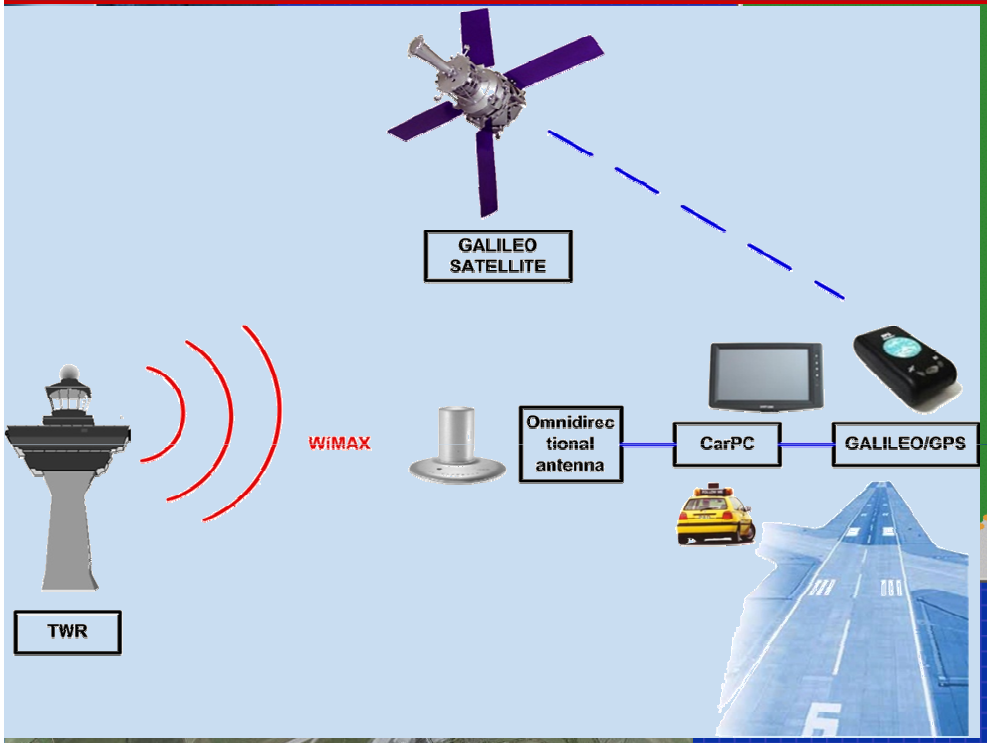
Overall eCall architecture



Projects supported by Ministry of Transport of the Czech Republic

- **Monitoring and Control of Moving Objects on Airport Surface with help of GNSS**
  - is one of the pilot applications prepared within project „Involvement of the Czech Republic into Galileo Project“ (**802-210-112)** supported by Ministry of Transport
  - is pilot application of performance parametres testing (reliability, safety, availability, integrity etc.)
  - time schedule 2001 - 2006

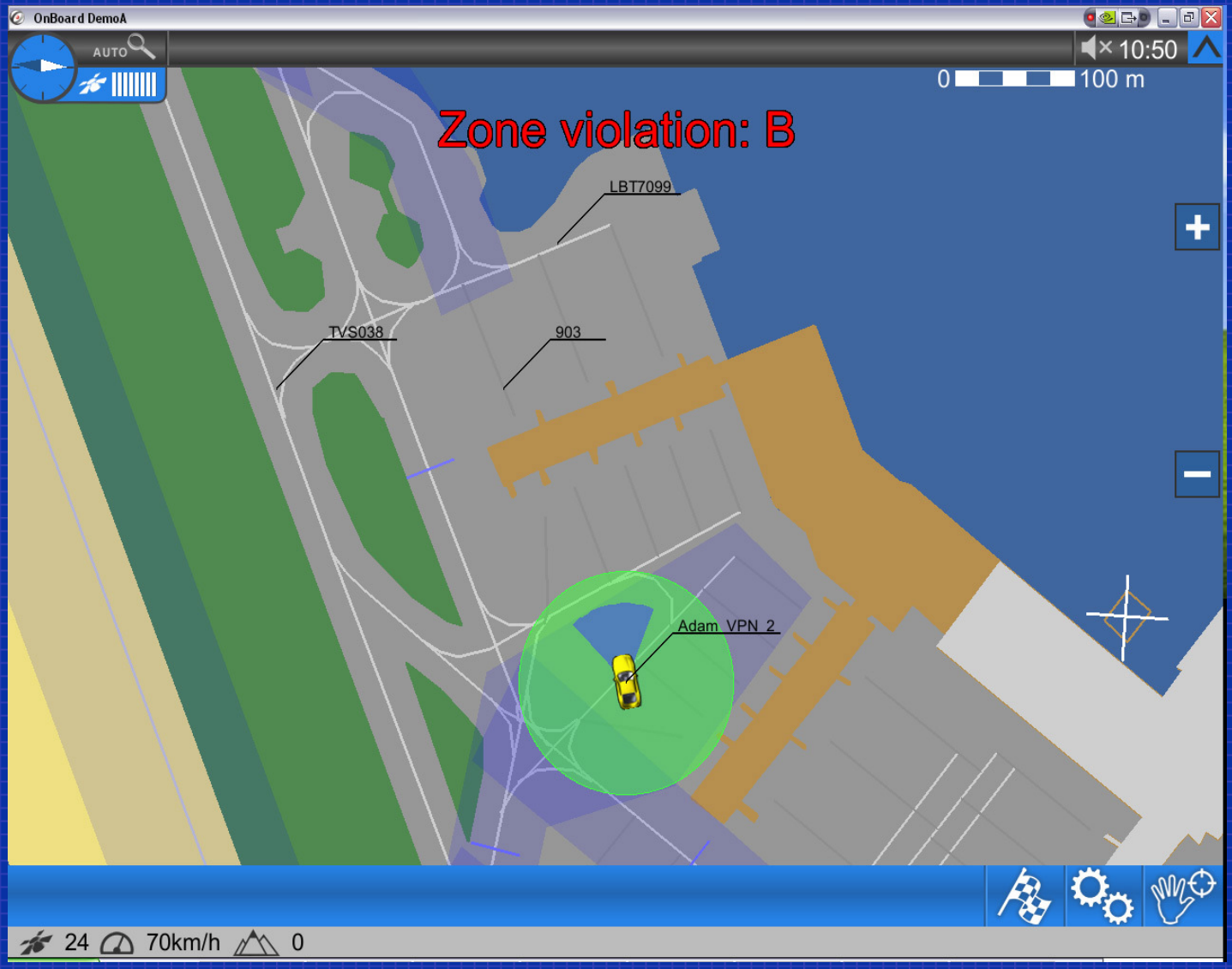
- Control and monitoring of airport fleet
- Warning! in case of on-coming collision
- Vehicles navigation over airport ground
- Routing through zones approved by dispatcher



- Prague Airport – dramatically developing Airport
- Dominant Czech Airport at least 30 years
- 52 movements / rush hours
- 628 movements / da80 vehicles - Prague Airport
- 7 vehicles - Air Navigation Services

Dispatcher HMI of CaMnA system

HMI of CaMnA system



Pilot testing at Prague Airport

The National R&D Project Description

The project:

Economical, Ecological and Safety Electronic Fee Collection

- is supported by Ministry of Transport of the Czech Republic
- the project consortium is:
  - Czech Technical University of Prague, Faculty of Transportation Sciences
  - Czech University of Agriculture in Prague, Technical Faculty
  - Telematix Services, a.s.
- time schedule is 2004 – 2007

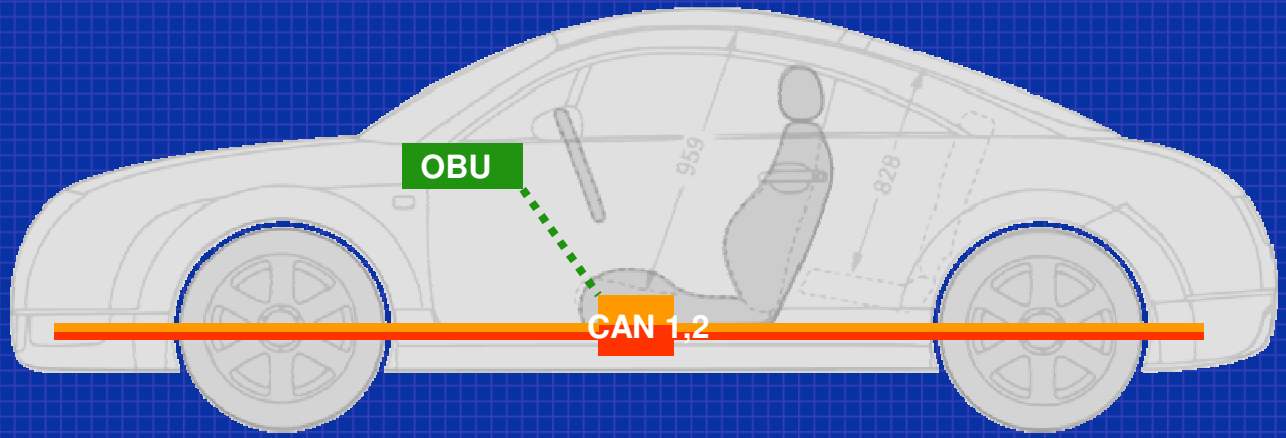
Technická fakulta
Česká zemědělská univerzita v Praze

telematix
services a.s.

ČVUT V PRAZE

Using of in-vehicle data in transport telematics applications

- The connection between OBU and in-vehicle data (CAN) can yield to providing the new telematics services:
  - In-vehicle weight in motion
  - on-line assessment of vehicle emission
  - on-line measurement of externalities
  - safety assessment of vehicle driving
  - ecological assessment of vehicle driving,
  - etc.



In-vehicle weight in motion system (example of presented principle)

- The basic principle comes from Newton's Law of Inertia:

  $F = m \cdot a$

  F – vector of vehicle force,

  m – vehicle weight,

  a – vector of vehicle acceleration

- The acceleration *a* is measured by accelerometer or GPS/GALILEO locator inside OBU
- The vehicle force *F* is measured by processing of CAN bus data
- Novak M., Svitek M., Votruba Z.: The patent application CZ PV 2003-3337

The In-vehicle weight in motion equation

$$m_i := \frac{\frac{ip \cdot up}{Ra} \cdot M(n_i) - a_i \cdot \left(\frac{ip^2 \cdot Im}{up \cdot Ra^2} + \frac{Ia + Ib}{Ra^2} \right) - \frac{0.5 \cdot \rho \cdot cw \cdot SP}{3.6^2} \cdot (v_i - vx_i)^2}{a_i + \left(ka + \frac{v_i}{3.6} \cdot kb \right) + 9.807 \cdot \sin\left(\operatorname{atan}\left(\frac{\alpha_i}{100} \right) \right)}$$

- **Im** -the moment of inertia of a revolving component of an engine connected to the clutch, scaled on to the crankshaft
- **Ia, Ib** - the total moment of inertia of all driving wheels and all driven wheels, including the complete system auxiliaries and their axis reduction
- **ip** - the total gear ratio between the crankshaft and the driving wheels in gear s = 3.
- **up** - the mechanical efficiency for energy transmission from the crankshaft to the driving wheels at a given nominal load and at standard road quality and running temperature of the oil
- **Ra** - the updated rolling radius of the vehicle drive wheels during travel
- **ai** - lineal acceleration of the vehicle
- **vxi** - perpendicular to the vector projection of speed along the longitudinal plane of the vehicle
- **vi** - the linear speed of the vehicle
- **ni** -the frequency of rotations for the crankshaft
- **αi** - the elevation of a given section of the road expressed in %, i.e. 100.tangent.α
- **ka** - the coefficient for all the constant components of rolling resistance for a standard surface.
- **kb** - the coefficient of linear dependence between the rolling resistance and vehicle speed on standard surface.
- **SP** - the front surface area of the vehicle car body.
- **cw** - the aerodynamic resistance of the vehicle.
- **ρ** - the air density.

Projects supported by SKODA or VW

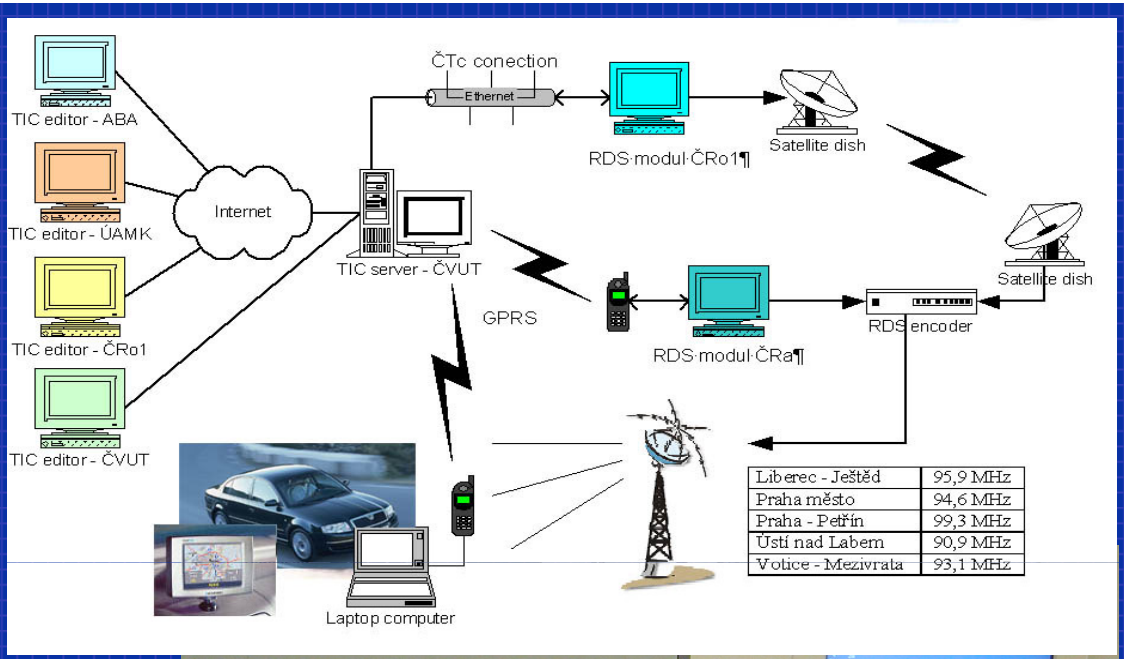
RDS-TMC Pilot Project in the Czech Republic www.rds-tmc.cz

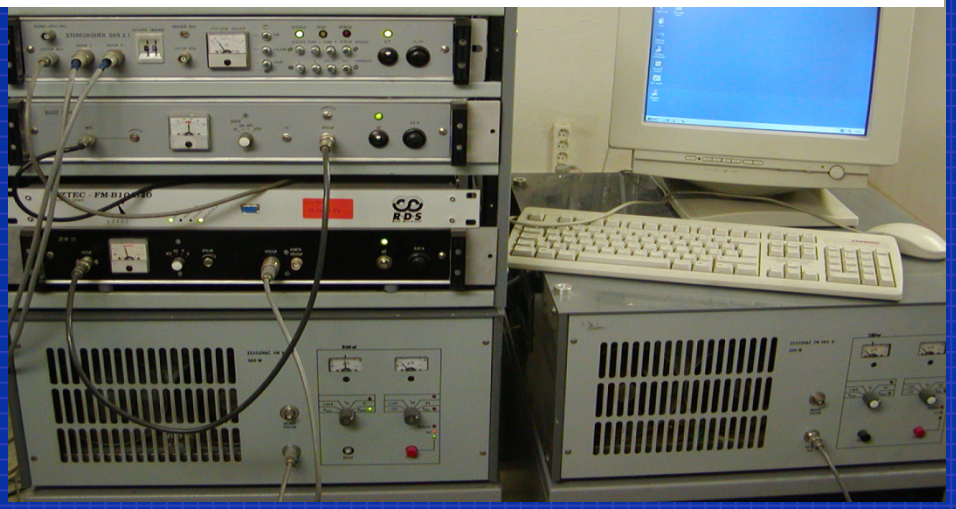
- Integration of traffic information from different data sources:
  - traffic data localization (localization tables for CR)
  - definition and implementation of data exchange protocol (XML)
  - definition and implementation of traffic database (SQL server)
- Pilot implementation and testing of RDS-TMC system in conditions of the Czech Republic
- Translation and adaptation of the ALERT-C protocol into Czech language

R·D·S RADIO DATA SYSTEM

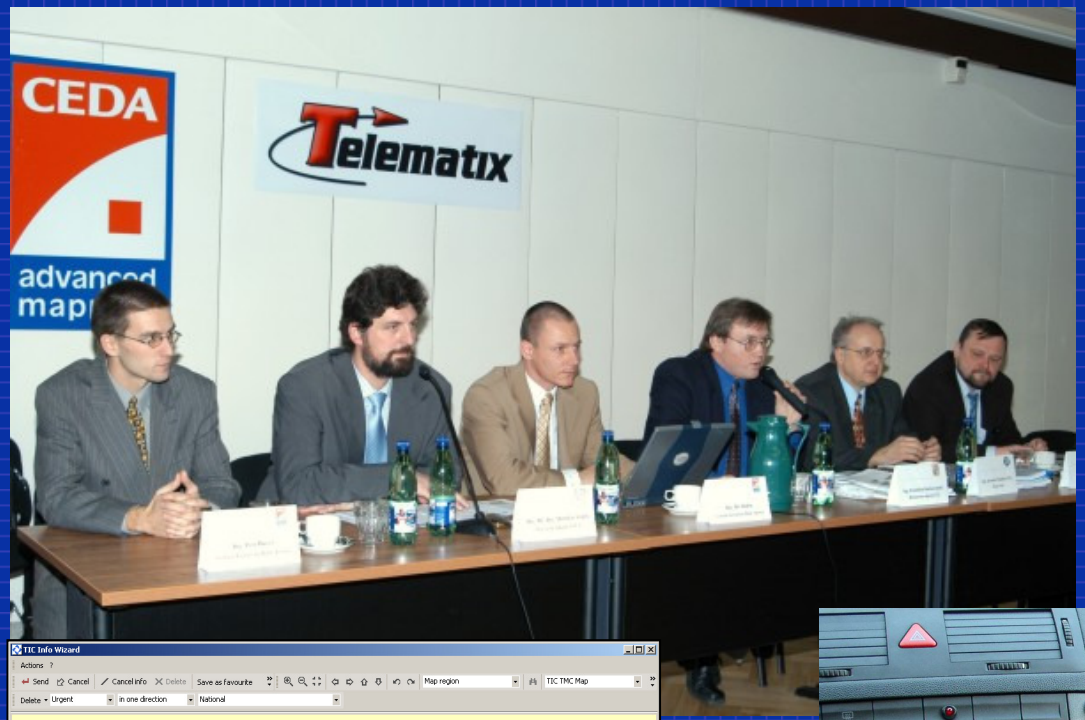
TMC TRAFFIC MESSAGE CHANNEL

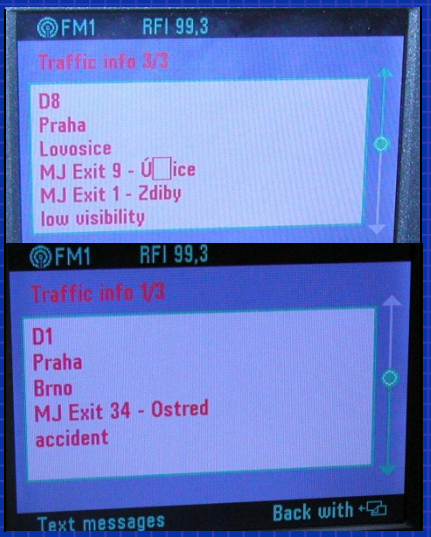
Results of RDS-TMC Pilot Project

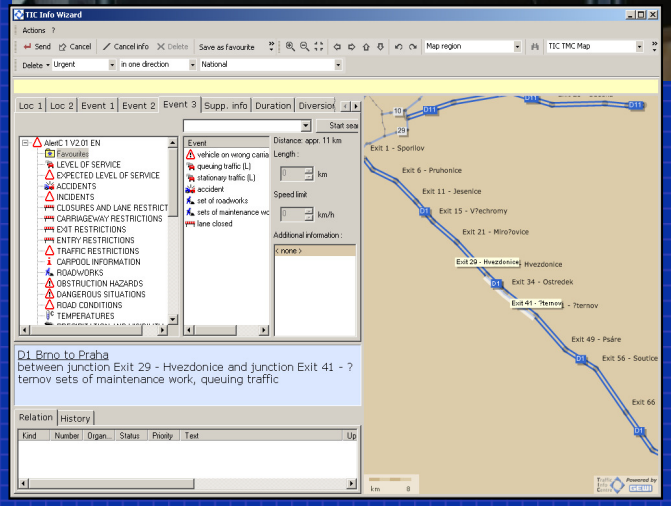


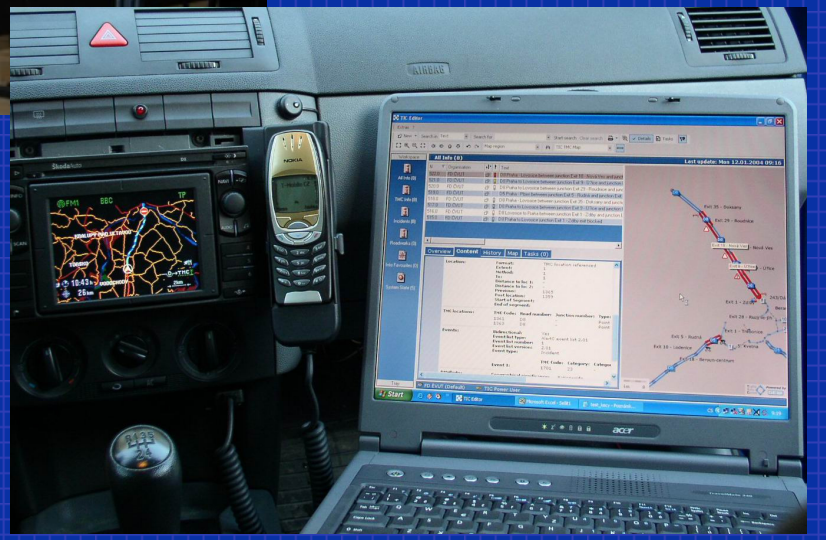


Result of RDS-TMC Pilot Project

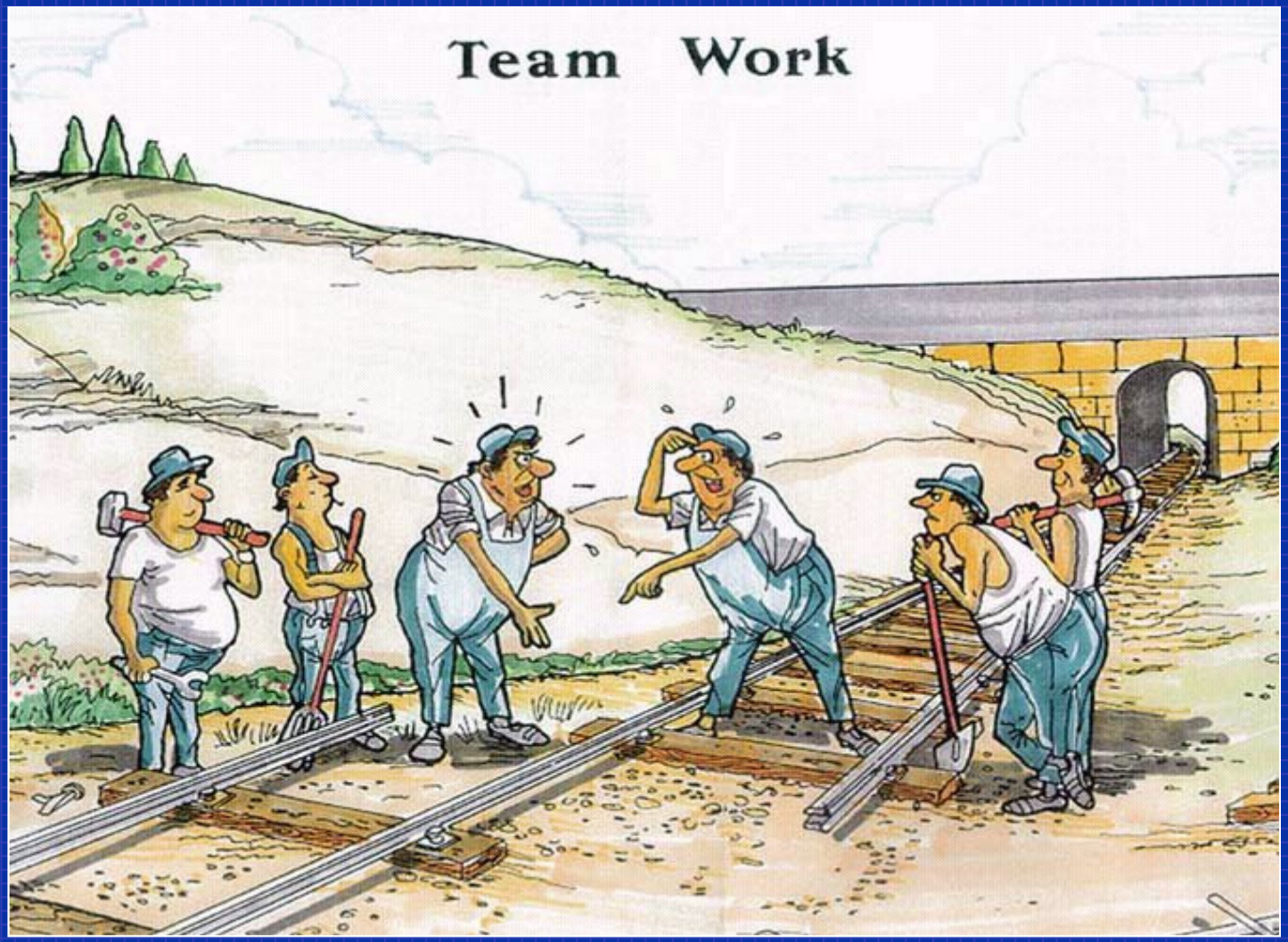








Thank you for attention



More information: WWW.LT.FD.CVUT.CZ, WWW.DYNAVIX.COM