Czech Technical University in Prague

Faculty of Transportation Sciences

Department of Control Engineering and Telematics

Laboratory Of Telematics

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

Telematics fundamentals, architecture, applications and benefits

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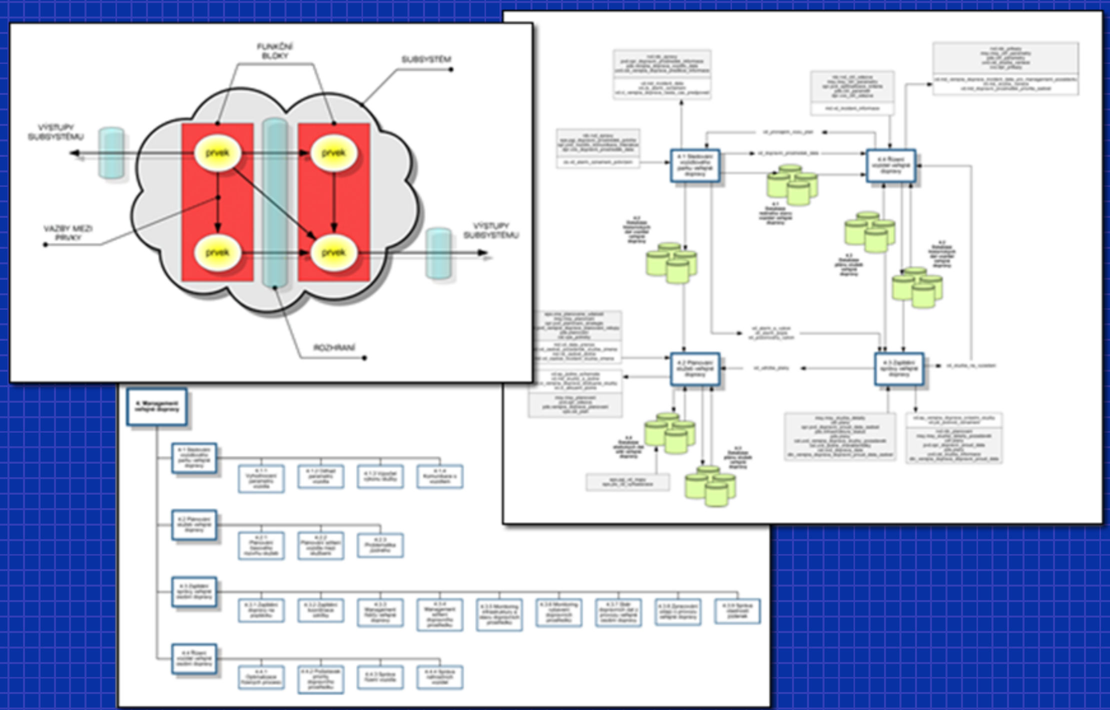
ITS models

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



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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

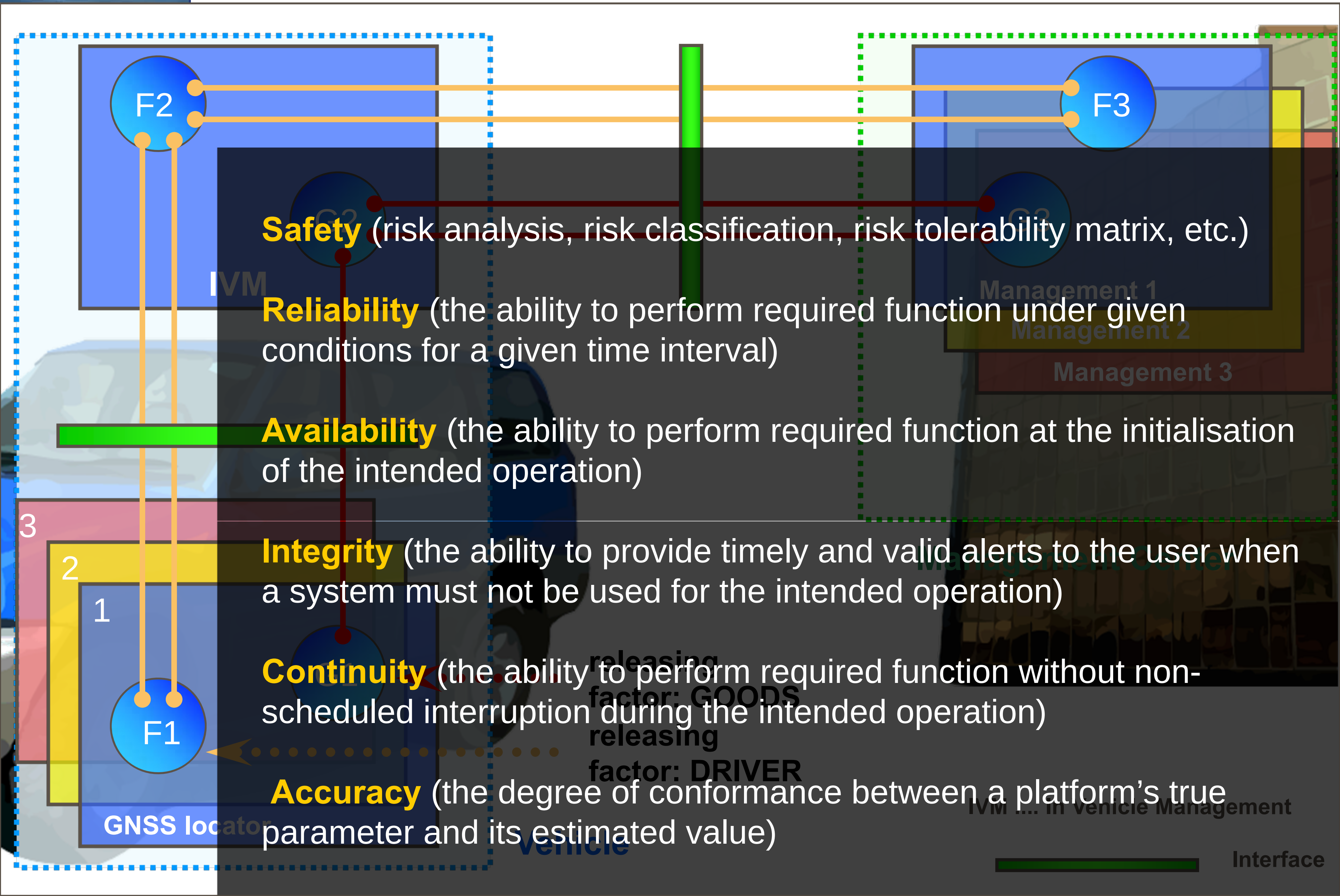
Information architecture – defines requirements on collection, transfer and processing of information

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)

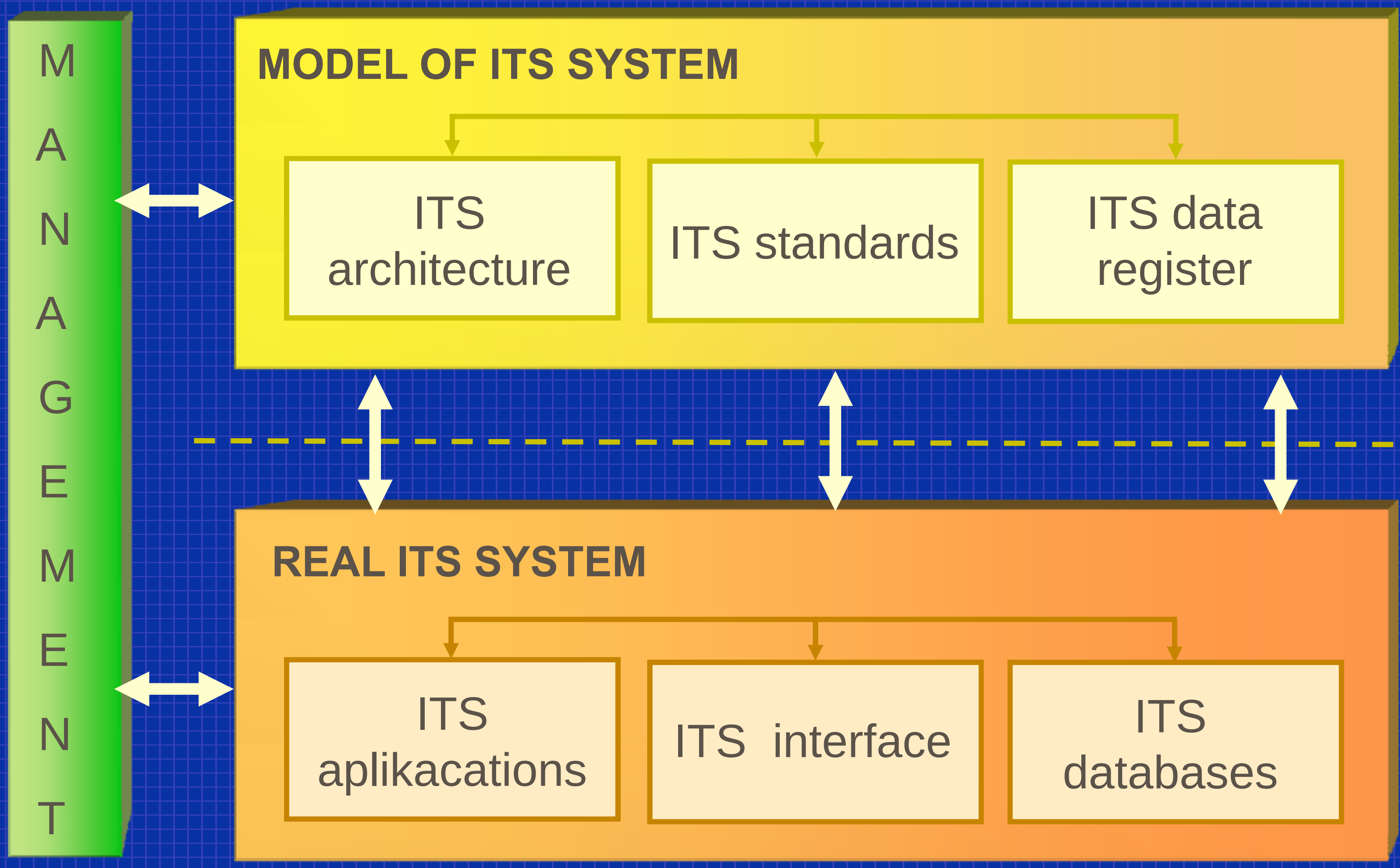
Availability (the ability to perform required function at the initialisation of the intended operation)

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

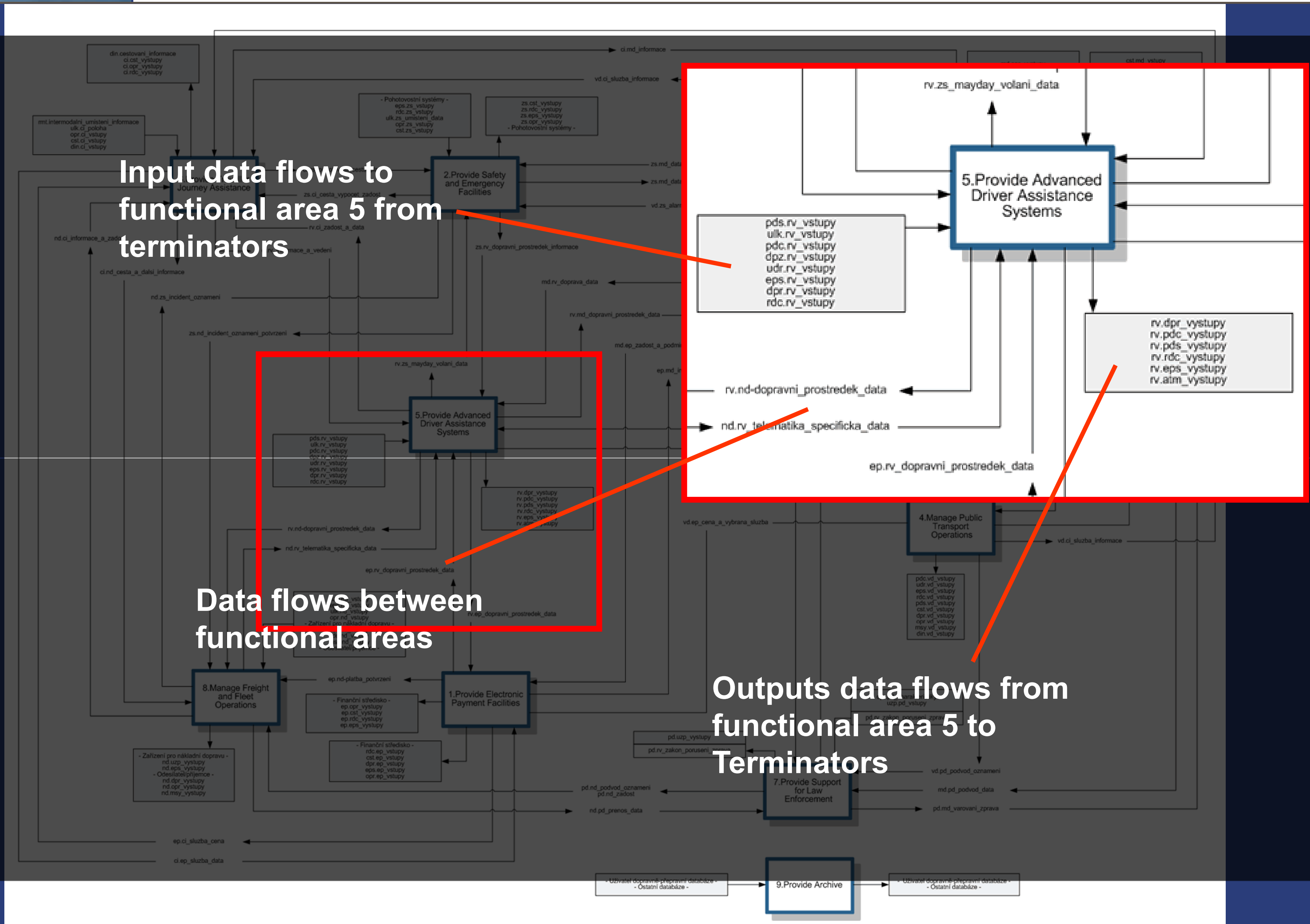
Continuity (the ability to perform required function without non-scheduled interruption during the intended operation)

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

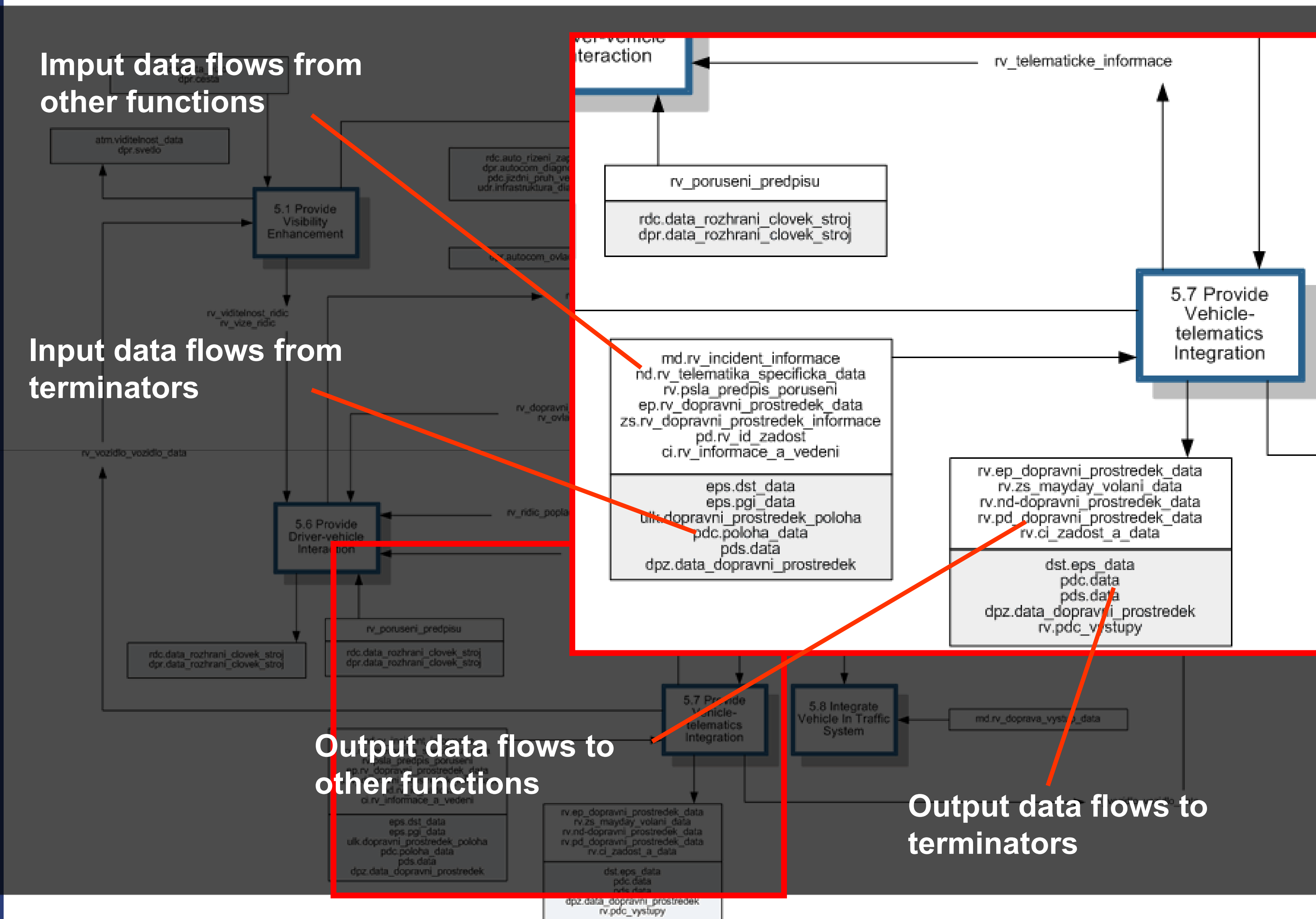
Management of ITS systems - model and reality



ITS architecture – Information data flow



ITS architecture – Information data flow



ITS architecture – physical architecture

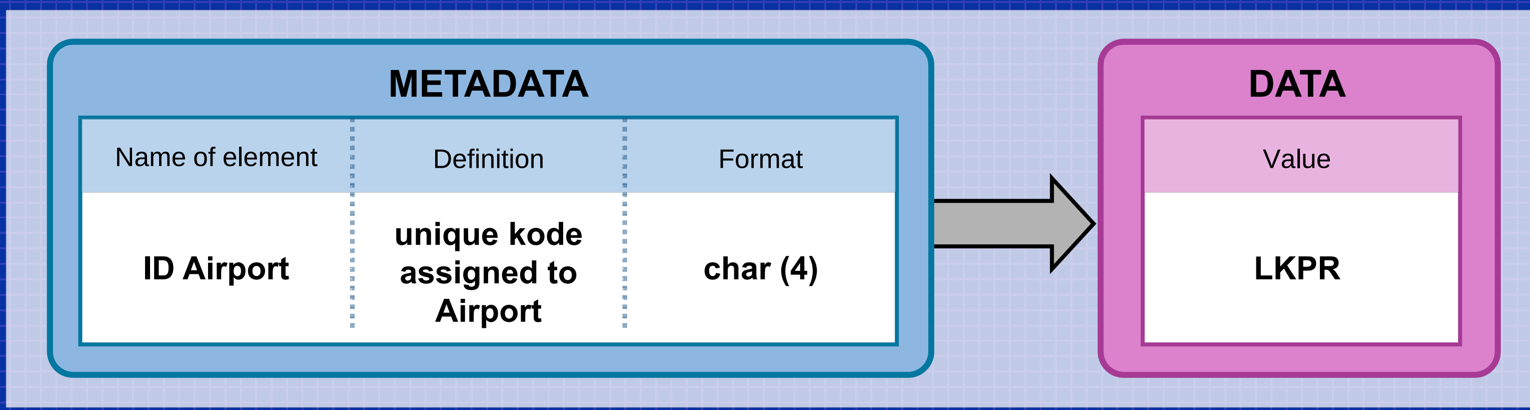
ITS Data Register

The definition of data registry (ISO/IEC 11179)

- An information resource kept by a registration authority that describes the meaning form of data elements, including registration identifiers, definitions, names, value domains, metadata and administrative atributes

The data registry should manage two types of information

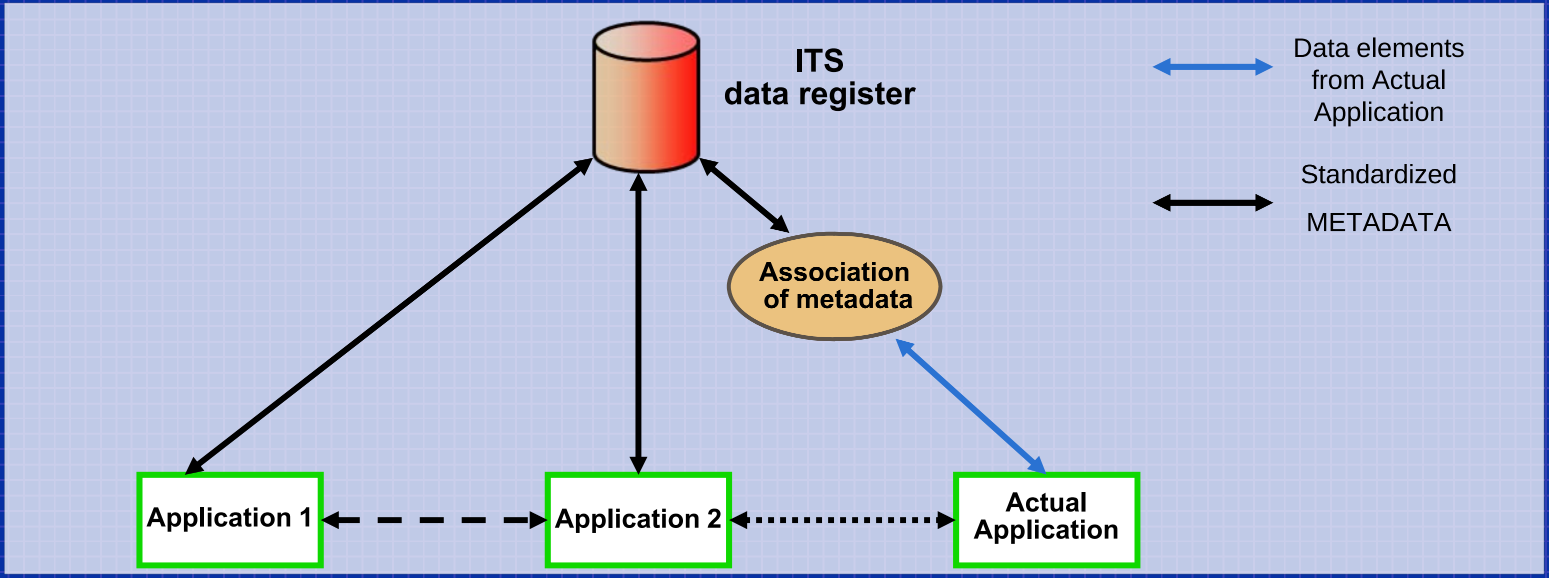
- Data and information standards at micro and macro information levels to be used in data management
- Information about current (legacy) data elements



ITS Data Register

Benefit of data registry:

- **Data quality and access** – reducing the ambiguity about similar data defined differently across systems
- **Interoperability** – today, system interfaces are customized between pairs of systems (expensive to build and maintain, inflexible) – solution is data structure definition
- **Cost effectiveness** – constrained budget can be used when data services can serve multiple systems rather than when each system develops its own data services locally
- **Flexibility** – common data services developed with automated tools allows system-wide access to metadata and the data behind them more easily and efficiently



ITS Standards

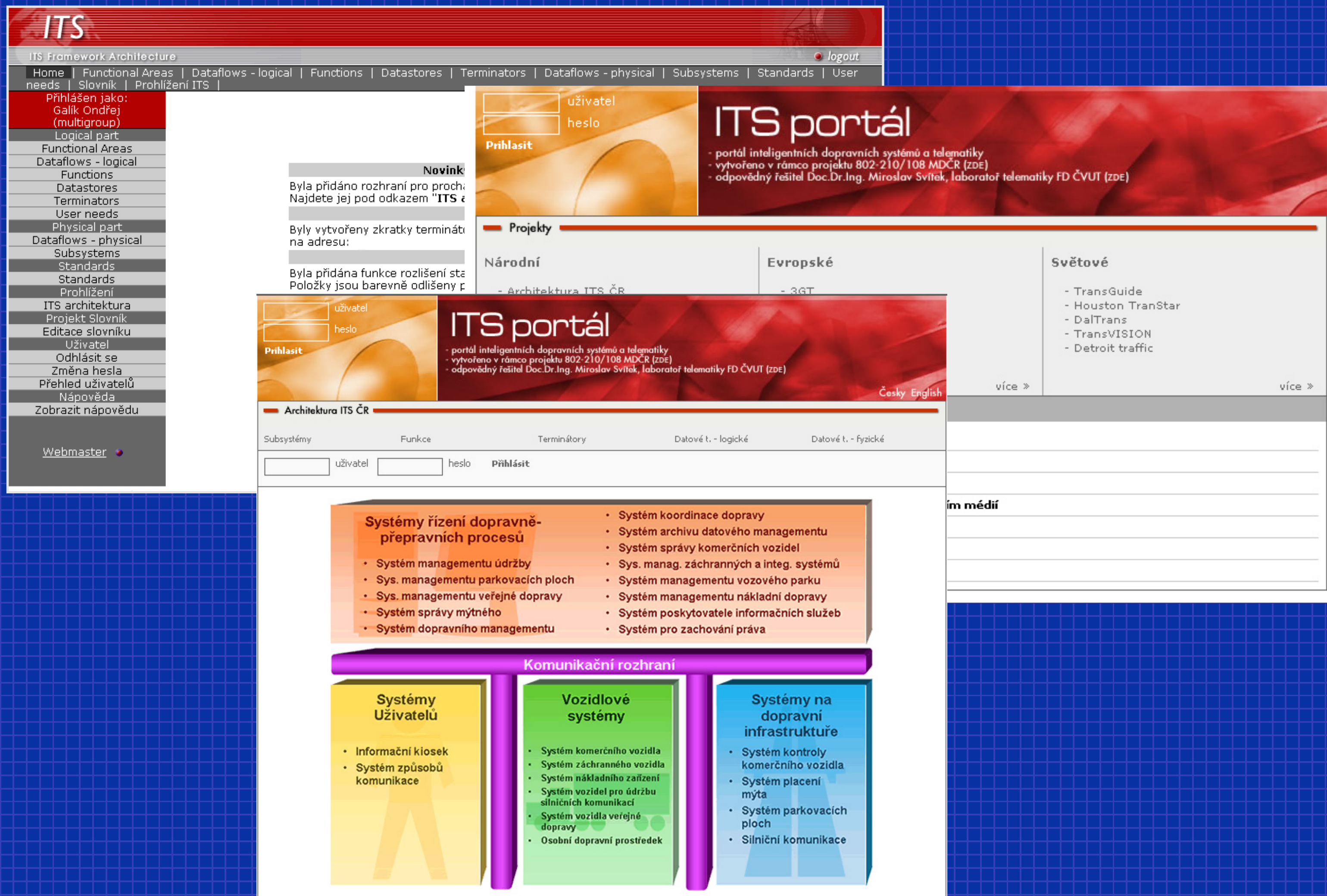
ITS standards (CEN, ISO) could be linked with

- ITS architecture: functions, interfaces, physical subsystems, communication links
- ITS data registry: data model, transmission messages

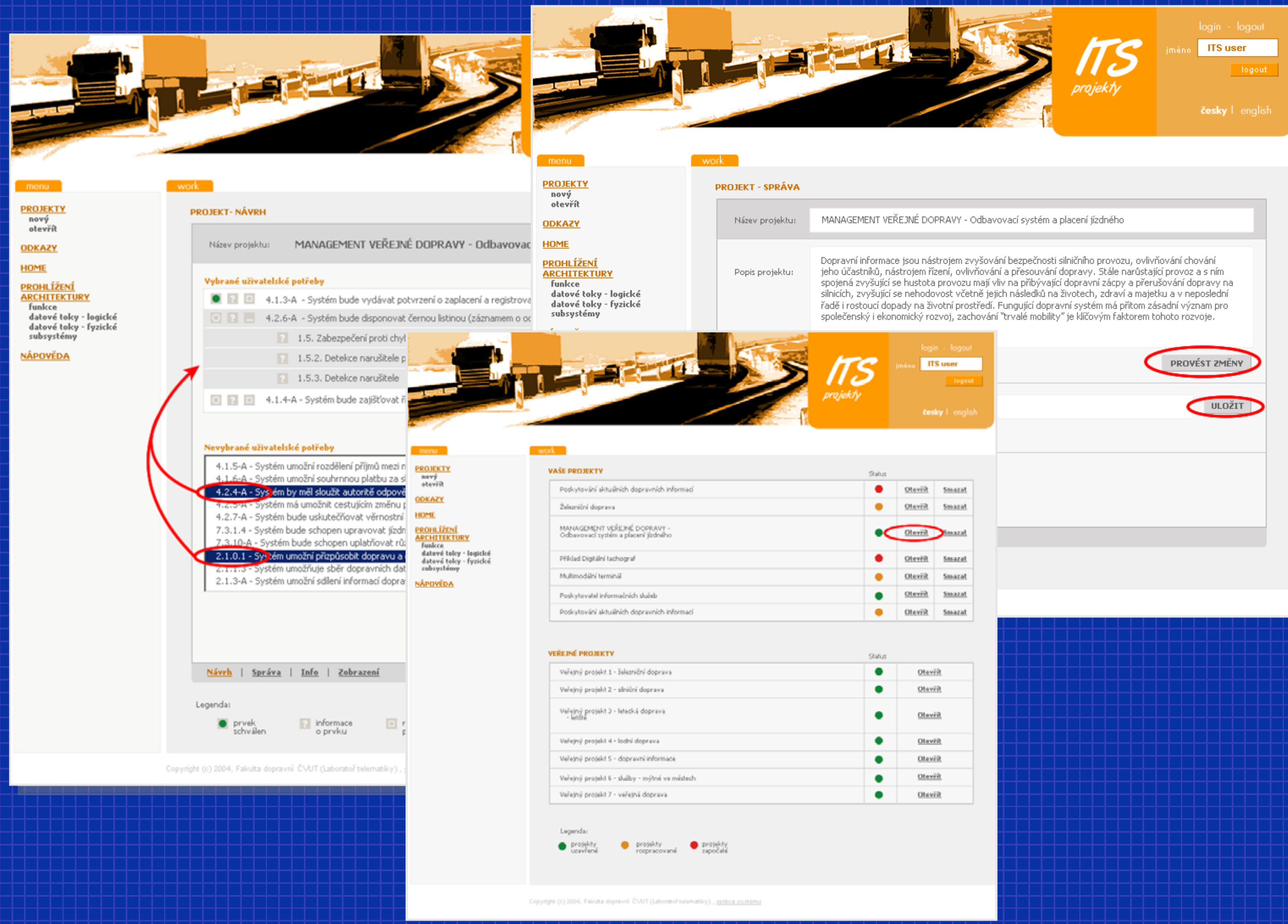
The role of ITS standards could be summarized:

- instrument for time, parameter and protocol synchronization
- added value for ITS architecture and ITS data registry

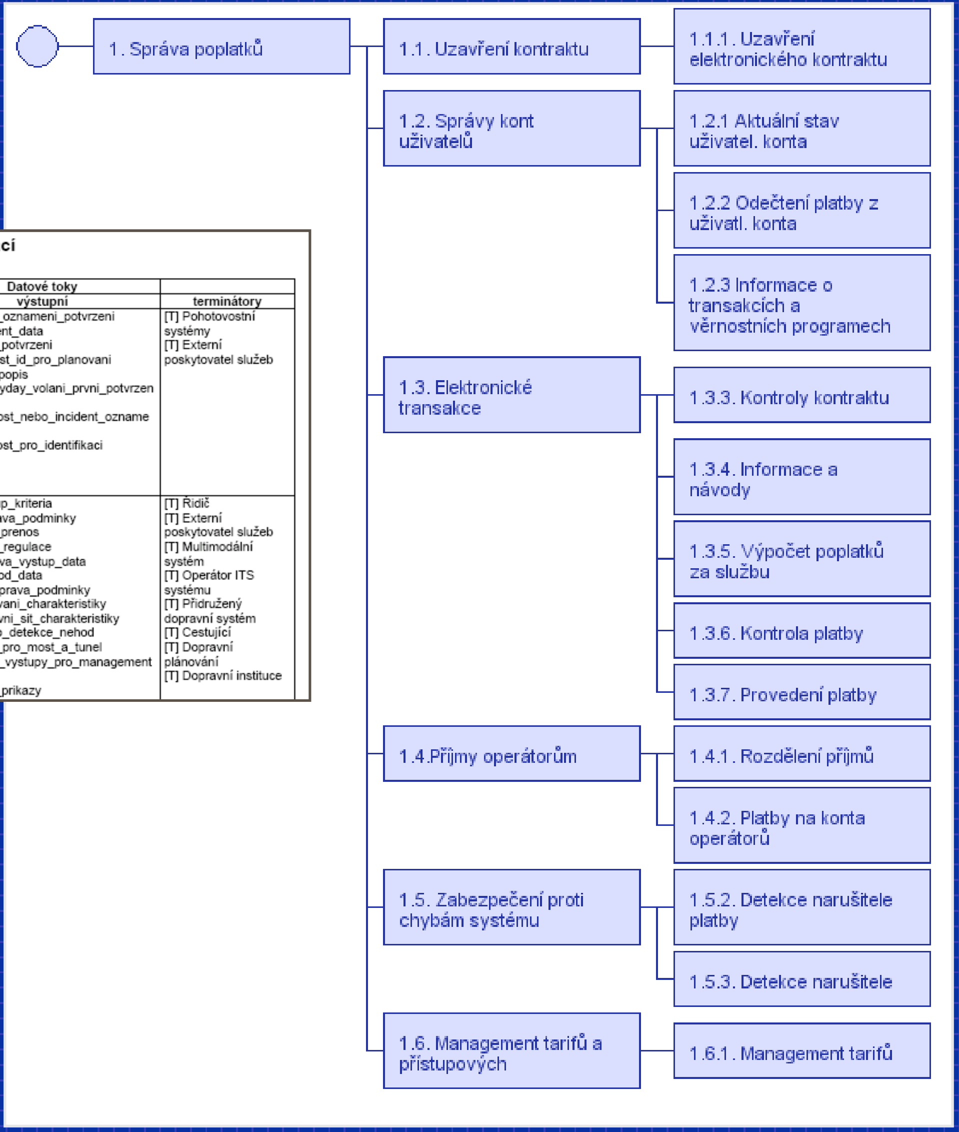
Web portal: www.its-portal.cz



Tools for ITS design



Tools for ITS design

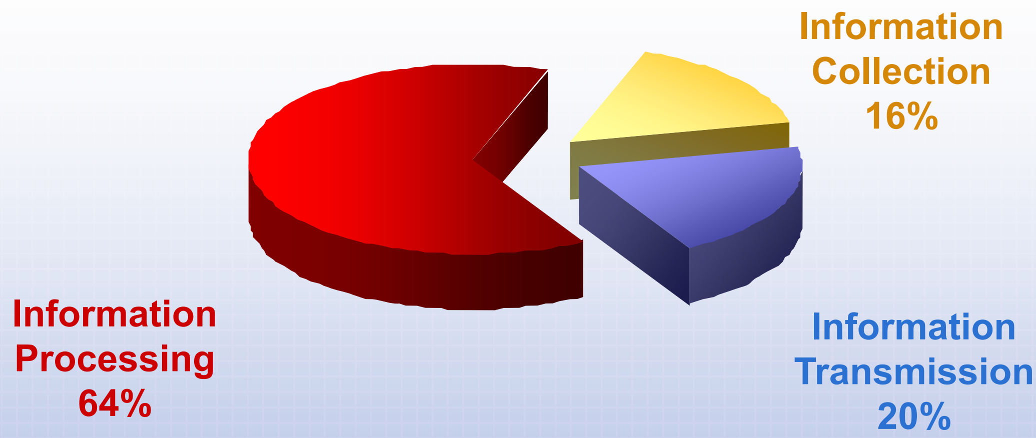


Informační architektura pro poskytování aktuálních dopravních informací

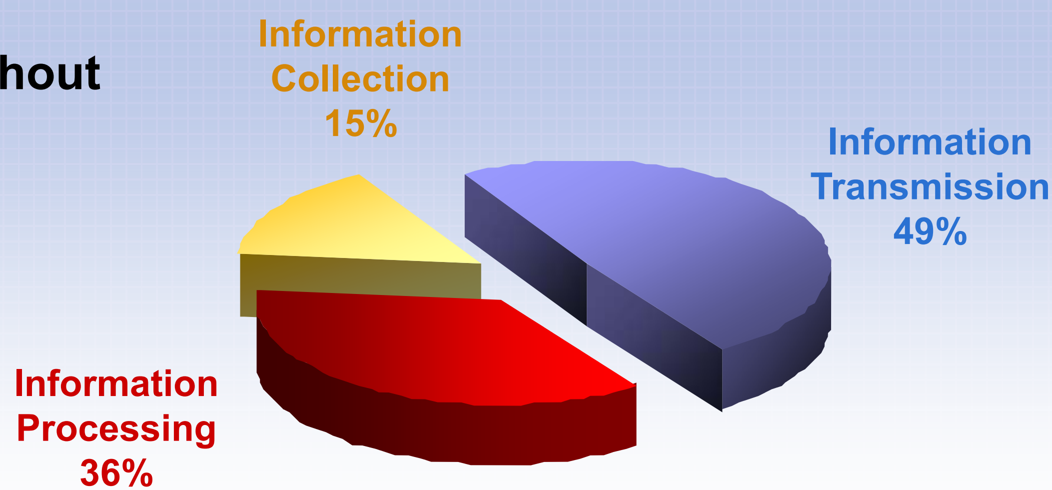
Realizující funkce	Datové toky vstupní	terminátory	Datové toky výstupní	terminátory
2.1.2.1. Identifikace a klasifikace nehod	pos.pohotovost_nebo_incident_oznameni eps.pgi_identifikace_odezva nd.zs_incident_oznameni md.zs_incident_oznameni rv.zs_mayday_volani_data zs_obecna_pohotovostni_data_ zs_pohotovost_popis zs_pohotovost_id_pro_preklasifikovani zs_okraj_mayday_volani rv.zs_dopravni_prostredek_data rv.zs_dopravni_prostredek_pozice	[T] Pohotovostní systémy [T] Externí poskytovatel služeb	zs.vd_alarm_oznameni_potvrzeni zs.md_incident_data zs.rv_volani_potvrzeni zs_pohotovost_id_pro_planovani zs_incident_popis zs_okraj_mayday_volani_prvni_potvrzeni pos.pohotovost_nebo_incident_oznameni pgi.eps_zadost_pro_identifikaci	[T] Pohotovostní systémy [T] Externí poskytovatel služeb
3.1. Dopravní řízení	zs.md_pohotovost_zadost msy.mpr_krizovatka_zadost opr.ods_doprava_prikazy pds.doprava_management_data cst.vyskyt_chodce dpl.strategie_a_predpoved_prikazy dpz.doprava_data_vstupy dpr.vvo_lokalni_priorita_zadost vd.md_dopravni_prostredek_priorita_zadost md_vstupy_most_a_tunel md_vstupy_management_pozadavku md_doprava_prostredi_vstupy	[T] Multimodální systém [T] Operátor ITS systému [T] Přidružený dopravní systém [T] Cestující [T] Dopravní plánování [T] Dopravní provoz [T] Dopravní prostředek	md.ep_pristup_kriteria md.ep_doprava_podminky md.vd_data_prenos md.rv_rizeni_regulace md.rv_doprava_vystup_data md.pd_podvod_data md.ci_sit_doprava_podminky md.ci_parkovani_charakteristiky md.ci_dopravni_sit_charakteristiky md_data_pro_detekce_nehod md_vystupy_pro_most_a_tunel md_doprava_vystupy_pro_management_pozadavku rdc.doprava_prikazy	[T] Řidič [T] Externí poskytovatel služeb [T] Multimodální systém [T] Operátor ITS systému [T] Přidružený dopravní systém [T] Cestující [T] Dopravní plánování [T] Dopravní instituce

Economical Analysis of ITS Architecture

Telematics system with designed architecture



Telematics system without designed architecture



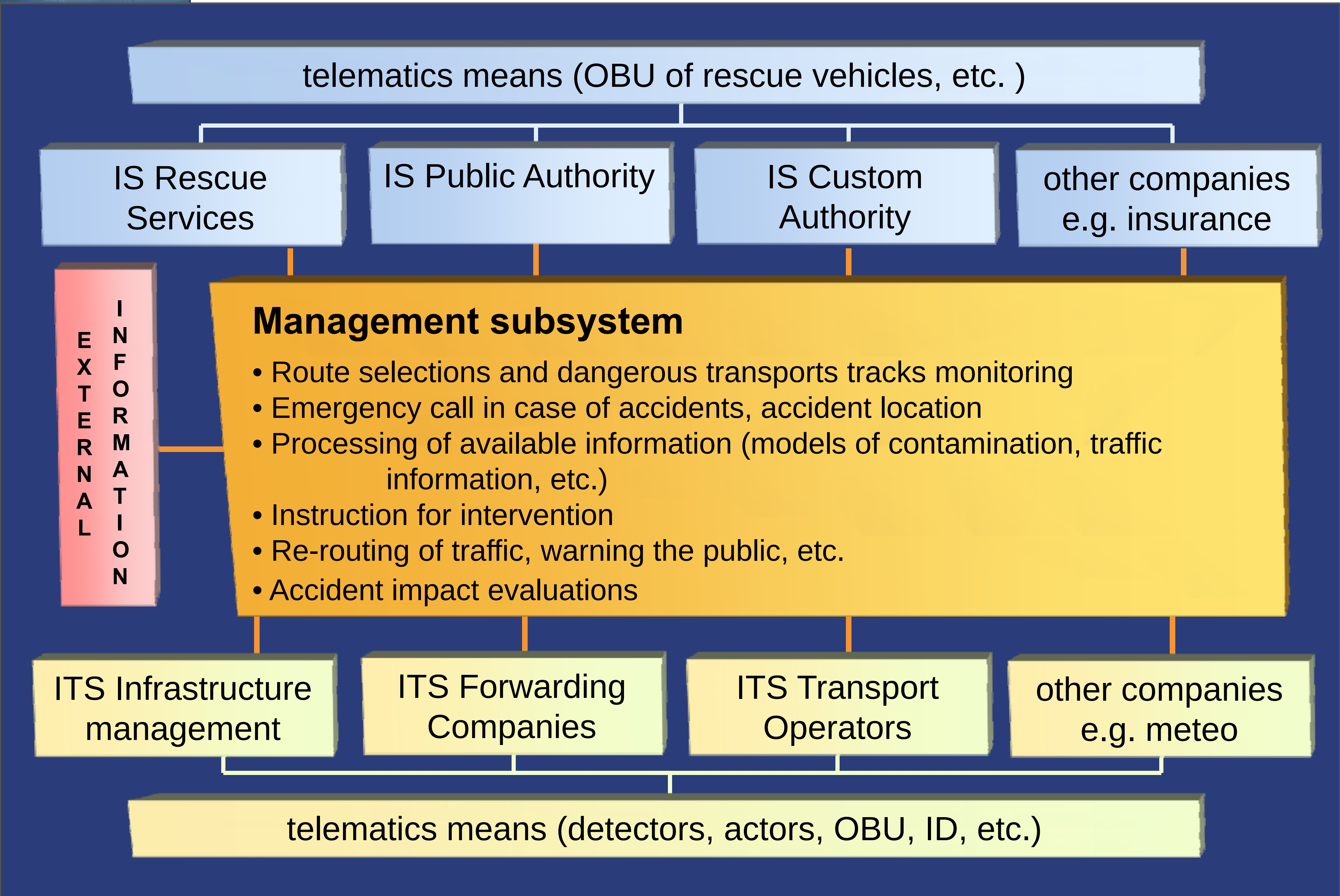
Application of ITS models

Project 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

System architecture



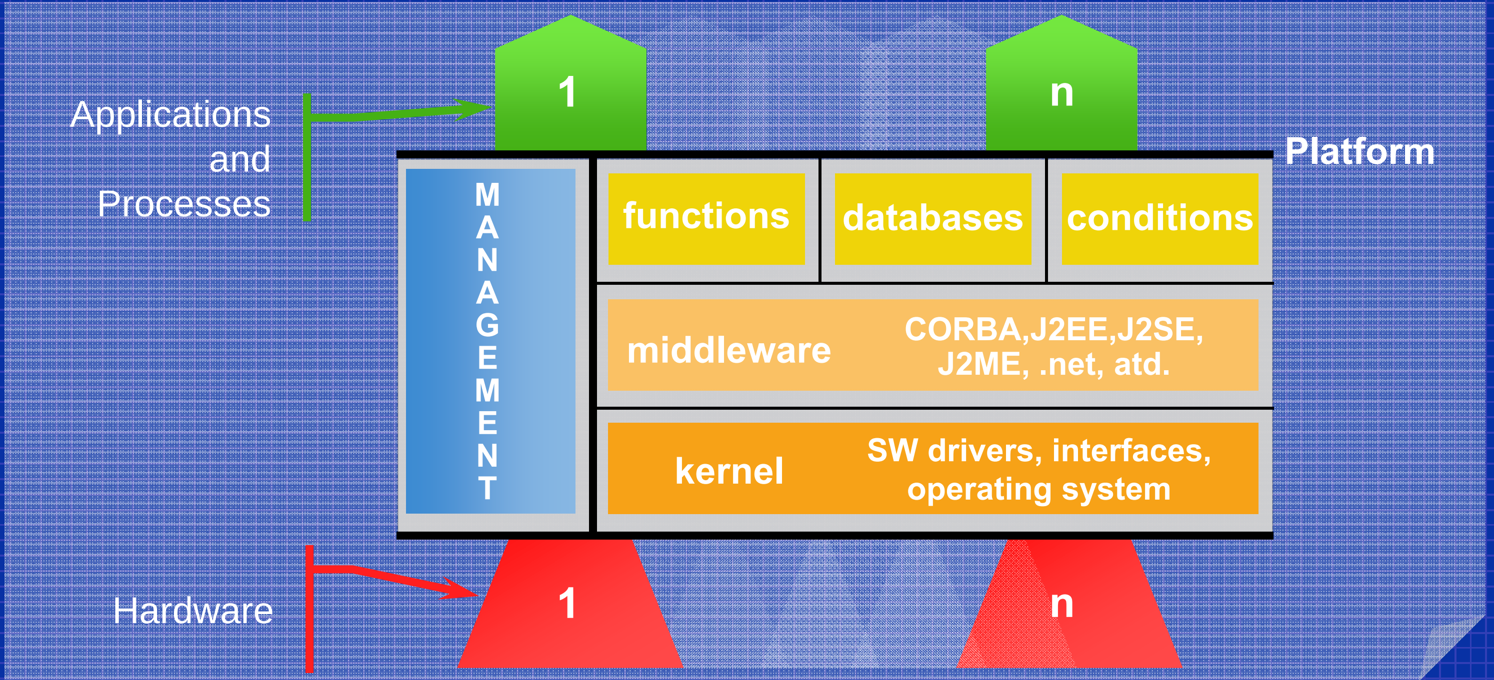
Project supported by Ministry of Trade and Industry of the Czech Republic

Universal On-Board Unit for ITS

- is the industry realization of universal ITS on-board unit in conformance with Czech patent
- Project consortium:
  - Honeywell,
  - Telematix Services, Telematix Software,
  - Faculty of Transportation Sciences, Czech Technical University
- time schedule
  2006 - 2009

System architecture

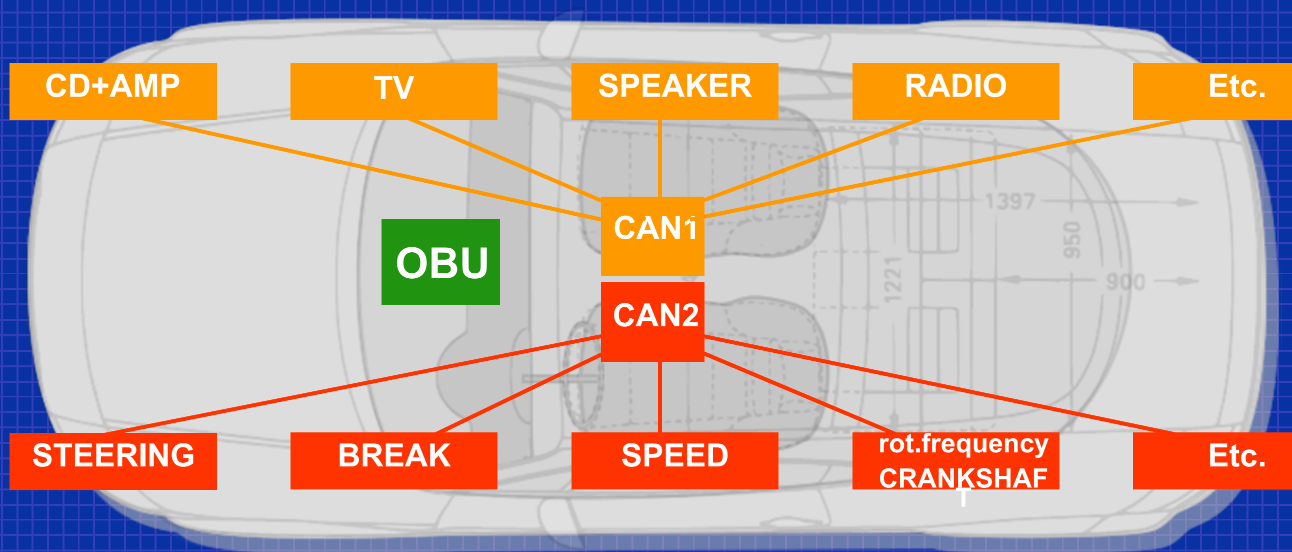
- Definition of all parameters used in OBU together with its attributes (sample frequency, accuracy, representation, etc.)
- Definition of unified SW modules available for all OBU processes (functions, databases and conditions)
- Definition of OBU management taking into account all system parameters (safety, priority, etc.)
- Definition of OBU processes/ applications using unified functions, databases and conditions (development kit)



Project supported by Ministry of Transport of the Czech Republic

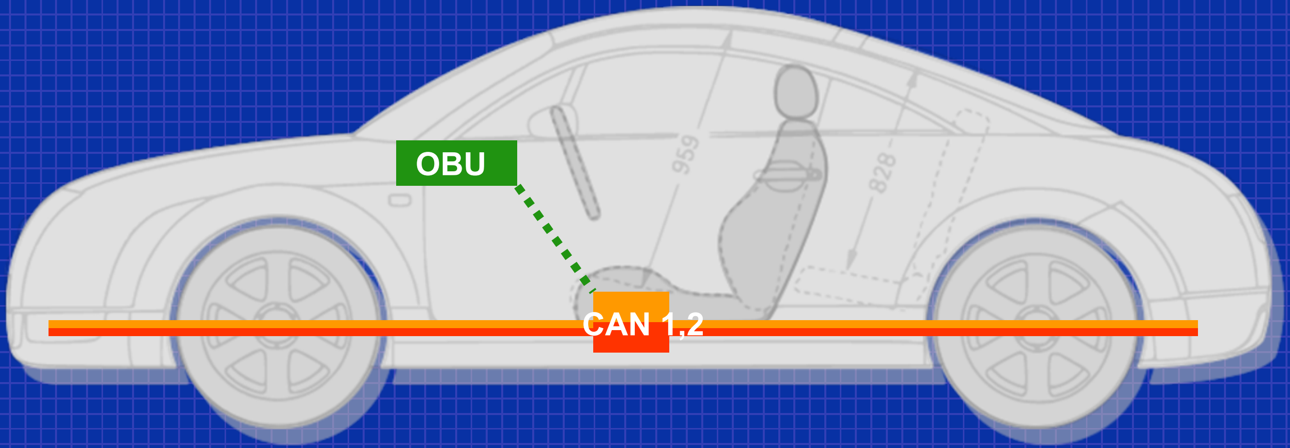
Economical, Ecological and Safety Electronic Fee Collection

- 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



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.



Illustrative example - In-vehicle weight in motion system

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

  F = m . a

  F – vector of vehicle force,

  m – vehicle weight,

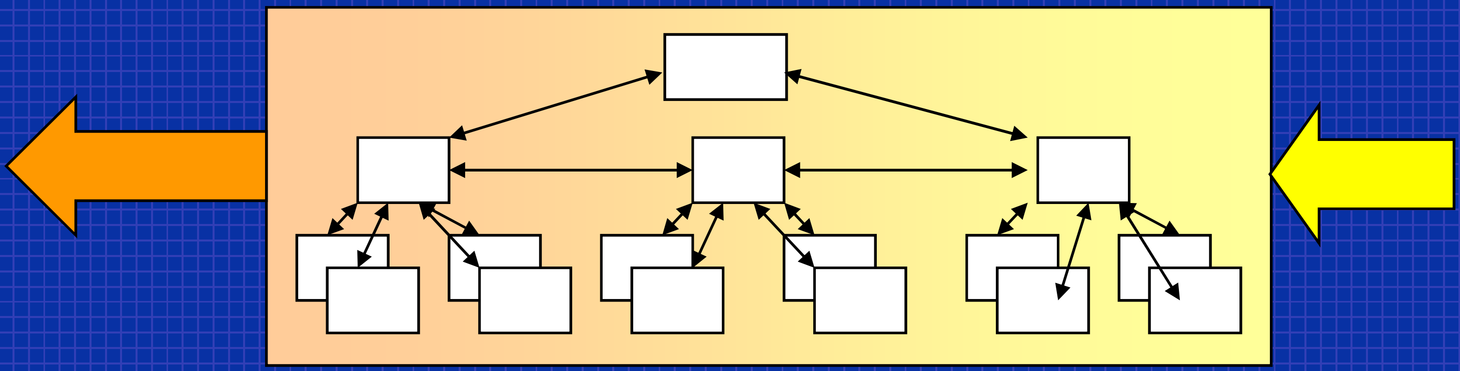
  a – vector of vehicle acceleration

- 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

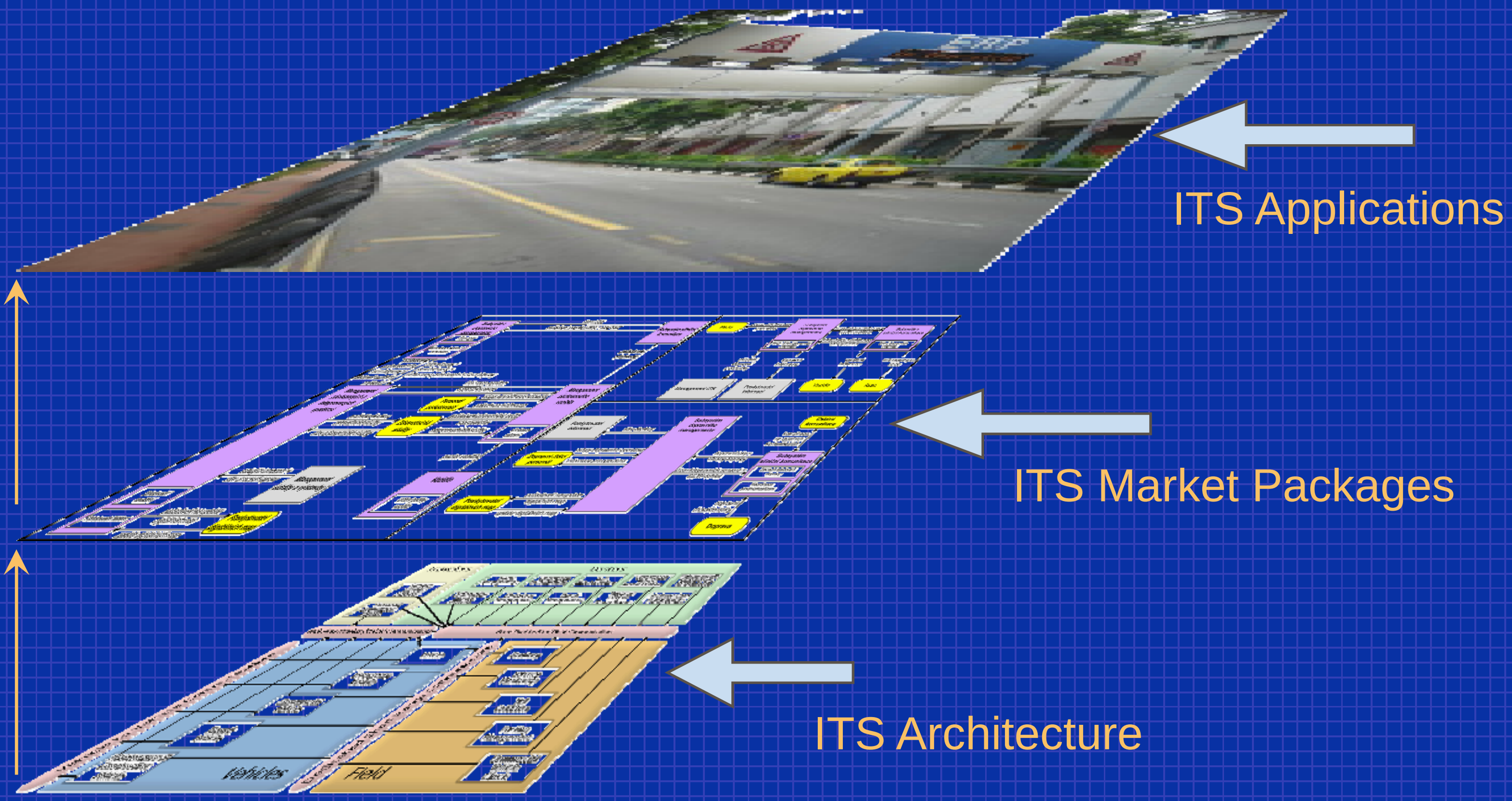
$$m_i := \frac{\frac{ip \cdot up}{Ra} \cdot M(n_i) - a_i \cdot \left(\frac{ip^2 \cdot Im}{up \cdot Ra^2} + \frac{Ia + Ib}{Ra^2} \right) - \frac{0.5 \cdot \rho \cdot cw \cdot SP}{3.6^2} \cdot (v_i - vx_i)^2}{a_i + \left(ka + \frac{v_i}{3.6} \cdot kb \right) + 9.807 \cdot \sin\left(\operatorname{atan}\left(\frac{\alpha_i}{100}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

ITS effectiveness

- Is supported by Ministry of Transport of the Czech Republic
- Project consortium:
  - Telematix Services, a.s.
  - Babtie, s.r.o.
  - Telefonica O2, a.s.
- time schedule 2004 - 2008

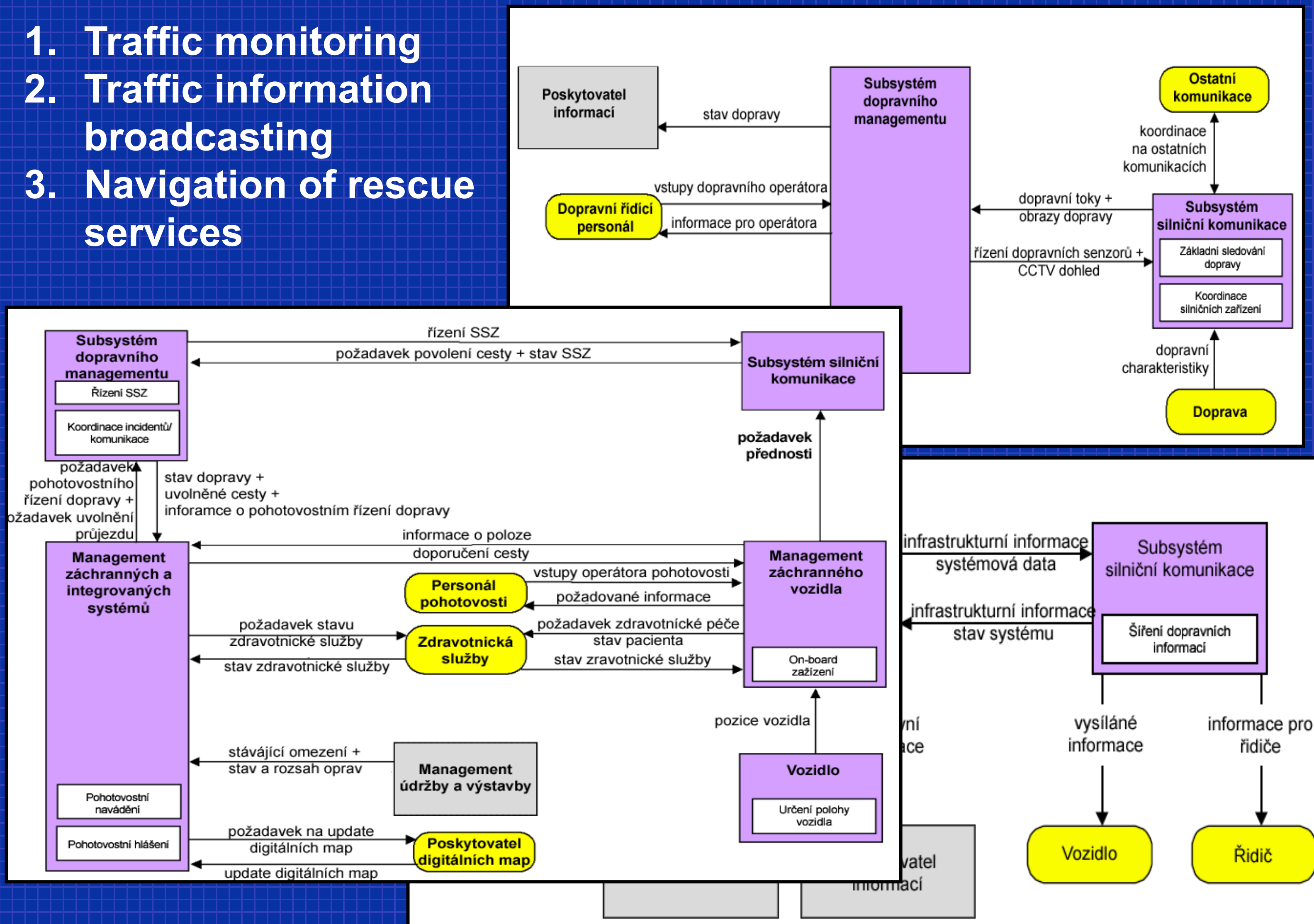


ITS market packages

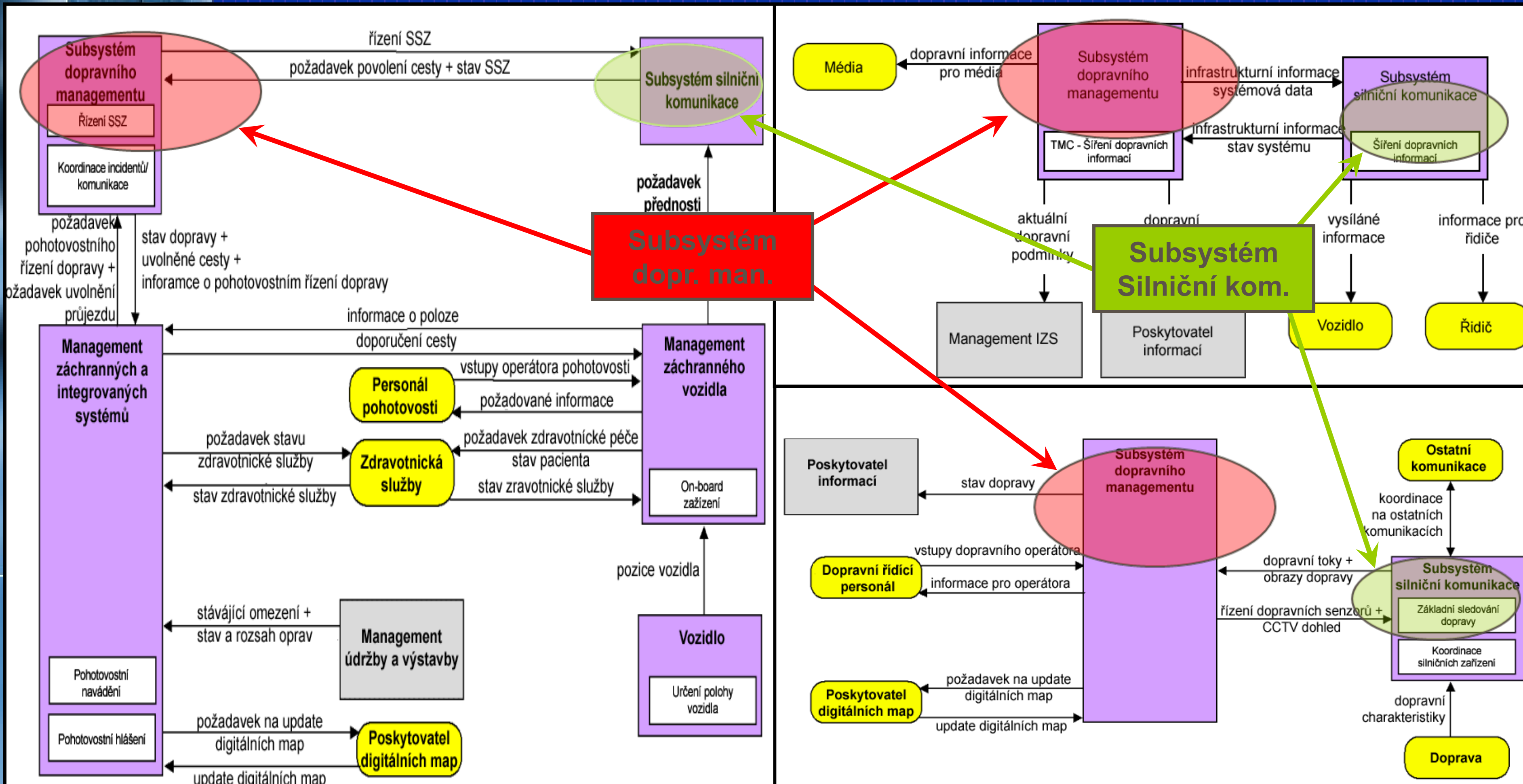


Example – 3 ITS market packages

1. **Traffic monitoring**
2. **Traffic information broadcasting**
3. **Navigation of rescue services**

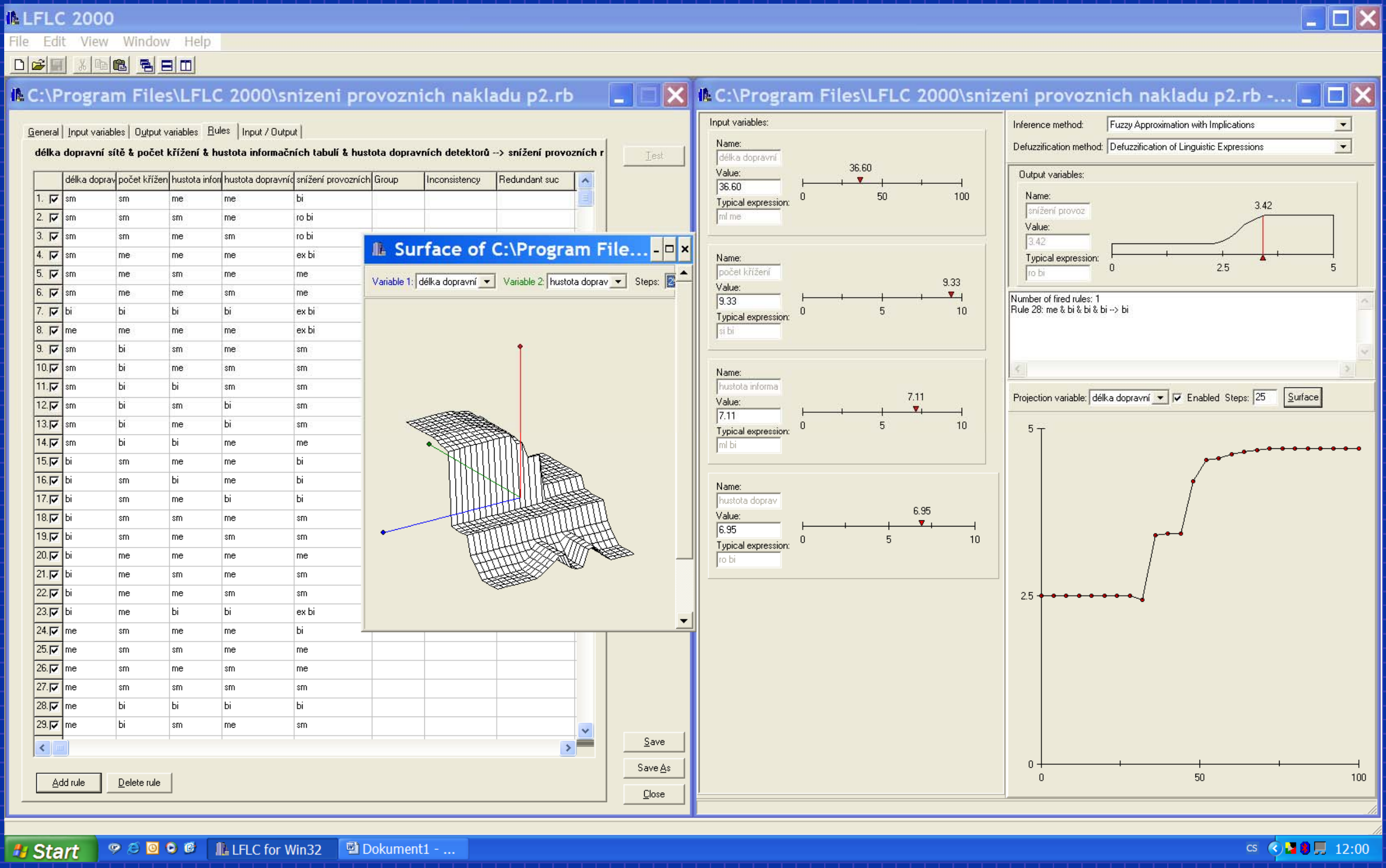


Example – synergy models of ITS packages



Fuzzy-linguistic approximation

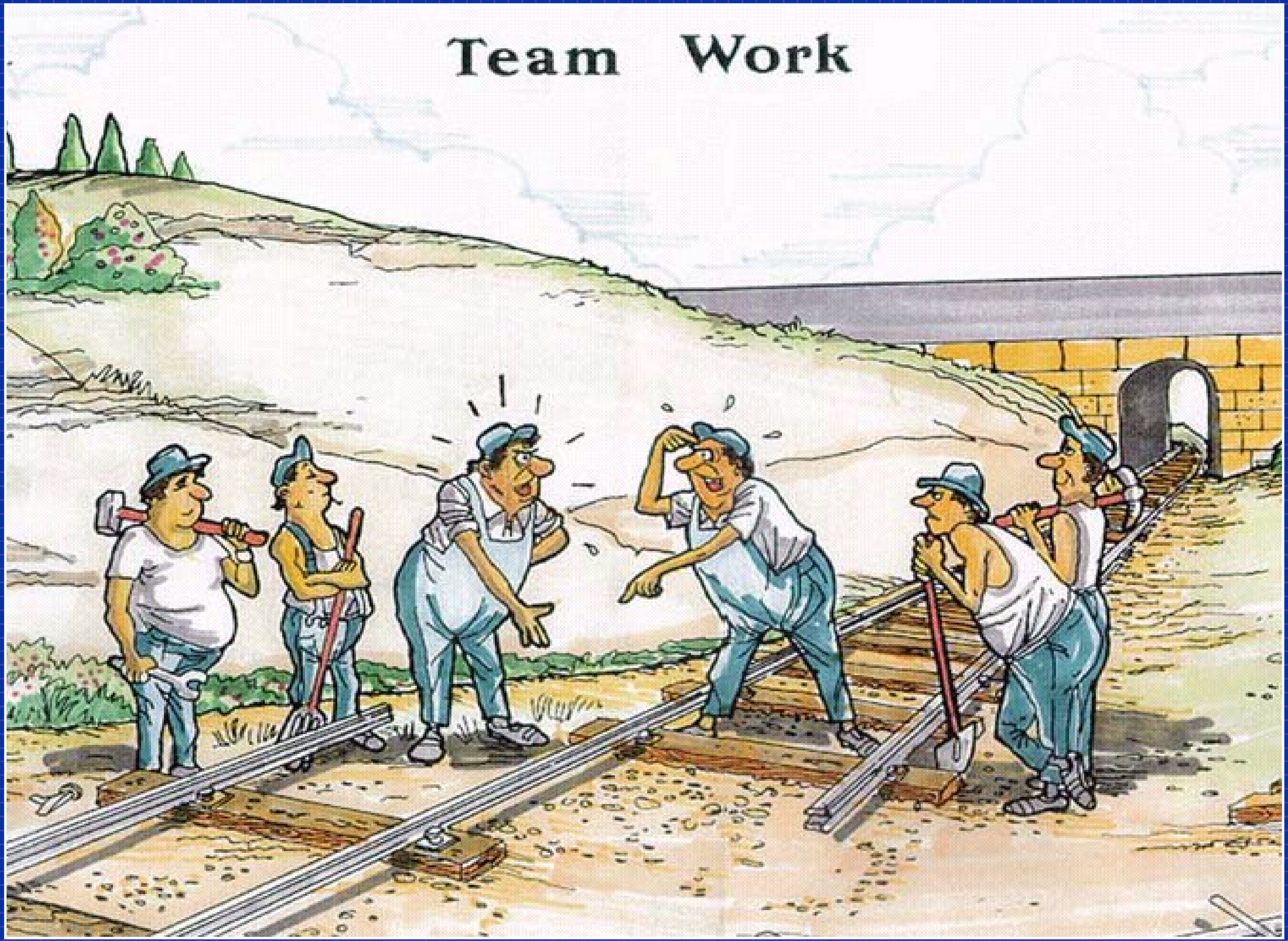
- Processing of different knowledge representations (experts knowledge, equations, statistical knowledge)
- Synergy models of cost/benefit indicators



ITS Certification Laboratory

- 2005 - 2007 – a lot of lessons learned through EFC system implementation
- 2007 – expert team of Minister created basic EFC architecture with recommend opened interfaces
- 2007 – first contract signed between Ministry of Transport and Faculty of Transportation Sciences to launch ITS certification laboratory
- 2007 – first ideas how to legally create the laboratory were discussed:
- ITS architecture and standards are main support documents for certification
- Certification is in reality the compliance evaluation between predefined architecture/standards and real product of supplier
- 2008 – certification laboratory starts to work

Thank you for attention



More information: WWW.LT.FD.CVUT.CZ