Project B4
Analysis and Communication for Dynamic Traffic Prognosis
Dr. Thomas Liebig, Prof. Dr. Michael Schreckenberg, Prof. Dr. Christian Wietfeld

Challenge: Step-wise Transition Towards Autonomous Traffic
- Coexistence of automated vehicles and human drivers
- Coordination capabilities depend on availability of communication systems
- Automated systems react passively on human malpractice
- Increased amount of empty runnings due to freight and on demand traffic

Evolution of the Research Goals
- Analysis of hybrid traffic on highways as well as in inner cities
- From channel-aware LTE data transfer to context-predictive V2X communication
- Poisson Dependency Networks and Sum-Product Networks
- Knowledge about physical traffic models is integrated into machine learning models

Analyzing Microscopic Traffic Models
- Derivation of a closed microscopic model for hybrid vehicular traffic (cellular automata)
- Interactions of automated vehicle with human driven once will be identified and analysed

Traffic Forecast and Jam Prognosis
- Assumptions of traffic flow and its impact on Travel times and Jam creation.

Overall System Model
- Traffic flow
- Scenario
- Macroscopic and microscopic traffic model

Methodological Approach
- Data Acquisition
- Flow Dynamics
- Data Exploitation
- Data Transfer
- Prediction

- Validation based on simulation and field evaluations

Novel Data Analysis Methods
- Routing with Reinforcement Learning
  - Vehicles = agents
  - Turning decisions = actions

Preparatory Work
- Problem and Methodology for Phase 3
- Artifical Intelligence Group
- Microscopic Traffic Models
  - Derivation of a closed microscopic model for hybrid vehicular traffic (cellular automata)
  - Interactions of automated vehicle with human driven once will be identified and analysed

Data Acquisition
- Radio-fingerprinting-based Vehicle Classification
- Channel as a sensor
- Determination of the traffic situation and vehicle type information
- Resource-efficient implementation using L1/L2-SVM

Exploiting 5G Technology
- Predictive Beam Steering
- Precise alignment required for reliable and efficient data transfer

Intelligent Traffic Control
- Conditional Sum-Product Networks
- Deep structure and probabilistic model
- Routing with Reinforcement Learning and Breakdown Minimization Principle (BMP)
- Incorporate BMP to prevent critical traffic flows
- Adds constraints to reinforcement learner

Artificial Intelligence Group
Physik von Transport und Verkehr
Communication Networks Institute