Preparing Simulative Evaluation of the GLOSA Application

ITS World Congress, Vienna, 26 of October 2012

D. Krajzewicz, L. Bieker, J. Erdmann; German Aerospace Center

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Introduction
DRIVE C2X

Aim: to lay out the foundation for rolling out cooperative systems in Europe

- Co-funded by the European Commission
- 31 partners and 15 support members
- Seven test sites
- Validating 18 V2X functions
- Duration of 36 months
- 18.8 mio. € budget

Introduction

GLOSA - Green light optimized speed advisory

GLOSA is a pure I2C (Infrastructure-to-Car/Vehicle) function

- Infrastructure sends Information
  - **SPAT**-messages:

    “Signal Phase And Timing” containing information about traffic light state and prediction of next switches

    Period: 1s
  - **INFRA**-messages:

    Information about the road topology

    Period: 1s
- Vehicles receive messages only, do not send information

Introduction

GLOSA - Green light optimized speed advisory

Function Behavior

- Knowing the topology and the signal timings ahead, the vehicle on-board-unit (OBU) can compute the speed to choose for passing the next traffic light at green
- The speed is presented to the driver as an advice

Expected impacts:

- Reduction of stop times and acceleration in urban areas, hence
  - Reduction of fuel consumption, emissions and travel time
  - Smoother traffic flow

Introduction

Purpose of the simulative Investigations

Simulations are used in several steps of the DRIVE C2X project

- Preparing test trials
- Predicting performance to be expected
- Verification of used models
- Extrapolation of performance

In this report, we describe

- Implementation of GLOSA in a simulation environment
- First simulation results

Set Up
Simulators

The state-of-the-art system for simulating C2X-applications consists of

- a traffic simulation, here SUMO (“Simulation of Urban Mobility”, http://sumo.sf.net)
- a communication simulation, here an own development, described in [1]
- a simulation of the C2X function to evaluate
- a system for coupling these modules

[1] L. Bieker, D. Krajzewicz, M. Röckl, H. Capelle (2010) Derivation of a fast, approximating 802.11p simulation model. In: Intelligent Transport Systems Telecommunications (ITST2010), 9.-11. Nov. 2010, Kyoto, Japan.

Set Up
Scenario

The Helmond (NL) test site was modeled

- Originally imported from OpenStreetMap (http://www.openstreetmap.org)
- Manually corrected speed limits, number of lanes, traffic lights
- Traffic lights were set up with a fixed cycle, Helmond actually has adaptive lights

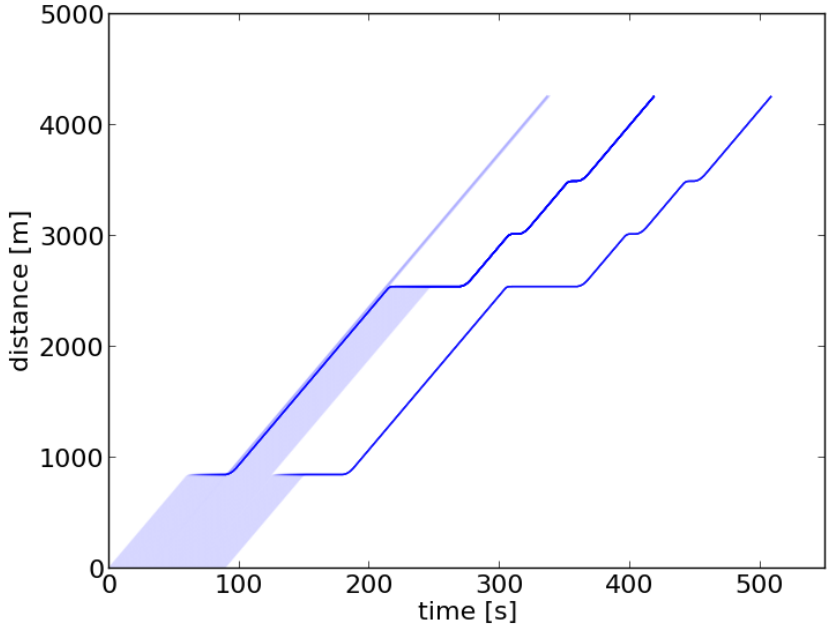
Set Up
Tests

Different simulation set-ups

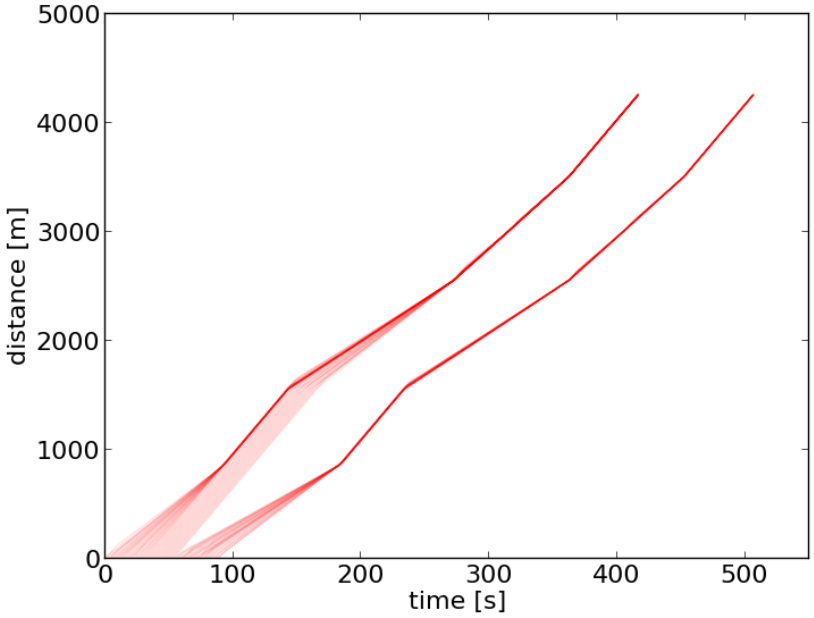
- Single vehicle behavior
  - Equipped vs. unequipped
  - Validation of single vehicle behavior
  - Dependency on the communication range
- Group behavior
  - Equipped vehicles starting in front of unequipped vehicles
  - Equipped vehicles starting between unequipped vehicles

Evaluation
Trajectories

Below: trajectories of 90 vehicles, starting at different time offsets; cycle lengths of all traffic lights is set to 90s, 40s green per direction



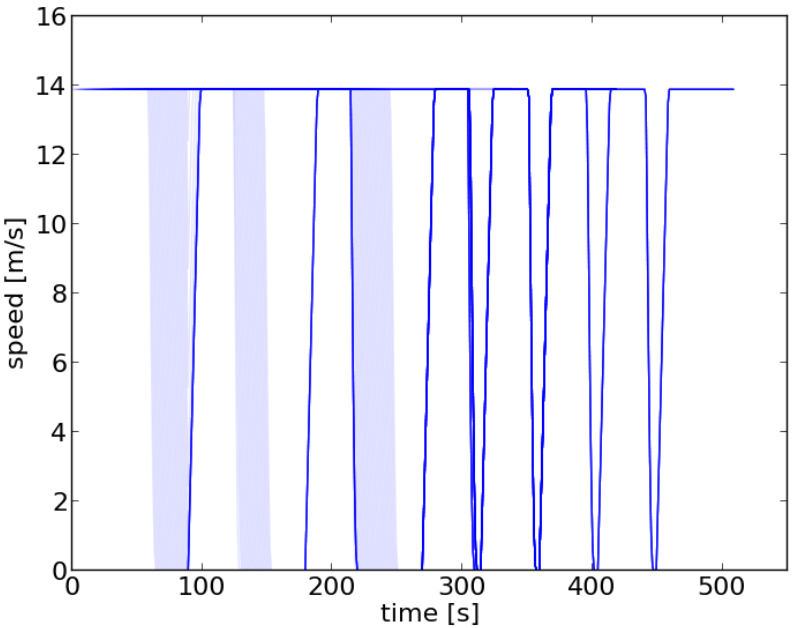
unequipped



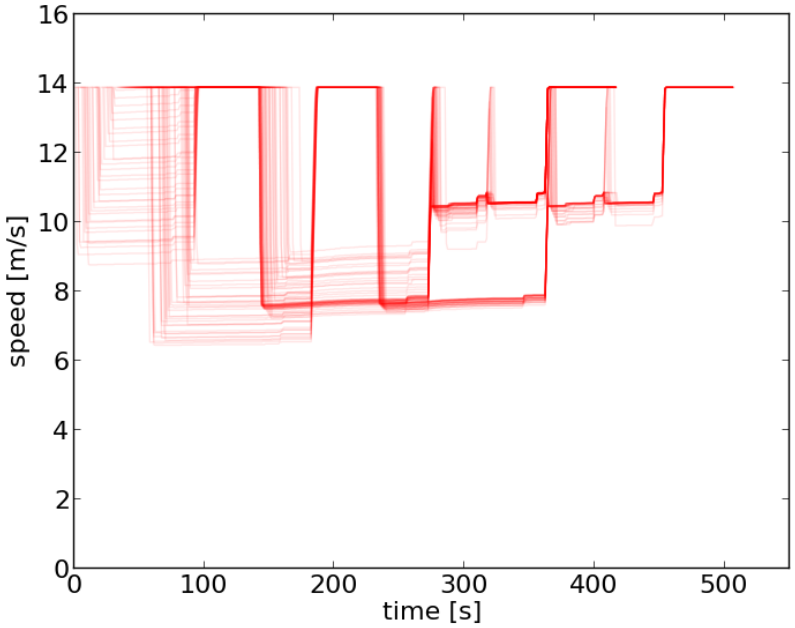
equipped
communication range: 1000m

Evaluation
Trajectories / 2

Below: progress through the network, same settings as before



unequipped

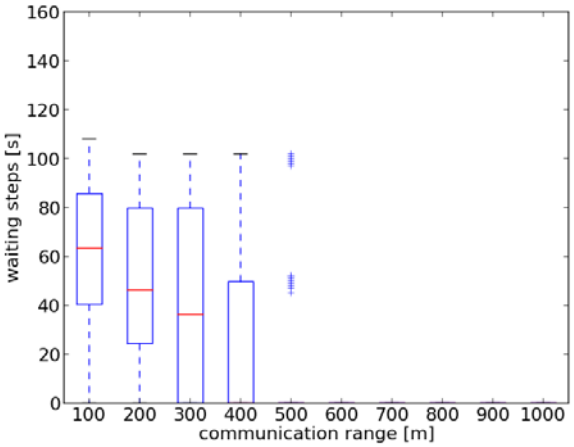


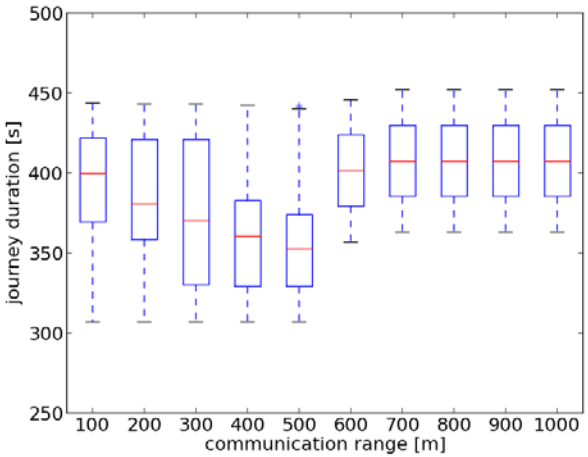
equipped
communication range: 1000m

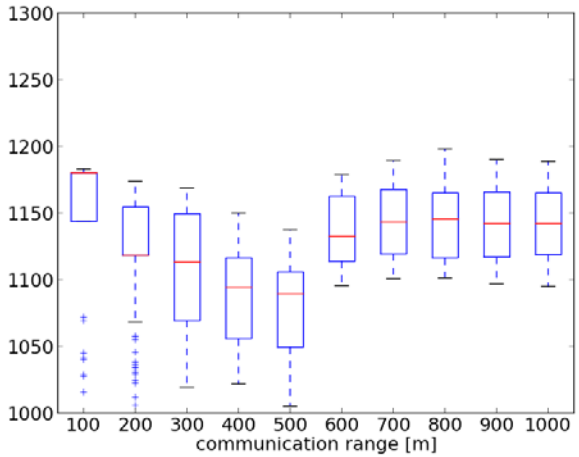
Evaluation
Aggregated Measures

Below: distributions for 90 vehicles, as above, but for different communication ranges

- Note that not all performance values decrease…

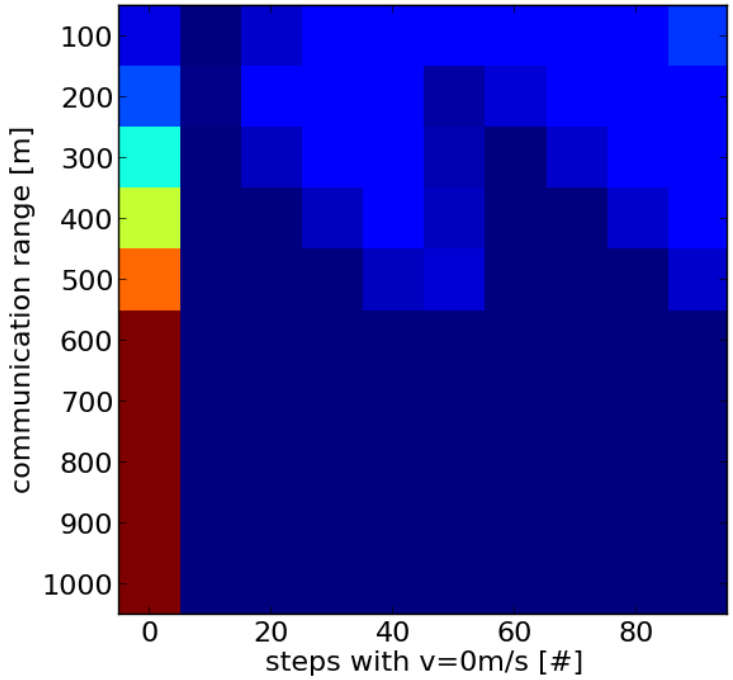


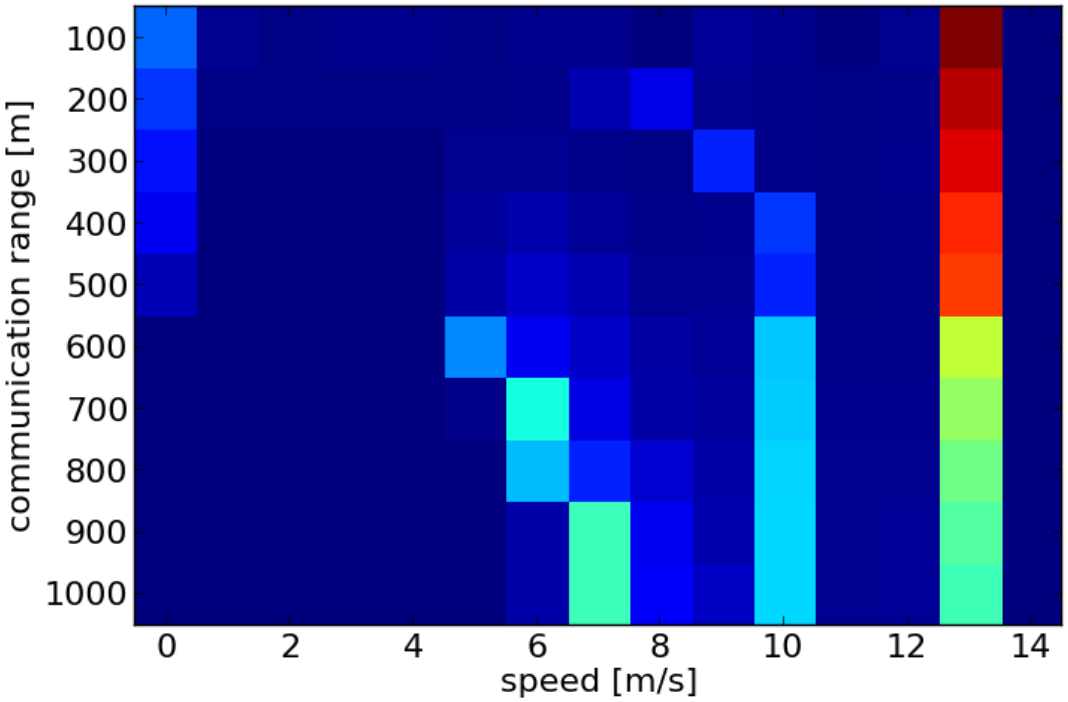




Evaluation
Some Explanation

Why not? … because of moving slowly towards the intersection:





Results

Observations and Issues

Issues found (in our model)

- Problems if the allowed speed changes while approaching a traffic light
- A meaningful lower boundary for advised speed

Things to be determined using test trials and model extension

- Performance in conjunction with adaptive traffic lights
- Shadowing from buildings, trees, etc. and other vehicles
- Real-world driver behavior – esp. deceleration – when using GLOSA