CHALMERS
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BikeCom

Cooperative Application for Bicycle Safety

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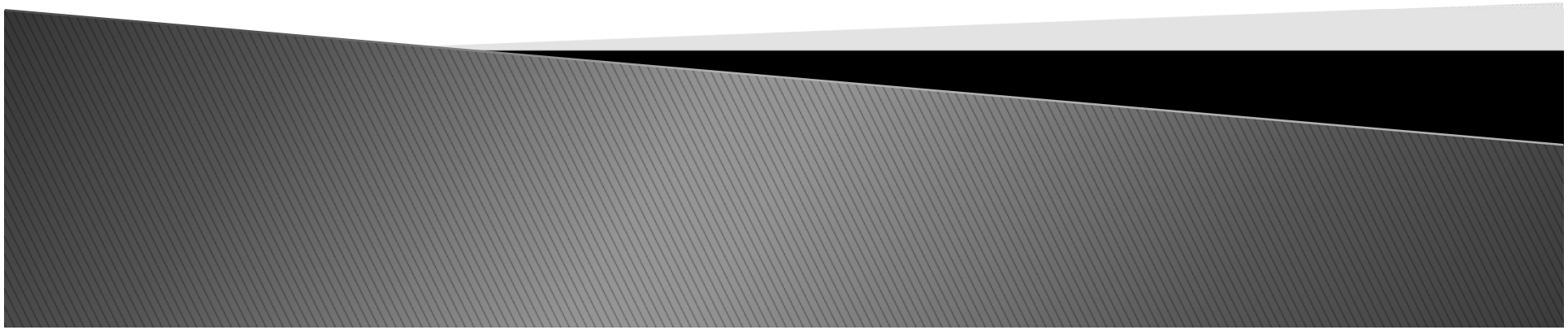
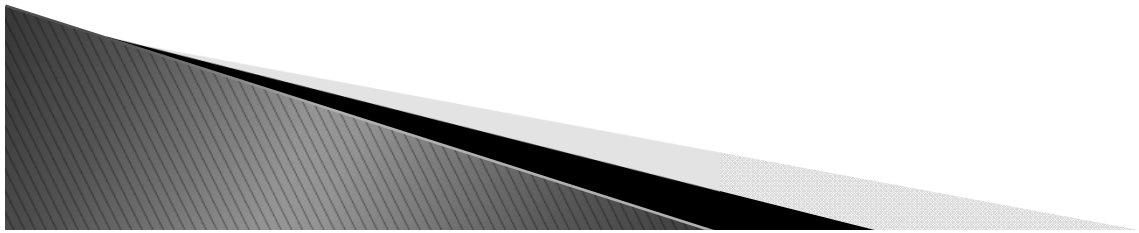


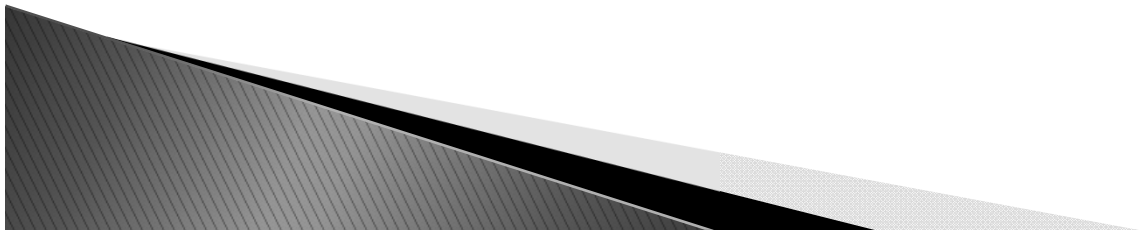
Introduction

- Background
  - 2083 deaths in Europe in 2010
  - Increased use of bicycles
- Objective
  - Develop a cooperative application to increase bicycle safety



Safety critical situation

- Identify a relevant safety critical situation by means of:
  - Naturalistic cycling data analysis
  - EU accident statistics analysis
- Safety critical situation description with use cases
  - Consider different scenarios for the chosen situation
  - Decide what are the implications for the application

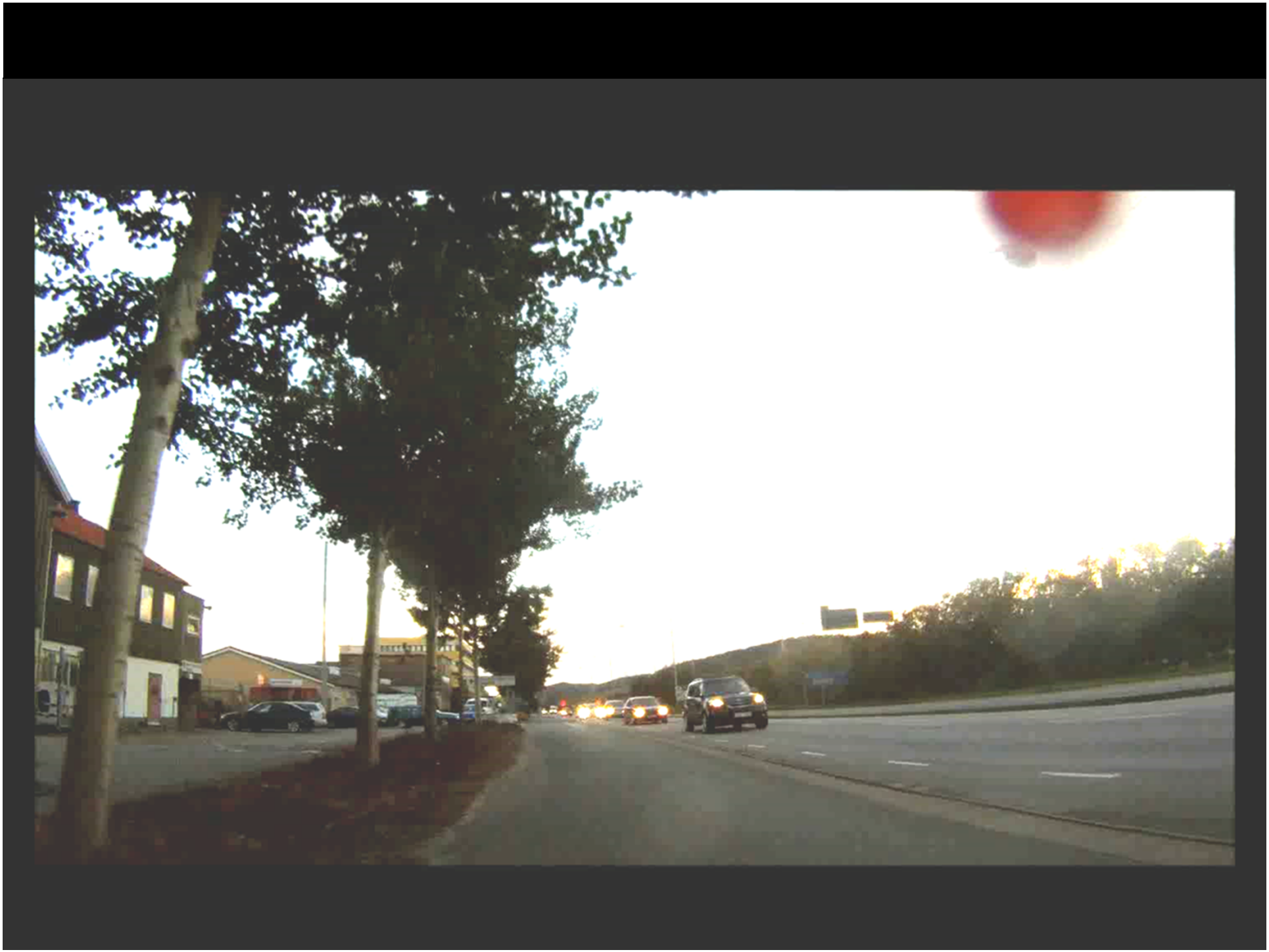


Safety critical situation

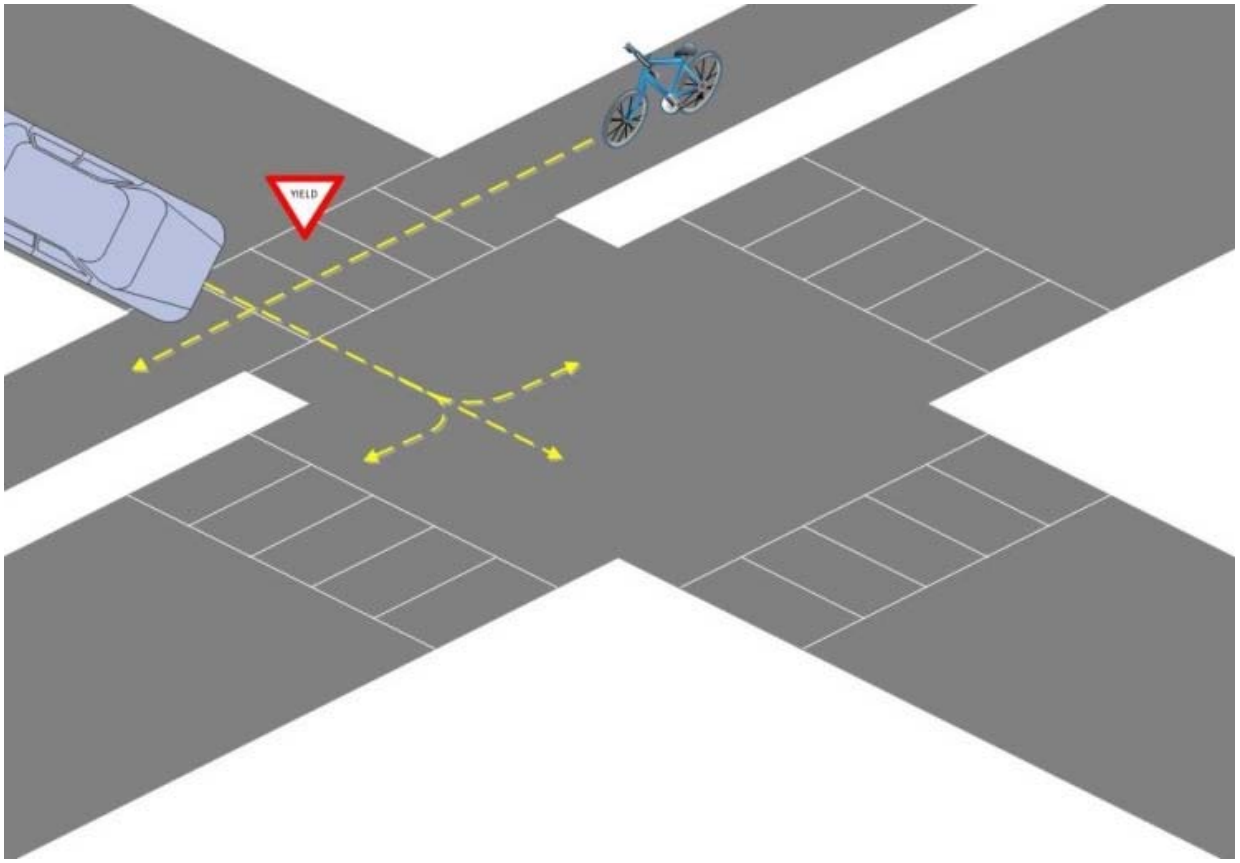
- Not many cyclist or pedestrian fatalities in conflicts with pedestrians
- 64% of cyclist fatalities in Europe occur at crossroads

Common observed conflicts for cyclists in naturalistic cycling data

Type of critical situation	**Percentage of occurrence out of the total number of critical situations observed**
Conflict with pedestrian	27%
Conflict with car at intersection	20%
Conflict with other bicycle	17%
Traffic rule violation	16%
Conflict with car on parallel driving	8%
Conflict with animal	6%
Self-conflict	6%



Safety critical situation

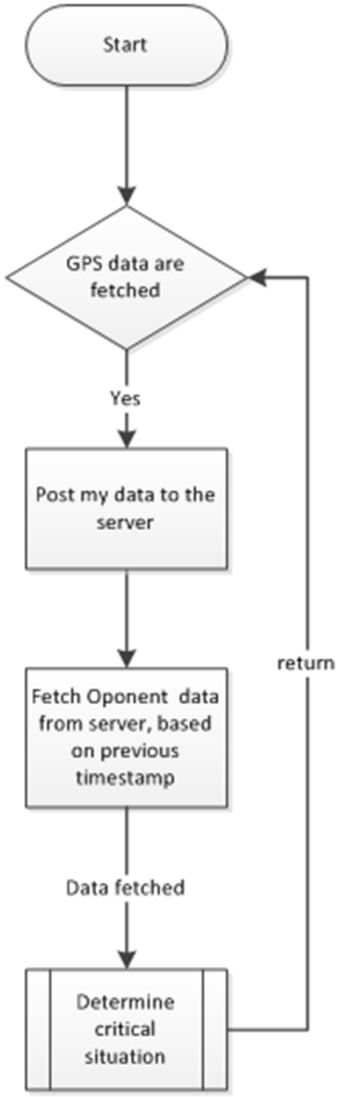


Sketch of the traffic situation to be addressed with the safety application

Application

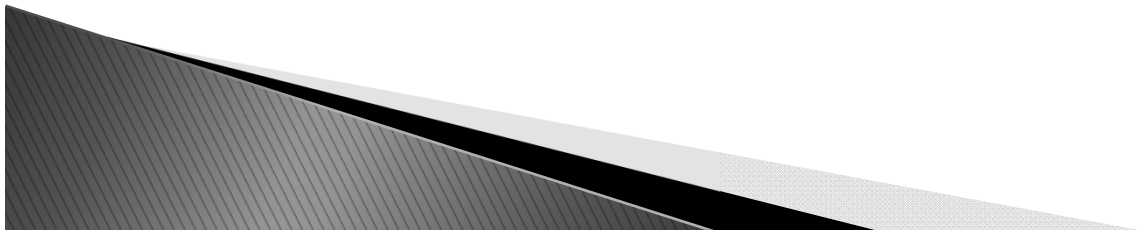
- General requirements
  - Wireless communication
  - GPS data
  - Audible warning

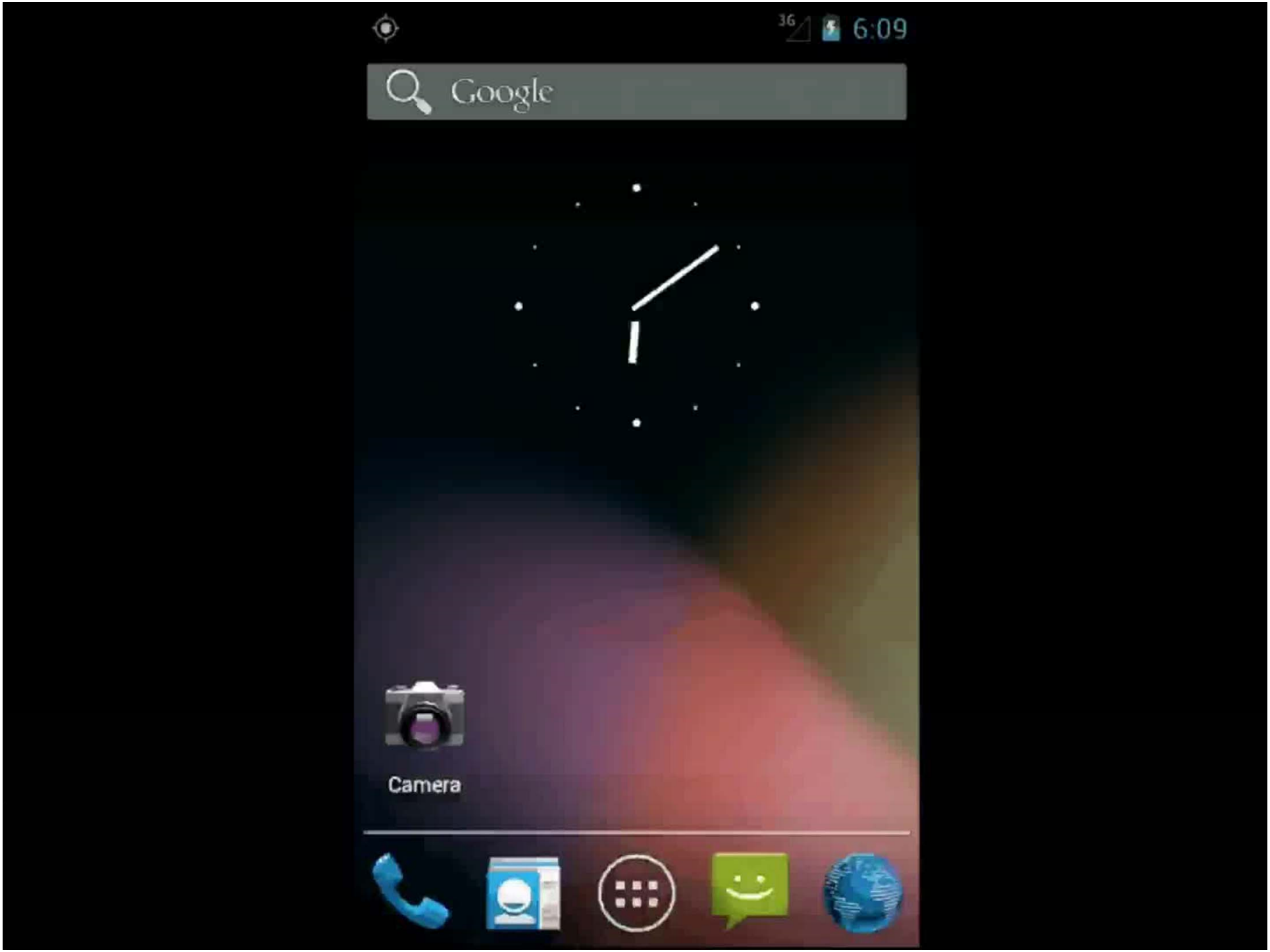
Main Algorithm



Application

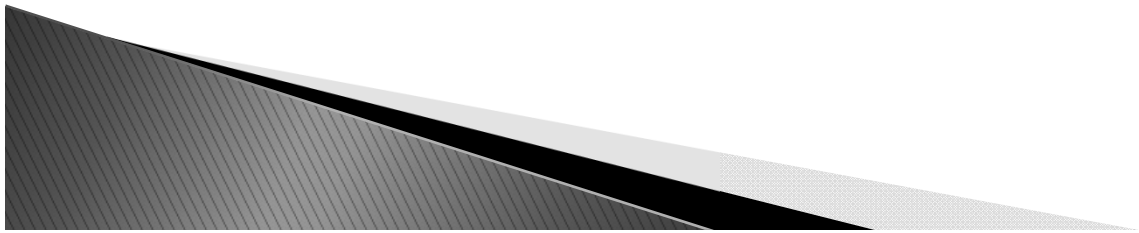
- Reasons for developing smartphone application
  - Calculate trajectories and intersection points
  - Warn
  - Communicate
  - Widely spread

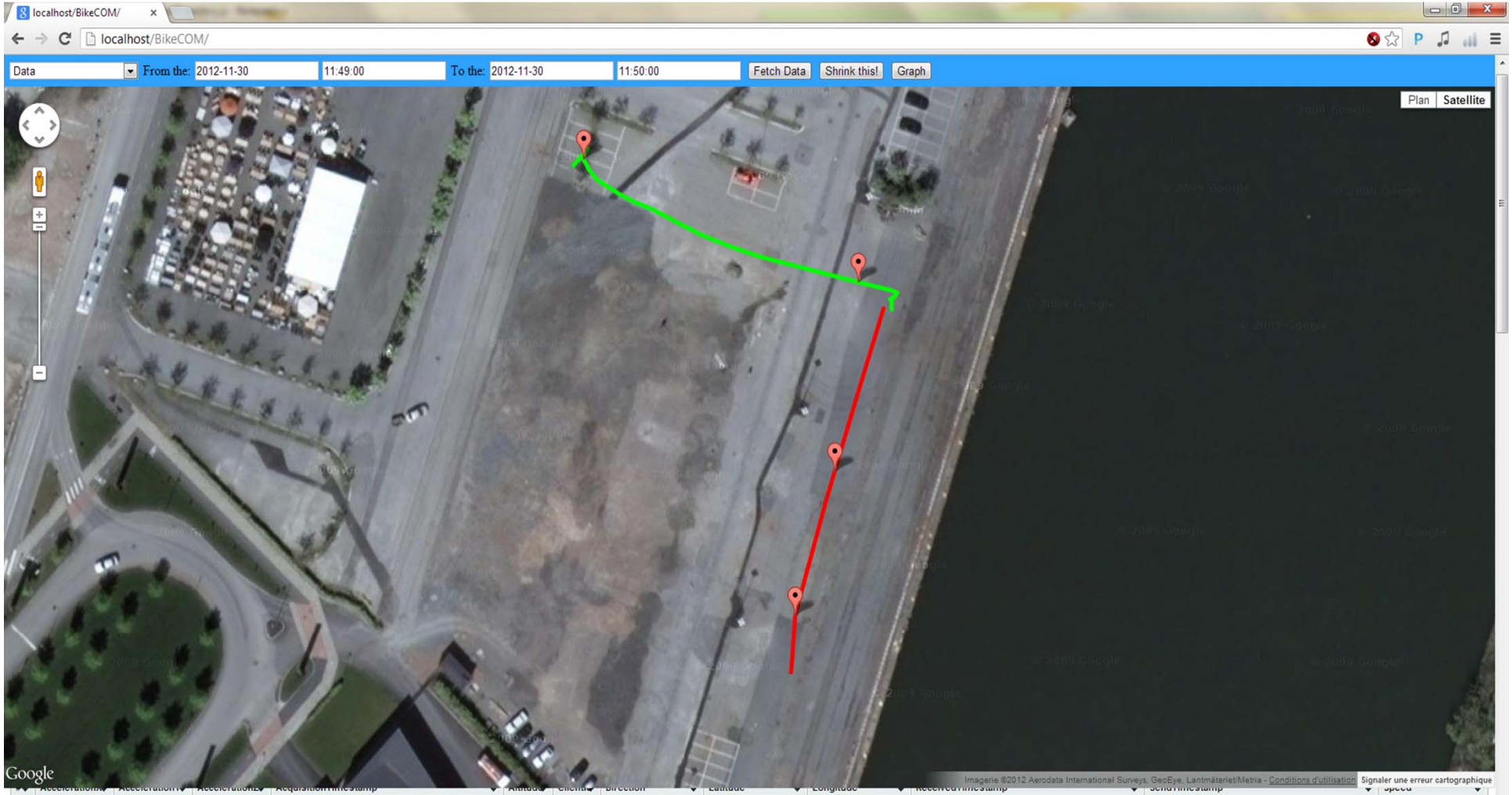



3G
6:09
Google
Camera

Testing

- Testing of the application
  - Simulated environment
  - Car and bike with smartphones in a controlled traffic environment
  - Different scenarios that would both trigger and not trigger the warning
- Data analysis software
  - Web service that allows retrieving data from the server
  - Developed based on Google interface
  - Position plotting
  - Signal plotting





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2	0	0	0	Fri Nov 30 2012 12:49:02 GMT+0100 (Paris, Madrid)	0	444	0	57.71330297458917	11.949358843266964	Fri Nov 30 2012 11:50:37 GMT+0100 (Paris, Madrid)	Fri Nov 30 2012 11:50:37 GMT+0100 (Paris, Madrid)	0
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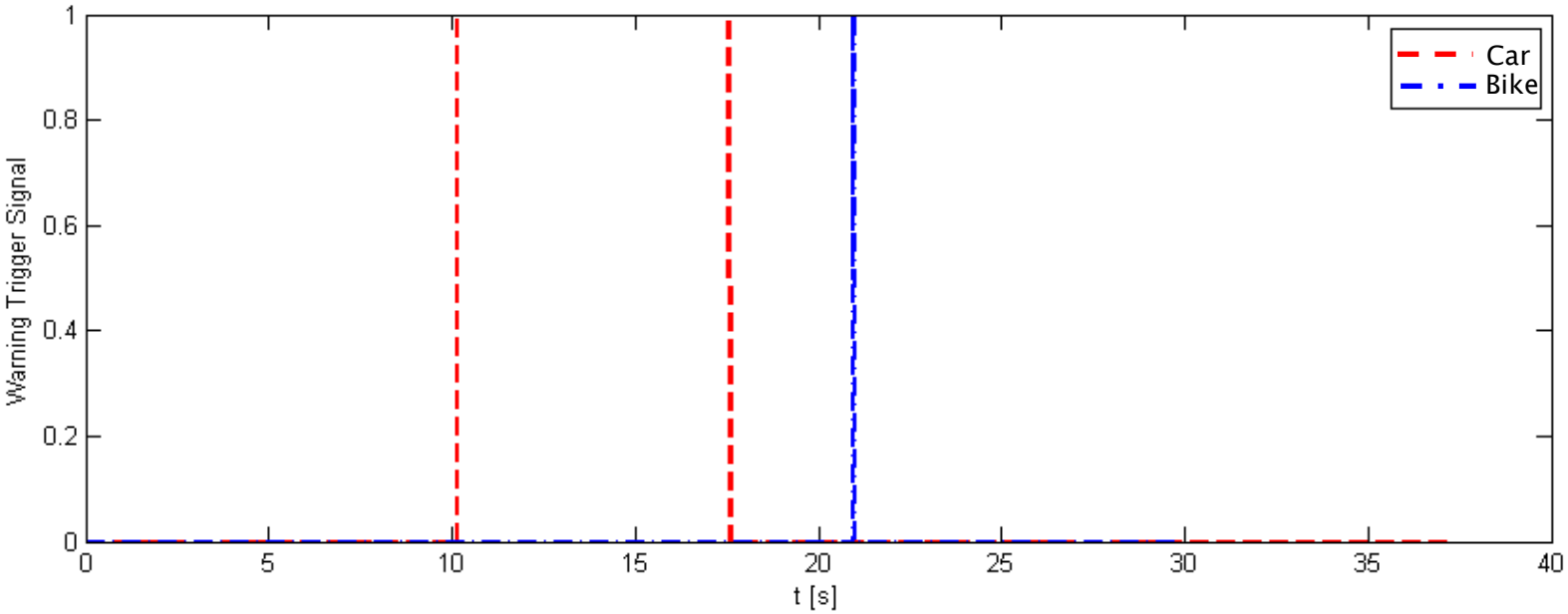
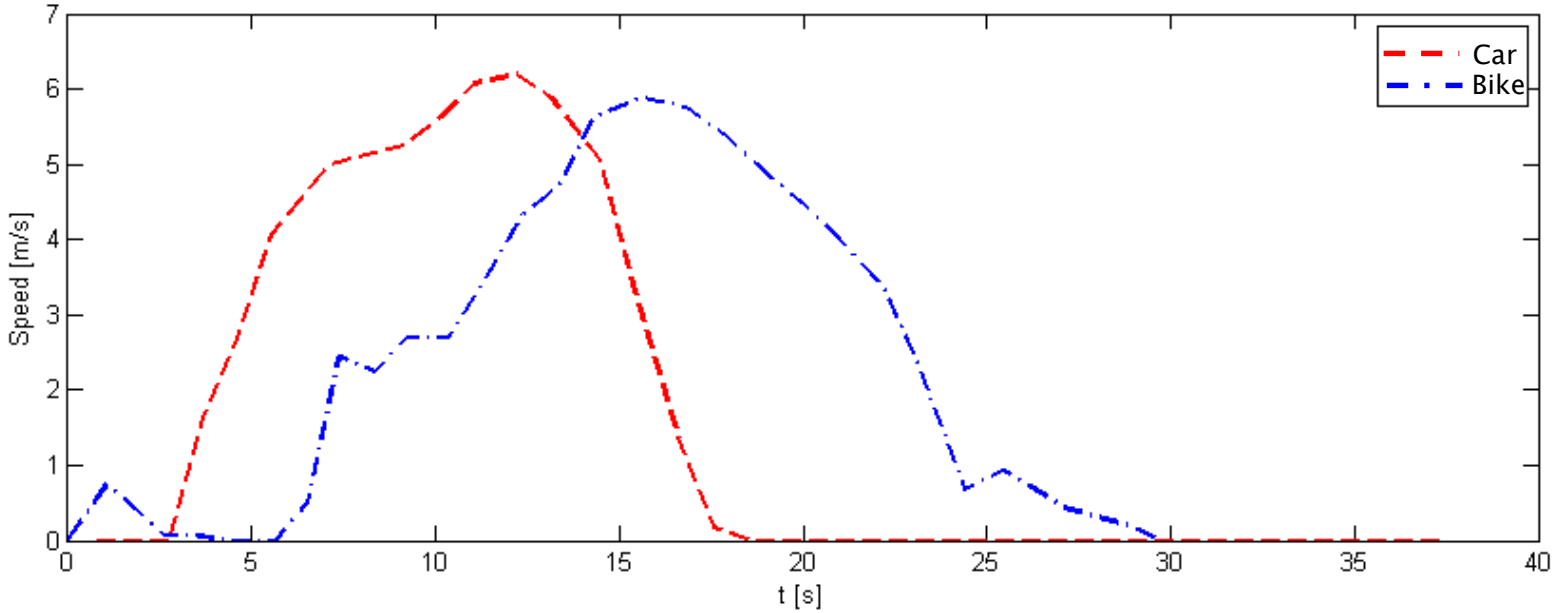
BIKE CAM

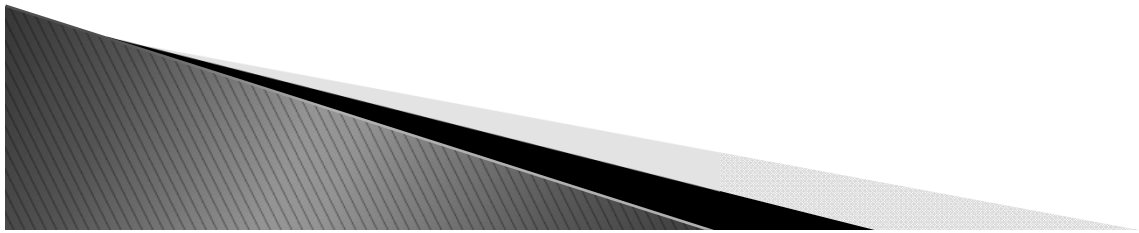
CAR CAM


Warning Trigger Signal
t [s]
Car
Bike
0
0.2
0.4
0.6
0.8
1
0
5
10
15
20
25
30
35
40


Speed [m/s]
t [s]
Car
Bike
0
1
2
3
4
5
6
7
0
5
10
15
20
25
30
35
40

Discussion and Conclusion

- Performance of the application
  - Communicate wirelessly (cooperative)
  - Calculate and transmit paths, speeds, possible intersection
  - Do threat assessment
  - Give a warning in a specific safety critical situation



Discussion and Conclusion

- Naturalistic data to application
- Warn 2 road users (core value of cooperative systems)
- Importance of field trials to verify results obtained from simulations
- BikeCom is a proof of concept, which shows technical feasibility
- Shares the same concerns as all cooperative and active safety systems

Discussion and Conclusion

- Future work
  - Make the application faster
  - Map matching
  - HMI improvements: different levels of warning, visual aids, distinguish left and right etc.
  - Increase compatibility for more users
  - Extend to more cases
  - Complete field trials

Challenges:
- Roaming cost
- GPS accuracy
- Latencies