
TOWARDS EFFICIENT METHODOLOGIES FOR RAPID-PROTOTYPING OF COMMUNICATION TECHNOLOGIES AND COOPERATIVE ITS APPLICATIONS

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How can communication technologies and applications be prototyped for usage both on real target and inside simulation environments? A realization sketch by a combination of the ezCar2X framework with the network simulator ns-3.



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How are ITS Technologies and Applications typically developed today?

Rapid-Prototyping Frameworks (typ. vendor specific)

 **Features implemented twice!**

Simulation Frameworks

- ns-3
- Riverbed Modeler (formerly OPNET)

Joint Approaches used Elsewhere

- Matlab / Simulink
 - Build-in simulation
 - Code generation for dedicated target platforms
 - But:
 - Expensive and limited features available
 - Complex to extend/modify and maintain interfaces
 - Others ...
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Joint Development for Real Target and Simulation Environment

Central Goals

- Implement features only once
- Minimize requirement for wrapper code

Programming Paradigms

- Object oriented programming, e.g. C++
- Heavy use of design patterns
- Abstraction via interface classes
- High modularization

ezCar2X and ns-3 as an Example of Joint Development

Exchangeable ITS-Stack Software Components

- Basic real world information, e.g. time, GPS position etc.
- Hardware wireless communication interfaces, e.g. RF-Frontend
- Event scheduler

 **Switch between simulator and real target via configuration parameters!**

Challenges

- Combination of CMake and WAF build system (solved)
- Combination of ns-3 and boost callback structure (solved)
- Integration of GPS positions into ns-3 (concept phase)
- (Multi-)Threading adjustment
- Others ...

One Central Challenge Regarding Future Mobility

Obtain a methodology for joint development of ITS applications, enabling deployment of ITS based ADAS, for usage both on real targets and inside simulation environments.

THANK YOU FOR YOUR ATTENTION!

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