KICK – Künstliche Intelligenz für Campus-Kommunikation

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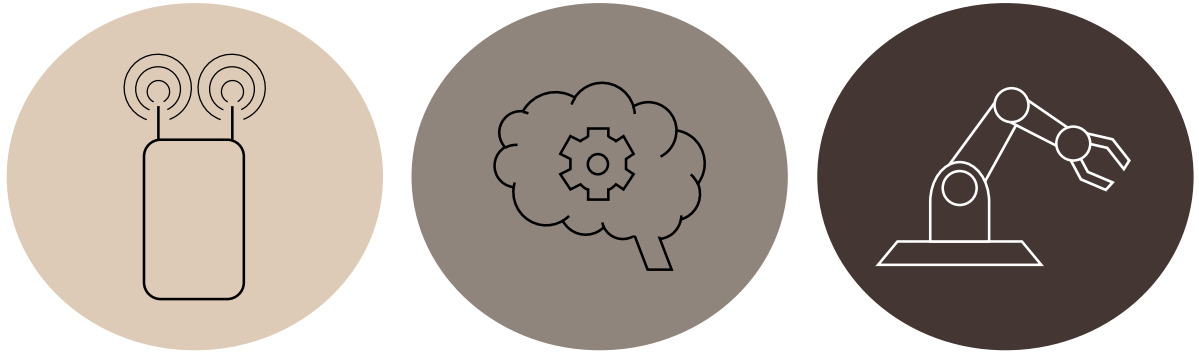

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Introduction

- The project KICK (Artificial Intelligence for Campus-Communication) is a research project funded by the Federal Ministry for Education and Research (BMBF)
- It researches the applicability of Artificial Intelligence (AI) in future private and public 5G campus networks.
  - Significantly simplify and improve the operation of future 5G campus networks by using AI methods.
  - The focus here is on Industry 4.0 environments with their high reliability and latency requirements
- Project runtime 01.01.2020 – 31.12.2022
- Project volume ~ 9.43 M€
- Consortium:

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Project Objektives

- The development and demonstration of
  - a system model for 5G campus networks and
  - a hybrid AI solution for network management.
- Selection, optimization and validation of the AI algorithms for
  - adapting campus networks to periodic upgrades (medium time scales),
  - monitoring and optimization of campus networks (short time scales) and
  - the use of learned mechanisms in other situations (transfer learning).
- The validation, experimental evaluation and demonstration of the developed solution in a real production environment.
- The identification of possible standardization needs.

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Novelty of the KICK solution approach

- Linking AI methods with 5G campus networks for Industry 4.0 environments
- Address the inherent limitations of radio-based communication networks
- Using production data for the prediction in communication networks
- A hybrid approach to network control and optimization, by using the analysis of real data with expert knowledge and system models from the "production" and "communication" domains
- Consider tactical network management on medium time scales in addition of operational network management for dedicated situations
- Use transfer learning to cope with new situation faster by learning from previous situations

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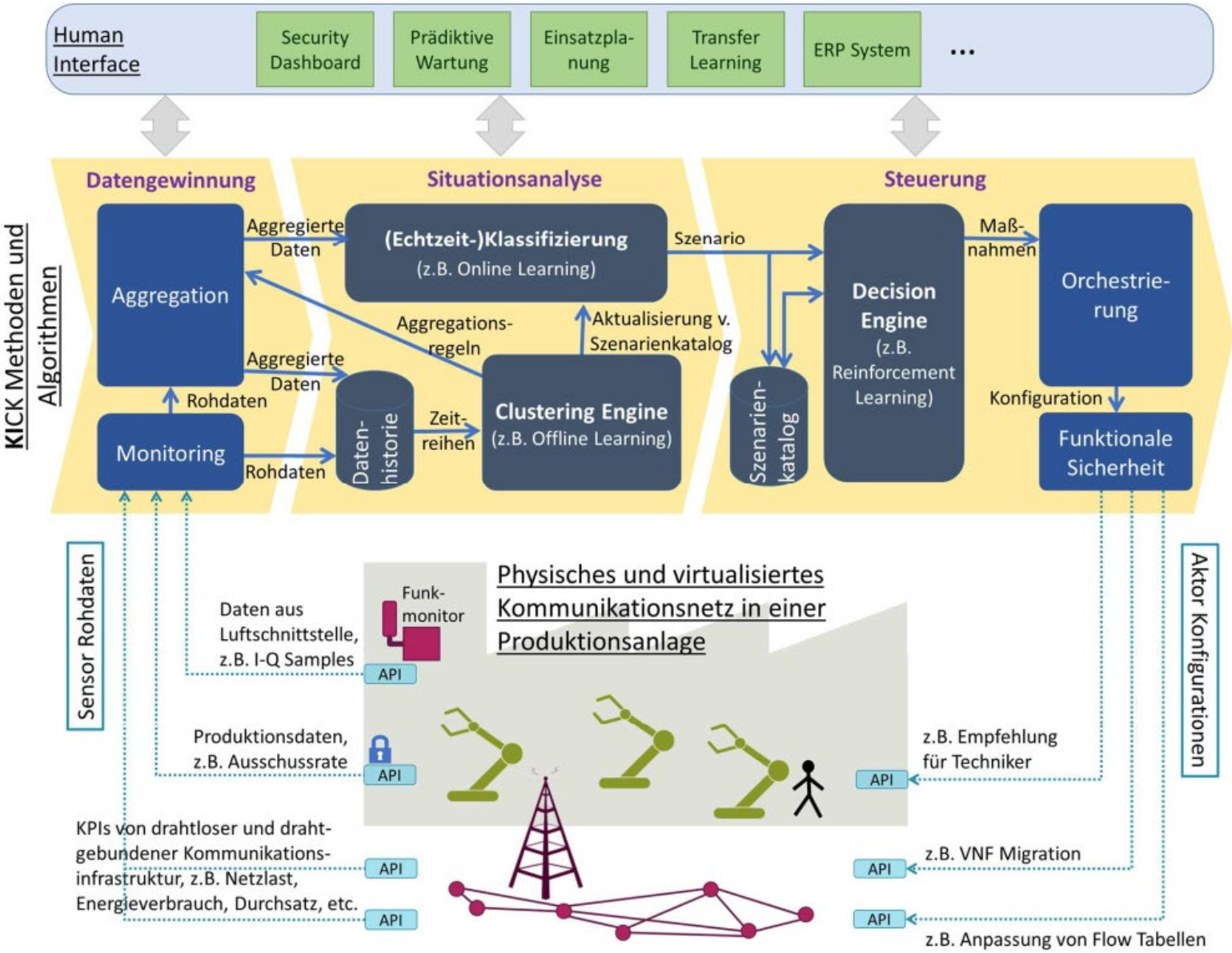
Illustration of solution approach



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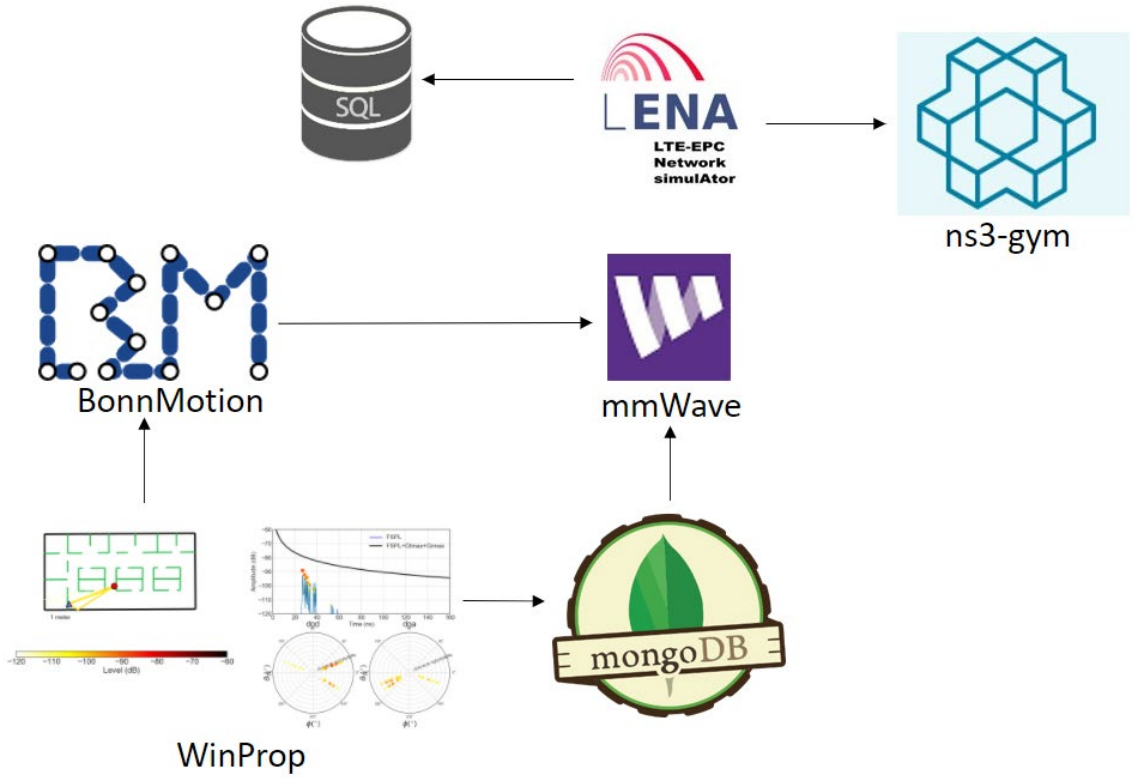
Verification / Validation approaches

- To test and validate the solutions
  - a testbed is set up by Nokia at Bosch Feuerbach,
  - several emulators by specific partners and
  - a system simulation of the aspects relevant for KICK is used (ns-3, mmWave).



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Some research activities

- Coverage map prediction Using ray traces generated from the KICK testbed
- Radio channel prediction with Deep learning
- Network Slicing Management
- QoS prediction
- Intralogistics management

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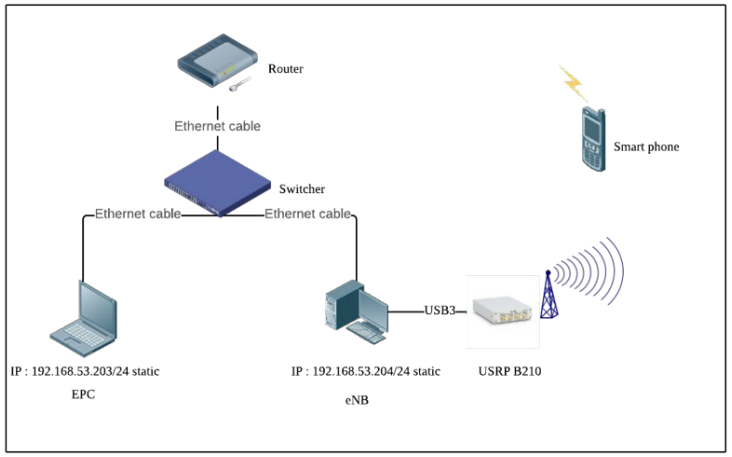
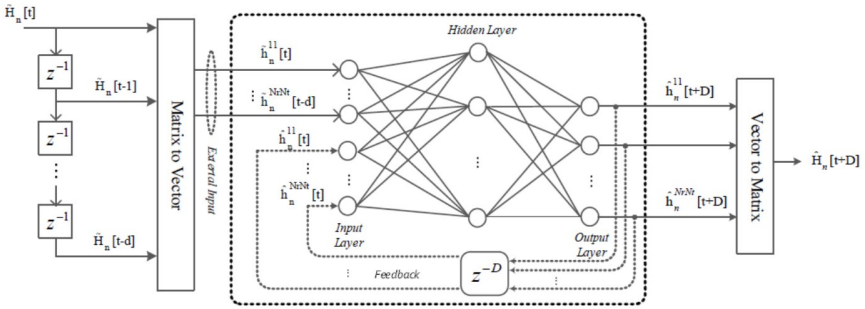
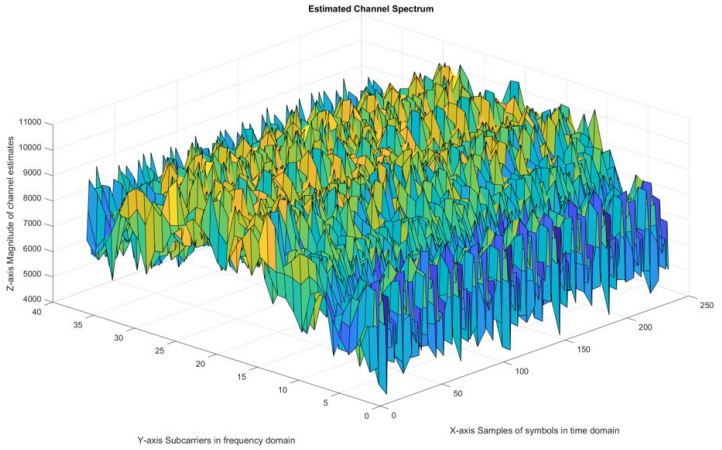
DL-based channel prediction

- Real channel measurements (every 1ms)
- Setup: OpenAirInterface LTE uplink measurement

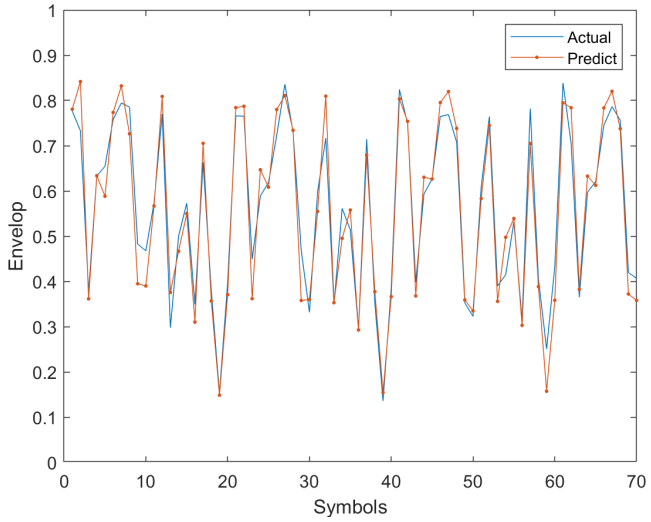


RNN





SISO, 10 hidden neurons, RNN, 1 step ahead



$MSE = 2.3 \times 10^{-3}$

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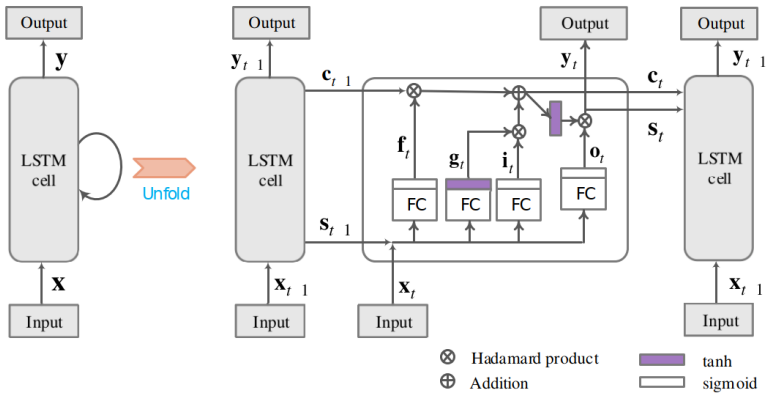
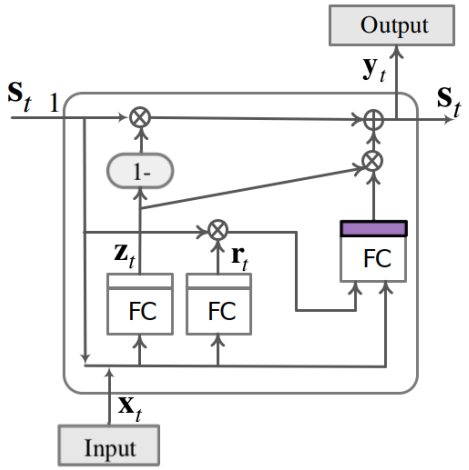
DL-based channel prediction

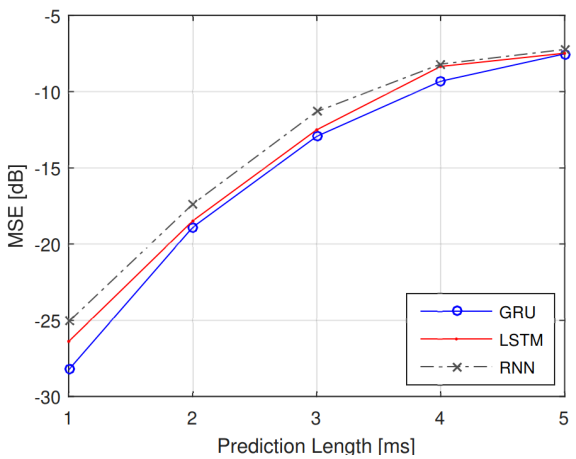
- Improve the prediction performance using LSTM and GRU

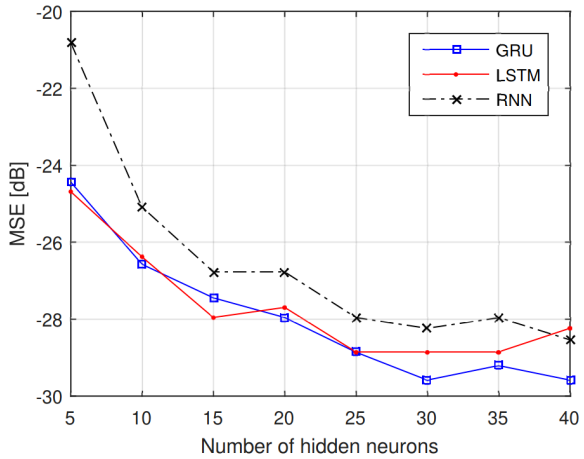
LSTM

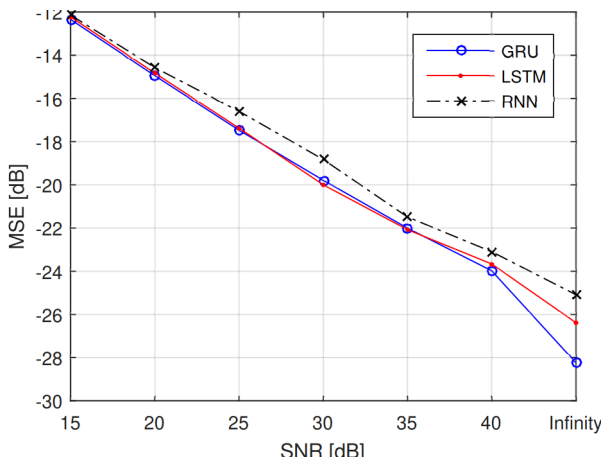


GRU









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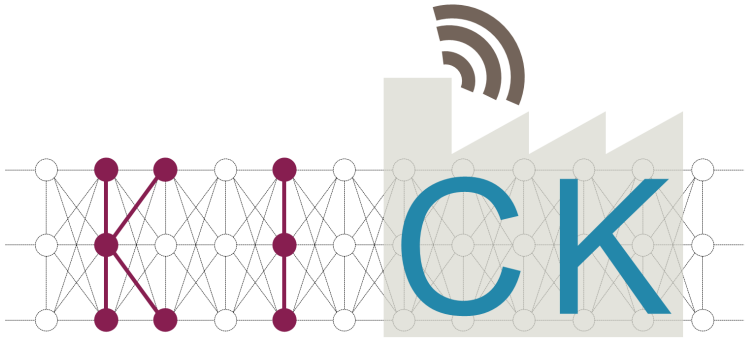

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