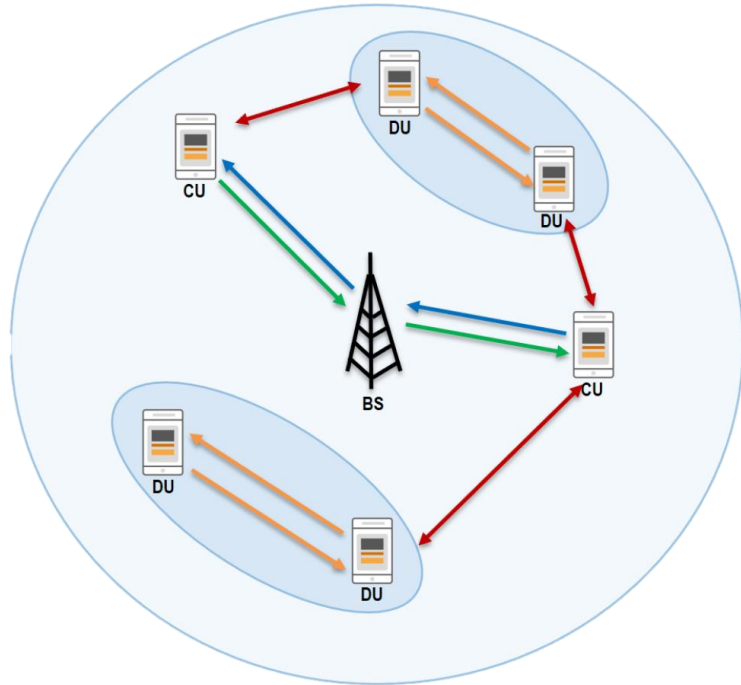




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Multi-Agent Reinforcement Learning for Coordination of Device-to-Device Communication

Sabrina Pochaba, Peter Dorfinger,
Matthias Herlich, Roland Kwitt,
Simon Hirländer

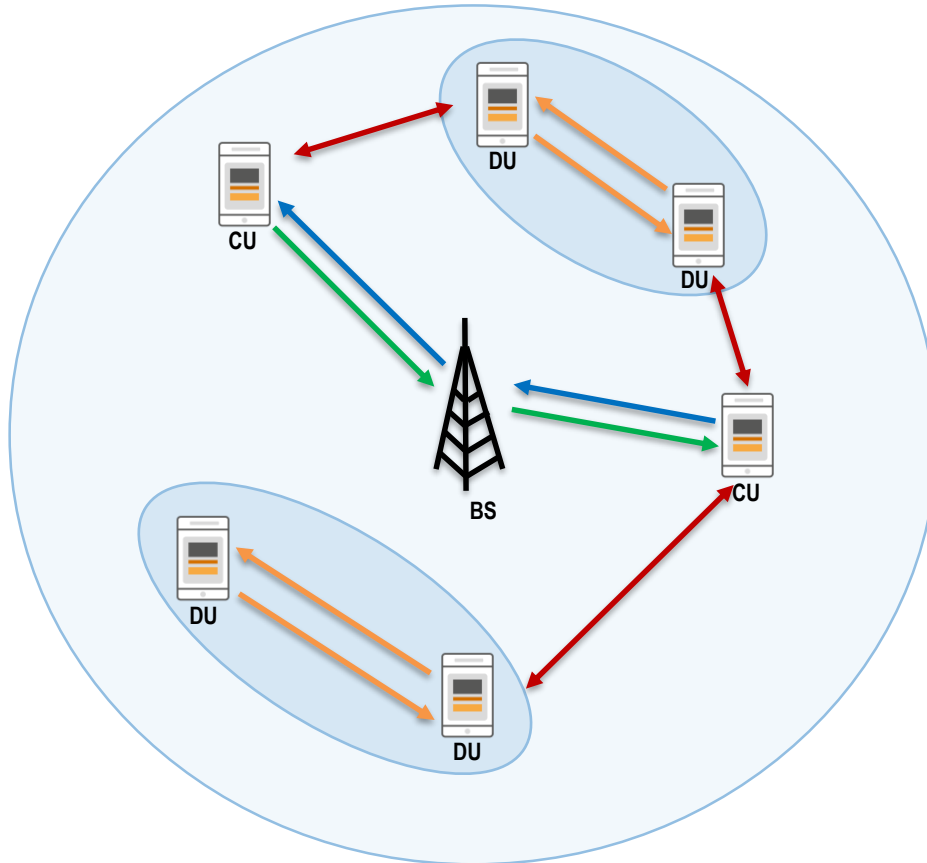
06.10.2022

Content

- Cellular and Device-to-Device (D2D) communication
- Reinforcement Learning (RL)
- Multi-Agent Reinforcement Learning (MARL)
- MARL for D2D
- Conclusion & Outlook

Cellular and D2D communication

BS = Base Station
CU = Cellular User
DU = D2D User



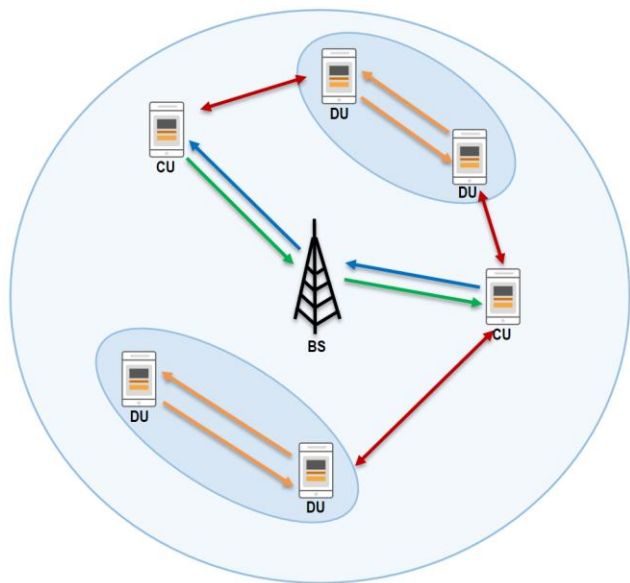
Problem:
Reliable Communication
without regulation of BS

Solution:
Multi-Agent Reinforcement
Learning

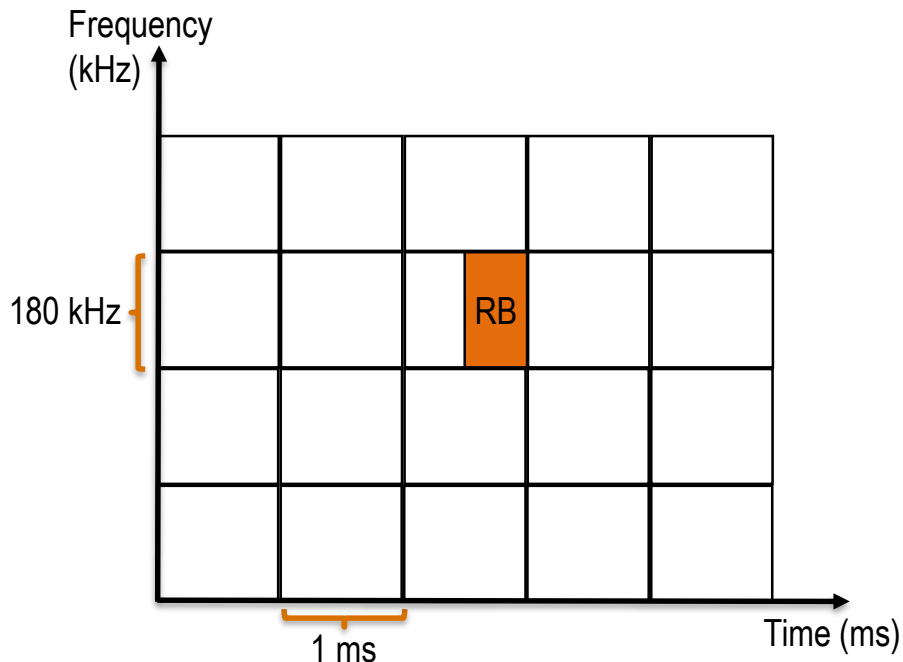
Cellular and D2D communication

Problem:

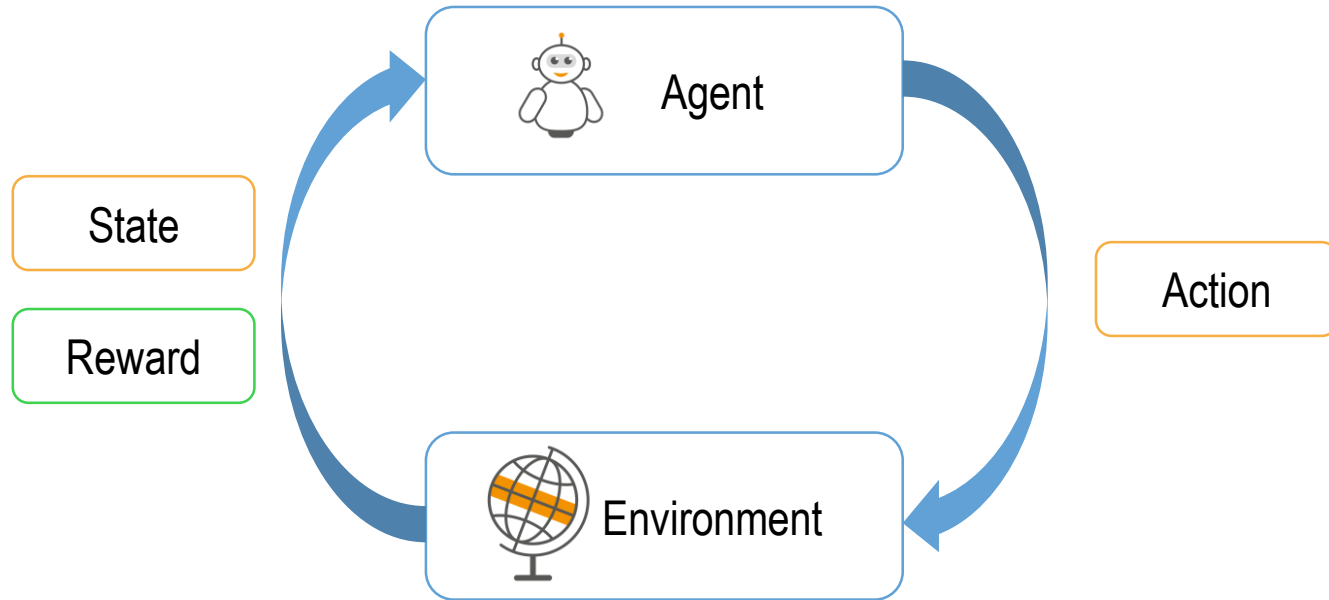
Reliable Communication
without regulation of BS



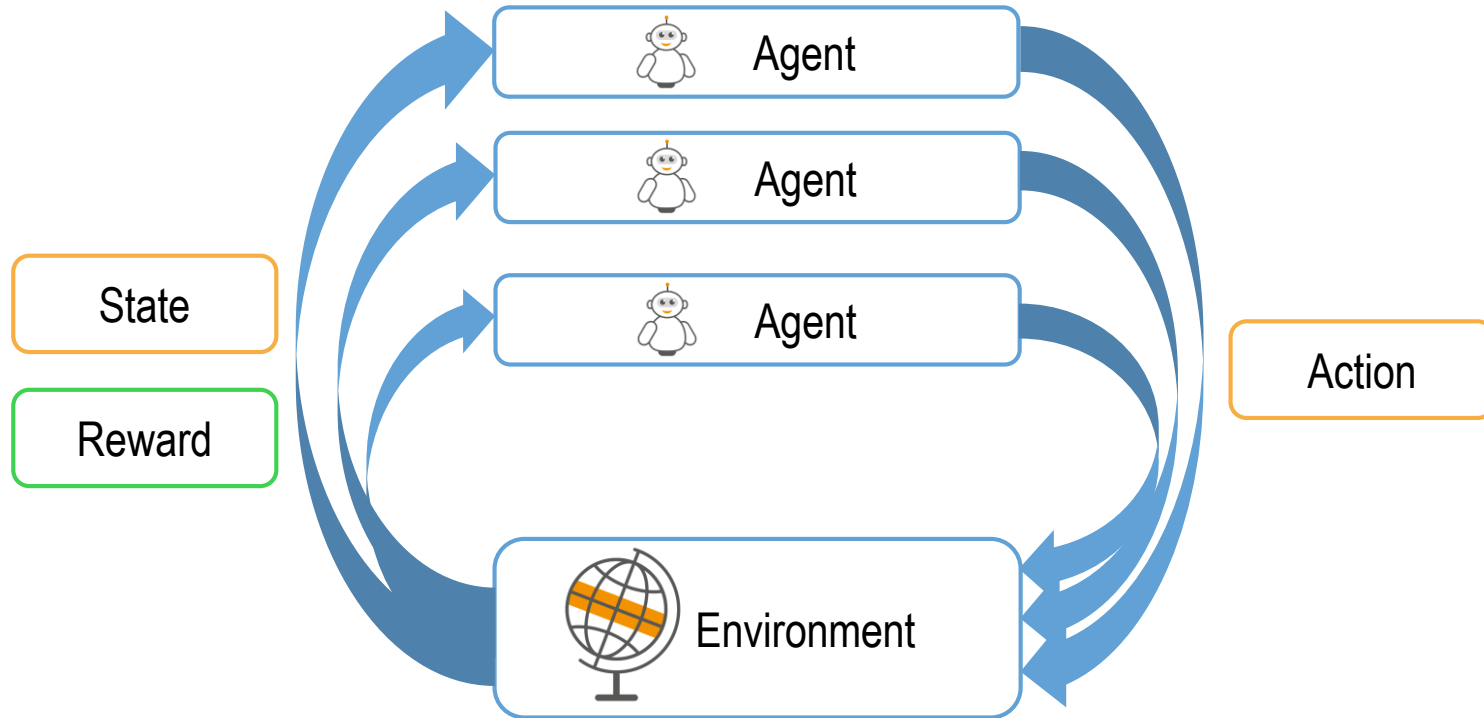
Resource Usage in Resource Blocks (RBs):



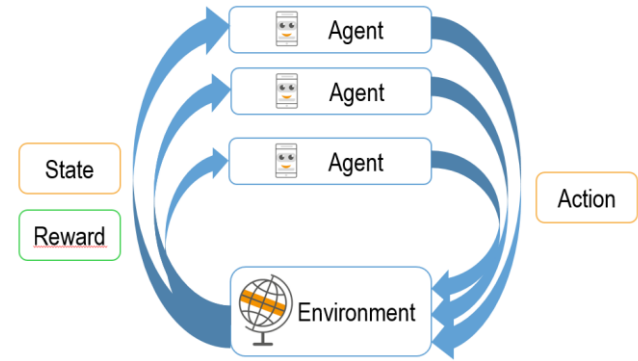
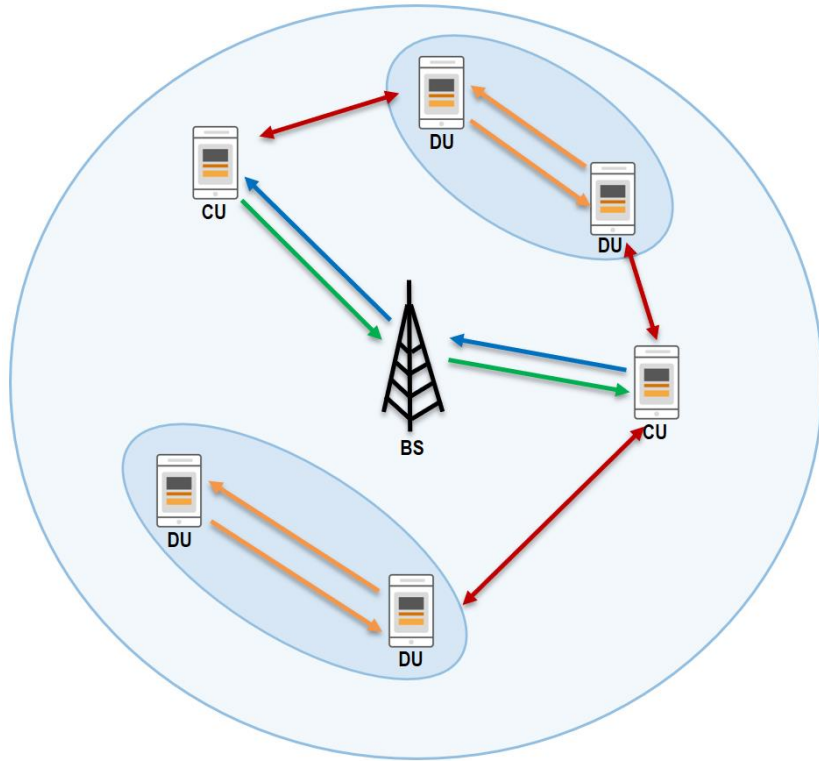
Reinforcement Learning



Multi-Agent Reinforcement Learning



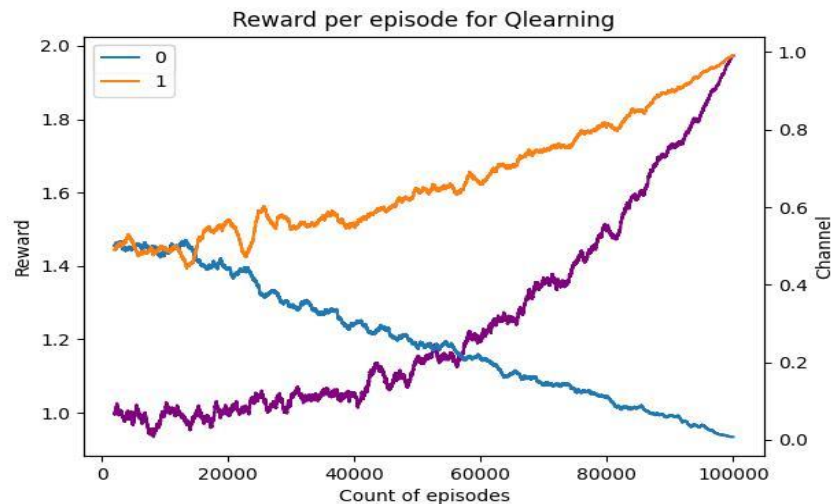
MARL in D2D: Setting



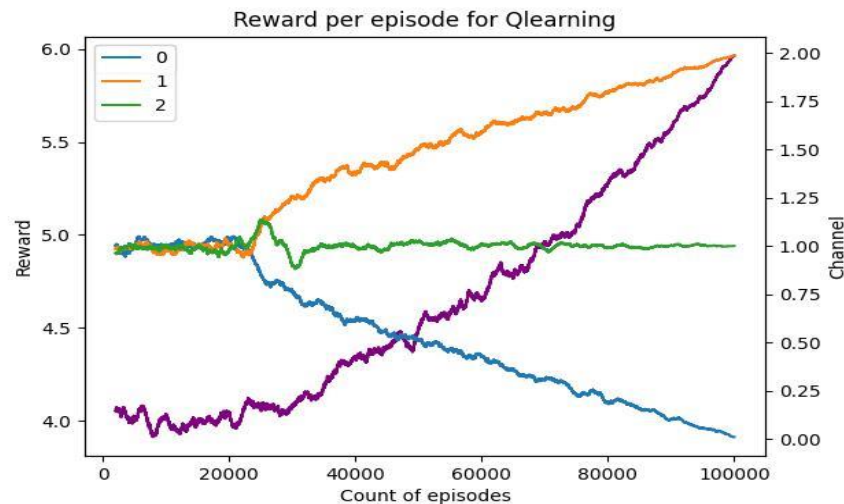
- Action: Choose RB
- State:
 - Own RB selection
 - Satisfaction (QoS)
 - Neighbors
 - RB selection of neighbors
- Reward: Satisfaction (QoS) of all devices

MARL in D2D: First Results

2 Agents



3 Agents

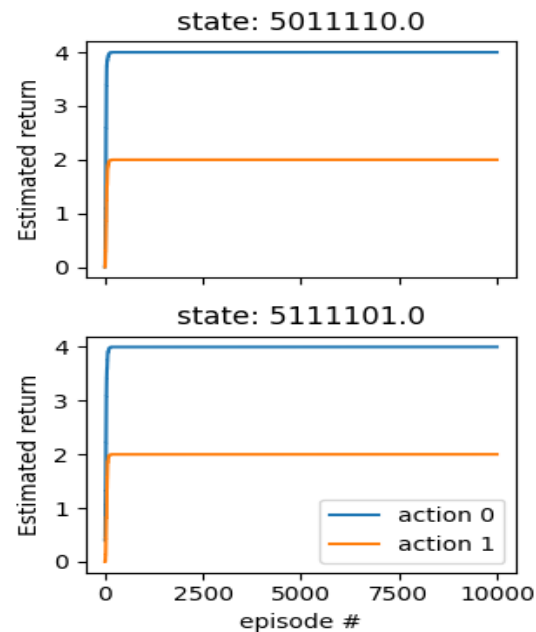
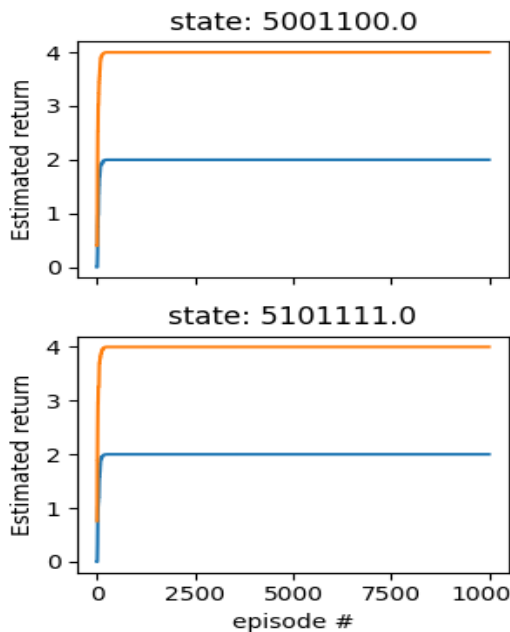
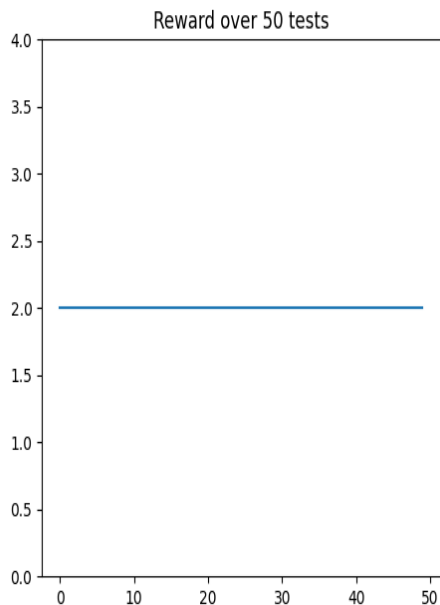


$$Q(s, a) \leftarrow Q(s, a) + \alpha(R + \gamma \max_a Q(s', a) - Q(s, a))$$

MARL in D2D: First Results

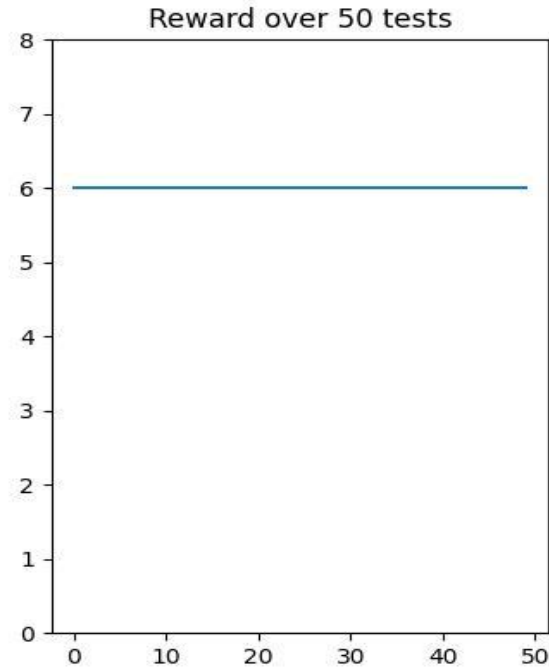
- 2 Agents

- Q-Values for Device 1:

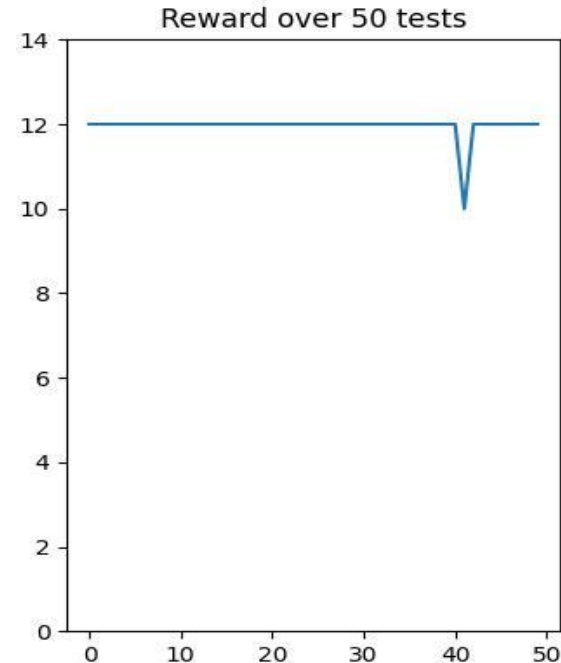


MARL in D2D: First Results

- 3 Agents



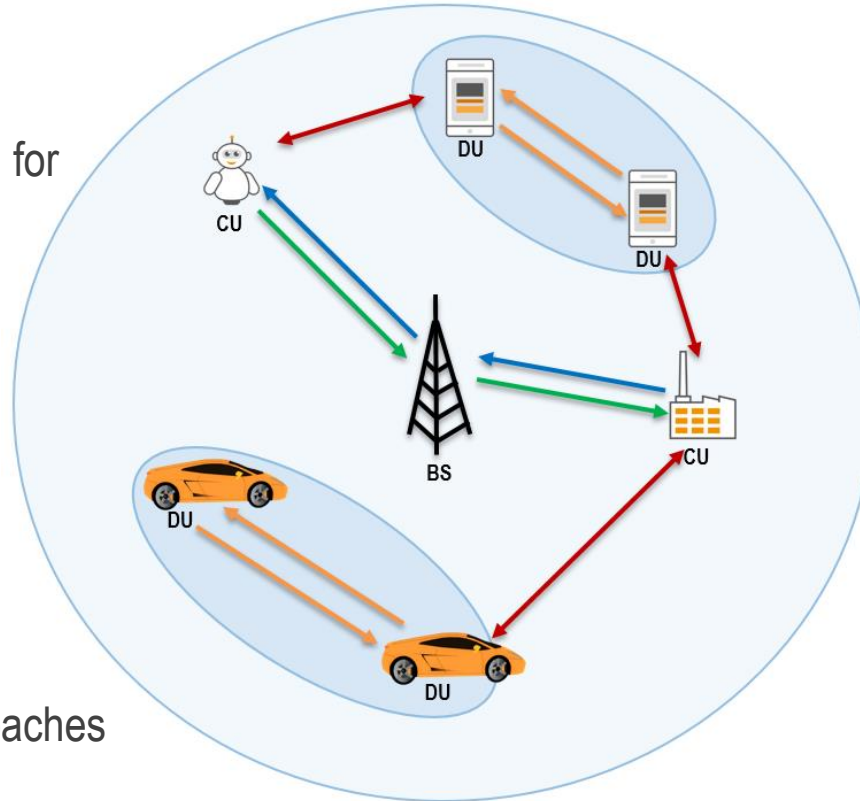
- 4 Agents



Conclusion & Outlook

Outlook

- Tabular Q-Learning for many Agents
- Nash-Q Algorithm
- Discrete to continuous setting
- Deep Q-Learning
- Policy-based approaches



Problem:
Reliable Communication
without regulation of BS

Aim:
Optimization of
Communication with
Multi-Agent Reinforcement
Learning



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Thank You!

Sabrina Pochaba



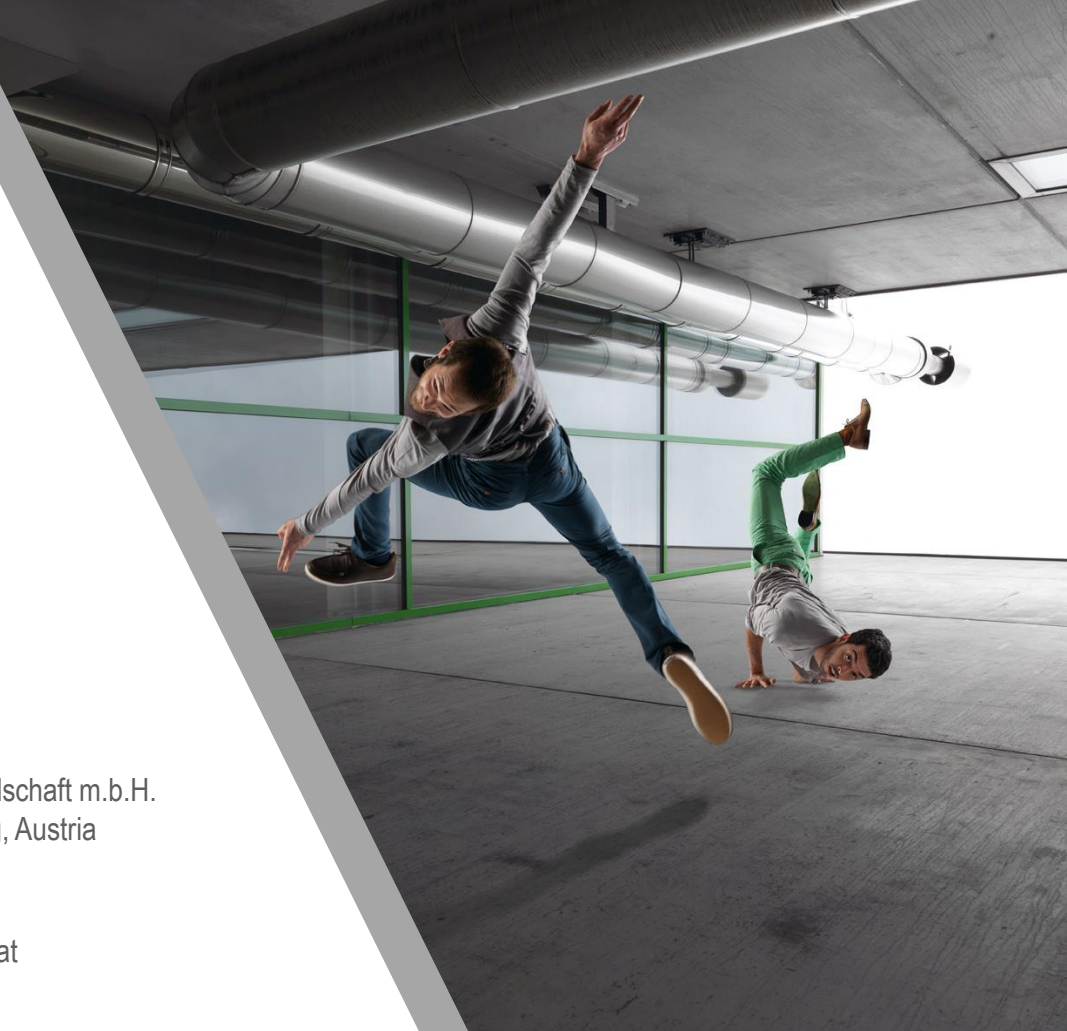
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