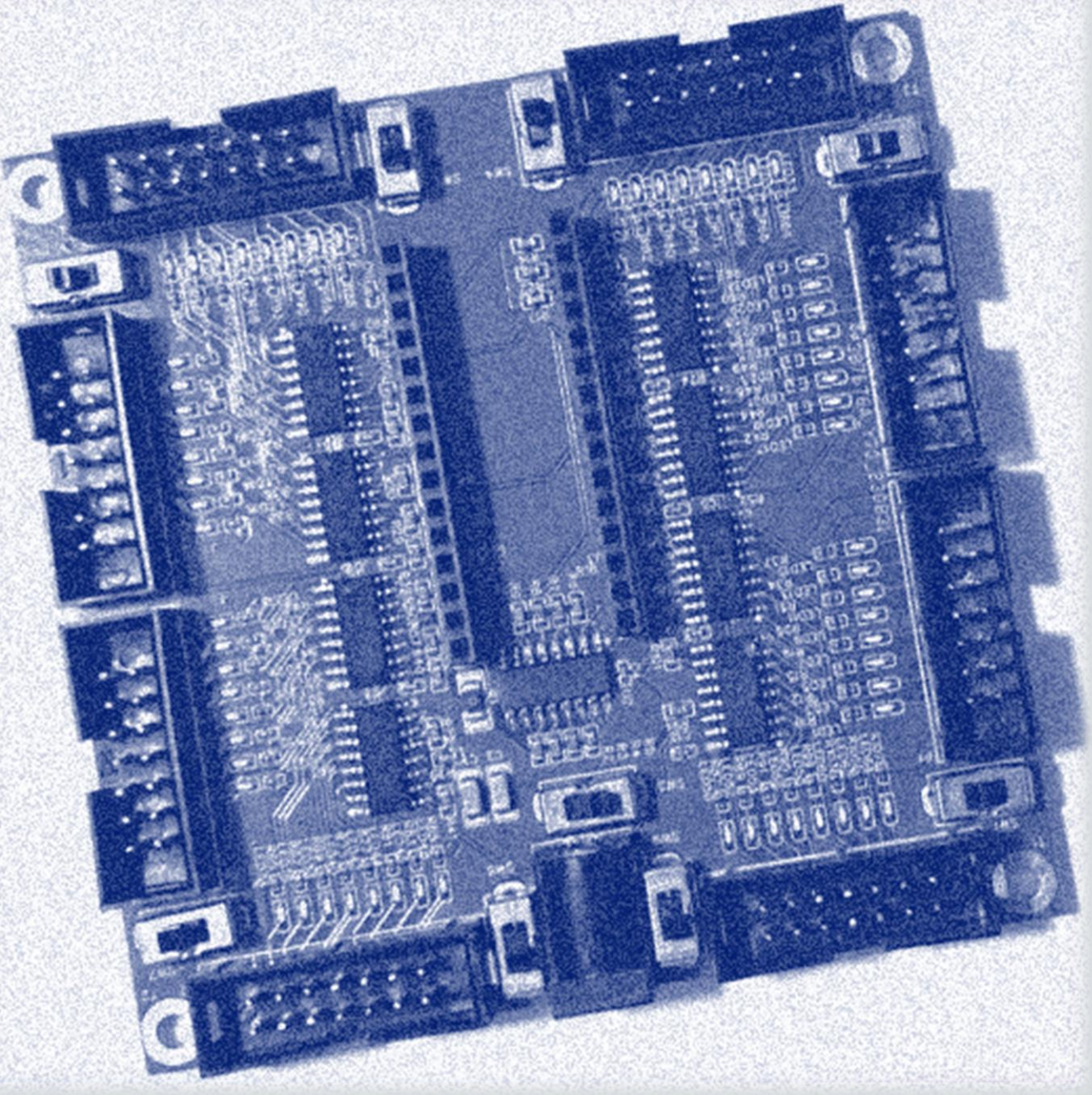

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German Research Center for Artificial Intelligence

RPTU Rheinland-Pfälzische Technische Universität Kaiserslautern Landau

Towards Smart Resource Distribution in V2X Dynamic Networks: A Modular RIS Approach

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Agenda

- Introduction
  - RIS and V2X: A Synergy Perspective
- Motivation
- Smart Network Distribution
- A Modular Reconfigurable Intelligent Surface Approach
- Simulation Insights
- Conclusion and Outlook

Introduction

- What are Reconfigurable Intelligent Surfaces (RISs)?
- What is Vehicular-to-everything (V2X) communication?
- The relevance of RIS and V2X in the research of the Sixth Generation (6G) of wireless networks.
- How RIS and V2X can work together?

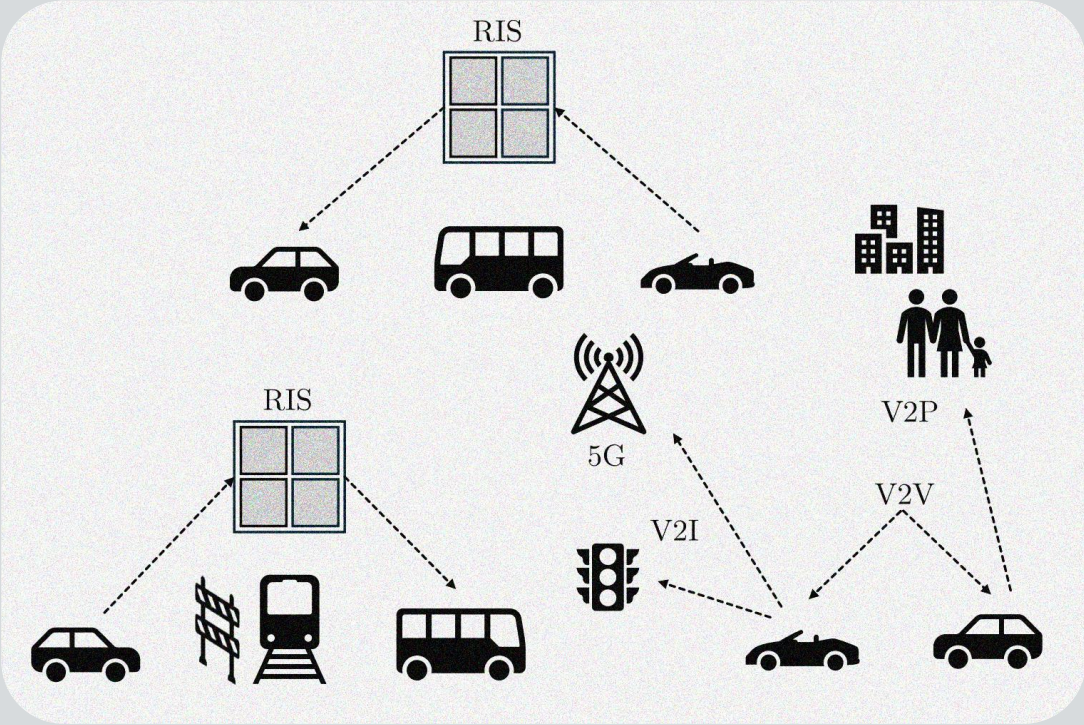
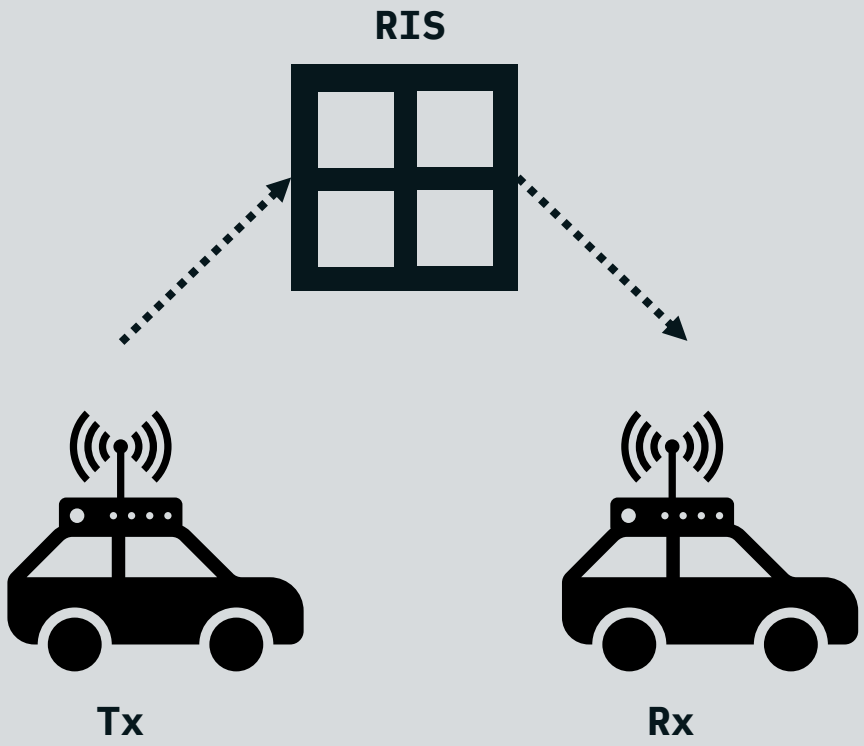


Figure 1: Conceiving urban scenarios in which RIS and V2X work together to assist vehicular communications

Motivation

- Changing environments require dynamic solutions.
- A modular RIS approach can offer flexibility and adaptability to those use case scenarios.
- The rise of AI can support usage prediction and thus, smart reallocation of network resources.



Related Work

Research on V2X technology takes a significant step forward

Ye et al. (2022) discuss a modular active antenna suited for 3.48 to 20.97 GHz

Saikia et al.(2023) explore a full duplex 6G-V2X communication utilizing RIS

2010 - 2022 2023

Abdel-Wahab et al. (2019) present a modular architecture for active phased array antennas at 20/30 GHz

Gu et al. (2022) consider the deployment of RIS and V2X scenarios, focusing on joint resource allocation to increase the V2I capacity

N. Rahmatov and H. Baek (2023) study the deployment of RIS on Unmanned Arial Vehicles (UAV)

Smart Network Distribution

Dynamic adaptation

Intelligent beamforming

Efficient resource allocation

Improved coverage

Proactive maintenance

A Modular Reconfigurable Intelligent Surface Approach

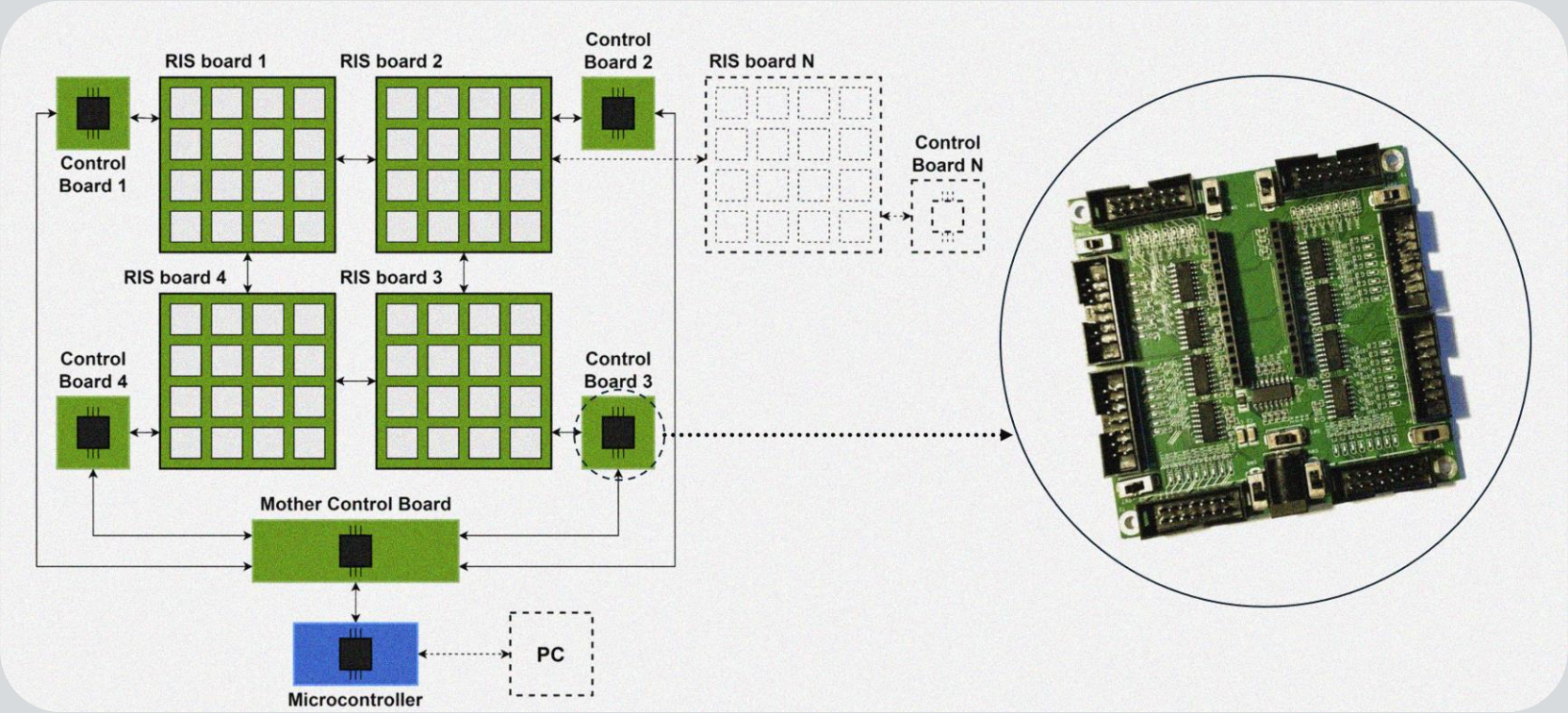


Figure 2: Proposed modular RIS approach through designed PCB control boards for the interconnection and management of different RIS sub-blocks, in which each RIS module is connected to its own control board

Simulation Insights

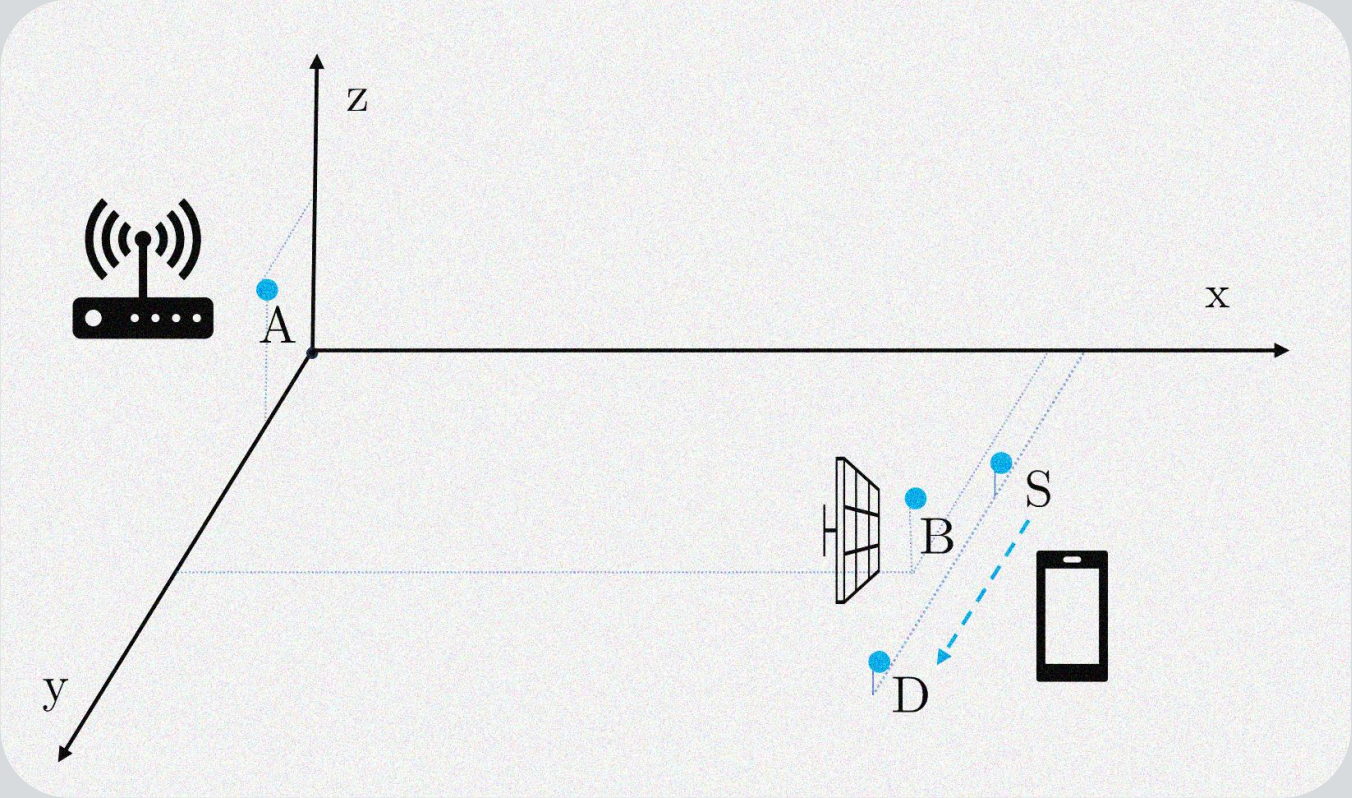


Figure 3: Conceptual system setup with 1 transmitter, 1 receiver, and 1 RIS

Simulation Insights

TABLE I: Simulation parameters for the system simulations

Parameter	Value	Description
Environment	2	1/2 for Indoor/Outdoor environment
Scenario	1	1/2 for RIS orientations in xz/yz plane
ArrayType	2	1/2 for uniform linear/planar array
Nt	1	Single input
Nr	1	Single output
Tx(x,y,z)	(0,25,30)	Position of transmitter
Rx(x,y,z)	(130,y,1)	Position of receiver
RIS(x,y,z)	(120,150,2)	Position of RIS

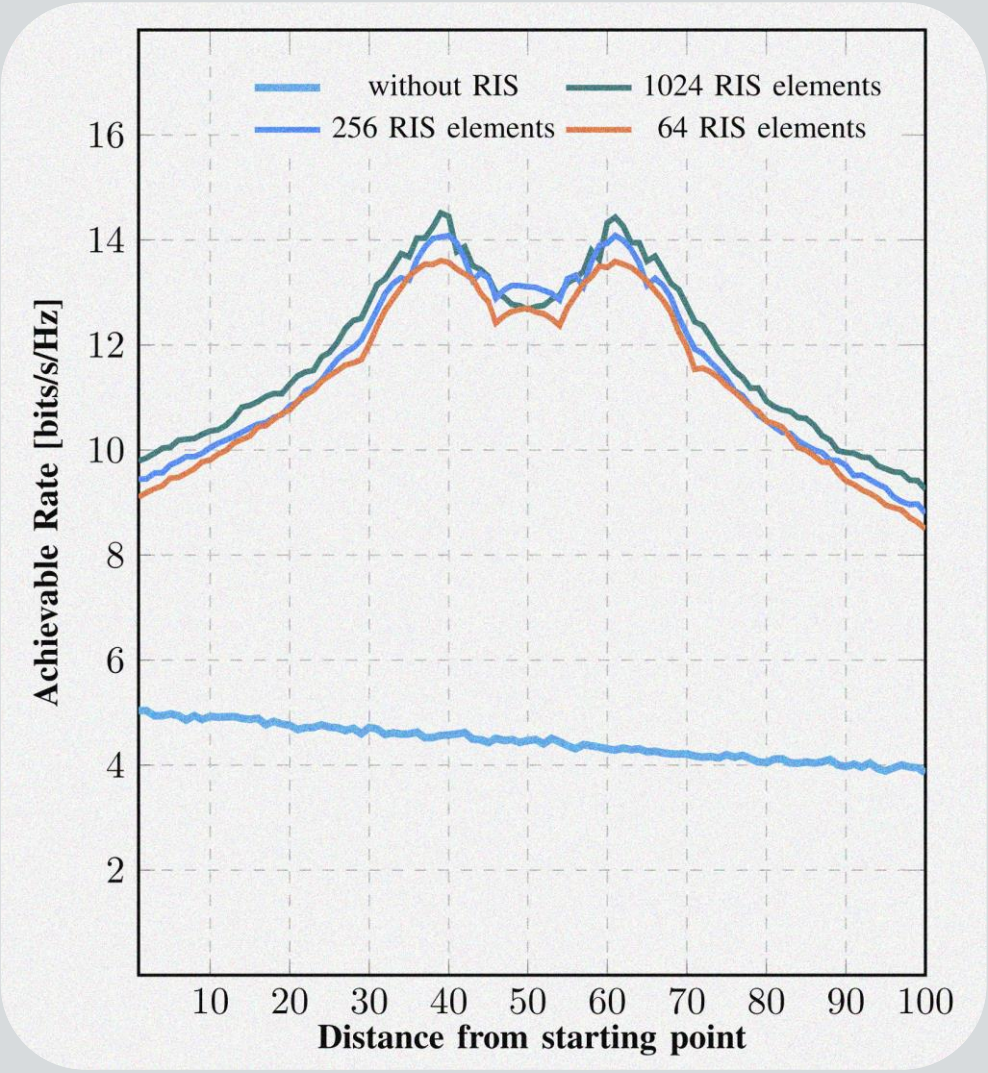


Figure 4: Achievable transmission rate with different numbers of RIS elements

Conclusion and Outlook

- RIS can support V2X communications by enhancing the Line of Sight (LoS) between vehicles.
- The correlation between the number of unit cells and the achievable rate obtained supports the approach of a modular RIS configuration for dynamic scenarios.
- AI can aid in performing smart resource allocation through usage network prediction.
- It is envisaged to carry out similar tests on actual RIS hardware for future work.

THANK YOU

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