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Underpinnings of User-Channel Allocation in Non-Orthogonal Multi-Access for 5G

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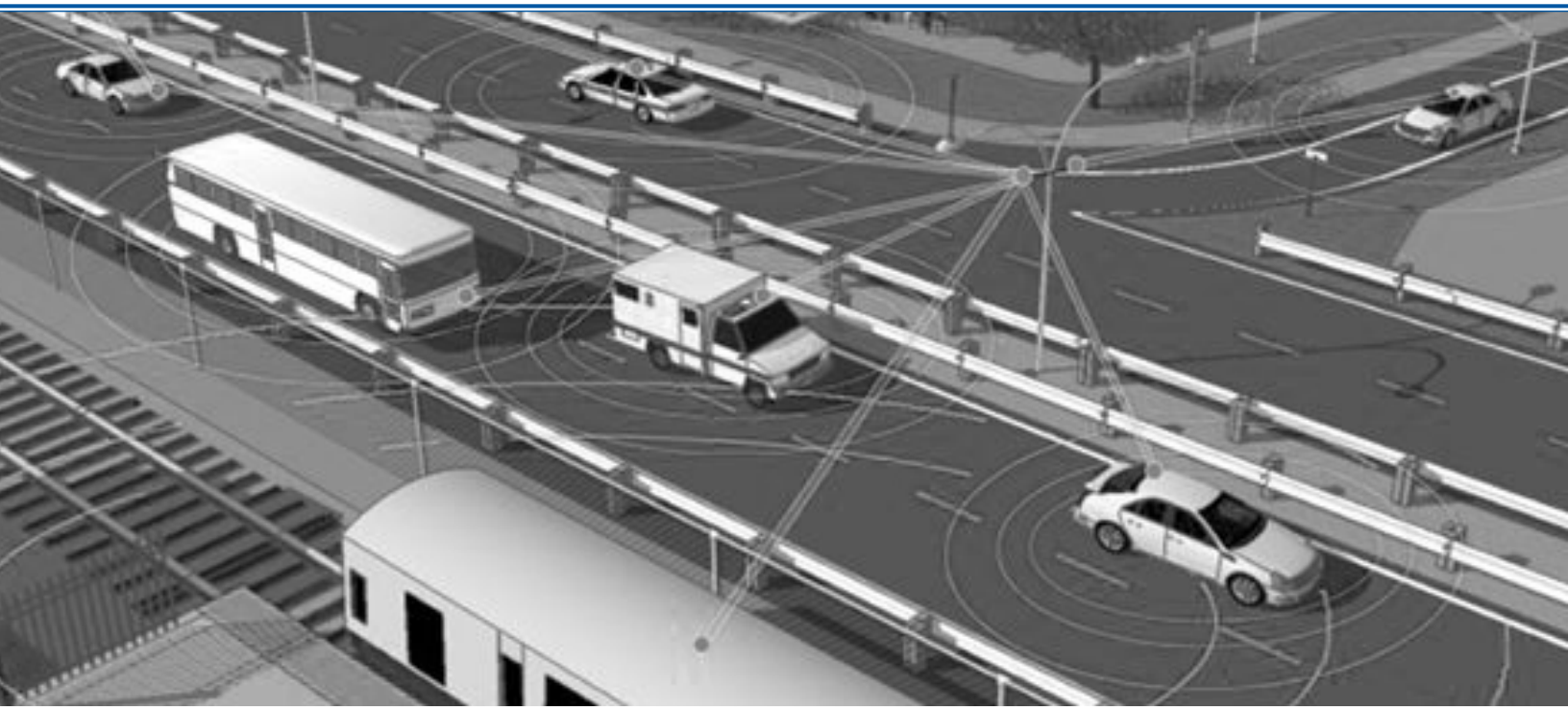


Vehicular communication is an important element of smart cities, where connected vehicles can be remotely controlled. Bosch and Daimler have chosen California as the pilot location for the tests of automated vehicles. It is an application of the Internet of Things (IoT) that is anticipated to be a part of the 5G technology for smart transport. One advantage of cellular vehicle to everything (V2X) communications is deploying the long-term evolution (LTE) infrastructure that is already in place wherever cell phones are used. The US Department of Transportation had previously proposed DSRC (Dedicated Short-Range Communications). However, Celluar-V2X (C-V2X) offers wider coverage for vehicles, lower delays, and higher reliability. The onboard safety features of vehicles can benefit from C-V2X for blind spots, road hazard information dissemination, left turn assist (LTA), active rollover protection (ARP), etc.

Multiple access is a basic function of C-V2X to share resources for communication and can be either orthogonal or non-orthogonal. The non-orthogonal multiple access (NOMA) technique for 5G improves spectrum efficiency. However, implementing non-orthogonality is challenging. Therefore, resource allocation for cellular non-orthogonal multiple access needs further investigation.

This work presents a stable resource allocation scheme for non-orthogonal multiple access in NOMA for 5G cellular communications.

Study Methods

The problem of channel allocation in non-orthogonal multiple access (NOMA) is cast to structures that determine stability, convergence, and game theoretical models.

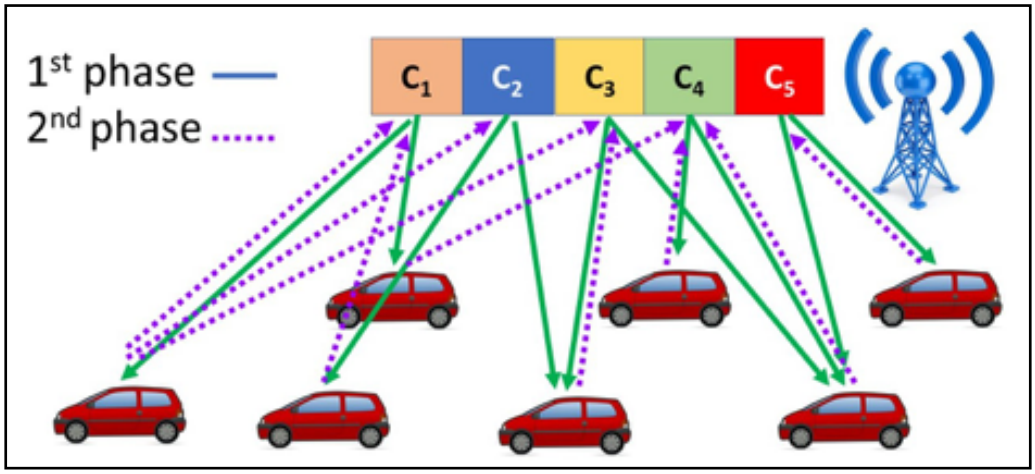
Findings

NOMA user-channel resource allocation can be viewed as a non-cooperative bargaining game, in which the subgame perfect Nash equilibrium is used for sequential games. The main reason behind this model is that the set of subgame-perfect Nash equilibrium outcomes of the game has the setwise stability property considering a complete-information setting. Stability is an important factor for NOMA resource allocation. The two types of players of this sequential extensive-form game are the channels (represented by the cellular base station) and the NOMA users (here the vehicles). The strategy of each player involves the selection of a subset of the other type of players.

Stable cellular NOMA resource allocation schemes need to be designed to serve the ever-increasing number of vehicles that are vying to be connected for different services, such as the onboard safety features or passengers' multimedia amenities.

Policy Recommendations

In practice, in the adoption of cellular vehicular communications for smart transportation (e.g., in auto industry), it is important to use a stable NOMA resource allocation that is guaranteed to converge to a solution, such as the algorithm presented in this work.



The Subgame Played by the Set of Users and the Set of Channels Related to Setwise-Stable NOMA Resource Allocation

About the Authors

Dr. Shabnam Sodagari received her PhD in electrical engineering from the Pennsylvania State University (Penn State). She is a senior member of the IEEE and a faculty member at the electrical engineering department, California State University Long Beach.

To Learn More

For more details about the study, download the full report at transweb.sjsu.edu/research/1868

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