

# Chapter 6


## Fuzzy Decision Model for Selecting Core Factors in Vehicular Network Communications

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### ABSTRACT

*The efficacy of the vehicular networks is highly dependent on the choice of communication models. The vehicular network communication models outline the nature of interactions between the entities of vehicles, infrastructure, and the environment. Some of the most common communication models in existence are Vehicle-to-Vehicle, Vehicle-to-Infrastructure, Vehicle-to-Grid, and Vehicle-to-Network. These models are categorized based on the entities involved, direction, and purpose of communication. The choice-making of these communication models are hurdled by the primary challenges of heterogeneity of applications and dynamic network conditions. This*

DOI: 10.4018/979-8-3693-6422-2.ch006

*chapter proposes solutions to these challenges by constructing a fuzzy-based multi-criteria decision-making method of LBWA (Level Based Weighting Assessment). This fuzzy model considers the factors to be taken into account in selecting the vehicular network communication models and also determines the weightage to each of the factors considered. This model developed in this chapter facilitates identifying the most significant factors in selecting the communication models. The optimal ranking of the factors is validated with other decision methods to determine the consistency of the results. The chapter concludes with future research directions.*

## **1. INTRODUCTION**

Vehicular networks are revolutionizing transportation systems and are emerging as a significant component in establishing smooth networking. These wireless networks form the building blocks of the intelligent transportation system and they are crucial in managing traffic congestion and safety measures. The vehicular network communication models (VNC) give directions for the vehicles to interact with other vehicles, infrastructure, and the immediate environment. These VNC models shall be categorized into three groups namely Direct vehicle communication, Vehicle to infrastructure communication, and Vehicle to network communication (Aljeri & Boukerche, 2023). Direct vehicle communication encompasses different communication models that facilitate direct interaction with every vehicle, pedestrians, and electronic devices. This group of models comprises Vehicle-to-Vehicle (V2V), Vehicle-to-Pedestrian (V2P) and Vehicle-to-Device (V2D). Direct communication between the vehicles is governed by V2V kind of communication networks and these networks consider the exchange of data related to the position, speed, acceleration, and other pertinent data (Almeida, 2023). The communication between vehicles and pedestrians is guided by V2P kind of networks (Appaji & Raviraj, 2023). The communication between the entities of the vehicle and external devices is networked by V2D type of communication models. These kinds of communication networks play a crucial role in averting traffic congestion and in maintaining smooth traffic flow.

Vehicle-to-infrastructure (V2I) communication and Vehicle-to-Grid (V2G) communication are network models contributing to the interaction between vehicles and various infrastructure elements. V2I communication deals with direct communication between vehicles and roadside infrastructure, such as traffic lights, road signs, toll booths, and roadside sensors. This type of networking facilitates in receiving real-time data from the elements of infrastructure namely the traffic status, road conditions, and other related information. V2G communication enables bi-directional communication between electric vehicles (EVs) and the power grid infrastructure. Further, this kind of networking facilitates the electric vehicles to

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