System for Adaptive Resource Allocation for Enhancing Quality of Service in a Vehicular Communication Network

1. Technology:

The proposed system focuses on resource allocation between Roadside Units (RSUs), Base Stations (BS), and drones to provide context-based Quality of Service (QoS) for vehicular service requests. The geographical area is divided into regions, and the fitness metric score is used to identify optimal RSU placement. When vehicles approach the edge of a cell or face base station issues like resource constraints or non-line-of-sight (NLOS), drones are deployed to ensure service continuity. The system uses a Multi-Agent Reinforcement Learning (MARL)-based strategy for dynamic resource allocation. Agents (vehicles) interact with the environment and make resource allocation decisions based on real-time conditions. RSUs are allocated with frequency resources, and incoming service requests are classified into Guaranteed Services (GS) and Non-Guaranteed Services (NGS). QoS prediction is carried out using a Markov model that estimates the Signal-to-Interference-plus-Noise Ratio (SINR) and predicts future states based on past SINR values. Drones, equipped with GSM modules, provide resources when BSs face overload or failure, drawing from a Virtual Shared Resource Pool (VSRP) if needed. The drones also act as transceivers to manage high communication loads, ensuring guaranteed services without interruption. Path loss and propagation loss models, based on 3GPP standards, are employed for precise SINR estimation. This system ensures efficient resource allocation, reducing end-to-end delays and enhancing vehicular communication networks through adaptive, predictive models and real-time optimization.

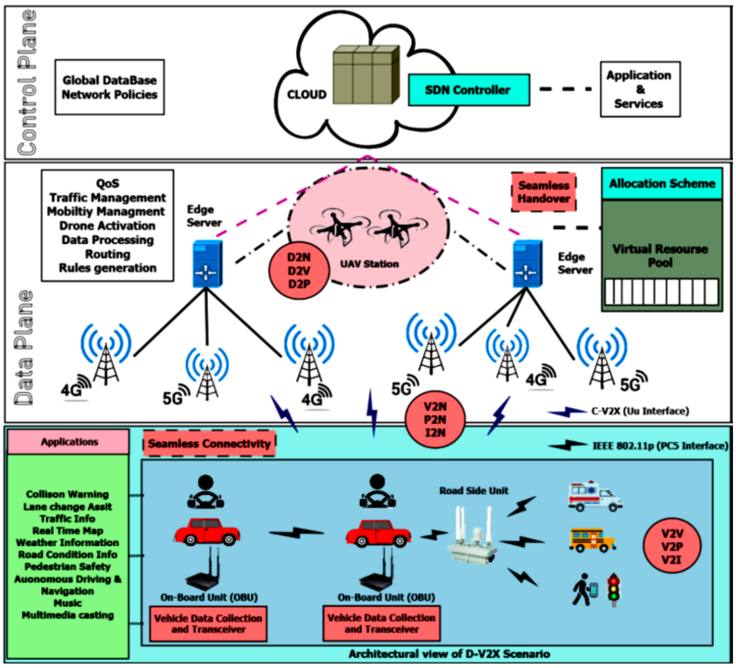

Fig. 1 Exemplary view of a proposed system for enhancing Quality of service (QoS) in Vehicular Communications

2. Problem Addressed:

The system addresses the problem of ensuring uninterrupted Quality of Service (QoS) in vehicular communication networks when Base Stations (BS) face resource constraints, non-line-of-sight (NLOS) issues, or overload. It dynamically allocates resources using drones and reinforcement learning to maintain service continuity.

3. Industrial Applications:

The developed system has industrial applications in smart transportation, autonomous vehicle networks, and emergency response systems, where maintaining seamless communication and coverage is crucial. It can optimize drone-assisted network management in highway surveillance, rural connectivity, and disaster recovery operations.

4. Patent Application Number: 202341076465