National Institute of Technology Rourkela

Defence Seminar

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| Seminar Title | : Radio Resource Allocation Strategies for High-Reliability and Safety in Vehicular Ad-Hoc Networks (VANETs) |
| Speaker | : Biraja Prasad Nayak ( Rollno : 519cs1005) |
| Supervisor | : Arun Kumar |
| Venue | : Department Meeting Room |
| Date and Time | : 25 Sep 2025 (11 AM) |
| Abstract | : Vehicular Ad Hoc Networks (VANETs) play a pivotal role in ensuring road safety through the timely dissemination of safety-critical messages. Effective radio resource allocation is crucial to meet the requirements of high reliability and low latency communication in VANETs. This thesis proposes innovative approaches to address key challenges in resource allocation, message prioritization, and real-time communication for vehicular networks.<br>The first contribution introduces an Analytical Hierarchy Process (AHP)-based prioritization mechanism for Vehicle-to-Vehicle (V2V) communication. By ranking Vehicular User Equipment (VUE) pairs based on critical attributes, the best resource blocks are allocated to high-priority pairs, ensuring faster delivery of safety-critical data. Simulation results demonstrate that the proposed method outperforms existing algorithms in reducing latency and enhancing the reliability of critical message dissemination.<br>The second contribution addresses the categorization and handling of messages based on their criticality using 5G numerology. Safety-critical messages, such as accident notifications, are assigned numerologies with low delay requirements, whereas non-critical messages, like infotainment data, prioritize high throughput. An efficient algorithm for bandwidth part allocation, combined with a priority queue system, is developed to optimize resource usage. Results indicate that the proposed algorithm significantly improves throughput and reduces delays for safety-critical messages, thereby fulfilling Vehicle-to-Everything (V2X) communication Quality of Service (QoS) requirements more effectively than existing methods.<br>The third contribution presents a Reinforcement Learning-based resource allocation strategy for Mode 1 and Mode 2 communication, where resources are allocated without a base station&rsquos involvement. By incorporating the Age of Information (AoI) to prioritize messages and discard outdated packets, the proposed scheme mitigates congestion and ensures efficient resource utilization during high traffic loads. This approach significantly reduces packet delays and enhances system reliability under bursty traffic conditions.<br>Collectively, these contributions advance the state-of-the-art in VANET resource allocation and message prioritization, addressing critical challenges of reliability, latency, and scalability. The proposed methods offer practical solutions for improving safety-critical communication, resource utilization, and adaptability in dynamic vehicular environments. |