ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may544

Social Networks and the Internet of Vehicles: Towards Intelligent and Collaborative Vehicular Mobility

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Publication Date: 2025/05/20

Abstract: The integration of social networks into the Internet of Vehicles (IoV) is emerging as a transformative element in the future of transportation. While IoV primarily focuses on the communication between vehicles, infrastructure, and users, social networks within this context add a layer of interactivity and collaboration that enhances the overall transportation experience. This paper explores the role of social networks in IoV, emphasizing how these platforms facilitate communication among drivers, vehicles, and surrounding infrastructure in real-time. Furthermore, the paper examines the challenges posed by privacy concerns, data security, and the need for interoperability between diverse platforms. Drawing on current research and emerging applications, this study highlights how social networks within IoV systems are reshaping the way people interact with vehicles and each other in the evolving transportation ecosystem. The paper concludes by exploring the potential of social IoV to drive future innovations, particularly in autonomous driving, smart cities, and connected mobility.

Keywords: *IoV, Social Networks, SIoV, Vehicle-to-Everything (V2X).*

How to Cite: Tarandeep Kaur (2025) Social Networks and the Internet of Vehicles: Towards Intelligent and Collaborative Vehicular Mobility. *International Journal of Innovative Science and Research Technology*, 10(5), 687-693. https://doi.org/10.38124/IJISRT/25may544

I. INTRODUCTION

The evolution of vehicular technology over the past two decades has been nothing short of transformative. As vehicles have become increasingly connected, automated, and intelligent, the very definition of mobility has shifted [1]. What was once a closed mechanical system is now part of an expansive digital ecosystem, where data flows between cars, infrastructure, cloud platforms, and end-users in real time. This shift is encapsulated in the growing framework of the Internet of Vehicles (IoV), a complex network where vehicles interact not just for functional optimization but as active digital agents within broader urban and social environments [2].

Amid this transformation, a compelling development has begun to surface: the fusion of social networking principles with vehicular communication, commonly referred to as the Social Internet of Vehicles (Social IoV) [3]. This is more than a technological novelty. It marks a conceptual pivot, from machine-oriented vehicular communication toward a human-centered, socially-aware model of mobility. In this emerging paradigm, vehicles no longer just exchange sensor data or traffic information; they participate in socially contextualized interactions. They recommend routes based on behavioural trends, alert nearby vehicles of hazards based on peer input, or even facilitate spontaneous ride-sharing based on mutual preferences or shared affiliations [4]. The impetus behind this shift is twofold. First, the exponential growth of social media and digitally mediated social behavior has normalized real-time, peer-to-peer information exchange. Second, the limitations of conventional IoV, particularly in contexts that require adaptive, human-like judgment, have exposed a gap that social logic is well-suited to fill. Social IoV seeks to leverage not only the mechanical and environmental data a vehicle collects but also the collective intelligence and preferences of the community around it. The integration of social layers into vehicular networks is far from straightforward [5]. The challenges are as profound as the opportunities. Incorporating user-generated content into vehicle decision systems invites concerns around trust, misinformation, and data integrity. Likewise, the social profiling of drivers, used, for instance, to suggest navigation routes or carpool partners, raises serious questions around privacy, consent, and algorithmic bias [6]. Furthermore, as these networks evolve, the issue of interoperability between proprietary platforms and public infrastructure becomes a technical and political battleground.

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This paper aims to critically examine the role of social networks in the context of IoV. Through a multidisciplinary lens, combining insights from computer science, transportation studies, urban sociology, and data ethics, it investigates how socially-embedded vehicle networks are shaping the next generation of mobility systems. The focus is not only on current implementations but also on the trajectories such systems might follow as they mature within the broader framework of smart cities and autonomous mobility.

II. THE INTERNET OF VEHICLES (IoV)

The Internet of Vehicles (IoV) represents one of the most ambitious intersections of transportation and information technology [7]. At its core, IoV refers to a system in which vehicles operate not as isolated units but as interconnected entities embedded within a larger communication network. Through real-time data exchange between vehicles (V2V), infrastructure (V2I), pedestrians (V2P), and networks (V2N), IoV enables a new level of coordination, awareness, and automation in mobility systems. Originally envisioned as a means to improve traffic efficiency, road safety, and energy consumption, the scope of IoV has since expanded significantly [8].

The architecture of IoV is built on a multi-layered communication model that includes embedded sensors, on-board computing units, wireless communication modules (such as DSRC, 5G, and LTE-V), and cloud platforms. These components enable vehicles to share information such as speed, location, road conditions, and even driver behavior. This constant stream of data supports applications like collision avoidance systems, adaptive traffic signal control, dynamic navigation, and predictive maintenance [9]. As the ecosystem matures, IoV is increasingly viewed as a foundational element of future smart cities. As vehicles become more autonomous and digitally aware, there is a growing need for these systems to interpret not only physical environments but also social contexts. A vehicle navigating a crowded urban space must understand not only the geometry of the road but also the behavior of other drivers, the norms of human interaction, and the collective intentions of those around it. Traditional IoV frameworks, while efficient at transmitting data, often fall short in addressing these nuances. This gap has opened the door to a more socially intelligent layer of vehicular networking, one that brings in principles from social computing, peer-to-peer platforms, and user-driven information systems. The idea is that vehicles can benefit from the same kinds of social intelligence that humans apply when navigating shared environments. Whether it’s through reputation-based systems, collaborative filtering, or community-generated updates, social intelligence adds a new dimension to vehicular communication, one that is adaptive, contextual, and increasingly human-like.

III. SOCIAL NETWORKS IN THE CONTEXT OF IoV

The integration of social networking principles into the Internet of Vehicles marks a significant turning point in how mobility is conceptualized and operationalized. While traditional IoV systems are largely designed around functional data exchange, vehicle speed, GPS location, and proximity to obstacles, the Social Internet of Vehicles (Social IoV) introduces an additional layer of human and behavioral intelligence [10]. It brings with it the logic of social relationships, trust dynamics, community participation, and peer-driven information sharing. The result is a system in which vehicles are no longer merely technical nodes in a network, but socially aware entities capable of interacting based on shared interests, histories, and objectives [11].

At its core, Social IoV builds upon the mechanisms that underpin mainstream social networks, such as Facebook, Twitter, or LinkedIn, but adapts them for vehicular and mobility contexts. In this framework, vehicles can form ad-hoc social groups based on location, driving behavior, mutual destinations, or past interactions. A vehicle might "follow" other vehicles for real-time route recommendations or join a temporary convoy of trusted drivers heading in the same direction. Similarly, drivers can share experiential data (e.g., a pothole on a specific route, real-time traffic jams, road closures) that is then dynamically disseminated through the network based on relevance and social trust [12]. This form of interaction is enabled by several types of communication models [13] [14]:

- **Vehicle-to-Grid (V2G):** V2G enables electric vehicles to exchange energy with the power grid, allowing for energy storage and grid stabilization. It helps balance supply and demand while supporting renewable energy integration.
- **Vehicle-to-Cloud (V2C):** V2C allows vehicles to connect to cloud services for real-time data sharing, updates, and remote diagnostics. It enables features like navigation, software updates, and vehicle management.
- **Vehicle-to-Network (V2N):** V2N connects vehicles to communication networks (e.g., cellular, Wi-Fi) for high-bandwidth data exchange. It supports cloud-based services, infotainment, and autonomous driving systems.
- **Inter-Vehicle (Inter-V):** Inter-V facilitates communication between multiple vehicles, enabling synchronized movement in fleets or convoys. It supports coordinated driving, especially in autonomous vehicle scenarios.
- **Vehicle-to-Vehicle (V2V):** V2V enables vehicles to exchange safety-related information directly with one another, such as collision warnings and traffic updates. It enhances road safety and enables advanced driver-assistance systems.
- **Vehicle-to-Smartphone (V2S):** V2S allows vehicles to interact with smartphones for features like remote control and data syncing. It enables personalized experiences, such as adjusting vehicle settings based on the user’s preferences.

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- **Vehicle-to-Home (V2H):** V2H enables vehicles to interact with home systems, like using an EV's battery to power a home. It integrates vehicles with smart home devices for seamless automation.
- **Vehicle-to-Pedestrian (V2P):** V2P allows vehicles to communicate with pedestrians via mobile devices or wearables to improve safety. It sends alerts to both vehicles and pedestrians to avoid accidents in urban environments.
- **Vehicle-to-Infrastructure (V2I):** V2I enables vehicles to communicate with infrastructure like traffic signals and road sensors for optimized traffic flow. It provides real-time road condition updates and enhances driving efficiency.

Beyond these models, Social IoV also allows for trust-based decision systems, where vehicles evaluate incoming data based on the reputation of the source, much like how humans weigh online information based on who posts it. This helps filter out noise, misinformation, or malicious inputs, especially in open vehicular networks where data authenticity is a critical concern. However, unlike traditional social media, where incorrect information might lead to confusion or annoyance, in Social IoV, the consequences can be far more serious. Incorrect alerts, manipulated social data, or biased recommendations can compromise road safety or lead to inefficient routing. As a result, the social layer of IoV must be tightly coupled with robust verification, authentication, and ethical design protocols.

Ultimately, Social IoV signals a departure from purely data-driven mobility toward socially embedded, community-oriented vehicular ecosystems. It transforms how information is shared, how trust is built among drivers and systems, and how mobility decisions are collectively shaped. In the next section, we will explore specific applications and use cases that illustrate the practical potential of Social IoV in real-world environments.

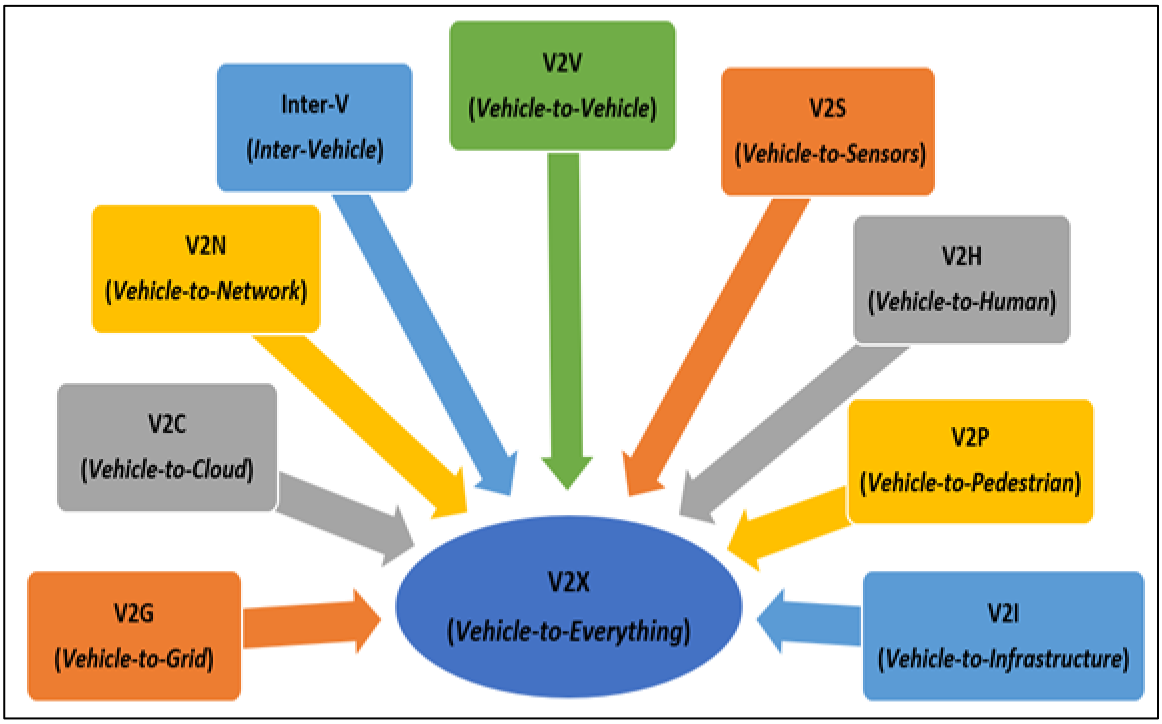

Fig 1: Types of Connectivity between Vehicles

Table 1: Major Studies Related to IoV and Social Networks

Reference No.	Year	Journal/ Conference	IoV	Social Networks	Research Contribution
[1]	2024	Journal	✓		Explored the integration of digital twins with the IoV. Two primary applications are majorly discussed: i) Single vehicle and digital twins, ii) the whole traffic system and the digital twins. They have proposed a four-layered architecture having layers: perception, transport, data analysis, and application layer.
[3]	2024	Journal	✓		Proposed the integration of Edge Intelligence (EI) in the context of IoV. They have proposed a layered vehicular EI architecture to exploit the potential of EI in heterogeneous IoV.

[4]	2022	Journal	✓		To alleviate the traffic congestion, Collaborative Edge Computing technique is proposed for the Social Internet of Vehicles. Uses a three-layer architecture combining vehicular edge computing (VEC), mobile edge computing (MEC), and traffic light control (TLC)
[5]	2020	Journal	✓	✓	A model is proposed for the sharing of information and recommendation systems for IoV. This agent-based model comprises of three entities: humans, vehicles, and points of interest
[6]	2020	Journal	✓		Proposed an edge information system (EIS) that includes edge caching, edge computing, and edge AI.
[7]	2019	Conference		✓	Discussed the two-fold nature of SIoV: VO-SIoV (Vehicle-Oriented Social Internet of Vehicles) and DO-SIoV (Driver-Oriented Social Internet of Vehicles).
[8]	2021	Journal		✓	Proposed a hybrid recommendation system "SafeDrive" , This system uses Dynamic Driver Profile (DDP) approach for the analysis of the drivers behaviour.
[9]	2014	Journal		✓	Proposed a route-recommendation system to provide the tourists with real-time personalized recommendations
[11]	2020	Journal	✓		Proposed a key agreement protocol to provide mutual authentication. This protocol uses an additional feature of user anonymity.
[13]	2020	Journal	✓		Provided a comprehensive survey on V2X technologies and explored the cloud-based IoV (CIoV)
[14]	2015	Journal		✓	A cyber-physical architecture is proposed for the Social IoV.
[17]	2021	Journal	✓		A Six-layered architecture model is proposed which is based on the protocol stack and network elements. A data analytics model is also proposed.
[18]	2021	Journal		✓	Cluster-based Distributed Service Discovery (CDSD) protocol has been proposed for the IoV networks.
[19]	2019	Journal		✓	The SPS discovery method (Social Profile Search) is proposed that used the relationships of the social networks to improve its navigability and scalability

IV. MAJOR COMMUNICATION TECHNOLOGIES FOR SIOV

The effectiveness of Social IoV hinges not just on its conceptual design but also on the robustness and adaptability of its underlying communication technologies. As vehicles transition from isolated systems to socially aware, data-exchanging agents, the demand for reliable, low-latency, high-throughput communication infrastructure has intensified. This section outlines the key communication technologies that form the backbone of IoV and, by extension, Social IoV.

➢ *Bluetooth:*

This wireless technology allows drivers to connect their smartphones with vehicle infotainment systems. It enables in-vehicle communication between the various sensors and devices. It allows for hands-free calling and audio streaming. Bluetooth can be used for V2V communication for sharing information with other vehicles. It has the capability to gather information regarding driving habits and behaviors, vehicle condition, and maintenance requirements.

➢ *Zigbee:*

A wireless protocol used for communications in low-powered and short-range applications. Zigbee provides intra-vehicle communication using in-vehicle sensors; V2V communication that helps in collision avoidance, and cooperative driving; V2I communication to interact with traffic lights and parking management systems; V2C communication as Zigbee can transmit data to the cloud for analysis. Zigbee uses encryption to ensure the security and authentication of devices and their data.

➢ *DSRC (Dedicated Short-Range Communication):*

The DSRC is based on IEEE standard 802.11p wireless communication technology that provides highly secure and high-speed data exchange in V2V and V2I. DSRC is based on Wi-fi technology that enables vehicles to share location, speed, direction, etc. DSRC helps in enhancing road safety, efficient traffic management, enhanced emergency response,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may544

eco-friendly driving, and support for autonomous vehicles. The key advantage of DSRC is its “see around corners”.

- *5G:*

5G is the integration of fifth-generation cellular network technology into automobiles and the surrounding ecosystem. The high speed and low latency connectivity of 5G provides enhanced vehicle connectivity, real-time data transmission, Autonomous driving, improved infotainment and user experience, edge computing, cloud services, and many more. 5G provides vehicle-to-everything communication, OTA (Over The Air) updates, remote vehicle control, fleet management, and connected road infrastructure. However, there are certain challenges in implementing 5G in the automotive industry, such as standardization and compatibility, security and privacy issues, regulatory and legal framework, and network reliability.

V. APPLICATIONS OF SOCIAL NETWORKS IN IOV

The conceptual value of Social IoV becomes truly tangible when examined through its practical applications. As vehicles begin to function not only as means of transport but also as social nodes, a wide array of innovative use cases has emerged, spanning safety, traffic efficiency, resource sharing, and personalized user experiences. This section explores some of the most prominent real-world and experimental implementations of Social IoV, demonstrating how the fusion of vehicular networks with social intelligence is redefining mobility.

- *Real-Time Collaborative Traffic Reporting:*

One of the most immediate and widely adopted applications of Social IoV is the use of real-time, community-driven traffic reporting. Unlike conventional navigation systems that rely solely on sensor data or historical traffic patterns, Social IoV systems aggregate input from drivers to provide up-to-the-minute updates on traffic congestion, road closures, construction, or accidents.

- *Socially-Aware Carpooling and Ride-Sharing:*

Social IoV also enables a smarter, more dynamic form of ride-sharing. By leveraging users’ social preferences, affiliations, or behavioral patterns, vehicles can identify compatible ride partners or form ad-hoc travel groups. This approach moves beyond basic route-matching algorithms by integrating trust and social compatibility into the equation. For instance, a vehicle might suggest carpooling options with individuals who are the part of the same workplace, university, or online community. In more sophisticated systems, users can set filters based on trust scores, past experiences, or mutual connections, making the ride-sharing experience not just efficient but comfortable and socially acceptable. This social filtering mechanism significantly increases the adoption of shared mobility, especially in regions where cultural or safety concerns have traditionally been barriers.

- *Context-Aware In-Vehicle Services:*

In Social IoV environments, vehicles can deliver highly personalized services based on the user's social identity and behavior. Examples include recommending restaurants based on friends’ reviews, alerting the driver to nearby events attended by their social circle, or syncing media preferences across vehicles. These services are built on the integration of social media APIs with vehicular infotainment systems, enabling real-time interaction with both the physical world and one's digital network.

- *Emergency and Safety Collaboration:*

Social IoV also offers critical advantages in emergencies. In the event of an accident, vehicles can automatically alert nearby users who have relevant skills, such as off-duty paramedics, mechanics, or first responders, within a given radius. These alerts can be customized based on social graphs or proximity and are particularly valuable in remote or congested areas where formal response times may be delayed. Similarly, when natural disasters disrupt infrastructure, socially-aware vehicular networks can serve as decentralized information channels, helping people coordinate evacuations, locate supplies, or reconnect with separated groups based on shared routes and locations.

VI. CHALLENGES AND RISKS IN ADOPTION OF SIoV

Despite its innovative potential, the Social Internet of Vehicles introduces a complex set of challenges that must be addressed for safe and ethical deployment.

- Privacy and Data Ownership: Social IoV systems collect vast amounts of personal and behavioral data, often passively. Without clear user consent and control, this raises significant privacy concerns. Users must have transparency over what is shared, with whom, and for what purpose.
- Trust and Misinformation: In socially driven networks, the authenticity of shared information becomes critical. False alerts or malicious data inputs can disrupt traffic or cause safety hazards. Trust models based on social reputation and source validation are essential but still under development.
- Cybersecurity Threats: Increased connectivity expands the system’s vulnerability to cyberattacks. Hackers could manipulate social data, intercept communication, or disable vehicular functions, posing real risks to safety. Robust encryption, intrusion detection, and authentication mechanisms are required.
- Ethical and Social Bias: Relying on social profiles can lead to biased decisions, such as excluding users based on limited online activity or reinforcing social inequalities. Fairness, inclusivity, and transparency must guide system design.
- Standardization and Interoperability: The lack of common protocols and data standards across manufacturers and regions hinders large-scale deployment. Interoperable frameworks are needed to ensure seamless communication between diverse platforms and devices.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may544

VII. FUTURE TRENDS AND DIRECTIONS

As Social IoV continues to evolve, several key areas require further research and development to address challenges and optimize its impact:

- Privacy Protection: Developing privacy-preserving technologies like differential privacy, data anonymization, and local data processing through edge computing will be crucial to ensure user data is securely managed.
- Decentralized Trust Systems: Future systems may leverage blockchain or federated learning to create decentralized trust networks, enhancing data integrity and security while reducing reliance on centralized authorities.
- Adaptive Communication Protocols: Research into low-latency, high-bandwidth communication protocols, especially using 5G, edge computing, and VANETs, will be essential to support real-time data exchange and social interactions.
- Social Behavior Modelling: Advanced models to predict group movement patterns and optimize traffic flow based on social interactions will help enhance route planning and traffic management in real-time.
- Policy and Regulatory Frameworks: Development of clear regulatory frameworks is needed to govern data sharing, security, and ethical design in Social IoV, ensuring equitable access and protecting user rights.

VIII. CONCLUSION

The Social Internet of Vehicles (Social IoV) offers a transformative approach to mobility by integrating social networking with vehicular communication. This innovation enables smarter traffic management, enhanced safety, and personalized in-vehicle experiences. However, challenges around privacy, trust, and security must be addressed for widespread adoption. The future of Social IoV depends on advancements in communication technologies, privacy protections, and ethical frameworks. With continued research and development, Social IoV can reshape transportation into a more connected, efficient, and socially aware system, benefiting both individuals and society as a whole.

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