**A Hybrid Drift-based LSTM model integrated with a hybrid RIS to predict the attack on the 6G network for V2X communication**

**1. Introduction**

Along with the huge advancements in technologies like smartphones, pervasive computing, and mobile communication, the smart transportation system has also achieved great advancements. Vehicle-to-everything (V2X) communication is the crucial part of these smart transportation systems, as it is necessary for the vehicle to make correct decisions for its movement and to ensure road safety in urban areas [7]. V2X communication is the interconnected network of millions of vehicles, sensors, and the infrastructure, and it is an important aspect for the development of the Autonomous Vehicle (AVs) [9]. The V2X system not only facilitates the exchange of information between vehicles, infrastructure, and other roadside units but also achieves accurate positioning of vehicles. Therefore, there is a high demand for a fast, continuous, and secure network for communication. To overcome this demand, the focus was shifted to the 6th-Generation (6G) network as it is more reliable than the existing networks; also, it helps in connecting several devices without lagging in connectivity to make continuous communication [10]. Unmanned Aerial Vehicle (UAV) communication and Reconfigurable Intelligent Surfaces (RISs) are necessary for enhancing the 6G network.

The places with high network tools are suitable for applying the UAVs to ensure that there is no pressure on the global networks due to the Wide Area Network (WAN) [11].One of the revolutionary technologies is the Reconfigurable Intelligent Surfaces (RIS) introduced for enhancing the multi-connective ability of the 6G network, as it can improve the quality of the signals, and it can be used for less energy consumption [16] Along with the development of 6G network RIS has become the important technology for the communication which has several cost efficient meta surface elements for shifting the signals for every units and it can also be easily integrated to avoid low performance [1].RIS can also be used for enhancing the security of the details shared through the network by increasing the quality of the signal to the receiver side and destroying it to the attacker side, as the security of the information transmitted through the interconnected network is becoming questionable due to attacks and illegal access [17] [12]. There are several methods introduced for enhancing the vehicular communication network safety by integrating the UAV and RIS technologies into the 6G network.

Though the RIS and UAV technologies integrated 6G network is more reliable than the existing networks, it faces several cybersecurity issues, like data breaches, eavesdropping, which cause a threat to the intelligent transportation system and V2X communication [18] [13]. Protecting the privacy of vehicle owners as well as the data during communication is very important therefore, if no privacy protections are implemented on top of authenticated communications, vehicles can be tracked remotely, and information about drivers and their personal behaviour can be inferred by authorities, infrastructure operators, and adversaries [14]. Some of the existing solutions based on AI technology require multi-sensor fusion for enhancing the communication, and some were not modelled to be adaptable to all the real-world situations. Certain UAV-assisted solutions are limited by the delay ratio, which was not satisfactory, and the DRL-based V2V communication requires a lot of computation time. To improve the capacity of the UAV and RIS-integrated 6G network [15] for fast, secure, and reliable communication, robust security solutions need to be implemented. To enhance intelligent learning and to make flexible decisions for the vehicle, there is a need for new solutions in the future.

**2. Literature review**

Long, X., *et al.* [1] developed a deep learning model for locating the vehicle for accurate communication by integrating the RIS mechanism, and a flexible deep deterministic policy gradient (FL-DDPG) algorithm was used as a solution to the optimization issue. The accuracy of locating the vehicle increased by 89% using this algorithm, which was found during the performance evaluation, and the developed model also performed better than various existing models. The suggested algorithm was not applied to the real hardware device, and a mechanism to identify the errors was not added.

Gharsallah, G. and Kaddoum, G., [2] introduced an Artificial Intelligence-based technique to improve the V2X communication by incorporating the LiDAR and wireless data, and also by iterating the simulation tools like the CARLA as well as the Sionna. By combining these mechanisms in a single approach, the introduced model performed better than the other existing models in terms of accuracy, efficiency, and analysis performed based on various scenarios, but it couldn’t predict the joint V2X, as it requires the fusion of multiple sensors.

Bashir, E., *et al.* [3] presented a method integrated with the double reconfigurable intelligent surfaces (RIS)for secure vehicle-to-Everything (V2X) communication, along with the integration of the improved gray wolf optimizer (IGWO) for enhancing the performance of the model. The introduced method outperformed various existing methods by gaining a greater accuracy rate and strength; however, the model was trained only with small inputs, and the model was not adaptable to various real-world updates.

Eskandari, M., *et al.* [4] provided an energy-efficient system for secure communication among the autonomous vehicles by utilizing the multi-output (MIMO) and the antennas of the communication station into the communication 6G network with the integration of reconfigurable intelligent surface (RIS). According to the experimental results, the introduced method achieved an accuracy of 0.2 meters; however, factors like environment and hardware can affect the resolving power.

Al-Rahamneh, A., *et al.* [5] introduced a method for communication among vehicles, specifically the bike, by combining the smart city to improve road transport in the city areas. The model was simulated with the complete 3D method, and certain technologies were used to improve its interaction ability; also, its performance was analysed with various performance metrics. The model's performance was better in various use case scenarios, but the method faces several technological as well as infrastructural challenges due to the deficiency of infrastructure and the fragmentation of the data.

Abou Houran, M., *et al.* [6] introduced a SISO system that was merged with several IRS for radio access networks (RAN) communication, which is based on the V2X. Clustering was used for combining the IRS into groups, and the Viterbi algorithm was used for determining the best IRS among the clusters. The model achieved great performance by increasing the transmitting strength during the validation, yet the model was not evaluated with large users and complex scenarios.

Mao, Y., *et al*. [7] developed a technique for maintaining the V2X communication, allocating and planning the requirements by integrating the RIS and UAV system. A distributed optimization algorithm was used to improve the overall performance of the introduced solution. The model was evaluated with several parameters to validate its capabilities, and the results showed that there was a reduction in the communication delay, but it did not focus on balancing the delay and the capacity of the system by dynamic alterations of the parameters.

Tang, H., *et al.* [8] presented a method using the graph neural network (GNN) for maintaining the continuous connection in the V2X communication network by integrating the RIS. The GNN model was used with adapters for maintaining the complex nature of the system to identify the coupling between the functioning of the vehicles, control stations, as well as several nodes. A SAC agent was used, and experiments were conducted using the real-time data, which showed that the introduced system performed better than existing techniques in terms of its continuous network connectivity during the communication; however, managing the complex communication and the requirements for the communication was challenging for the system.

**3. Challenges**

* The algorithm [1] needs further validation by applying it to the real hardware devices, and feedback options need to be included
* The resource requirements for the implementation of the introduced model [3]caused various challenges during the real-world deployment of the system due to its complex nature and the line-of-sight (LOS) conditions held for only a few times.
* The factors like environment, hardware, and the shifting of the RIS step could affect the robustness, reliability, as well as performance of the introduced method [4] in messy urban areas.
* [5] There were no completely developed platforms and tools for observing the effects and usage of the introduced solution among the citizens.

**4. Proposed Methodology**

To enhance the network safety in the 6G network integrated with the UAV and RIS technologies, the proposed solution introduces the Hybrid Drift-based Federated LSTM model for the accurate classification of the attacker and the normal. The 6G-based V2X is simulated using the Simulation of Urban Mobility (SUMO), and during the simulation, attacks like DDOS and Sybil will be simulated in the 6G network; also, the hybrid RIS will be integrated to improve the signal strength and coverage. A request will be made by the vehicles to the network for accessing the data transmitted through the network, and when the request is granted, the data will be accessed from the base station. The data stored in the base station will be given to the next step for authentication and validation, and after the validation, it will be fed into the Hybrid Drift-based Federated LSTM model for training. Border collie dog and Walrus optimization algorithms will be used to perform the optimization, as the combination of these algorithms will improve the classification accuracy and enhance the model’s performance. The trained model will be tested with the test data to ensure its accurate prediction in terms of accuracy, specificity, sensitivity, delay, throughput, and theoretical statistics, along with channel capacity and outage probability. After this, the model will be used for predicting the attacks, and the results will be updated to the Roadside Unit (RSU) through the base station. The implementation of the proposed model will be carried out in PYTHON. Moreover, the analysis will be done by considering normal and attack scenario. The systematic representation of the proposed model is illustrated in Figure 1.

6G based V2X simulation using SUMO

Base station data storage

Data Authentication and Validation

Hybrid Drift based Federated LSTM model

Model

Test data

Update to RSU through base station

Attacker

Normal

Walsay Optimization

Border Collie Dog

Request

Access

Simulate External Attacks in 6G (DDoS, Sybil)

Hybrid RIS

**Figure 1.** Structure of the proposed model

**5. Objectives**

* To develop an RIS-integrated 6G-based simulation data for detecting the attacks caused to the data transmitted during the V2X communication
* To access the data from the network and store it in the base station to perform authentication and validation on the data.
* To develop an efficient Hybrid Drift-based Federated LSTM model, integrate with optimization techniques for detecting attacks and update the information to RSU.
* To check the performance of the developed model in terms of accuracy, specificity, sensitivity, delay, throughput, and perform theoretical statistics.

**References**

[1] Long, X., Zhao, Y., Wu, H., and Xu, C.Z., 2024. Deep reinforcement learning for integrated sensing and communication in RIS-assisted 6G V2X system. IEEE Internet of Things Journal.

[2] Gharsallah, G. and Kaddoum, G., 2024. MVX-ViT: Multimodal collaborative perception for 6G V2X network management decisions using vision transformer. IEEE Open Journal of the Communications Society.

[3] Bashir, E., Hernando-Gallego, F., Martín, D., and Shoushtari, F., 2025. Secure Cooperative Dual-RIS-Aided V2V Communication: An Evolutionary Transformer–GRU Framework for Secrecy Rate Maximization in Vehicular Networks. World Electric Vehicle Journal, 16(7), p.396.

[4] Eskandari, M., Savkin, A.V. and Deghat, M., 2025. RIS-Enabled Energy Efficient Integrated Localization and Communication for Autonomous Vehicles: Complementary to Visual SLAM. IEEE Transactions on Green Communications and Networking.

[5] Al-Rahamneh, A., Astrain, J.J., Villadangos, J., Klaina, H., Guembe, I.P., Lopez-Iturri, P. and Falcone, F., 2022. Bi2Bi communication: Toward encouragement of sustainable smart mobility. IEEE Access, 10, pp.9380-9394.

[6] Abou Houran, M., Asad, M., Srivastava, G., Mirza, J., Ranjha, A., Javed, M.A. and Yang, X., 2024. Intelligent reflecting surfaces assisted cellular v2x based open ran communications. IEEE Transactions on Vehicular Technology, 73(7), pp.9226-9233.

[7] Mao, Y., Yang, X., Wang, L., Wang, D., Alfarraj, O., Yu, K., Mumtaz, S. and Yu, F.R., 2024. A high-capacity MAC protocol for UAV-enhanced RIS-assisted V2X architecture in 3-D IoT traffic. IEEE Internet of Things Journal, 11(13), pp.23711-23726.

[8] Tang, H., Zeng, W., Du, M., Zhao, P., Jiao, P., Wu, H. and Sun, H., 2025. VariSAC: V2X Assured Connectivity in RIS-Aided ISAC via GNN-Augmented Reinforcement Learning. arXiv preprint arXiv:2509.06763.

[9] Chen, X., Feng, W., Chen, Y., Ge, N. and He, Y., 2024. Access-side DDoS defense for space-air-ground integrated 6G V2X networks. IEEE Open Journal of the Communications Society, 5, pp.2847-2868.

[10] Ning, Z., Li, T., Wu, Y., Wang, X., Wu, Q., Yu, F.R. and Guo, S., 2025. 6G Communication New Paradigm: The Integration of Unmanned Aerial Vehicles and Intelligent Reflecting Surfaces. IEEE Communications Surveys & Tutorials.

[11] Cao, Y., Xu, S., Liu, J. and Kato, N., 2022. Toward smart and secure V2X communication in 5G and beyond: A UAV-enabled aerial intelligent reflecting surface solution. IEEE Vehicular Technology Magazine, 17(1), pp.66-73.

[12] Ghadi, F.R., Kaveh, M., Wong, K.K. and Martín, D., 2024. Physical Layer Security Performance of Cooperative Dual-RIS-Aided V2V NOMA Communications. IEEE Systems Journal.

[13] Sedjelmaci, H., Kaaniche, N., Boudguiga, A. and Ansari, N., 2023. Secure attack detection framework for hierarchical 6G-enabled internet of vehicles. IEEE Transactions on Vehicular Technology, 73(2), pp.2633-2642.

[14] Mande, S. and Ramachandran, N., 2024. A Comprehensive Survey on Challenges and Issues in V2X and V2V Communication in 6G Future Generation Communication Models. Ingenierie des Systemes d'Information, 29(3), p.951.

[15] Georgiades, M. and Poullas, M.S., 2023, June. Emerging technologies for V2X communication and vehicular edge computing in the 6G era: Challenges and opportunities for sustainable IoV. In 2023 19th International Conference on Distributed Computing in Smart Systems and the Internet of Things (DCOSS-IoT) (pp. 684-693). IEEE.

[16] Basharat, S., Hassan, S.A., Pervaiz, H., Mahmood, A., Ding, Z. and Gidlund, M., 2021. Reconfigurable intelligent surfaces: Potentials, applications, and challenges for 6G wireless networks. IEEE Wireless Communications, 28(6), pp.184-191.

[17] Lu, Z., Qu, G. and Liu, Z., 2018. A survey on recent advances in vehicular network security, trust, and privacy. IEEE Transactions on Intelligent Transportation Systems, 20(2), pp.760-776.

[18] Porambage, P., Gür, G., Osorio, D.P.M., Livanage, M. and Ylianttila, M., 2021, June. 6G security challenges and potential solutions. In 2021 Joint European Conference on Networks and Communications & 6G Summit (EuCNC/6G Summit) (pp. 622-627). IEEE.