Service needs. The network traffic control mechanism handled the quality of Service impacts on network congestion control. But, the load balancing time was not reduced. Markov Decision Process (MDP) was introduced in [6] with reasonable assumptions using Q-learning method. Though the packet delivery ratio was improved, the computational complexity was not reduced by using MDPRP.

A new vehicular and hoc network routing model was introduced in [7] with network quality measures. The designed model carried out the optimal route selection with minimal routing cost. However, the computational cost was not minimized by using vehicular ad hoc network routing model. For minimizing system costin [8],Multiple parked vehicle-assisted edge computing paradigm was designed. Multiple offloading node selection algorithm chose parked vehicles by mobile edge computing server in computing tasks. But,failed to enhance the load balancing efficiency.

For load balancing during vehicle ad hoc networks through ant colony optimization and artificial bee colony, suitable method was designed [9] with energy awareness. But, the computational complexity was not reduced. An SDN enabled location-aware routing was employed in [10] to handle workload nodes with minimum energy consumption constraints. But, the energy consumption was not reduced by using SDN enabled location-aware routing.

A two-period game was introduced in [11] handled the decision making of vehicles and internal resource competation.Every vehicle increased throughput through Medium Access Control (MAC) and Physical layers.But, the load balancing efficiency was not enhanced by two-period game, Volunteer computing-based VANET and various methodsweredesigned [12]. For fault tolerance through task failure avoidance, An Adaptive task replication method was used. However, it was failed to minimize the computational complexity level.

III LOAD BALANCE IN VANET

VANET is the largest developing machinery in wireless networks using mobile vehicles. Intelligent Transport System (ITS) provide large applications for vehicle safety and entertainment purposes. Road Sided Unit (RSU) are hardware situatedby roadside to perform connective device for supporting moving vehicles. On Board Unit (OBU) are hardware wassituated on movable node. It has giventransceivers the data where data received was sent to RSU. OBU are hardware positioned on movable nodes. OBU are given with the transceivers where the information received sent to the RSU or nearby vehicles. RSU are linked with peer-to peer networks and to the Base Station (BS). Load balancing effectively dispenses incoming network traffic across collection of backend servers.

A.Adaptive Load Balancing schema for data distribution

Data dissemination in VANET has large vision to promise security during V2V as well as V2I communication. Effective data dissemination method was designed with vehicles during existing RSU in accommodatingmanner. Emergency dissemination was performed asan accident, assist to the driver forreceiving suitable measures. On-Demand service requests were the messages which were served with request received from vehicle. The designed model pondered the real time delay to provide the large information flow between vehicles without any jitter. ACLBincluded three functions. Majorpurpose included property of request distributionfor suitable RSU which need is serviced. Bandwidth scheduled service was present RSU purpose. Requests were feasible for server allocated to road server unit. Scheduling process played key role in VANET with minimal time consumption and higher efficiency. An effective data dissemination model algorithm scheduled response messages in queue with criteria. Every algorithm gets varied in priority.

B. G-3MRP: Game-theoretical multimedia multimetric map-aware routing protocol

New game-theoretical approach with geographical routing protocol was designed for VANETs in smart cities. Game theory was measured as motivating theoretical structure to examine, optimize resource distribution issues during digital communication situations. The designed approach improved the VANET performance in urban scenarios with minimal packet loss. The designed approach considered different QoS parameters to choose subsequently forwarding vehicle for every packet during hop to packet destination. The designed approach was used to achieve multimeric score. Weights of QoS metrics were self-configured for calculatingas well as modernize weights all over time consistent with current state of environment.

C. Energy-SLA-aware genetic algorithm in vehicular networks

VANET was a developing technology with comfortable,effective travel experience for implementing applications. Mobile vehicles in VANET were classified through minimum computational, memory usage facility. New offloading algorithm optimized energy of computing platforms wasbased on Evolutionary Genetic Algorithm (EGA). The designed algorithm has used the adaptive penalty function to include the optimization constraints within EGA. The designed algorithm executed the vehicle request on edge server where the request was submitted to the cloud servers. The offloading decision was carried out where total energy consumption of all requests was minimized through maintaining every request SLA of latency and processing time requirements. The designed offloading algorithm in vehicular networks reduced the total energy consumption of vehicle requests. The optimization NP-hard problem was addressed through adaptive penalty function to attain near-optimal solution in polynomial time.

D. Chaotic Grey Wolf Optimization-based resource distribution

Device-to-device (D2D) permitted straight message amongV2X devices. An efficient power control and radio sub-channel allocation method presented needs for information traffic with number of vehicular devices. Resource distribution issue was addressed in V2X networks. VUEs were classified as safety and non-safety VUEs. The designed scheme increased system throughput while preserving the QoS. Chaotic Grey Wolf Optimization (CGWO) algorithm was used to address the resource allocation issue in V2X communication. CGWO was used with chaos to enhance the GWO performance. The logical maps were employed to establish chaos for optimization algorithm. The maps were dynamic with mathematical equation to discover search space.

E. QoSA-ICN: Quality of Service Aware- Information-Centric Networking

Quality of Service Aware- Information-Centric Networking (QoSA-ICN) was introduced for classifying request priority with QoS needs through codifying object during interest/data packets. It converge route through multi-hop for eradicating pre-building route overhead. Network traffic control method was employed for controlling possible brunt of QoS. An information-centric design was carried out for vehicular architecture. In QoSA-ICN, vehicular nodes handled time-perceptive information during disseminated manner. QoSA-ICN architecture allowed content obtainability and broadcasting to accommodate the data requests. Flexible QoSA-ICN architecture increased data broadcasting for time-sensitive contents. The vehicular scenario was assumed for estimation through real traffic data delivery needs. QoS facilitate ICN and vehicular network minimized data arrival time for crisis incidents.

F. Joint Load Balancing and Offloading

MPVEC paradigm was designed with computing tasks. Workload distribution strategy was introduced for optimizing system performance. Offloading approach minimize system rate. Joint load balancing optimization has reduced the system cost under delay limitations. Offloading included offloading node selection and workload distribution. Efficient workload distribution policy depend on dynamic game was used for optimizing system effectiveness through load balancing.

IV. PERFORMANCE ANALYSIS OF DIFFERENT LOAD BALANCED DATA COMMUNICATION TECHNIQUES IN VEHICLE AD-HOC NETWORK

In order to perform the different load balanced data communication techniques, number of vehicle nodes is taken as an input to conduct the experiment. Experimental evaluation of six methods namelyefficient power control and radio sub-channel allocation schemeAdaptive Co-operation on Load Balancing (ACLB),game-theoretical approach, novel offloading algorithm, information-centric design and MPVEC paradigm are carried out. Result analysis of existing load balanced data communication are estimated with certain parameters are,

Load balancing efficiency(LBE),
Load balancing time and(LBT)
Energy consumption(EC)
Impact on LBE

LBE is mea*sured as ratio of number of vehicle nodes which are correctly balanced load to number of vehicle nodes. LBE is measured in percentage (%). It is calculated as,*

*LBE=(Number of vehicle nodes that are correctly balanced load)/(Number of vehicle nodes)*100* (1)

From (1), load balancing efficiency (LBE) is calculated.

Number of Vehicle Nodes	Load Balancing Efficiency (%)					
	ACLB	G-3MRP	Offloading Algorithm	Resource Allocation	ICN	MPVEC paradigm
100	88	85	72	80	76	78
200	90	87	75	82	78	80
300	87	84	73	79	75	77
400	85	82	70	77	72	75
500	83	80	68	75	70	73
600	86	83	71	78	73	76
700	88	85	73	80	76	78
800	90	88	76	83	78	80
900	92	90	78	85	81	83
1000	95	92	80	87	83	85

Table 1 Tabulation of LBE

Table 1 : Explains of load balancing efficiency with vehicle nodes..When vehicle nodes gets increased, load balancing efficiency gets enhanced or reduced. Vehicle nodes is 400, load balancing efficiency of ACLB, game-theoretical approach, novel offloading algorithm, efficient power control and radio sub-channel allocation scheme, information-centric design and MPVEC paradigm is 85%, 82%, 70%, 77%, 72% and 75%.

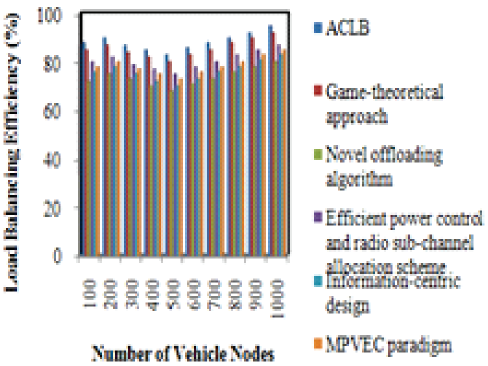

Figure.1 Load Balancing Efficiency Measure

Figure 1: Describes load balancing efficiency measure versus vehicle nodes. From figure, load balancing time of ACLB is higher than conventional techniques. This is due to using efficient data distribution method for vehicles during accessible RSU. On-Demand service requests served with the request received from vehicle. The designed algorithm used adaptive penalty function with optimization constraints. By this way, the load balancing efficiency gets increased. As a result, ACLB increases load balancing efficiency by 3%, 20%, 16%, 13%, and 10% when compared to the game-theoretical approach, novel offloading algorithm, information-centric design and MPVEC paradigm, efficient power control and radio sub-channel allocation scheme.

B.Impact on LBT

LBT is measured as product of number of vehicle nodes as well as amount of time utilized to perform load balancing. *LBT* is measured in milliseconds (ms). LBTis calculated as,

LBT = N * Time consumed by single vehicle node for load balancing (2)

From (2), load balancing time (LBT) is determined.

Number of Vehicle Nodes	Load Balancing Efficiency (%)					
	ACLB	G-3MRP	Offloading Algorithm	Resource Allocation	ICN	MPVEC paradigm
100	40	38	21	35	27	32
200	43	40	23	37	29	34
300	45	43	25	39	31	36
400	48	44	28	42	33	39
500	50	46	30	45	35	41
600	52	48	32	47	37	44
700	54	50	35	49	39	47
800	57	52	38	51	41	49
900	60	54	40	53	43	51
1000	62	56	42	55	45	54

Table 2 Tabulation of Load Balancing Time

Table 2: Describes load balancing time with vehicle nodes. When vehicle nodes areenhanced, load balancing time gets higher. Vehicle nodes is 600, load balancing time of ACLB, game-theoretical approach, novel offloading algorithm,information-centric design and MPVEC paradigm ,efficient power control and radio sub-channel allocation scheme, is 52ms, 48ms, 32ms, , 37ms and 44ms, 47ms

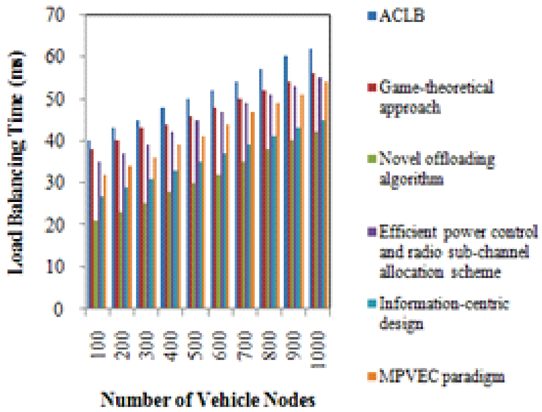

Figure 2. Load Balancing Time Measure

Figure 2 describes load balancing time measure with number of vehicle nodes. Through the figure, the load balancing time of novel offloading algorithm is minimum than other conventional techniques. As a result, novel offloading algorithm reduces the load balancing time by 39%, 34%, 14%, and 27%,31% when compared to the ACLB, game-theoretical approach, information-centric design and MPVEC paradigm, efficient power control and radio sub-channel allocation scheme.

A.Impact on EC

It is measured as product of amount of energy utilizedin single vehicle node to total number of vehicle nodes. ECis estimated in Joules (J). It is computed as follows,

$$EC = N * \text{Energy consumed by single vehicle node} \quad (3)$$

From (3), energy consumption '*EC*' for data communication is calculated. '*N*' symbolizes the number of vehicle nodes.

Number of Vehicle Nodes	Load Balancing Efficiency (%)					
	ACLB	G-3MRP	Offloading Algorithm	Resource Allocation	ICN	MPVEC paradigm
100	35	27	24	12	18	22
200	37	29	25	15	20	24
300	39	31	27	18	23	26
400	42	33	29	20	25	29
500	44	35	31	23	27	31
600	47	37	33	24	30	33
700	49	39	37	27	32	35
800	51	41	40	29	35	38
900	53	44	42	31	38	40
1000	55	46	43	34	40	42

Table 3 Tabulation of Energy Consumption

Table 3: Explains energy consumption with vehicle nodes. When vehicle nodes getenhanced, energy consumption gets higher. Vehicle nodes is 800, ECof ACLB, game-theoretical approach, novel offloading algorithm, information-centric design and MPVEC paradigm, efficient power control and radio sub-channel allocation scheme, is 51J, 41J, 40J, 35J and 38J, 29J

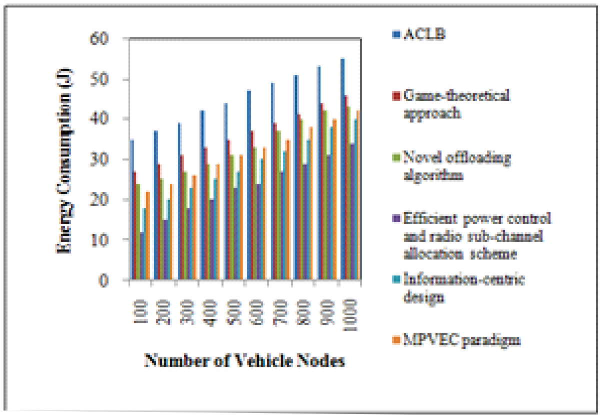

Figure 3 Measurement of Energy Consumption

Figure 3: Depicts energy consumption measure versus number of vehicle nodes. This is because of applying CGWO algorithm to address resource distribution issue in V2X

communication. The chaos designated the deterministic method for nonlinear dynamic system. By this way, the energy consumption gets reduced. As a outcome, efficient power control and radio sub-channel allocation scheme minimizesEC by 50%, 37%, 31%, and 29% , 20%, when compared to ACLB, game-theoretical approach, novel offloading algorithm , information-centric design and MPVEC paradigm, efficient power control and radio sub-channel allocation scheme.

V. DISCUSSION OF LIMITATIONS ON LOAD BALANCED DATA COMMUNICATION TECHNIQUES IN VANET

Adaptive Load Balancing Scheme was introduced for effective information distribution in v2i communication. The designed scheme used the allocation property of requests to appropriate RSU. Designed scheme minimized the delay time. But, the load balancing time was not minimized by ALBS. A new game-theoretical approach was designed to forward video-reporting communication in elegant cities. Game theory analyzed and optimized resource distributionissuesduring digital communication scenarios. The designed approach reduced packet loss. But, load balancing efficiency was not improved by using .game-theoretical approach.

CGWO algorithm addressed resource allocation problems in V2X communication. Addressed the demands for data traffic control with large number of vehicular devices, Power control and radio sub-channel allocation scheme is designed.CGWO increased the throughput. But, the computational complexity was not minimized by CGWO algorithm. New offloading algorithm minimized energy of edge computing platform. The computational cost was not minimized by offloading algorithm. MPVEC model assigned the workload among MEC server and parked vehicle. Reduced system cost under delay constraints, Joint load balancing and offloading optimization is designed. But, LBEwas not improved by MPVEC paradigm.

A. Future Direction

The future direction of the work is to perform an efficient load balanced data communication by using machine learning methods through higher efficiency,minimum time consumption.

VI. CONCLUSION

A performance analysis of different load balanced data communication techniques is carried out. In the study, the load balancing efficiency was not increased by MPVEC paradigm. In addition, the computational complexity was not minimized by CGWO algorithm. The load balancing time was not minimized by ALBS. Broad experiment on existing techniques calculates the outcome of various load balanced data communication techniques and discusses its problems. From the outcome analysis, research work is performedby machine learning and ensemble learning techniques for load balanced data communication with higher efficiency and lesser time consumption.

References

[1] Vijayakumar V and Suresh Joseph K, "Adaptive Load Balancing Schema for efficient data dissemination in Vehicular Ad-Hoc Network VANET", Alexandria Engineering Journal, Elsevier, Volume 58, 2019, Pages 1157-1166

[2] Ahmad MohamadMezher and Mónica Aguilar Igartua, "G-3MRP: A game-theoretical multimedia multimetric map-aware routing protocol for vehicular ad hoc networks", Computer Networks, Elsevier, Volume 213, 2022, Pages 1-17

[3] HunedMaterwala, Leila Ismail, Raed M. Shubair and RajkumarBuyya, "Energy-SLA-aware genetic algorithm for edge–cloud integrated computation offloading in vehicular networks", Future Generation Computer Systems, Elsevier, Volume 135, 2022, Pages 205–222

[4] IbtissemBrahmi, MoniaHamdi and FaouziZarai, "Chaotic Grey Wolf Optimization-based resource allocation for Vehicle-to-Everything communications", International Journal of Communication Systems, Volume 35, Issue 15,

October 2022, Pages 1-19

[5] Jessica McCarthy, S. R. Chaudhry, PerumalKuppuudaiyar, RadhikaLoomba and Siobhan Clarke, "QoSA-ICN: An information-centric approach to QoS in vehicular environments", Vehicular Communications, Elsevier, Volume 30, 2021, Pages 1-30

[6] Juan Aznar-Poveda, Antonio-Javier Garcia-Sanchez, Esteban Egea-Lopez, and Joan Garcia-Haro "MDPRP: A Q-Learning Approach for the Joint Control of Beaconing Rate and Transmission Power in VANETs", IEEE Access, Volume 9, 2021, Pages 10166 - 10178

[7] Tony SanthoshGnanasekar and DhandapaniSamiappan, "Impact of hybridized rider optimization with cuckoo search algorithm on optimal VANET routing", International Journal of Communication Systems, Wiley Open Access Journal, 2021, Pages 1-21

[8] Xinyue Hu, Xiaoke Tang, Yantao Yu, SihaiQiu and Shiyong Chen "Joint Load Balancing and Offloading Optimization in Multiple Parked Vehicle-Assisted Edge Computing", Wireless Communications and Mobile Computing, Hindawi Publishing Corporation, Volume 2021, 2021, Pages 1-13

[9] RenQun and Seyedeh Maryam Arefzadeh, "A new energy-aware method for load balance managing in the fog-based vehicular ad hoc networks (VANET) using a hybrid optimization algorithm", IET Communications, Wiley Publications, Volume 15, 20121, Pages 1665-1676

[10] KumariRenuka, DiptenduSinha Roy and K. Hemant Kumar Reddy, "An SDN empowered location aware routing for energy efficient next generation vehicular networks", Authors. IET Intelligent Transport Systems, Volume 15, 2021, Pages 308–319

[11] Zemin Sun, Yanheng Liu, Jian Wang, Rundong Yu, and Dongpu Cao, "Cross-layer tradeoff of QoS and security in Vehicular ad hoc Networks: A game theoretical approach", Computer Networks, Elsevier, Volume 192, 2021, Pages 1-19

[12] Abdul Waheed, Munam Ali Shah, Abid Khan and GwanggilJeon, "An infrastructure-assisted job scheduling and task coordination in volunteer computing-based VANET", Complex & Intelligent Systems, Springer, 2021, Pages 1-14