International Journal of Advanced Trends in Engineering and Management
(ISSN 2583-7052)

Vol. IV, No. 12, pp. 51-63, December

AI and Optimization-Based Routing Protocols in Manet: A State-of-the-Art Review

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ABSTRACT: In Mobile Ad Hoc Networks (MANET), a massive investigation has been conducted in recent years for increasing the efficiency of routing protocols. MANETs are dynamic, infrastructure-less wireless networks where each mobile node functions as both host and router. Due to frequent topology changes, limited bandwidth and energy constrains, efficient and reliable routing remains a critical challenge in MANETs. Traditional routing protocols often struggle to maintain performance in such highly dynamic environments. In recent years, Artificial Intelligence (AI) and optimization techniques are emerged as promising solutions to enhance routing efficiency, adaptability and robustness. This paper presents a comprehensive review of the current state-of-the-art in AI and optimization-based routing protocols in MANETs. Various methodologies including Machine learning (ML), Deep learning (DL) and Optimization techniques are analyzed and compared in terms of performance metrics such as packet delivery ratio, delay, energy consumption and scalability. The review also identifies key challenges, limitations and future research directions to guide the development of next-generation intelligent routing solutions in MANETs.

Keywords: Mobile Ad Hoc Network, Routing protocol, Comparison of routing protocol, Machine learning, Deep learning, Optimization.

1. Introduction

For wired communication media, an electrical cable is utilized for carrying data from its source to its destination. More cables and ports are required, where the fibre optic cables and the entire wired media is expensive. In order to overcome these issues, wireless communication is used. Wireless communication is referred as unguided media where messages are through air, water, infrared, radio wave and micro wave [1]. Thus medium like ports and cables are not necessary to transfer messages. Early wireless network like Packet Radio Network (PRNET) had limitations in terms of mobility, as devices remained typically connected to a specific access point or base station [2].

In modern era, MANET is considered as the most prominent field for growth of wireless network. MANET is a distributed network comprising of mobile nodes that communicate with one another without depending on a fixed infrastructure. The MANET's mobility is an important parameter that affects the network performance very quickly. Decision about switching networks are handled by mobility management. The advantages of MANET are, it is highly scalable and suits the expansion of more network hub and forms a highly dynamic autonomous topology with the presence of one or multiple different transceivers between nodes [3]. Figure 1 displays the diagram of MANET. Furthermore, to discover shortest paths and forward data packets through intermediate nodes, allowing for MANET communication routing is essential [4]. Routing protocols in MANET are classified into three types, Proactive, Reactive and Hybrid. Figure 2 displays Routing protocols of MANET.

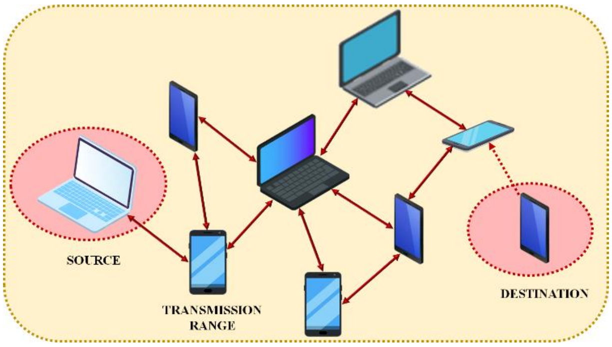


Figure 1: *Mobile Ad Hoc Network*

The proactive protocols ensure each other's routing information recent and consistent. Each node is forced by these protocols to maintain up with routing table modifications and change with alterations in the network design. In order to maintain an identical view, modifications are transmitted throughout the network. The advantages of proactive protocols is low latency for data transmission as routes are readily available. However, it has high overhead due to frequency updates, especially in dynamic networks. Some of the proactive protocol includes Destination Sequenced Distance Vector (DSDV) and Global State Routing (GSR). However, it suffers from high overhead due to constant routing table updates, especially in large networks and waste bandwidth even when the network is idle and GSR experience increased path length and instability at high mobility due to frequent cluster head changes. [5-7].

On-demand routing information is produced by reactive routing protocols. Dynamic Source Routing (DSR) and Ad-Hoc on Demand Vector Routing Protocol (AODV) are two significant implementations of reactive routing system. Only when establishing a transmission session is necessary to finding route process. However, it takes a long time to re-establish a new route in the event of a route failure [7-8].

Reactive and proactive routing techniques are used in hybrid routing systems to better handle different network sizes and node mobility. However, it have various drawbacks include increased complexity, potential inconsistencies, and higher resource demand [9]. To overcome the issues in routing protocols an advanced routing protocols are practised which includes ML, DL and Optimization.

***Related Works*:**

Satveer Kour *et al* (2025) [10] have implemented the effects of Terrain Dimensions and Network Scalability using evaluation of MANET routing protocols. Terrain dimensions are used for an area of land or a type of land when considering the physical features of a designed scenario. For the analysis of routing protocols over numerous terrain dimensions and scalability, Network Simulator is utilized. However, larger terrains and increased node density lead to increased routing overhead and longer route discovery times.

Beom Kyu Suh *et al* (2025) [11] have suggested a deep reinforcement learning and unsupervised learning in MANETs using a robust routing structure to reduce update expenses. It is used to establish paths in MANET and these protocol, gathers nodes based on mobility and connection characteristics to select reliable paths. Nevertheless, it suffers from scaling problems with an excessive amount of state and action spaces due to the complexity of updating reward values in reaction to frequent topology changes.

Agnes Shifani *et al* (2024) [12] have presented a logical and secure routing protocol for intelligent data transmission over MANET. Developing secured and logical routing protocol for MANET is crucial for enabling intelligent data communication, particularly in dynamic conditions. These networks are characterized by their decentralized nature, dynamic topology and the requirement for effective and reliable routing protocols to facilitate data exchange. Nonetheless, these include increased overhead due to security measures, scalability limitations as the network grows and potential vulnerabilities to attacks like black hole attack.

Ahmed M. Eltahlawy *et al* (2024) [13] have introduced an enhanced AODV protocol in MANETs for the detection of sequence number attacks. It is used to detect and mitigate sequence number attacks, which exploit vulnerabilities in the AODV routing protocol by manipulating sequence numbers to disrupt routing. Though, it faces complexity in implementation and possible susceptibilities in the chosen security mechanism. Moreover, some solutions remain not to be scalable for very large and active networks.

Liana Qabajeh *et al* (2024) [14] have proposed a MANET using dynamic scalable energy aware routing protocol. It targets to optimize energy consumption while efficiently routing data packets in a network where nodes move and the network topology changes frequently. These protocols are crucial for MANETs rely on battery powered devices and efficient energy usage for network durability and dependability. Conversely, these protocols often struggle with load balancing and maintaining network connectivity, especially during high mobility consequences.

***Problem Statement*:**

Choosing the best and direct track to travel the informations from source to destination is the main purpose of routing protocol but the existing protocols have some limitations which include increased complexity, potential inconsistencies, higher resource demand and more overhead due to frequency updates, especially in dynamic networks. ML, DL and Optimization based variance detection models provide better responsiveness and efficiency for finding the shortest path.

AI based technologies are essential for detecting the best and shortest path for data transmission. This paper provides a performance-driven existing routing protocols demonstrating their features and abilities.

The main objectives of the discussed approach are given below:

- ❖ To predict the shortest path ML technique is practised.
- ❖ To identify the best and shortest path DL techniques is used.
- ❖ To explore modern difference detection methods, optimization technique is introduced in this paper.

1.1 Review of ML based Routing approaches in MANET

This section reviews the detection of best and shortest path to transfer data from source to destination based on AI-driven optimization techniques.

1.1.1 Support Vector Machine (SVM)

SVM is well-suited for classification and regression tasks, particularly when dealing with high-dimensional data and non-linear relationships. In the context of MANETs, SVM trained to classify which available path is likely to be the shortest and most efficient, considering multiple input features such as, node mobility, residual energy, hop count and link quality. After training, the SVM model determines the shortest or best-quality path by dynamically predicting the route among multiple possibilities.

$$\max_{\alpha} \sum_{i=1}^{n} \alpha_i - \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \alpha_i \, \alpha_j y_i y_j K\left(z_i, z_j\right) \quad (1)$$

The above equation is subject to,

$$\sum_{i=1}^{n} y_i^t \, \alpha_i = 1{,}0 \leq \alpha_i \leq c, i = 1, \dots, n \& \forall_i = 1,2,3, \dots, n \quad (2)$$

The final discriminate function is,

$$f(z) = \sum_{i=1}^{n} \alpha_i \, K\left(z_i, z_j\right) + b \quad (3)$$

Where, b is the bias term and $K\left(z_i, z_j\right)$ is a kernel matrix which needs to be defined during performing SVM. Radial basis kernel is mathematically defined as, Figure 2 shows the structure of SVM.

$$K\left(z_i, z_j\right) = \exp(-\gamma \left\| z_i - z_j \right\|^2) \quad (4)$$

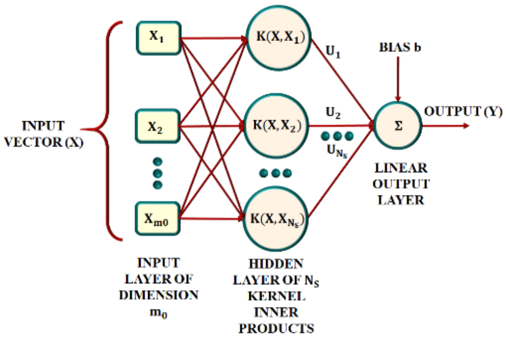


Figure 2: *Structure of SVM*

However, SVM face several challenges when applied to MANET include computational difficulty, sensitivity to parameter tuning and difficulty in handling high dimensional data [15].

1.1.2 Random Forest (RF)

To forecast the shortest routing path in MANET using RF involves leveraging machine learning to predict the most efficient path between source and destination nodes based on various network features. Instead of using traditional shortest path algorithms like Dijkstra or AODV, RF is trained on features such as hop count, signal strength, node energy, link reliability, and delay to classify or rank potential routes. During routing, the RF model evaluates multiple path options and selects the one predicted to offer the best performance, often balancing path length with stability and reliability. This approach allows for more adaptive and intelligent routing in the highly dynamic MANET environment. This section explains the formula employed for calculating the RF prediction.

$$\hat{y} = \frac{1}{N} * \sum i\,, N \qquad (5)$$

Where N is the overall amount of decision-making trees in the forest, yi is the expected result of the ith decision tree, and $\hat{y}$ is the predicted output. Figure 3 shows an illustration of the RF diagram.

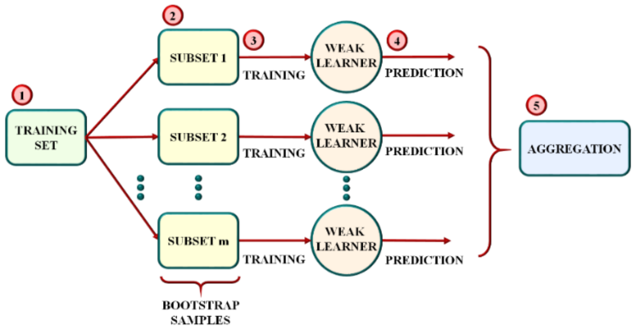


Figure 3: *Structure of RF*

Unlike traditional routing protocols that rely on predefined rules, RF learns from historical network behavior and adapts to changing conditions, helping reduce packet loss and improve route stability. However, implementing RF in MANETs presents challenges such as increased computational overhead, energy consumption, and the need for quality training data, which must be carefully managed due to the limited resources of mobile nodes. Despite these challenges, RF offers a promising data-driven alternative to enhance routing decisions in MANETs [16].

1.1.3 Naïve Bayes (NB)

NB is a ML technique that employed to diminish the risks of malicious packet dropping attacks in MANET. NB is a supervised ML algorithm based on the Bayes theorem. Bayes theorem states that,

$$P\left(\frac{Y}{X}\right) = \frac{P\left({}^{X}\!/_{Y}\right) * P(Y)}{P(X)} \qquad (6)$$

In the above equation $P(X)$is constant and add extra calculation in the computation, hence the above formula is modified as,

$$P\left(\frac{Y}{X_I}\right) = \sum_i P\left(\frac{X_i}{Y}\right) * P(Y) \qquad (7)$$

Equation (7) gives the result of NB classifier. Figure 4 shows the NBs algorithm in ML.

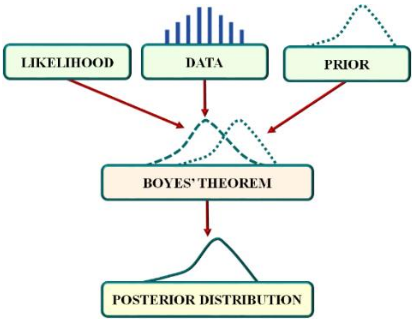


Figure 4: *NBs algorithm in ML*

The Bayes Theorem, which acts as the foundation for the NB technique, states that the likelihood of a hypothesis being verified by information corresponds to the likelihood of the evidence confirming the hypothesis equals the hypothesis's prior probability. To avoid data loss in mobile networks lacking infrastructure, the work proposes an automated intrusion detection system based on NB. However, network security and performance are at risk by targeted dropping of packets or system failures. [17].

1.2 Review of DL based Routing approaches in MANET

In many instances, DL is more efficient than usual ML algorithms since it gathers important characteristics from data eliminating the need for manual engineering. The primary subcategories of DL involves,

1.2.1 Deep Neural Network (DNN)

In MANETs, where network topology changes frequently due to node mobility, finding the shortest and most reliable path is a critical challenge. Traditional routing protocols often struggle with high overhead and slow adaptation. DNN is used to logically predict the shortest path by learning patterns from various network parameters such as node positions, signal strength, link quality, energy levels, and traffic conditions. By training on simulated or real-world network data, the DNN quickly predict the optimal route between a source and destination without the need for constant route discovery or maintenance. This approach reduces routing overhead, improves decision-making speed, and adapts better to dynamic environments, making it an efficient solution for real-time, scalable routing in MANETs. Figure 5 indicates the DNN classifier. A neural network's single layer is formed as,

$$y = g(w^T x + b) \tag{8}$$

Where x is the input data, b is a bias term, g is the activation function, y is the output layer and w are the weights. DNNs are a core component of DL and are often used in applications that require high accuracy and the capability to hold complex data.

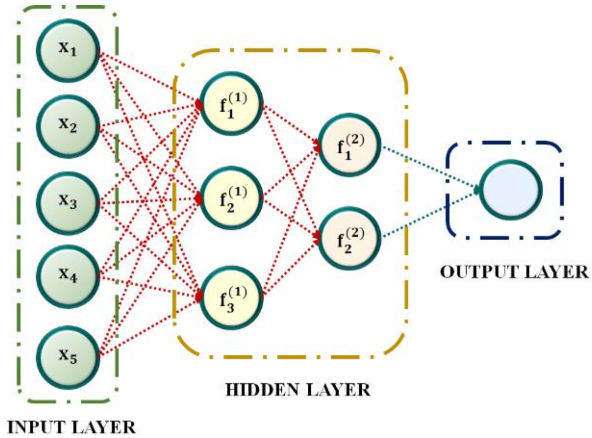


Figure 5: *DNN classifier*

However, DNN require high computational power and large amounts of training data, which are difficult to obtain in the dynamic and resource-constrained environment of MANETs. These networks consist of mobile nodes with limited processing capacity and energy, making it impractical to run or update complex models in real-time. Additionally, DNN struggle to adapt for rapid topology changes, leading to poor generalization in real-world scenarios. Their black-box nature also makes them difficult to interpret or debug, which is problematic for critical applications. [18].

1. 2. 2 Convolutional Neural Network (CNN)

CNN are a type of DL model increasingly employed in MANETs, particularly for tasks like intrusion detection and network security. While CNNs are primarily known for image processing, their ability to learn hierarchical features from sequential or grid-like data makes them suitable for analyzing network traffic patterns in

MANETs. This sort of feed forward neural network is capable of performing the convolution operations labelled in equation 9 with a multi-dimensional filter and multi-dimensional data. Through performing the similar symmetrical modifications to several altitudinal positions within the input data, the layers are able to identify local patterns. Figure 6 represents the diagram of CNN.

$$S(i,j) = (K * X)(i,j) = \sum_m \sum_n X(i-m, j-n)\, K(m,n) \quad (9)$$

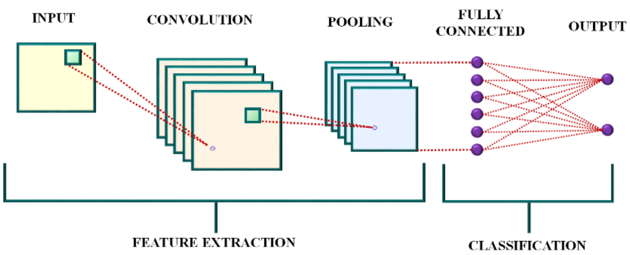


Figure 6: *Architecture model of CNN*

In order to generate a feature map S with dimensions i by j, the process of convolution operates through using the dot product of the filter K for dimension m by n and the input data all through the input space. CNNs perform best with collections that possess a grid-like framework, like times series data and images. For the purpose to enhance efficiency and reduce the memory requirement, the leverage parameter allocates the interactions. However, it often requires high computation, data dependency and interpretability challenges [19].

1. 2. 3 Long Short-Term Memory(LSTM)

To enhance MANET security, Location-Aided Routing (LAR) is integrated with an LSTM-based trust forecast mechanism. It is a modified version of a current neural network developed to minimize expenses and resolve the problems of disappearing and bursting gradients. Considering its unique structure, cell state and gates that regulate data transfer through the different layers, the LSTM method preserves information for a long period of time. Figure 7 depicts the diagram of the LSTM model. The LSTM equations are shown below.

$$i_t = \sigma(W_i x_i + U_i h_{t-1} + b_i) \quad (10)$$

$$f_t = \sigma\left(W_f x_t + U_f h_{t-1} + b_f\right) \quad (11)$$

$$O_t = \sigma(W_o x_t + U_o h_{t-1} + b_o) \quad (12)$$

$$\widetilde{C_t} = \tan h(W_c x_t + U_c h_{t-1} + b_c) \quad (13)$$

$$C_t = f_t \otimes C_{t-1} + i_{t-1} \otimes \widetilde{C_t} \quad (14)$$

$$h_t = O_t \otimes \tan h(C_{t-1}) \quad (15)$$

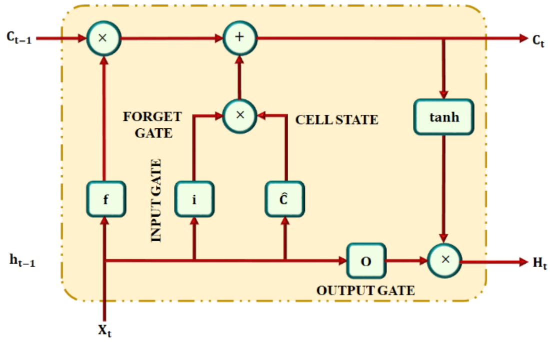


Figure 7: *Structure of LSTM*

This framework's concept is that the cell state performs as a memory unit, utilizing various gate operations to remember crucial information. The input gate filter removes the information which is added to the cell via the present input and previous data; the forget gate eliminates a portion of preceding material thus the cell erase the value it holds, and the output gate generates the material only when it is required. However, it includes computational complexity, overfitting and challenges in hyperparameter tuning [20].

1.3 Review of Optimization based Routing Approaches in MANET

1. 3. 1 Particle Swarm Optimization (PSO)

In the monarchy of MANET, PSO has been utilized to optimize diverse network parameters and elevate overall network performance. The benefits of using PSO in MANET is to optimize network parameters such as transmission power, route selection and cluster formation. By employing PSO, MANETs dynamically adjust network configurations based on changing environmental conditions, node mobility patterns and traffic loads leading to improved network efficiency and reliability. In PSO, every particle symbolizes a possible solution to the optimization problem and navigates through the multidimensional search space. Each particle's velocity is adjusted in every iteration based on its prior velocity its proximity to the best-known position it has encountered (local best) thus far, and its proximity to the best-known position among all particles in the swarm (global best). The flowchart of PSO algorithm is shown below. The point and velocity of particle i at iteration k are correspondingly conveyed as,

$$X_i(k) = [X_{i1}(k), X_{i2}(k), \ldots\ldots, X_{iN}(k)] \quad (16)$$

$$V_i(k) = [V_{i1}(k), V_{i2}(k), \ldots\ldots, V_{iN}(k)] \quad (17)$$

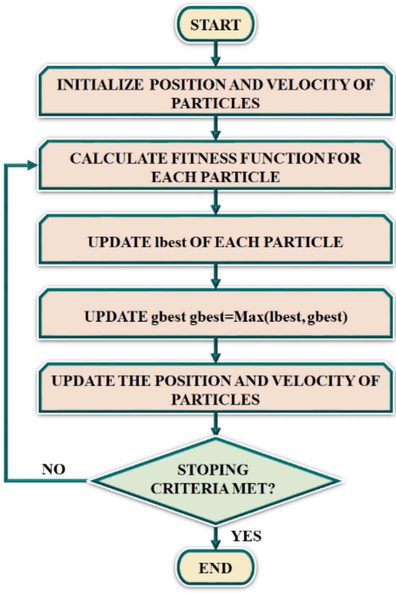


Figure 8: *Flowchart of PSO algorithm*

Particle i maintains a record of its coordinates in the solution space which matches the finest explanation of the particle is identified. Usually define this number as local best, *lbest*. The best value that any particle in the particle's surroundings possesses was far achieved is additional greatest value that the PSO monitors. Usually identify this value as *gbest*. The following expression is employed to estimate particle position and velocity at iteration $k+1$.

$$V_i(k+1) = WV_i(k) + C_1V_1\big(lbest(k) - X_i(k)\big) + C_2V_2\big(gbest(k) - X_i(k)\big) \quad (18)$$

$$X_i(k+1) = X_i(k) + V_i(k+1) \quad (19)$$

In this equation C_1 and C_2 are constants which determine the influence of the local best and the global best position, W is the inertia of weight However, it requires memory to update velocity, low quality solution and early convergence [21].

1. 3. 2 Artificial Bee Colony (ABC)

The ABC algorithm excels in optimizing complex, energy aware routing decisions in dynamic networks such as MANETs, due to its nature inspired search mechanism based on honeybee foraging behaviour. The ABC algorithm, inspired by the foraging behaviour of bee colonies, to identify the shortest path between source and destination nodes in MANETs. This technique targets to decrease the usual vigour custom of certain route in MANETs. New findings stood attained, based on the topological atmosphere, packet size and node speed. The approach is based on analyzing how actual bees behave while determining the amounts of nectar and notifying other bees in the hive regarding food sources. These bees seek out the finest nectar that possibly be kept in the hive. ABC comprises three distinct types of agents such as scout bees, onlooker bees and employed bees.

The initialization of parameters and the used bee phase are the first step in this method. Using the fitness function, the fitness function of each bee, which stand for possible solution is assessed. The initial population is defined as equation,

$$P = \{P_{1,}P_{2,} \ldots., PN\} \quad (20)$$

$$f(pi)\text{= 1- Accuracy } (pi) \quad (21)$$

For each $pi \in$ p, where Accuracy (pi) is the model's classification accuracy after training with the hyper parameters described by P. However, the active and distributed nature of MANETs makes it difficult to implement and maintain an ABC system [22].

1. 3. 3 Ant Colony Optimization (ACO)

The ACO technique, which promotes ant searching habit and deployed to multiple issues in real life, is applied in MANET to regulate the most efficient route between source and destination. For the purpose to obtain food, it serves as the direct path from the colony to a food source. ACO is an algorithm that pertains to discrete optimization issues and frames responses based on problem data. Ant seeks for a food supplier in an unexpected technique. When they detect a food supply, they transport it to their colony. Ants play around a chemical substance known pheromone along paths. In addition, the shortest path contains more pheromone trails, which are an ant's form of communication.

The strength of the pheromone trail remains on the soil based on the quality of the solution. Compared to longer paths, multiple ants on shorter paths have higher pheromone trails decrease at the rate of evaporation. Exploration is granted and stalling is prevented in the local minimum evaporation process. Pheromone parameters are updated at the conclusion of each loop.

$$P_{ij}^{k}(t) = \begin{cases} \frac{[\tau_{ij}(t)]^{\alpha}\ [\tau_{ij}(t)]^{\beta}}{\Sigma[\tau_{ik}(t)^{\alpha}]\ [\eta_{ik}]^{\beta}} & if\ j\epsilon\ allowed_{k} \\ 0 & otherwise \end{cases} \tag{22}$$

Where, P_{ij}^{k} is the probability, when ant k selects the shift from node i to node j, η_{ik} is a heuristic function, τ_{ij} is the amount of pheromone concentration.

$$\tau_{ij} \leftarrow \tau_{ij} + \Delta\tau_{ij}^{k} \tag{23}$$

$$\Delta\tau_{ij}^{k} = \begin{cases} \frac{Q}{f(\psi^{k})}, & l_{ij}\epsilon\psi^{k} \\ 0 & otherwise \end{cases} \tag{24}$$

The updated equation is given by,

$$\tau_{ij} \leftarrow (1-\rho)\tau_{ij} \tag{25}$$

Where $\rho\ and\ Q$ are constant factors, and $f(\psi^{k})$ is the cost of solution by the ant. After a certain amount of iteration, the above optimization is terminated. However, handling larger dataset poses high significant challenges [23].

2. Comparative Analysis

A comprehensive comparison of various anomaly detection techniques in MANET, incorporating AI-driven and optimization- based approaches is outlined in Table 1, 2 and 3.

Table 1: *Comparative analysis of ML Techniques in MANET*

SI.NO	Author/Year of Publication	Methodology	Advantages	Limitations
ML Techniques				
1.	Kaur et al [2025] [24]	SVM	This technique performs a better detection in MANET with high dimensional data handling.	However, SVM struggle with high computational complexity.
2.	Singh et al [2024] [25]	RF	This method is effective for dynamic network topologies in MANET.	Nevertheless, it significantly impact the performance and reliability of MANET
3.	Abdallah et al [2024] [26]	NB	It enhances prediction efficiency and integrates seamlessly.	Nonetheless, it reduce the performance at higher speeds.

Table 2: *Comparative analysis of DL Techniques in MANET*

SI.NO	Author/Year of Publication	Methodology	Advantages	Limitations
DL Techniques				

1.	Saravanan et al [2025] [27]	DNN	In MANET, it improves the security by enhancing intrusion detection.	On the other hand, it is complex to design and require more time for reinforcement learning procedures.
2.	Arulselvan et al [2025] [28]	CNN	It ensure the ability to automatically learn features in MANET.	However, it require high energy consumption and high computational cost.
3.	Sarangi et al [2025] [29]	LSTM	Enhances mobility prediction, security and intrusion detection.	Nonetheless, it is difficult to handle very long sequences.

Table 3: *Comparative analysis of Optimization Techniques in MANET*

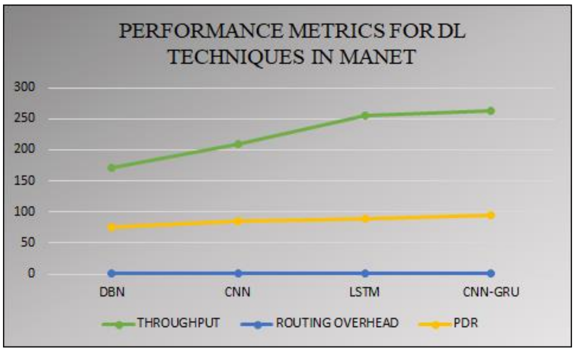
SI.NO	Author/Year of Publication	Methodology	Advantages	Limitations
Optimization Techniques				
1.	Verma et al [2024] [30]	PSO	It predicts the most effective routing paths for data transmission.	However, it often implies rapid loss of diversity during optimization process
2.	Rathod et al [2025] [31]	ABC	It improves routing efficiency and enhancing security.	Nonetheless, it express limited focus on fixed costs,
3.	Kour et al [2025] [32]	ACO	It reduce control overhead and improves energy efficiency in certain scenarios.	However, handling larger dataset poses significant challenges.

Table 4: *Comparative analysis of ML Techniques for Routing in MANET*

SI.NO	Techniques	Throughput(Kbps)	Delay(ms)	PDR%
1.	SVM [15]	85	130	93
2.	RF [16]	98	120	94
3.	NB [17]	83	132	92

Table 4 represents a comparative analysis of a various ML techniques for routing, highlighting that the RF exhibits enhanced performance from the ML models.

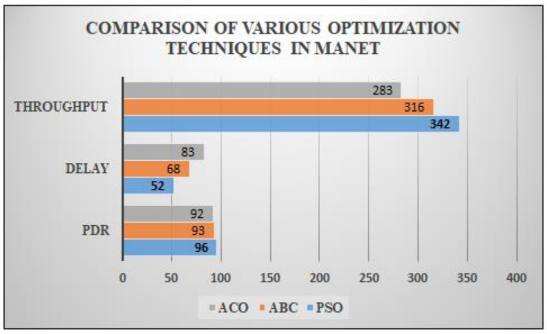
Graph 1: *Comparison of DL Techniques for Routing in MANET*



Graph 1 illustrates the comparison between the performance metrics of various DL techniques in MANET. Among the models, CNN-GRU demonstrates the best overall performance, achieving the highest throughput (approximately

260–270 units) and the highest PDR (close to 95%), indicating more efficient and reliable data transmission. Throughput steadily increases from DBN to CNN-GRU, while PDR also shows a gradual improvement. Routing overhead remains consistently low across all models, suggesting that the inclusion of deep learning techniques does not significantly burden the network. Overall, CNN-GRU proves to be the most effective model for enhancing MANET routing performance, offering a strong balance between high data delivery and low overhead [19].

Graph 2: *Comparison of Optimization Techniques for Routing in MANET*



Graph 2 shows the comparison of different Optimization techniques for routing in MANET. Among the three techniques, PSO demonstrates superior performance with the highest throughput of 342 kbps, the lowest delay at 52 ms, and the highest PDR at 96%. ABC follows closely behind with moderate values, throughput of 316 kbps, delay of 68 ms, and PDR of 93%. ACO, while still effective, performs the lowest with a throughput of 283 kbps, delay of 83 ms, and a PDR of 92%. Overall, the chart clearly indicates that PSO provides the most efficient and reliable routing performance in MANETs, making it the most suitable optimization technique among the three compared [32].

3. Conclusion

This review underscores AI and optimization-based routing protocols for improving the performance, adaptability, and efficiency of MANETs by addressing key challenges such as dynamic topology, limited energy, and unpredictable node mobility. As MANET applications expand into areas like disaster recovery, vehicular networks, and military communication, AI-driven and optimization-based routing protocols will remain central to achieving reliable, secure, and scalable network performance. Techniques like PSO, ABC, and ACO ensure demonstrated notable improvements in key metrics such as throughput, packet delivery ratio, and delay. Among them, PSO often emerges as the most effective due to its fast convergence and low overhead. Future research focus on developing advanced models that effectively capture complex routing under varying conditions. Additionally, utilizing refined optimization strategies enhance model performance, ensuring faster processing and more accurate detection. Implementing adaptive learning mechanism further strengthen the routing process in MANET.

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