# SECURED AND ENERGY EFFICIENT BUFFER AND QUEUE LENGTH CONTROL FOR MOBILE ACCESS WITH INCREASED QoS PARAMETERS

J.Arul Keerthi Dhaya, S.Raja Mohamed

**Abstract**— The main focus of the recent years in Networks is Security. The development of fully secure schemes for these networks has not been entirely achieved till now. The two of the most important security problems in Networks are Authentication and Cooperation. To provide the strong Authentication in the network we proposed the Rational Intrusion detection with Fusion method. This method is helpful to overcome the active and the passive attacks which are created by the external environment. Several authentication methods are present to increase the security in the network. But still many Active and passive attacks are present in the network to reduce the privacy of the network. Passive attacks such as eavesdropping, Traffic analysis, and active attacks such as interfering, Masquerading, relay, message modification and denial of service attacks. Passive attack means, that the attacker does not send any message. The attacker just listen the channel therefore, it is almost impossible to detect this attack. In contrast, the active attack modifies, deletes the packets, inject packets to invalid destination. Active attack can be detected. On the one hand, a summary of the current state of the art in the authentication protocols will take us to the conclusion that the topic is still open. We propose the intrusion detection and fusion methods to overcome the active and the passive attacks in the network.

***Index terms--*** Cognitive Radio (CR), Location Aware Routing Protocol (LARP), Primary User (PU), Primary User Emulation (PUE), Secondary User (SU).



## 1 INTRODUCTION

The large scale development of vehicle communications leads to delay in the data delivery to the nodes participate in the communications. The bus based network is an alternative way to efficient data transfer between the nodes. The access of large set of users are simplified with the use of public transportation systems. The increase of delivery probability to the destination is the challenging task in the research work. The relationship among the peoples strengthened by generating and publishing the contents to the data in addition to downloading the information.

The cost effective infrastructure for publishing the information is called distributed infrastructure. There are two components participated in the distributed architecture. They are Road Side Buffers (RSB) and Vehicle Nodes (VN). The devices deployed in the road side architecture is called RSB. RSB are not necessarily connected to the internet which able to selectively retrieve the data and also they allows the mobile vehicles to download the cached files. The communication between the vehicles are carried through the on board units called Vehicular Nodes (VN). The dissemination of contents to the urban areas are also done using the VNs.

The network to increase the data delivery ratio in vehicles called Vehicle Ad-hoc Network (VANET). The mobile content delivery is the delivery of multimedia contents from one or more access points to the vehicles travelling through Area of Interest (AoI). The MCD system satisfies the high data download and throughput since the contents are audio, image and video. But, the wireless is the lossy medium with limited bandwidth and interference which reduces the throughput of the system. The bandwidth efficiency improved by Network Coding (NC) which allows the intermediate nodes combined to receive the data packets. The packet reception rate also improved by modifying the NC into Symbol Level Network Coding (SLNC).

The existing wide area cellular architecture (3G /4G) is improved with direct download of services called Dedicated Short Range Communications (DSRC). This architecture consider the major issues the data rate and intermittent hot spot coverage. The time and cost effective system created by the content dissemination strategy. The content dissemination process. The peer to peer vehicle to vehicle communication deliver the data in the other devices from the subsets of network.

The alternative architecture for high data rate at low price will be sparsely distributed architecture. The several research works carried out for Delay Tolerant Network in sparse architecture. The distinguish characteristics of DTN over the existing network are frequent link disruptions, high transmission delays. The DTN routing is used in this model to increase the delivery ratio and the reduction of average time delay. The main issue in all the routing topologies is security. Two major security problems are authentication and cooperation. The active and passive attacks are affect the security problem in the network. Hence, the efficient algorithm for secure packet delivery and energy of the delivery and throughput is analyzed in this paper.

In this paper, the efficient authentication of distributed vehicle network is proposed. The system uses the rational in-

ISSN 2229-5518

trusion detection model of the vehicle network with fusion method. The comparative analysis for intrusion detection with Rational Operating Recall Curve Algorithm (RORCA) on the parameters of packet delivery ratio, average energy, control packet overhead, data packets delivered, the energy difference, throughput and remained energy are also proposed.

The rest of the paper is organized as follows. Section II presents a description about the previous research which is relevant to the distributed vehicle network and the possible solutions. Section III involves the detailed description about the proposed method. Section IV presents the performance analysis. This paper concludes in Section V.

## 2. Related Work

This section deals with the works related to the Vehicle Network (VN) and the authentication techniques and the security attacks are implemented to enhance the performance of distributed architecture. *Muthusamy et al* [1] presented the algorithms built based on the distributed hash table abstraction and decentralization. The root hot spots in the network avoided by bottom up tree search technique. Fault tolerance also achieved by using the replication scheme. Subscription delegation way presented to address the load balance. Vehicles in the network were classified into two types based on the bandwidth and range of communication. They were high cost, low bandwidth, long range radio and low cost, high bandwidth short range radio. The suitable optimization was required to solve the content dissemination to the vehicles with pre- determined value. *Joon et al* [2] examined the tradeoff between cost and system utility as a numerical optimization problem. The optimal discrete solution found by using polynominal time algorithm. The autonomous cost effective infrastructure was needed to enhance the content sharing mechanism. *Luan et al* [3] unfolded the design of Vtube in content sharing by description of principles and they also presented the mathematical model for evaluating the mean delay for mobile users. They also solved the optimization problem by using the distributed random walk based algorithm. The distributed networks was needed to carry the largest scale, self-organized and decentralized networks. Then they called community networks. *Navarro et al* [4] outlined the aim, development, infrastructure for community lab network. They also presented the demonstration of current status of development and deployment. *Raftopoulou et al* [5] presented the distributed social and semantic search system which allows users to share and search for content among friends and clusters of users that specialized on the query topic. The search analysis produced two facets addressing friends and addressing nodes.

Vehicular Ad-hoc Network (VANET)-based multimedia applications were considered to be very important role in the intelligent transportation systems and vehicular infotainment systems. *Tal et al* [6] presented the architecture of the novel user-oriented cluster-based multimedia solution was presented together with the cluster-based mechanism employed for multimedia transmissions. *Changqiao et al* [7] presented the novel grouping strategy for chord overlay, reduction of segment seeking traffic and load balancing. The novel multi-path scheme achieved the efficient video delivery to the destination and high success rates. Mobile phones and laptops increases the data traffic with the rapid development of mobile applications. *Dimatteo et al* [8] presented and evaluated the integral architecture for migration of cellular networks into wireless access points (AP). The smart real time analytics prediction measured the large scale market factors, customer requirements. *Katsarakis et al* [9] focused the mechanisms which empowered the users with real time analytics and quality of experience. They also presented the modular multi framework for efficient market analysis. The deployment cost of the access point are variable. *Ning et al* [10] made an effort for investigation of capacity – cost tradeoff between infrastructure and AP.

The deployment of contents to the distributed infrastructure over the cloud data centers was the challenging task in the research areas. *Jian et al* [11] formulated the deployment problem as a minimum cost networking problem with the consideration of cost and user's experience. They also presented the Nash bargaining solution for optimal bandwidth and optimal video placement strategy. The suitable model was required to provide the effective inter communications between the cloud centers. *Esposito et al* [12] presented the interconnection solution for cloud center federations. They also discussed the fundamental requirements for the cloud centers interns of reliability and vulnerability. In multimedia processing, the transcoding and transmoding techniques produced the high burden to the computing infrastructure. *Hyeokju et al* [13] presented the Map-Reduced based image conversion module for reduction of burden of computing power in the cloud centers. The system consists of two parts: storage system for image and Map-reduced program for image transforming. The overall process done in parallel which reduces the computational burden in the system. The challenging problem in the cloud center was addressed in the existing methods are context sensitive task scheduling. *Haridas et al* [14] called the context problem as cloudy knapsack problems and they also found the theoretical bound for cloudy knapsack problems with various simulations. The optimization of energy problem was required in intelligent networks called smart grid. *Zhong et al* [15] discussed the challenges and opportunities in the communication areas. They also focused the key parameters for smart grid security and privacy.

The texture analysis was needed to describe the texture patterns in the video transcoding process. *Costa et al* [16] presented the Segmentation based Fractal Texture Analysis (SFTA) for segmentation. The segmented texture patterns were described by decomposing the image into binary values using SFTA analysis. The receiver operating characteristics for data delivery paid an attention to the researchers. *Powers et al* [17] introduced various measures for receiver operating characteristics. They were Krippendorf's Alpha, Scott's Pi, Powers' Informedness and Markedness, as well as a great many variant Kappa statistics. Using these measures the researchers found the non-uniform distribution of the contents. The algorithm was needed to convert the non-uniform to uniform distribution. *De Felice et al* [18] presented the Brzozowski minimization algorithm are super-polynomial for the uniform distribution of content in the vehicle network. The number of states of the minimal automaton of the mirror of a rational language rec-

ISSN 2229-5518

ognized by a random deterministic automaton within states was studied. The construction of rational approximation requires the computation of eigenvalues and eigenvectors. The computation of eigenvalues is slow in the VNs. *Haut et al* [19] presented the fast and accurate algorithm for computation of eigenvalues and eigenvectors in the rational approximations with singularities , shape transitions. *Aigner et al* [20] presented the implicit and parametric representations for VN models for various security attacks. The performance of VN is enhanced compare to the state of art by the suitable algorithm called Rational Operating Recall Curve Algorithm (RORCA) in this paper.

## 3. PROPOSED SYSTEM

The main idea to implement efficient authentication on security attacks in Distributed Vehicle Network (DVN) is that computing the performance parameters such as packet delivery ratio, average energy, control packet overhead, data packets delivered, the energy difference, throughput and remained energy against the time using Rational Operating Recall Curve Algorithm (RORCA) principle. The block diagram of proposed method is shown in Fig.1.

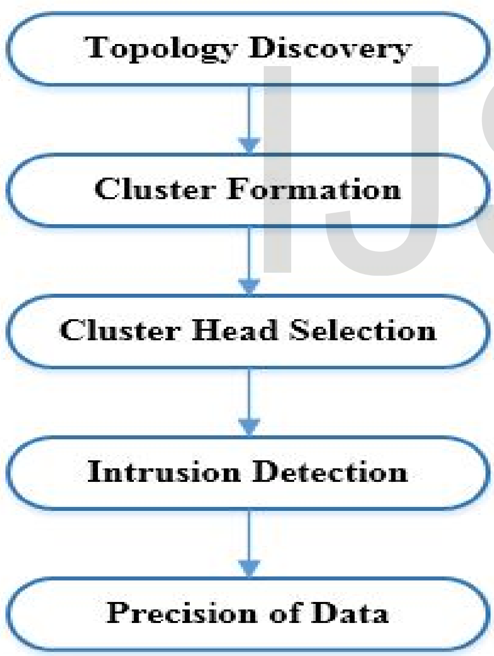



Fig. 3.1 Block diagram of proposed method

The proposed method implemented using various processes. The topology for analysis formed using the top-disc algorithm with own path cost metric and the cluster for the topology is formed and the head of the cluster is selected. The tolerance of the network and network monitoring increased using the intrusion detection and precision method. The flow for proposed method consist of successive steps. They are network formation, send the request to the cluster. If the request is valid then the cluster head selection carried out otherwise the top disc algorithm modify the cluster formation and again the request is checked. After the selection of cluster head the intrusion detection is performed with Rational Operating Recall Curve (RORC) algorithm. The precision and recall carried out after RORC in the data fusion to estimate the high tolerance. Finally, the various performance parameters such as average energy, packet delivery ratio, and remained energy are measured against time.

The flow of proposed method of short cut tree routing as shown in Fig.2.

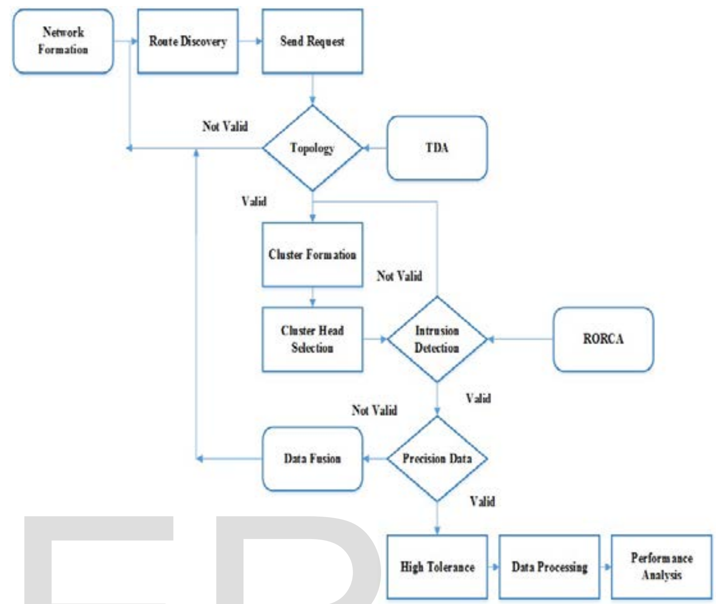



Fig. 3.2 Flow of proposed method

### 3.1 Topology Discovery

The topology is constructed based on the Top-Disc Algorithm (TDA) using own path cost metric. In route discovery process, the request from the source is sent to the destination. The acknowledgement received by the source from the destination for the topology discovery process. TDA is derived from the simple greedy log(n)-approximation algorithm to find the set cover. TD differs from the trivial approaches in its response mechanism. Only a subset of nodes is selected to respond back to the topology discovery queries. The union of neighborhood lists of the selected subset of nodes forms the approximate topology of the network.

The subset chosen is such that each node in the network is either a part of the subset or is a neighbor of a node in the subset. Thus the subset is a dominating set for the network and should have minimum cardinality for optimal consumption of resources. A coloring algorithm that finds an approximate solution to the above problem in a distributed manner and compares well to a centralized solution of the same.
The different colors and their definitions are given below.

White node represents yet undiscovered node, or node, which has not received any topology discovery packet. Black represents cluster head node, which replies to topology discovery request with its neighborhood set and grey node which is covered by at least one black node i.e. it is neighbor of a black node.

ISSN 2229-5518

### 3.2 Cluster formation

In general, the cluster is referred as the formation of the group of nodes in the network. Various protocols used for cluster formation. They are mobility based, non-mobility based. The mobility based scheme is sub divided into direction based and non-direction based protocol. Direction based protocol is used for cluster formation in this paper. The TD algorithm is used for cluster formation.

The node which initiates the topology discovery request is colored black and broadcasts a topology discovery request packet. All white nodes become grey nodes when they receive a packet from a black node. Each grey node broadcasts the request to all its neighbors with a random delay inversely proportional to its distance from the black node from which it received the packet. When a white node receives a packet from grey node, it becomes a black node with some random delay. In the meantime if it receives any packet from some other black node, it becomes a grey node. Again the random delay is inversely proportional to the distance from the grey node from which the request was received. Once nodes are grey or black, they ignore other topology discovery request packets.

### 3.3 Cluster Head Formation

At the end of the TD topology discovery process, the sensor network is divided into n clusters and each cluster is represented by one node, which is called the cluster head. The cluster head is able to reach all the sensor nodes in the cluster directly because they are all within its communication range. On behalf of using the cluster and the cluster head concept in the network we can increase the tolerance of the network. The network monitoring are also increased by using this concept.

### 3.4 Intrusion Detection

Intrusion Detection is defined as that, how we are detecting the intrusions which are created by the external environment. To detect the intrusion in our network we proposed the Rational Operating recall Curve Algorithm (RORCA). This RORCA is used find the intrusion detection rate of the system effectively. And also employees to reduce the intrusion rate of the system during the process of communication in the network.

### 3.5 Precision of Data

In the field of information retrieval, precision is the fraction of retrieved documents that are relevant is given by

$$\text{Precesion} = \frac{\text{(relevant documents-retrival documents}}{\text{(retrieved documents)}} \quad (1)$$

Precision takes all retrieved documents into account, but it can also be evaluated at a given cut-off rank, considering only the top most results returned by the system. Similar to precision the recall also identified in the efficient data delivery. Recall in information retrieval is the fraction of the documents that are relevant to the query that are successfully retrieved.

$$\text{Recall} = \frac{\text{(relevant documents-retrival documents)}}{\text{(relevant documents)}} \quad (2)$$

Precision is the average probability of relevant retrieval. Recall is the average probability of complete retrieval. Here we average over multiple retrieval queries.

### 3.6 Link Buffer Size Estimation

The max-min method to estimate the link buffer size from the estimated transmission delay and the differences between maximum and minimum round-trip times (RTTs). Further incorporated the max-min method into a measurement tool for use in access networks. By increasing the link buffer size in the network, the packet delivery ratio and the packet send ratio is increased. And overall performance of the network is also increased.

The rapidly emerging mobile data networks fueled by the world-wide deployment of 3G, HSPA, and LTE networks created new challenges for the development of Internet applications. Unlike their wired counterpart, mobile data networks are known to exhibit highly variable bandwidth. Moreover, base stations are often equipped with large buffers to absorb bandwidth fluctuations to prevent unnecessary packet losses. However these two factors together invalidate the assumptions used in conventional protocol designs, which routers are assumed to have fixed link capacity and a small buffer. Consequently to optimize protocol performance in mobile data networks it is essential to be able to accurately characterize the network properties such as bottleneck link buffer size. This work tackles the challenge in estimating link buffer size in modern mobile data networks. Using extensive trace-driven simulations based on actual bandwidth trace data measured from production mobile data networks, we show that existing link buffer size estimation algorithms such as max-min and loss-pair no longer work well in bandwidth-varying networks. We develop a novel sum-of-delays algorithm to tackle this challenge. Simulation results show that it can accurately estimate the link buffer size under both fixed and varying bandwidth conditions, outperforming the existing algorithms by multiple orders of magnitude.

This work tackles one of these challenges by developing a novel *sum-of-delays* algorithm to estimate the link buffer size. In contrast to previous works the proposed algorithm is designed for bandwidth-varying networks and has mechanisms to compensate for link bandwidth variations. The proposed algorithm can be implemented using both *active estimation* – commonly employed in network measurement tools, and *passive estimation* – which eliminates the need for sending extra measurement packets and simply measures the in-band data packet timings to perform estimation. This latter approach enables the integration of the link buffer size estimation algorithm into existing transport protocols such as TCP to optimize flow and congestion controls.

An accurate estimation of link buffer size has a number of significance. First, transport protocols such as TCP are originally designed for wired networks of which the link buffer size is often small (e.g., in the order of tens of kilobytes per port). This is no longer the case in mobile data networks

ISSN 2229-5518

where the buffer size is often in hundreds of kilobytes and as such, TCP often perform sub-optimally in mobile data networks [13]. Therefore knowledge of the link buffer size will enable the development of a new generation of TCP variants optimized for mobile data networks.

### 3.7 Queue Length Estimation

The reason being that unlike link buffer size, which is a physical network property, queue length can vary from time to time depending on many parameters, including offered traffic load, traffic characteristic, link capacity, and so on. Therefore queue length measurement is meaningful only in the context of the actual data flow generated by the transport and/or application protocols. By increasing the Queue length of the network, the coverage area of the network is increased. the possible density profiles with the corresponding queue lengths (related via avirtual traffic demand $q$ in the model below) are known, the queue lengths can be estimated easily by selecting that density profile which makes the observed set $x1,\ldots,xn$ of probe vehicle positions to be as likely as possible.
For the concrete implementation of this approach, assuming stationary traffic conditions, the possible density profiles $K(q)$ can be derived Analytically (cf. [6]) based on a common traffic flow model [7] which can also be used to describe urban traffic [8]. Moreover, depending on the virtual traffic demand $q$, the density profiles $K(q)$ are uniquely associated with the corresponding queue lengths $L(q)$. Then, based on the normalized versions $Kq$ of $K(q)$, the probability for registering a given single probe vehicle position $x$ is defined by $Kq(x)$, and the queue length $L^*$ for the observed data set $x1,\ldots,xn$ can be estimated via *: ( *) where *: argmax ( | , , ) : argmax ( ) .
Mathematically spoken, this is a kind of generalized maximum-likelihood estimation where $wq$ are suitable a-priori weights. At this point, by modifying these weights, the search space for the correct virtual traffic demand $q^*$, i.e. the correct queue length $L(q^*)$ can be adjusted in a very flexible way. For example, if the correct queue length $L(q^*)$ or the correct virtual traffic demand $q^*$ were already known from some additional traffic information, it would be even possible to reduce the set of potential estimates so that it would comprise the value $L(q^*)$only. Just let $wq = 0$ for all $q \neq q^*$. Hence, these a-priori weights obviously allow for the integration of nearly arbitrary additional traffic information, i.e. they provide an extremely flexible way for real data fusion with other than probe vehicle data.

## 4.EXPERIMENTAL RESULTS

### 4.1 TOPOLOGY DISCOVERY

The topology is constructed based on the Top-Disc algorithm using our own path costmetric. For the Route Discovery process the request is sent by the source to the destination. And the Acknowledgement received by the source from the destination for the topology discovery process. Top-Disc Algorithm which is derived from the simple greedy log(n)-approximation algorithm for finding the set cover.

In the trivial approaches, all nodes respond back to the topology discovery queries. Top-Disc differs from the trivial approaches in its response mechanism. Only a subset of nodes is selected to respond back to the topology discovery queries. The union of neighborhood lists of the selected subset of nodes forms the approximate topology of the network.

The subset chosen is such that each node in the network is either a part of the subset or is a neighbor of a node in the subset. Thus the subset is a dominating set for the network and should have minimum cardinality for optimal consumption of resources. We describe a coloring algorithm that finds an approximate solution to the above problem in a distributed manner and compares well to a centralized solution of the same. The algorithm is described below:
The Coloring Algorithm to find the Responding Set:
We use three colors to select the responding set. The different colors and their definitions are given below. All nodes, which receive a topology discovery request packet and are alive, to respond are considered as discovered nodes.



Fig 4.1 NetAnim output for the topology in the network

### 4.2 CLUSTER FORMATION IN THE NETWORK

ISSN 2229-5518

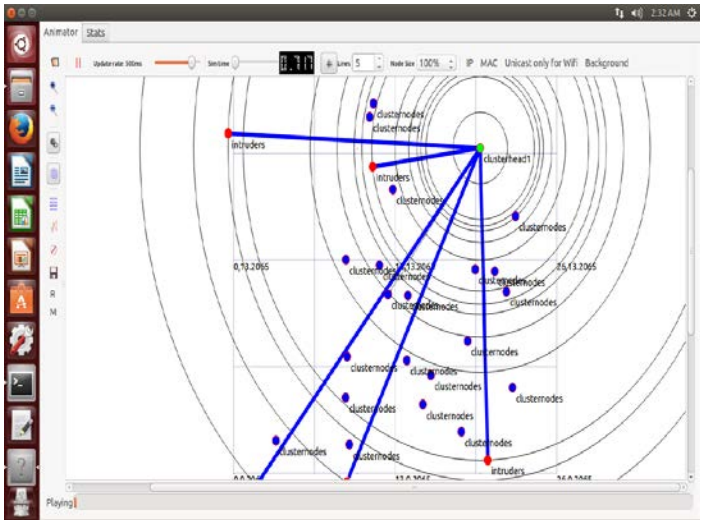


Fig. 4.2 NetAnim output for Cluster formation in the network

When a white node receives a packet from grey node, it becomes a black node with some random delay. In the meantime if it receives any packet from some other black node, it becomes a grey node. Again the random delay is inversely proportional to the distance from the grey node from which the request was received.

### 4.3 INTRUSION DETECTION IN THE NETWORK

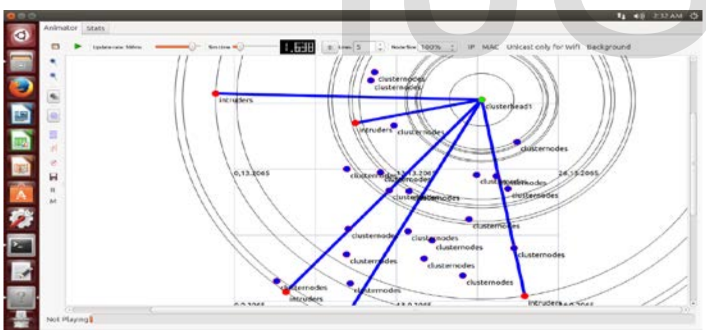
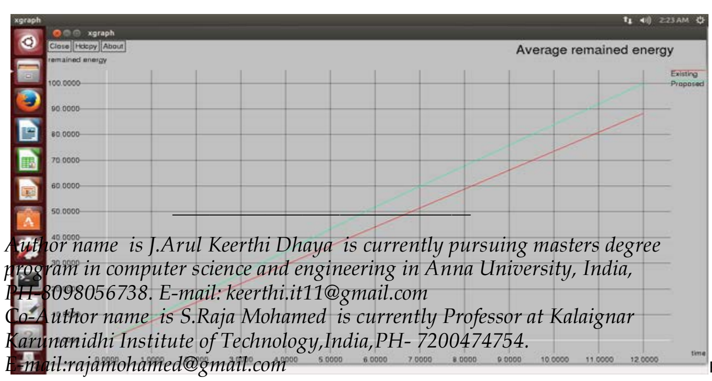


Fig. 4.3 NetAnim output for Intrusion Detection in the network

### 4.3 GRAPHICAL REPRESENTATION OF THE NETWORK





- Author name is J.Arul Keerthi Dhaya is currently pursuing masters degree program in computer science and engineering in Anna University, India, PH-8098056738. E-mail: keerthi.it11@gmail.com
- Co-Author name is S.Raja Mohamed is currently Professor at Kalaignar Karunanidhi Institute of Technology,India,PH- 7200474754. E-mail:rajamohamed@gmail.com


Fig. 4.3 NetAnim Graphical Represaentation of the network

### PERFORMANCE ANALYSIS

This section presents the performance analysis of the proposed authentication scheme in CR network. The proposed authentication scheme used Rational Operating Recall Curve Algorithm (RORCA) for various measurements. The proposed scheme is also compared with the existing rule base model based on the attacker performance. The evaluation of the attacker's performance on detection ratio, packet delivery ratio, average overhead, average latency and average dropped packet is measured.

### CONCLUSION

We propose the intrusion detection and fusion methods to overcome the active and the passive attacks in the network. Rational Operating recall Curve Algorithm is introduced in the rational intrusion detection method. This Rational operating recall Curve Algorithm is used find the intrusion detection rate of the system effectively. And also employees to reduce the intrusion rate of the system during the process of communication in the network. The fusion method is also introduced to find the precision rate of the network. The comparative analysis is done, as the result we conquered that the proposed method performed well when compared with the existing met

## 5. REFERENCE


[1] V. Muthusamy and H. A. Jacobsen, "Infrastructure-Free Content-Based Publish/Subscribe," *IEEE/ACM Transactions on Networking*, vol. 22, pp. 1516-1530, 2014.

[2] A. Joon, M. Sathiamoorthy, B. Krishnamachari, B. Fan, and Z. Lin, "Optimizing Content Dissemination in Vehicular Networks with Radio Heterogeneity," *IEEE Transactions on Mobile Computing*, vol. 13, pp. 1312-1325, 2014.

[3] T. H. Luan, L. X. Cai, C. Jiming, S. Xuemin, and B. Fan, "VTube: Towards the media rich city life with autonomous vehicular content distribution," in *Mesh and Ad Hoc Communications and Networks (SECON), 2011 8th Annual IEEE Communications Society Conference on Sensor*, , 2011, pp. 359-367.

[4] L. Navarro, P. Escrich, R. Baig, and A. Neumann, "Community-Lab: Overview and invitation to the research community," in *IEEE 12th International Conference on Peer-to-Peer Computing (P2P), 2012*, 2012, pp. 71-72.

[5] P. Raftopoulou, C. Tryfonopoulos, E. M. Petrakis, and N. Zevlis, "\mathcal{DS}^{4} : Introducing Semantic Friendship in Distributed Social Networks," in *On the Move to Meaningful Internet Systems: OTM 2013 Conferences*. vol. 8185, R. Meersman, H. Panetto, T. Dillon, J. Eder, Z. Bellahsene, N. Ritter, *et al.*, Eds., ed: Springer Berlin Heidelberg, 2013, pp. 185-203.

[6] I. Tal and G. M. Muntean, "User-oriented cluster-based solution for multimedia content delivery over VANETs," in *IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB), 2012*, 2012, pp. 1-5.

[7] X. Changqiao, Z. Futao, G. Jianfeng, Z. Hongke, and G. M. Muntean, "QoE-Driven User-Centric VoD Services in Urban Multihomed P2P-Based Vehicular Networks," *IEEE Transactions on Vehicular Technology*, vol. 62, pp. 2273-2289, 2013.

[8] S. Dimatteo, H. Pan, H. Bo, and V. O. K. Li, "Cellular Traffic Offloading through WiFi Networks," in *IEEE 8th International Conference on Mobile Adhoc and Sensor Systems (MASS), 2011*, 2011, pp. 192-201.

ISSN 2229-5518

[9] M. Katsarakis, G. Fortetsanakis, P. Charonyktakis, A. Kostopoulos, and M. Papadopouli, "On user-centric tools for QoE-based recommendation and real-time analysis of large-scale markets," *Communications Magazine, IEEE*, vol. 52, pp. 37-43, 2014.

[10] L. Ning, Z. Ning, C. Nan, S. Xuemin, J. W. Mark, and B. Fan, "Vehicles Meet Infrastructure: Toward Capacity–Cost Tradeoffs for Vehicular Access Networks," *IEEE Transactions on Intelligent Transportation Systems*, vol. 14, pp. 1266-1277, 2013.

[11] H. Jian, W. Di, Z. Yupeng, H. Xiaojun, and W. Yonggang, "Toward Optimal Deployment of Cloud-Assisted Video Distribution Services," *IEEE Transactions onCircuits and Systems for Video Technology*, vol. 23, pp. 1717-1728, 2013.

[12] C. Esposito, M. Ficco, F. Palmieri, and A. Castiglione, "Interconnecting Federated Clouds by Using Publish-Subscribe Service," *Cluster Computing*, vol. 16, pp. 887-903, 2013/12/01 2013.

[13] L. Hyeokju, K. Myoungjin, H. Joon, and L. Hanku, "Implementation of MapReduce-based image conversion module in cloud computing environment," in *International Conference on Information Networking (ICOIN), 2012* 2012, pp. 234-238.

[14] H. Haridas, S. Kailasam, and J. Dharanipragada, "Cloudy knapsack problems: An optimization model for distributed cloud-assisted systems," in *14-th IEEE International Conference on Peer-to-Peer Computing (P2P),* , 2014, pp. 1-5.

[15] F. Zhong, P. Kulkarni, S. Gormus, C. Efthymiou, G. Kalogridis, M. Sooriyabandara, *et al.*, "Smart Grid Communications: Overview of Research Challenges, Solutions, and Standardization Activities," *Communications Surveys & Tutorials, IEEE*, vol. 15, pp. 21-38, 2013.

[16] A. F. Costa, G. Humpire-Mamani, and A. J. M. Traina, "An Efficient Algorithm for Fractal Analysis of Textures," in *25th SIBGRAPI Conference on Graphics, Patterns and Images (SIBGRAPI), 2012* 2012, pp. 39-46.

[17] D. M. W. Powers, "The problem of Area Under the Curve," in *International Conference on Information Science and Technology (ICIST), 2012*, 2012, pp. 567-573.

[18] S. De Felice and C. Nicaud, "Brzozowski Algorithm Is Generically Super-Polynomial for Deterministic Automata," in *Developments in Language Theory*. vol. 7907, M.-P. Béal and O. Carton, Eds., ed: Springer Berlin Heidelberg, 2013, pp. 179-190.

[19] T. Haut and G. Beylkin, "Fast and accurate con-eigenvalue algorithm for optimal rational approximations," *SIAM Journal on Matrix Analysis and Applications*, vol. 33, pp. 1101-1125, 2012.

[20] M. Aigner, B. Jüttler, and A. Poteaux, "Approximate Implicitization of Space Curves," in *Numerical and Symbolic Scientific Computing*, U. Langer and P. Paule, Eds., ed: Springer Vienna, 2012, pp. 1-19.