Research Journal of Applied Sciences, Engineering and Technology 6(4): 551-556, 2013
DOI:10.19026/rjaset.6.4164
ISSN: 2040-7459; e-ISSN: 2040-7467

Submitted: December 20, 2012 Accepted: April 12, 2013 Published: June 20, 2013

Research Article

An Efficient AI Based Approach for Multimedia Traffic Management in Wireless Network

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Abstract: This study presents Artificial Intelligence based channel estimation and monitoring technique call AI-Monitoring System (AIMS), for integration of Multimedia traffic in wireless network. Through AIMS technique every node in the network has the capability to monitor the neighbour node transmission and also before sending the traffic. The sending node evaluates the SNR ratio as primary parameter and queue limit of the receiving node as secondary. With the help of AIMS every node has the pre-determined information about the selected channel as well as node. Based on conditional and distribution probability model, the proposed Bay Estimator model analyses the SNR ratio before forwarding the multimedia traffic on selected path. We determine the performance of our proposed technique by obtaining the recursive analysis matrix methodology. Amendment of pre-distinct parameters make us capable to maintain the quality of service, multipath adaptability for attack prevention, as well as minimize the packet loss ratio.

Keywords: Artificial intelligence, multimedia, noise ratio, signal to, traffic management

INTRODUCTION

The Ad-hoc network is an emerging technology. All nodes in a wireless network have limited amount of storage capacity and processing capability. The security mechanism for traditional networks like ad-hoc network cannot be directly applied on the nodes as they consume huge amount of energy, requires large storage capacity and computation power.

Generally, there are three classes of traffic namely text, audio and video, each of which requires different type of Quality of Service measuring parameters. According to the 3GPP, they classify the traffic into four classes: Conventional, Background, Streaming and Interactive (V6.3.0, 3, 2005). According to this formation, every class has its own responsibility: Conventional class is responsible for audio traffic; Streaming for video; and the other two classes' Background and Interactive are used for internet application link; and also these classes require different variety of bandwidth.

In frequency reusability concept, the wireless network adopts the short cell sizing concept to improve the system efficiency. This short sizing technique also increases the more recurrently handoff, which increases to achieve the connection level quality of service. Handoff plays an important role in effectiveness of the system for maintaining it, high priority and low call dropping ratio. Due to this reason, the efficient utilization of the bandwidth with respect to classes has always created a bottleneck in the wireless network. For this reason, service provider formulates maximum resources to achieve the quality of service with respect to different classes of traffic.

In wireless networks, mostly an optimum single path is selected and saved for future transmissions. It gives good performance for normal traffic, but becomes performance barrier in case of multimedia traffic due to the heavy weight nature of the said load and buffering capacity of relaying nodes.

This study analyzes the adaptation of multipath in order to minimize packet loss ratio as well as to provide mechanisms for secure communication over a wireless medium especially in presence of transport layer attacks such as session hijacking**.**

LITERATURE REVIEW

To formulate this AI model, we go through an extensive literature review for bandwidth management. Katzela and Naghshineh (1996) discuss the bandwidth management with different aspects; they also discuss one of the more important issues that a system handling limited bandwidth between numerous classes using several services. In 2.5 G and 3G they use Radio Resource Management (RRM) technique to handle incoming and outgoing multimedia traffic. Most of the service providers use this technique due to its flexible nature which is able to maintain the good QoS. Huang *et al*., (2004) present a moveable-boundary scheme that

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adjusts the channel according to the classes of the traffic dynamically and they claim that their proposed scheme is able to handle the bandwidth efficiently and also fulfils the requirement of the Quality of Service. In their proposed scheme, the moveable-boundary model cannot identify the new call or handoff call (Katzela and Naghshineh, 1996).

Heredia presented a model which divides the channel into multiple channels according to the respective service. They introduce Multiple Fraction Channel Reservation (MFCR). As per their technique, they evaluate the available resources and requirement of the associated cell. But there is a high computational complexity involved in resolving this problem (Heredia-ureta *et al*., 2003).

Leong *et al*. (2004) presented a methodology for multimedia traffic as inadequate fraction guard channel mechanism and they called this mechanism as Call Admission Control (CAC). They introduced a policy for handling multimedia traffic in wireless network environment (Leong *et al*., 2004). Schembra (2005) enhanced the CAC along with the resource management strategy for various types of traffic coming with dynamic data rate. They enhanced the CAC with prioritize mechanism which works according to the traffic. The channel allocation method is based on the throughput of the operating system assigned by the user. They also criticised that the guard channel allocation method is not much useful for heterogeneous traffic patterns which have different QoS requirements. They claim that the feature of CAC is based on guard channel which is the cause of the pitiable channel deployment (Schembran, 2005).

Ortigoza-guerrero and Cruz-pe (2005) presented a mathematical model which is able to measure the performance of Fractional Channel Reservation (FCR) technique on equal basis according to the QoS. They also analysed the call performance with respect to different services but they didn't discuss any handoff precedence technique. According to their proposed model, bandwidth dynamically increases and decreases with respect to the traffic load (Ortigoza-guerrero and Cruz-pe, 2005).

To minimize the congestion of the different classes of the traffic, there is a need of a knowledge based application or an artificial Intelligence based system. Enhancement of multimedia traffic makes traffic management operation a very active research area (Scemama, 1994). To map the current traffic management problem, with most common road traffic management system, the limitation, management, behavior and control when high traffic volume exists on the road. They follow the two main defined system SCOOT (Hunt and Bretherton, 1981) and UPOPIA (Mauro and Di-Taranto, 1989) and many more. SCOOT has been improved, predominantly to put forward a constantly extensive variety of traffic management tools. SCOOT prime policy is to manage the traffic according to the defined policy objectives like: supporting meticulous routes or activities, decreasing network interruption, due to its efficient modeling and control according to the behavior of the traffic. SCOOT has a great deal to handle traffic than less resourceful structure. SCOOT has the capabilities to identify on which path, congestion is going to be created and also according to the priority of the traffic, SCOOT is able to minimize it.

According to the literature review or the current situation of the traffic on the network, there should be some real time Artificial Intelligent system to handle the real time traffic according to the classes.

The scrutiny that a dilemma realm can be unsurprisingly festering in many small formation, each of them dedicated to resolve the dilemma according to the nature. The small formulation or part may dived into more other to resolve the specialize task. Due to this reason there should be a comprehensive intelligent system like KITS (Boero *et al*., 1993), TRYS (Hernandez, 1999b), CLAIRE (Bielli *et al*., 1994), FRED (Ritchie and Prosser, 1990), ERUDIT (Hernandez, 1999b) and FLUIDS (Hernandez, 1999a) systems.

KITS concentrate on motorway and municipal traffic management based on architectural come up to attractive perception; whereas, FLUIDS approach is to handle the private traffic management in municipal areas. Two most common things of both of these systems have worked on the base of common tool along with knowledge based approach, which can be easily adapted to the application for its specific task (Hernandez, 1999a).

MATERIALS AND METHODS

To make multimedia traffic management approach intelligent, each node is equipped with AI Monitoring System (AIMS) and every node has the information about the classes of the traffic, Quality of Service parameters, channel information and also have the information about the neighbor node queue limit.

AI Monitoring System (AIMS): AIMS is built using two bay estimators BEP (Bay Estimator Primary) and BES (Bay Estimator Secondary).

O is the overall Observation and X is the overall measurements relevant to Queue and SNR for BEP and BES, respectively. L defines the Loss function/ Squared Error, Error is the amount difference from the estimator to the quantity. θ gives the probability of SNR on link with prior distribution π (Whereas π is uncertainty of measurement of θ) and $\delta_{Comp}$is the estimator of θ, $\delta_{Comp} = \delta_{xi......xn}$

$$O\left[E\left\{L\left(\theta_{snr}, \delta_{Comp}\right)\middle|X_{Comp}\right\}\right] \tag{1}$$

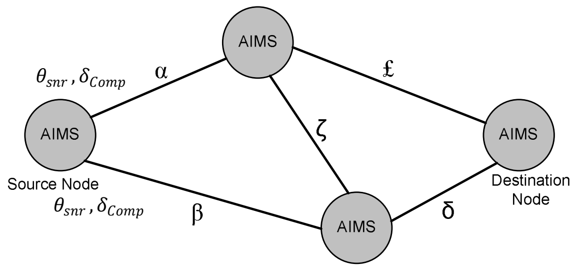

Fig. 1: AIMS based wireless infrastructure

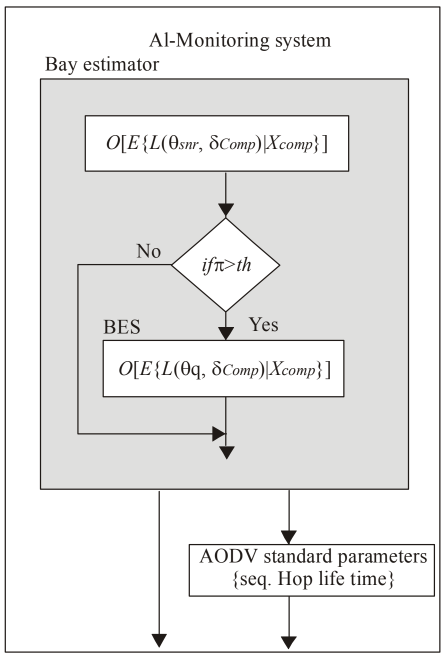

Fig. 2: AI monitoring system

$$if\ \pi > th$$

$$O\left[E\left\{L\left(\theta_q, \delta_{Comp}\right)\middle|X_{Comp}\right\}\right] \tag{2}$$

Figure 1 shows simple four nodes Wireless Network model; by imbedding the AIMS, every node becomes intelligent. Every node is based on modified Bay estimator model and before forwarding the traffic and evaluates the condition of the associated links. By using the Eq. (1) every node calculates the SNR value of the associated links and Eq. (2) helps for cushion the queue information. The calculation function is described in Fig. 2.

On the basis of the Bay Estimator, we develop a real time estimation protocol call Artificial Intelligence Monitoring System (AIMS).

In view of Fig. 1 scenario, where each node is equipped with AIMS, assume that node S receiving R_{mt} real time multimedia traffic and D is the destination and traffic will forward through intermediate nodes I_a or I_b. Node S by using AIMS computes the link condition by:

- Estimating the SNR ratio with the help of Eq. (1) of the link α and β and
- Calculating the queue limit of I_a or I_b through Eq. (2). The computed result is compared as per-defined threshold value. If the current state of the link is ≤ the threshold, S will forward the traffic via the link α and β.

To further evaluate the confidence interval for the means, on the basis of the minimum and maximum confidence limits, we also cater the channel range as upper bound and lower bound. Normally, in evaluating with technique of upper bound or lower bound, a chance of error is estimated, which is incorporated as:

Lower bound = $\bar{d} - t \propto/2, W-1\ SE$
Upper bound = $\bar{n} + t \propto/2, W-1\ SE$

whereas SE is the Standard Error
here $t\propto$ represents upper critical value for the t distribution with $W-1$ degrees of freedom where W is the sample size (no of observations) and $\bar{d}$ *and* $\bar{n}$ represents sample mean, for Standard Error (SE) calculation, we may adopt the simple standard deviation methodology $S = \sqrt{S^2}$ and for Standard Error it becomes $SE = \frac{S}{\sqrt{W}}$. On the basis of this equation, we also calculate the variance (S^2) of the network. So:

$$S^2 = \frac{1}{W-1}\sum_{i=0}^{m} n_i\left(d-\bar{d}\right)^2$$

In our study, we assume that the threshold value of every node will be X%, a node can receive packets upto (100-X)% of its queue limit, when queue limit will be (100-X)%, its threshold indicator initiates the AIMS. Therefore, to evaluate our monitoring system, we create a Wireless Network test bed of 8 work stations and generate real time traffic to monitor the efficiency of our proposed monitoring system. On the basis of our assumption of X% threshold limit, we also calculate the mean with respect to 0.9 orderly mean values:

$$T_{0.9} = \frac{1}{0.9\,W}\{(@(nn_{k1}+1-\ t_n)d_{k1}+1+$$
$$W{-}nnk2{-}1 - tndk2 + i{=}k1{+}2k2{-}1nidi@$$

where k_1 and k_2 are the parameters which satisfy the following condition:

$$nn_{k1} < t_n \leq nn_{k1+1}$$

and also:

$$W - nn_{k2} < t_c \leq W - nn_{k2-1}$$

Alogorithm:

$N_S \rightarrow$ received R_{mt}

- I. *Initiate the AIMS*
- II. *Compute O, X*
- III. *Chack the θ_{snr}*
- IV. *If $\theta_{snr} \leq th$*
- V. *then*
  - i. *Chack θ_q*
  - ii. *Forward the R_{mt}*
  - iii. *Else*
  - iv. *Check alternate*
- IV *endif*

Fig. 3: Functional flow of AIMS based wireless network environment

and $t_n = (X\%)W$, If $k_{1+1} = k_2$ then $T_{0.9} = d_{k2}$

AI Based traffic management: In this study, we propose an adaptive channel estimation technique according to the classes of the traffic. The proposed model (AIMS) to amalgamate with multimedia traffic in mobile networks. AIMS will analyse the most feasible channel according to traffic and with AI technique, it will adapt the appropriate link on which AIMS will find the minimum SNR ratio as shown in Fig. 3.

RESULTS AND DISCUSSION

For evaluation of our proposed protocol we created three topologies of 10, 15 and 25 nodes having no mobility in Object Modular Network Testbed in C++ as shown in Fig. 4. Every node in the given scenario is equipped with AIMS and is following the flow as shown in Fig. 3, discussed earlier. The evaluation is based on 10 flows of variable data rate based on different type of multimedia traffic. Table 1 Shows other parameters used in the simulation.

To explore the adaptation of available multi paths between source and destination, the enhanced AODV has been used that store multiple paths for forwarding the data, through enhanced AODV, every node in wireless network becomes able for self-optimized route resolution and traffic forwarding mechanism in order to accomplish high packet delivery ratio with minimise packet overhead. Before forwarding the multimedia traffic every node will calculate the condition of the selected path.

We educate every node about the SNR as well as congestion value. For any reason (attack implementation or real congestion) if a node finds SNR or congestion more than the threshold level, the proposed protocol will not allow to forward the traffic on the said path. Figure 5 shows a clear picture of the overall packet transmission rate during X-AODV

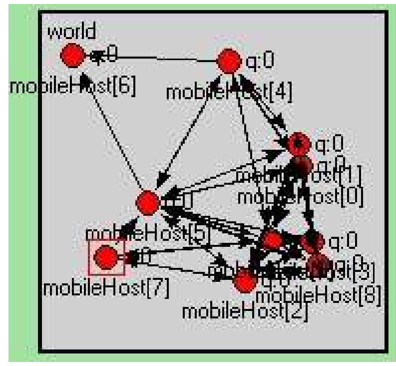

Fig. 4: 10 nodes environment

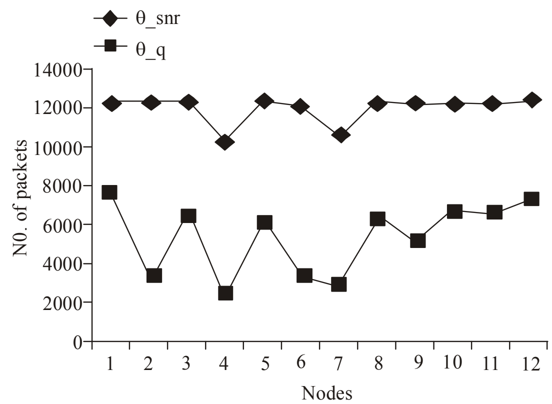

Fig. 5: Overall throughput using AIMS

Table 1: Simulation parameters

No of nodes minimum	10
No of nodes maximum	25
Field size	1000×1000
Routing protocol	XAODV
Simulation time	100 sec
Type of traffic	CBR
Packet size	512 bytes
Transmission range	250 m

detected SNR as well as congestion. A very small amount of packets were dropped when congestion occurred as well as when SNR went up from threshold value.

To design and develop an Artificial Intelligence Monitoring System (AIMS) which has the capability to identify the malicious behavior of neighbour node at control traffic level, specifically transport/network layer attacks. Proposed method will be able to identify, adaptively, the malicious behavior of the neighbour node and update the other good nodes about the abnormality. Once detected, shall enforce the counter measures to overcome it. Whereas Fig. 6 shows the overall packets delivered from multiple paths at the time of SNR detection. In this study our prime parameter is SNR and we considered queue limit as secondary, so we evaluate the overall performance over queue limit along with also SNR to minimize packet loss.

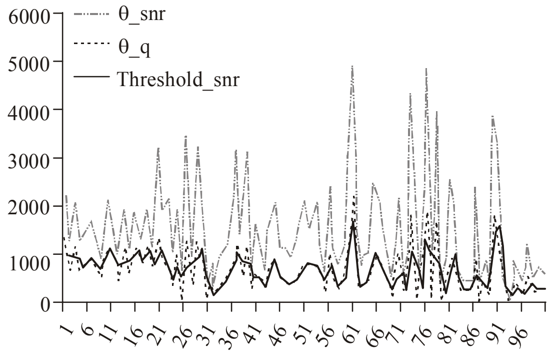

Fig. 6: Threshold based traffic analysis

The purpose of this study is not to compare our algorithm with any one, but to present an artificial intelligence technique based on SNR and queue to minimize packet loss ratio as well as to provide mechanisms for secure communication over a wireless medium.

Though, results are not promising in terms of queue estimation, reason being that multiple flows may exist or diverted to a node, having lesser queue entries. However, the drawback being at any particular time, neighbours of a node may estimate about its queue, simultaneously; and all may reroute at the same time. Similar is the fashion shown in the results as discussed above and compared with SNR in Fig. 5, which are independent parameters and has higher throughput aggregation due to non-mobility; and variation is not much estimated. The SNR based approach (BEP) gives almost 20% packet drop which comparative to Samarth *et al*. (2003), is 10% less.

CONCLUSION

In this research we proposed a novel adaptive channel adaption protocol AIMS, with integration of Multimedia traffic in Wireless Networks environment and evaluate the service concert with respect to classes of the traffic as well as protocol. By using the degradation and compensation technique its performance improve more than the normal. The analysis model analysis by conditional probability analysis as well as Bay Estimators. The study circumstances with the Artificial Intelligence model recursively by the data set analysis on the bases of Matrix.

For the routine analysis and evaluation with respect to numerical results, we can wrap up that the AIMS is able to accomplish absolute provision demarcation for different multimedia traffic types. By adjusting the predefine threshold level of the adopted channel alert we are not only able to maintain huge amount of multimedia traffic, secure channel as well as minimize packet loss.

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