International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online)), Volume 2, Special Issue 3, February 2014)
International Conference on Trends in Mechanical,Aeronautical,Computer,Civil,Electrical and Electronics Engineering
(ICMACE14)

Enhancing Quality of Monitoring In Multichannel Network Using Efficient Channel Allocation Algorithm

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***Abstract*— In wireless networks, wireless sniffers are distributed in a region to monitor the activities of users. It can be applied for fault diagnosis, resource management, and critical path analysis. Due to hardware limitations, wireless sniffers typically can only collect information on one channel at a time. Therefore, it is a key topic to optimize the channel selection for sniffers to maximize the information collected, so as to maximize the Quality of Monitoring for wireless networks. In this paper, a Multiple-Quantum-Immune-Clone-Algorithm based solution was proposed to achieve the optimal channel allocation. The extensive simulations demonstrate that MQICA outperforms that related algorithms evidently with higher monitoring quality, lower we carry out the full investigation on the current wireless monitoring networks and establish a system monitoring model based on the undirected bipartite graph .Then, compared with existing algorithms, we propose an optimization solution "Multiple Quantum Immune Clone Algorithm" to solve the problem. Finally, the algorithm has been proved to be with good performance both in theory and experiments.**

***Index Terms*—Sniffers, Quality, Monitoring, wireless.**

I. INTRODUCTION

A wireless network is any type of computer network that uses wireless data connections for connecting network nodes. Wireless networking is a method by which homes, telecommunications networks and enterprise (business) installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. A multi-channel network is an organization that works with YouTube channels, to offer assistance in areas such as "product, programming, funding, cross-promotion, partner management, digital rights management, monetization, sales, an,/or audience development" in exchange for a percentage of the ad revenue from the channel. They are also known as Online Video Studios, MCNs, OVSs, YouTube Networks or simply Networks.

Wireless monitoring is a passive approach for capturing wireless-side traffic with rich MAC/PHY layer information.WM can suffer, however from low capture performance i.e.,high measurement loss, due to the unreliable wireless medium[2].Prior works have attained a constant factor of the maximum monitoring coverage in a centralized setting. Our algorithm preserves the same ratio while providing a distributed solution that is amenable to online implementation. Also, our algorithm is cost-effective, in terms of communication and computational overheads, due to the use of only local communication and the adaptation to incremental network changes[6]. interface switching to utilize all the channels, even when the number of available interfaces is smaller than the number of available channels.

To proposed to carry out the full investigation on the current wireless monitoring networks and establish a system monitoring model based on the undirected bipartite graph. Then, compared with existing algorithms, we propose an optimization solution "Multiple Quantum Immune Clone Algorithm" to solve the problem. Finally, the algorithm has been proved to be with good performance both in theory and experiments and investigate the channel allocation for sniffers to maximize the Quality of Monitoring for wireless monitoring networks, which is proved to be NP-hard. A Multiple-Quantum-Immune-Clone-based channel selection algorithm is put forward to solve the problem. By theoretical proof and extensive experiments, we demonstrate that MQICA can solve the channel allocation problem effectively, and outperform related algorithms evidently with fast convergence. As an ongoing work, we are reducing the computation complexity and proving the convergence performance of algorithm in theory.

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The rest of paper is organized as follows. Section II describes the methodologies for our schemes. In Section III describes about experimental results. Finally, Section VI concludes the paper and discusses some possible future work.

II. METHODOLOGIES

In a wireless network there may be number of users and channels and a sniffer set. First each sniffer initializes the number of users and channels. Next it allocates the suitable or efficient channel for each user by using channel allocating algorithm. This algorithm clones each channel and by using the channel affinity value it allocate the channel.

A. Network Model:

Consider a wireless network of m monitoring sniffers, n users, and k optional channels. {s1, s2, . . . ,sm} is the set of sniffers, U = {U1, U2, . . . , Un} is the set of users, and C = {C1, C2,..., Ck} is the set of channels. In homogeneous networks, sniffers have the same transmission characteristics. They have the ability to read frame information and can analyze the information from users or other sniffers. But at any point in time, a sniffer can only observe transmissions over a single channel. Let puj denote the transmission probability of a user uj (= 1, 2, . . . , n) that works on channel c(uj)€C. These users can be a wireless router, access point or mobile phone user, and so forth. If a user sends data through a channel at time t, it will be called active user in time t.

B. Cloning Operation:

A self-adaptive clone operation is proposed as follows:

$$T_c(A(t)) = \{T_c(r_1), T_c(r_2), \ldots, T_c(r_N)\},$$

where $Tc(ri) = Ei\times ri$, $i = 1, 2, \ldots, N$ and Ei is a unit row vector with qi columns, while $q\ i$ indicates the clone scale of the CQA and is decided by the equation as follows:

$$q_i = \left\lceil N_c \times \frac{Q(C_i)}{\sum_{j=1}^{N} Q(C_j)} \right\rceil$$

Where $Nc > N$. It can be concluded that if the channel affinity of a specific CQA is greater than that of the others in the population, then corresponding clone scale will be larger. Thus this clone strategy guarantees that the more excellent an antibody is, the more resource it will get, and this will obviously drive the algorithm to evolve towards the optimal solution much more quickly. Once the clone operation is completed, the population (t) is expanded to have the following form

$$A'(t) = \{A(t), A'_1(t), \ldots, A'_N(t)\},$$

$$A'_i(t) = \{r_{i1}(t), r_{i2}(t), \ldots, r_{iq_i-1}(t)\},$$

$$r_{ij}(t) = r_i(t), \quad j = 1, 2, \ldots, q_{i-1}.$$

C. Immune Genetic Variation:

MQICA algorithm implements a single-gene mutation on every triploid chromosome during the evolution. Compared with full-gene mutation, it has been proved in the literature that single gene mutation can dramatically improve the search efficiency of the algorithm. Denote rtz as a CQA in $A'i\ (t)$ = $\{r\ i1\ (t), r\ i2\ (t) \ldots r\ iq\ i-1\ (t)\}$ which is generated by clone operation on the ith CQA of population $A(t)$. Choose the jth allele $[x\ t\ zj\ \alpha\ t\ zj\ \beta\ t\ zj]\ T$ randomly from $r\ t\ z$ and perform two kinds of Gaussian mutation on it:

$$x_{zj}^{t+1,\varpi} = N\left(\mu_{zj}^{t,\varpi}, \left(\delta_{zj}^{t,\varpi}\right)^2\right)$$

$$= \begin{cases} x_{zj}^{t} + N\left(0, \left|\alpha_{zj}^{t}\right|^2\right), & \varpi = \alpha, \\ \dfrac{x_{\max} - x_{\min}}{2} + N\left(0, \dfrac{\left|\beta_{zj}^{t}\right|^2}{\chi}\right), & \varpi = \beta. \end{cases} \quad x_{zj}^{t+1,\varpi} = \begin{cases} \dfrac{k-1}{k}, & x_{zj}^{t+1,\varpi} > 1, \\ 0, & x_{zj}^{t+1,\varpi} < 0, \\ N\left(\mu_{zj}^{t,\varpi}, \left(\delta_{zj}^{t,\varpi}\right)^2\right), & \text{others.} \end{cases}$$

.

D. Immune Selecting Operation:

There shall form a new population

$$A''(t) = \{A(t), A''_1(t), \ldots, A''_N(t)\}$$

After the immune genetic variation wherein

$$A''_i(t) = \{r''_{i1}(t), r''_{i2}(t), \ldots, r''_{iq_i-1}(t)\}, \quad i = 1, 2, \ldots, N.$$

E. Full Interference Crossover:

To make full use of the information of all CQAs in the population, thus to guarantee that new antibodies will be generated in case of antibody precocity, which may cause the algorithm converge to a local optimal solution, a full interference crossover strategy [28] is adopted in this paper. Denote the jth allele in the ith antibody before and after the crossover operation to be $A\ ij$ and $B\ ij$ respectively; the relationship between $A\ ij$ and $B\ ij$ can then be revealed as

$B\ ij = A\ [(i+j)\%N][j]$.

F. Implementation

Implementation is the stage of the project when the theoretical design is turned out into a working system.

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Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective.The implementation stage involves careful planning, investigation of the existing system and it's constraints on implementation, designing of methods to achieve changeover and evaluation of changeover methods.MQICA algorithm is used and the process can be defined as

Step 1: Initialize population and set the algorithm parameters **A(0).** Calculate the CQA
Step 2: Caculatet clone scale of each CQA A'(t)
Step 3: Do mutation operation and get A"(t)
Step 4: Do immune selection and the new population is A(t+1)
Step 5:calculate the channel affinity of each CQA.if the former does not change any more and the latter tends to be zero infinitely or t>tmax

III. Experimental Results

The validity of the proposed algorithm, MQICA, in solving multichannel allocation problems in order to validate the correctness of the algorithm and eliminate the possibility of local optimal solution, we take traversal method for the small scale monitoring network. we can easily conclude that MQICA will generate a good performance in channel allocation problems. It can be quickly uniform convergence to the optimal solution when the size of monitoring networks is small or moderate. If the scale is large; MQICA can also be better converged to the optimal or near optimal solution in most cases. These experimental results have proved the effectiveness of the proposed algorithm from various scales.

To analyse the performance of the proposed system lots of simulation experiments are conducted. The proposed system is implemented in Network Simulator (NS2). In the simulation experiments several parameters are used. They are listed in the below table

TABLE I. Simulation Setup

No of nodes	15
Area Size	1000 x 1000
Target Size	[500,500] x [500,500]
Simulation Duration	50
Pm	0.5
Pc	0.88
Nc	15
X	3
€	10^{-5}
Tmax	100

A. Quality of Monitoring

This is one of the performance metrics. This metric is used to analyze the quality of the channel in several iteration. In this project the Quality is monitored in three covering stages. They are small scale, medium scale and large scale iteration. In this project the Quality is monitored in three covering stages. They are small scale, medium scale and large scale.

TABLE II. QoM of Small Scale

Iteration	QoM
100	0.8
200	1.1
300	1.5
400	1.5
500	1.5
600	1.5
700	1.5

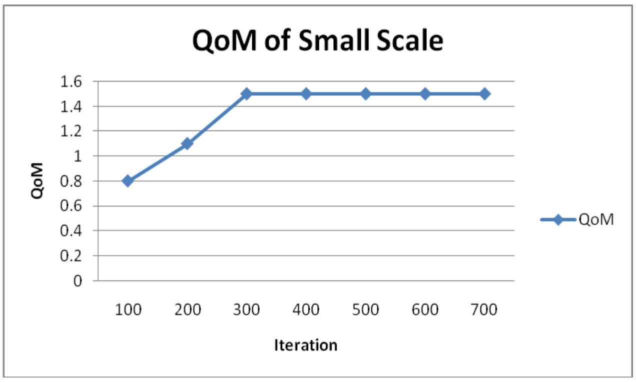

Fig. 1. QoM of Small Scale

TABLE III. QoM of Medium Scale

Iteration	QoM
100	8.3
200	8.5
300	9
400	9.3
500	9.8
600	9.8
700	9.8

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Number of Nodes	Gibbs	LP	Greedy	MQICA
4	0.78	0.68	0.66	0.8
6	0.97	0.7	0.65	1.0
8	0.99	0.78	0.75	1.2
10	1.30	0.8	0.7	1.35
12	1.2	0.85	0.65	1.4

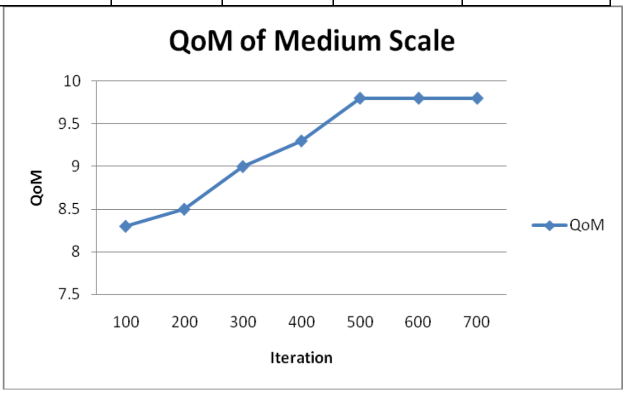

Fig. 2. QoM of Medium Scale

TABLE IV. QOM OF LARGE SCALE

Iteration	QoM
100	26.5
200	26.7
300	27
400	27.5
500	27.8
600	28
700	28.5

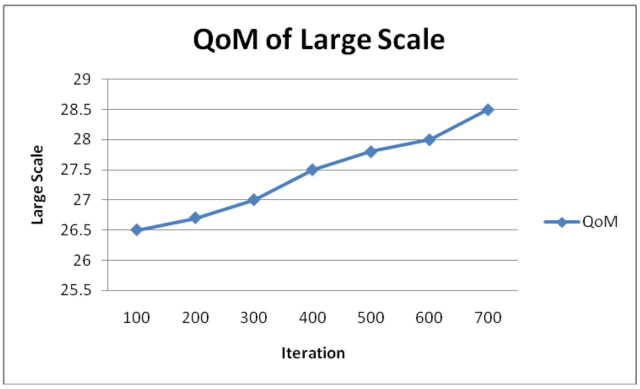

Fig. 3. QoM of Large Scale

B. Average number of Active users Monitored

This is one of the performance metrics. This metrics is used to found the average number of Active users Monitored. This metrics is analysed for the MCQICA, Gibbs, LP and Greedy. This is shown in the below table.

TABLE V. AVERAGE NUMBER OF ACTIVE USERS

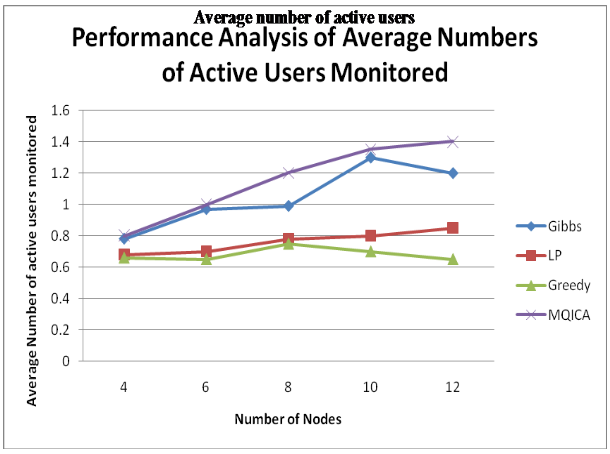

Fig.4. Average number of active users

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IV. CONCLUSION

In this paper, we investigate the channel allocation for sniffers to maximize the Quality of Monitoring (QoM) for wireless monitoring networks, which is proved to be NP-hard. A Multiple-Quantum-Immune-Clone-based channel selection algorithm (MQICA) is put forward to solve the problem. By theoretical proof and extensive experiments, we demonstrate that MQICA can solve the channel allocation problem effectively, and outperform related algorithms evidently with fast convergence. As an ongoing work, we are reducing the computation complexity and proving the convergence performance of algorithm in theory.

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