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AN OPTIMIZED QUALITY OF SERVICE ELEMENTS ENABLING TECHNIQUE FOR NEXT GENERATION WIRELESS CELLULAR COMMUNICATION USING ARTIFICIAL IMMUNE SYSTEM

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ABSTRACT

Next generation of Wireless Cellular Network (WCN) customers required an improved WCN where it can connect the entire world with high achievement in terms of seamless and ubiquitous communication among anybody, anything, anywhere, anytime and anyhow. In order to satisfy the WCN customers, it is essential to improve the Quality of Service. This paper is motivated to provide an improved QoS based WCN by enabling optimum elements in the network for effective communication. This proposed work is carried out in three different stages such as: (i). Optimizing the channel selection for long term connection.(ii). High security provision. Finally,(iii).Optimizing the data transmission route.Here the entire three stages of the proposed work is done by utilizing Artificial Immune System (AIS), whereas AIS is used to choose the optimum WCN elements for increasing the communication effectiveness. This proposed approach is implemented and experimented using MATLAB software and the performance is evaluated by comparing the obtained results with the existing system results.

KEYWORDS: Wireless Cellular Network, Mobile Communication, Quality of Service, Optimum Channel Selection.

INTRODUCTION

Wireless cellular communication is drastically growing technology and it is one of the emerging fields used by entire world every day. Consequently communication and sharing services among heterogeneous networks is also rapidly growing towards next generation wireless networks through multi-mode mobile nodes. These kinds of heterogeneity create challenges in terms various Quality of Service (QoS) parameters due to sharing different network operations. Heterogeneous networks are proliferated with more number of smart terminals which are interconnected mainly by internet applications. It is predicted that the mobile traffic is increased more than 1000 times in every 10 years (2000 – 2010 – 2020). Similarly various types of devices interconnected through internet is also increased more than billions.[1] Due to more number of devices, communication and sharing services it is a great demand to improve the network performances such as low-delay, high-throughput, less-energy consumption and high security. Hence, all the cutting edge technologies show the need for a novel wireless cellular communication generation like 5G technologies.

Background Study

During the year of 2012, there were 91 commercial deployments of LTE networks are carried out in 47 countries. Those deployment of the technologies were taken care by 335 operators. The advanced level of LTE was developed in 2013.[9] B4G networks were discussed by various European FP7 projects.[10] The research people were frequently used the keywords as adaptive, learning, cognitive and intelligent. These keywords are practically applied in BuNGee [Beyond Next Generation Mobile Broadband] which motivated to increase the overall capacity of the mobile network infrastructure including density.[11] The expectation of the BuNGee is also to improve the infrastructure capacity in an order of magnitude (10x) to an ambitious goal of 1Gbps in 1km x 1km area anywhere in the cell.[12] Due to increase the long term connectivity the basic requirement is seamless mobility support for roaming users. All the connectivity based services and supports can be provided by improving the quality of QoS parameters whereas the parameters are optimized by various optimization functions.[13, 14, and 15] In[16], the author presented a channel allocation scheme for cellular networks. A set of channels are assigned as a fixed channels for each cell in the network. The frequently used channels are assigned in high density cells and the unused channels are assigned to low density cells. Keeping channels as unused are entirely waste in terms of cost and time, instead of that channels can be allocated as much as possible. Channel allocation and assignment is most important where even channel sharing, channel borrowing increases the interferences.[16] Various research people utilized various optimization approaches for channel allocation and channel assignment. In[17] Sancho Salcedo-Sanz, et. al., uses hybrid genetic algorithms for optimal switch location in mobile communication networks. Chandralekha[18] used genetic algorithm to minimize the number of handoffs in heterogeneous wireless networks.

From the above discussions it is clear that providing a challenging WCN to the public is more in demand. The existing research works concentrates on various requirement of WCN through various techniques. But this paper provides a complete solution for improving the effectiveness of WCN using optimization methods. This paper motivated to select an optimum channel and allocate the channel to satisfy the demands without violating any constraints or to produce interference-free allocation. One of the main tasks in WCN is channel selection and channel allocation where it selects best channel and assign an available channel to the mobile user at the time of requirement. The entire contribution of this paper is:

- ✓ Design a low-complex network architecture.
- ✓ An AIS based channel selection
- ✓ Increase the security in terms of authentication and re-authentication using Distributed Key Management System (DKM)
- ✓ An AIS based route selection for effective data transmission
- ✓ Channel Allocation
- ✓ Performance evaluation

The contribution of the channel allocation process is:

- ➢ Reduces the number of channels used subject to various conditions in order to avoid the occurrence of interferences between calls.
- ➢ If the interferences are imminent then minimize the severity of the interferences.

The entire functionalities of the proposed approach discussed in this paper are depicted in Figure-1.

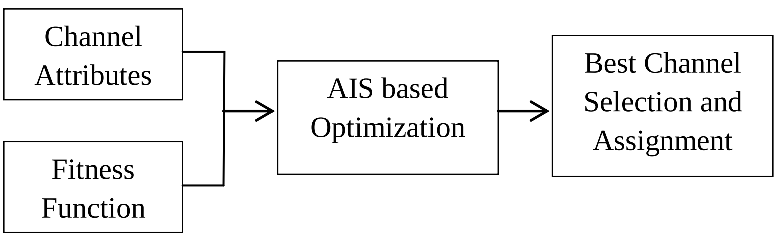

Figure-1: Proposed System Model

Low-Complex Network Architecture

The network architecture considered in this paper illustrates the channel selection and chooses the channel after optimization (see Figure-2). Finally through the optimized channels the route is discovered. Each time the channels are selected by applying AIS algorithm and it investigates the parameters of the channels and selects the best.

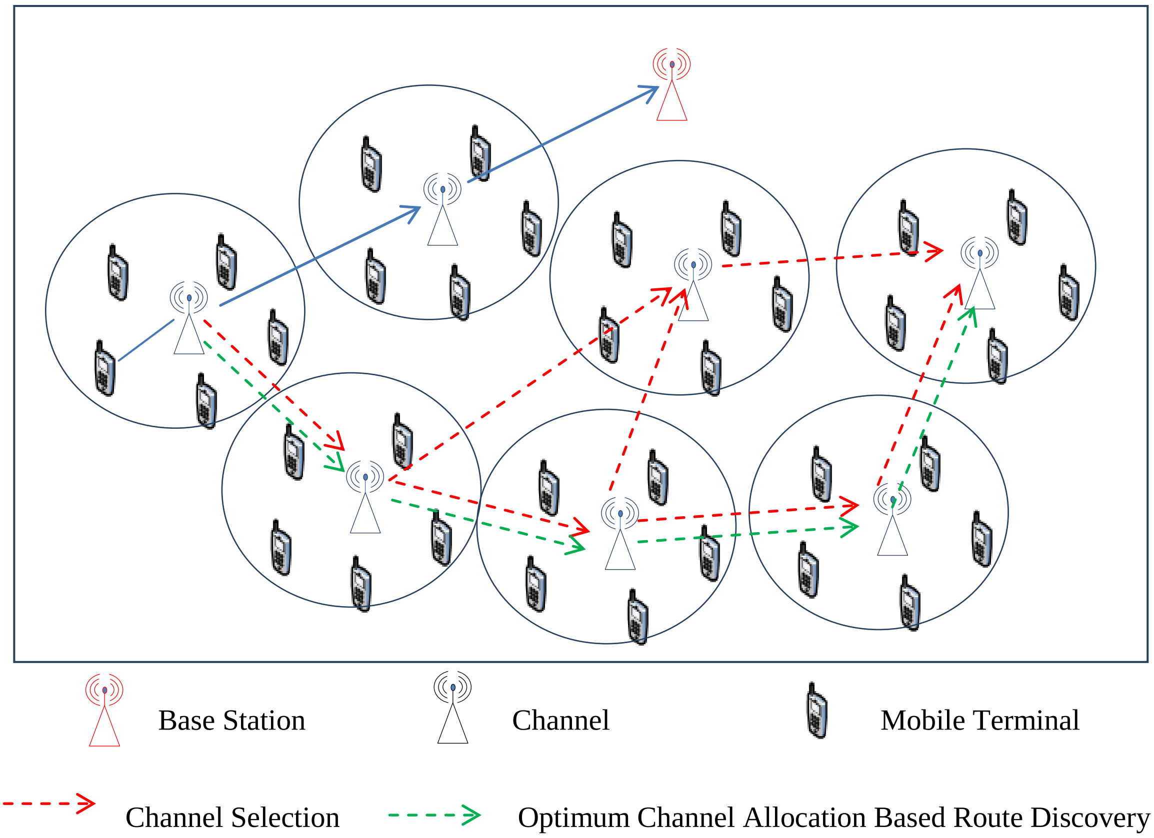

Figure-2: Proposed Network.

Need for Channel Allocation

There are chances when two channels can use same frequency and it is called co-channel cells. Similarly if the channels used in one site are repeated in other site then the capacity of the system increases. At the same time, cells become close to each other co-channel interference may occur. In order to avoid co-channel interference the cells must be located little far away from that cell unit. Similarly, cells may use the same channel, so that they should be placed in a distance. It can be avoided by placing the cells with a defined radius R and in reuse distance D. So, the co-channel interference is measured as D/R.

$$D/R = (3N)^{1/2} \quad \text{---- (1)}$$

Where, ***N*** is the number of cells in a cluster. Co-channel interference is the main reason for creating noise in cellular systems and it depends on the traffic. During high traffic (or in peak hours) co-channel interference is created in a greater manner.

If a cell consists of more number of users than a normal scenario of a cell, then the cell need more than one channel. In this case while assigning channels in the same cell these channels cannot be assigned since they become adjacent channels. This kind of scenario creates a co-site interference problem since they are nearby channels. Co-site interference is also the next source of noise creation in cellular networks. This co-site interference is avoided by placing the channels with minimum of five spaces between channels.

It is well known that cells placed close to each other cannot use adjacent channels. This scenario leads to create adjacent channel interference. This adjacent channel interference is not sever like the above two interference discussed earlier. But this adjacent channel interference has a vital role in monitoring and controlling the performance of the cellular system. Even though the above three different interferences must be avoided/eliminated by assigning proper channel in the cellular planning.

Channel selection and assignment process determines the channels which are appropriate; to be used in every cell and it is important for the operation and reliability of cellular system. It is essential to consider three strategies in channel assignment. There are three different types of strategies to be considered in channel assignment, they are: (i). Fixed channel Assignment. (ii). Dynamic Channel Assignment. and, (iii).Hybrid Channel Assignment.

Optimized Channel Selection

In cellular networks the cellular area is divided into regions called as cells. A well configured Base Station (BS) is placed in the center of the network or center of the each cell. The BS located in the center of the cell is called as Local Base Station (LBS) and the BS located at the center of the network is called as Global Base Station (GBS). All the mobile hosts (MH) in a region are connected to a channel assigned by the LBS through the channel MHs connects to BS. Channel allocation motivates to reduce the percentage of failure rate when a new call in a cell is assigned to channels or while moving assigning channels to an active call to a new cell. If the channel assignment to a new call fails then that call is blocked. Also call dropped happens when an ongoing call has been handed over from a channel to a new cell gets failed. As a result of increasing the number of users an ideal cellular system reduces the call dropping and call blocking probabilities in the network. Power regulation, reducing the interference, same frequency selection for communication and frequency reuse level determination are bring to the required level is obtained by channel assignment. In order to reuse all the frequencies by the cells the frequency reuse factor is set to 1. Cellular communication needs a high degree of capacity due to provide service to a maximum number calls. In order to provide good service in terms of more number of calls, mobility and proper handover the most important job is to select and assign a best channel among various channels available in the network. In this paper, to select a best channel an Artificial Immune System is utilized for optimizing the channel allocation and assignment by investigating the attributes of the channels.

Distributed Key Management based Authentication / Re-Authentication

In this paper an automatic key development and key distribution method is used to provide authentication and authorization. The automatic key management is exists only inRobust Security Network Association(RSNA).[2, 4] This key management is focused and utilized in IEEE 802.1X standards. This key distribution and key verification is launched during handshaking for packet transmission. The automatic key is generated dynamically, randomly and arranged in a sequence for assigning to network participants. Main motto of the key distribution method is to apply authentication and enhances the confidentiality. Initially generated key is assigned to the mobile hosts, local base stations and global base station also to APs in the network. Once the key is generated, it is folded as a token-key and provided to each hosts. During communication each concern's key is verified by a security association mechanism integrated in the WCN application. Sometimes the application may use open system authentication available in IEEE 802.11 standard. The sharing of key and getting mutual authentication used in this paper is derived from EAP protocol.[3] The key distribution and management procedure follows the 4-way handshake method discussed in.[5] The shared key confirms the link as secured link and is ready to allow normal data traffic.

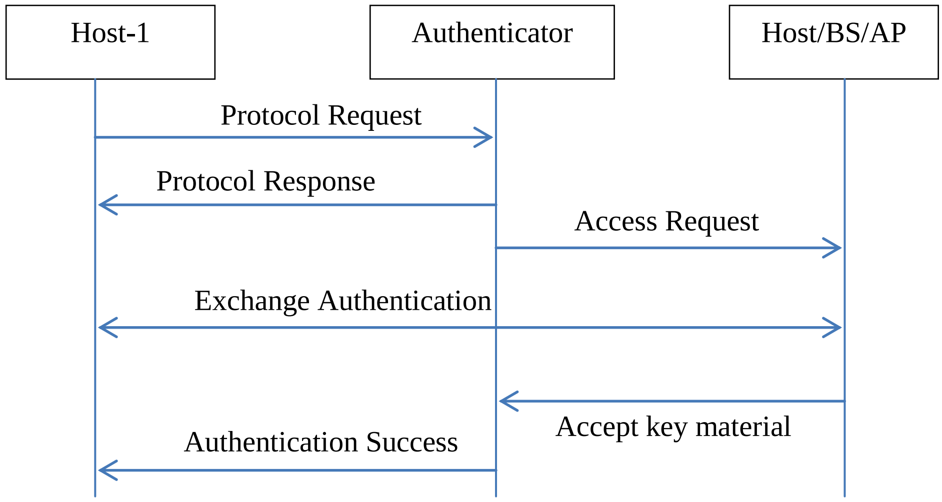

Figure-3: Authentication during Handshaking.

The authentication process provides successful link between any IEEE 802.1X port and the authenticator in the network architecture. Both-end keys are verified by the authenticator or by the AP then a key success handshaking is provided that is so called 4-way handshake is depicted in Figure-3. Figure-3 illustrates the complete security association establishment process step by step. This handshaking process says the link established is highly secured by key submission and verification and it is ready for normal data traffic.[5]

But assuming that the scenario is under mobility (roaming), the authenticator requires re-association by submitting the keys for re-authentication process.The above key submission and verification process is repeated for initial contact association, but its host deletes the token-key during roaming. During the roaming process the host leaves the old cell and entering into a new cell since it needs to remove all the old association and authentication information and has to proceed with the new association and authentication for a new link dynamically without breaking the old link. The same operation of the network authentication process is repeated and after successful verification link is transferred.[6]

Optimized Route Selection

It is well known and clear that mobile nodes are participating and interacting with the WCN, it is necessary to understand that they involved in the routing–route calculation at the network layer. Routing is not a big issue once if the optimized channel selection and allocation is provided for communication. Here the stationary nodes take care of route the information to the appropriate destinations. Consider a mobile node is treated as a sink; a routing table is created and maintained for transmitting information effectively to the destination.

In case of moving nodes, then a dynamic decision tree is created as a routing tree which can be computed as the mobile nodes moves from place to place in geographical area. In order to eliminate un-necessary re-computational works only the routing tree is updated by the locality of the moving nodes in the network. Sometimes the routing tree updation can be obtained by creating a new complete routing tree according to the distance of the node moved from their original location also it is done only when it is necessary. The routing efficiency can be improved in term of: Optimum Route discovery, route maintenance and service. Optimization on the route is obtained by choosing energy efficient path, cost effective transmission and inexpensive network topology maintenance. So that the energy efficiency should be investigated in each area to the degree that appropriately matches its importance in meeting the overall objective. Also in the optimized routing priority based service is applied in long-term basis. Also the data traffic should be light weight and optimization of energy cost on each route is not nearly as important as reducing overhead during route setup phase.

Channel Optimization-1

The channel allocation process is considered as NP-hard problem where it is not able to solve it as a polynomial time. In order to avoid interferences channel allocation becomes an important task. The basic channel allocation model can be written as.[17] The necessity and the number of channels to be allocated under network constraints are given in the below steps.

- Number of cells in the network is **N**
- $d_i, 1 \geq i \leq N$ is the number of channel required for the cell i, where the total demand $D = \sum_{i=1}^{N} d_i$
- $|N| \times |N|$ Compatibility matrix $C_{ij}, 1 \geq i, j \leq N$
- Minimum reuse distance between cell i and cell j if $i \neq j$ for co-channel constraint
- Minimum channel distance between cell i and cell j if $i \neq j$ for adjacent channel constraint.
- Minimum separation distance if $i = j$ for co-site constraint.

The Secondary objective is to find the minimum number of best channel used to satisfy all demands, by avoiding violation of constraints which could result in interference. The secondary objective function is defined as.

$$Min \sum f_{ik}, \; i \geq 1, \; 1 \leq k \leq N \quad \text{---- (2)}$$

Where f_i is the channel which is allocated to the cell **k**. it can be represented as a positive integer as (1, 2, 3… N). While allocating the channels is necessary to verify the distance among the celli, j. In case of two channels f_i and f_j are assigned to, two cells as i *and* j then the minimum distance which other users in different cells must have in order to use the same channel. The following parameters are considered under certain constraints for selecting a channel and assign.

$\min(st)$	: Minimum set up time taken for a new connection
$\min(Ld)$	: Minimum load distribution
ft	: fault tolerance
s	: Scalability
co	: Computational overhead
$\min(ho)$	: Minimum handoff
nca	: Number of calls accepted parallel

Channel Optimization-2

In order to select a channel the above parameters are evaluated where each parameter has been assigned with a threshold value to provide better performance. The user should know the condition of the channel prior the whole period of **T** slots. Due to WCN communication the current channel information (state) is updated to the BS, so that any user can select an available channel for further communication. The optimum channel selection.[7] in terms of channel mode is given as

$$\text{Objective fucntion } \mathbf{OFV} = \mathbf{maximum} \sum_{n=1}^{N} w_n \overline{\mathbf{Th_n}} \quad \text{--- (3)}$$

Obtained by modifying the Equation (2)

subject to$\overline{\mathbf{Th_n}} = \mathbf{E}\left[\sum_{m=1}^{M} \mathbf{Th_{m,n}}(\mathbf{t})\mathbf{l_m}(\mathbf{t})\right], \forall \mathbf{n}$

$$\bar{\mathbf{E}}_\mathbf{n} = \mathbf{E}\left[\sum_{m=1}^{M} \mathbf{E_{m,n}}(\mathbf{t})\mathbf{l_m}(\mathbf{t})\right] \le \widehat{\mathbf{B_n}}, \forall \mathbf{n}$$

$$\sum_{m=1}^{M} l_m(t) = 1, \forall t$$

$l_m(t) \in \{0, 1\}, \forall t, \forall m$

Where,E – is the expected value

$\overline{\mathbf{Th_n}}$ Denotes the throughput

$\bar{\mathbf{E}}_\mathbf{n}$ Represents the energy consumption

$\widehat{\mathbf{B_n}} = B_n/T$ denotes the energy-cost per slot

The main objective of **OFV** is finding the maximum of weighted sum of all users' average throughput during the slot **T**, by choosing optimal mode at each period. The weight of each user $\boldsymbol{i}$ is represented as $\boldsymbol{w_i} \geq \boldsymbol{0}$ *and* $\boldsymbol{w_i} = \boldsymbol{1}$ for helper user. Maximum of average throughput, minimum energy consumption and less day are the objective function. Base station does the optimization problem and intimates the selected mode to each user as the result of scheduling.

Mode $\boldsymbol{m}$ based selection metric is represented as.

$$\widehat{U}_m(t) = \sum_{n=1}^{N} \left(w_n R_{m,n}(t) - \lambda_n E_{m,n}(t) \right)$$

Where, all the matric is chosen at time slot$\boldsymbol{t}$, i.e.

$$m^*(t) = \underset{m}{\operatorname{argmax}}\, \widehat{U}_m(t)$$

Artificial Immune System

Artificial Immune System (AIS) algorithm is basically a biological evolutionary algorithm. It is a natural selection and gene representation algorithm. AIS is used in various kinds of comparison and searching problems from medium to large in size. In this paper using AIS, a hybrid channel selection and assignment algorithm is applied. AIS has a large size populations which represents solution of the problem, whereas each solution is represented as a chromosome. Collection of chromosome forms a population. In human body a chromosome consists of several genes and it is represented in binary format. Each bit in the chromosome denotes a gene. Chromosomes are also called as individuals or strings. From the population AIS selects a best possible solution on the basis of a Fitness Function (FF) value (also called as threshold value) which is defined by the user according to the problem solution required. The FF is unique for each optimization problem. The fitness of the entire chromosome in the population is measured and the best one is selected. AIS ensure a fast convergence to the near-optimal solution. Any problem which is represented as an optimization problem can be solved using AIS. This process is repeated in an iterative manner until meet the termination condition reached or the iteration reached. In this paper, AIS is utilized for selecting the best channel suit for present cellular communication in the WCN. The attributes of the channels are taken as a chromosome and investigated by comparing with the FFV. The channel is selected one which meets the FFV in less convergence rate and which is well suitable for the cell. To understand in better manner the AIS algorithm is given in the form of algorithm and pseudo code below.

AIS Algorithm.

1. Assign a random population P
2. For each population, compute OFV as the optimum channel
3. In order to provide more solutions, compute the affinity value where it can be calculated by 1/OFV for P
4. To determine the number of new solutions, compute the rate of cloning $(ROC = (\frac{1}{OFV} * P)/ \ Total\,affinity\ value)$
5. Clone generation for the problem, according to the ROC.
6. Check and maintain the size of population is S after successful cloning.
7. Do inverse and pairwise mutation on S, arrange all P in ascending order and eliminate R% of highest OFV based clones.
8. Replace R% of the highest OFV based solutions by new random population generation.
9. Repeat (2) until obtaining a best OFV.

AIS Flowchart

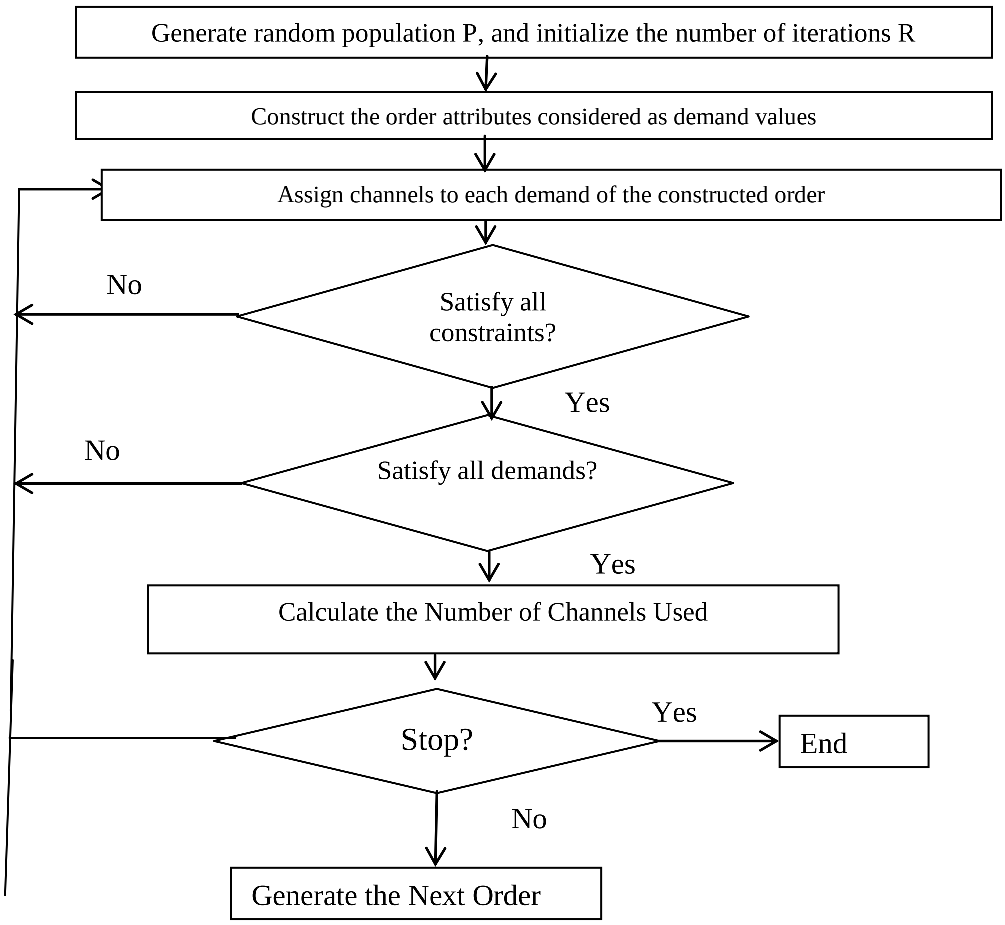

Figure-4: Flowchart for AIS

AIS Channel Optimization-3

Where, $\mathbf{df_n}$is the decision function, the decision is made according to the bandwidth $\mathrm{ban_n}$, power consumption $\mathbf{E_n}$and cost $\mathbf{Cost_n}$. $\mathbf{w_a}$, $\mathbf{w_b}$ and $\mathbf{w_c}$ are the weight factors determines the weight of the parameters such as $\sum \mathbf{w_i} = \mathbf{1}$

$$Ch_{opt} = argmin\left(f^{ch}\right)\forall\ ch,$$

Where, $f^{ch}$is the channel optimization function for**WCN**n**,** and it can be calculated as:

$$f^{ch} = \sum_{s}\left(\left(\prod_{i} E^{ch}s\,;i\right)\sum_{j} f^{ch}\ s;j\ (w_{s;j})\ N(Q^{n}\ \ s;j)\right)$$

$N(Q^n\ \ s;j)$is the normalized Quality of Service parameters, $Q^n s;j$represents the best quality of channel carry out service **s** in cellC**,** on network **n.** $f^{ch}\ s;j\ (w_{s;j})$represents the weighting function for service $s$and$E^{ch}s\,;i$represents the elimination factor of service$s$**.** The best channel is selected according to the available bandwidth, RSS, power consumption, distance and roaming access quality. The optimization function is written as:

OFV = avgmin (f^{ch}**)**

$$OFV(ch,q) = w_q \times Qualtiy(ch,q) + \ w_d \times distance(ch) + \ w_{pc} \times pc(ch) + \ w_c \times capacity(ch) + w_{co} \times cost(ch,q)$$

for all $ch\ \in CH = \{ch_1, ch_2, \dots, ch_n\}\ n \in Z$ **and** $q\ \in Q(ch) = \{q_1, q_2, \dots, q_m\}\ m \in Z$

Where $ch$the set of channels is perceives and $Q(ch)$ is the set of quality of levels at which the channel ch can be selected for the channel allocation and service s under consideration. Each q_i represents various QoS parameters of a channel like bandwidth, RSS and roaming access etc.

The entire quality of the channel ch is determined by the parameters assigned values$Q(ch)$. The optimization of **ch** is decided from the quality levels of $Q(ch)$ and it can be written as:

$\forall\ ch\ \ \in CH\ \{\mathbf{max}\forall\ q \in Q(ch)\{OF(ch,q)\}$

From the above channel optimization methods AIS creates a chromosome by choosing some important parameters. The chromosome created in this paper is.

$S = \{E, Th, T_{slot}, Co, BW, S, RSS, D, RAQ\}$

E	:	Energy
Th	:	Throughput
T_{slot}	:	Time per Slot
Co	:	Cost
BW	:	Bandwidth
S	:	Service
RSS	:	Received Signal Strength
D	:	Distance
RAQ	:	Roaming Access Quality

Each entity in the S is assigned by two values as “1” and “0”. If the entity satisfy the QoS level to the demand of the user then it is assigned as “1” else it is “0”.

Initialization

The overall functionality of AIS algorithm is described in terms of algorithm and in flowchart for optimizing the channel to be selected and allocated to a dynamic user. To obtain the objective function OFV, some of the values are initialized as the size of the population (P), number of iteration (K) and replacement factor R as.

P = 50, 100

K = 100, 500, 1000

R = 10%, 20%

The above P, K and R has a lower bound and upper bound values, whereas the channel quality level may change within a range for various kind of WCN such as 3G, WiFi, LTE and WiMAX. But in our experiment the objective value is obtained when P=100, K=1000 and R=20% for WiFi.

AIS – Numerical Illustration

Initialization

In above section we initialized P, K and R by some initial values. The population is generated randomly to create possible chromosome with different combinations. It is also called as a string or a clone whereas the number of clones is P. The entire set of P is taken into account as an initial population in the initial stage of the problem. For example the string S is written as.

$$S = \{ 1, 1, 1, 0, 1, 0, 1, 0, 0\}$$

Objective Function

The main objective of this paper is to fulfill the demand of the user regarding a channel selection and channel allocation with maximum capacity, throughput, Roaming access quality and minimum energy consumption, distance, cost within minimum time [MAX(QoS_{CH})]. In order to fetch a QoS_{CH}, for all P compute the affinity value from OFV using.

Affinity value = **1/OFV**

Clonal Selection and Expansion

A single clone represents a solution. The affinity value is inversely proportional to the objective function value. From the affinity value the best case clones can be chosen for finding optimum value called as Rate of Cloning (ROC), it can be calculated using.

$$\text{Rate of cloning [ROC]} = \frac{affinity\ value * Population\ Size}{Total\ of\ affinity\ value\ of\ the\ solution}$$

One clone is the original copy of one string. In order to improve the optimization accuracy it is necessary to generate more solutions. So with respect to ROC value new clones are generated. If the ROC value is 1.4, then the new number of clones is 2. This process increase the temporary population of the clones and it is called as Clonal Expansion.

Mutation

To create new clones there are two different kinds of mutation is applied such as Inverse Mutation and Pairwise Mutation. By applying mutation new clones of the population can be generated and it is shown in the following Figure-5 and in Figure-6.

Original String	1	1	1	0	1	0	1	0	0
Changed String	1	1	0	1	0	1	1	0	0

Figure 5: Inverse Mutation.

Figure-3 shows inverse mutation on a string S. After inverse mutation the OFV is calculated for the mutated string and compare with the OFV of the original string. If the OFV of mutated string is maximum than original string then the original string is replaced by the mutated string, else retain the original string and proceed with pairwise mutation.

Original String	1	1	1	0	1	0	1	0	0
Changed String	1	1	0	1	0	1	1	0	1

Figure-6: Pairwise Mutation

Figure-4 shows pairwise mutation on a string S. After inverse mutation the OFV is calculated for the mutated string and compare with the OFV of the original string. If the OFV of mutated string is maximum than original string then the original string is replaced by the mutated string, else retain the original string.

After mutation process completion, it is clear that the population size is increased than the initialization size P as 50. In order to maintain the population size as 50, the entire population is arranged in ascending order according to the OFV value. From that the top 50 populations are only taken for further process and the remaining populations (more than 50) are deleted from the list.

Robust Replacement Process

AIS have a unique feature that eliminating worst-case scenario to avoid/reduce the computational complexity. To do this, R% of worst-case populations are removed from the available population P, then new populations are generated randomly and newly for the same R% which maintains P.

This process is repeated iteratively until reach the objective or until meet the termination constraints. It is assumed that a best channel can be chosen when S is as.

$$\boldsymbol{S} = \{\, \mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{1} \}$$

But it is rare to obtain all the Quality of service factor meets the user requirement at the same time.

SIMULATION RESULTS AND DISCUSSION

In this paper MATLAB software is taken for experiment our proposed AIS approach and evaluates the performance.Here, there are various number of cells with various number of channels is deployed. Each time the channel selection and channel allocation is applied by executing the AIS code. The AIS algorithm is implemented in MATLAB software (m code) and experimented. The area of the network is given as a fixed size such as: 1500 x 1500 (for simulation only). Each parameter is assigned by some values which meets the user demand in terms of WLAN.[8] While evaluating the obtained values of the parameters are compared with the values given in Table-1. If it matches mean the channel meets the user demand and ti can be allocated to the appropriate user.

Table-1: Simulation Parameter Evaluation Values

QoS Parameters		Weight Factors	Lower Bound	Upper Bound
Energy (Joules)	P1	0.122	0.1	0.162
Throughput (MPs)	P2	0.234	54	540
Slot Time (s)	P3	0.01453	3.5	5
Cost (per KB)	P4	0.411	1	4
Bandwidth(Mbps)	P5	0.321	11	15
Service (Mbps)	P6	0.0431	<5	<10
RSS	P7	0.1243	99	102
Distance (m)	P8	0.054	50	150
RAQ(km/s)	P9	0.123	60	120

In order to examine the performance of the channels there are nine numbers of parameters are used here. Channels are selected initially by the availability and it should be little closer to the user one need for channel connection. This functionality is verified by investigating the total number channels, mode of the channels and the distance from the user. The obtained results from the experiment are shown in Figure-7, where it illustrates the dynamic behavior of the channels and number of channels can be selected. Here, the less distance based channels are selected and their availability is examined. A channel may in any one of the mode such as: Sleep, Listen, Service and Idle, where in our experiment it looks for the channels which are in sleep of in idle mode. Figure-7 says that 1% of the channels are available in closer distance to the user. In case of scalability the number of users gets increased and the availability of the channel becomes poor. Second parameter which leads to select a best channel is the amount of energy consumption taken by the channel and the communication among the channel and the user. The amount of energy consumed by the channels and users are different, since the channels are well configured and little more memory than the users. Because a channel can transmit and receive the information from a user located far away and its RSS is good also it is capable for more communication at the same time. Energy consumed by the channel and the user are more or less equal and it depends on the distance and the data rate. According to the changes in the data rate, distance and size of the data energy is consumed. The energy consumed by the channel and the user is examined experimentally and the result is shown in Figure-8.

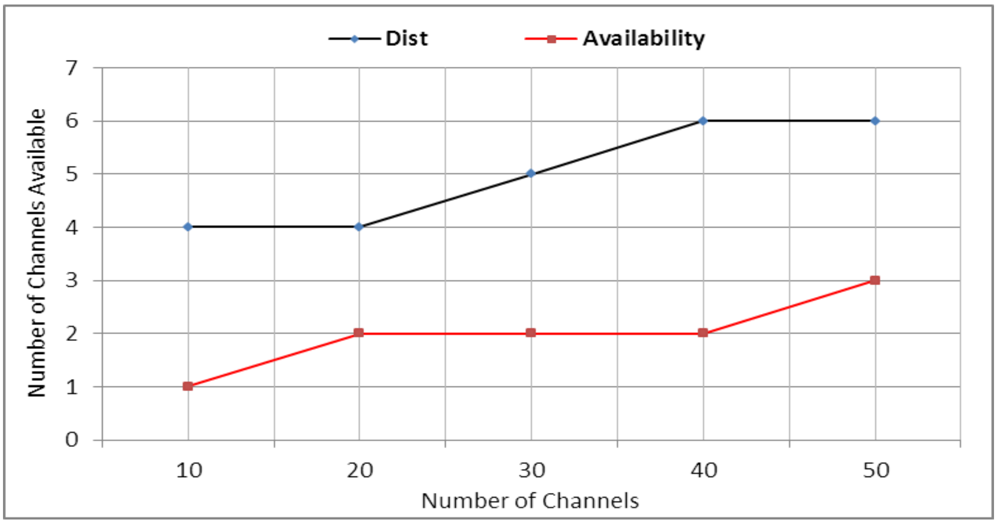

Figure-7: Channel Availability.

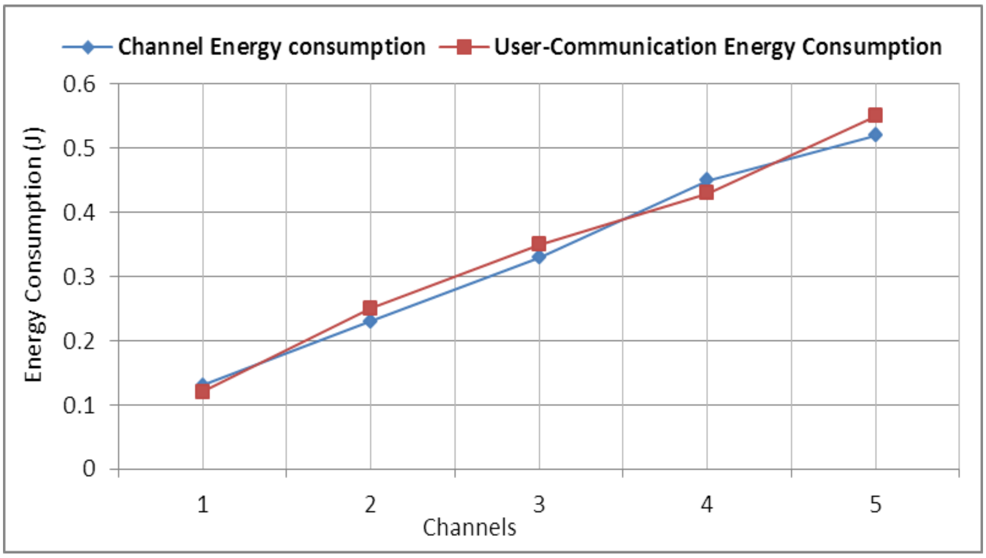

Figure-8: Energy Consumption.

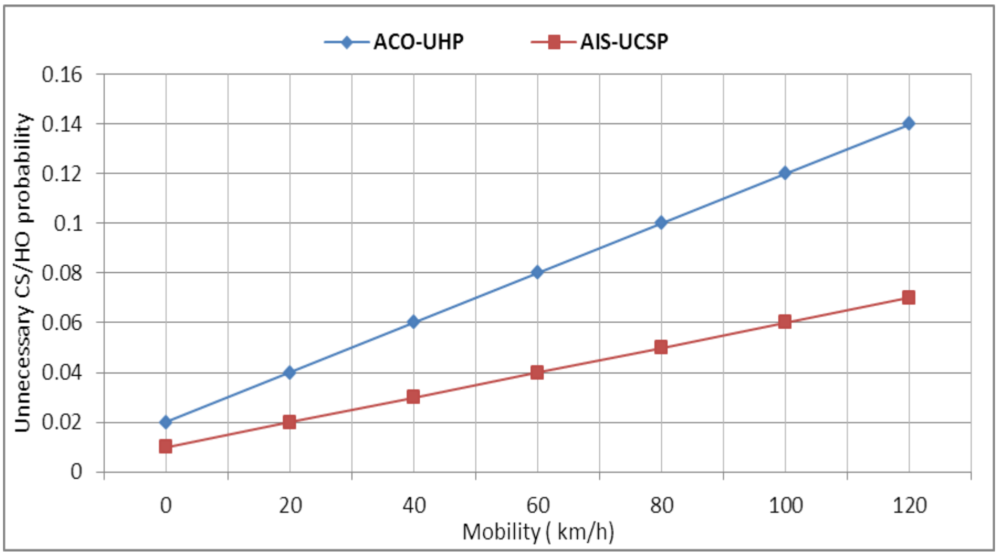

Figure 9: Unnecessary Probability.

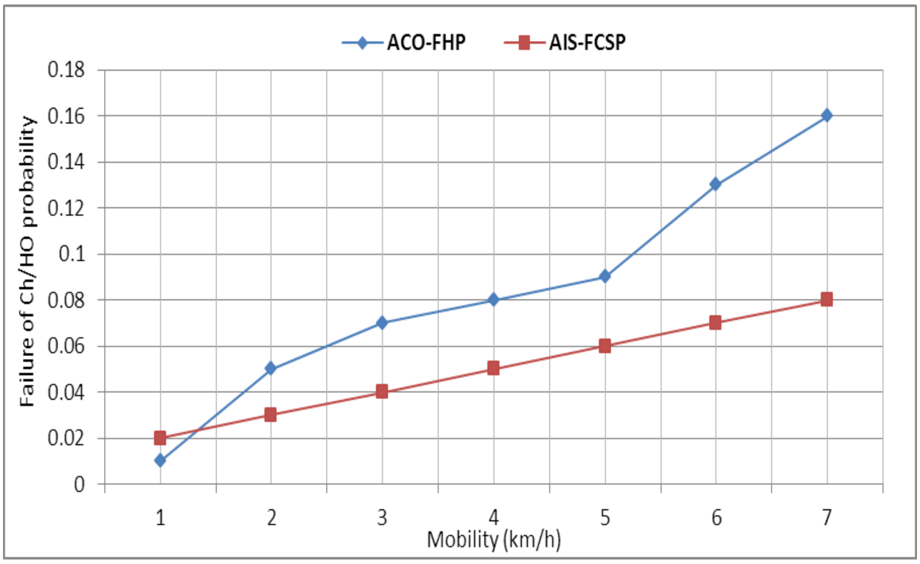

Figure-10: Failure Probability.

Figure-9 and 10shows that, with our AIS approach it can find a solution with channel selection and allocation failure probability less than the specified value (0.005) and unnecessary channel comparison for selection-allocation probability less than the specified value (0.005) independently of the mobile user mobility. The parameters of the channels are examined are channel selection and unnecessary channel comparison probability to the total number of channel availability, bandwidth, service, cost and time of service. In this simulation AIS is compared with Ant Colony Optimization – (ACO) method to RSS based.

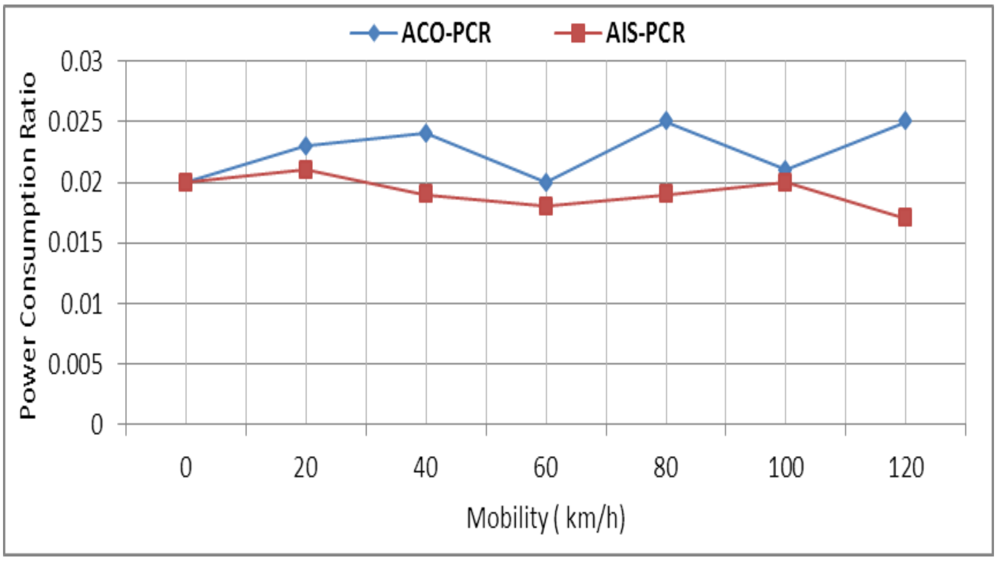

Figure-11: Power Consumption Ratio Comparison.

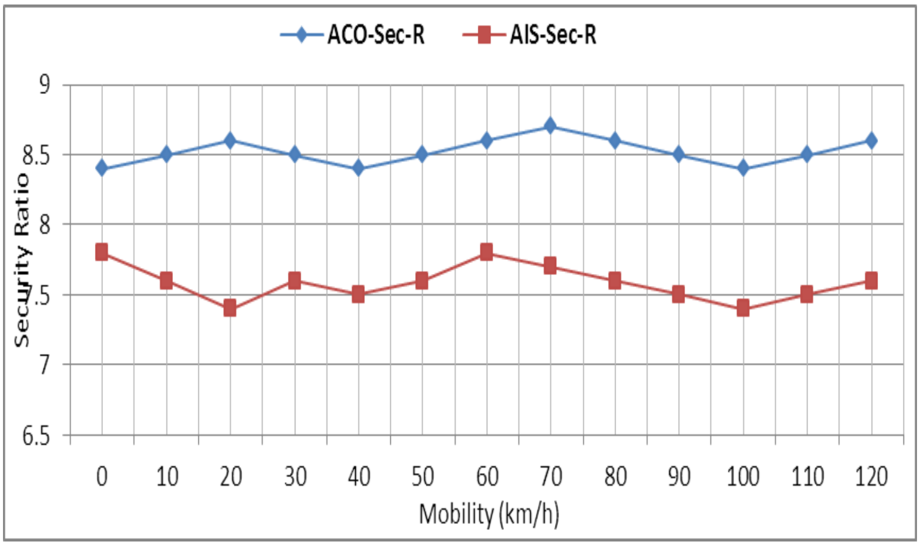

Figure-12: Security Ratio Comparison.

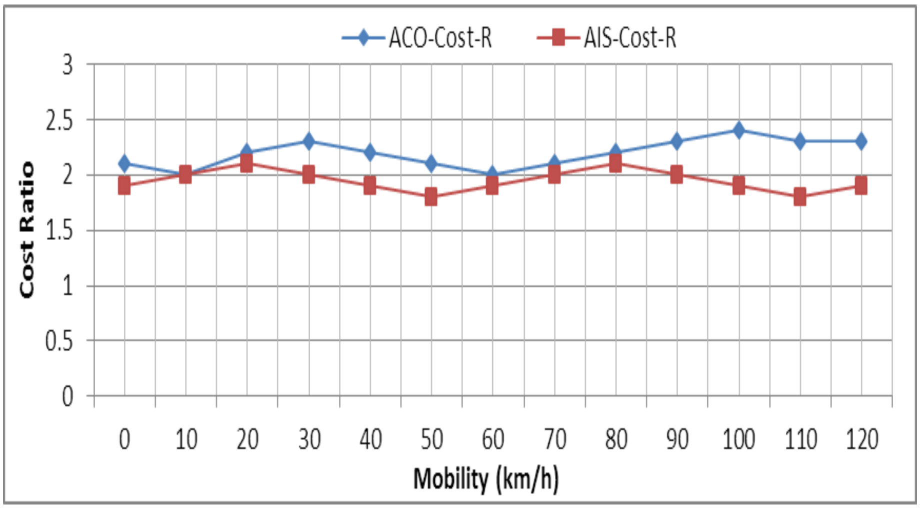

Figure-13: Cost Ratio Comparison.

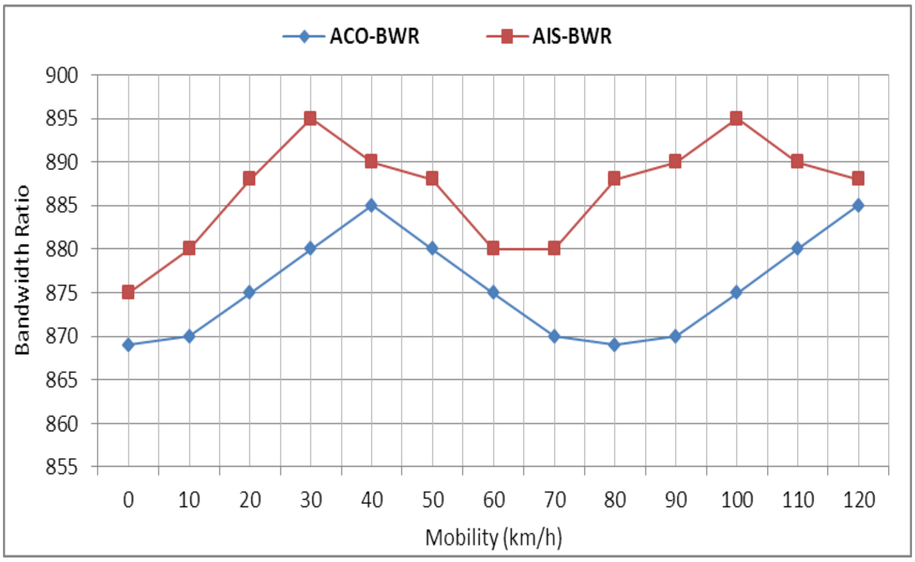

Figure-14: Bandwidth Ratio Comparison.

From Figure-11 to 14, the proposed AIS approach and ACO approach are compared in terms of energy consumption ration, security ratio, cost ratio and bandwidth ratio obtained while mobility for various number channels and users. It is aimed to achieve much better performance than ACO, in terms of QoS parameters. The reason for comparing with ACO is, ACO is already compared with RSS and HNE based methods and proved it as a better approach.

From the Figure-11 to 14, it is clear that it cannot reduce the number of failures and unnecessary channel selection and allocation up to 95% regardless of the mobility of the users. Even though, we got better QoS in terms of bandwidth, security, power consumption and cost of service. For better explanations on the performance comparison, bandwidth cost of service, security and power consumption of the ACO method and AIS are compared for different number of users and different number of channels.

From the figures, it is clear and proved that AIS approach obtained a better performance than ACO. Also the following Table-2 gives the summarized values of bandwidth, cost of service, security and power consumption under different solutions. It is clear from the table and the figure, when increasing the number of users we can obtain a better performance.

Table-2: Performance Comparison among RSS, ACO and AIS

No. of MTs	size	Cost			Bandwidth			Security			Power consumption		
		RSS	ACO	AIS	RSS	ACO	AIS	RSS	ACO	AIS	RSS	ACO	AIS
100	10	4	3	2.9	830	930	942	6.5	8	8.3	0.17	0.05	0.048
100	20	3.7	2.7	2.68	840	940	953	6.7	8.3	8.6	0.12	0.03	0.026
100	50	3.4	2.5	2.43	860	960	967	7.2	8.4	8.7	0.075	0.025	0.022
100	100	3.1	2.4	2.3	880	970	972	7.4	8.5	8.7	0.055	0.02	0.019
50	100	3.1	2.6	2.58	880	955	964	7.4	8.4	8.6	0.055	0.025	0.021
20	100	3.1	2.7	2.65	880	930	943	7.4	8	8.2	0.55	0.035	0.031
10	100	3.1	2.9	2.87	880	915	921	7.4	7.8	8.1	0.55	0.043	0.041
50	10	4	3.2	3.1	830	920	929	6.5	7.7	7.9	0.17	0.07	0.68
50	20	3.8	3	2.88	840	930	936	6.8	8	8.3	0.12	0.042	0.037
50	50	3.4	2.7	2.61	870	950	961	7.2	8.2	8.5	0.075	0.032	0.03
20	20	3.4	3	2.76	860	920	934	7.1	7.9	8.3	0.075	0.042	0.037
20	10	3.8	3.2	3.14	840	910	918	6.8	7.7	8.2	0.12	0.06	0.056
20	10	4.1	3.5	3.39	830	900	911	6.6	7.5	7.9	0.18	0.09	0.081
10	10	4.1	3.6	3.48	825	880	895	6.6	7.3	7.8	0.18	0.11	0.08
10	20	3.8	3.4	3.36	840	890	898	6.8	7.5	7.8	0.12	0.08	0.04
10	50	3.4	3.1	2.78	865	905	912	7.2	7.7	8.1	0.078	0.052	0.034

Appendix

Table-2: Simulation Parameter Settings.

Parameters	**Values**
Number of cells	20, 40, 60, 80, 100
Average Number of mobile nodes in a cell	200, 400, 600, 800, 1000
Average number of channels deployed in each cell (5%)	10, 20, 30, 40, 50
Minimum distance among the channels	3km
Maximum distance among the channels	8 km
Transmission Energy (J)	$35.28e^{-3}$
Receiving Energy (J)	$31.32e^{-3}$
Propagation Delay	Two Ray Ground Delay

DISCUSSION

Channel selection is an initial process for creating internal connectivity, i.e. routing from one user to BS or from user to Channel/AP or user to user. The intermediate connection decides the lifetime of a connection in WCN, whereas lifetime of a connection provides a seamless connectivity in the network. Choosing the channel determines the connection, fast and efficient data transmission and long term connection. A channel selection and allocation is static process and it is sometimes dynamic process. Once the connection created with optimized channel then it is guaranteed that the connection is seamless even the user moves from one location to other location. Perfect channel based connection can provide a perfect handoff results. Since an optimum channel can provide long term connection in terms of bandwidth, distance, data rate, energy, distance, security and cost it can give a seamless connection, where a handoff mechanism is aimed to provide a seamless connection. Hence an optimum channel can reduce the handoff process in WCN also it doesn’t require re-authentication since the channels can retain the user information.

CONCLUSION

The main objective of this paper is to select and allocate optimized channels in WCN. Due to more number of users, cells, channels and communication it is necessary to provide an optimum channel allocation for the users in order to provide more efficiency. This paper utilizes Artificial Immune System approach for optimizing the channel to be selected and allocated for WCN users. The channel Quality of Service parameters are examined and evaluated by comparing the objective function value and channels are elected. The channel selection process is handled automatically by evaluating the static and dynamic behavior of the channels. From the experimental results it is proved that AIS approach based channel selection and allocation is done in effective manner.

REFERENCES

1. Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, *2013-2018*, Cisco, San Jose, CA, USA, Feb. 2013.
2. E. Sithirasenan, K. Ramezani, S. Kumar and V. Muthukkumarasamy, "EAP-CRA for WiMAX, WLAN and 4G LTE Interoperability", http://dx.doi.org/10.5772/54837.
3. Almus, H, Brose, E, Rebensburg, K, & Kerberos-based, A. EAP method for re-authentication with integrated support for fast handover and IP mobility in wireless LANs", in *Proceedings of the 2nd international conference on communications and electronics*, ICCE., 2008; 61-66.
4. IEEE Standard 802i Part 11, "Wireless Medium Access Control (MAC) and PhysicalLayer (PHY) specifications. Amendment 6: Wireless Medium Access Control (MAC)Security Enhancements," July (2004).
5. Iyer, A. P, &Iyer, J. Handling mobility across WiFi and WiMAX", in Proceedings of the2009 international Conference on Wireless Communications and Mobile Computing: Connecting the World Wirelessly, IWCMC., 2009; 537-541.
6. Machiraju, S, Chen, H, & Bolot, J. Distributed authentication for low-cost wireless networks", in *Proceedings of the 9th Workshop on Mobile Computing Systems and applications*, Hot Mobile., 2008; 55-59.
7. Jongwook Lee, Jin-Ghoo Choi, Saewoong Bahk, "Opportunistic downlink data delivery for mobile collaborative communities", Elsevier, Computer Networks., 2013; 57: 1644–1655.
8. Sunisa Kunarak and Raungrong Suleesathira, "Algorithmic Vertical Handoff Decision and Merit Network Selection Across Heterogeneous Wireless Networks", WSEAS, TRANSACTIONS on COMMUNICATIONS, January 2013; 1(12).
9. 4G Americas, "HSPA+LTE Carrier Aggregation", June 2012.
10. ETSI 2nd Future Network Technologies Workshop. Available : http :/ / www . etsi .org / WebSite/NewsandEvents/Past_Events/2011_FUTURENETWORKSTECHNO.aspx
11. Enhancing the CEllular Infrastructure: COgnitiveRAdio Networks for Beyond 4G (CECORA). Available: http://www.bth.se/com/ccs.nsf/pages/cocoa.
12. BuNGee: Beyond Next Generation Mobile Broadband. Available: http: // cordis. Europa. eu/fp7/ict/futurenetworks/projectsummaries/bungee.pdf.

13. G. Lampropoulos, A. K. Sankintzis, and N. Passas, “Media-Independent Handover forSeamless Service Provision in Heterogeneous Networks”, IEEE Communications Magazine, January 2008; 64-71.
14. P. Taaghol, A. K. Salkintzis, and J. Iyer, “Seamless Integration of Mobile WiMAX in3GPP Networks”, IEEE Communications Magazine, October 2008; 74-85.
15. C. Yiping and Y. Yuhang, “A New 4G Architecture Providing Multimode TerminalsAlways Best Connected Services”, IEEE Wireless Communications, April 2007; 36-41.
16. Sudarshan Subhashrao Sonawane, Dr. A. J. Patil, and Dr. A. K.Sachan, “Channel Allocation Scheme in Cellular System”, International Journal of Advanced Networking and Applications, 2010 02(01): 452-457.
17. Suliman, SaifulIzwan, Graham Kendall, and Ismail Musirin, "Optimizing channel allocation in wireless communication using single-swap mutation based heuristic”, *Advanced Communication Technology (ICACT), 2013 15th International Conference on*, IEEE, 2013.
18. Mrs. Chandralekha, Dr.Praffula Kumar Behera, Minimization of number of handoff using Genetic Algorithm in heterogenous wireless networks, International Journal of Latest Trends in Computing (E-ISSN: 2045-5364) 24 Volume 1, Issue 2, December 2010.
19. Jiahai Wang, Zheng Tang, XinshunXu, Yong Li, A discrete competitive Hopfield neural network for cellular channel assignment problems, Elsevier: Neurocomputing., 2005; 67: 436–442.