Maintaining Spectrum Sharing through Software puzzles in WSN

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ABSTRACT

Nowadays demand for spectrum is growing very fast but being a scarce asset, if not properly shared would result in wastage and unauthenticate usage. The problem can be solved by sharing the spectrum efficiently. Spectrum sharing is been used at many places in our day-to-day life, different laptops can communicate with each other using bluetooth or wi-fi router which is sharing wi-fi spectrum with other users, but There is no central brain which can automatically detect the unused spectrum and accordingly change its transmission or reception parameters to the needful users. We adopted a mechanism in which a CR acting as a auctioneer presents the spectrum availiabilty to the bidders and introduces a puzzle to solve as a method to gain the access of the spectrum. Our algorithm provides a centralized, easy to implement and computational fast multiple access scheme which can be verified by all the participating users.

Keyword:-*Cognitive Radio(CR),Puzzle Generation,Puzzleevaluation,DecisionTree,Fuzzy Logic.*

1. INTRODUCTION

Due to advent of newer technologies there is continuous progress in the modes of communication, demand for spectrum is growing day by day owing to progress in technology and high number of users.   Advancement in wireless communication is the solution to the ever increasing demand of the spectrum. The availability of the spectrum is fixed and number of users are increasing day by day. This problem can be solved by only efficient spectrum sharing techniques. In our project we have analyzed one such method for spectrum sharing. The ownership of the spectrum is given to fixed users (primary/liscensed).This method although easy to implement, it is wasteful since primary users do not utilize it fully at all times resulting in the wastage of spectrum. When the spectrum is idle it can be utilized by the secondary (unliscensed) users thus increasing the efficiency of spectrum.

1.1 PUZZLE GENERATION

The algorithm which we used is 'puzzle based auction mechanism'. In this mechanism one user will be acting as an auctioneer who advertises the spectrum availability to the bidding users. This auctioneer defines a puzzle which needs to be solved by the bidding users in order to gain access to the spectrum. The puzzles will be presented in the form of mathematical equations with a specific processing time and the difficulty level of the puzzles will be increased accordingly. The bidder who presents the solution quickly and correctly will gain the access for a fixed time interval. If the specific bidder uses less processing time and number of attempts to gain the access of the spectrum are more then that bidder is considered as greedy (malicious) user. For such greedy bidders the difficulty level of the puzzles is increased. The higher order mathematical equations with increased complexity are presented to the greedy users. The puzzle generation mechanism is mainly used in preventing the unauthorized access for the spectrum.

1.2 FUZZY LOGIC

Fuzzy logic is a form of many valued logic in which truth values of variables may vary between zero and one. It handles the concept of partial truth which ranges between completely true and completely false. The value computed by fuzzy logic will decide the range of the bandwidth to be allocated.

2. LITERATURE SURVEY

[1] Describes Fuzzy logic as a logic which tends to deal with the imprecise value lying between [0,1]. The real number lying nearer to 1 is said to more true and the number lying near to 0 is said to be less true. The trueness gives the degree of membership of that quantity. Load flow analysis is a fundamental step in the power analysis system. Fuzzy logic based analysis used provides the solutions faster than any other method. It requires more number of iterations in comparison to Newton Raphson method. Although it require more number but provides us with the most accurate results.

[2] Proposes Cross layer fuzzy logic based back off system which is being used in Wireless body area network. It helps to improve the network reliability in terms of packet delivery ratio and collision rate. Helps in improving the throughput in WBAN without increasing the latency. Adaptability of the system is also increased. Therefore Network reliability and performance improved keeping message latency at low level.

[3] Outlines effective supply chain management which helps the organization to compete and have strategic competitive advantage. Various soft computing techniques are used to achieve this. This includes fuzzy logic and fuzzy sets. Fuzzy logic differentiates itself from binary logic by including intermediate values. It helps in dealing with complex systems and is effective in the situations where near optimum solutions are accepted.

[4] Introduces fuzzy logic hybrid model with semantic filtering approach for query expansion. Here fuzzy logic is used as a method for query expansion. It considers relevant score produced by different rank aggregation approaches. It combines different weights of each term using fuzzy rules in order to determine weights of additional query terms. The additional query terms are combined with original query terms resulting in the improvement of the system. Fuzzy logic based semantic similarity algorithms are used to remove irrelevant terms from fuzzy logic based query expansion method.

[5] gives that, it requires to solve a correct cryptographic puzzle before a connection to be established. It is designed to cut down solution time by utilizing high performance Graphic Processing Unit(GPU).The puzzle which is given will be present in the form of JAVA byte code. Code –compliant obfuscation is the process used for protection ,however this method will not obstruct more sophisticated byte code. An advanced Javabytecode obfuscation method with byte code validity is described in this paper. The code-compliant restriction by transforming a sequence of instructions is reduced in this method.

[6] proposes an algorithm for processing Connect-the-Dots puzzles. Specially use of Optical Character Recognition (OCR) and other image processing algorithms to process is explored in this algorithm. To identify the numbers in the puzzle,Matlab and C# are used.The functioning is evaluated by visually capturing the make upofpuzzle and then compare it with the ideal results. The results gives us great accuracy with small improvments in the implementation. The resultant output will give high applications to provide education to children.

[7] implements that, the biggest threat to cyber security and client puzzle are Denial-of-service (DoS) and distributed DoS (DDoS).We study how to protect DoS/DDoS attackers from infliating their solving capacities. Also we introduce software puzzle as new client puzzle .As we know existing client puzzle publishes its puzzle in advance,a software puzzle is randomly generated only after client requests and is received at server.The algorithm generated includes an attacker is notable to solve the puzzle in advance.

[8]gives examples towards programming environment. Programmersoftenly find new programming skills that programmers even finds it unfamiliar. In this paper process is described to reduce burden of learning new programming concepts. It also gives proposal for programming environment that adopts to the skill level programmer.It gives learning programming with automatically generated tutorials.Aso it adapts the programming environment based on programming skills. This skill will enable the user to learn new programming concepts found within the unfamiliar code. This environment includes rapid programming assesments,which is done by traditional test which is longer than rapid online test method. To manage programmer's load suggesting examples method is adapted by environment . Programming puzzle is generated by suggestive environment.

[9]explains Body Area Networks (BAN) is a wireless protocol used for connecting wearable and implantable sensors. These sensors are placed near or on the surface of human body or are located inside the human body. The nearby devices which share the same spectrum or the co-located BANs create interference which could significantly affect the communication link reliability. In order to preserve the link quality in the high-interference environments, there is an efficient alternative called as link adaptation schemes. The link

adaptation schemes are used to mitigate the cross-interference caused by several neighbouring Body Area Networks. The link adaptation schemes combined with energy detection threshold adaptations lead to even better performance.

[10]outlines IEEE 802.11ac enhances the throughput of WLANS. It makes use of spatial diversity, new modulation and coding schemes (MCS), and channel bonding in order to increase the data rate. With the increase in channel width, the data rate is increased but the number of non-overlapping channels is reduced. The usage of multiple narrow channels is a good choice in highly loaded networks and dense environments. An interesting future work to be undertaken is to deduce a selection algorithm that dynamically selects the channel width to maximize the spectrum throughput.

[11]narrates There is an ongoing development of 5th generation (5G) commercial networks as well as the hyper-connected internet of things (IoT). Thus it is necessary that the heterogeneous commercial radio links are able to simultaneously share spectrum in new ways. The 5G-like spectrum sharing radio uses both Non-Contiguous-Orthogonal Frequency Domain Modulated (NC-OFDM) and an electrically Reconfigurable Alford Loop Antenna (RALA). They efficiently share spectrum with a co-channel IEEE 802.15.4, or ZigBee, radio link. Currently, the prototype of the NC-OFDM radio is being built and it's co-existence with ZigBee and other commercial radios will be tested.

[12]describes There are various recent developments in the technology that point towards the use of spectrum databases to make automated real-time decisions on spectrum sharing. The use of spectrum databases is increasing in spectrum sharing mechanisms as well as in novel licensing regimes, network optimization and regulatory monitoring. Spectrum database are effective, reactive and are sometimes required to operate along with spectrum sensing if their operation requires automation. The work in progress IEEE 1900.6b standard aims to serve a number of compelling cases by making improvements in the baseline IEEE 1900.6 standard. The future work will continue to finalize the aspects of the text input to the standard progressing towards development of the draft.

3. PROPOSED METHODOLOGIES

The proposed methodology of spectrum sharing for file server is depicted in the below figure 1. and it can be explained through the following steps.
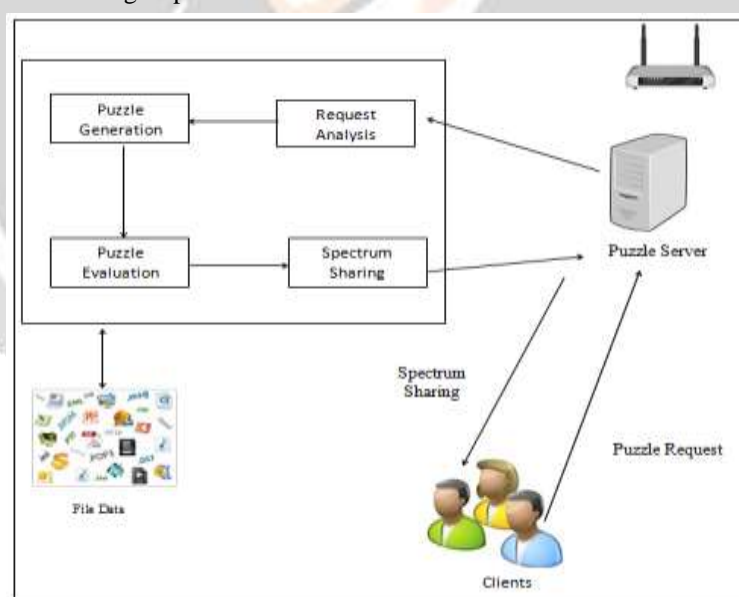

Figure 1: System overview of the proposed System

Step 1: Puzzle level Request - The proposed system made a setup of three machines in the real time scenario where all are connected to a centralized wireless router to establish a strong network in LAN. Where one machine is considered as the File server , which eventually allocates the spectrum based on the puzzle level to deliver the requested files by the clients.

And another two machines are considered as the clients which request for the puzzle by selecting the puzzle level which is designed based on the fuzzy Crisp values like VERY LOW, LOW, MEDIUM, HIGH and VERY HIGH. So the client machine selects the puzzle level to access the files according to that speed and along with the this it sends its own IP to the server.

Step 2: Request identification and puzzle generation - Once the File server receives the request from the clients it identifies the puzzle level and its IP through the split function of Java and record the same for the coming process. Then these puzzle levels are assigned a numerical values like for VERY LOW - 1 to 20 , LOW - 21 to 40 , MEDIUM - 41 to 60 , HIGH - 61 to 80 and VERY HIGH - 81 to 1000. Then for each of the level a random integer **R** is selected using the random function of Java.

On the other hand 10 different levels of raw puzzle are created which are having static string and they all are stored in a list. The random integer **R** which is generated is normalized and is used to as the index to extract the static raw puzzle from the puzzle list. This row puzzle is then replaced with the random integers using random container of java to form a unique puzzle for the instance and send it back to the client by using its recorded IP.

Step 3: Puzzle evaluation- Here in this step file server receives the puzzle answer for the provided puzzle from the respective client along with its level. Once this is received, puzzle evaluation is started using the infix expression evaluation function. Where all the operators and operands are maintained in a stack . Then each of the elements are popped up to solve the puzzle based on the occurrence of the operator and their priority. The whole process of the puzzle evaluation can be illustrate with the pseudo code mentioned below.

<div align="center">PSEUDO CODE FOE PUZZLE EVALUATION</div>

Step 0: Start
Step 1: If character exists to be read:
Step 2: if character is operand or (. push on Stack
Step 3: else if character is operator
 Step 3a :while top of Stack is not of smaller precedence than this character
Step 3b: pop op from Stack
Step 3c: pop two operands op1 and op2 from Stack
Step 3d:store op1 op op2 on the Stack back to 3a
Step 4:else if character is) [do the same as 3b – 3d till encounter ( ]
else // no more character left to read
Step 5: pop operators till operator stack is not empty
Step 6: pop top 2 operands and push op1 op op2 on operand stack
Step 7: return top value from Stack
Step 8: Stop

Step 4: Spectrum Sharing - Once the puzzle is evaluated , then file server displays all the files that are avaialble to download to the respective clients and allow them to choose their data file to download. Once the client selects the data to download then based on their level of solved puzzle the spectrum is shared by the file server. For VERY LOW - 64 bytes, for LOW - 128 bytes, for MEDIUM - 254 bytes, for HIGH - 512 bytes and for VERY HIGH - 1024 bytes.

4. RESULT AND DISCUSSIONS

The proposed methodology of Spectrum sharing in WSN is deployed in real time using the computers. Each of thme are powered with corei3 processor with 4GB of RAM with the windows operating system. Machines are configured with Java 8 and proposed system uses Netbeans 8.0 as the standard development IDE. A Dlink single atenna wireless router is used for the establishment of the wireless network.

To measure the performance of the system we set the bench mark on different number of users in the WSN application for File Server bandwidth Sharing system . And then we allow the number of users to seek the availability of the Bandwidth for file Sharing system.

When system is conducted for the performance time for puzzle solving task only and compared with other systems, obtained results are depicted in the below table 1.

Difficulty Level	Genetic Algorithm	Information Entropy Algorithm	Infix Evaulation Algorithm
Easy	3 Seconds	3 Milli seconds	3 Milli seconds
Medium	7 Seconds	4.6 Milli Seconds	4 Milli seconds
Hard	13 Seconds	4.66 Milli Seconds	4 Milli seconds
Evil	15 Seconds	5.99 Milli Seconds	5Milli seconds
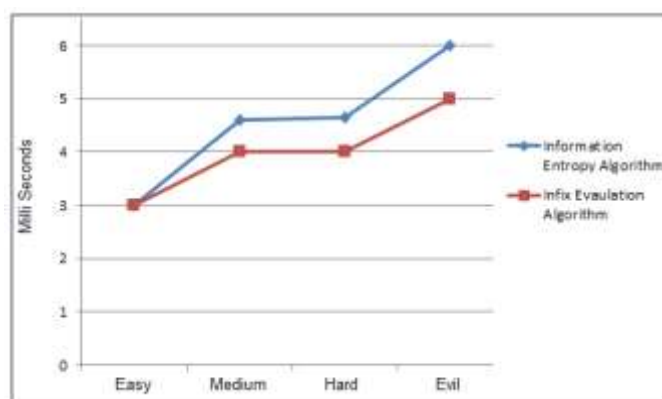
Table 1: Different   Comparison table with Algorithms

Figure 2: Comparison Plot with Information Entropy Algorithm

The above plot shows proposed system of Infix Evaluation algorithm over performs than of [13].

5. CONCLUSION AND FUTURESCOPE

The proposed methodology narrates about the incorporation of the Bandwidth or Spectrum handling for any WSN applications through using of proxy server for puzzle generation instead of captcha or image number. Proposed system efficiently identifies the Puzzle level patterns using Decision tree estimation. Then the system will evaluate the puzzle levels to send the generated puzzle to the clients . Puzzle generation will be done at the proxy server for the said level using the infix expression evaluation technique for different levels from very easy to very hard ranges. This method of ours efficiently proves one of the best gateways for Spectrum sharing counter measure technique using puzzle creation.

As the future scope of this system can be enhanced to generate more complex puzzles for variable operands and operators for handling complex network system in LAN and WAN.

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