Minimization of risk probability of collision in wireless networks using Artificial Neural Inference system (ANFIS)

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Abstract: Zigbee Router (ZR) in the Zigbee Network is responsible for scheduling a transmission of beacons to avoid the collision. Schedule of a beacon in a tree decides packet transport latency from previous devices to the coordinator at the foundation itself. Usually the schedule of a beacon depends upon Zigbee Router. The Zigbee Router doesn't support the reuse of a beacon slots because it's already used by its associates or neighbors. The chances of beacon collisions are very low in this case. The chance of collision is evaluated by means of Neural Network via which the chance is optimized. Based in this scheme, evaluation of the risk of slot reuse through a node pair may be completed judiciously. Slot does not allow if the chances are high means. This bureaucracy the essence of our maximum likelihood estimation of collision which can be optimized using neural network.

Keywords: Zigbee, beacon slots, hazard possibility, Neural Network

I. INTRODUCTION

A very famous radio device in IEEE 802.15.4 standard is Wireless PAN, which contains many good features compared to other devices that are it uses less power and it contains low data rates, which is in turn used for short distance communication, and finally it is available with less cost [1]. A PAN works depends upon instructions provided by a PAN coordinator. PAN coordinator allows beacon modes for defining the new frames which uses less energy to perform operations. For minimization of energy, here is a choice to active the beacon mode with the aid of defining a super frame. A PAN may contain lively and an inactive duration. The lively duration starts with a beacon body in the presence of the coordinator and it is also used for making affiliation with the coordinator also. Among the coordinators and clients, it will find a number of time slots used for records. As coming to inactive period it follows the lively duration and it doesn't support records site visitors within the network. There by it will be in saves electricity or gadgets supported by other PAN's. We know that for PAN famous person topologies are providing by IEEE 802.15.4 standard. The Zigbee technology allows a way for arranging no.of gadgets like a tree or mesh topology. In case of tree based Zigbee network, the root acts a Zigbee Coordinator (ZC), inner nodes act as a Zigbee Routers (ZRs), and leaf nodes acts as a Zigbee End Devices (ZEDs).

In tree based Zigbee Network, each coordinator and router should responsible for its own broadcast beacon. During the active period of beacon, the coordinator and router can exchange their records with its kids. At the same time, every router and end devices of an Zigbee network should track and keep time synchronization and exchange information. Multiple transmissions of a beacon from number of coordinators and routers leads to collisions at receiver side it leads to screw ups during the delivery time this process is referred as beacon collision. Sometimes, the active duration of coordinators and routers in a Zigbee Network may be shifted to avoid beacon collisions. If any router joined in a network means it should have mentioned the time duration for transmission with respect to its parent's. Here beacon scheduling again finds every routers time duration for transmission to avoid beacon collisions with in the network. A straight forward yet conservative new method is to reduce overlap problems lively periods among Zigbee coordinators and routers whether or there is no overlap ends in with collisions or no longer. This technique is sincerely safe and it won't be useful further while numerous routers are concerned. Since it disallows concurrent transmissions of statistics packets via scattered ZRs, this method additionally will increase packet shipping latency from each tool to the ZC, making it now not suited for converge cast. A new better strategy is introduced for overlapping energetic intervals which might be seemingly collision loose. Merging during active sessions is disallowed in that arrangement might also supply upward thrust to beacon collisions. It states that active duration of a router within the network is no longer overlap with its neighbors.

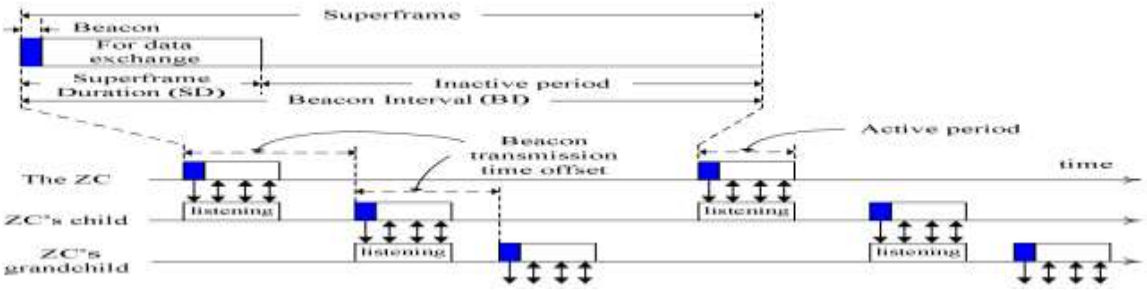

Figure 1: Beacon schedule and construction of a superframe

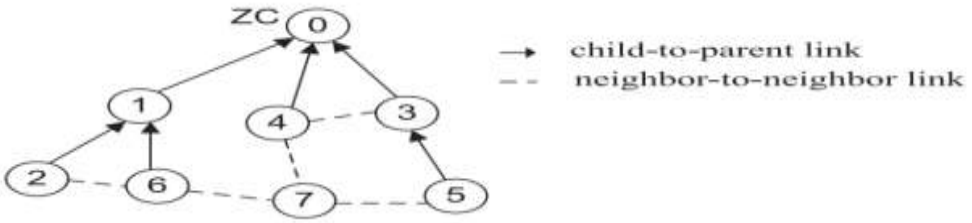

Figure 2 : A tree based Zigbee Network.

IEEE 802.15.4 devices are categorized into two types

1. Full characteristic gadgets (FFDs)
2. Reduced Function Gadgets (RFDs).

Here FFDs are acts as a PAN coordinator. And these are used to forward frames to the other PAN contributors. But RFDs doesn't contain these features which works are depending upon FFD's body. It will forward the service and communicate with other gadgets in the PAN. In a tree based Zigbee community, coordinators and routers are equal to PAN Coordinators, and therefore can most effective be FFDs. RFDs, it can join as a tree in ZED's.

II. LITERATURE SURVEY

Meng-Shiuan Pan *et al*. described a new method called Minimum Delay Beacon Scheduling (MDBS).He said that it is to be compliant to the Zigbee fashionable [1]. They said that the MDBS trouble existed in constant Node Pair and proposed foremost solutions for heuristic algorithms for preferred cases. This algorithm efficiently agenda the routers of an Zigbee beacon instances for gaining thefast converge forged. Lun-Wu Yeh *et al*. explained a new scheduling model nothing but LTBS for tree based Zigbee networks, they mentioned that beacons are meant for the nodes which in turn used for broadcast and converge cast traffics [2]. They formulated that a slot undertaking trouble wherein every node needs to manage slots for the transmission of up and down streams for reducing the interference. And also they proposed one algorithm regarding slot venture. This algorithm based on sequence node concept which in turn facilitates the manner traffics. Fang-Jing Wu *et al*. explained an efficient scheme like wakeup scheduling method for the collection of records in a sensor community. They mentioned that they achieved low power consumption and less latency by using this scheme[3]. Zdenek Hanzálek *et al*. proposed a method in his paper which gives a new mechanism for a tree based clutser wireless network. The method he proposed in his article is a TDCS. Which can find bounded verbal exchange mistakes [4]. Their goal became to meet all the limits of a fixed time-bounded facts. It willminimize the strength of a nodes by placing more duration.Here all clusteres are active handiest as soon as throughout the time, the given end-to-cease delay may also extent over some periods.For the correct configuration they used scheduled tool in this IEEE standard. Here Four beacon-enabled cluster-tree WSNsdetermines the time. Giuseppe Anastasi *et al*. described his paper based on simulation and experiment analysis.Here he was investigating the primary reasons of this trouble, and he discovered by using this experiment that it is resulting from MAC protocol which is used for channel for entry to and also its predefined values [5]. Along with this he got with a greater suitable MAC parameters placing, it's far realistic to moderate the trouble and acquire good delivery percentage up to one hundred%, at the least in the situations. However, this development in conversation reliability changed into done on the price of an accelerated latency, which might not be suited for business packages with increasing time durations.Jaehyun Park *et al*. proposes an indoor localization system for concurrent a couple of robot's localization in a wide carrier area divided into multiblocks for dependable sensor operation [6]. The beacon color code scheduling algorithm is developed so that you can keep away from sign interference and to achieve an green localization with a high accuracy and a quick sampling time. The performance of the proposed localization system has been demonstrated thru actual experiments. Emanuele Toscano *et al*. mentioned in his paper that beacon collisions of cluster-tree networks cause loss in between nodes and coordinators during the synchronization coordinator [7]. For this motive, authors advanced a Multichannel Super frame Scheduling (MSS) set of rules, a unique approach that avoids beacon collisions by way of scheduling exceptional frames over one of a kind radio channels, at the same time as preserving the connectivity of all the clusters.Xu Li *et al*. Proposed a unique Deterministic dynamic beacon Mobility Scheduling (DREAMS) algorithm, beneath the as per the instruction provided by fly[8]. They explained that It will move

from sensor to sensor in line with the Received Signal Strength (RSS) which depends upon measurement of the distance. They proved that DREAMS ensures complete localization here all measurements are considered to be free of noise, which can derive the top values of a beacon in that situation. Janghee HAN *et al*. Proposed a utilization conscious combination of scheduling techniques for cluster tree Zigbee community [9]. The approach aims to beautify the schedule of the main network depends mainly on medium and also it depends on avoiding the collision at the identical time.Xi Jin *et al*. Proposed the collision-loose multichannel outstanding frame algorithms in IEEE 802.15 Four cluster based tree type network. By considering the characteristics of an extraordinary frame collisions, they defined 3 different scheduling constraints, which gets remarkable frames without collisions, and also they analyzed two important conditions at the schedulability.Li-Hsing Yen *Et al.* mentioned that reduction of packet transport latency depends upon re use of beacon slots.depends upon this he analyzed that the reuse of slots was did between two consecutive nodes.if the results in risk means slot reuse will be stopped. Otherwise we can go with reusage of slots. Proposed method is hazard-aware, probabilistic beacon scheduling algorithm. Even although numerous techniques were proposed to lessen the chance chance, the reduction isn't wonderful. So on this work a novel technique with ANFIS is proposed to in addition optimize the hazard opportunity.

III. METHODOLOGY

Let us assume that node size as *A*, and all the nodes are equally distributed within the region *R*, here size of node should be greater than area i.e., $A>>\pi*r^2$. Consider that pair of nodes uses a identical slots of a beacon. If any fresh node *w* joins in the network.There will be a probability of getting harm for w which is caused by reuse of 2 nodes such as u and v denoted as $P_v=(u,v)$.

$where\ P(u,v) = (1+\frac{3\sqrt{3}}{4\pi})p$

Predict Chaotic Time-Series using ANFIS

In time domain representation, time *t* representspresent values of a type, which is used for finding the values in the future represented as*t+P*. for finding the values we should map data points *D* per Δ units in time ($x(t-(D-1)\ \Delta)$, …… $x(t-\Delta)$, $x(t)$). $x=(t+P)$ is used for finding the future values. ANFIS is used to find series of time domain representation of values with Mackey-Glass (MG) time domain equation is shown in the below

$$x(t) = \frac{0.2x(t-\tau)}{1+x^{10}(t-\tau)} - 0.1x(t)$$

Where t =time instant

$\boldsymbol{\tau}$= predicted time interval

For getting the best result using Mackey-Glass equation let us consider D=25 and Δ=*P*=6. And the input for ANFIS is a 4-column vector shown in below

$$w(t)=[x(t-19),\ x(t-12),\ x(t-6),\ x(t)]$$

the output data corresponding to above is represented as below.

$$s(t)=x(t+6)$$

Here we are getting 1000 input / output Samples for *t* having the range from 118 to 1117. In this example, first 25 samples act as a training data and the second 25 samples are responsible for validating the data. Hereone sample point is presented in the row of training data and checking data. Four dimensional input is presented in first 4 columns and the output s is in the 5th column.

IV. RESULTS AND DISCUSSION

Simulation of risk probability of collision has been performed in MATLAB. The results which are evaluated using ANFIS are compared with previous work. The results signify that the risk probability of collision of visible pair with the use of ANFIS is much reduced than the previous method under the situation when a new node is getting joined into the network.

The comparison of values of risk probability of collision using ANFIS and without ANFIS is shown in table below.

Number of joining nodes	Risk probability of visible pair without theimplementation of ANFIS	Risk probability of visible pair with the implementation of ANFIS**(Proposed method)**
0	0	0
2	0.015947	0.013685
4	0.044296	0.038013

4	0.053599	0.045996
5	0.063787	0.054739
6	0.074861	0.064242
7	0.086821	0.074506
8	0.099667	0.08553
9	0.113399	0.097314
10	0.128017	0.109858
11	0.143521	0.123163
12	0.15991	0.137228
13	0.177186	0.152053
29	0.398668	0.342119
51	0.708743	0.608212

The above table shows that as the number of joined nodes is increased the risk probability is minimized with the use of chaotic time prediction method of ANN.

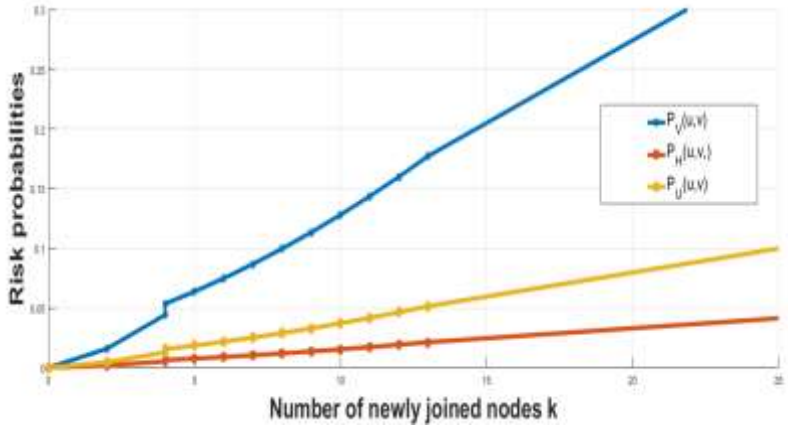

Figure 3 : Risk probability of collision for visible pair $P_v(u,v)$, inhibited pair$P_U(u,v)$ and hidden pair$P_H(u,v)$

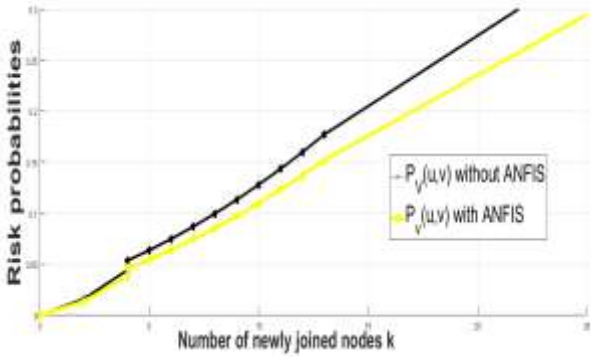

Figure 4: Comparison ofrisk probabilities of collision for visible pair without ANFIS and with ANFIS

V. CONCLUSION

With the use of chaotic time prediction in ANFIS, the risk probability of collision in visible pair when new nodes are getting joined is reduced by 8.5 percent. In other words it can be concluded that even as the number of neighboring nodes joining is increased, the risk probability is reduced more using the ANFIS as compared with the previous method.

REFERENCES

[1] "Utilization –aware hybrid beacon scheduling in cluster-tree Zigbee network" by *Janghee HAN,jiyong HAN,Dongseup LEE*, IEICE Trans.inf&syst.,*Vol E98-D, September 2015*.

[2] "Collision-free multichannel super frame scheduling for IEEE 802.15.4 cluster-tree networks " by *Xi Jin, Qiong Zhang and Peng Zeng* , Int. J. Sensor Networks, *Vol. 15, No. 4, 2014* .

[3] " Beacon scheduling for broadcast and converge cast in Zigbee wireless sensor networks" by *Lun-Wu Yeh a, Meng-Shiuan Pan*, Elsevier, *October 2013.*

[4] "Dynamic Beacon Mobility Scheduling for Sensor Localization " by Xu *Li, Nathalie Mitton, Isabelle Simplot-Ryl, and David Simplot-Ryl* , IEEE transactions on parallel and distributed systems, *vol. 23, no. 8, august 2012.*

[5] "Risk-Aware Distributed Beacon Scheduling for Tree-Based Zigbee Wireless Networks "by *Li-Hsing Yen, Yee Wei Law, and Marimuthu Palaniswami* , IEEE transactions on mobile computing, *vol. 11, no. 4, April 2012.*

[6] " A Comprehensive Analysis of the MAC Unreliability Problem in IEEE 802.15.4 Wireless Sensor Networks " by *Giuseppe Anastasi, Marco Conti, and Mario Di Francesco* , ieee transactions on industrial informatics, *vol. 7, no. 1, February 2011*.

[7] " Energy Efficient Scheduling for Cluster-Tree Wireless Sensor Networks With Time-Bounded Data Flows: Application to IEEE 802.15.4/Zigbee " by *Zdenek Hanzálek ˇ, and Petr Jurcík*, IEEE transactions on industrial informatics, *vol. 6, no. 3, august 2010.*

[8] "Distributed Wake-up Scheduling for Data Collection in Tree-Based Wireless Sensor Networks " by *Fang-Jing Wu and Yu-Chee Tseng* ,IEEE communications letters, *vol. 13, no. 11, November 2009.*

[9] "Quick converge cast in Zigbee beacon-enabled tree-based wireless sensor networks" Meng-*Shiuan Pan, Yu-Chee Tseng*, Elsevier, *December 2008.*