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Neighbor Conduct Sensitive QoS Variance Aware Spectrum Sensing and Allocation

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Abstract: QoS (Quality of Service) aware spectrum sensing and channel allocation in cognitive radio wireless mesh networks is a continuous practice due to the divergent scope of communication in wireless mesh networks. Henceforth the current research is moving in a direction to find effective solutions towards QoS aware spectrum sensing and channel allocation. But all of these solutions are specific to one or two QoS factors. According to the real-time practices the QoS assessment by one or two factors is impractical. Moreover majority of current approaches are delivering the computational complexity as O(n2), which due to the magnification of number evolution against the increment in number of channel availability in cognitive radio wireless mesh networks. In this context here we devised a Neighbor Conduct Sensitive QoS variance assessment strategy for cooperative spectrum sensing and channel allocation strategy, which enables to assess the QoS state of a spectrum under possible malicious cooperation that is based on multiple number of QoS factors and also should stabilize the computational complexity to O(n*log(n)). The experiment results are indicating the significance of the proposed model towards scalable and robust QoS variance aware spectrum sensing and channel allocation strategy for cognitive radio wireless mesh networks.

Keywords: Cognitive Radio Networks, Channel Assignment, Dynamic Spectrum Access, Wireless Mesh Networks, dynamic frequency selection, selective cooperative sensing, node conduct sensitivity

I. INTRODUCTION

Cognitive Mesh Network (COMNET) is a network implementation of Dynamic Spectrum Access (DSA) in a typical mesh network for intelligent spectrum sensing and management. The network approach improves the spectrum utilization and the communication and overcomes these problems faced in the existing Fixed Spectrum Allocation (FSA) approach.

In the Fixed Spectrum Allocation (FSA) the service providers for providing data and voice services acquire spectrum license and operate in fixed spectrum bands for a particular geographical region. This strategy causes incompetent and uneconomical spectrum utilization results mostly in spectrum shortfall. To overcome these communication hurdles, Dynamic Spectrum Access (DSA) has been developed.

Dynamic Spectrum Access (DSA) strategy is an efficient way of spectrum utilization. It is based on utilizing the idle frequencies of licensed users with occasional transmissions and the specific frequencies kept for requirements such as defense and disaster management services however used infrequently.

The existing Wireless Mesh Networks (WMNs) for spectrum management provide extensive broadband networking and Internet access [1] to users over LANs, WANs, Wi-Fi and mobile networks. However in WMNs, the increase in the user base of applications results in traffic bottlenecks and the scarcity of the limited bandwidth. The Cognitive Radio technology is proposed to overcome this problem by maximizing the spectrum utilization.

The Cognitive Radio (CR) technology [2], [3], [4], [5], [6] implemented in DSA enhances the spectrum detection by sensibly detecting and utilizing the frequencies. Cognitive radios are wireless units that operate independently in the network and based on the service provider commands as well as individual performance, detect and monitor the radio frequency environments settings and efficiency. It dynamically changes its settings according to the spectrum requirements and intelligently assigns the frequency bands and thus addresses the hassles of spectrum unavailability associated with the existing Wireless Mesh Networks.

The Cognitive Mesh Network (COMNET) for dynamic spectrum access incorporates the CR technology in WMNs. In the COMNET, cognitive radios detect the licensed spectrum space unoccupied by its users and utilize suitable frequency bands available for providing connectivity in the unlicensed spectrum space. This is based on the understanding that the space is quickly restored to the license user when it senses commencement operation by the user in the accessed bands of spectrum frequencies.

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The availability of frequency bands depends on the spectrum usage patterns, sudden spectrum requirements and transmission error rates. Any changes of these factors affect the spectrum availability and the existing connections. The CR network in real time configures the radio's settings [7] using techniques of cognitive capability and reconfiguration [8]. COMNET is spectrum aware in channel assignment and overcomes the interruptions of retransmissions and channel switching by including in its algorithmic framework [9] the CR technology. In the channel selection process the algorithms modifies the spectrum parameters, transmission waveform protocols, frequency parameters and the parameters of the techniques used for accessing channels, etc. The channels selected are those that have been mostly inactive for a long period of time and with low rates of error.

The challenges [10] of networks embedded with CR technology are related to the management of the interferences between the users of licensed and unlicensed spectrum, improving the techniques of spectrum as well as channel selection and development of strategies as a whole for maximizing the spectrum utilization as well as connectivity.

The applications and services of cognitive radios are observed in the current wireless implementations and services, in the upcoming demand for mobile television where bandwidth and user saturation are the main challenges and in the future wireless communication of smart grids.

II. RELATED WORK

In this section, we provide a review of some of the research work in the field of wireless mobile networks (WMNs) and cognitive radios networks (CRN) as below,

The spectrum allocation approach "Clique Based and Localized Heuristic" by R. V. Prasad, el al. [11] has been designed for Cognitive Radio Adhoc Networks based spectrum distribution.

Jianwei Huang et al. design for dynamic selection of channels depicts maximum channel selection (MCS) with binary integer nonlinear optimization [12]. The technique for CR based secondary networks focuses on maximizing the channel usage. The authors also study in CR networks, the diversity of channels in the problem of greedy channel selection and show measureable close to optimal efficiency.

The two approaches of channel selection and channel switching by L. Cao et al. [13] in dynamic spectrum aware networks reduced disruptions for primary user's network usage. They foretell the availability of spectrum with intelligent spectrum assessment and analysis of previous histories of channels.

The channel selection approaches given in [14], [15], [16] are designed for cognitive radio based networks. A few selection strategies in these papers are for channel selection in Multi-Radio nodes based networks.

The continuous-time alternating ON/OFF Markov Renewal Process (MRP) modeling the interferer's activity is provided in the study of [11], [15], 17]. This model is further studied and proved in the paper [18] for the primary user signal incidence in IEEE 802.11b networks.

The channel assignment approaches in the papers [13], [16], [17], [19] are designed for overcoming the problems of network interference in multi-radio wireless mesh networks.

An approach for channel assignment DDMAC, a distance based MAC protocol proposed in [19] is distance as well as traffic-aware. The technique for Cognitive Radio Networks is DDMAC based algorithm for channel assignment. The approach incorporates the traffic profile including the relationship between signal's attenuation model and distance.

III. NEIGHBOR CONDUCT SENSITIVE QOS VARIANCE AWARE SPECTRUM SENSING AND ALLOCATION

A secondary user in a Cognitive Radio Wireless Mesh Network (CRWMN) relies on neighbor nodes to identify idle spectrums. In this practice, the compromised neighbors are usually responds with falsified information of spectrum availability due to selfishness or malicious attitude that may misleads secondary user, so that the secondary user may infers spectrum usage by primary nodes or would fail to utilize the idle spectrum. In a cooperative spectrum sensing strategy a secondary user that seeks a spectrum seeks information about idle spectrums from all of its neighbor nodes. Further the secondary user is selective to rely on the information given by these neighbors. The model devised in this paper is significant to verify the conduct of the neighbors to avoid information from compromised and falsified neighbor nodes and to select QoS optimal spectrum for usage. The spectrum sensing strategy devised here in this paper is passing through four phases, and they are (i) neighbor conduct verification to consider the information sharing about available spectrum for secondary user, (ii) Assessing QoS variance of available spectrums acknowledged by selective neighbors, (iii) Evaluating the QoS variance assessed of the selective spectrums and (iv) the act of neighbor conduct rejuvenating.

A. *Assessing the neighbor conduct*

Let an intended secondary user isu of a cognitive radio wireless mesh network region is looking for available spectrum collects the status of the available spectrums from the selective neighbor nodes. The selection process selects

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among all the neighbors, the conduct sensitive neighbors towards prominent cooperation. The intended secondary user assesses conduct sensitivity of the neighbor as follows:

If cns is the set of cooperative neighbors to the intended secondary user isu

A handshake message sent by intended secondary user isu to all nodes in cns

$$foreach\ \{cn_i \forall cn_i \in cns\} \quad msg_{isu->cn_i}$$

The communication in CRWMN is done by using the asynchronous public and private key cryptographic methods. The intended secondary user isu creates a cooperation request message crm and encrypts it with relevant public key of $\{cn_i \forall cn_i \in cns\}$ and then sends. The message msg formed for each neighbor node is represented as follows

$$foreach\ \{cn_i \forall cn_i \in cns\}$$
$$isu \to cn_i : enc^{cn_i}(isu_{idt}, crm, h(isu_{idt}), h(crm)) \ldots..$$
(Eq1)

$h(isu_{idt}), h(crm)$ of eq1 represents the one way hash of the intended secondary user identity and cooperation request message respectively. Upon receiving this message, the authorized neighbor node decrypts the message and verifies the identity of isu, if valid then responds back with response message $rcrm$. The response message $rcrm$ from each neighbor node contains the following:

For each neighbor node $\{cn_i \forall cn_i \in cns\}$

$$\begin{aligned} rcrm(cn_i): enc_{isu(pk)}(&idt, cg, cas, cgrs, cgrft, \\ &h(idt, cg, cas, cgrs, cgrft)) \end{aligned} \ldots. \text{(Eq2)}$$

Eq2 representing that Identity idt , Conduct gain cg, Cooperation appeal sum cas, Conduct gain revise sum $cgrs$, and Conduct gain revision frequency threshold $cgrft$, also includes digital signature, which is one way hash value of the string formed by concatenating those attributes with a delimiter such as ','. These message further encrypted by the public key of the isu.

Upon receiving the $rcrm$ by intended secondary user isu validates the identity of the 'cn_i' and then evaluates digital signature as below:

For each $\{cn_i \forall cn_i \in cns\}$

$$sig(cn_i) \cong h(idt, cg, cas, cgrs, cgrft) \ldots. \text{(Eq3)}$$

The signature $sig(cn_i)$ is shared by most recent intended secondary user isu_p that took cooperation support from cn_i, which reflects the most recent updates occurred during the cooperation shared between 'isu_p' and 'cn_i'. If signature is valid then current intended secondary user isu that is seeking cooperation, measures conduct scope cs of the cn_i as follows:

$$cgr \leftarrow cg : cas \ldots. \text{(Eq4)}$$

Here in this equation (Eq4), the cgr represents the conduct gain ratio of cooperative node cn_i

$$csrdr \leftarrow cgrft : cas \ldots. \text{(Eq5)}$$

Here in Eq5, $csrdr$ is conduct scope revision divergence ratio, which gives the divergence count of intended secondary users involved to generate conduct gain cg.

$$cgrf \leftarrow cgrs : cas \ldots. \text{(Eq6)}$$

Here in equation Eq6, $cgrf$ is the conduct gain revision frequency of the cooperative node cn_i. Further, intended secondary user isu assesses conduct scope cs of each $\{cn_i \forall cn_i \in cns\}$ and then intended secondary user isu accepts cooperation from selective nodes, which have been selected based on their conduct scope (Eq7). In regard to this the optimal neighbor will be selected based on their conduct scope cs.

$$cs(cn_i) = cgr \otimes csrdr \otimes cgrf \ldots.. \text{(Eq7)}$$

B. Assessing QoS variance

Let us consider a cognitive radio wireless mesh network with set of network regions and each region is having set of nodes as secondary and primary users.

The spectrums in set $st_i = \{s_1, s_2, s_3, \ldots. s_x\}$ are x number of spectrums that available for sensing and allocation to secondary users of the mesh network. Hence the spectrum allocation to a secondary user should be considered from set of x spectrums.

The selected spectrum to allocate to secondary user can influence the QoS. Hence, it is essential to pick optimal spectrum. The QoS variance aware strategy proposed in this paper is based on the characteristics of spectrum and their earlier allocation impacts, which are described as follows:

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- A spectrum can be rated best in a particular factor, but might fail to deliver the same performance under the consideration of multiple QoS factors.
- A spectrum can be rated divergently with respect to its various QoS factors. As an example, a spectrum s can be best with respect to Primary User conflict scope, but the same spectrum might be moderate in terms of retransmissions and inference scope, worst in the context of channel occupancy time elapse scope.
- The importance of the QoS factors might vary from context of mesh network to other.

According to the characteristics of the spectrums described, it is evident that the best ranked spectrum under single QoS factor is not always the optimal towards spectrum sensing allocation. The spectrum that performed well under some prioritized QoS factors are always need not be the best fit under other prioritized QoS factors. In regard to this the devised QoS variance aware strategy finds the fitness of the spectrum, which is based on QoS variance and primary QoS factor opted. This process is labeled as QoS variance evaluation of the spectrum. Further spectrums are ranked according to their QoS variance and will be used in the same order to finalize a spectrum towards sensing and allocation.

The QoS metrics of each spectrum considered to assess the best fit spectrum for sensing and allocation are describe below, and these metrics are categorized as positive and negative, which is based on their value. The metrics with desired value as high referred as positive metrics and the metrics with desired value low are referred as negative metrics.

- PU (Primary User) conflict scope (-ve metric): Since low conflict scope is desired, this metric is categorized as negative metric. This metric indicates the ratio of conflict between primary user of a spectrum with the secondary user to whom that spectrum allocated. The conflict scope can be measured as follows.

$$cs(s_i) = ecot_{PU} - ecrt_{SU} - celt$$

- Here in the above equation $cs(s_i)$ is conflict scope of the spectrum s_i, $ecot_{PU}$ is expected channel occupancy time by PU, $ecrt_{SU}$ is expected channel release time of SU, $celt$ is channel release elapse time threshold. If $cs(s_i) <= 0$ then discard this spectrum from selection criteria

- Retransmissions scope (-): This is also a negative metric, since the lower values are desirable. This metric indicates the average of retransmissions required on specific spectrum. This can be measured as follows:

$$rs(s_i) = \frac{notr(s_i)}{trr(s_i)}$$

- Here in the above equation $rs(s_i)$ indicates the retransmission scope metric value of a spectrum s_i, $notr(s_i)$ is indicating the number of transmissions occurred in previous allocations and $trr(s_i)$ is indicating the transmissions required in earlier allocations.

- Inference scope (-): This metric is also desired with lower values, henceforth it is categorized as negative metric. This metric indicates the possible inference observed at spectrum, which is due to unpredictable spectrum utilization intervals of the PU. This metric can be measured as follows

$$is(s_i) = \frac{noii}{noi}$$

- Here in the above equation $is(s_i)$ is indicating the Inference scope of the spectrum s_i, $noii$ is indicating the no of irregular intervals of spectrum utilization by PU, noi is indicating the number of intervals

- Occupancy time elapse scope (-): This is also a negative metric, since it desires low values. This metric indicates that how frequently this spectrum effected by time elapse in usage by secondary users. This metric can be measured as follows:

$$os(s_i) = \frac{nol}{noa}$$

- Here in the above equation $os(s_i)$ is indicating the occupancy time elapse scope, nol is indicating the number of occupancy time elapses observed and noa is indicating the number of allocations done.

- Fading scope (-): Is also another negative metric, which indicates the possibility of channel fading during spectrum utilization. this metric can be measured as follows:

$$fs(s_i) = \frac{nof}{nos}$$

- Here in the above equation $fs(s_i)$ indicating the fading scope of the spectrum s_i, nof is indicating the number of times fading observed and nos is indicating the number of attempts to sense the spectrum.

- Usage Scope (+): is only positive metric, which is indicating the successful spectrum usage ratio. This can be measured as follows:

$$us(s_i) = \frac{nsu}{noa}$$

- Here in the above equation $us(s_i)$ is indicating the usage scope of a spectrum s_i, nsu is indicating the no of successful fair utilizations and noa is indicating the no of spectrum allocations.

C. *Evaluation strategy of QoS variance of Spectrums*

Let PU conflict scope, retransmissions scope, inference scope, channel occupancy time lapse scope, spectrum fading scope and spectrum usage scope as a set of QoS factors

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Vol. 4, Issue 3, March 2015

$F = \{f_1, f_2, f_3, f_4, ... f_n\}$ of available spectrums $S = \{s_1, s_2, ... s_i\}$

Let a QoS factor f_{opt} is said to be the anchor to rank the spectrums. The QoS factors of the spectrums can be classified as positive and negative factors. The factors that are having highest values as optimal values are said to be positive factors and the factor that are optimal with minimal values are said to be negative factors.

Henceforth the values of negative and positive factors are normalized as follows:

For each service $[s_j \exists s_j \in S]$ begin

For each factor $[f_k \exists f_k \in F_{s_j}]$ Begin // here F_{s_j} is the set factors of service s_j

If f_k is positive factor then $norm(f_k) = 1 - \frac{1}{val(f_k)}$

Else if f_k is negative factor then $norm(f_k) = \frac{1}{val(f_k)}$

End

End

Then the available spectrums are ranked by their normalized values from maximum to minimum, such that each service gets different rank for different factors.

Further these ranks will be used as input to measure the QoS fitness.

Let rank set of a spectrum $[s_j \exists s_j \in S]$ is $rs(s_j) = [r(f_1), r(f_2), ... r(f_n)]$, then QoS variance value (qvv) of each spectrum can be measured as follows.

$$qvv(s_j) = \left[\frac{\sqrt{\left(\sum_{k=1}^{n} \left(\frac{\sum_{i=1}^{n} r(f_i \exists f_i \in F_{s_j})}{n} \right) - r(f_k \exists f_k \in F_{s_j}) \right)^2}}{n} \right]^{-1}$$

The above equation is derived from the statistical approach of calculating variance between given number of attribute values. Here in this equation, $\left(\frac{\sum_{i=1}^{n} r(f_i \exists f_i \in F_{s_j})}{n} \right)$ represents the mean of the all feature ranks of the feature set F_{s_j}.

Then the QoS fitness of the spectrum will be sorted based on the rank of the f_{opt} ($[f_{opt} \exists f_{opt} \cong f_i \exists f_i \in F]$), which is the anchor factor.

Then the set of spectrums $[pst_{ij} \subseteq st_{ij}]$ will be considered, which is based on the max rank threshold mrt given.

Then the processed spectrums set pst_j will be sorted from minimum to maximum of their QoS variance value and the same order will be preferred to select services for composition.

D. Updating conduct gain

Upon completion of the spectrum sensing process, the intended secondary user isu provides the updated conduct gain of the cooperative node involved in spectrum sensing cn_i. The intended secondary user isu furnishes the revised conduct of the cn_i as '$\{\pm 1, 0\}$'. If cooperation from cn_i found fair and useful then cg of cn_i incremented by one ($cg + 1$), if cooperation found to be fair but not useful then no change applied on cg ($cg + 0$), or if cooperation is intended to be malicious then cg will be decremented by one ($cg - 1$). The conduct gain update process as follows:

The 'isu' prepares conduct gain update message $cgum$ and sends to cooperative node cn_i, In regard to this, the 'isu' relies on blindfold approach. The conduct gain update message $cgum$ is formed by isu is as follows:

$ecg = enc_{bf}(cg + salt)$ ….. (Eq8a)

$eidt = enc_{bf}(idt)$ ….. (Eq8b)

$sig = h(idt(cn_i), cg, cas, cgrs, cgrf)$ ….. (Eq8c)

$cgum = \{ecg, eidt, h(ecg), h(eidt), sig\}$ ….. (Eq8d)

enc_{bf} (see eq8a,eq8b) is encryption key of the key pair $\{enc_{bf}, dec_{bf}\}$ that used in blindfold approach. The message

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Vol. 4, Issue 3, March 2015

$cgum$ contains encrypted format of the salted version of cg (here salt is a random integer) and the id of isu and their respective one way hash values. This is to prevent conditional acceptance of new conduct gain by cooperative node cn_i. Upon receiving $cgum$, the cooperative node cn_i verifies the integrity of hash values ($h(ecg), h(eidt)$) and then publishes sig as its new signature, and then acknowledges the same to isu. Further intended secondary user isu reveals decryption key of the pair $\{enc_{bf}, dec_{bf}\}$ and $salt$ to the cooperative node cn_i.

Further the cooperative node cn_i decrypts $cgum$ and updates conduct gain 'cg', '$cgrs$' and '$cgrft$' and '$salt$'.

IV. EMPIRICAL STUDY BY SIMULATION

The aim of the simulations is to analyze the relevance of quality of service towards handling the Spectrum Sensing and allocation to secondary users in cognitive radio wireless mesh networks under malicious cooperation activities. A simulated model of a cognitive radio wireless mesh network is devised with the nodes of range of 80 to 500 of 8 to 35 network groups. The malicious cooperation scope maintained between the ranges of 4 to 22%. The characteristics and attributes are illustrated in table1. The devised QoS variance aware cooperative spectrum sensing with and without neighbor sensitivity analysis model for cognitive radio wireless mesh networks is assessed by comparing with detect and relay model [20], since this proposed QoS variance aware spectrum sensing and allocation strategy for cognitive radio wireless mesh networks and Cooperative Spectrum Sensing by Detect and relay [20] are both comes under similar category called cooperative spectrum sensing by QoS assessment. The metrics used in this assessment are (i) ratio of interference observed and (ii) ratio of spectrum fair utilization.

Figure 2 shows the ratio of interference between secondary and primary nodes spectrum utilization activity, which is due to the malicious cooperative nodes. The average interference ratio observed under the 'detect and relay' strategy [20] is more than that observed under QoS variance aware spectrum sensing and allocation strategy with and without node sensitive analysis that devised here in this paper. The average ratio of inference observed in 'detect and relay' strategy is around 3% more than that observed in QoS variance aware strategy and around 13% more than QoS variance aware strategy with conduct sensitivity analysis.

In the absence of conduct sensitivity analysis, the QoS variance aware strategy, the interference ratio observed is around 10% more than that observed with node sensitive analysis approach. The performance of the devised model is observed better, which is due to the QoS factors considered and the approach of identifying the variance of these factors along with conduct sensitivity analysis. The Node sensitive QoS variance aware spectrum sensing and allocation strategy is scalable and robust against divergent percentage of malicious cooperative nodes and network groups.

Number of nodes	80 to 500
Malicious cooperation scope	4%-22%
Percentage range of secondary users	45% to 75%
Range of network groups formed as a mesh network	8 to 35
Mesh network coverage area	2750 m × 1550 m
Radio spectrum minimal range	124 sqm
No of channes	92
Radio frequency per second	9 rps*
Average transmission load	0.9 KB
Transmission speed	256 to 512 kb per second
Core transmission size at physical link	3.0 Mb per second

Table1: The parameters and their values range used in simulations. (*radios per second)

Figure 3 indicates the ratio of successful spectrum utilization by secondary users in cognitive radio wireless mesh networks, which indicates the advantage of the QoS variance aware spectrum sensing and allocation strategy with conduct sensitive analysis over without conduct sensitive analysis and "detect and relay" strategies. The simulation in regard to assess the metric called ratio of fair spectrum utilization, the spectrum utilization ratio is observed in dense and sparse network groups under divergent percentage of malicious cooperative nodes. The observations are indicating that the spectrum sensing and allocation is fair, optimal and robust in devised QoS variance aware Strategy with conduct sensitive analysis that compared to "without conduct sensitive analysis" and "detect and relay" strategies.

The average of 14% percent of fair spectrum utilization by secondary users is observed in proposed Conduct Sensitive QoS variance aware Cooperative Spectrum sensing that compared to detect and relay strategy, which is due to the conduct sensitivity analysis and QoS factors considered in proposed model. The QoS variance aware strategy without Conduct sensitive analysis also having around 2% advantage of fair spectrum utilization over detect and relay strategy, which due to the QoS factors considered.

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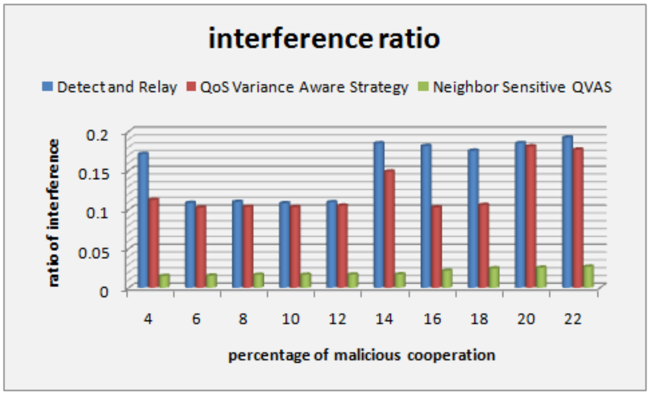

Figure 2: The Interference Ratio observed in QoS Variance Aware Strategy with and without conduct sensitivity analysis and 'Detect and Relay' Strategy

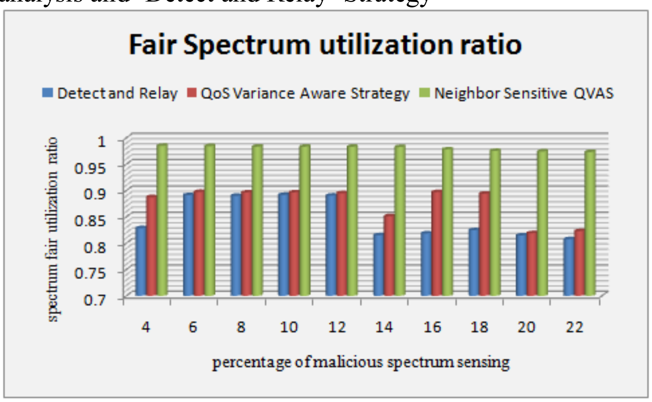

Figure 3: The Spectrum utilization ratio observed at QoS variance aware strategy with and without conduct sensitivity analysis and Detect and Relay Strategy

V. CONCLUSION

Here in this paper, we proposed a novel Conduct Sensitive QoS variance aware Cooperative Spectrum Sensing and allocation strategy for cognitive radio wireless mesh networks that accepts cooperation from selective nodes that are eligible under conduct sensitivity analysis. The QoS variance assessment depends on sensitive QoS factors of spectrum and these factors are (i) Primary User conflict scope, (ii) retransmissions scope, (iii) inference scope, (iv) channel occupancy time elapse scope, (v) spectrum fading scope and (vi) spectrum usage scope. The model proposed here is capable to avoid the falsified spectrum sensing and allocation, which is due to the devised approach called conduct sensitivity analysis that helps to accept cooperation from fair neighbor nodes. The impact of the QoS variance assessment is observed as robust and scalable towards effective spectrum sensing and allocation. Majority of the existing models are only using the specific QoS factors and also not considering the deviation of the opted QoS factor state from other QoS factors, which in turn reflecting negative performance of spectrum sensing and allocation. Henceforth, here in this paper we consider the other dimension of QoS assessment for spectrum sensing and allocation. The model devised here is having four phases and those are (i) assessing conduct of the cooperative neighbor nodes (ii) assessing ranks of spectrum under different QOS factors, (iii) finding the variance between divergent spectrum ranks under different QoS factors and (iv) updating the conduct gain of the cooperative nodes involved in spectrum sensing. These four stages followed by the process of selecting fair neighbor nodes for cooperation, ordering the spectrums by the anchor (primary) QoS factor and then the spectrum with less QoS variance value, which is in the order of max ranked threshold will be allocated to the secondary users. The quantitative analysis done through simulations indicating that the devised model is scalable and robust towards handling the QoS ware spectrum sensing and allocation in cognitive radio wireless mesh networks, and finally updating the conduct gain of the cooperative neighbor nodes involved in spectrum sensing. The model devised here in this paper is also considering falsified cooperation or non cooperation attitude of the malicious and selfish nodes.

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