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Research Article

Minimizing Information Asymmetry Interference using Optimal Channel Allocation in Wireless Mesh Networks

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Abstract: The Wireless Mesh Networks (WMNs) are implemented in IEEE 802.11 standards and are widely used due to its adaptability in real-time network scenarios; where the overall performance has been increased by incorporating Multi-Radio and Multi-Channel (MRMC). However, due to the limited number of frequency spectrums in IEEE 802.11 standards and co-located links' channel interference, the problem of channel assignment arises for maximum utilization of available bandwidth. One of the well-known interference issues is Information Asymmetry (IA) interference where the source mesh nodes of different mesh links cannot sense each other’s activity before transmitting data on the same frequency channel. This non-coordination among various mesh nodes leads to data collision and packet loss within the data flows, which degrades the overall performance of mesh network. In this work, we propose a novel and near-optimal channel assignment model called Information Asymmetry Minimization (IAM) model using integer linear programming. The proposed IAM model incorporates various constraints within MRMC-WMNs along with the objectives and optimally assigns non-overlapping channels (1, 6 and 11) from IEEE 802.11b technology to various MRMC-WMN links. Our objective is to minimize the information asymmetry interference among various mesh nodes, which in turn minimizes the communication disruption while increasing the overall network throughput. Furthermore, using OPNET simulator, the proposed model is tested on different network scenarios for randomly generated mesh topologies of various mesh nodes. We show that our proposed model gives 11% aggregate network capacity improvement over the traditional RTS/CTS mechanism.

Keywords: Wireless Mesh Network, Information Asymmetry, Channel Assignment, Integer Linear Programming, Coordinated Interference.

1. INTRODUCTION

In recent years, Wireless Mesh Network (WMN) has become a better option for users as it reliable, self-configurable and low cost technology. In WMN, there are three types of nodes involved for communication i.e. mesh routers, mesh clients and gateway nodes. Mesh routers form a mesh topology and are connected with each other. These Routers forward packets on behalf of the other nodes called mesh clients as mesh clients may not be within each other’s direct wireless transmission range [1]. Wireless Mesh Network is almost static or moving with minute mobility that makes a backbone network called mesh backbone. PDAs, desktop systems, laptops, smart phones etc. are traditional mesh client nodes. Mesh clients access Mesh Routers to communicate and with each other and with outside world using Gateway nodes. Each node in the WMN gives the end users a reliable environment due to

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its multiple path and redundant links. In case of failure on single route the flow of data is sent on the alternate redundant path. That is the reason why WMNs are reliable and self-configurable [2]. Wireless Mesh Network (WMN) has static mesh routers with minimum mobility [3].

The complete architecture of MRMC-WMNs is shown in Fig. 1. Wireless mesh network can have single or multiple radios. In our research we have taken multi-radios architecture where the mesh nodes are equipped with multiple radios. These multiple radios perform significant role in maximizing the aggregate network capacity. Recently researches have adopted the use of multiple interfaces concept. Further multiple channels at MAC layer can be assigned at the same time to a wireless mesh node to take advantage by using multiple channels. Compared to single radio architecture multiple radios enhance the overall network capacity.

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1.1. Multi-Radio WMNs

Multi-radio WMN is equipped with multiple interfaces or radios. Due to the presence of multiple interfaces on each mesh router multiple channels form IEEE 802.11b can be assigned to mesh node. This strategy improves the network throughput up to a great extent [4]. In case of single-radio design each mesh node has only one radio and that radio can use only one frequency channel at one time. The main drawback of single-radio structural design is, less throughput and limited network capacity due to limited number of channels [5]. Keeping in view the disadvantages of single-radio design the alternative design is multi-radio-multi-channel structure where multiple channels can be assigned to each node. The multi-radio multi-channel leads to simultaneous communication among mesh nodes and hence network throughput can be maximized by using optimal channel assignment strategies [6].

The wireless technology used in this research is 802.11b that works on 2.4 GHz band. IEEE 802.11b standard consists of 11 frequency channels in which three channels are non-overlapping i.e. 1, 6 and 11. Each channel has a transmission capacity of 11mbps. Nodes can communicate only if they are within the transmission range of each other. However, due to limited number of available channels, the mesh nodes interfere with each other for accessing channel for communication. Earlier studies have categorized these issue i.e. information asymmetry interference, near-hidden and far-hidden interference [8]. In this research we minimize information asymmetry problem so as to maximize WMN network capacity. To overcome information asymmetry problem, there are various optimization and channel assignment models that have been proposed in the literature. The main objective of the previous channel assignment mechanisms is to decrease channel interference between different wireless links [7]. In 2006, Michele and coauthors categorized channel interference named coordinated (CO), information asymmetry, near-hidden and far-hidden interference. The focus of this study is to deal with coordinated links and minimize information asymmetry interference schemes [8].

1.2. Coordinated Interference

Coordinated interference was pointed out for the first time in 2006 by Michele et al [8], is the case where the transmitters of different links are located within each other's the carrier sensing range. Fig. 2 represents coordinated interference along with transmission range and carrier-sensing range of the source node *a1* of link *l1* respectively. Both the link ***l1*** and *l2* are coordinated as they are sharing the same frequency channel 1. For coordinated interference CSMA/CA protocol (Jasani and Alaraje 2007) [22] is used to share the share the channel capacity among links. CSMA/CA is a technique where a wireless node senses a frequency channel before sending the data. Before sending data it checks the medium for transmission. If the transmission medium is found idle then the node transmits its data. If the medium is sensed busy then the sender node starts waiting for a long period of time in order to access a frequency channel.

It may happen that two or more nodes sense an idle channel and starts sending their flows at the same time, this can cause collision among their data flows. This kind of problem is solved by handshake mechanism which is used by CSMA/CA also known as Request-To-Send/Clear-To-Send technique [22]. In case of RTS/CTS mechanism the station sends a RTS packet in order to gain medium for its data transmission. After RTS if the medium is found free, the receiving station on the receiving side responds back with a Clear-To–Send (CTS) signal. The sending then starts transmitting data after it sees the CTS signal [9]. Earlier studies done so far shows that coordinated interference (CO) is not harmful as the sending nodes shares a frequency channel among multiple nodes. Apart from CO interference another well-known interference type is information asymmetry that is discussed in the next section 1.3.

1.3. Information Asymmetry (IA) Interference

In Information Asymmetry interference, the source nodes of any two links are located outside the carrier sensing ranges of each other. For example, in Fig. 3 three links (s1, d1), (s2, d2) and (s3, d3) are operating on the same IEEE 802.11b frequency channel. The following condition in equation (1) and (2) creates the information asymmetry interference between (s1, d1), (s2, d2) and between (s1, d1), (s3, d3) [10]:

$$d(s2, d1) < CR. \qquad (1)$$

$$d(s3, d1) < CR \qquad (2)$$

Here d represents the geographic distance among WMN nodes. Similarly, the CR shows the carrier-sensing or interference range of each mesh node. In Fig. 2 the solid line circle shows the CR of the source node s1 while the dotted circle represents carrier-sensing range of the receiving node d1.

Source nodes s2 and s3 are in the carrier-sensing range of receiver node d1 i.e. shown in equation (1) and (2). In this case if all the given links in Fig. 3 are assigned the same frequency channel then the flow on link (s1, d1) may interfere with both (s2, d2) and (s3, d3) that leads to information asymmetry interference. Studies have shown that information asymmetry interference till now is not solved and handled carefully by the well-known CSMA/CA (carrier sense multiple access) protocol. CSMA/CA protocol functions inside the carrier-sensing ranges while information asymmetry problems arise outside the carrier-sensing range of sending nodes. The main purpose of this research is to propose a linear programming model to minimize the information asymmetry problem and to maximize the WMN network capacity. In the next section we present a detailed survey on interference issue in WMN.

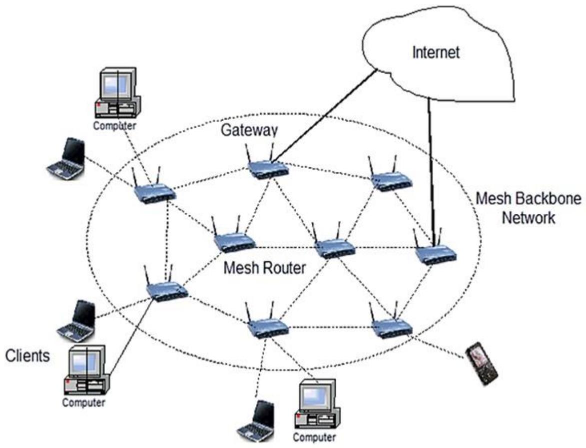


Fig.1. An example architecture of wireless mesh network

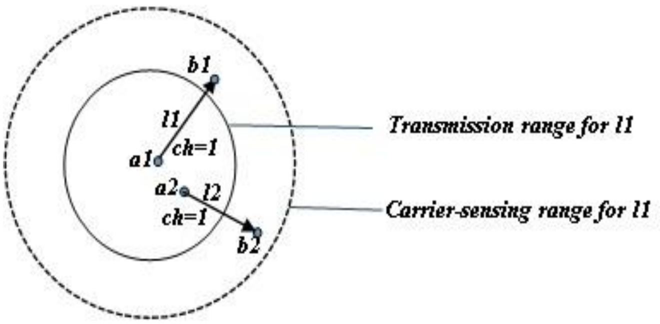


Fig. 2. Coordinated relationship between links *l1* and *l2*

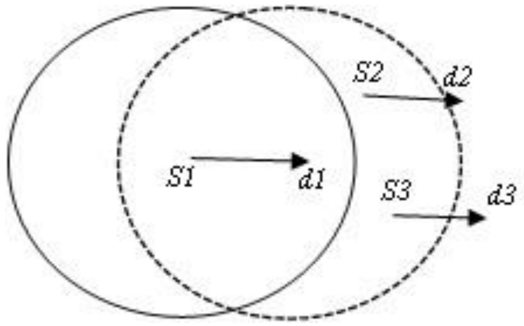


Fig. 3. Information Asymmetry links in wireless mesh network

2. LITERATURE REVIEW

In [1], the author formulated a unique constraint for channel assignment. They observed wireless mesh network connectivity issues and traffic pattern that caused interference. The Mesh-Tic strategy was presented for frequency channel assignment. Reena et al. (2013) [11] identified an issue in multi-radio wireless mesh network that was local link failure problem. They presented a system i.e. Autogenesis Network Reconfiguration System (ARS), the system ensured the protection of local link failure in WMN and also maintain the network throughput. The autogenesis network reconfiguration system gives better result over other previous models and the channel efficiency increased up to 90%. In [12] different issues of wireless mesh network such as channel assignment, power control and routing problem of wireless mesh network were discussed. It was analyzed that nodes equipped with multiple radios and operating on multiple channels can cause reduction in interference issue and can improve the capacity of a network.

Sadiq et al. 2013; Saini et al. 2013 [10, 21] worked in MRMC-WMNs that is link interference problem for both coordinated and non-coordinated Interference. The author proposed a linear algebraic model which is entirely based on non-coordinated interference. From the results they concluded that the proposed model gives considerable network capacity improvement of sparse network over the dense network i.e. 19%. In [13] the author's focused on multi hop wireless mesh network, each router in a network has multiple radios and for the purpose of communication multiple channels are available. The authors formulated a channel assignment scheme that was an NP-hard problem.

Fang and Bai (2012) evaluated that MRMC-WMNs is a promising technology where each node is equipped with multiple radios and each radio is assigned a single channel [5]. The authors presented a novel topology control scheme and formulated different NP hard complexity problem. It was concluded that addressing such issues in MRMC WMNs supply more favorable services to end user. In [14], the author divided the interfering links into two main parts that is coordinated interference (CO) and non-coordinated (nCO) interference. A new clique-based clustering channel assignment scheme was presented for the minimization of CO interference and nCO interference. The network is divided into different clusters and channel assignment was done on the basis of proposed algorithm. The main objective was to decrease CO and nCO interference in the network. Through various simulations the result showed that the CCCA proposed scheme can reduce the end to end delay and can maximize the network capacity of wireless mesh network. Weifeng et al. (2012) proposed an efficient dynamic cross layer design named as R-CA. Through simulation results it was shown that the network throughput can be enhanced by this proposed channel assignment algorithm [7]. In [15], the authors explained different issues of MRMC-WMN and various solution and approaches were presented. They worked on partially overlapping channel assignment and on different issues and challenges related to MRMC-WMN that is routing issues in designing of wireless mesh network. Sadeq and Mesut (2016) investigated that the reduction in capacity of multi-radio wireless mesh network is caused by the interference between links in wireless communication. They worked on cluster channel assignment mechanism and formulated problems occurred due to channel assignment among different nodes in wireless mesh networks. This approach has two main parts. The first part consists clustering of WMN to overcome the local problem within the cluster. Secondly, in order to make use of frequency channel efficiently within the cluster, Cluster-based frequency channel allocation mechanism is employed to minimize the complexity of assignment of channels and again to use the channel in different cluster [16].

Subramanian et al. (2008) proposed a greedy algorithm for the purpose of minimization of wireless mesh network interference. The author also worked on centralized Tabu-based algorithm for efficient channel allocation mechanism for different network interfaces. The Tabu-based algorithm did not work efficiently when the less number of radios was used [17]. Ying et al. (2016) presented the issue of joint channel assignment and routing issue. The authors stated that the problem is NP-complete. In first phase, the authors use a model called rate-variable model that enhances the network aggregate throughput. Secondly, they proposed a mathematical programming model that formulates the channel assignment and routing problem by deriving an integer linear programming (ILP) problem. Their simulation and experimental results show that their proposed approach effectively increases the network throughput [18]. The authors in [8] divided the channel interference into non-coordinated and coordinated interference. The non-coordinated interference is further divided into near-hidden, information asymmetry and far-hidden interfering links. The authors proposed an analytical model for minimizing coordinated interference and also non-coordinated interference. It was concluded in the end that the non-coordinated interference is much harmful than the coordinated interference among mesh links.

In [19], the authors proposed three different channel assignment models. Their names are i) protocol model, ii) the signal-to-interference ratio model and iii) the SIR model. The main objective of this research work was to find out the minimum non-overlapping frequency channels needed to get interference-free communication among the WMN nodes. In the end they concluded that channel assignment based on interference model called SIR model requires more frequency channels for network throughputs at various node-degree constraints as compared to simpler interference models.

3. PROPOSED MODEL FORMULATION

In this section we are formulating a linear programming model to minimize information asymmetry interference. The proposed model is termed as information asymmetry minimization (IAM) model. The IAM consists of a binary decision variable, one objective function and a set of constraints.

3.1. Binary Decision Variable

The function of binary decision variable is to assign IEEE 802.11b channel *j* to a link *i*. If the variable has value 1 then the decision variable states that the directed link *i* is transmitting on channel *j* otherwise it is considered 0. Our binary decision variable is represented through Eq. (3):

$$x_{i,j} = \begin{cases} 1 & \text{if a directed link } i \text{ operates on channel } j \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

3.2. Objective Function

The main objective of the proposed *IAM* model is the maximization of the MRMC-WMN capacity. The given objective function that maximizes the overall network capacity in Eq. (4), adds all the WMN edges *E* with data flow *fi* over the link *i* fulfilled after optimal channel assignment scheme [10]. Here λ is fraction of flow successfully transmitted on link *i*;

$$\max \sum_{i\in E}\sum_{j\in H} x_{i,j}.\lambda_i.f_i \quad (4)$$

Here, *H* is the set of IEEE 802.11b non-overlapping channels i.e. 1, 6, 11 and *E* is the set of mesh edges (links).

3.3. Constraints Set

The objective function is accompanied with constraints representing the restrictions on the optimization model. The proposed constraints for our proposed model are represented through Eq. (5), Eq. (6) and Eq. (7).

3.3.1. Single channel constraint

The single channel constraint ensures that only one channel is given to a single link at one time. This shows that every link in the set *E* must be turned only on one frequency channel. Single channel per link constraint clearly states that if *i* is a link then on only one channel *j* for the set *H* is assigned to it [10];

$$\sum_{j\in H} x_{i,j} = 1 \qquad \forall i \in E, j \in H \quad (5)$$

3.3.2. Coordinated interference constraint

Coordinated links do not create severe interference instead they share the capacity of the frequency channel. The frequency channel capacity is divided among those links that are coordinated with each other. The constraint is already proposed by [10, 23] and is represented in Eq. (6). Here λ is the fraction of traffic flow fulfilled on link *i and k* is the coordinated links set of link *i* e.g. *co (i)*.

$$x_{i,j}.\lambda_i.f_i + \sum_{k \in co(i)} x_{i,j}.\lambda_k.f_k \le C_j \qquad \forall i,k \in E, \forall j \in H \qquad (6)$$

3.3.2. Information asymmetry minimization constraint

This is the proposed constraint of this research that minimizes the information asymmetry interference. The channel assignment strategy restricts that two IA links will not operate on common or fully overlapping frequency channel. Here *IA*(*i*) is the set of information asymmetry links of link *i*. Only one channel *j* can be assigned to either *i* or *k* for IA set.

$$x_{i,j} + \sum_{k \in IA(i)} x_{k,j} \le 1 \qquad \forall i,k \in E, \forall j \in H \qquad (7)$$

4. RESULTS AND DISCUSSION

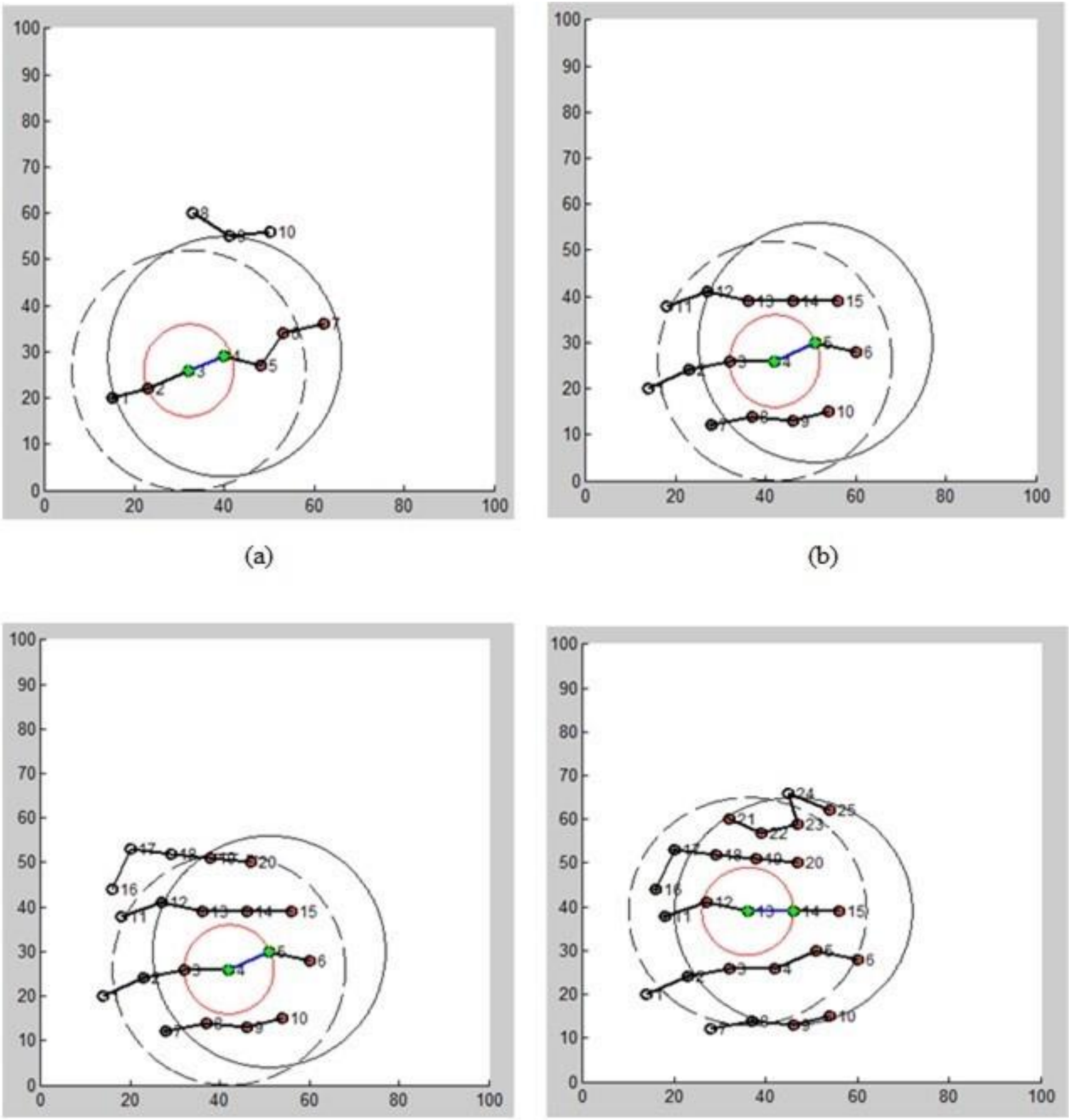
This section is divided into three sections. In first section, we create multiple MRMC-WMN topologies in MATLAB. The purpose of the topology construction is the identification of information asymmetry and coordinated links of each link in the network. We have created four different topologies by randomly deploying mesh nodes using MATLAB. The identified results are then given to A Mathematical Programming Language (AMPL) tool to get near optimal channel assignment results from the proposed IAM model. Furthermore, the channel assignment results are given to OPNET simulator. In section three extensive OPNET simulations have been done to verify the model results.

4.1. Multi-radio WMN topology construction

We present four different WMN topologies in Fig. 4 that have been created in MATLAB. These topologies consist of 10, 15, 20, 25 nodes respectively. The interference effect of IA is checked on topologies with increasing number of nodes from 10 to 25. We assumed that every mesh node has a transmission range of thirty 30 meters while the carrier-sensing range is 2.6 times of transmission range i.e. 78 meters. From all the four topologies coordinated and IA links are identified. In Table 1 all the coordinated and IA interfering links of each link (considered link) is given. For example link *(13,14)* is considered from Fig. 4(c) are the set of coordinated links i.e. *(2,3)(4,5)(3,4)(11,12)(7,8)(12,13)(13,14)(16,17)(14,15)(17,18)(18,19)(19,20)(21, 22)(23,24)(22,23)* while the set of given information asymmetry (IA) mesh edge is *(24,25).* The same method has been used to identify interference links for all the remaining MRMC-WMN topologies. The results taken from these WMN topologies are then given to AMPL (A Mathematical Programming Language) tool in order to get the optimal channel assignment scheme.

4.2. Proposed Model Results

The results have been taken in AMPL using Gurobi solver. In Table 1 all the coordinated and information asymmetry links have been identified for each link. The total links taken are twenty. For all other topologies given in Fig. 4 the same approach has been followed by identifying information asymmetry and coordinated edges. These links in Table 1 are given as input to AMPL solver that considers all the channel assignment constraints. One of the assumption taken here is that all the paths are taken as single link paths. Each link flow demand has been varied from 100 packet per second to 500 packets per second on each source node. In Table 2 the channel allocation results are given taken from AMPL solver for Fig. 4(b). Clearly it is shown that those links that are information asymmetry to each other do not share the same frequency channel. The channel assignment results given by IAM model are simulated in OPNET for further verification. A total of four scenarios with multiple mesh network sizes are simulated to compare the IAM model results with that of the existing RTS/CTS channel assignment model given in [10]. Various simulation parameters are given in Table 3 that are taken into consideration from [23].



(a) (b)

(c) (d)

Fig. 4 (a, b, c, d) represents WMN topologies. Each consists of 10, 15, 20 and 25 nodes respectively. The broken line circle shows carrier-sensing range (Cr) of the source node (e.g. node 3 in (a)) while solid line circle represents the CR of the given receiver node (e.g. node 4 in (a)). Similarly, circle in red color represents the Tr of the source node (e.g. node 3 in (a).

4.3. Simulation Results

4.3.1. Simulation assumptions

The following assumptions have been considered for simulations:

1. The channel transmission capacity of each frequency channel is the same.
2. Each mesh node is equipped with multiple radios instead of one.
3. Each mesh node is kept static and all paths are taken as single link path.
4. The carrier-sensing range and transmission power is assumed to be the same for all the mesh nodes.
5. Three non-overlapping channels used for channel allocation are 1, 6 and 11.

Every mesh router or node in the network consists of maximum of three radios and the reason is to take

Table 1. Coordinated and Information Asymmetry set of all links calculated from Fig. 4(d)

WMN Link	Coordinated links (CO)	Information asymmetry links
(1,2)	(1,2) (6,7) (2,3) (12,13) (11,12) (17,18) (16,17)	(3,4)(7,8)(13,14)(18,19)
(2,3)	(1,2)(3,4)(6,7)(7,8)(11,12)(12,13)(13,14)(16,17)(17,18)(18,19)	(4,5)(8,9)(14,15)(19,20)
(3,4)	(1,2)(2,3)(4,5)(6,7)(7,8)(8,9)(11,12)(12,13)(13,14)(14,15)(16,17)(17,18)(18,19)(19,20)	(9,10)(22,23)
(4,5)	(1,2)(2,3)(3,4)(7,8)(8,9)(11,12)(12,13)(13,14)	(24,25)
(6,7)	(2,3)(3,4)(7,8)(8,9)(9,10)(18,19)(19,20)	(4,5)(9,10)(14,15)(19,20)
(7,8)	(2,3)(3,4)(4,5)(6,7)(8,9)(9,10)(12,13)(13,14)(14,15)(19,20)	Nil
(8,9)	(2,3)(3,4)(4,5)(6,7)(7,8)(9,10)(13,14)(14,15)(19,20)	Nil
(9,10)	(4,5)(7,8)(8,9)(14,15);	Nil
(11,12)	(1,2)(2,3)(3,4)(12,13)(13,14)(16,17)(17,18)(18,19)(21,22)	(4,5)(14,15)(19,20)(22,23)
(12, 13)	(2,3)(3,4)(6,7)(11,12)(12,13)(13,14)(14,15)(16,17)(17,18)(18,19)(22,23)(23,24)	(4,5)(14,15)(19,20)(24,25)
(13,14)	(2,3)(3,4)(4,5)(7,8)(11,12)(12,13)(13,14)(14,15)(16,17)(17,18)(18,19)(19,20)(21,22)(22,23)(23,24)	(24,25)
(14,15)	(3,4)(4,5)(7,8)(8,9)(12,13)(13,14)(21,22)(22,23)(23,24)(24,25)	(9,10);
(16,17)	1,2)(2,3)(3,4)(11,12)(12,13)(13,14)(17,18)(18,19)(21,22)	(3,4)(14,15)(19,20)(22,23)
(17,18)	(11,12)(12,13)(13,14)(16,17)	(3,4)(13,14)(18,19)(21,22)
(18,19)	(3,4)(11,12)(12,13)(13,14)(16,17)(17,18)(21,22)(22,23)(23,24)	(4,5)(14,15)(19,20)(24,25)
(19,20)	(3,4)(4,5)(12,13)(13,14)(14,15)(21,22)(22,23)(24,25)	Nil
(21,22)	(12,13)(13,14)(14,15)(18,19)(22,23)(23,24)	(14,15)(19,20)(24,25)
(22,23)	(12,13)(13,14)(14,15)(17,18)(18,19)(19,20)(21,22)(23,24)(24,25)	(4,5)
(23,24)	(14,15)(19,20)(21,22)(22,23)(24,25)	Nil
(24,25)	(21,22)(22,23)(23,24)	(19,20)

Table 2. IAM Model Channels assignment results

WMN Link	Assigned IEEE 802.11b channel
(1,2)	1
(2,3)	1
(3,4)	11
(4,5)	6
(5,6)	6
(6,7)	11
(7,8)	6
(8,9)	11
(9,10)	6
(10,11)	1
(11,12)	1
(12,13)	11
(13,14)	1
(14,15)	6

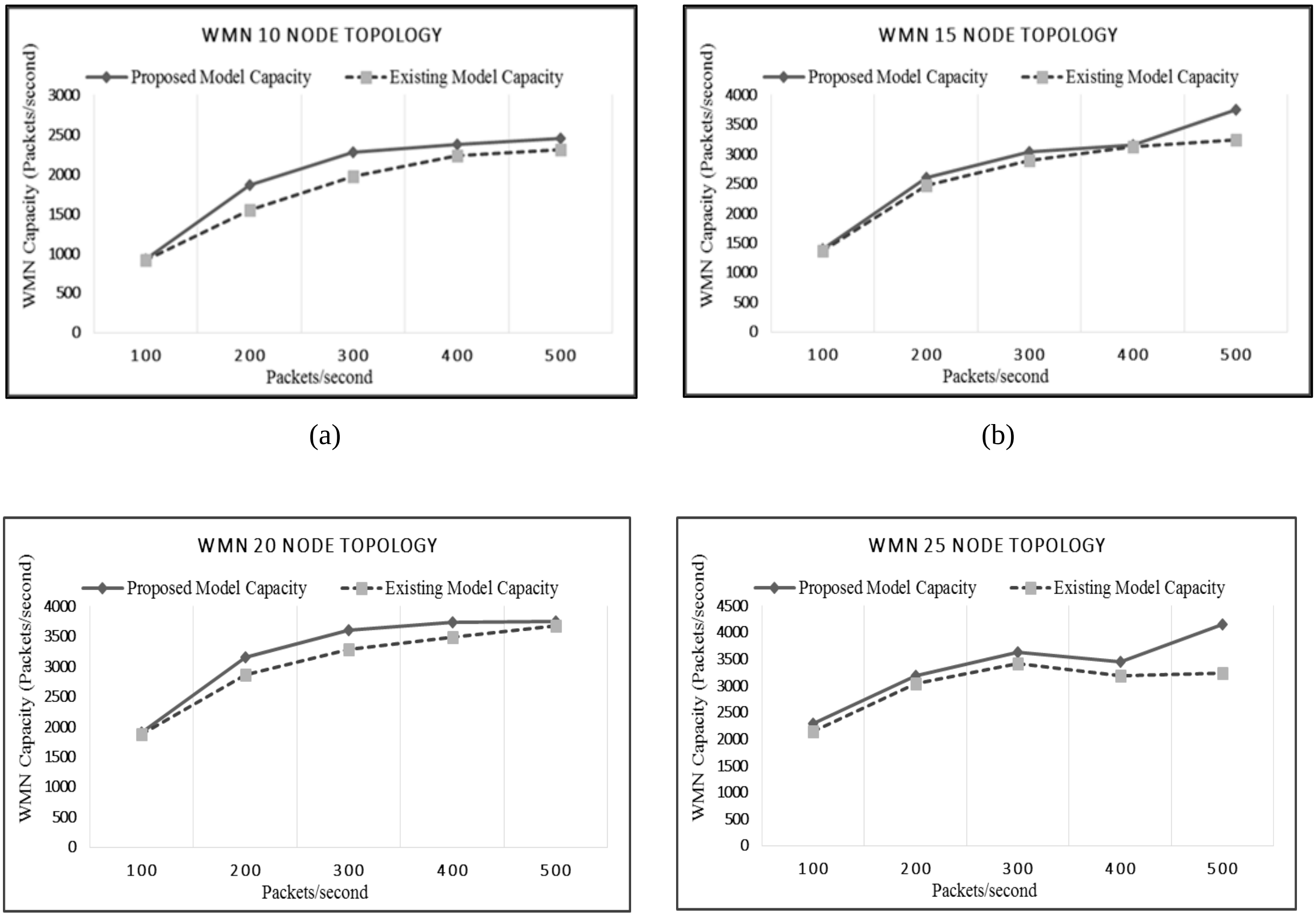
Table 3. Parameter used during simulation results

Simulation Parameter	Value
Number of Mesh Nodes	10,15,20,25
Radios per node	2
Channel Capacity	11Mbps (Max.)
Transmission Range	30 meters
Carrier-Sensing Range	78 meters
Simulation time	3 minute

maximum advantage of multiple channels. Like AMPL the flow demand is kept varying from 100 packets/sec to 500 packets/sec. For traffic or flow generation on source node the poison traffic generator is used. Table 4 summaries the results of the IAM model results for all the scenarios. The average improvement of the proposed optimization model shows better capacity improvement over existing RTS/CTS model. The reason behind this difference is that in RTS/CTS mechanism the channel during allocation at source nodes are collided that causes transmission losses.

Table 4 shows the summary results taken for all the topologies having network size of 10, 15, 20 and 25 nodes respectively. These results show that with increase in the number of nodes the net capacity of the MRMC-WMN increases in presence of IAM model. Same kind of increase is also occurring with the increase in packet per second from 100 to 500 Packets/sec. The channel assignment results from the RTS/CTS mechanism are tested from the same topologies present in Fig 4 (a, b, c, d).

Table 5 consists of these results varying from 10 nodes to 25 respectively. For simulating existing model; the parameters are kept the same as for the proposed model i.e. Table 3. For comparative analysis the results of proposed IAM and RTS/CTS mechanism are represented through line graph in Fig. 5. In case, the flow demand raises, the aggregate network capacity of proposed model gives higher result values over the existing channel assignment model. The behavior of the graph in Fig. 5 clearly shows the overall aggregate capacity increases with the increase in flow demand at source nodes. The graph clearly shows that the IAM channel assignment model given better capacity results than the existing model. In Table 6 the percentage improvement of IAM model over existing model has been measured for each topology. For this analysis the data has been taken from Table 4 and 5. It is clear from Table 6 that the percentage improvement is high in those environments where the information asymmetry (IA) interference is high. The maximum percentage increase that IAM model has given over the RTS/CTS mechanism is 28.31%. This improvement is determined for the network topology that has 25 nodes and high data rate i.e. 500 packets per second. The percentage improvement for 25 nodes topology is also shown in Fig. 6. From all these results it is concluded that our proposed IAM model can perform better in large and high data demand networks. The overall percentage improvement averaged is 11%.



(a) (b)

(c) (d)

Fig. 5. Proposed and existing model comparison for (a) 10 node, (b) 15 node, (c) 20 node and (d) 25 node WMN

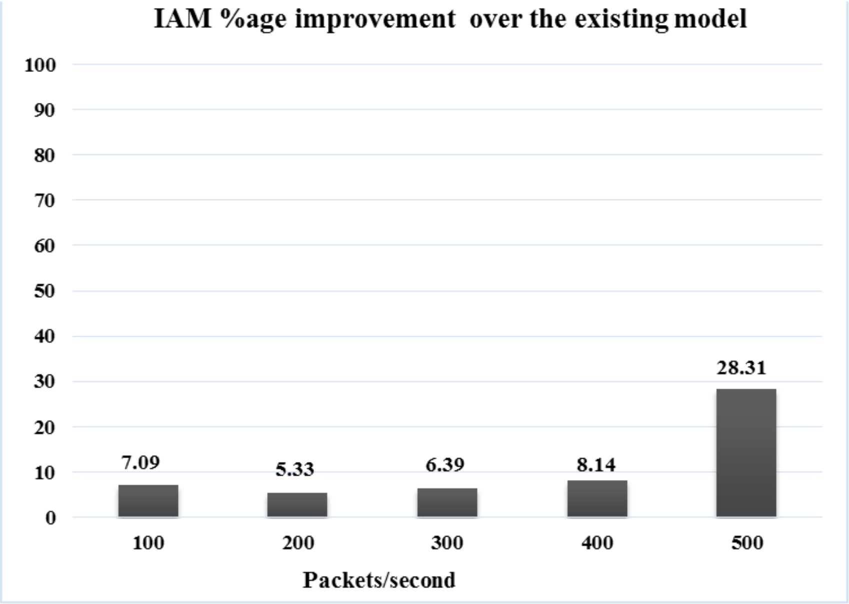


Fig. 6. IAM percentage increase over RTS/CTS Mechanism

Table 4. Proposed IAM Model Simulation Results

Flow Demand	**Network Capacity(10N)**	**Network Capacity(15N)**	**Network capacity(20N)**	**Network capacity(25N)**
Packet/sec	Packet/sec	Packet/sec	Packet/sec	Packet/sec
100	932.8	1403.14	1898.09	2288.25
200	1866.21	2605.88	3154.27	3195.56
300	2279.24	3038.48	3599.99	3630.54
400	2373.77	3160.108	3740.64	3456.47
500	2447.39	3755.65	3755.35	4155.99

Table 5. RTS/CTS Mechanism Simulation Results

Source flow Packet/sec	**Network Capacity(10N)**	**Network Capacity(15N)**	**Network capacity(20N)**	**Network capacity(25N)**
100	911.8	1371.44	1882.08	2135.66
200	1544.87	2476.59	2863.8	3033.82
300	1978.04	2895.1	3290.88	3411.26
400	2234.54	3130.9	3493.34	3194.99
500	2310.49	3242.91	3672.48	3238.8

Table 6. IAM percentage increase over RTS/CTS Mechanism

Source flow	**Network Capacity (10N)**	**Network Capacity(15N)**	**Network capacity(20N)**	**Network capacity(25N)**
Packet/sec	**Percentage Increase**	**Percentage Increase**	**Percentage Increase**	**Percentage Increase**
100	2.30	2.24	0.90	7.09
200	20.73	5.17	10.14	5.33
300	15.17	4.88	9.36	6.39
400	6.23	0.93	7.07	8.14
500	5.92	15.68	2.17	28.31

5. CONCLUSION AND FUTURE WORK

In this paper we compared proposed IAM model is compared with traditional RTS/CTS mechanism, using both model evaluation and simulation in MRMC-WMN. It is observed that IAM optimization model performs better results in those environments where the Information Asymmetry interference occurs in high ratio. From the results it is concluded that IAM optimization model provides 11% capacity improvement over RTS/CTS mechanism. The collision that occurs due to lack of coordination in RTS/CTS mechanism is now reduced up to 11%. Our analysis shows that the proposed model performs better in with dense mesh networks, hence the chances of Information Asymmetry interference increases with the increase in density. In future the proposed model may be extended to Partially Overlapping Channel (POC) assignment. Furthermore, it can also be tested with other types of interference that exist in WMN i.e. Near-Hidden and Far -hidden node problem.

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