

MULTI CHANNEL ASSIGNMENT FOR PATH SELECTION IN MULTI HOP WIRELESS SENSOR NETWORK

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Abstract—Nowadays more and more people, families, and companies rely on wireless services for their daily life and business, which leads to a booming growth of various wireless networks and a dramatic increase in the demand for radio spectrum. The important operation in wireless ad hoc networks is broadcasting. In networking protocols control information is broadcast for the realization. Normally broadcast in ad hoc networks are conducted on a common channel, that to be shared by all nodes in the network. Multiple channels in Wireless Sensor Networks (WSNs) are often exploited to support parallel transmission and to reduce interference. However, the extra overhead posed by the multi-channel usage coordination dramatically challenges the energy constrained WSNs. In the work, Modified Regret Matching based Channel Assignment algorithm (MRMCA) to address this challenge, in which each sensor node updates its choice of channels according to the historical record of these channels' performance to reduce interference. The advantage of MRMCA is that it is highly distributed and requires very limited information exchange among sensor nodes. Mainly in this work investigate the path selection problem in multi-hop wireless sensor network. So that only MRMCA achieves better network performance in terms of both delivery ratio and packet latency.

sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on. A WSN system incorporates a gateway that provides wireless connectivity back to the wired world and distributed nodes. The wireless protocol you select depends on your application requirements. Some of the available standards include 2.4 GHz radios based on either IEEE 802.15.4 or IEEE 802.11 (Wi-Fi) standards or proprietary radios, which are usually 900 MHz. Wireless Sensor Networks, or WSNs, have been used to enable better data collection in scientific studies, create more effective strategic military defenses, pinpoint the origin of a gunshot, and monitor factory machinery. All of these uses depend on the ability to collect data such as light, vibration, moisture, temperature, and more, as well as the ability to communicate with each other. This last ability is what makes a collection of nodes so much more powerful than any node in particular.

A WSN node contains several technical components. These include the radio, battery, microcontroller, analog circuit, and sensor interface. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth.

I. INTRODUCTION

1.1 WIRELESS SENSOR NETWORK

A wireless sensor network (WSN) (sometimes called a wireless sensor and actuator network (WSAN)) are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of

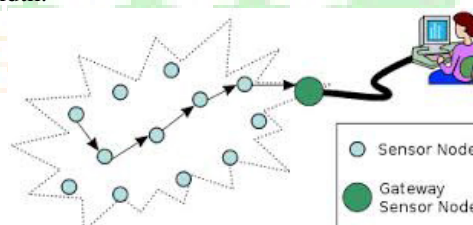


Figure 1.1 Wireless Sensor Network

A sensor node, also known as a mote, is a node in a sensor network that is capable of performing some processing, gathering sensory information and communicating with other connected nodes in the network. A mote is a node but a node is not always a mote. Gateway that provides wireless connectivity back to the wired world and distributed nodes. WSN nodes are typically organized in one of three types of network topologies:

1. Star Topology
2. Cluster tree Topology
3. Mesh Topology

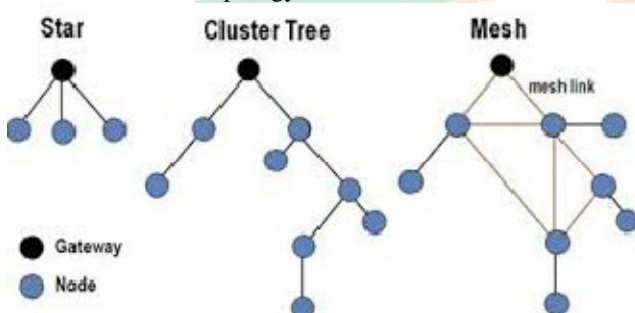


Figure 1.2 Three Types of Network Topologies

In a star topology, each node connects directly to a gateway. In a cluster tree network, each node connects to a node higher in the tree and then to the gateway, and data is routed from the lowest node on the tree to the gateway. Finally, to offer increased reliability, mesh networks feature nodes that can connect to multiple nodes in the system and pass data through the most reliable path available. This mesh link is often referred to as a router. The multi channel assignment is to explain how wireless sensor networks work, including the workings for each individual mote. The way the multi-function chips are made, as well as the communication system will be discussed. Specialized motes will not be discussed, as multifunction motes are more appropriate for this report. Past uses and potential applications will be touched upon briefly to further illustrate the faculty of these machines. The introduction of these collections of computing devices has brought forth changes in factory safety, machine maintenance, data collection, and military effectiveness. Section one describes how motes communicate with each other, the way they collect data, and the way they transfer data to a computer. The following section will discuss the capabilities and structure of an individual mote

1.1.1 Safety Mechanisms Used in WSN

In addition to communicating, motes also adapt to their situation. In the case of a malfunction the remaining

motes will reform the network. For example, there are 500 motes in place around a system. If 20% or 100 motes die, the rest of the motes will reconfigure the network to continue working with the remaining 400. Furthermore, 400 motes will collect as much data as 400 scientists working non-stop for that period of time. The bigger problems that face these networks are people with destructive intentions, and the potential for motes to keep "working" while spitting out bad information. Corrupt data can sometimes be caught when the information is used and reread by humans, but the times that it goes unnoticed can slightly or significantly alter conclusions drawn from the data. The threat of hackers is a serious problem because the operating system for the motes is an "open-source" system, which allows relatively easy access to codes. Some security systems are in place currently, such as code recognition software imbedded in the operating systems. All security procedures will develop with the growth of the technology in response to a larger number of hackers. The harder people try to break the system, the more the system will be protected.

1.1.2 How do WSNs Communicate with the User

Wireless sensor networks communicate within themselves as well as with a user not necessarily near the network's location. How does this work? Wireless sensor networks collect data about what is happening, and perform some action according to that data, be it moving, setting off alarms, or simply recording the data. All of these actions change the world that the mote is in, causing other changes, and so on. Because of the connection between the motes, all of these changes affect each mote, and all of the data collected by the mote is routed to the parent mote. This parent mote is connected to a computer of higher power that performs a function for which the motes are not designed. One such function is to access the internet and transfer the motes' data to the user's computer. The user may also communicate with the motes. If the user gives some directives, the directives will be sent over the internet to the computer/station. The computer/station will communicate the same directives to the parent mote, which then disperses the message amongst its "children".

1.1.3 Parts of a Mote

Motes, the individual computers that make up a Wireless Sensor Network, are very small and simple. While it associate a computer with a PC, the technical definition of a computer is a thing that computes, be it human or machine, thus motes are computers. Most motes consist of five crucial components. These components include a number of sensors, such as temperature, moisture, and vibration sensors, a power source, in the

case of older motes, 2 AA batteries, a radio transmitter/receiver, and an electric “brain.”(Figure 1.3).

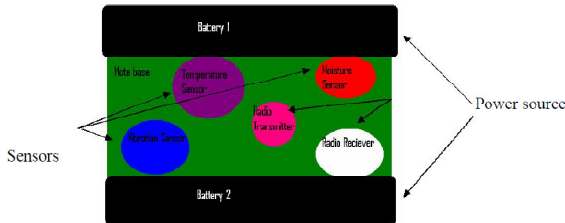


Figure 1.3. The construction of a first generation mote, usually known as a Mica-mote.

Sensors:When motes are under construction, their intended purpose often dictates the sensors that are added to the mote. The mote in Figure 1.3 contains three types of sensors: temperature, moisture, and vibration. This is a fairly typical mote, but some motes have many more functions. There are motes that take photographs of the surroundings, sense motion, measure light intensity, and much more. The sensors are attached to the mote base and communicate readings to the electronic brain.
Power Source:The power source for the mote also depends the mote’s intended use. If the mote is designed to last a very long time, say one year, it will have a larger power source than a mote that is only meant to run for a month. The power sources usually range between a couple of AA batteries, and a watch battery, but with the new smart-dust motes, also called “Spec,” they can collect enough energy to sustain themselves from ambient light, or even vibrations. The power source is connected to the mote base and provides energy required to run the sensors, electronic brain, and radio.
Radio:The radio consists of a radio transmitter and a radio receiver. Both of these parts must exist for any mote to fully communicate with the other motes. The radio, when transmitting, receives information from the electronic brain and broadcasts the data to other motes according to the network connections. In the other direction, when receiving, the radio receives information from another mote’s radio and transmits it to the electronic brain. The radio is connected to the mote base.

The Electronic Brain:The older motes’ brains consist of a microprocessor and some flash memory. Many of them have connectors to add other processes and sensors with ease. The MEMS motes also contain an analog-digital converter. The basic functions of the electronic brain are to make decisions and deal with collected data. The electronic brain stores collected data in its memory until enough information has been collected. Once this point is reached, the microprocessor portion of the electronic brain then puts the data in “envelopes,” or packages of data formatted for greatest transferring efficiency. These envelopes are then

sent to the radio for broadcast. The brain also communicates with other motes to maintain the most effective network in much the same way it deals with data. The electronic brain is connected to the base and interacts with the sensors and radio.
Mote Base:The mote base is simply the base on which the mote is built. In the case of MEMS motes, the base is the inactive metal layer in the chip, and in the case of multi - chip motes, the base consists of a circuit board that provides connections between the mote’s pieces.

Mote: Theory of Operation

Motes collect and transfer data using four stages: collecting the data, processing the data, packaging the data, and communicating the data. Each mote collects data using its various types of sensors. After collecting the data, the mote processes the data using its electronic brain. Once the data has been processed, the brain packages the data into an easily handled form. This process is known as enveloping. Once the data has been collected and processed to this point, the mote then begins to interact with other motes.

This process is one of many ways motes differ from traditional computers. Another way is motes spend as much as 99% of their time “sleeping” to conserve energy, only waking up to record data, send and receive information (either data or instructions), or when instructed to by its programming.

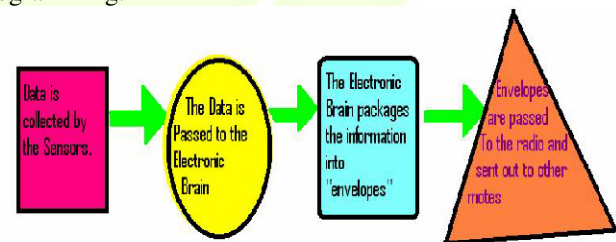


Figure 1.4 The ordered processes a mote undergoes when collecting data and communicating data to other motes.

II. LITERATURE SURVEY

2.1 Game Theoretical Approach for Channel Allocation in Wireless Sensor and Actuator Networks (Jiming Chen, Qing Yu, Peng Cheng, Youxian Sun, Yanfei Fan, and Xuemin Shen)

Multi-channel allocation in wireless sensor and actuator networks is formulated as an optimization problem which is NP-hard. In order to efficiently solve this problem, a distributed game based channel allocation (GBCA) Algorithm is proposed by taking into account both network topology and routing information. For both tree/forest routing and non-tree/forest routing scenarios, it is proved that there exists at least one Nash Equilibrium for the

problem. In Wireless Sensor and Actuator Networks (WSANs), communication and control are highly integrated. By using wireless technology to facilitate the control of dynamic systems, several features of the wireless communications, such as packet drop and delay, are inevitable issues in developing control policies. To this end, the objective is to design sophisticated estimation and control mechanisms to tolerate a certain amount of packet loss and/or delay. A distributed game based channel allocation (GBCA) Algorithm is proposed by taking into account both network topology and routing information. The GBCA algorithm is to assign channels in a static way based on the static network topology assumption. These protocols cause very limited communication overhead. The payoff of a player depends only upon the channels chosen by its interfering players, so players only need to exchange information with their interfering players to implement BR. Based on BR, it proposes a distributed Game Based Channel Allocation algorithm (GBCA) to cope with. For the channel allocation game, the most important elements are the payoff functions of players, which reflect the benefit of players and further determine the NE of the game and its performance, and the BR dynamics of players, which determines the dynamic evolution of the game. The payoff functions and BR also constitute GBCA.

Advantages

- It has larger delivery ratio and higher throughput and lower energy consumption.
- It gets more remarkable with the increase of the number of flows.
- It tries to balance the channel usage in two-hop neighborhood.

Disadvantages

- The static channel assignment is not an efficient way to handle interference.
- It achieves lower delivery ratio, smaller channel access delay, and less energy consumption in a single CCA.
- It yields higher delivery ratio but larger access delay and more energy consumption double CCA.
- It consumes more energy and increases the transmission delay and also decreases both throughput and delivery ratio.

2.2 Channel Allocation and Routing in Hybrid Multichannel Multiradio Wireless Mesh Network (Yong Ding, Kanthakumar Pongaliur, and Li Xiao)

To maximize network throughput in a multichannel multiradio wireless mesh network, most current solutions are based on either purely static or purely dynamic channel allocation approaches. In a hybrid multichannel multiradio wireless mesh networking architecture, where each mesh node has both static and

dynamic interfaces. An Adaptive Dynamic Channel Allocation protocol (ADCA), which considers optimization for both throughput and delay in the channel assignment. In addition, it also proposes an Interference and Congestion Aware Routing protocol (ICAR) in the hybrid network with both static and dynamic links, which balances the channel usage in the network. Adaptive Dynamic Channel Allocation protocol (ADCA), which considers both throughput and delay in the channel assignment. Compared with MMAC, ADCA is able to reduce the packet delay without degrading the network throughput. The throughput of a wireless mesh network can be dramatically increased by utilizing multiple channels instead of a single channel. Goal is to maximize the total throughput in the hybrid network with both static links and dynamic links. It wants the routes of different flows to be selected efficiently such that the channel usages are balanced at each node and thereby avoiding congestion in the network. Routing decision in the network: in the hybrid structure. It proposes an Interference and Congestion Aware Routing protocol (ICAR), which aims at balancing the channel usage over the network and thus improves the network throughput.

Advantages

- The connectivity of the network topology can be well maintained by using one dynamic interface in each mesh node.
- Each dynamic interface is able to communicate with any other interface within radio transmission range.
- It achieves a better load balance in the network by using dynamic links.

Disadvantages

- It does not contain the details of how a real implementation affects the protocol performance.

2.3 Resource-Minimized Channel Assignment for Multi Transceiver Cognitive Radio Networks (Ryan E. Irwin, Allen B. MacKenzie, and Luiz A. DaSilva)

A channel assignment scheme for cognitive radio networks (CRNs) that balances the need for topology adaptation focusing on flow rate maximization and the need for a stable baseline topology that supports network connectivity. It focuses on CRNs in which nodes are equipped with multiple radios or transceivers, each of which can be assigned to a channel. Cognitive radio (CR) technologies have enabled increased flexibility in modern communication systems, allowing intelligent reconfiguration of many communication components in software. Cognitive radios have the ability to adjust many radio parameters such as frequency assignment, transmit

power, and channel bandwidth, as well as the ability to sense various frequency channels for other radio frequency (RF) activity. CR node transceivers that addresses both goals of

(1) Supporting baseline network connectivity.

(2) Allowing the network to adapt, pursuing end-to-end goals of flow ratemaximization.

Advantages

- It support light loads such as control traffic.
- It dynamically assigns channels to the remaining transceivers in response to traffic demand.

Disadvantages

- High computation Overhead occurs.
- It is an effective strategy for channel assignment in a cognitive radio network in which nodes have multiple transceivers.

2.4 Throughput Satisfaction based Scheduling for Cognitive Radio Networks (D. Gzpek, B. Eraslan, and F. Alagz)

Opportunistic scheduling algorithms in cognitive radio networks (CRNs) allocate resources by exploiting the variations in channel conditions and spectral activities of primary users. However, most of these scheduling algorithms ignore the per-user throughput requirements. It formulate a scheduling problem called maximizing the number of satisfied users (MNSU), which maximizes the number of secondary users that are satisfied in terms of throughput in a centralized CRN. It show that MNSU is NP-hard in the strong sense and cannot be approximated within any constant factor better than 2 unless $P = NP$. Also prove that MNSU is at least as hard as the max-min fair scheduling problem, which has previously been proven to be a computationally very difficult problem in the literature. Then propose two heuristic algorithms: 1) best first resource assignment and 2) resource assignment with partial backtracking. Demonstrate that our proposed algorithms yield high performance while still achieving low computational complexity. The dynamic spectrum access (DSA) concept aims to enhance spectrum utilization by having intelligent devices called cognitive radios (CR). These devices can opportunistically utilize portions of the spectrum that are temporarily unused by their licensed owners. Licensed owners are called primary users (PUs), whereas CR devices are called secondary users (SUs). Resource allocation algorithm to maximize user satisfaction in orthogonal frequency-division multiple-access (OFDMA) systems. Their algorithm assigns subcarriers to the users in an OFDMA system while maximizing the number of satisfied users, where a user is satisfied if the average data rate it experiences is greater than or equal to its average data rate requirement.

Advantages

- It has a maximum transmission power.
- It maximizes the number of secondary users that are satisfied in terms of throughput in a centralized CRN.
- The algorithms yield high performance while still achieving low computational complexity.

Disadvantages

- It cannot isolate the nodes that do not want to receive information, unnecessary power may be consumed.
- It has a minimum throughput requirement.
- The scheduling schemes can not be used for a distributed environment.

2.5 Realistic and Efficient Multi-Channel Communications in Wireless Sensor Networks (Yafeng Wu, John A. Stankovic, Tian He, and Shan Lin)

Use multiple channels to improve communication performance in Wireless Sensor Networks (WSNs). First investigate multi-channel realities in WSNs through intensive empirical experiments with Micaz motes. Our study shows that current multi-channel protocols are not suitable for WSNs, because of the small number of available channels and unavoidable time errors found in real networks. With these observations, Propose a novel tree-based multichannel scheme for data collection applications, which allocates channels to disjoint trees and exploits parallel transmissions among trees. In order to minimize interference within trees, define a new channel assignment problem which is proven NPcomplete. Then propose a greedy channel allocation algorithm which outperforms other schemes in dense networks with a small number of channels. Implement our protocol, called TMCP, in a real testbed. Through simulation and real experiments, show that TMCP can significantly improve network throughput and reduce packet losses. More importantly, evaluation results show that TMCP better accommodates multi-channel realities found in WSNs than other multi-channel protocols. Tree-based Multi-Channel Protocol (TMCP) for data collection applications in WSNs. The idea of using multi-channel is to firstly partition the whole network into multiple vertex-disjoint subtrees all rooted at the base station and allocate different channels to each subtree, and then forward each flow only along its corresponding subtree.

Advantages

- It allocates channels to disjoint trees and exploits parallel transmissions among trees.
- It is used to minimize interference within trees.
- To improve the communication performance by using multiple channels in WSNs.

Disadvantages

- The node-based multi-channel protocols are not suitable for the real sensor networks.

- It won't consider user density and address life time.
- It also have an unavoidable time synchronization errors.

III. PROPOSED SYSTEM

3.1 PROCESS MODEL

When the communication to be started, it will first search the available network. Then Personal communications, information systems, broadcast and entertainment will have merged into a seamless pool of content available according to the user's requirement. The user will have access to a wider range of services and applications, available conveniently, securely and in a manner reflecting the user's personal preferences. So the user preference parameter are to be collected because they are access to communicate each other. The collecting parameter to access the communication then the network to be find scope for the network position. Find the best network for the user communicate to each other according to the rank. Spearman Rank Correlation Coefficient tries to assess the relationship between ranks without making any assumptions about the nature of their relationship. Spearman's Rank correlation coefficient is used to identify and test the strength of a relationship between two sets of data. It is often used as a statistical method to aid with either proving or disproving a hypothesis e.g. the depth of a river does not progressively increase the further from the river bank. Quality of service is the ability to provide different priority to different applications, users, or data flows, or to guarantee a certain level of performance to a data flow. For example, a required bit rate, delay, jitter, packet dropping probability and/or bit error rate may be guaranteed.

3.2 SYSTEM ARCHITECTURE

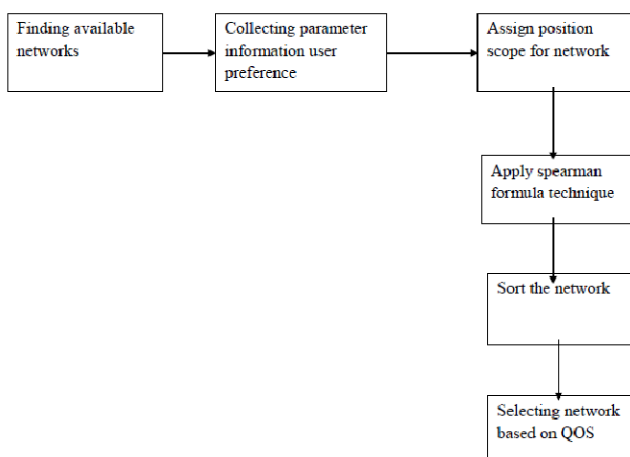


Figure. System Architecture

3.3 MODULES

The major motivation is to utilize the WSN more efficiently, and to be able to maintain the most efficient form of communication without interference and mobility model. To make the work as efficient it divided the work into small modules, such as given as below:

- Application selection
- Evolution of Wireless network
- Customizing parameters
- Network selection

3.4 MODULES DESCRIPTION

3.4.1 Application Selection

Wireless Sensor Networks are closely application-dependent. The constrained resources (e.g. processing, storage and transmission range) limit sensor nodes in WSNs to contain a wide variety of applications as the traditional network does. The designs of applications and management architectures in WSNs are also dependent on application semantics. As a result, application designers have to develop various complex and special program to execute node localization, data routing and data aggregation tailored to specific sensor applications.

In real time, user can select any type of application like as video calling, voice calling, internet and e-transfer and so on... and in the work it will taking three items video, audio, e-transf. In work, it can included application selection module for setting the specific application with some fixed properties preference as given as below

App/properties	Bandwidth	Cost	Security
Video	High	Less than high	Medium enough
Voice	Low enough	Should be low	Low enough
E-trans	Medium enough	Cost is negligible	Should be high

Figure. Fixed properties preference

3.4.2 Evolution of Wireless Network

Mobile communications systems revolutionized the way people communicate, joining together communications and mobility. A long way in a remarkably short time has been achieved in the history of wireless. Evolution of wireless access technologies is about to reach its fourth generation (4G). The Fourth generation (4G) will provide access to wide range of telecommunication services, including advanced mobile services, supported by mobile and fixed networks, which are increasingly packet based, along with a support for low to high mobility applications and wide range of data rates, in accordance

with service demands in multiuser environment. Wireless sensor network, then, must itself be dynamic and adaptable in all aspects, with built-in intelligence. Thus a 'software system' rather than a hard-and-fixed physical system is indicated. Integration, needed to reflect the convergence issues already mentioned, is also a key to wireless sensor network, in particular integration of the channel access and the core network elements, which must be designed as a whole rather than segmented as in the past. Such developments will of course be accompanied by ongoing evolution of already anticipated 4G services, such as: access Large-file transfer.

Some of the key drivers to WSN will be a multitude of diverse devices (distributed, embedded, wearable, pervasive), predominance of machine-to-machine communications, location-dependent and e-business applications, the extension of IP protocols to mobility and range of QoS, privacy and security, dynamic networking and air-interfaces, improved coverage mechanisms, improved and dynamic spectrum usage. These services in themselves represent an increase in requirements for accessing information, for business and commercial transactions, as well as for a raft of new location-dependent information services, all including significantly higher bit-rate requirements. From the above it will be seen that WSN will need to be highly dynamic in terms of support for:

- The users' traffic
- Air interfaces and terminal types
- Quality-of-service types
- Mobility patterns.

There may some cases for failures while communication Failures in wireless networks occur for various reasons. It discuss and classify the most common causes of failures and Table I presents their classification according to the previously proposed criteria.

1) Node Failure: There are several possible sources of node failure.

2) Link Failure: Path loss, shadowing, multipath fading and interference are the major wireless channel impairments that can cause link failures.

3.4.3 Customizing Parameters

The parameters are given below:

- Fully converged services
- Ubiquitous mobile access
- Diverse user devices
- Autonomous networks
- Software dependency

Fully Converged Services: Personal communications, information systems, broadcast and entertainment will have merged into a seamless pool of content available according to the user's requirement.

Ubiquitous Mobile Access: The dominant mode of access to this pool of content will be mobile, accounting for all voice communications, the majority of high-speed information services, and a significant proportion of broadcast and entertainment services. Diverse User Devices: The user will be served by a wide variety of low-cost mobile devices to access content conveniently and seamlessly. Special devices tailored for people with disabilities will be common place. Autonomous Networks: Underlying these systems will be highly autonomous adaptive networks capable of self-management of their structure to meet the changing and evolving demands of users for both services and capacity. Software Dependency: Intelligent mobile agents will exist throughout the networks and in user devices, and will act continually to simplify tasks and ensure transparency to the user.

3.4.4 Network Selection

In the current cellular systems, which are based on a star-topology, if the base stations are also considered to be mobile nodes the result becomes a 'network of mobile nodes' in which a base station acts as a gateway providing a bridge between two remote ad hoc networks or as a gateway to the fixed network. This architecture of hybrid star and ad hoc networks has many benefits; for example it allows self-reconfiguration and adaptability to highly variable mobile characteristics. Example channel conditions, traffic distribution variations, load-balancing) and it helps to minimize inaccuracies in estimating the location of mobiles. A suitable access network has to be selected once the handoff initiation algorithm indicates the need to handoff from the current access network to a target network. Formulate the network selection decision process as a MADM problem that deals with the evaluation of a set of alternative access networks using a multiple attribute wireless network selection function (WNSF) defined on a set of attributes. The WNSF is an objective or fitness function that measures the efficiency in utilizing channel resources and the improvement in quality of service to mobile users gained by handing off to a particular network. Network selection in a heterogeneous all-IP wireless network environment depends on several factors. The WNSF is triggered when any of the following events occur: (a) a new service request is made; (b) a user changes his/her preferences; (c) the MT detects the availability of a new network; (d) there is severe signal degradation or complete signal loss of the current channel link. Parameters (attributes) used for the WNSF include the signal strength (S), network coverage area (A), data rate (D), service cost (C), reliability (R), security (E), battery power (P), mobile velocity (V), and network latency (L).

It is likely that aggregate models will not be sufficient for the design and dynamic control of such networks. It is likely that aggregate models will not be sufficient for the

design and dynamic control of such networks. Input data from both the user and the system are required for the network selection algorithm, whose main purpose is to determine and select an optimum cellular/wireless access network for a particular high-quality service that can satisfy the following objectives:

- Good signal strength: Signal strength is used to indicate the availability of a network, and an available network can be detected if its signal strength is good.
- Good network coverage: A network that provides a large coverage area enables mobile users to avoid frequent handoffs as they roam about.
- Optimum data rate: A network that can transfer signals at a high rate is preferred.
- Low service cost: The cost of services offered is a major consideration to users and may affect the user's choice of access network and consequently handoff decision.
- High reliability: A reliable network can be trusted to deliver a high level of performance.

Handoff Scheme: Handoff refers to a process of transferring an ongoing call or data session from one channel connected to the core network to another. The channel change due to handoff may be through a time slot, frequency band, code word, or combination of these for time-division multiple access (TDMA), frequency-division multiple access (FDMA), code-division multiple access (CDMA), or a hybrid scheme. Handoff is also called as 'Handover'.

Reasons for a Handoff to be conducted:

- To avoid call termination when the phone is moving away from the area covered by one cell and entering the area covered by another cell.
- When the capacity for connecting new calls of a given cell is used up.
- When there is interference in the channels due to the different phones using the same channel in different cells.
- When the user behaviors change

3.5 METHODOLOGY

MRMCA converges almost surely to the set of correlated equilibrium, in which the action of each sensor node is an optimal response to its environment and to the actions of other sensor nodes so that the whole network achieves a reasonable suboptimal network performance. MRMCA also adapts the channel assignment dynamically to the time-variant transmission flows in the network to reduce interference efficiently. MRM exchanges very limited information among sensor nodes. MRM converges almost surely to the set of correlated equilibrium, in which the action of each sensor node is an optimal response to its environment and to the actions of other

sensor nodes so that the whole network achieves a reasonable suboptimal network performance. Modified RMCA also adapts the channel assignment dynamically to the time-variant transmission flows in the network to reduce interference efficiently. Simulation results of both the fixed flows and time-variant flows scenarios show that MRM achieves better network performance than CONTROL and randomized CSMA. Modified RMCA also adapts the channel assignment dynamically to the time-variant transmission flows in the network to reduce interference efficiently. Simulation results of both the fixed flows and time-variant flows scenarios show that MRM achieves better network performance than CONTROL and randomized CSMA. The sensor node only receives the packet from the sender in each stage. Extra packets for supporting the channel assignment algorithm are not needed. The communication overhead can be greatly reduced. Pareto optimality, is a state of allocation of resources in which it is impossible to make any one player better off without making at least one individual worse off. To evaluate the ability of RMCA to handle interference, perform the first group of simulations, in which the flows in one simulation are fixed throughout the simulation. To achieve a better tradeoff between energy consumption and network performance, make each sensor node perform a Modified Regret Matching procedure to play the channel assignment algorithm. Simulation results of both the fixed flows and time-variant flows scenarios show that MRMCA achieves better network performance than CONTROL and randomized CSMA. The experiment results demonstrate that:

- MRMCA is very convenient to be implemented in real hardware system.
- MRMCA is able to make the sensor nodes in the same collision domain use different channels.
- MRMCA achieves better network performance in terms of both delivery ratio and packet latency than MMSN and randomized CSMA.

Some of the steps can be done in the MRMCA, first it initialize the application properties then it will collecting the Network information for further going process. Secondly, initializing network parameters based on the user requirements, next network can be sorted for ranking. After giving rank to the network finally the network can be selected. These are the steps can be handled in the MRMCA algorithm.

3.5.1 Algorithm: Modified Regret Matching Based Channel Assignment Algorithm (MRMCA)

Achieve a better tradeoff between energy consumption and network performance, make each sensor node perform a Modified Regret Matching procedure to play the channel assignment algorithm. However, in order

to save energy, MRM exchanges very limited information among sensor nodes. MRM converges almost surely to the set of correlated equilibrium, in which the action of each sensor node is an optimal response to its environment and to the actions of other sensor nodes so that the whole network achieves a reasonable suboptimal network performance. Modified RMCA also adapts the channel assignment dynamically to the time-variant transmission flows in the network to reduce interference efficiently. Simulation results of both the fixed flows and time-variant flows scenarios show that MRM achieves better network performance than CONTROL and randomized CSMA. RMCA also adapts the channel assignment dynamically to the time-variant transmission flows in the network to reduce interference efficiently. RMCA achieves higher delivery ratio than MMSN and randomized CSMA do, and their delivery ratio differences increase when the network load gets heavier. RMCA converges almost surely to the set of correlated equilibrium, in which the action of each sensor node is an optimal response to its environment and to the actions of other sensor nodes so that the whole network achieves a reasonable suboptimal network performance. RMCA also adapts the channel assignment dynamically to the time-variant transmission flows in the network to reduce interference efficiently.

IV. EXPERIMENTAL RESULTS AND DISCUSSIONS

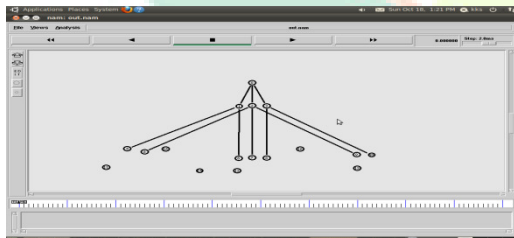


Figure 4.1 Initial Nodes in the Communication

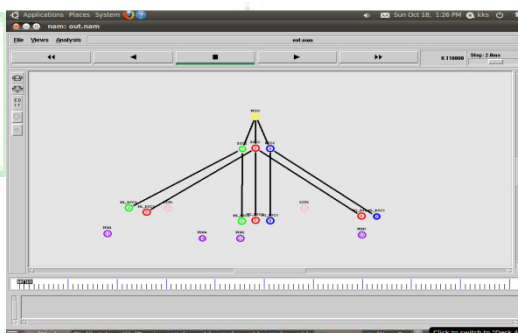


Figure 4.2. Identification of a Nodes by Colors

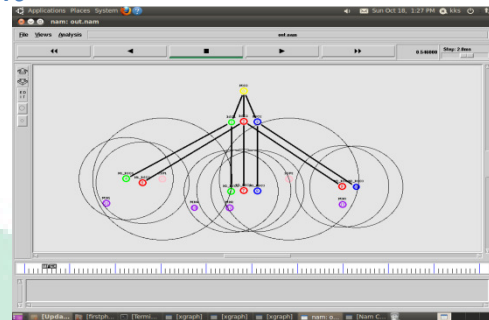


Figure 4.3. Coverage Area Selection

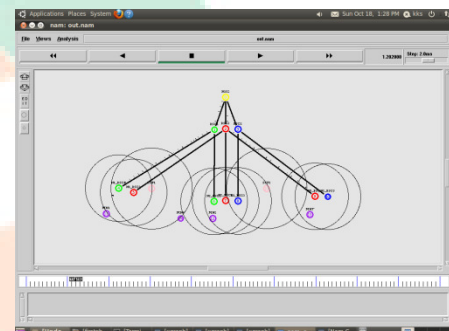


Figure 4.4 Node11 communicate through MSC Node0 to Node13

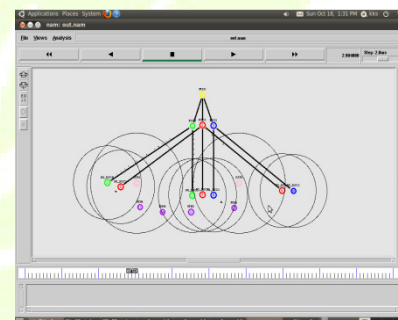


Figure 4.5 Node11 communicate through BSC Node1 to Node13

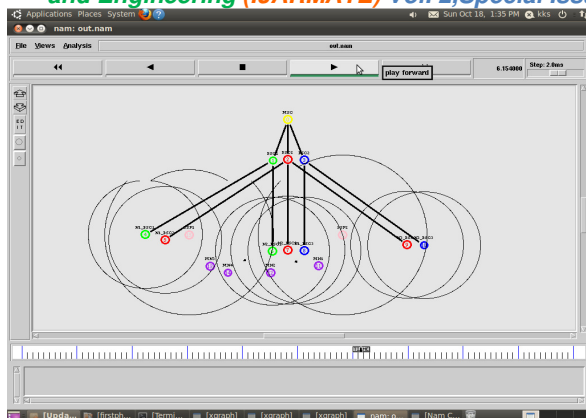


Figure 4.6 Node11 communicate directly to Node13

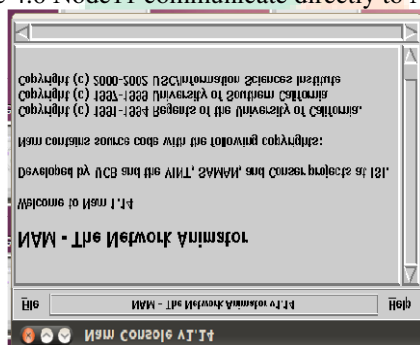


Figure 4.7 NAM Window Output

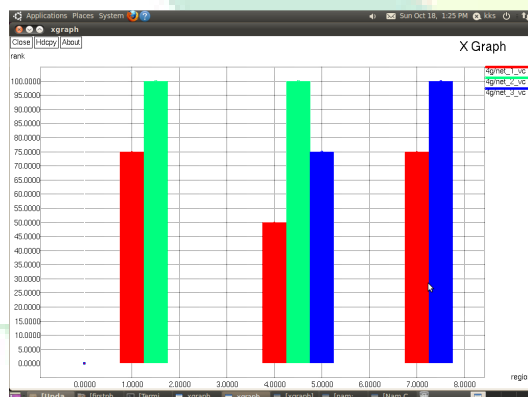


Figure 4.8 Rank vs Region

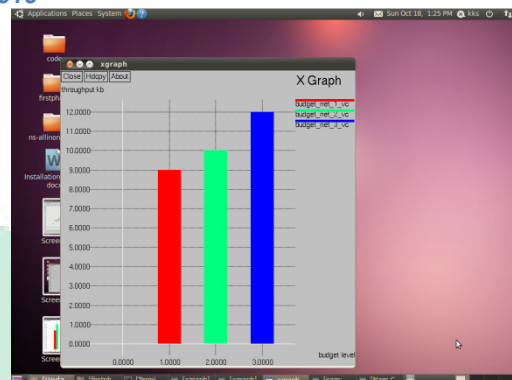


Figure 4.9 Throughput vs Budget Level

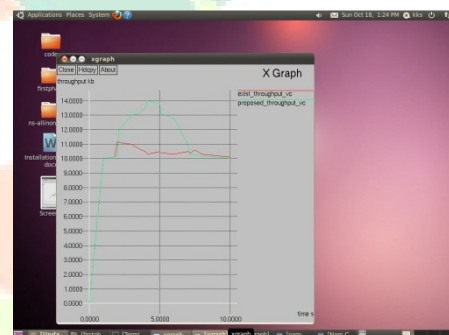


Figure 4.10 Throughput vs Time Slice

V. CONCLUSION

The dynamic channel assignment in WSNs to exploit parallel transmission and reduce interference. Different from existing dynamic channel assignment protocols, it have considered the challenges posed by the multi-channel co-ordinations to the energy constraint of WSNs, and proposed a Modified Regret Matching based Channel Assignment algorithm. It is highly distributed and exchanges very limited information for sensor nodes to dynamically select channels. It converges almost surely to the set of correlated equilibriums. The correlated equilibrium implies that all sensor nodes optimally respond to the environment and to the actions of other sensor nodes. The whole network can also achieve a reasonable suboptimal network performance. Moreover, MRMCA can adapt the channel assignment among sensor nodes to the time-variant flows and network topology, and improve the network performance over time.

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