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An Optimized Interference Aware Channel Allocation Strategy for Decentralized Cognitive Radio Network

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Abstract:

Cognitive Radio Networks are spectrum utilizing random nodes deployed in an Adhoc fashion for on demand communications. The scalable and sharing property of CR network is subjected to change as per Secondary User utilization, communication drop and paused transmission increases that in turn decrease network performance. To minimize the impact of dynamic channel allocation a two fold process of Opportunistic State based channel allocation and XOR based Network Coding (NC) are proposed. The former allocates channel based on available bandwidth and Secondary User transfer rate. The later minimizes replication due to dynamic sharing by allocating distinct transmission through same channel with lesser interference.

Keyword: Cognitive Radio Networks, XOR based Network Coding, Secondary User and channel allocation

I. INTRODUCTION

Cognitive radio network is a wireless network which is used for communication. In this CR network the transceiver can wisely sense which communication channels are occupied and which are not occupied, and can instantly move into unoccupied channels while avoiding occupied ones. This mechanism optimizes the use of available radio-frequency (RF) spectrum while minimizing interference to other users. Cognitive Radio is also known as hybrid technology which progress software defined radio (SDR) as applied to spread spectrum communications. Possible functions of cognitive radio include the ability of a transceiver to determine its geographic location. There are two major types of cognitive radio which are classified as full cognitive radio and spectrum-sensing cognitive radio. Full cognitive radio processes all parameters that a wireless node or network can be aware of it. Spectrum-sensing cognitive radio is used to detect channels in the radio frequency spectrum and must include technologies to prevent interference, such as spectrum sensing and geo-location capabilities.

CRN requires a radio device that is very flexible, so it can radically change various protocol functions at runtime. Software-defined radios (SDRs) are an ideal platform for CRNs. Most radios which are used in today can implement virtually all physical layer processing and some Medium Access Control protocol functions in hardware, limiting the degree of runtime adaptively to a small predefined set of changes, e.g., choosing between a handful of transmission rates. SDRs, on the other hand, challenge to do as much processing as possible in the digital domain. However, due to the limitations of analog/digital converters, digital processing capacity and power constraints, a combination of analog and digital processing is still used. An analog circuit converts the signal between the radio carrier frequencies and an intermediate frequency. The signal at the intermediate frequency is digitized so all other processing can be done digitally in software, making it easy to change at runtime. Even the analog circuits are designed to be flexible.

For example, oscillator frequencies, receiver attenuation, transmit power, filter center frequencies, and receiver gain may all be under the control of SDR software. In cognitive networks it does not strictly require SDRs, the flexibility offered by SDRs is very attractive, especially when prototyping and evaluating cognitive networking technology.

The scope of the work is intended to allocate optimal bandwidth for multi user concentrated CR-networks. In a user-concentrated CR-network channel allocation and drop prevention is tedious due to interrupted communications, optimization through Channel allocation and non-redundant transmission is carried out for channel concentrated Transmission and user specific allocation. The better channel selection is initiated at the time of broadcast for forehand channel allocation strategy. This prevents multi-hop drop for each Wireless links associated with the active transmitting users

II. RELATED WORK

Congestion state of each channel peaks up such that channel loss factor is high. The outage probability of each forward communication increases the pause time of communication. Limited or restricted transfer rate minimizes date rate. In order to improve the performance of throughput, delay and drop various methods are employed for secure transmission.

III. PROPOSED WORK

To provide a secure transmission design for cognitive radio networks. This proposal is based on wireless communication by using adhoc networks. It is an on-demand service and it is also infrastructure less. In cognitive radio network, the user has major problem of congestion, outage and limited transfer rate. The proposed work consists of two methods for the improvement of the performance in throughput, drop and delay.

1. Opportunistic Channel state information.
2. Network coding based EXOR Transmission.

IV. EXPLANATION

ARCHITECTURE MODEL 1:

Primary Users are responsible for bandwidth allocation among the secondary users. Primary users are called licensed users. Primary users allocate reserve and reuse bandwidth for the other users at the time of communication initialization. Secondary users are those who request service providers for channel allocations and services that are shared by the Pus. Neighbours are otherwise called as intermediate; they enable data forwarding and transmissions over the network. Channel State of an intermediate can either be busy or idle. An unallocated channel remains idle and an assigned channel is busy for the next user request. After each allocation and deallocation, channel status is updated to the previous neighbour.

(A) ADAPTIVE CHANNEL ALLOCATION

Adaptive Channel Allocation takes place under two constraints: Update of past history of the transmissions followed by channel allocation. The SU decide or optional channel allocation based on the past transmission carried out in the channel. The past transmission history maps the following with the

CHANNEL ID:

- Transfer rate: The countable rate of data that is transmitted to the receiver from the sender that is observed in the span of channel assignment.
- Response Time: The successive time difference between request generation time and reply time is called response time.
- Congestion Factor: The unbearable load handled by the channel that would result in drop is called congestion factor. Congestion is further classified as: low, medium and high. Congestion factor varies as the number of transmission increases or request servicing is increased.

(B) PROCESS

The process of channel state information is explained through the below steps:

Step1: The PU receives multiple requests from the available SUs

Step2: The PU checks the availability of channel and broadcasts the "idle" channel and its status to the requesting SUs.

Step3: SUs check for the feasible and adaptable channel for transmission and reply with the Channel_ID to the PU.

Step4: PU assigns channel to the SU and changes the channel state to "busy".

Step5: PU ensures the idle channel is not reassigned to other SU requests until the CS is changed to "idle".

Step6: If more than one SU request the same channel at the same instance of time, PU initiates co-operative transmission, allowing time slotted concurrent transmission through the same bandwidth.

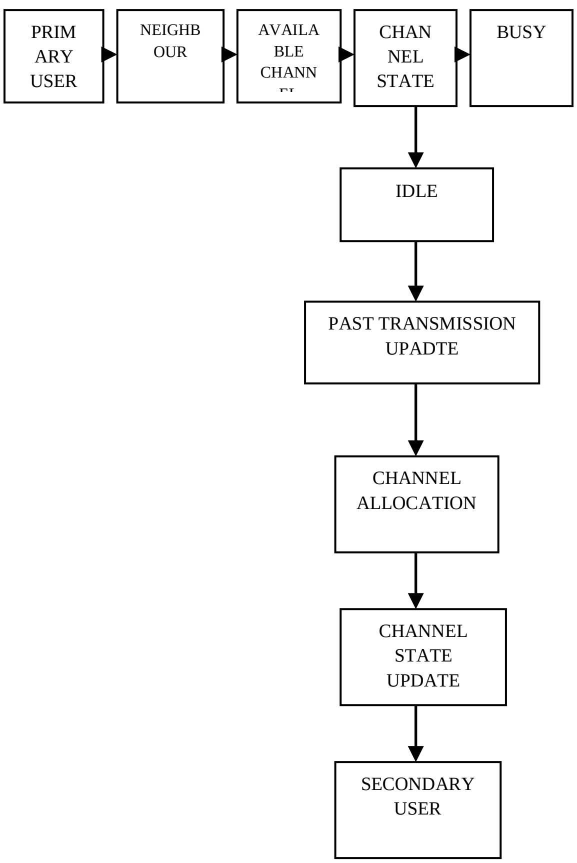

Figure 1: Opportunistic channel state information

In this selection of the channel based on the features and after using the channel, the user should update the channel state, to reduce the overload and interference, so that channel loss factor will be low and drop will be minimized.

Architecture Model 2:

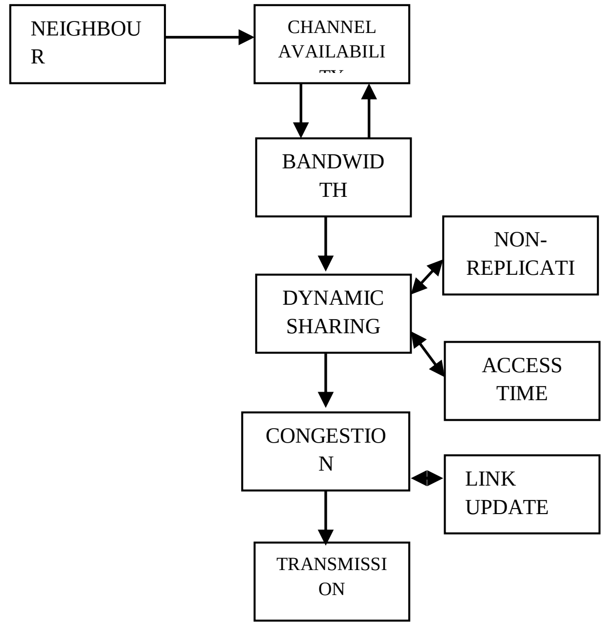

Figure 2: block diagram of XOR based Network Coding

The above block illustrates the communication forwarding that takes places between intermediates. Each neighbour is checked for its channel availability and bandwidth utilization. Bandwidth utilization can either be maximum or minimum; the minimum utilized nodes are opted for dynamic sharing with the new requests or other pending requests.

For a dynamic channel sharing, the following metrics have to be considered:

- Non-Replicated Transmission and
- Access Time

When two or more users share the same bandwidth of the intermediate, crossover occurs that increases congestion and interference rate, resulting in communication drop. Non replicated transmission ensures packets being transmitted without redundancy to the SU. For the process of non-replication or avoiding duplication, XOR based link and transmission update scheme is proposed that ensures lesser cross over and overlapping of transmissions. Access time decides the maximum wait time for each of the SU request. Access time of the users will be queued in ascending order of time of request. The PU will check

For the maximum livelihood of the request and from which channel allocation is initiated. If the live time period of the SU request is lesser than the access time, optimal channel allocation is followed. If the SU request can wait beneath the active time, slotted alternative transmission is initiated.

In an alternate successive transmission, two or more SU share the same channel under variable time slots. The intermediates are considered to perform XOR network coding, and the PU and all SUs are assumed to store the data transmitted of a sub-frame to intermediates within their own buffer.

V.PARAMETER EVALUATION

(A) THROUGHPUT

The amount of data transferred per unit time is called throughput

Throughput = data rate / time.

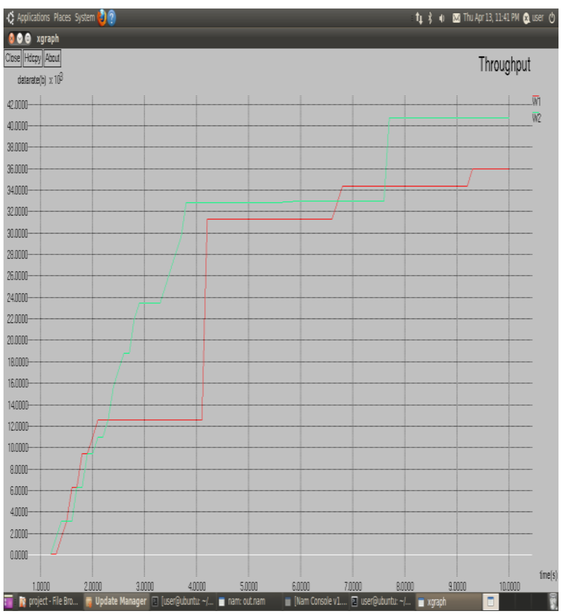

Figure 3: throughput performance graph

(b) DROP

The last data / unreceived data after transmission from the source is called drop.

Packet drop = (data transferred -data queued – data received)

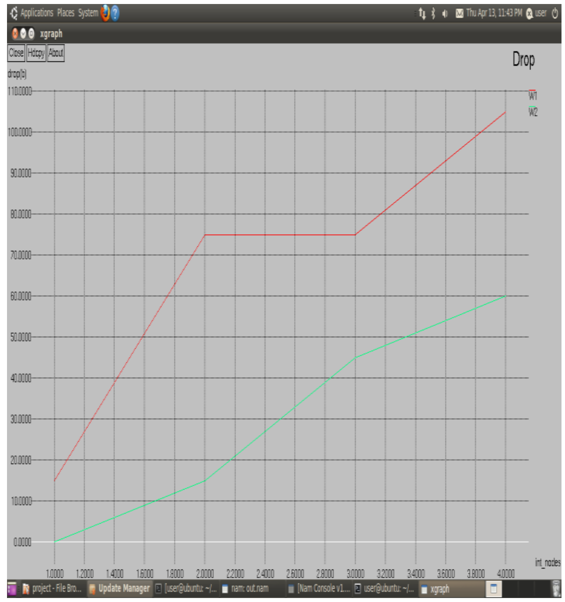

Figure 4: Packet drop performance graph

(c) DELAY

Delay is the successive time difference observed between initial transmission time and reception time at the destination.

Delay = [Rx time (i) – Tx time (i)]

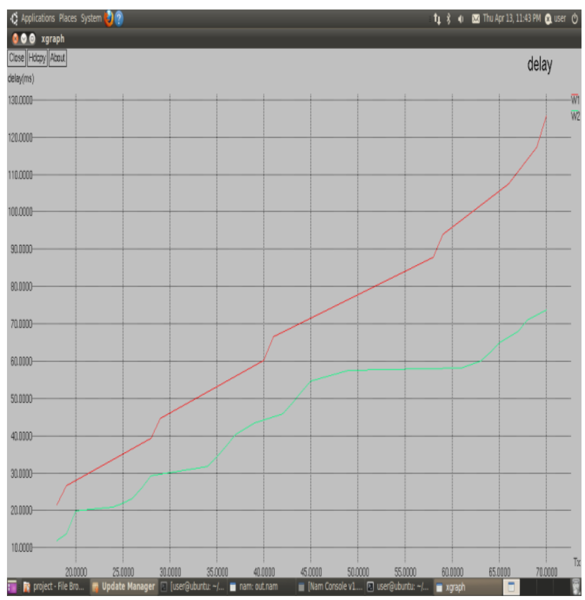

Figure 5: Delay performance graph

CONCLUSION

The proposed system consists of Channel Aware routing and Neighbour aware channel selection that prefers optimal allocation despite interference causing neighbours. Besides, cooperative communication is balanced with XOR based network coding to minimize the effect of overlapping. The integrated approach improves network performance by minimizing the interference by allocating optimal channel for each user with time slotted transmissions that do not cause interference. The process is carried out in three stages: dynamic channel allocation, co-operative communication and redundancy avoiding channel allocation. Delay is minimized to 33.33 % , drop is minimized to 80% and throughput is increased to 15.12 %.The work can further be extended to improve heterogeneous communication handoff with devices that utilize variable bandwidth and on-demand channel allocation. Besides, the consideration of energy utilization would improve the network performance by balancing the energy and bandwidth utilization with minimum tradeoff.

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