ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

National Symposium On Emerging Trends In Computing & Informatics, NSETCI 2016, 12th July 2016,Rajagiri School of Engineering & Technology, Cochin, India.

CR simulator: A Wireless System for IOT

***Rejin R Krishna and Nikhila T Bhuvan.**
Department of Information Technology, Rajagiri School of Engineering and Technology, India.

Manuscript Info

Key words:
Internet of Thing; IoT ,
Cognitive radio networks,
CR simulator

Abstract

Proliferation of wireless systems increases the need for more radio spectrum band which unfortunately is not available. Radio spectrum is fully allocated for different services, applications and users, observation showed that not al the allocated spectrum is completely utilized. By the evolution of cognitive radio concept, spectrum utilization can be improved. The Internet of Things, fast-emerging ecosystem of intercommunicating devices is proliferating rapidly. Current research on Internet of Things (IoT) mainly focuses on sensing general objects of the physical world and make them connected sharing their observations. In this paper, a cognitive radio network based system is proposed and how they provide Internet of things a perceptive network condition. The system can analyze the perceived knowledge, perform adaptive actions, and make intelligent decisions which aim to maximize network performance.

Introduction:-

The transition in wireless communication systems from wireless telephony to interactive internet data and multi-media type of applications achieves higher data rate transmission. Cognitive radio is the exciting technologies that offer new approaches to the spectrum usage. Cognitive radio (CR) was the brain child of Joseph Mitola III and Gerald Q. Maguire, Jr in 1999 [2]. Spectral crowding problem where some frequency bandsare heavly crowded, can be avoided by cognitive radio tecnology by introducing the oppurtunistic usage of frequency band which are not heavly utilized by their licensencez users.The primary advantage is to utilize the available spectrum in the most efficient way. An interconnected set of cognitive radio devices that share information is defined as a Cognitive Radio Network(CRN). Cognitive Radio Networks[3] aim at performing the cognitive operations such as sensing the spectrum, managing available resources, and making user-independent, intelligent decisions based on cooperation of multiple cognitive nodes. A definiton would be appropriate for Cognitive Radio, it is a radio that can change its transmitter parameters based on interaction with the environment in which it operates.A basic architechture for the cognitive radio communication is shown in figure 1 below,

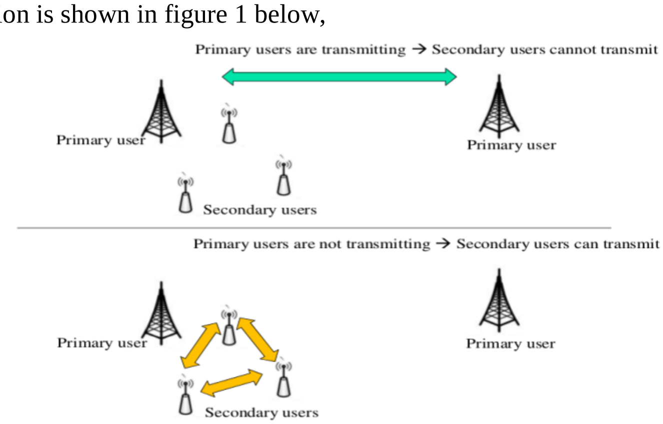

Fig 1 Cognitive radio communication[3]

In the early 2000s, Kevin Ashton from MIT Auto-id Center proposed the term "Internet of Things" combining the Radio Frequency Identifiers(RFID) information to the Internet. Soon, the interest for an Internet and connected devices raised the attention of the government and leading IT companies that recognized the concept of their scope for future economic growth and sustainability. Today, the Internet of Things has gained popularity as they connect internet and computing capability to a variety of objects, devices, sensors, and everyday items. Using IP to connect devices other than computers to the Internet is not a new idea. The first Internet "device" an IP enabled toaster that could be turned on and off over the Internet was featured at an Internet conference in 1990. Over the next several years, other "things" were IP enabled, including a soda at Carnegie Mellon University, a coffee potin the Trojan Room at the University of Cambridge, etc.

The main issues that are to be dealt with in dealing Internet of things are the security issue, privacy issue, interoperability issues, spectrum scarcity issue. In this paper the spectrum scarcity issue is also an important area of discussion. With the advent in Internet of things the number of devices using the spectrum is also increasing. From cellphones to police scanners, from TV sets to garage-door openers, virtually every wireless device depends on access to the radio frequency wireless spectrum which make it one of the most tightly regulated resource. Hence, the use of cognitive radio networks will be an efficient and economic solution for the communication for wireless systems.

The sections of report are structured as follows: A detailed overview of economic feasibility of using cognitive radio technology with Internet of things is provided in section 2. Section 3 will gave a breif idea about proposed method. And section 4 , will provide a report on the analysis of the same.

Cognitive Radio Networks with Internet of Things:-

Gartner[8] estimate that the Internet of Things is at it peak unlocking significant economic value, citing a lack of standardization as the main obstacle to rapid progress. A cognitive radio should effectively sense the spectrum by monitoring the available spectrum bands, capture their information, and then detect the spectrum holes to improve its efficiency[5]. Since CR networks should select the proper spectrum bands from multiple available spectrum depending on the application requirements, called spectrum decision. The Internet of things being an environment for the communication of connected devices can efficiently utilize the technology. The cognitive radio networks when works with the Internet of things are actually providing an economical and efficient utilization of spectrum.

Cognitive M2M not only improves spectrum utilization but also exploits alternate spectrum opportunities. In addition, cognitive M2M is inherently equipped to address the challenges of interference management, energy efficiency, and device heterogeneity. Cognitive M2M opens new application areas for M2M communications which may need to device and autonomous peer network with other nodes, whether local or remote, and this should be supported through a decentralized, distributed approach to the architecture, with support for semantic search, discovery and peer networking. Anticipating the vast volumes of data that may be generated, it is important that it also includes mechanisms for moving intelligence and capabilities for filtering, pattern recognition, machine learning and decision-making towards the very edges of the network.

Cognitive Radio Simulator Model:-

The crSimulator model is developed using OMNeT++ simulation platform with an architecture inspired from paper Cognitive Machine-to-Machine Communications for Internet-of-Things: A Protocol Stack Perspective [1]. OMNeT++ provides several benefits which make it a clear choice for networks simulation research [9]. The separation of functionality implemented in C++ from the design of nodes and networks through NED language, makes OMNeT++ very suitable for developing generic models for networking research. Several implementations can be developed for example for a single layer of the protocol stack without changing anything in the architecture of a simulated node. The basic architecture which is being used throughout the network is as show below.

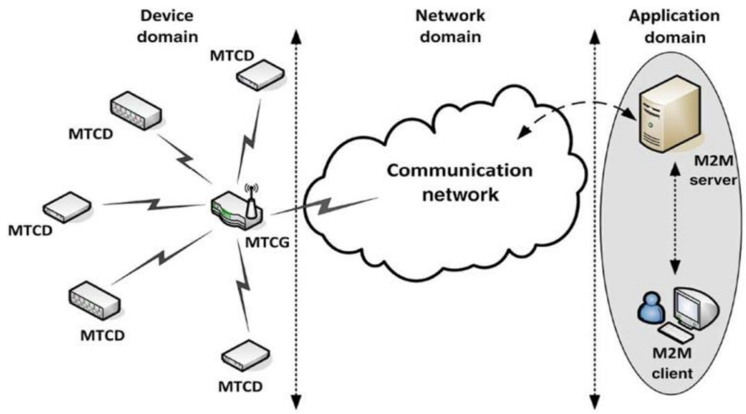

Fig 2 Cognitive radio communication architechture.

The model consist of MTCDs, MTCG , M2M server and M2M client. MTCDs basically act as a IoT devices which communicate with their corresponding MTCG. MTCG is a common gateway that is being provided through with the MTCDs can communicate with the server. Here in this paper how the packets will be transfered among the system in the absence of the protocol is being tested. For that purpose of testing the system architecture in the both the absence and presence of the protocol are considered. The protocol used for this purpose is a Packet Reservation based MAC Protocol. This protocol is implemented within the above architecture and checked for the packet transfer.

A Packet Rservation Multiple Access (PRMA) based protocol can be considered as a combination of slotted ALOHA, time division multiple access (TDMA), and a reservation scheme. Slotted ALOHA : An improvement to the original ALOHA protocol was ”Slotted ALOHA”, which introduced discrete timeslots and increased the maximum throughput. A station can send only at the beginning of a timeslot, and thus collisions are reduced. In this case, only transmission-attempts in one time-frame is considered, no two consecutive times frames need to be considered, since, collisions can only occur during each timeslot. The maximum throughput is 1/e frames per frame-time (reached when G = 1), which is approximately 0.368 frames per frame-time, or 36.8%. Slotted ALOHA is used in low-data-rate tactical satellite communications networks by military forces, in subscriber-based satellite communications networks, mobile telephony call setup, set-top box communications and in the contactless RFID technologies.

Time Division Multiple Access : Time division multiple access (TDMA) is a channel access method for shared medium networks. It allows several users to share the same frequency channel by dividing the signal into different time slots. The users transmit in rapid succession, one after the other, each using its own time slot. This allows multiple stations to share the same transmission medium while using only a part of its channel capacity. TDMA is used in the digital 2G cellular systems such as Global System for Mobile Communications (GSM), IS-136, Personal Digital Cellular (PDC) and iDEN, and in the Digital Enhanced Cordless Telecommunications (DECT) standard for portable phones. It is also used extensively in satellite systems, combat-net radio systems, and PON networks for upstream traffic from premises to the operator.

While the architecture was implemented and packet transfer was held the communication process did happen but the collision rate was much high. This communication basically does not involve PRMA based protocol. Hence the communication can cause collision during the execution phase. Initially the client will establish communication with the server and the server with MTCG. On request from server MTCG will be ready to accept input from the IoT clients but since here there is no particular protocol being employed for performing the operation, there occurs the chance for collision. The next phase of the network topology is actually employed with a PRMA based MAC protocol which will reduce the collision and synchronize the transfer of data packets across the network. From the elog generated by the omnet++ tool it becomes clear that the chance of occurrence of collision in the given network topology is very high without a proper protocol. The eLog is as shown below in figure 3.

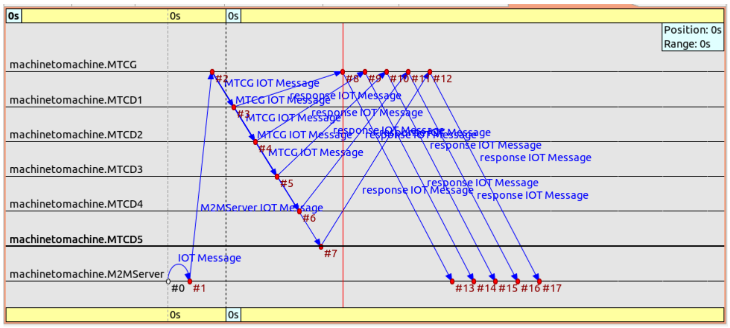

Fig 3 eLog obtained for communication without protocol.

From the implementation phase it was clear that the chance of occurrence of collision was very high in absence of a proper protocol. From the literature survey ,PRMA based MAC protocol was identified as an effective solution for the same and which helps in scalability, energy effciency requirements, periodic traffic patterns, and large-scale deployments for IoT devices. A network was simulated using Algorithm1 defined below and the eLog is figure 4 was obtained.

Algorithm1

Intial condition : UL slots of frames are made available for contention.
Contention follows a slotted ALOHA.

BEGIN: While (positive ACK count <= no of iot devices) {

1. MTCD that has data to send will contend in available slot.
2. If (MTCG receive a packet a positive ACK)
3. Replied in DL time slot.
4. Else if (any case of collision)
5. The contention process is repeated in another time slot.
6. At start of multiframe all MTCD will be contented for reservstion for fairness, and channel information will be updated. }

STOP:-

The omnet++ simulation for communication with the PRMA Based MAC protocol is as Shown in figure 4

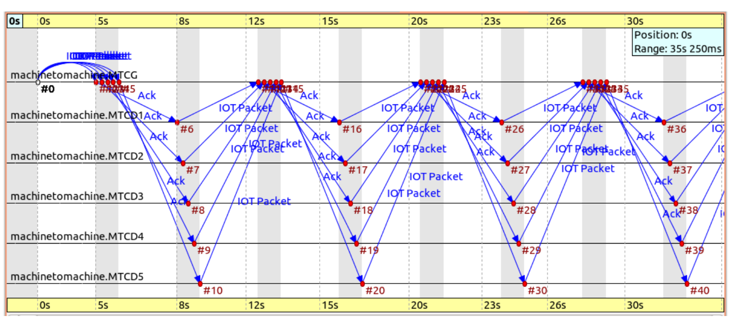

Fig 4 eLog obtained for communication with protocol.

Here, the MTCG is controlling the incoming and outgoing packets. MTCSs are the IoT devices where the data packets are generated. According to PRMA based MAC Protocol implementation it can be explained as a slotted time protocol which is a combination of slotted aloha with time Multiplexing. Data packets will take more time to transfer than the Acknowledgment that is being simulated using omnet++ tool actually defines the time taken by an MTCD to communicate with MTCG in a single slot and after the complete simulation of the network, an eLog is being generated which is shown in figure 4 that depicts the flow of packet across the network. Here, the comparison of the elog generated during the network implementation phase without a protocol to the one with network implementation with PRMA based MAC protocol is performed. It can be noticed that the probability of occurrence of collision is reduced , which shows an efficiency and scalable transfer of packet within the network. Hence successful implementation of the PRMA based MAC protocol within the network was done.

Conclusion:-

Cognitive radio and Internet of Things have emerged as promising technologies to enhance our live by efficiently using the existing resources. The Internet of Things is a vision that encompasses and surmounts several technologies at the confluence of Nanotechnology, Biotechnology, Information Technology and Cognitive Sciences. Internet of Things is likely to develop fast and shape a newer "information society" and "knowledge economy" with much pace. With help of omnet++ tool, given network topology is being analyzed first in the absence of a protocol and later with the PRMA based MAC protocol after performing a detailed study on the same. Identified that the chance of collision can be reduce to a great extent by using the protocol. The main advantage of using the protocol is to reduce the time required for sending the acknowledgment while the Time Frames required for transferring the data packet are considerably more, thus helping in increasing the efficiency in the packet transfer. As and advancement the protocol can be developed to work, when equipped by multiple MTCGs and analyze the performance of network. IoT devices from multiple heterogeneous network communicating to their respective MTCGs over PRMA based MAC protocol can be simulated and analyzed.

References:-

1. **Cognitive Machine-to-Machine Communications for Internet-of-Things**: A Protocol Stack Perspective Adnan Aijaz, Member, IEEE, and A. Hamid Aghvami, Fellow, IEEE
2. **Cognitive Internet of Things: Concepts and Application;** Mingchuan Zhang, Haixia Zhao, Ruijuan Zheng, Qingtao Wu and Wangyang Wei Electronic & Information Engineering Colloge, Henan University of Science and Technology Luoyang 471003, China
3. **A New Paradigm beyond Connection** Qihui Wu,Senior Member, IEEE, Guoru Ding, Student Member, IEEE, Yuhua Xu, Student Member, IEEE, Shuo Feng, Zhiyong Du, Jinlong Wang, Senior Member, IEEE, and Keping Long, Senior Member, IEEE
4. **Internet of Things (IoT): A vision, architectural elements, and future directions** Jayavardhana Gubbi a , Rajkumar Buyya b, ∗ , Slaven Marusic a , Marimuthu Palaniswami.
5. **Cognitive radio: An intelligent wireless communication system Authors:** Marja Matinmikko (editor), Marko Höyhtyä, Miia Mustonen, Heli Sarvanko, Atso Hekkala, Marcos Katz, Aarne Mämmelä, Markku Kiviranta, Aino Kautio.
6. **An Overview Understanding the Issues and Challenges of a More Connected World** By Karen Rose, Scott Eldridge, Lyman Chapin 15 OCTOBER 2015
7. **Future Directions in Cognitive Radio Network Research** NSF Workshop Report Edited by: Peter Steenkiste, Douglas Sicker, Gary Minden, Dipankar Raychaudhuri March 9-10, 2009
8. Available at : "http://www.gartner.com/smarterwithgartner/whats-new-in-gartners-hype-cycle-for-emerging-technologies-2015/ ", reffered on 24 januvary.
9. Omnet++: An open discrete event simulation system. [Online]. Available: **http://www.omnetpp.org**