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Research Article

Multi-Scenario Adaptive Station Re-Distribution/Re-Association Scheme for Green Wireless Networking

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Abstract

Wireless Green Networking is a widely used concept in mobile communication systems due to their minimal power consumption, very low costs of installation and considerable ease of deployment. Network deployment, installation and running costs are on the rise owing to the high consumption of power. Current trends, these issues are increasing the effective costs of energy. Energy consumption of a mobile network comes from the BS (Base Station) and is a difficult task to power and heterogeneous network provide low energy consumption with low costs. Here we used wireless LAN in network infrastructures since access points in them are operated continuously to provide connectivity for STAs (stations). In our proposed work we have created wireless radio network which consists of access points. Access points and STAs are placed limited and confined area of about 20 m-square at first. The Mac/physical layer protocol between STAs and APs is IEEE 802.11a and access points are assigned to the different channels so as to prevent interference. In this paper we propose a multi-scenario adaptive station re-association scheme for achieving high power savings for various scenarios including ones in which the number and nature of STAs changes over time. We have proposed a multi-scenario adaptive station redistribution/association scheme for green wireless networking which implements a modified version of the station aggregation and station distribution functions individually in WLANs IEEE 802.11a and evaluated the performance of the scheme under different scenarios through simulation using QualNet simulator.

Keywords: *IEEE 802.11a, ROD, Energy Efficiency, Wireless Networking, Station Reassociation, Green Networking.*

1. Introduction

Wireless devices has increased in the recent years with its applications ranging from the mobile data services to video streaming, surveillance, health care and facilities for smart homes. Major problem in wireless communication is data traffic. To overcome this problem, heterogeneous wireless technologies were developed. Design solutions that will effectively decrease the amount of power consumed in portable computers, sensor, mobile phones, base stations and access points and we have to know, how the protocols and operations can impact the power (S. Pablo *et al*, 2012).

Contemporary trends of several mobile communication devices like smart phones, smart watches, personal wearable communication devices, smart glasses, and wearable health care devices are extensively implemented in the wireless green networking. Green communication among mobile and wireless networks provides potential benefits like information sharing, routing adaption, spectrum/energy awareness, optimizing and balancing the load in resource usage, and data caching and saves the power entirely on wireless and mobile networks (J. Premlatha *et al*, 2015). Considering the problems and issues in wireless devices, there are many networks that are used namely personal area networks (PANs), wireless metropolitan area networks (WMAN), and wireless local area networks (WLAN).

Performance evaluation is major thing for summarizing the results for energy efficiency and consumption. Some of the metrics are average BS (Base station) consumed power, radio frequency ((b.m/s)/Hz/W), measuring the rate of data transmitted and transmission distance (L. Suarez *et al*, 2012). Nowadays internet is rapidly growing and becoming a global network infrastructure. There is an imminent need to implement energy-efficient networking technology. Various power saving technologies have been proposed (R. Bolla *et al*, 2011). Recently network technologies are providing services to the wire line networks depending on the wire line solutions i.e. IEEE 802.11. WLAN can transmit data with up to hundred meters of cell radius and is mainly used in heterogeneous environments. WMAN covers wide areas (entire cities), WWAN covers a cell radius of

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approximately 50km. However, in wireless LAN, IEEE 802.11 is the most deployed technology and also HiperLAN is used. A WLAN is composed of hundreds of thousands of APs (Access Points) in the centre and there are a number of STAs (Stations) that are connected to these central APs. IEEE 802.11 is mainly employed in the physical and MAC layer. Towards achieving reduced power consumption in high density capacity WLANs, we adopt the highly efficient strategies for resource management.

These strategies allow scaling of power consumption by WLANs depending upon user demand. This means that WLAN resources should be readily made available to users' on-demand. APs, Switches and Controllers should be made to power off when no users are using the resources and conversely, should be made to power on based on the location and volume of user demand (A.P. Jardosh *et al*, 2009; A.P. Jardosh *et al*, 2007). This ensures some power management features in the wireless technologies like reduced operating expense, reduced power requirements, toned down carbon foot print, and simplified WLAN security management via the ability to restrict WLAN usage depending upon the day, time or location. Wireless LAN can work on 3G, WiMax mobile networks, multi-hop 802.11(homogeneous) Wi-Fi deployments and the consumption of power based enhancements using IEEE 802.11. In IEEE 802.11 based Wireless networks, resource management became the bonafide standard for providing wireless access in various applications such as campus Wireless LAN, wireless hotspots in airports and hotels, and military battle field applications. IEEE 802.11a and b reaches the high data rate as 54Mbps and 11 Mbps and also provides data rates of 6, 9, 12, 18, 24, 36, and 48 Mbps (Ming Li *et al*, 2008).

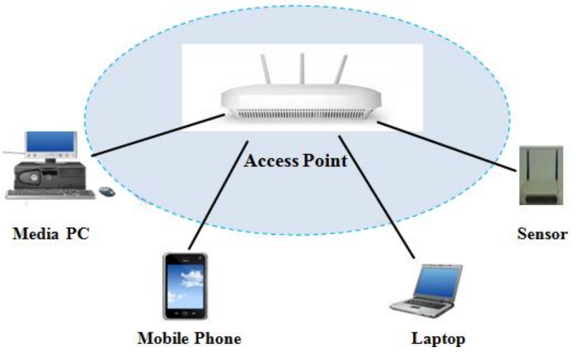

Fig. 1 Example Network

In previous works an ROD (Radio On Demand) based wireless technology is considered in which APs are made to go into sleep mode during periods of no activity (idle periods) and conversely woken up during active periods by stations based on communication demands. However, Wireless LANs APs are always powered on and made to transmit frames even when there is no station associated and are not designed to be optimized in terms of power consumption.

A power saving mode is defined in IEEE 802.11 and APs manage the STA of sleep/wake-up mode (S. Tang *et al*, 2012). In the ROD wireless LANs each access points measures data utilization. If the data utilization is below a predefined threshold value, the AP will enter to the sleep mode. By using this ROD-WLAN scheme power consumption in WLANs can be decreased considerably (K. Fujimoto *et al*, 2011). In this paper, we propose an Adaptive STA re-association scheme as an enhancement of the STA re-association and STA aggregation schemes that targets high power saving while maintaining the quality of service in multiple non-uniform realistic WLAN environments.

The paper is structured as follows: In section 2, we present a general classification of the existing proposals based on their power consumption and operational time-scale. In section 3, we discuss about how the power consumption and operational time problems are tackled in proposed work. Following this, in section 4 analyses the working and performance of the current work and compare our proposed work with existing systems and presents simulation results. Finally we conclude the findings of the overall work presented in the paper and present some future scope.

2. Related Work

A.P. Jardosh *et al* (2009) proposed the green WLAN on demand infrastructures. In this paper the adoption of power consumption with high density is the major goal and to this end, proposed and implemented an Radio on Demand (ROD) strategy that is policy driven (SEAR: survey, Evaluate, Adapt, Repeat) for Wireless LANs having high density. SEAR provides adequate bandwidth and adequate amount of resources to the enterprise users that ensure complete coverage. The main purpose SEAR is maintained user connectivity and reducing the power wastage. This scheme has its basis in the threshold based schemes for powering ON/OFF access points. Some APs in SEAR need to be always powered on to control and manage AP groups (when there is no or negligible traffic). These schemes are easy to implement and achieve the significant energy savings.

Y. Kondo *et al* (2012) proposed the energy efficient scheme for Wireless LAN with on demand AP wake up using IEEE 802.11 frame. In this paper proposed a rather detailed overview of ROD WLAN system. When an AP is in a sleep mode, most of its modules including the WLAN module are turned off except for the minimum area of internal CPU memory. Issues are arising in an ROD-WLAN design. To overcome the problem of design issues in ROD-WLAN, authors in (S. Tang *et al*, 2012) proposed the wake up receiver. This receiver exploits RF energy detection which can be deployed at considerably low cost and then run with even lower power consumption and also shares the antenna with its co-located WLAN module. But this system fails in the hardware configuration and is not clear about the power consumption of the wake-up receiver.

K. Fujimoto *et al* (2011) proposed ROD-low power utilization and station aggregation scheme for continuous operation of APs and avoid the unnecessary power consumption on the WLANs. In this work the utilization of the Access Points is measured in the ROD-WLAN in to understand and analyze the usage of the wireless network. Using this measurement, APs axiomatically go to the sleep mode. In addition APs have a "wake-up receiver" that receives wake-up packets from the STAs with low power consumption. When an AP has entered into the sleep mode receives the wake up signal from a STA. The AP switches to "awake" mode and resumes communication with the wired network.

K. Kumazoe *et al* (2012) proposed multiple station aggregation scheme for ROD-WLANs. APs in ROD (Radio on Demand) technology are provided with wake-up receivers that change their status to active or sleep mode depending on the network traffic distribution. In this work proposed the concept of station aggregation for resource utilization. This scheme is improves the power saving and balancing of load in ROD networks.

K. Kumazoe *et al* (2013) proposed station aggregation scheme for ROD-WLAN in considering channel interference. In this scheme, Access Points cooperate with each other and aggregate their STAs based on the channel utilization information rather than the AP utilization. This will decrease the power consumption considerably by decreasing the number of active APs at any given time. In STA aggregation two configurations are considered, in first a controller controls all of the Access Points within the network and in other APs operate in a co-ordinate and distributed manner.

In papers (K. Kumazoe *et al*, 2012; K. Kumazoe *et al*, 2013) the basic performance of station aggregation scheme was analyzed and evaluated in a wireless communication system where the traffic is uniformly distributed and the quantity of traffic decreases over time. The proposed system demonstrated that this scheme improved the power saving performance in a ROD network. However, in Wireless LANs, the load is non-uniformly distributed and thus some of the APs are more likely to be congested than others, finally these statuses change over the time.

Wake on WLAN is integration software developed by Intel which integrates hardware with computers or mobile phones or sensors. Wake on Wireless LAN (WoWLAN) provides powerful capabilities in remote management for wireless clients as is done by them for wired clients. WoWLAN could be adapted to wake up APS in WLAN, but it cannot be used to change the AP status (active to sleep). I. Haratcherev *et al* (2009) introduced an Indoor APs that have a low power sleep mode and out-of-band wake-up mechanism. This scheme demonstrated by low power sleep mode into access points to fulfill eco-sustainability requirements, by ensuring the wake up receiver. In this paper, proposed new concept "Reverse Beaconing" by implementing considerably low power consumption properties of radios for sensor network modules. M.A. Marson *et al* (2010) presented a simple analytical model to determine the effectiveness of policies that activate APs in Dense WLANs. The first policy depends on the number of users that are associated with each access point and the second policy is dependent on the number of active users (users that are generating traffic based). Both policies can be defining a value of threshold for the activation of additional access points and a value of hysteresis to boost the operation stability. The capability of ROD strategies for energy efficient operation of Dense-WLAN with a centralized management style using a simple analytical model was presented.

3. Proposed Work

In this paper we proposed the multi scenario adaptive re-association scheme for Green wireless networking using WLAN IEEE 802.11a. This protocol allows transfer of association from one Access Point to another, enabling the station to move from one station to another. WLAN described by the IEEE 802.11 specifications which are increasingly used, because of its low installation cost, high scalability and ease of deployment. In addition, ROD is used in WLAN IEEE 802.11 since ROD reduces the amount of power consumed which provides users with radio access in an on-demand manner. In the ROD framework, we proposed Adaptive Station Re-association scheme in which STAs are aggregated to another active AP depending upon the utilization of access points (STAs aggregation) and also avoids throughput degradation at APs (whose utilization is high) via the Station distribution process. Figure 1 demonstrates the adaptive re-association scheme architecture in which a destination node connects with 4 access points (APs) and 20 Stations (STAs) in wireless radio network(connects with mobile devices and laptop).

3.1 Adaptive Station Re-Association Scheme

Adaptive station Re-association scheme is implemented by using the two approaches:

- STA Aggregation
- STA distribution

In this scheme using four thresholds set that are included:

1) $Aggre_{start}$: STA aggregation start at the Access Point(AP)
2) $Reassociate_{max}$: STA Re-association end at a new AP
3) $Dist_{start}$: STA distribution start at the AP
4) $Dist_{end}$: STA Distribution end at the AP.

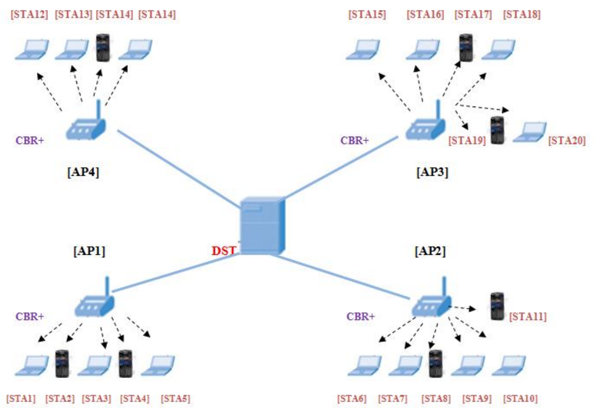

Fig. 2 Adaptive Re-association Scheme Architecture

In the adaptive station reassociation scheme, the station aggregation function is almost identical to the one which is presented in paper (K. Fujimoto *et al*, 2011). i.e. AP detects its AP utilization and finds that if it is less than $Aggre_{start}$ ($AP_{utilization}$<AP_{start}), the AP initiates the Station aggregation operation and then moves its associated STAs to other AP, finally, AP turns itself off. This reduces the total number of active APs and in this stage the consumption of power is reduced.

If an AP detects that the monitored AP utilization is higher than $Dist_{start}$($AP_{utilization}$>$Dist_{start}$), this triggers the station distribution function. Based on the rate of transfer between the access points and the stations, this station distribution function appoints and selects a new AP for the stations. In certain cases several candidate APs for one station distribution maybe found, so by employing the MELU algorithm any particular one of the APs maybe selected (K. Fujimoto *et al*, 2011). Now using the MELU algorithm, APs can select a new AP for each station depending on the utilization value after re-association. When the projected AP utilization drops below the designated $Dist_{end}$ value, APs terminate the station distribution function. In station distribution process, almost always an active AP is preferably selected as the candidate AP. However, if the distributed STAs cannot be accommodated by the active APs and AP utilization remains above $Dist_{end}$, then any of the "asleep" APs can be made the candidate AP. This AP is woken up, if the rate of transfer of data between the "asleep" AP and the station is greater than or equal to the rate between the current AP and a station.

As seen in figures 2 and 3, we can understand that how the adaptive station re-association scheme will work.

1. AP executes the station distribution process when the AP utilization at AP is found to be more than $Dist_{start}$,.
2. The information of active APs which can be reassociated is checked by AP in the list stored in the first targeted STA.
3. STA is reassociated to the first AP if the rate of transfer between the STA and AP is greater than or equal to the transfer rate between STA and the other AP and the approximated utilization at first AP if the STA were reassociated would be less than $Reassociate_{max}$
4. If the approximated utilization at second AP after STA is being reassociated with it would be larger than $Dist_{end}$, step 5 is executed, otherwise if the estimated utilization at second AP is less than $Dist_{end}$, the station distribution process is terminated.

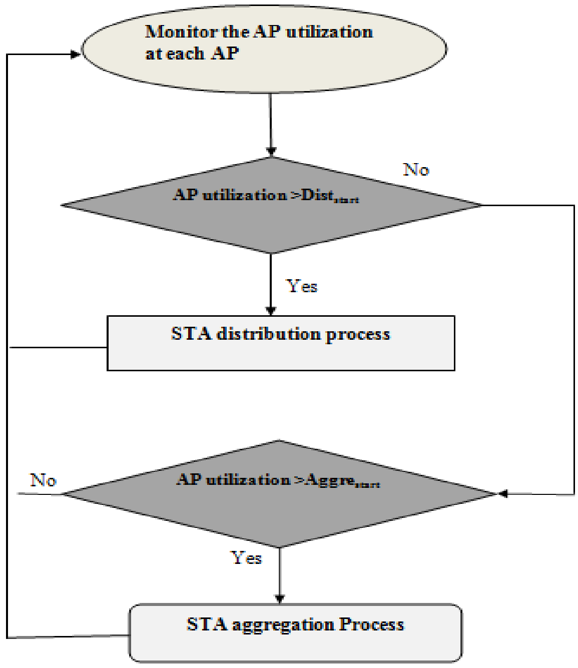

Fig. 3 Outline of Adaptive Station Re-association Scheme

5. Now the next STA is targeted. Here the AP executes the same operation as in step 2 and finds that this STA can be reassociated with first AP.
6. The total rate of transfer between the APs and STAs is compared. If the latter is greater than or equal to the former, then the approximated utilization at first AP after second STA is being reassociated with it would be less than $Reassociate_{max}$ is checked. If so, STA second is to be re-associated with first AP and if the approximated utilization at second AP after second STA is re-associated to the first AP is below $Dist_{end}$, the station distribution process is aborted. If not, that is, if first AP can't be a candidate AP, it searches for another AP whose status is active. If active AP is not found, then sleeping AP is found. In which case, there is no other active AP but asleep AP can be found. Then AP calculates the approximated utilization in the case of second STA being re-associated with the AP which is sleeping and finds that the approximated utilization would be less than $Reassociate_{max}$. Then STA wakes up this asleep AP and the station is re-associated to this AP.
7. The process finally terminates if the approximated utilization at AP after STA is being re-associated to the formerly asleep AP, is found to be less than $Dist_{end}$. If

not, step 5 is re-executed and the remaining stations are targeted, replacing present station.

4. Performance Evaluation and Simulation Results

We carried out simulations using the QualNet simulator to evaluate the effectiveness and performance of the proposed systems. QualNet is a communications based simulator. Using this QualNet, users can evaluate and analyze the basic behavior of a network, and run tests on various combinations of network features and also QualNet has a very specific network topology which is referred as a scenario. It allows users to specify all the network components and conditions under which the network will operate.

As shown in figure 4, multiple APs are put at the edge of a 20m-square area and stations are randomly and non-uniformly distributed and are stationary. The physical/MAC layer protocol between stations and access points is IEEE 802.11a. To prevent any interference, APs are assigned to different channels. The transmission rates among the stations and access points may vary depending up on their distances. The duration has an exponential distribution with a mean of 10-50 seconds. Each STA sends CBR data to a node that is connected to all associated APs via wired links. The STA CBR data has periods of ON and OFF functionality to the aforementioned node. The CBR flow executes the transfer of data at random within 10s; the ON and OFF periods have exponentially distributed durations with means of 50 s and 10 s, respectively 3 Mb/s CBR data is transmitted only during ON periods. We proposed scheme for various scenarios including ones in which the number of STAs changes over time.

In this section, we show the performances under WLAN IEEE 802.11a, the ROD default scheme, station reassociation scheme and our Adaptive station reassociation scheme. Figure 4 shows the simulation model for our proposed scheme in which we used 9 APs and 10-30 STAs connected with the wired links. Subsection 4.1 shows the basic outline of characteristics of the proposed multi-scenario adaptive reassociation scheme as well as the performance for CBR client and server parameter settings for the STA aggregation and distribution and finally shows the impact of traffic parameters on the performance and the subsection concludes with simulation results.

4.1. Basic characteristics of proposed Adaptive Station Reassociation Scheme and simulation results:

In this scheme we can prove, how our proposed system achieves a high energy efficiency compared to WLAN and the default scheme ROD. In this work, we give scenario for using Adaptive Station Reassociation scheme.

Scenario 1: 4APs

Step 1: We create wireless radio network. It consists of 4APs (WLAN Access point), 10-30 STAs (stations) nodes.
Step 2: APs and STAs are put in a 20 meter-square area.
Step 3: The physical/MAC layer protocol between STAs and APs is IEEE 802.11a, and APs are designated to seperate channels to prevent any interference.

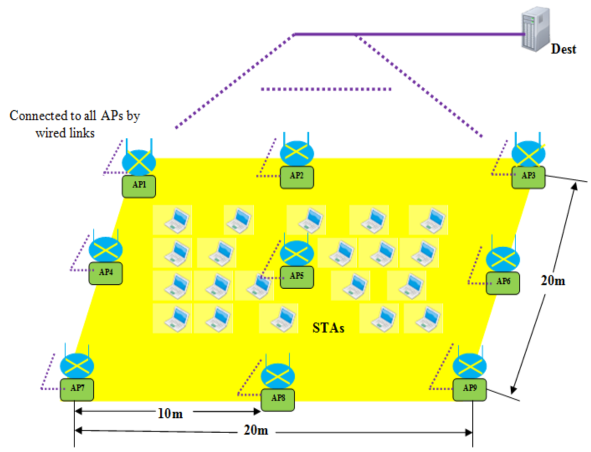

Fig. 4 Example Simulation Model

Table 1 Parameter Settings for simulation

Network Simulator	QUALNET
Wireless Standard	IEEE 802.11a
Area	20m-sq.
No. Of APs	4 & 10
No. Of STAs	10-30
Transmissin Rate In Wired Link	100 MBps
Transmission Rate In Wireless Link	54 MBps
Transport Protocol	UDP(CBR)
UDP Datagram size	1472 Bytes
CBR PARAMETERS	
Data Transmission Rate for each STAs in ON period	3MBps
STA Distribution for ON/Off periods	10s and 50s

Step 4: The Data transmission rates between APs and STAs vary based on the distances between them. Each STA sends CBR data to a node that is connected to all associated APs via wired links. The STA CBR data has periods of ON and OFF functionality to the aforementioned node. The CBR flow executes the transfer of data at random within 10s; the ON and OFF periods have exponentially distributed durations with means of 50 s and 10 s, respectively 3 Mb/s CBR data is transmitted only during ON periods.

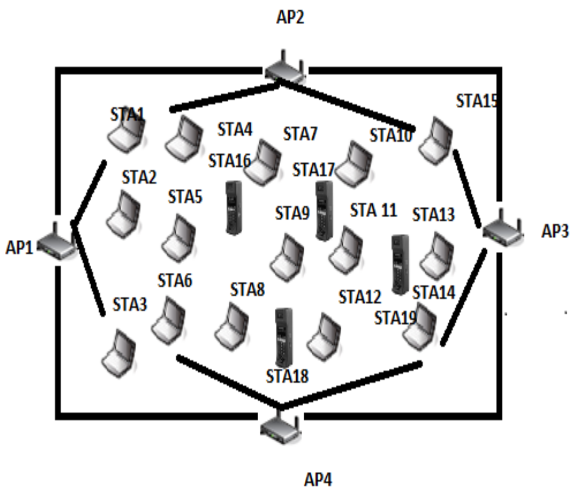

Fig. 5 Network configuration

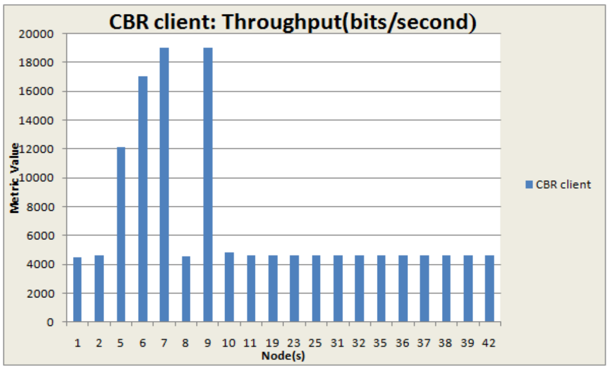

Fig. 6 CBR client throughput(bits/second)

Figure 6 shows that the performance analysis of CBR client throughput for nuber of nodes. Here we analysis the data transfer rate for number of nodes. Number of nodes considers as a stations(STAs). In this paper we calculate the metric value for nodes.

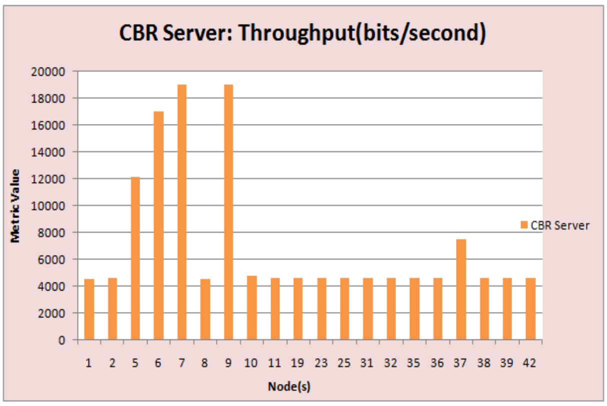

Fig. 7 CBR server Throughput (bits/sec)

Figure 7 shows that the number of nodes achieved throughput while varying the metric value for CBR server. Here the average throughput varied based on the ON: OFF periods of CBR server.

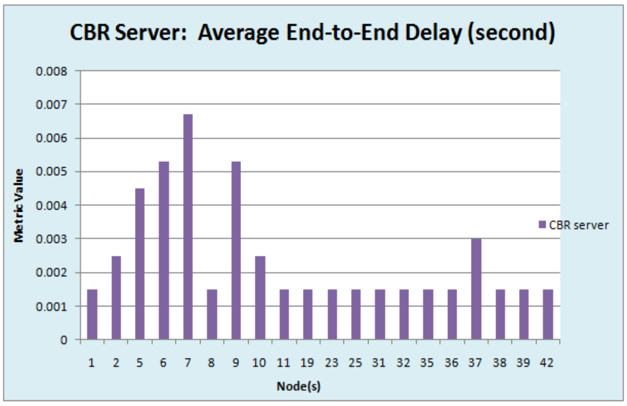

Fig. 8 CBR server: Average End-to-End Delay (second)

Figure 8 shows that the average end to end delays for the CBR server metric value with respect to the number of nodes. In this graph show that, if the number of nodes metric value is high, the delay is reduced and the data transfer rate is high.

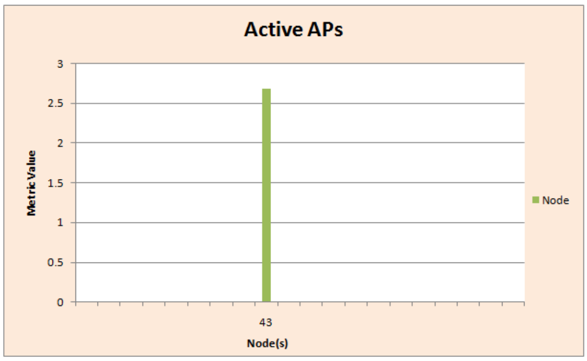

Fig. 9 Active APs

Figure 9 shows that the active access points running in the CBR. The numbers of access points are running and transfer the data between the CBR client and server. So the user can identify the currently running the access points.

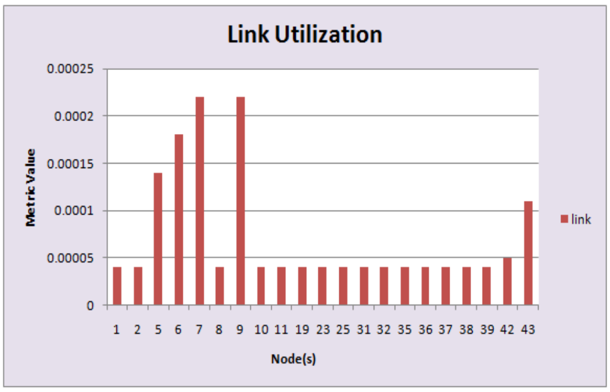

Fig. 10 Link Utilization

In this graph we calculate the link utilization for number of nodes. Link utilization is used for congestion control over the access points. Link utilization data provides information about the nodes distributed on the networks over the time periods. To improve the energy efficiency, transmission speed, low delay, and low power consumption, here we used WLAN IEEE 802.11a. It can achieve a maximum speed of 54Mbps. Although the typical data rate transfer is at 22Mbit/s. Data rate will be reduced to 48, 36, 24, 18, 12, 9 then 6Mbit/s respectively. This usually occurs as the distance between the access points. In our proposed work WLAN IEEE 802.11a improves the communications between the nodes (STAs and APs). From the simulation results we can prove our system efficiency and power consumption while data transmission across the nodes.

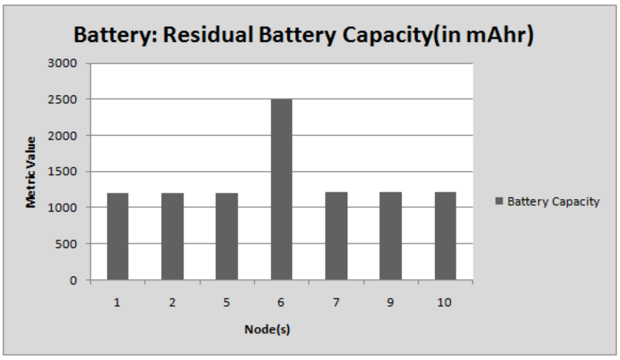

Fig. 11 Battery: Residual Battery (in mAhr)

Scenario 2: 10 APs

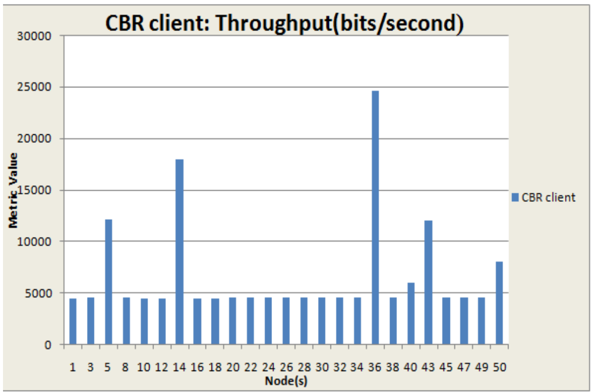

Fig. 12 CBR client throughput(bits/second)

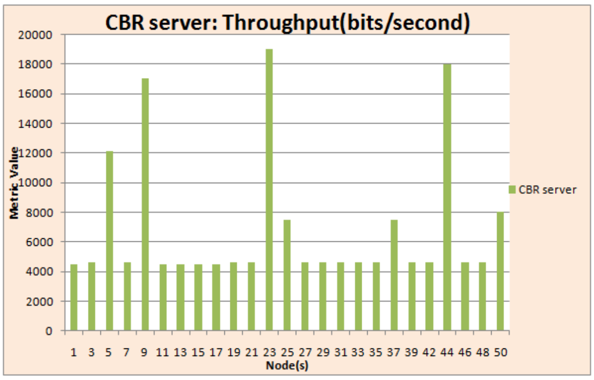

Fig. 13 CBR Server: Throughput (bits/second)

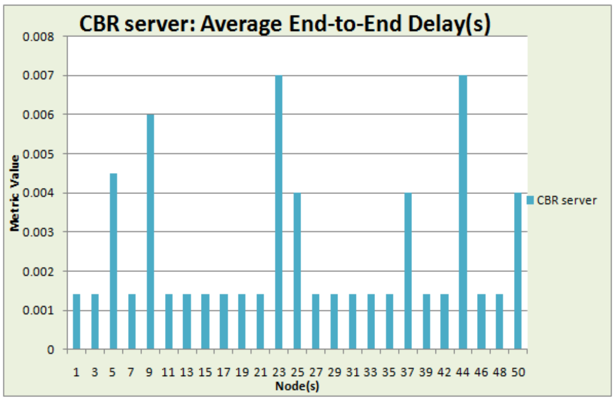

Fig. 14 CBR server: Average End-to-End Delay (second)

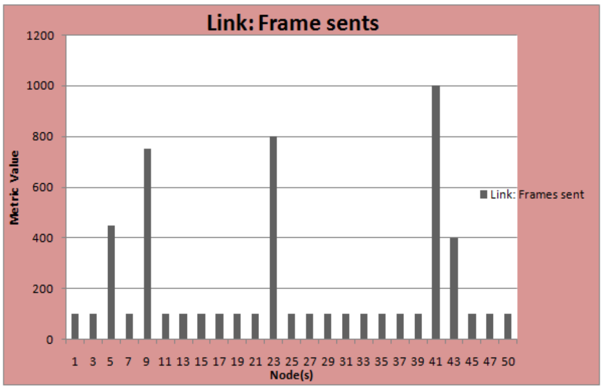

Fig. 15 Link Frame sent

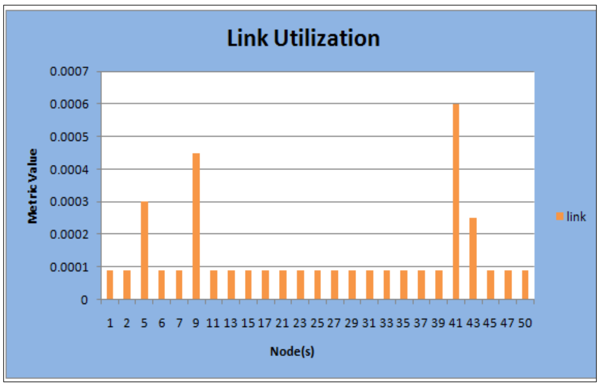

Fig. 16 Link Utilization

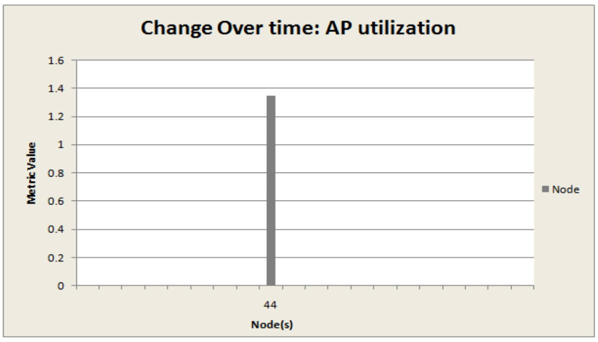

Fig. 17 Change in AP Utilization Over Time

Conclusion and Future Scope

We have proposed a multi-scenario adaptive station redistribution/association scheme for green wireless networking which implements a modified version of the station aggregation and station distribution functions individually in WLANs IEEE 802.11a and evaluated the performance of the scheme through simulation. In our proposed work, we used QualNet simulator which is used for identifying the network behavior. Improving the performance of the energy efficiency, here the physical/AV layer protocol between STAs and APs used is IEEE 802.11a and APs are designated to different channels to avoid any interference. Transmission rates between APs and STAs vary depending on their distances. Each STA sends CBR data to a node that is connected to all associated APs via wired links. The STA CBR data has periods of ON and OFF functionality to the aforementioned node. We proposed scheme for various scenarios including ones in which the number of STAs changes over time. In the future, research may be focused on investigating the performance of these schemes in larger as well as to develop more schemes to simultaneously achieve larger energy savings in any type of network be it wired or wireless.

References

S. Pablo, D. LA Oliva Antonio, P.Patras, V. Mancuso, A. Banchs (2012), Greening Wireless Communications: Status And Future Directions, *Computer Communications*, 35, pp. 1651-1661.

L. Suarez, L. Nuaymi, J.M. Bonnin (2012), An Overview and classification of research approaches in green wireless networks, *EURASIP journal on wireless communications and networking*, vol. 2012(Feb. Issue) 18 pages.

A.P. Jardosh, K. Papagiannaki, E.M. Belding, K.C. Almeroth, G. Iannaccone, B. Vinnakota (2009), Green WLANS: On-demand wlan infrastructures*. Mobile Networks and Application„* Vol.14 (No.6), pp. 798–814.

Go Green with Adaptive Wireless LAN Power Management,http://www.cisco.com/en/US/prod/collateral/wireless/ps5755/ps6301/ps6305/brochure c02-519055.html/.; last accessed Jan, 2014.

Y. Kondo, H. Yomo, S.Tang, ,M. Imai, T. Tanaka, H. Tsutsui (2012), Energy-efficient WLAN with on-demand AP wake up using IEEE 802.11 frame length modulation. *Elsevier Computer Communications*; Vol. 34 (Issue 14), pp. 1725–1735.

S. Tang, H. Yomo, Y. Kondo, S. Obana (2012), Wake-up receiver for radio-on-demand wireless lans. *EURASIP Journal on Wireless Communications and Networking*; Vol. 2012 (April issue), 13 pages.

K. Fujimoto, D. Nobayashi, Y. Fukuda, T. Ikenaga, T. Ito (2011), Power saving scheme with low-utilization station aggregation for radio-on demand networks. *IEEE PACRIM'11*, pp. 625–630.

K. Kumazoe, D. Nobayashi, Y. Fukuda, T. Ikenaga, K. Abe (2012), Multiple station aggregation procedure for radio-on-demand WLANS, *Proc of BWCCA 2012,* pp. 156–161.

K. Kumazoe, D. Nobayashi, Y. Fukuda, T. Ikenaga (2013), Station aggregation scheme considering channel interference in WLANS, *Proc of IEEE PACRIM 2013*, pp. 265–270.

http://notesapplication.abcelectronique.com/027/27-45534.pdf, Intel Centrino Mobile Technology Wake on Wireless LAN (WoWLAN) ; Last accessed March, 2014.

I. Haratcherev, C. Balageas, M. Fiorito (2009), Low-power sleep mode and out-of-band wake-up for indoor access points. *Proc. of Globecom Workshop 2009*, pp. 1 – 6.

M.A. Marsan, L. Chiaraviglio, Ciullo, M. DMeo (2010), A simple analytical model for the energy-efficient activation of access points in dense wlans. *Proc of E-Energy '10,* pp. 159 – 168.

J.Premalatha, U.Anitha, V.Manonmani and P.Ganesan (2015), Survey on energy Saving methods for green communication network, *Indian Journal of Science and Technology*, Vol 8 (19).

Deepshika Ukey, Prof. Somesh Dewangan (2014), Enhancing Dynamic Base Station Relay station Association in Cellular Network for Load Balancing, *International Journal of engineering research and technology*, Vol.3. Issue 3, pp. 2070-2074.

Ming Li, Roberto Riggio, Francesco De Pellegrini (2008) Resource Management in IEEE 802.11 based wireless networks, *Wireless Multimedia: Quality of Service and Solutions 2008*, Chapter 4, July Edition, pp. 77-109.

Xiaofang Jie, Haili Shi, Jian Liu, Zeyang Dai (2008), Relay assisted network cooperation scheme for green communications in heterogeneous wireless networks, *15th international conference on communication technology* '13, pp. 254-258.

B. Jooris, A. Schouttet, F. Vermeulen, I. Moerman (2007), Access network controlled fast handoff for streaming multimedia in WLAN, *16th IST mobile and wireless communications summit '07*, pp. 1-5.

Kazumi Kumazoe, Daiki Nobayashi, Yutaka Fukuda, Takeshi Ikenaga (2014), Station Reassociation Scheme for wireless Green Networking, *Procedia computer science*, 32, pp. 1147-1153.

Yulong Zou, Jia Zhu, Rui Zhang (2013), Exploiting Network cooperation in Green Wireless communication, *IEEE transactions on communications* '13, 61(3), pp. 999-1010.

R. Bolla, R. Bruschi, F. Davoli, F. Cucchietti (2011), Energy Efficiency in the Future Internet: A survey of Existing Approaches and Trends in energy-aware fixed network infrastructure, *IEEE Communications Surveys and Tutorials*, Vol.13 (2), pp. 223-244.

A.P. Jardosh, G. IannaCCone, K. Papagiannaki, B. Vinnakota (2007), Towards an energy-Star WLAN Infrastructure, *8th IEEE workshop on Hot Mobile 2007*, pp. 85-90.

D. Nobayashi, K. Kumazoe, Y. Fukuda, T. Ikenaga, T. Ito (2011), Performance Evaluation of Power Saving Scheme for Wireless LAN with Station Aggregation, *InCoS 2011*, pp. 338–339.