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MOBILE OFFLOADING USING POWER BASED DECISION IN WIRELESS COMMUNICATION

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Abstract
The cognitive radio techniques are integrated to offload the mobile traffic from mobile Base Stations (BSs) to Internet Service Providers (ISPs). Finding the solution for the mobile offloading has been a topical in recent years. Hence in wireless networks to improve the energy efficiency it is essential to analyze and optimize the power utilization and bandwidth allocation. Therefore the proposed system presents a power based decision algorithm in which offloading is done by choosing the energy efficient Wi-Fi Access Point. The user Filtration technique will offload the user to Wi-Fi Access Point by considering the bandwidth allocated for the services and the SBS (Secondary Base Station) bandwidth.

Introduction
Cellular networks are recently overloaded with data traffic due to various bandwidth-hungry applications. Mobile data offloading is the solution by which is complementary communication technologies to deliver the data traffic for transmission over cellular networks. In order to offload mobile traffic, mobile network operators usually provide small cell base stations (BSs), e.g., pico-BSs, femto-BSs and WiFi hot spots, in the area where the mobile traffic is high [1]. Such mobile network deployment is named heterogeneous mobile networks, which is used to offload mobile user traffic from macro BSs, thus decrease the consumption of power in mobile networks. However, given that small cell BSs requires backhaul networks which connect the small cell BSs and the mobile networks. The energy consumption of the backhaul networks may equal the increased energy efficiency. Thus, the lack of cost-effective backhaul connections for small cell BSs is often critical to their performance while offloading mobile traffic and enhances the energy efficiency of mobile networks. ISPs such as Comcast and Optimum are densely deploying the Wi-Fi hot spots which are responsible for Wi-Fi connectivity to their customers in all area in order to manage the rapid growth in wireless data [2]. Therefore, it is desirable to utilize the hotspots deployed by ISPs to offload mobile data traffic. However, since carrying mobile traffic introduces additional operation cost to ISPs networks, without proper incentives, the ISPs are not willing to open their networks to mobile network subscribers. A novel mobile traffic offloading scheme is leveraged by cognitive radio techniques referred as Energy Spectrum Trading (EST). The EST techniques give the advantage of both mobile and ISPs networks. One of the benefits in the mobile networks is that the networks are working on licensed spectrum which is not allowed for unlicensed users. Therefore, by stringently managing the spectrum, mobile networks can give the different services with QoS (Quality of Service). Though, as compared with the hotspots provided by ISPs, the BSs of mobile networks are typically limited. Such deployments are not better in terms of the energy and spectral utilization. One of the benefits of ISPs hotspots is that they are densely provided and are able to provide high speed data rates to their subscribers. Conversely, while operating on unlicensed spectrum, the QoS is not guaranteed [2].
The EST scheme enables mobile networks to offload data traffic to ISPs networks to increase the energy and spectral efficiency, and allows ISPs hotspots access to the licensed spectrum to provide ISPs data services with different QoS levels. The EST technique enables between the PBS (Primary Base Station) and SBS (Secondary Base Station) by event driven or traffic driven. For the event driven EST, the PBS triggers an EST process when a user in the cell boundary activates the request of the data service. For traffic driven EST, the PBS checks the intensity of traffic in the cell. When the traffic intensity is beyond the given threshold value then an EST process is initiated [3]. Assuming the PBS experiences weighty traffic load from the users, the algorithm is considered to optimize the EST between the PBS and SBS to decrease the PBS power consumption of when this process is originated. However, decreasing the energy consumption of the PBS in the EST scheme is not easy. As it is critical to diminish the power utilization in the PBS it has to maximize the number of users to offload in SBS. The main objective is to solve the power consumption minimization (PCM) problem by finding the user-BS associations and bandwidth allocations. Thus it decreases the utilization of power in PBS. Therefore, this algorithm is used to determine the correct optimal solution achieved by the brute force search. The heuristic algorithm first finds the PU's (Primary Users) whose user-BS associations are not well resolved. From the resultant set of PU's, it continuously associates the PU's whose power-bandwidth ratio is largest with SBSs. If there is decrease in power utilization of the PBS then the PU is associated with SBSs. otherwise, the PU should be associated with

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the PBS. The increase in energy consumption may lead to the shortage of networks battery life. Hence the main objective of the proposed system is to allocate the bandwidth dynamically and energy efficiently.

Related work

In this section, overview of the related works on mobile traffic offloading, Decision making framework and Energy Spectrum Trading is given.

Mobile traffic Offloading

Based on the traffic in network access the Mobile offloading consists of two parts: Infrastructure-based offloading and Ad-hoc based offloading. Infrastructure-based offloading: the mobile data traffic is offloaded to pico/femto BSs or Wi-Fi hot spots. Wi-Fi hot spots are efficient in terms of offloading the mobile data traffic. The traffic offloading will increase the spectral and energy efficiency. By offloading the traffic to the pico/femto cells or Wi-Fi networks it decreases the network overfill and the consumption of energy in mobile networks [4]. The most related work area is Infrastructure base offloading. Ad-hoc based offloading: Ad-hoc-based offloading depends on Device to Device communications to broadcast the contents. Instead of downloading contents directly from BSs, The user equipment receive the contents from the neighboring user equipment.

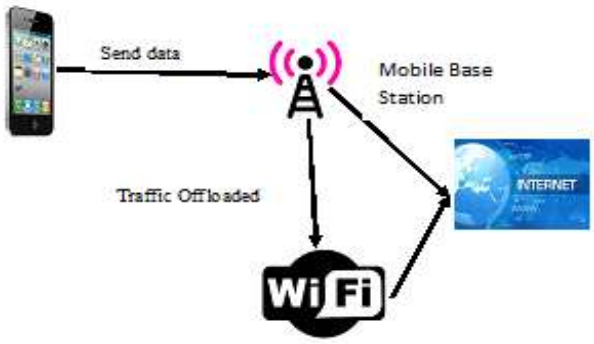

Fig.1. Mobile Offloading

The user-BS association with the cell biasing algorithm is used to balance the load and measures the signal strength and then stimulates the offloads. Due to the additional cost of backhaul connections in pico/femto cells, the Wi-Fi networks are used efficiently in offloading the Email like files are transferred. The content pushing system is used to push the content to mobile users through Wi-Fi connections [3],[7]. The mobile users request the content code to the Wi-Fi connections. The user routes are determined and the content is delivered when user connects to the Wi-Fi access points.

Energy spectrum trading

The Energy Spectrum Trading (EST) is to improve the spectral and efficiency in mobile networks. The EST with cognitive radio technique enables the equal sharing of spectrum for both PU's and the Secondary Users (SU's), where it reduces the energy consumption and increases the spectral efficiency of the mobile networks. The PBS provides data services to primary users (licensed spectrum) within a large area. The secondary Base Station (SBS) provides data services to secondary users (unlicensed spectrum) within its coverage area. For the PU's the data rates are high because they are located at the cell edges, in both bandwidth and power consuming. The EST scheme provides a less wireless channel fading for the SBS closer to the PU's and provides the data services to PU's with high spectral efficiency and energy. However the SU's which unlicensed spectrum is not a guaranteed. Hence the licensed bands from the PBS shared to the SBS to provide data services to both the users i.e. PU's and SU's with different Quality of Services (QoS). Meanwhile the SBS are closer to the PU's within the coverage area, the data services are provided to PU's and also satisfy the QoS requirements by make use of the allocated bandwidths [2],[3]. PU's are allocated with 2 MHz bandwidth for the data rate in order to satisfy the minimum data rate. SU's are allocated with 1 MHz to ensure the minimum data rates which is an unlicensed user. The power consumption is reduced by offloading some of the PU's to SBS and make the licensed bandwidth for the low power transmit. The EST is stimulated by event driven or traffic driven.

Decision making framework for offloading

Offloading has two techniques Wi-Fi offloading and mobile to mobile offloading. Due to the increase of traffic in mobile base station, the offloading technique is used here to shift the services to open access Wi-Fi. The Decision making framework is used to manage the offloading. This framework takes the decision locally on the smartphone whether offloaded to infrastructure or opportunistic communication [5]. Based on the three criteria number of neighbours, battery lifetime and signal strength decision is taken to offload.

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Proposed system

A sample network is to be created. A network with 'n' number of nodes is to be created. All the nodes are deployed randomly across the network. All the nodes can communicate each other. The wireless properties are given to the network. The wireless mobile network is created. All the nodes are configured and randomly deployed in the network area. PBS, SBS, PUs are selected and configured. All the PUs is connected to their respective SBSs. Sender and receiver nodes are randomly selected and the communication is initiated. Power consumption is analyzed for the routing initiated. The mobile traffic is offloaded to Wi-Fi networks [6]. Mobile data offloading is the use of alternate network technologies for delivering data originally targeted for mobile networks. The mobile offloading techniques are stimulated by either through an end-user or a network operator. Energy spectrum trading (EST) scheme which stimulates the macro BSs to offload the data traffic from the mobile BSs to Internet service providers (ISPs) in the company of cognitive radio techniques. Since the ISPs are close to the mobile users, the efficiency of energy and spectral can be increased. As a result by proper spectrum management in mobile networks are able to provide the subscribers different services with different QoS levels [3], [4]. It allows the secondary users to provide ISPs data services with different QoS level. The user filtering technique is used to reduce the offload for the certain types of PU. If the PU service allocated BW is less than the BW available in SBs then assign the PU to SBS by offloading else assign it to the PBs

Algorithm 1: Power Based Decision Algorithm

1: Input: The data service for 3G and Wi-Fi
2: Output: Power consumption for the services in 3G, Wi-Fi networks and make the decision to offload
3: Begin
4: Predict the throughput $B_{Wi\text{-}Fi}$ for Wi-Fi and B_{3G} for 3G networks
5: Estimate the capacity for offloading in Wi-Fi Cw
6: Calculate the duration for the services in 3G and
Wi-Fi networks
7: Estimate the prefetching capability of the Wi-Fi
8: If prefetching capability > C_W
9: offload the mobile traffic to Wi-Fi
10: else
11: the service is delivered through 3G
12: End If
13: End

Wi-Fi is mostly energy efficient than 3G. Mobile Traffic is offloaded to Wi-Fi networks that cause more power consumption to acquire location information and to connect with the Wi-Fi that are predicted to be available. Predict the throughput of 3G and Wi-Fi networks from the location

Wi-Fi is mostly energy efficient than 3G. Mobile Traffic is offloaded to Wi-Fi networks that cause more power consumption to acquire location information and to connect with the Wi-Fi that are predicted to be available. Predict the throughput of 3G and Wi-Fi networks from the location information and the history. The offloading capacity in Wi-Fi networks is C_W that is number of bits offloaded to Wi-Fi networks is calculated. Calculate the duration of the services to be delivered in Wi-Fi networks.

$$\frac{Cw}{B_{Wi-Fi}} \qquad (1)$$

The duration of the services to be delivered in the 3G networks is

$$\frac{C_W}{B_{3G}} \qquad (2)$$

Prefetching capability to Wi-Fi networks from 3G is predicted. If the prefetching capability is greater than the offloading capacity then it offloads to Wi-Fi else to 3G networks. The Prefetching is estimated through the behavior and mobility of the users [11].

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Table1 Preference & behavior learning

Learning	Data
Browsing Behavior	Behavior Time interval between two web requests, Enter time, Leave time of the web pages
Browsing Preference	Keywords in the title, visited URLs

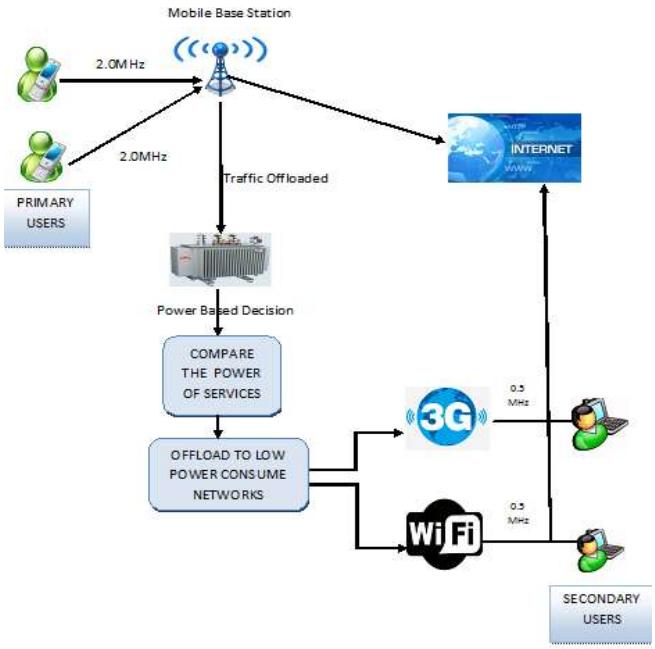

Fig.2. System Architecture

The Fig.2 describes the system architecture about the primary user and secondary user who use the mobile networks through base stations. The primary user and secondary user are increasing in number so it needs more than one base station now days and it leads to traffic and more energy consumption in base station. To decrease the power consumption the content of the user are offloaded to other Internet service provider [8]. The EST scheme differentiate the user by leveraging the cognitive radio techniques to provide the bandwidth 2 MHz for the primary user (licensed user) and 1 MHz for the secondary user (unlicensed user) which is triggered by event and traffic driven [9]. The power based decision will predict the throughput of content for both the 3G and Wi-Fi and the offload the data traffic to the networks which consumes less power for the services.

Implementation

The technique implemented here is NS2 [10]. When more number of primary users are communicated with primary base station, the energy is reduced and packet loss. Hence the users are offloaded to secondary base station. The user filtration is implemented through calculating the distance and sorted. The power of the service is calculated and offloaded to networks that consume low power

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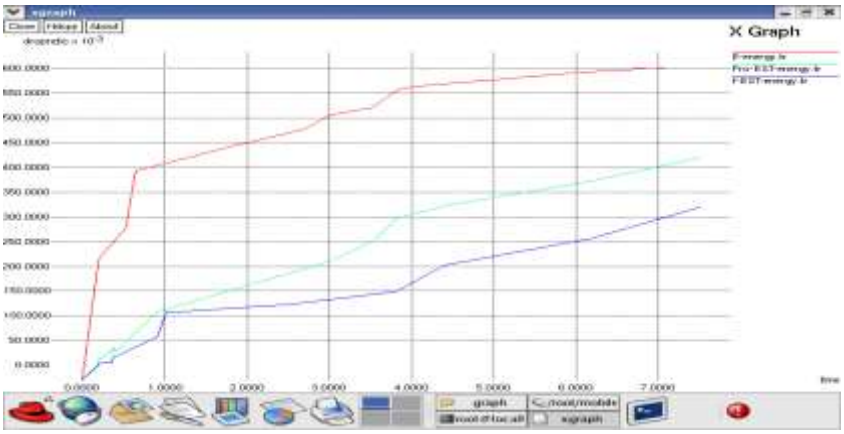

Fig.3. Energy based comparison with EST vs Power based decision

Conclusion

In this paper a novel energy spectrum trading (EST) scheme is introduced to stimulate the macro BSs to offload their mobile data traffic to Internet service providers (ISPs) with the use of cognitive radio techniques. The proposed approach of power based decision induces the mobile base station to offload the traffic from cellular networks to Wi-Fi or 3G networks. This technique calculates the power consumed for the services and offload to the networks that consumes low power for the services. By using this method smart phones select the energy efficient Wi-Fi Access point. Thus the energy consumption is reduced in mobile base stations**.**

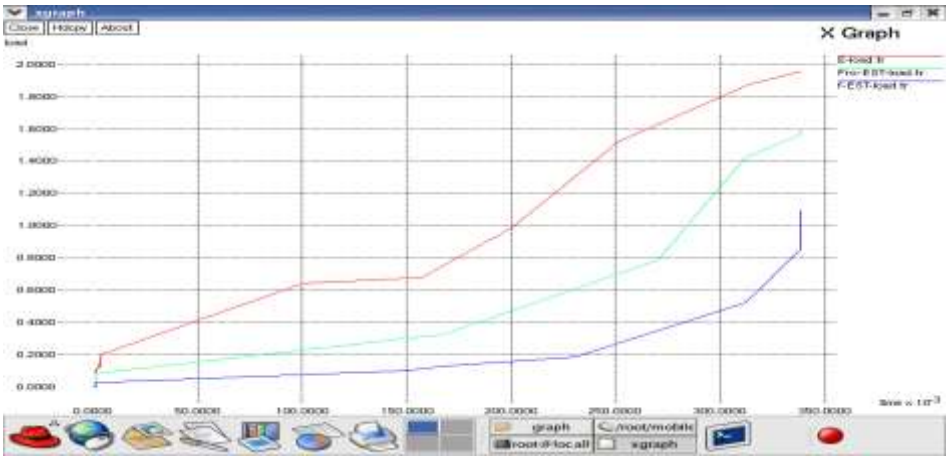

Fig.4.Load based comparison with EST vs power based decision

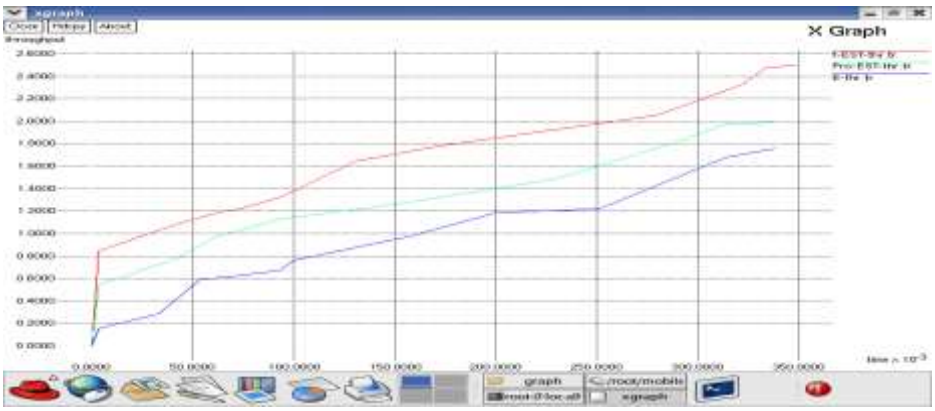

Fig.5. Throughput based comparison with EST vs power based decision

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