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Expansion Of Current Wi-Fi Implementation Through Energy Efficient Way

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Abstract: ***In Present days WiFi provide easy access to internet through portable devices such as smartphones, tablets. This technique implement the current WiFi implementation in the way to design that allow mobile devices to advertise and discover small chunk of information in very energy efficient way. This is easily possible in the crowded environments. This mechanism is also known as energy efficient discovery in a WiFi network. Another way this is says implementation of current WiFi in driver level implementation.***

Keywords: ***WiFi, PDA, asynchronous wake up protocols, energy efficiency, discovery, MAC protocols***

1. Introduction

Increasing popularity of wireless internet access through mobile devices like PDA or mobile phones faces two challenges firstly, need easily access to internet and secondly need very low energy consumption. To reduce the energy usage implement a factor that limit the utilization of WiFi in a portable devices that will give the greater impact on energy usage .This reduce or minimize the energy impact of portable devices connected to WiFi access Point. The current implementation contain periodic scan with an increasing interval of up to certain time interval. This technology based on WiFi that an application running in background which will allow device to discover and advertise information while roaming .This designed mechanism require firmware upgrade to current WiFi radios, So there is no hardware modification needed. The main technology in this technique is referred to as Energy Efficient Discovery. Major work in this technique are 1)Design a novel synchronous duty cycle mode which is optimized for broadcast transmission.2)An efficient scanning algorithm that allows energy efficient devices to discover the other portable devices or clusters in there surrounding environment and this contain already deployed access points and an external clock for synchronisation.3)Thirdly contain a performance level evaluation and observation, how the mobile devices discover and advertise small chunks of information in a very energy efficient way.

2. Related work

In the area of power efficient wireless sensor network this work is done for adapting the concept into mobile stations and 802.11 based systems for example S-MAC describes wake up/sleep according to the sensors in the neighboring station sensors synchronize forming virtual clusters of synchronize devices in a flat topology. For using S-MAC protocols which will reduce the forward delay in broadcasting. According to S-MAC protocol the time period during the awake sensors is fixed. T-MAC protocol is the extension of S-MAC which improves the energy efficiency by making the sensors sleep only fixed timeout where no data has been received. In addition T-MAC uses the RTS/CTS exchange which optimize the node to sink communication in a sensor network .which are more critical in mobile devices.

Asynchronous low duty cycle MAC protocols are also used for the lower power listening and preamble detection For individual wakeup/sleep is set by the B-MAC protocol. If a transmitter is want to communicate with a receiver but when the receiver is sleep state it will detect in the next wakeup period and then remain awake for further data exchange. WiseMAC is included in the design of this technique, the receiver is advertise the sleep schedule so the transmitter can easily send the data exchange in the wakeup period. Asynchronous protocols are poorly used in this technique because in a broadcast transmission receivers are active at different times. Relevant scanning algorithm are used in this technique for quorum-based asynchronous wakeup for wireless sensor network .Quorum protocol is used to trade off between duty cycle and reduce the discovery delay by defining unsynchronized sequence of awake and sleep and limited the overlapping behavior of the neighboring stations. For instance the time is divided into contiguous slot, which is t^2 slots. These are arranged into txt matrix. Each station selected a random column and row from a matrix and awake during the selected values in the matrix. The neighboring stations discovering each other in less than t^2 time slots with duty cycle of $\frac{2t-1}{t^2}$.The authors proposed Recursive Binary Time Partition(RBTP) is used to synchronize every few hours in internet through NTP servers This technology does not require internet connection it is only needed a Wi-Fi radio. There are several technologies developed for energy efficient discovery and hence these are related to the proposed system. FlashLinQ is the one of the emerged technology related to the proposed work ,in this GPS signaling is used to synchronous the system. Bluetooth Low Energy (BLE) is the technology used to discovery and advertises with reduced power consumption.

3. System Design

The proposed technique attempts to resolve is how to allow a set of neighboring device to advertise and discover small chunks of information in a power efficient way. The designed system has following requirement.

- The designed system do not need current hardware modification.
- According to the designed system the neighbouring devices concurrently discover and publish information.
- The battery life is saved in the designed system.

Solving the above problems this technique is worked in two mode of operation

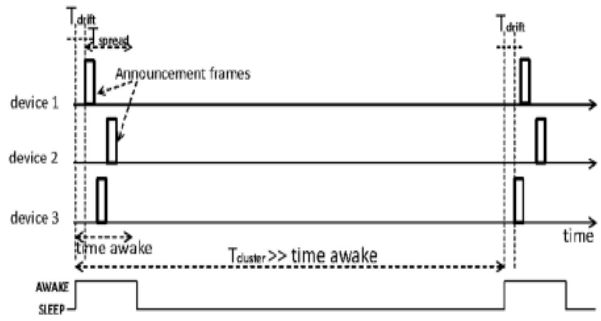

Fig. 1. E^2D Wi-Fi operation in *Synchronous* mode.

T_{drift} =Fixed waiting time before transmission to get clock drift. T_{spread}= Duration over which the transmission time is randomized.

3.1 The synchronous operation

The design of synchronous mode is working with low duty cycle MAC protocol such as S-MAC protocol for WSN_s.. WiFi devices discover each other and synchronous with common wake up schedule. Group of devices are also called *cluster* and these are synchronous with common wake up schedule and let the period of wake up schedule be $T_{cluster}$. The duty cycle of the devices in a cluster is calculated by ratio between the time a device is awake and $T_{cluster,}$ as illustrated in Fig 1.In synchronous mode use small duty cycle in order to minimize energy consumption. If all devices are awake in a same time broadcasting is very easy so in this design use broadcast frames which are known as announcement frames. Synchronous mode solve two challenge:1) how can mobile devices synchronized with a clock drift and 2) how can avoid the large number of collisions.

3.1.1 Cluster Synchronization

This technique provide the following algorithm for synchronization. For scheduled transmission every station contain the cluster wakeup and transmit announcement frames. Each announcement frame contain timestamp and local station clock value $t_{timestamp}$ and the cluster time period $T_{cluster.}$ Then $t_{now} \leftarrow t_{timestamp.}$ Which means that the station clock is updated by the announcement frame received on the target transmission. Wakeup events are occur t_{now} mod $T_{cluster}$ equals a pre defined offset that is shown to all the devices.

3.1.3 The Announcement Frame

The announcement frame designed in this technique is making use of 802.11 extensibility features. Announcement frames are in the form of 802.11 management frames. Announcement frames are of type Public Action. Here the destination address is set to broadcasting address. Announcement frames contain the several type value encoded sub-element defined which actual functionality is implemented. Fig 2 shows the two of these sub element which is the format of announcement frame in the synchronous mode.

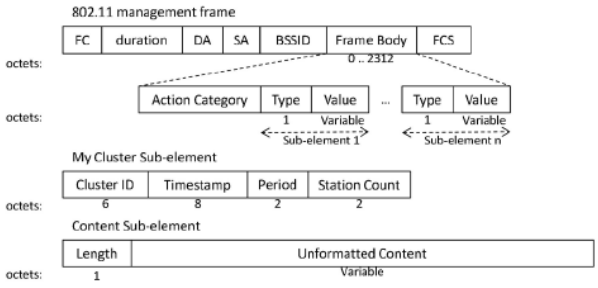

Fig. 2. Announcement frame contents in E^2D Wi-Fi.

3.2 scanning operation

In this technique an energy efficient algorithm is used to understand which clusters is want to join in the multiple clusters in the given environment

3.2.1 An Energy Efficient Scanning Algorithm

For instance, assume that clusters potentially operate in Nchnl different channels also device activity time is with respect to the period Tcluster, then the passive scan life is should last for at least TD = TclusterNchnl seconds. The worst case discovery delay increases in the range up to TD scanning seconds, where scanning is the scanning duty cycle of the device. Previously the discovery delay in tens of seconds but after applying energy efficient algorithm then the discovery is improved in pedestrian speeds. The scanning mechanism in energy efficient Wi-Fi is need an external source of synchronization. This cluster and devices need this common external synchronization. The work is done in this method is determined the time and frequency coordinate an which determined where the discovery should happen and the clusters and devices are sleep at rest of time. The external source of synchronization is obtained in the GPS signals or NTP server. But in this technique the external synchronization obtained from WiFi access points(APs) distributed in the public space. This technique may not be able to connect to this infrastructure APs. This connection is done by Beacon frames or Probe Response transmitted in the given area ,and activate the external source of synchronization.

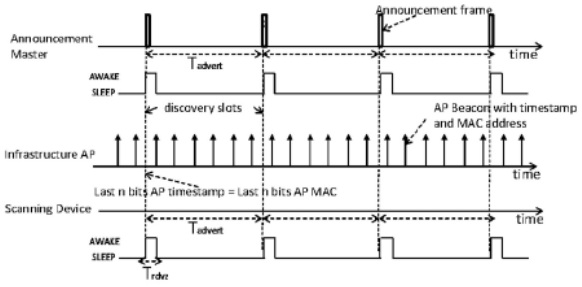

Fig 3: Scanning mode operation

Some station also known as Announcement Masters, the station assist the scanning devices and this perform the procedure to determine discovery slots and transmit announcement frames in

those slot. Which frames used by scanning stations to discover the clusters. This operation of scanning algorithm shown in Fig.3.

Algorithm 1: Announcement Master Selection
Variables:
$S_{infra\text{-}AP}$ ← Soft-state list of known infrastructure APs.
Breaker ← Tie Breaker of this station.
MAC ← MAC of this station.
After performing a scan:
if AnnMaster_APs_MAC is NULL **then**
for APs ∈ S_{infra_AP} **do**
if APs.AM_MAC is NULL or Breaker < APs.TieBreaker **then**
Start operating as Announcement Master for this AP
AnnMaster_APs_MAC ← APs.APs_MAC
APs.AM_MAC ← MAC
break
Executed only after receiving an Announcement frame:
if infraAPs_SubElement is present **then**
APsrcvd ← infraAPs_SubElem
if AnnMaster_APs_MAC = APsrcvd.AP_MAC **then**
if Breaker > APs_{rcvd}.TieBreaker **then**
// Stop operating as Announcement Master for this AP
AnnMaster_APs_MAC ← NULL
//Insert or update APrcvd in the list of our known APs
S_{infra}_APs ← {S_{infra}_APs ∪ APs_{rcvd}}

Am stations done normal operation in a cluster ,scan and select an infrastructure APs and maintain synchronization. These AM stations goes to Wi-Fi physical channel and find where the APs sitting and transmit announcement frames. This will easy to discover the potentially scanning stations shows in Fig.3.Algorithm 1 is used to discover which station is act as an announcement master in following way. The AM stations declare their role in neighbors by including AP sub-element in the infrastructure is depicted in fig .4,where is the announcement frames transmitted within the cluster. The sub-element field contain which station is act as announcement master and a Tie Breaker field If a station receives a sub element field from another station which means that another station act as a AM, and check which one has greater Tie breaker field then the corresponding station will act as a announcement master Algorithm 1 results in having one AM station for each infrastructure APs that must be in each neighborhood.

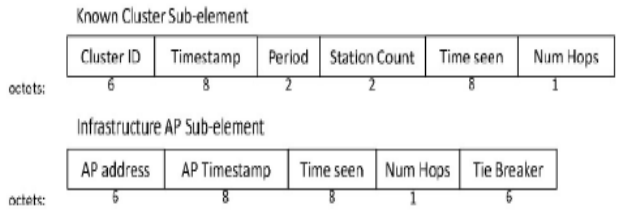

Figure 4: Structure of announcement frame sub element

4. Result and Evaluation

Figure 5:E2D (energy efficient discovery)

This contains WiFi coverage area distributed in the environment (Fig.5). Here the developed application installed system communicates with each other. This is also contain the general WiFi contents like SSID, authentication, encryption, signal strength and radio signal quality. The right bottom side shows the battery percentage.

Figure 6:E2D Wi-Fi Settings

Here we created the corresponding system. The application allows transmission in these systems with the developed application. The transmitted messages are shown in the neighbouring field in the above fig 6.

Figure 7: E2D Message Transfer

This is the design of energy efficient WiFi(fig.7). This section contain receiver name and which stations are active in the

transmission time. Also broadcast the message section is involved in this field.

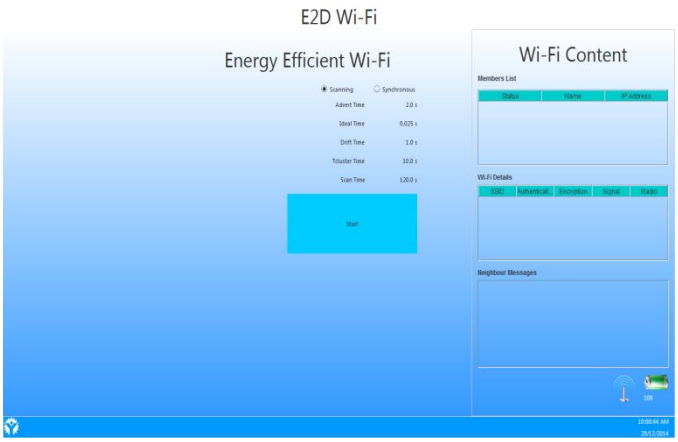

Figure 8: .E2D Wi-Fi content

This section (Fig.8) contains the two mode of operation in our designed system. This contain scanning mode and synchronous mode operation. This scanning mode work with following factors Advert Time-time interval between discovery slot in the scanning algorithm. Ideal Time-idle time without hearing any transmission before going to sleep. Drift Time-Fixed waiting time before transmission to absorbe clock drift. Tcluster time-time intervals between wake up events when operating in cluster. Scan Time-time interval between scanning attempts when a station is a part of a cluster. And synchronous mode contain predefined time of wake up from previous experience and basis of duty cycle.

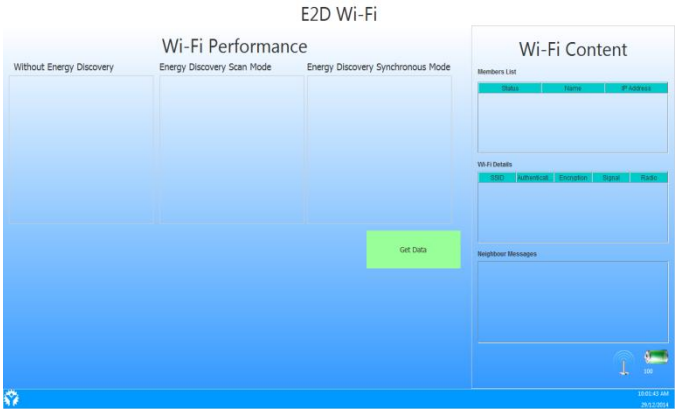

Figure 9: E2D Wi-Fi Performance

This Fig.9 shows that the total energy performance with when mobile devices operated in scanning mode and synchronous mode. After that an option to find the WiFi energy performance. This performance shown below fig.

Figure 10: E2D Wi-Fi Performance

This section (Fig.10) contains remaining power in seconds, work with the when the transmission start. Here we can see that the usage of power with the initialization of the designed application.

5. Conclusion

In this technique consist of energy efficient discovery and the extension of current WiFi implementation. So this will increase the battery life and mobile devices can easily discover, synchronize, advertise small chunks of information in energy efficient way. This design mechanism allow mobile devices to attach APs concurrently.

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