Green WiFi (VL4-13)

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Overview
The aim of this project is to research and develop a potential algorithm related to the sleeping policy of WiFi systems to achieve green WiFi. This project is motivated by the increasing need of faster and environmentally friendly access points (AP) or "routers". To utilize the air-channel efficiently and minimize the energy waste of the AP, protocol plays an important role. Protocols are the rules controlling the communication methods and flows among AP and users. However, protocols are usually set to focus on performance rather than energy efficient. To overcome the tradeoff between performance and energy efficient of AP, a protocol prototype is introduced. This prototype is an improved version of a well-developed protocol, Token Ring Protocol, in local area network (LAN). The prototype has similar working principle but weaker performance. Although it has large improvement area, it is exciting to discover and think more on how to balance the tradeoff between better performance and achieving "green".

Designed Protocol
Designed Protocol is the Protocol prototype. It uses the sending request-response methods. Similar to other protocol, Designed Protocol contains two parts, the Uplink and Downlink. APs, those apply protocol, has two channel of handling different information. The larger channel is used for data transmission and the smaller channel is used for management channel. When there is a need to transmit data, user will need to request AP to add it into the transmission queue and wait for pair up. The request or other management issue, like synchronization, will use management channel. This method will avoid large proportion of the channel occupied by management frame. It can be described as performance guarantee. The unique pair up will minimize rate of collision but increase delay. Because the management of management frame, energy efficiency can be increased. However, the increase of delay will prolong the working time of AP. Therefore, the sleeping period after each use has sent one time can confirm AP can sleep and avoid frequent requests from particular users.

Methodology
To find the performance of protocols, there are three elements; they are throughput, delay, and total energy consumption.

\[
\text{Energy required to send 1 Mb data (µJ/bit) = \frac{\text{Power (Watt)}}{\text{Throughput (Mbps)}}}
\]

The equation describes the total power consumed by the access-point in a particular period in such set of throughput. This is the most important equation to evaluate the energy efficiency.

\[
\text{Energy} = \text{Transmission} + \text{Power} + \text{Propagation} + \text{Processing}
\]

This equation describes the components of delay. The queuing delay is assumed the changing parameter in the equation. By using these two equations, we can measure the performance and degree of "green" of different protocols.

Results

The simulation result is obtained by network simulator 2. The data are comparing Pulse Protocol, Token Ring Protocol, and Designed Protocol.

Comparison of Power Consumption of Access Point

![Comparison of Power Consumption of Access Point](image1)

Comparison of Delay

![Comparison of Delay](image2)

Comparison of Performance Matrix and Traffic Load

![Comparison of Performance Matrix and Traffic Load](image3)

We estimated the data obtained and found that the Pulse Protocol consumed the most energy per mega bit when the Token Ring Protocol consumed the least. The Designed Protocol is between them. However, the delay of Designed Protocol is higher than the other two. We concluded that Designed Protocol has the potential to be "greener" but it has a large improvement area in the performance, especially the delay problem.