Power-Efficient Communication Strategy for Wi-Fi Aware Technology

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***Abstract– Wi-Fi Aware* is a new technique which enables devices to communicate with each other in the same vicinity without the help of access points. In this approach, we leverage Wi-Fi Aware technique and take field trials on the power efficiency of Wi-Fi Aware communications. Based on the experiment results, we conclude that the Wi-Fi Aware devices are suggested to transmit data with the help of proximity nodes according to their link speed so as to save energy.**

Index Terms– Wi-Fi Aware, proximity based services, link speed, power saving.

I. INTRODUCTION

Wi-Fi Aware [1] is an enhanced technique which provides uninterrupted device-to-device discovery without any means of GPS, cellular or access points. Such technology is developed for crowded/conjunction environments which supports bidirectional information sharing with proximity devices. In this paper, we are interested in the power efficiency experiments of smartphone with Wi-Fi Aware technique and try to observe the consumed power of different communication strategies through Wi-Fi Aware technique. Here, the consumed power is defined as the rate in which work is performed (in *Watts*) and the energy is the ability to do work, i.e., *Energy = power × time* (in *Joules*). Note that the power is measured at any point of time whereas energy is calculated in fixed intervals [2]. In addition, the energy depletion rate of smartphone is estimated based on observed voltage [3].

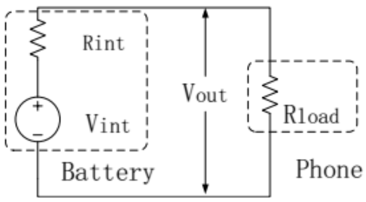

Fig 1. The circuit design for the power measurement.

Specifically, we design a circuit with a constant voltage source V_{int} which is a DC power source connected serially by the smartphone. In addition, the voltage across the smartphone is given by V_{out}, i.e., $V_{out}(t) = V_0 - V_{int}(t)$, where V_{int} is the voltage across the resistor whereas $V_0 = 4.3V$ is the constant source of voltage. Note that we use low resistance value such as $R_{int} = 0.5 \pm 0.05\ \Omega$ and the maximal achievable current in circuit is $500mA$, i.e.,

$$I(t) = \frac{V_{int}(t)}{R}.$$

Thus, the power consumption is calculated by

$$P_{out}(t) = I(t) \times V_{out}(t) = \frac{V_{int}(t)}{R*(V_0 - V_{int}(t))}.$$

Since it is hard to calculate the specific power events at a particular time while sending single packets to the receiver, we calculate the average power consumption by integrating Eqs.(1) and (2) as follows [4].

$$\bar{P}_{\mathrm{ph}} = \frac{1}{T}\int_0^T P_{ph}(t')dt', \quad (1)$$

$$d\bar{P}_{\mathrm{ph}} = \frac{1}{T}\int_0^T \left(P_{ph}(t') - \bar{P}_{\mathrm{ph}}\right)^2 dt'. \quad (2)$$

II. EXPERIMENT SETUP AND RESULTS

In this experiment, we conduct two scenarios to evaluate the performance on power consumption of Wi-Fi Aware devices. The first scenario is to send data packets directly from the transmitter to the receiver by 1-hop transmission and the second scenario is to transmit data in 2-hop manner through a middle Wi-Fi device. Specifically, the sender of the two scenarios is the *access point* and the receivers are Wi-Fi Aware devices. Those devices are connected to a platform in order to calculate power consumption and link speed. In addition, the platform is installed with *Android Debug Bridge (ADB)* package, which comprises Google's Android SDK and provides sufficient functionality to controls various operations through USB.

Table I. The experimented values of power consumption at 1 Mbps

Scenario (1-hop)		Scenario (2-hop)				
Link speed (Mbps)	Power (mAh)	(1st hop)		(2nd hop)		Total (mAh)
		Link speed	Power (mAh)	Link speed	Power (mAh)	
1	0.00281	65	0.00141	6	0.00127	0.00268
		52	0.00153	12	0.00125	0.00278
		36	0.0019	24	0.0012	0.0031
		24	0.00235	36	0.00112	0.00347
		12	0.0027	54	0.00102	0.00372

Specifically, in the experiment, the power consumption is measured when transmitting 10 MB of data. These experiments are repeated with different link speeds of 65, 52, 36, 24, 12 dB and the results are shown in Table I. As can be seen, the power consumption for 1-hop communication of 1 Mbps is 0.00281 mAh. Contrarily, the power consumption for 2-hop communication with 1st hop of 65 and 2nd hop of 6 Mbps is 0.00141mA and 0.00127 mAh, respectively. This shows that the total power consumption of 2-hop transmission is potentially less than that of 1-hop transmission. Besides, the total throughput of 2-hop communication is also higher than that of 1-hop transmission potentially.

III. CONCLUSION

In this paper, we have addressed the power optimization in close proximity of Wi-Fi Aware devices. A power-efficient strategy to transfer data by the help of proximity nodes is suggested depending on the link speed.

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