



ENERGY OPTIMIZATION IN MULTIMEDIA WIRELESS DEVICES

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Abstract: Energy conservation in battery powered mobile devices which perform wireless multimedia streaming has been a significant research problem. This is because these mobile devices consume a lot of power while receiving, decoding and ultimately, presenting the multimedia content[1]. What makes things worse is the fact that battery technologies have not evolved enough to keep up with the rapid advancement of mobile devices. This survey examines solutions that have been proposed during the last few years, to improve the energy efficiency of wireless multimedia streaming in mobile hand-held devices. Explosive demand for mobile multimedia communications has significantly increased not only spectrum requirements but also energy consumption.

Keywords: Energy Efficiency, Mobile, Multimedia, Power Consumption.

I. Introduction

Wireless communications is a fast-growing technology that enables people to access networks and services without cables. Wireless networks are simple to deploy, and in some cases cost less than wired LANs. The availability of the network connectivity and access to network servers *build into wireless network*[2]. Telecom trends such as smooth migration towards higher data rates and higher capacities for multimedia applications, and provision of various services (text, audio, video) from different standards with the same wireless device require integrated designs that work across multiple standards, can easily be reused and achieve maximum hardware share at minimum power consumption[3].

Energy consumption in hand held wireless devices is the challenge for wireless system. Increasing use of wireless devices every one suffers from energy consumption problem .To investigate the energy consuming devices to improve energy efficiency and performance [4].

Although display and decoding are often responsible for a large part of energy consumption, wireless interfaces can equally deplete the same amount of energy while running audio or video streaming applications in mobile devices. And the tremendous increase in mobile data traffic, there is a general trend towards the decentralization of mobile operator networks, at least to a certain extent. Backlight power minimization can effectively extend battery life for mobile handheld devices.

Also the process of streaming over wireless networks, mobile devices spend potentially a lot of power for decoding multimedia content, wireless communication, and presenting the content via speaker or display. In modern smartphones, having the display on and decoding the multimedia content can together consume a large part of the energy. The energy required to decode audio or video depends on the computational complexity of the codec and compression algorithms used for encoding [5].

II. Related work

As mobile networking and services are entering a new communication era offering smart phones to users with higher capabilities and more diverse applications, emerging service requirements create new challenges for the current mobile network architecture [3]. A mobile user activity indicated that the backlight used to illuminate the display subsystem consumes most of the energy; thus, it should receive the most attention with respect to improving energy efficiency. Whereas the transceiver circuits determine instantaneous power consumption, the average consumption depends on the power management of the complete system. Bluetooth and IEEE 802.11 (Wi-Fi) are two communication protocol standards that define a physical layer and a MAC layer for wireless communications within a short range (from a few meters up to 100 m) with low power consumption (from less than 1 mW up to 100 mW).With real-time applications like Voice over Internet Protocol (VoIP), this can be challenging since packets delayed above a threshold are lost. Moreover, the continuous nature of traffic makes it difficult for the radio to stay in the lower power sleep mode[2].

The GreenCall algorithm to derive sleep/ wake-up schedules for the WLAN radio to save energy during VoIP calls.In a very recent article [5], Vallina-Rodriguez and Crowcroft looked at smartphone energy management

techniques from the following perspectives: (1) energy-aware operating systems, (2) efficient resource management, (3) the impact of users' interaction patterns with mobile devices and applications, (4) wireless interfaces and sensors management, and (5) benefits of integrating mobile devices with cloud computing services[1]. In addition, while we focus specifically on multimedia streaming, they did not focus on any specific applications. Other than the standard 802.11 PSM, they also covered protocols such as energy efficient MAC for mobile ad-hoc network, energy conserving MAC, MAC using multiple wireless interface. Traffic shaping, scheduling and other power adaptive solutions for wireless multimedia streaming are also omitted from these existing surveys. For this reason, we consider the numerous solutions for energy efficient multimedia traffic reception at mobile devices.

III. Methodology

To energy savings by applying different approaches for total energy usages at different types

A. To Save Energy During a VoIP Call using PSM

The GreenCall algorithm to derive sleep/ wake-up schedules for the WLAN radio to save energy during VoIP calls two peers are used to energy saving .PSM goes to sleep packets arriving from the peer will be buffered at the AP. VoIP traffic small tolerable latencies and each packet must reach the client by its playout deadline. A strict sleep/wake-up schedule, we need to consider the latency (mouth-to-ear delay) of a packet from the peer to the client. PSM is ready to receive packets until clients come and AP is buffered. Refer figure 1 Latency characteristics between different locations on the Internet play an important role on VoIP call quality[6].

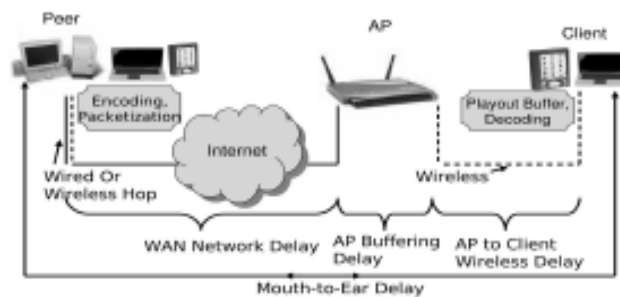


Figure 1: Illustration of end-to-end latency components of a VoIP call between a peer on a wired/wireless network and the client on a wireless network.[6]

A 12-minute conversation is used which is the typical average length of a VoIP session to emulate traffic with parameters derived from typical VoIP calls rather than use real VoIP sessions to provide more flexibility and ensure repeatability across tests. Packet level emulation also allows us to focus more on the networking issues and bypass application level operations involved that do not affect the results of this work. In our emulated VoIP session, UDP packets of 160 bytes were continuously exchanged between the mobile client and a peer for the duration of the call. When radio is in sleep mode packets are buffered .The problem is the possible packet arrival patterns for two cases at the client—when it does not go to sleep at all, and when it periodically goes to sleep. The packet receive times when client is not using PSM is not a straight line because the network latencies from peer to client are variable. The difference between the line representing receive times without PSM and line for playout deadlines is the time that the client has to play with to save energy

The reason for this is that GreenCall was implemented using the 802.11e UPSPD mode which keeps the client radio in sleep mode for at least the packet generation interval (30 ms in this case) each time before transmitting buffered packets. The difference in power consumption will become zero as the size of the calculated sleep periods decrease below the packet generation interval, which is the minimum sleep interval of the radio in UPSPD mode, a variant of GreenCall when silence suppression is used that does not rely on feedback between the client and peer[7].

Table 1: Energy saving in a day with and without greencall during calls[6]

	Energy (mWh)	% Savings
GreenCall	2142	20.9
No GreenCall	2707	

The measured values from our card and shows the possible energy savings by using GreenCall. the GreenCall algorithm that leverages the IEEE 802.11 PSM mode to save energy consumed by the wireless radio while at the same time ensuring that application quality is preserved. utility of GreenCall and underscored the great potential of saving energy even with real-time applications like VoIP[6].

B. To save energy using dynamic backlight scaling service

The backlight server is responsible for generating the video stream's backlight file when requested by a mobile device. Because different mobile devices may be equipped with different display subsystems and consequently

power models, we divide the generation process into two phases, device independent and device dependent, for optimization purposes. To increase the image brightness, thus allowing the LCD backlight levels to be reduced. This saves significant power as the majority of the LCD's display power is consumed by its backlight. In particular, Android smartphone, with all components running at peak levels, the LCD display and 3G network interface consumes 45 to 50% and 35 to 40% of the total system power respectively. The remaining power is consumed by the CPU and memory subsystems. Unfortunately, games, which account for more than 50% of current iPhone application downloads, tend to consume large amounts of CPU, memory, and display power in general — with multiplayer games also consuming large amounts of network interface power.

There are three kinds of TFT LCD panels: transmissive, reflective and transreflective [8] . The transmissive displays (Figure 2) use the backlight to illuminate the pixels and offer a wide colour gamut and high contrast. Transmissive displays provide the best visual quality under a broad range of lighting conditions — from completely dark to office lighting for example. However, they tend to be unsuitable for extremely bright environments where the ambient light overpowers the backlight. Reflective LCDs (Figure 3) are unique because they operate without the use of a backlight. Instead, they rely solely on ambient light. This allows the device to consume far less power than transmissive display.

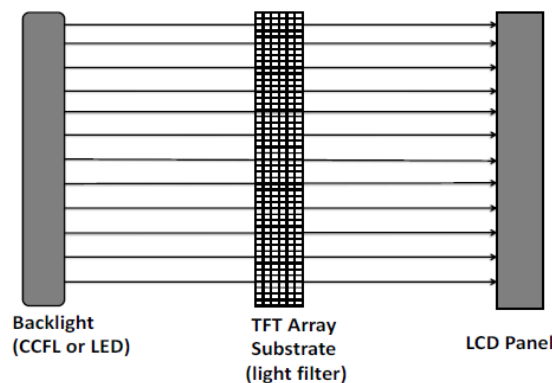


Figure 2: Transmissive LCD Display[8]

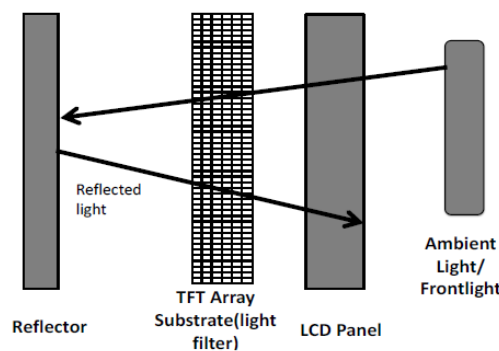


Figure 3: Reflective LCD Display[8]

The system presented in this paper is tuned specifically for TFT LCD display. However, there are other types of displays that are used for smartphones. In particular, organic light-emitting diode (OLED) is an emerging display technology that is becoming increasingly popular and has been used in smartphones. Emerging organic light-emitting diode (OLED)-based displays obviate external lighting, and consume drastically different power when displaying different colors, due to their emissive nature. This creates a pressing need for OLED display power models for system energy management, optimization as well as energy-efficient GUI design,

The biggest difference between a TFT LCD and an OLED display is that an OLED display functions without a backlight as each LED in an OLED display is lit individually. OLED displays consume less power (about 40% less) than a LCD display when the image is dark, but consumes more power than a LCD display.

Our methodology to determine the mapping between the backlight reduction and the Gamma-induced associated image compensation. Set the Gamma and backlight intensity to their default values (1 Gamma and 255 (full) backlight) and measured the perceived brightness (PB) of the screen using a light sensor placed close to the screen and pointing at it. Then, to increased the gamma by Δ and found the appropriate backlight level (BL) such that the PB was constant and similar to the base level. Equation 1 shows this functional relationship[8].

$$BL = f(\gamma) : PB \text{ is constant} \quad (1)$$

The value of the Gamma parameter ranged from 1 to 10, where 1 indicates default frame content and higher values result in brighter content. The backlight levels ranged from 0 to 255, where 0 indicates the backlight was off and 255 was the brightest backlight level.

C. To save energy using MAC Layer in Bluetooth and IEEE 802.11

Bluetooth and IEEE 802.11 (Wi-Fi) are two communication protocol standards that define a physical layer and a MAC layer for wireless communications within a short range (from a few meters up to 100 m) with low power consumption (from less than 1 mW up to 100 mW). MAC is a medium access control for wireless communications over a short action range low power consumption. In seven layer OSI model of computer networking, data communication protocol, it provides addressing and channel access control mechanism's. The best e.g. of this protocol is Wi-Fi, and Bluetooth [2].

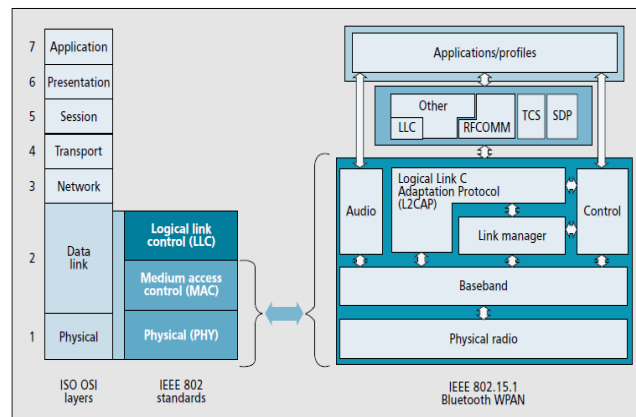


Figure 4: The Bluetooth stack [2].

The IEEE 802.15 working group has adopted the work done on Bluetooth (without any major changes) and made it an IEEE standard, 802.15.1 (Figure 4). A profile that emulates a serial port. RFCOMM is useful because many existing applications are based on serial communications. Up to 60 connections can be simultaneously active between two Bluetooth devices. This device may operate in either *master* or *slave mode*. The aim of the IEEE 802.11 standard is to provide wireless connectivity to devices that require quick installation, such as portable computers, PDAs, or generally mobile devices inside a wireless local area network (WLAN). Mobility is handled at the MAC layer, so handoff between adjacent cells is transparent to layers built on top of an IEEE 802.11 device[2].

Table 2: IEEE 802.11 Standards Family [2]

Standard	Description	Status
IEEE 802.11	WLAN; up to 2 Mb/s; 2.4 GHz	Approved 1997
IEEE 802.11a	WLAN; up to 54 Mb/s; 5 GHz	Approved 1999
IEEE 802.11b	WLAN; up to 11 Mb/s; 2.4 GHz	Approved 1999
IEEE 802.11g	WLAN; up to 54 Mb/s; 2.4 GHz	Approved 2003
IEEE 802.11e	New coordination functions for QoS	Task group development
IEEE 802.11f	IAPP (Inter-AP Protocol)	Approved 2003
IEEE 802.11h	Use of the 5 GHz band in Europe	Approved 2003
IEEE 802.11i	New encryption standards	Approved 2004
IEEE 802.11n	MIMO physical layer	Task group development

The IEEE 802.11 standard has been referred to as Wi-Fi, a Wi-Fi station will scan the available channels to discover active networks where beacons are being transmitted. A station can sleep to save power, and when it finishes infrastructure mode operation.

Table 3: Energy savings while using standardized and non-standardized link layer techniques for wireless multimedia streaming to mobile devices [1].

Link Layer Approaches	Wireless Network	Energy Saving
PSM	Wi-Fi	82%
PSM-A	Wi-Fi	2%
Bontu	LTE	50%
μ PM	Wi-Fi	30%

As Nokia E-71, Nexus S, Galaxy S3, Lumia 800 use an extra period that is approximately 200 ms long. Only iPhone 4 uses an aggressive value of around 30 ms[1].

IV. CHALLENGES AND ISSUES

The adaptive mechanism would involve significant design challenges in the middleware layer design and importantly, design of individual components for different aspects like – VoIP call using PSM, Dynamic backlight scaling, and MAC layer in bluetooth and IEEE802.11. Also for dynamically dimming the backlight is considered an effective method to save energy consumed by the mobile device displays. To save power on OLED displays, we need to darken the image instead of brightening it as brighter images consume more power.

V. CONCLUSION

To addressed the important problem of saving energy for wireless device clients due to the VoIP, Video (dynamic backlight scaling), Bluetooth. Minimizes the energy consumption incurred by the backlight when users access multimedia streaming on mobile devices. The Gamma function provided by those games to dim the LCD backlight and save display power. Also the complete system with careful user input to ensure that user perceived quality is not degraded due to the dimming of the LCD backlight. The GreenCall algorithm that leverages the IEEE 802.11 PSM mode to save energy consumed by the wireless radio while at the same time ensuring that application quality is preserved[8]. There is no sophisticated adaptive processes in the device that prolong the battery life in real-time, depending on the nature of the current application and current battery level [9]. This optimization allows the minimal cost, weight, and energy consumption [1].

IV. REFERENCES

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