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A Quality Based Power-Hump Mechanism for High Speed Network Connectivity of Mobile Devices in Digital Living Network Alliance Networks

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ABSTRACT

Mobile devices are increasingly assuming an important role in "smart home" network environments. Although their computing, storage and networking capabilities have evolved significantly, these devices remain power-constrained and, therefore, there is need to actively take measures to minimize their power consumption. In this paper, we propose a Power Saving (PS) mechanism for mobile devices in Digital Living Network Alliance (DLNA) home networks, which allows them to conserve power without compromising their higher-layer functionality. The proposed mechanism introduces a level of indirection that abstracts the low-level low-power support of different wireless bearers and exposes a uniform interface to higher-layer entities, such as applications and Universal–Plug-and-Play (UPP) agents. We define four abstract NC-PS modes and describe their mapping in the case of Bluetooth, a common wireless bearer for mobile devices, now supported in DLNA. Battery power is an important resource in Ad-hoc networks. It has been observed that in Ad-hoc networks, routing control messages and data transmission, these timers are set and refreshed on-demand. Nodes that are not involved in energy consumption do not reflect the communication activities in the network.

Keywords: Smart Home, Digital Living Network Alliance, Plug-And-Play, Ad-Hoc Networks, PDA, Adaptive-Buffer, Power Save Mechanism, Wireless Personal Area Networks, UPP, Mobile Handheld Devices, Digital Media Server, Digital Media Player, Digital Media Controller, Mobile Handheld Devices, Home Network Devices, MAC, VOIP, CBR

I. INTRODUCTION

Mobile devices are becoming increasingly popular for delivering multimedia content, particularly by means of streaming. The main disadvantage of these devices is their limited battery life. Unfortunately, streaming of multimedia content causes the battery of the device to discharge very fast, often causing the battery to deplete before the streaming task finishes, resulting in user dissatisfaction. It is generally not possible to charge the device while on the go as electricity socket and charger are required. Therefore, to avoid this user dissatisfaction, it is necessary to find ways to prolong the battery lifetime and to support the completion of the multimedia streaming tasks. A typical architecture for mobile multimedia streaming is presented in this architecture, a wired server streams multimedia content over a wireless IP network to a number of client devices. These devices could be PDAs, smart phones or any other mobile device with 802.11connectivity.

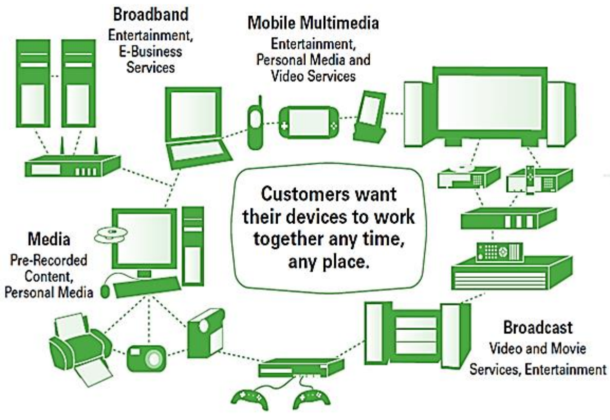

Figure 1: Contents of Digital Home [4]

In relation to possible power savings, the multimedia streaming process can be described as consisting of three stages: reception, decoding and playing. Other researchers have shown that energy savings can be made in each stage, for example by using pre-buffering in the reception stage, feedback control during decoding and backlight adjustment for playing. However, it is not a common practice to combine energy savings in the three stages in order to achieve the best overall savings. Due to the large amount of power used by the network interface card, the reception stage is the largest consumer of the battery. This paper proposes the Adaptive-Buffer Power Save Mechanism (AB-PSM) that provides significant power savings in the reception stage, and hence to the overall battery life. ABPSM introduces an additional buffer which hides data from the station it is intended for, allowing it to return to sleep and consequently save power. Data is eventually delivered in one of the station's following attempts to receive it. The proposed AB-PSM improves the existing Power Save Mechanism (PSM) without making any modifications to it. In this thesis we discussed the related works proposed to provide power savings for each stage of the multimedia streaming process. The legacy PSM in the 802.11 standard is then described and its weaknesses identified. The wide availability of inexpensive networking technologies, such as 802.11 Wireless Local Area Networks (WLAN) [1] and Bluetooth Wireless Personal Area Networks (WPAN) [2], has recently led to the rapid proliferation of home networks. Increasingly, the use of these networks is expected to move from more traditional computer networking applications (e.g. network printing, web browsing, file sharing) to new consumer-oriented applications currently provided by stand-alone devices (e.g. video and music playback and recording). Industry initiatives, such as the DLNA [3] and UPP Forum [4], aim at enabling such "smart homes" by ensuring interoperability among networked devices from the Consumer Electronics (CE), Mobile and Personal Computer (PC) industries. In particular, mobile devices (e.g. smart-phones) with their increasing multimedia and networking capabilities are expected to be first-class citizens in this digital "smart home" ecosystem. Version 1.0 of DLNA interoperability guidelines [5] addressed home networked devices which are in general static and not power-constrained. The new version of the DLNA guidelines [6] also introduces Mobile Handheld Devices (MHD), which are in general mobile, power-constrained devices, such as mobile phones, PDA's, and portable music players. There is always a need for a mechanism that would allow MHDs and M-NCFs to collaborate and manage their connection to save battery power .Network Connectivity Power Saving (NC-PS) mechanism between an MHD and an M-NCF. This proposal formed the basis of the NC-PS mechanism adopted in DLNA [6]. In this sense, this paper describes the basic ideas behind the adopted DLNA NC-PS mechanism, although not the exact mechanism itself.

Objectives

- To simulate and analysis a "power saving mechanism for mobile devices in DLNA home networks".
- To perform abstract modes of the connection between an MHD and an M-NCF to put the link between them in different Network Connectivity Power Saving (NC-PS) modes to reduce power consumption.

II. METHODS AND MATERIAL

DLNA, which stands for Digital Living Network Alliance, is a series of guidelines used by manufacturers of consumer electronics to allow entertainment devices within home share media content with each other seamlessly across a home network. The Digital Living Network Alliance is an international, collaborative organization of companies involved in consumer electronics, the computer industry, and mobile devices. Members of DLNA have developed an emerging concept of network communication where digital content such as photos, music, and videos can be shared across multiple electronic devices in and beyond the home. The organization provides guidelines defining a frame work of network protocols that support this interoperability concept. There is also a certification program to identify products that comply with DLNA guide lines.

Types of DLNA Devices

There are three main roles for a DLNA device, and a particular device may have one or more of these roles.

A) Digital Media Server (DMS)

A digital media server has a store of content (such as video files) which it makes available for client devices to use. If a client device cannot use a particular format, the media server may be able to convert the file before sending.

B) Digital Media Player (DMP)

A digital media player can show or play content which it requests (or is sent) from a server. Examples of digital media players include the Sony® PlayStation® 3, the Microsoft Xbox 360™, and some of Sony's Bravia range of televisions.

C) Digital Media Controller (DMC)

A digital media controller can instruct another device to do something, such as telling a server to play a video on a particular television or a photo frame to send a photo to a printer.

The Home Network Architecture

The DLNA home networking architecture is based on technologies defined by the IEEE 802 committee. Currently, DLNA [6] defines only three link-level technologies: 802.3, 802.11 and Bluetooth with the PAN profile. Figure 6 shows an example connectivity model in a DLNA network. Mobile Handheld Devices (MHD) and Home Network Devices (HND) are essentially similar with respect to applications and network-level connectivity. The main differences are in their support of possible different media formats and link-level bearers.

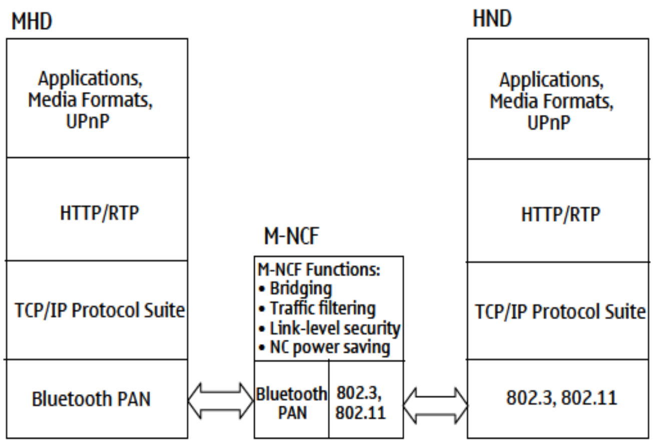

Figure 2: Depiction of an M-NCF bridging the network connectivity gap between MHD and HND devices.

Besides link-level connectivity, mobile devices have in general different requirements than fixed devices with respect to security and power saving. For instance, different requirements in the area of power saving may be due to the fact that most mobile devices are battery operated, while in the area of security to the fact that mobile devices may belong to visitors who only need to be given temporary access to the home network. In order to reflect these different requirements, the M-NCF may have additional mobile-specific functionality in addition to bridging. These features are built on top of the standardized link-level mechanisms. Finally, it is noted that it is not mandatory for MHDs to attach to the home network via an M-NCF. They can connect directly through Ethernet cables or off-the-self AP, provided they support the necessary link-level bearer. However, connecting through an M-NCF, if available, allows MHDs to benefit from the additional mobile-specific functionality.

The Bluetooth Technology

Bluetooth is a low cost and short-range radio communication standard that was introduced as an idea in Ericsson Laboratories [Ericsson www] back in 1994. Engineers envisioned a need for a wireless transmission technology that would be cheap, robust, flexible, and consume low power. The basic idea of cable replacement with possibility of many extensions was picked-up quickly and over 2500 companies joined the Bluetooth SIG [Bluetooth www] and have been chosen to serve as the baseline of the IEEE 802.15.1 standard for WPANs, supporting both synchronous traffic such as voice, and asynchronous data communication.

Ad Hoc Networking

Whenever a pair or small group of Bluetooth devices come within radio range of each other, they can form an ad hoc network without requiring any infrastructure. Devices are added or removed from the network dynamically. Thus, they can connect to or disconnect from an existing network at will and without interruption to the other participants. In Bluetooth, the device making the communication initiative to another device assumes the role of a master, while the recipient becomes a slave.

Wireless PANs

Wireless PANs (WPANs) has caused the latest revolution in the wireless technology. WPANs are short to very short range (from a couple centimeters to a couple of meters) wireless networks that can be used to exchange information between devices within the reach of an individual. WPANs can be used to replace cables between computers and their peripherals; to share multimedia content amongst devices; to build an infrastructure for sensor networking applications; or to establish various location aware services.

Power Consumption Model

In order to minimize power consumption, nodes remain in a sleep mode most of the time while adhering to the following two simple rules.

A) An inner node in the virtual routing tree, i.e., a node that serves as a parent to at least one of its neighbors, must wake up periodically in order to receive packets from its children. These children know the times when switches from sleep to active. The node stays active as long as it receives packets from its neighbors. After a time-out period of not receiving any packet, the node returns to sleep mode.

B) Every node also wakes up when its parent wakes up if and only if it needs to forward a packet through the parent to the gateway. Precise synchronization between neighboring nodes is unnecessary. If the nodes use an AODV-like MAC protocol in order to send data packets, a packet that is not ACK due to non-perfect synchronization will be retransmitted after a short time-out period.

Sensors & Sensor Networks

Sensor is a cheap tiny device that is able to detect local events and report them to a centralized gateway using wireless communication.

A sensor network is a multi-hop network, consisting of many sensors and one or more gateways. Routing is performed by the sensors in order to forward messages from the reporting sensor(s) to the gateway.

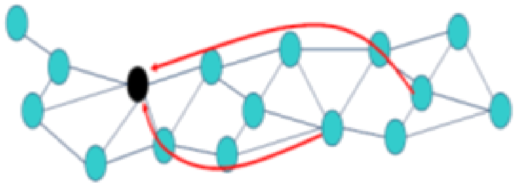

Figure 3: Sensor network

Network Simulator 2

- The 802.15.4 NS2 simulator [14] developed at the Joint Lab of Samsung and the City University of New York confirms to IEEE 802.15.4/D18 Draft. Figure 3 outlines the function modules in the simulator, and a brief description is given below for each of the modules.
- Wireless Scenario Definition: It selects the routing protocol; defines the network topology; and schedules events such as initializations of PAN coordinator, coordinators and devices, and starting (stopping) applications. It defines radio-propagation model, antenna model, interface queue, traffic pattern, link error model, link and node failures, super frame structure in beacon enabled mode, radio transmission range, and animation configuration.
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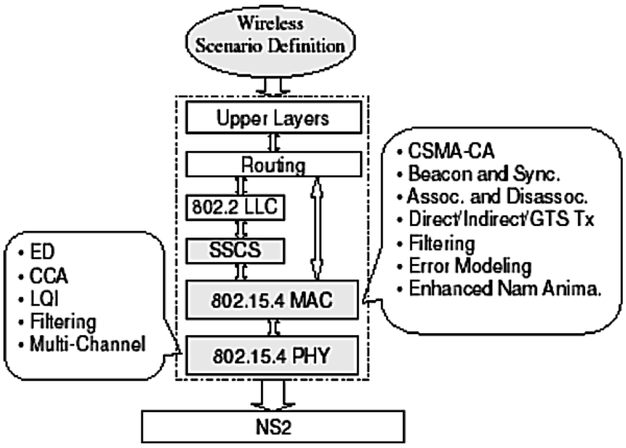

Figure 4: NS-2 Simulator for IEEE 802.15.4 [8]

- Service Specific Convergence Sub layer (SSCS): This is the interface between 802.15.4 MAC and upper layers. It provides a way to access all the MAC primitives, but it can also serve as a wrapper of those primitives for convenient operations. It is an implementation specific module and its function should be tailored to the requirements of specific applications.

- 802.15.4 PHY: It implements all 14 PHY primitives.
- 802.15.4 MAC: This is the main module. It implements all the 35 MAC sub layer primitives.

III. RESULTS AND DISCUSSION

The results are presented. The interval between sent packets is represented in terms of milliseconds and ranges from 25ms to 200ms. The packet sizes, or more specifically the size of the multimedia data chunks before lower layer fragmentation, are also shown and range from 512B (bytes) to 4096B. The different power saving scheme are presented. The 802.11 standard with the PSM switched off, with a 25ms interval and a packet size of 512B, and the legacy 802.11 PSM with the same settings, AB-PSM. The first has an inter-packet sending interval of 100ms and a packet size of 2048B and the second has an interval of 200ms and a packet size of 4096B. It should be noted that an identical amount of data is sent in all cases. The results show significant increases in the battery life when AB-PSM is used in comparison with both other cases: when no power saving and when the legacy PSM is employed respectively.

Loss Monitor Agent is used to calculate the packets received at the sink and used to draw the graphs. In the following graphs, the loss rate, received bytes and the throughput of all the six flows were compared. (If we use priority based service, then three of the six flows will be served in a better way).

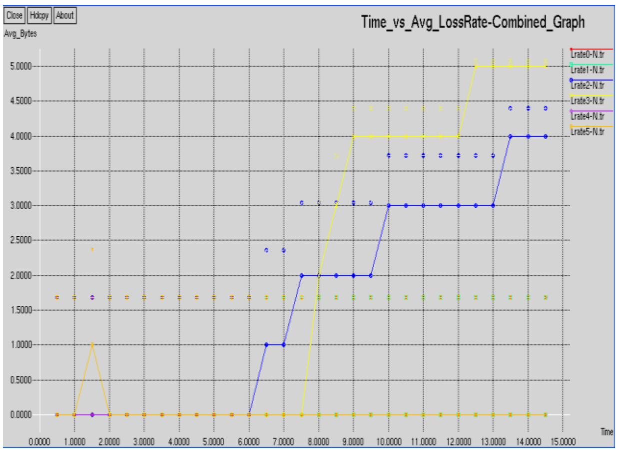

Figure 5: Time VS Avg loss Rate Combined [10]

In the graph 5 we can see the combined between the time and Avg _loss rate, six flows of loss rate by different six colors take dissimilar values with different periods time. According to the research it has been seen that when the traffic is established between the PAN coordinator and any one of the nodes, then all the other nodes get in sleep mode, unless the whole data conversation is not done between the nodes

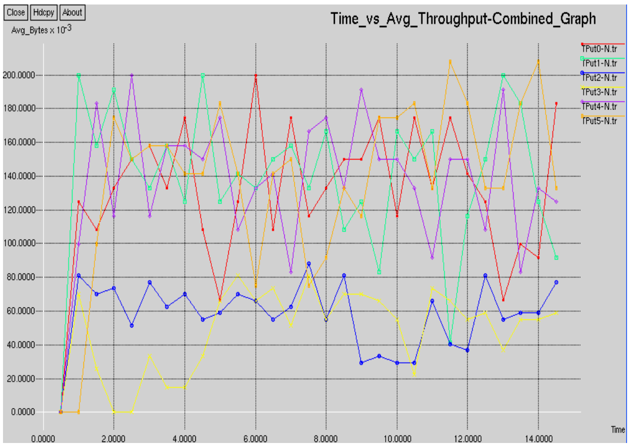

Figure 6: Time VS Avg throughput combined [13]

In the graph 6 we can see the combined between the time and Avg throughput; six flows of throughput by different six colors take dissimilar values with different period's time. The above graph shows, when the nodes are in active mode, then a huge amount of energy is dissipated as the network becomes a mesh network, because all the nodes are struggling for the establishment of traffic with PAN coordinator. In this simulation two sets of CBR, VOIP and Exponential Traffic were simulated. That is, two CBR traffics, two VOIP traffics and two Exponential traffics. The Six mobile nodes (0, 1,2,3,4,5,6) will send this six traffics to the node 0 via the access point 1.Since all the three pairs of the traffic has same priority, both the follows will be treated as the same.

In the graph 7,8,9 and 10 we can see the Traffic between the Time and Avg Bytes-CBR, Traffic between the Time and Avg Bytes-VOIP, Traffic between the Time and Avg Loss Rate-CBR, and Traffic between the Time and Avg Throughput-Exponential.

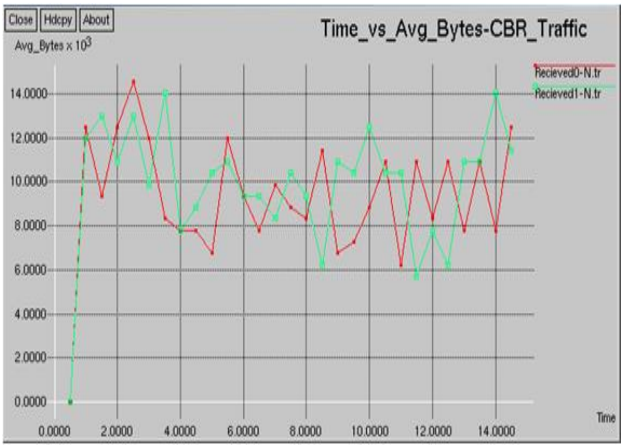

Figure 7: Time VS Avg Bytes-CBR_Traffic [12]

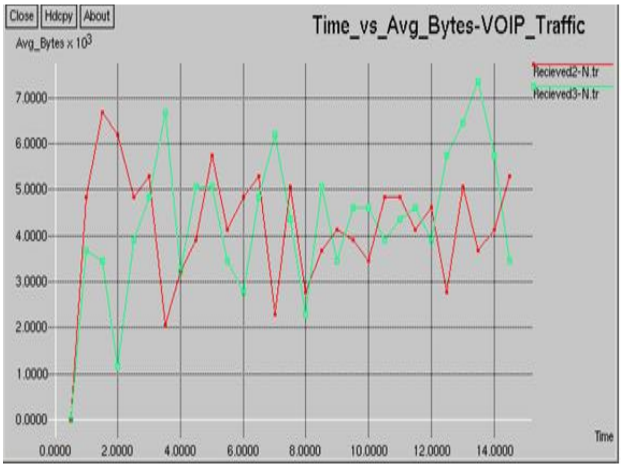

Figure 8: Time VS Avg Bytes-VOIP_Traffic [12]

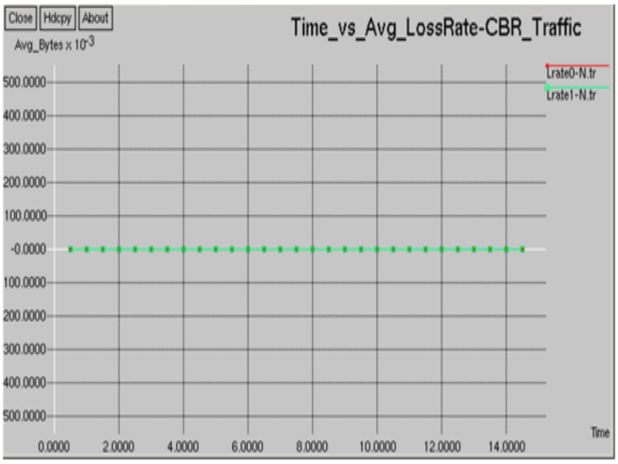

Figure 9: Time VS Avg Loss Rate-CBR_Traffic [16]

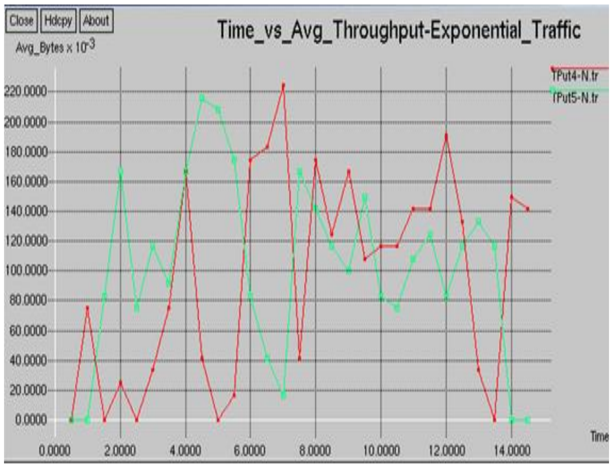

Figure 10: Time VS Avg Throughput- Exponential Traffic [16]

IV. CONCLUSION AND FUTURE SCOPE

In this paper, we proposed a Power Saving (PS) mechanism for mobile devices in Digital Living Network Alliance (DLNA) home networks, which allows them to conserve power without compromising their higher-layer functionality. We implemented a prototype of our framework in the NS-2 simulator that uses the IEEE 802.15.4 NS2 simulator and the IEEE 802.11 MAC protocol. We have simulated six mobile nodes which have sent six traffics (two CBR traffics, two VOIP traffics and two Exponential traffics) to the PAN coordinator node via the access point as soon as all the three pairs of the traffic had same priority, both the follows treated as same. That is both the CBR traffics, both VOIP traffics and both the Exponential traffics got same QoS (Quality of Service) and hence consume same network bandwidth. In our results, the loss rate, received bytes and the throughput of all six flows were compared; we used priority based service, therefore three of six flows served in a better way. Simulation studies using proposed scheme with the Dynamic Source Routing protocol show a reduction in energy consumption to the extent of 50% when compared to a network without power management under both long-lived CBR traffic, VOIP traffic and Exponential traffic, with comparable throughput, loss rate and received bytes.

We consider each sniff interval for our analysis, and further divide it according to the packet type (or bandwidth) desired by the application. In Bluetooth, 3 different packet formats are possible – DH1, DH3 and DH5 each having a different packet length, thus providing varying bandwidth to the application. The Bluetooth slave module operates as follows in its sniff mode with ACL connection to a master: It is in sleep mode by default. It wakes up every T sniff time to listen to the master and transmit all data from its buffer. It consumes IACL, Active during this transmission, and IACL, linking while asleep and connected to the master. We analyze the above at fixed data production rates – 75, 100, 150, 300, 600 and1200 Hz. We observe that for a fixed data production rate, increasing the sniff interval causes a proportionate decrease in power consumption. But, for a fixed sniff interval, decreasing data production rate does not cause a considerable decrease in power consumption via changing the different data production rates .So that we can achieve the determined volume of energy to be saved.

V. REFERENCES

[1] ANSI/IEEE 802.11, "802.11std. Wireless LAN Medium Access Control and Physical Layer specifications", August 1999.

[2] Bluetooth Special Interest Group, "Bluetooth Core", Specification of the Bluetooth System version 1.2. , November 2003.

[3] Digital Living Network Alliance (DLNA), 4UPnP Forum, "UPnP Device Architecture 1.0.1", December 2003.

[4] Digital Living Network Alliance (DLNA), "Home Networked Device Interoperability Guidelines v1.0", June 2004.

[5] Digital Living Network Alliance (DLNA), "Digital Living Network Alliance Home Networked Device Interoperability Guidelines Expanded: March 2006", March 2006.

[6] Yung-Hsiang Lu; De Micheli, G.,"Comparing system level power management policies", IEEE Design & Test of Computers, Volume 18, Issue 2, March-April 2001 Page(s):10 – 19 .

[7] Kravets, R.; Schwan, K.; Calvert, K.; "Power-aware communication for mobile computers", IEEE International Workshop Mobile Multimedia Communications, 1999. (MoMuC '99), 15-17 Nov. 1999 Page(s):64 - 73 .

[8] IEEE802.11, "Part 11: Wireless LAN Medium Access Control (MACand Physical Layer (PHYspecifications: Amendment : Medium Access Control (MACEnhancements for Quality of Service (QoS)", P802.11e/D12.0, November 2004 .

[9] Rong Zheng, Robin Kravets, "On-demand Power Management for Ad Hoc Networks", Proceedings of INFOCOM 2003. Twenty-Second Annual Joint Conference of the IEEE Computer and Communications Societies. IEEE, Vol. 1, 30 March-3 April 2003 Page(s):481 - 491 vol.1 .

[10] Consumer Electronics Association (CEA), "Power Management for A/V Network Capable Devices", CEA white paper, April 2004,

[11] Bluetooth SIG, "Personal Area Networking Profile v1.0", Bluetooth SIF Specification, February 14, 2003.

[12] "IEEE 802.11b: Higher-speed physical layer (PHYextension in the 2.4ghz band," 2001.

[13] J. Adams and G.-M. Muntean, "Power-dependent adaptation algorithm for mobile multimedia networking," IEEE International Symposium on Broadband Multimedia Systems and Broadcasting, April 2006.

[14] S. Chandra and A. Vahdat, "Application-specific network management for energy-aware streaming of popular multimedia formats," Proceedings of the General Track. 2002 USENIX Annual Technical Conference, pp. 329 – 42, 2002.

[15] J.Korhonen and Y.Wang, "Power-efficient streaming for mobile terminals, "Proceedings of the 15th International Workshop on Network and Operating Systems Support for Digital Audio and Video. NOSSDAV2005, pp. 39 – 44, 2005.

[16] G. Bae, J. Kim, D. Kim, and D. Park, "Low-power multimedia scheduling using output pre-buffering," 13th IEEE International Symposium on Modeling, Analysis, and Simulation of Computer and Telecommunication Systems, pp. 389 – 96, 2005.