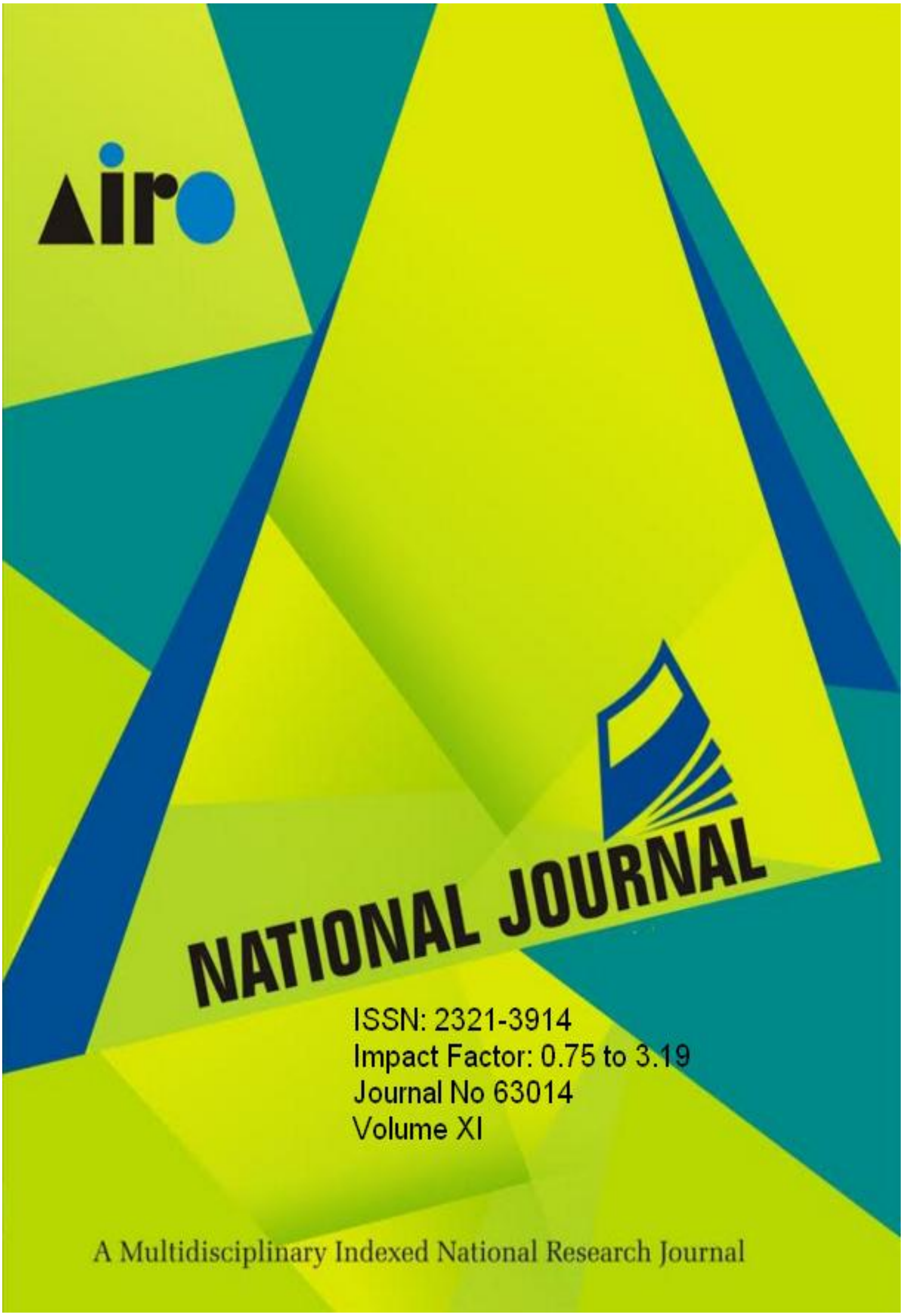
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ANALYSIS ON WIRELESS MULTIMEDIA COMMUNICATION AT SMALL SCALE OFFICE ENTERPRISE WITH QUALITY OF SERVICE GURANTEE

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ABSTRACT

In this work, we introduce an approach for maximizing the efficiency of wireless media communication at small scale due to source compression, channel coding and transmission subject to a fixed end-to-end source distortion. The availability of low-cost hardware such as CMOS cameras and microphones has fostered the development of Wireless Multimedia Sensor Networks (WMSNs), i.e., networks of wirelessly interconnected devices that are able to ubiquitously retrieve multimedia content such as video and audio streams, still images, and scalar sensor data from the environment. In this paper, the state of the art in algorithms, protocols, and hardware for wireless multimedia sensor networks is surveyed, and open research issues are discussed in detail. Architectures for WMSNs are explored, along with their advantages and drawbacks. Currently off-the-shelf hardware as well as available research prototypes for WMSNs is listed and classified. The key obstacle to communication over wireless sensor networks has been the lack of suitable processing architecture and communication strategies to deal with the large volume of data. Above theories also reveal that how to enhance the quality of service at small scale enterprises.

This paper presents new architecture and protocol for energy efficient communication processing and communication over wireless sensor networks. Practical results show the effectiveness of these approaches to make image communication over wireless sensor networks feasible, reliable and efficient.

All current multimedia services are provided over some type of a communication network. Most of these networks is packet based and shows a certain level of transmission efficiency because each communication network has some network architecture which is realized as a set of layers and protocols.

We illustrate our approach both on an abstract class of sources and channels and on a realistic H.263 video transmission system through a wireless channel. Performance under different channel environments and implementation schemes are investigated.

Keywords: *wireless multimedia, communication, small scale offices, quality of service*

INTRODUCTION

In recent years, there has been an increasing interest in applications of wireless sensor networks (WSNs). Applications such as real-time object tracking, source localization, multimedia surveillance, advanced healthcare delivery, and industrial process control which all require gathering of information in the form of multimedia such as audio, image and video; and thus, necessitate efficient and reliable multimedia communication in WSNs. In Wireless Multimedia Sensor Networks (WMSN), with the large volume of the multimedia data generated by the sensor nodes, both processing and transmission of data leads to higher levels of energy consumption than in any other types of wireless sensor networks (WSN). This requires the development of energy aware multimedia processing algorithms and energy efficient communication in order to maximize network lifetime while meeting the QoS constraints.

Quality of service is commonly defined as the service users' degree of satisfaction during a given communications session. Consistently anticipating and meeting users' quality of service needs is what distinguishes successful communications service and product providers from their competition. The multimedia content in sensor networks should be delivered with predefined levels of quality of service (QoS) under resource and performance constraints such as bandwidth, energy, and delay. These constraints limit the extent to which QoS requirements can be guaranteed. Although a high compression ratio makes multimedia applications suitable for low bit-rate wireless channels, the compressed multimedia stream become more vulnerable to transmission errors due to predictive coding.

On the other hand, the work on improving the battery life has focused on separate components such as algorithms and hardware design for specific video and channel coders and low power transmitter design. Moreover, low power communication constraints of sensor nodes worsen the effects of wireless channel errors and require energy-efficient communication protocols in order to achieve application objectives, while delivery of multimedia streams may be an energy consuming task. All of these challenges necessitate energy efficient and reliable error control schema for QoS multimedia communication over multi-hop WSNs.

Classically, source and channel coding literature and in particular joint source and channel coding techniques mainly focus on designing codes that minimize the overall distortion of the source as it travels through the channel. However, for mobile units that have limited battery capacities, power consumption of baseband processing should also be considered. Joint optimization of source compression, channel coding, and transmission to balance the quality of service and power requirements of the mobile has only recently attracted interest. In, the authors look at some specific operation modes of the H.263 video coder that result in different compression rates and almost the same perceptual quality. Multistage coded modulation is utilized to accommodate rates in the different modes.

REVIEW OF LITERATURES

Energy efficiency and QoS are both critical for wireless networks, especially in video communication systems.

Wang and associates have studied the optimal power allocation for video encoding and wireless transmission, and introduced a mechanism called achievable minimum distortion to quantify the distortion under a total power constraint.

They consider two scenarios in wireless video sensing: small-delay wireless video monitoring and large-delay video surveillance.

A general framework that considers multiple factors, including source coding, channel resource allocation, and error concealment, for the design of energy-efficient wireless video communication systems is presented in.

It can be applied to achieve the optimal trade-off between energy consumption and video delivery quality during wireless video transmission.

Sun et al. have set up a measurement system to reveal the battery capacity consumption behavior and its foot-printing in a video delivery system using H.264 codec. A systematic optimization framework which jointly considers the coding parameters and transmission parameters is proposed to achieve the trade-off between battery consumption and QoS.

For mobile multimedia communications, Wang et al. have proposed a novel time slicing technique where the cyclic prefix is replaced with the pre-coded pseudo-random sequence for MSE-OFDM system.

This technique can be used for both uplink and downlink transmissions of mobile multimedia communications with variable data rates. While wireless technologies like LTE (Long Term Evolution)/LTE-Advanced are capable of providing high speed, large capacity, and guaranteed QoS mobile multimedia service, the D2D communication will become a key feature supported by the next generation cellular networks because of its many beneficial features. The major ones are to provide extended coverage, to make offloading, and to improve throughput and spectrum efficiency for cellular networks.

RESEARCH METHODOLOGY

A. Channel Simulation

In order to catch bit-level errors, we develop WMSN channel with a two-state Markov chain called Gilbert-Elliott channel. It has been illustrated that this is a good approximation of the error characteristics in a wireless channel. Figure 1 illustrates a state diagram for a 2-state Markov model of Gilbert-Elliott channel. In particular, this model abstracts busty error distribution with one state representing a heavy error rate (bad state) with a short interval, and the other representing a longer interval of light error (good state). further, each state having an associated error probability and state transition probabilities can be derived from the experimental channel data. Where P(GB) is the probability of the state transiting from a good state to a bad state, and P(BG) is the transition from a bad state to a good state. Based on the channel model that we just described, we can express the average bit error probability of the WMSN channel as follows:

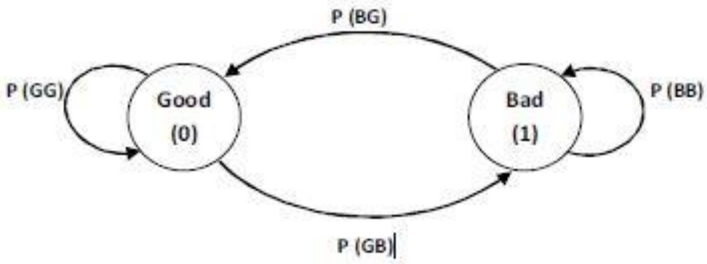

Figure 1. Markov model for Gillber-Elliot channel

$$\pi_G = \frac{p_{BG}}{p_{BG} + p_{GB}} \qquad \pi_B = \frac{p_{GB}}{p_{BG} + p_{GB}}$$

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$$p = p_G \pi_G + p_B \pi_B$$

B. Energy Consumption simulation

We use an energy model based on the MicaZ Motes in order to model the power consumption of a wireless multimedia node. This hardware is widely used in sensor network research and it is suitable for WMSNs because of its data rate and energy efficiency. According to our model, a node may consume energy during the reception, transmission, decoding, and encoding of transmitted/received packets as well as in the idle state. The power consumption during the transmit mode, the receive mode, and the idle mode, are denoted by , *r t P P* and *i P* respectively. If a sensor node spends T seconds transmitting or receiving a packet, the energy consumption can be computed as: E □T□ P *Tx t*□ *T* or E □T□ P *Rx r*□ *T* respectively. The energy dissipated during an idle listening period of T seconds is also calculated as: ( ) *I i E T* □ *PT* . Note that the major overhead of FEC codes is the energy consumption for decoding and encoding of packets. Since it is well known that the energy consumed at the FEC encoder is negligible , we only consider the decoding energy of FEC block codes in our simulations. In particular, the amount of power that multimedia sensor nodes require to decode RS codes is computed based on the total codeword length and the FEC code length. Hence, first the latency of decoding for a RS(u,w) is calculated and then the decoding energy consumption is computed using current and supply voltage of the processor. Note that RS (u,w) means w data bytes and (u-w) correction RS bytes where (u-w) correction bytes can restore (u-w)/2 corrupt bytes.

RESULTS AND DISCUSSIONS

In this section, we go through the results of robustness and efficiency of conventional error control protocols as a function of channel bit error rate (BER), error correcting capability, and maximum number of re-transmissions in WMSNs via extensive simulations. Simulation experiments are performed using ns network simulator along with a video quality evaluation tool named Evalvid to analysis the performance of error control schemas in terms of energy consumption, average peak signal-to-noise ratio (PSNR), and frame loss rate. The sender/receiver pairs are randomly chosen from a set within the area.

A. Frame Loss Analysis

Fig. 2, the frame loss rate is shown as a function of channel bit error rate for simple and hybrid error control schemas. Accordingly, RS (106,100) results in frame loss rate that is lower than both ARQ and RS (104,100). The ARQ schema with 7 retransmissions results in frame loss rate comparable to ARQ with 4 retransmissions, In particular.

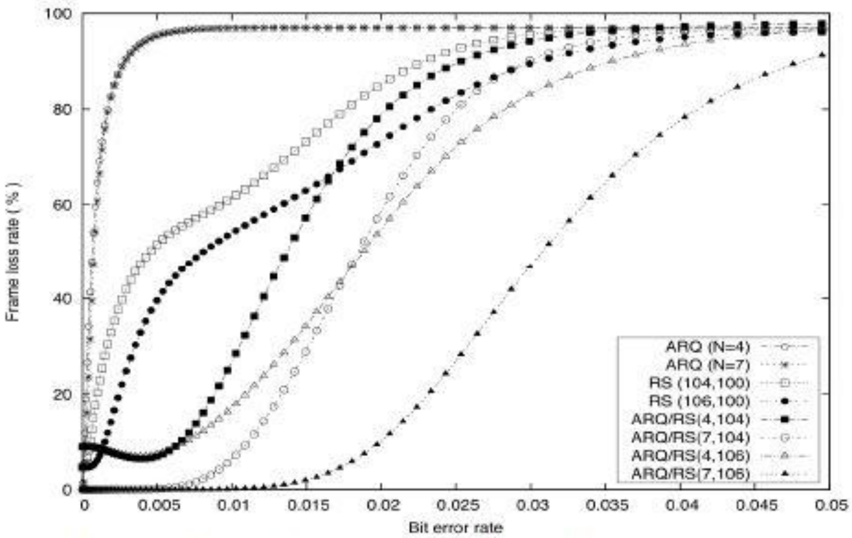

Figure 2. Frame loss rate versus channel bit error rates

B. Peak-Signal-to-Noise-Ratio Analysis

In this section, we investigate the performance of different error control schemas for video delivery over WSNs in terms of PSNR. A reasonable quality is provided for the end-user if typical PSNR of a frame be more than 30 dB. Fig. 3 shows the

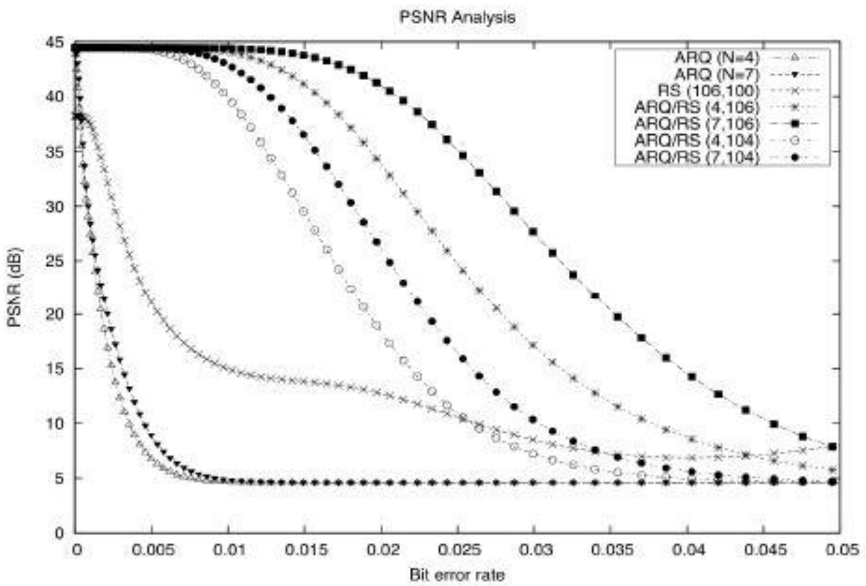

Figure 3. Average PSNR under varying channel bit error rates

Average PSNR of simple and hybrid error control schemas is decreased as channel bit error rate increases. This figure shows that the average PSNR of hybrid schemas do not drop until the channel BER reaches about .01, because these schemas are sufficient for error recovery under those BER conditions. However, the average PSNR begins to drop as the BER exceeds .01. Moreover, the drop in average PSNR is more severe for ARQ and RS (106, 100) error control schemas.

C. Energy Efficiency Analysis

The energy efficiency of the error control schemas that are discussed in this paper is shown for Micaz based wireless multimedia sensor nodes. The average power over all sensors for simple, and hybrid schemas subject to a channel bit error rate of .03 are shown as function of their error correction capability and maximum number of re-transmissions. In particular, the average power consumed is calculated by dividing the total energy consumed in sensors by the total simulated time.

CONCLUSIONS

In this paper, we performed simulations to comprehensively evaluate the performance of different error control mechanisms and development of efficiency in WMSNs. It is shown that the RS schema consumes energy efficiently; however, it cannot provide acceptable signals at the receiver in higher error rates, which does not come under the quality of service. Moreover, the ARQ schema has the worst performance in terms of PSNR. Furthermore, it can be observed from simulation results that hybrid ARQ/RS schema outperforms other schemas based on perceived video quality and frame loss rate, while it cannot provide the best energy-efficient results. Therefore, energy efficient reliable multimedia delivery is the most important change that needs to be addressed by new error control protocols for WMSNs. In the future work, we would extend this study to synthesis of other error control mechanisms such as erasure coding and cross-layer schemas. Furthermore, we also intend to add real time performance metrics like delay-constrained PSNR, end-to-end packet latency, and cumulative jitter to our comprehensive evaluations. This may be enhancing the quality of service of wireless communication at small scale.

The application layer protocol proposed in this paper incorporates an effective queue control strategy to reduce packet error rate. In addition, the protocol employs a strategy to allow only one node to transmit at a time, thereby reducing collision and congestion, and consequently the number of retransmissions. The quality of service is gained by practical results presented in the paper clearly demonstrate the effectiveness of the proposed techniques, namely significant reduction in energy cost of image communication. In contrast with the predictions made in available literature, the proposed strategies make communication over wireless sensor networks feasible.

Delivering service to meet end-user needs and expectations is essential for the continued development of a multimedia communications market. An end user's quality of service needs must be understood by all parties, from product designers to network administrators. The MMCF QOS framework provides the tools with which to develop discrete and useful yardsticks for different application categories. Although they may be among the first to use them, quality of service guidelines are not limited to use by design engineers. The QOS class system will be of considerable value to systems integrators, service providers, and end users who evaluate and identify desirable characteristics for networked multimedia solutions. The MMCF will continue to develop and publish updates to the quality of service document as applications, products, and services evolve.

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