International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol.2, Issue.4, July-Aug 2012 pp-2848-2851 ISSN: 2249-6645

Cross Layer Optimization for Multiuser Video Streaming Using Distributed Cross Layer Algorithm

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Abstract: *The Multimedia and networking are inseparable. The integration of multimedia services into wireless communication networks is a major source of future technological advances. Due to the integration of multimedia services, the increasing energy consumption of a mobile unit is also becoming a dominant factor in the design of communication systems. Video streaming over wireless networks is must for many applications, ranging from home entertainment to surveillance to search-and-rescue operations. Due to the increased energy requirement of signal processing and wireless transmission, the limited battery capacity of mobile devices has become a major drawback. This paper proposes a cross layer optimization algorithm, which includes routing based on neighbor discovery and dual congestion control for improving QoS. It helps in minimizing the energy required in transmission of video packets. This in turn leads to green computing*

Keywords - *Cross layer, Congestion control, Green computing, HCCA*

I. INTRODUCTION

This section provides a brief introduction about Wireless networks and multimedia

1.1 WIRELESS NETWORKS

Wireless network is a network set up by using radio signal frequency to communicate among computers and other network devices. It referred to as WiFi. They are of three types Wide area networks (WAN)that the cellular carriers create, Wireless local area networks(WLAN), that you create, and Personal area networks(PAN), that create themselves. The components of wireless network are Antennas, Transceivers, Integrated Circuits, Analogue-Digital Converters, LCD Screens and Batteries. Infrastructure of wireless network is Cell Towers**,** Base Stations (access points)**,** Filters**,** Routers & Switches**,** Power Amplifiers and Edge Packets. Working of wireless networks is two computers each equipped with wireless adapter and wireless router. When the computer sends out the data, the binary data will be encoded to radio frequency and transmitted via wireless router. The receiving computer will then decode the signal back to binary data.

IEEE 802.11 standards specify two operating modes: infrastructure mode and ad hoc mode. Infrastructure mode is used to connect computers with wireless network adapters,also known as wireless clients, to an existing wired network with the help from wireless router or access point. Ad hoc mode is used to connect wireless clients directly together, without the need for a wireless router or access point. An ad hoc network consists of up to 9 wireless clients, which send their data directly to each other

1.2 MULTIMEDIA

Multimedia means that computer information can be represented through audio, video, and animation in addition to traditional media (i.e., text, graphics drawings and images).

Multimedia is the field concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be represented, stored, transmitted and processed digitally. A Multimedia Application is an Application which uses a collection of multiple media sources e.g. text, graphics, images, sound/audio, animation and/or video. Hypermedia can be considered as one of the multimedia applications

1.2.1 GENERAL CHARACTERISTICS OF MULTIMEDIA SYSTEM

The four basic characteristics of multimedia systems are Multimedia systems must be computer controlled, Multimedia systems are integrated, the information they handle must be represented digitally, and the interface to the final presentation of media is usually interactive.

1.2.2 VIDEO STREAMING

Streaming video is content sent in compressed form over the Internet and displayed by the viewer in real time. With streaming video or streaming media, a Web user does not have to wait to download a file to play it. Instead, the media is sent in a continuous stream of data and is played as it arrives. The user needs a player, which is a special program that uncompresses and sends video data to the display and audio data to speakers. A player can be either an integral part of a browser or downloaded from the software maker's Web site. Major streaming video and streaming media technologies include Real System G2 from Real Network, Microsoft Windows Media Technologies

II. OBJECTIVE OF THE PAPER

The This paper proposes an algorithm called distributed cross layer optimization and cross layer optimization in order to prevent more amount of energy used in forwarding the video packets across the network.

When streaming live video across wireless links, two main sources of energy consumption are video coding and wireless transmission. In most of the state-of-the-art video encoders and wireless transmitters, there are configuration parameters which can be tuned based on varying channel conditions and/or video characteristics. It is desirable to minimize the energy consumption of all users, including both video coding and wireless transmission, while satisfying the video quality requirement imposed by the end-user.

Streaming can be more complex in a packet based network because they have strong and specific requirements. The QOS of the video streaming can specify some requirement which is the video data flows must be formatted, denoting that the latency between consecutive packets must be the same, the data bit rate has to be high and constant, and the video packet loss rate must be close to zero. Constant bit rate is needed to feed the decoder application in a proper way, and to see the video without interrupt.

III. Related Works

The main areas, the previous work concentrated are Low power design and changing the configuration parameters to reduce the energy during transmission of video packets.

3.1 LOW POWER DESIGN ISSUES

In the wireless network low power design issues have been addressed in the following four areas.

3.1.1 DEVICE LEVEL OPTIMIZATION

Low power VLSI design [2] and low power RF circuitry [3] optimization are the main technologies for energy saving approaches. Dramatic reduction in power dissipation requires architectural, algorithmic, and circuit design optimization, which are limited by semiconductor and device technologies.

3.1.2 MEDIUM ACCESS CONTROL (MAC) PROTOCOL DESIGN

Energy-efficient MAC protocol design principle has three constraints [4]

Packet structure. It partitions a packet into two parts: the low-bit-rate part for control information and the high-bit-rate part for data; due to the different error tolerant requirements of each part, one can achieve total energy saving.

Awake/Doze mode. It puts the system into the sleep mode while not receiving or sending data.

Error Control design. The description of this design can be found in the next item.

3.1.3 COMMUNICATION SYSTEM LEVEL OPTIMIZATION

A communication system-level optimization approach is devised called, global interference minimization [5]. Global interference minimization refers to the transmitter power control problem in cellular radio systems. This has provided an optimal solution in the sense that it minimizes interference (or outage) probability. The optimal solution for the power control problem involves solving eigen values of path gain matrices. This solution is computationally expensive and impractical in the real world.

There comes [6], [7] a simplified distributed power control algorithm to tackle this problem. The distributed power control algorithm differs from the centralized power control problem in which each mobile adaptively adjusts its transmitter power according to the received interference. The distributed method releases the computational task performed by each base station.

The CDMA power control strategy also provides a simple solution to the interference minimization problem. There are two types of power control algorithms, close-loop, and open-loop control [8], [9]. Close-loop control refers to the feedback made from the base station to mobile stations for adjusting mobiles' transmitted power. Open-loop control refers to the self transmission power adjustment of mobile stations by comparing the received signal strength from the base station with a reference signal level.

3.1.4 APPLICATION LEVEL DESIGN

Engineers are developing low complexity software or hardware for multimedia processing algorithms [10], [11]. Usually low complexity algorithms yield low energy consumption, provided that less iterations or looping are involved in the computation.

One of the reasons for not considering the power consumption issue in the resource management strategy has been the failure to acknowledge the importance of the interaction between the processing power and the associated transmission power.

3.2 HCF CONTROLLED CHANNEL ACCESS (HCCA)

The HCF (hybrid coordination function) controlled channel access (HCCA) works a lot like PCF(Point Coordination Function) it contrast to PCF, in which the interval between two beacon frames is divided into two periods of CFP (Contention Free Period) and CP(Contention Period), the HCCA allows for CFPs being initiated at almost any time during a CP. This kind of CFP is called a Controlled Access Phase (CAP) in 802.11e.

A CAP is initiated by the AP whenever it wants to send a frame to a station or receive a frame from a station in a contention-free manner. The other difference with the PCF is that Traffic Class (TC) and Traffic Streams (TS) are defined. This means that the HC (Hybrid Coordinator) is not limited to per-station queuing and can provide a kind of per-session service. Also, the HC can coordinate these streams or sessions in any fashion it chooses (not just round-robin). Moreover, the stations give info about the lengths of their queues for each Traffic Class (TC). The HC can use this info to give priority to one station over another, or better adjust its scheduling mechanism**.**

3.3 MULTIMODE ADAPTIVE POWER SAVING (MAPS) PROTOCOL

In protocol assumptions to be made are, i) The cellular network has a feedback power control mechanism, i.e., the base station commands mobile users to increase or decrease transmitted power through the control channel at a period of time. ii) The system is set for multimode transmission where radio frequency (RF) signal-to-noise (SN) ratios are different from mode to mode.

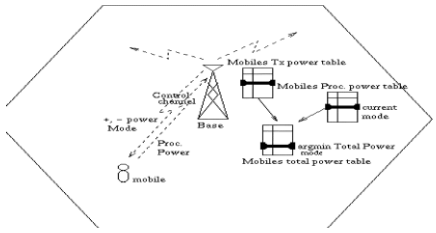


Figure.1 Base station controlled adaptive method

MAPS protocol can be summarized as,

Mobile ready to send, exchanging information between the base station and the mobile for the initial transmission power level and modes (e.g., in H.263 video transmission, one can set initially mode0 with intra coding frame).

After one frame is coded, the corresponding processing power is measured and sent to the base station, and it is stored in the processing power table. The remaining processing power levels of other modes are estimated by multiplying the pre-estimated inter mode factors.

The base station estimates the required transmitted power level of the mobile through the power control mechanism and stores the result in the transmission power table. Power levels of other modes can be easily found by multiplying different RF SN ratios.

Add the processing power table and the transmission power table to form a total power table. Find the minimum in the total power table and the corresponding mode.

The base station sends power and mode updates to the mobile; the mobile uses the new mode for next frame coding. Go back to step 2.

3.4 MULTIRATE TRANSMISSION SCHEME: MULTISTAGE CODED MODULATION (MCM)

To integrate a multimode coder into the power-saving system, an efficient transmission scheme has to be built. The beneficial transmission scheme is used here, therefore source/channel (S/C) rate optimized coding and multirate modulation (MM) are left as potential candidates.

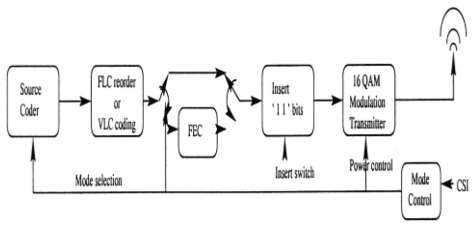


Figure.2 Multistage coded modulation

It has the simple reconfigurable QAM scheme and FEC coding that guarantee a given quality while minimizing transmission power consumption [12]. To make the switch between higher level and lower level modulation settings simpler, we introduce so-called inserted MQAM.

3.5 ISSUES IN THE RELATED WORK

Energy or power saving criteria is approached either from an information-theoretic perspective or from an implementation-specific viewpoint. Modulation strategies are derived for delay-bounded traffic. It is shown that when the transmit power and circuitry power are comparable, the transmission energy decreases with the product of bandwidth and transmit duration.

They however only consider an idealized network restricted to a single flow with no medium access controller (MAC) or link layer retransmissions, and with ideal constellation sizes.

Non-multimedia applications will experience degraded performance, cannot be universally applied to all network configuration.

IV. Problem Definition

In the proposed scheduling algorithm, we include routing based on neighbor discovery and dual congestion control for improving QoS. After receiving the request the resource server can schedule the request .that is the form a table for which node needs which data. After scheduling the resource server can perform three steps which are Analyze the nearest requested node by use of shortest path, check the requested nodes are neighbors of each other, Form the index for avoiding neighboring collision

If the requested nodes are neighbors of each other Resource server sent the RTS (ready to sent) and ID of the neighbor requested node and then Requested node can check the ID is a neighbor's ID. If the ID is a neighbor's ID the process move to congestion control otherwise the process move to routing component. If the requested nodes are not a neighbors of each other the process move to congestion control First Congestion Control Form the queue and sent RTS to first requested node and then Node can send the CTS (clear to sent) to the resource server Second Congestion Control Form the queue and sent requested data to that first sent CTS by the node and then Requested node can receive the data

4.1 DISTRIBUTED CROSS-LAYER ALGORITHM

In the Distributed Cross-Layer Algorithms for the Optimal Control scheduler implements joint application and fabric layer optimization scheduling algorithm. Cross-layer design introduces interlayer coupling across the application layer and the fabric layer and allows the exchange of necessary information between the application layer and the fabric layer.

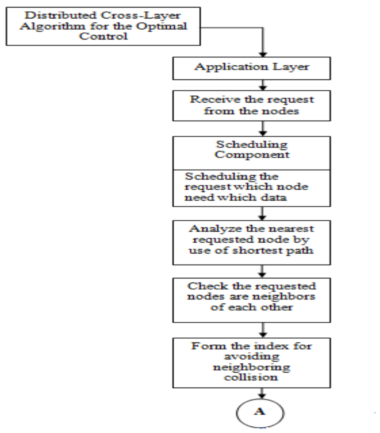


Figure 3 Distributed cross layer algorithm

First, calculate Cross-layer optimization of resource allocation throughput and Distributed Cross-Layer Algorithms for the Optimal Control throughput. Then Compare Joint optimization of resource allocation and User QOS satisfaction control & Distributed Cross-Layer Algorithms for the Optimal Control For wireless military mobile ad hoc networks, it requires a routing protocol that can dynamically adapt topology, and various other hierarchical changes of the network node.

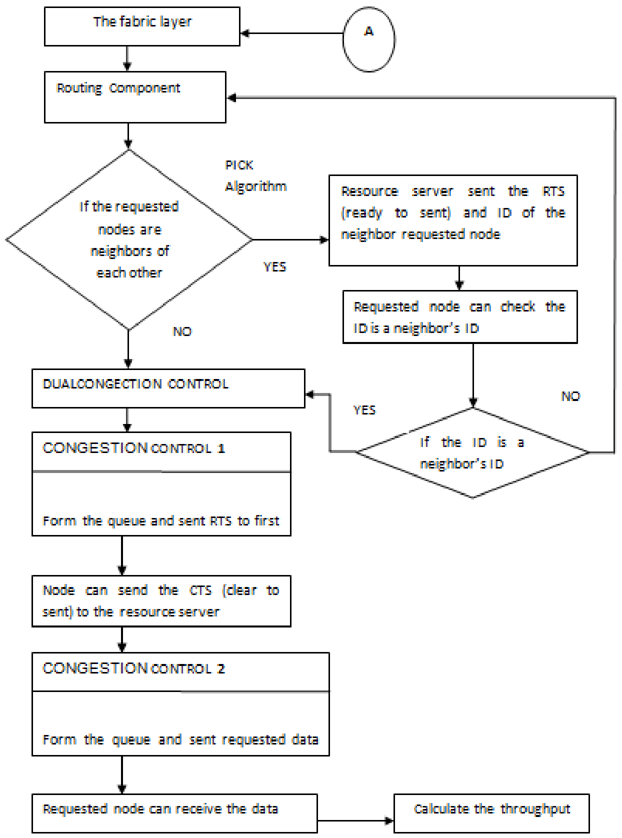


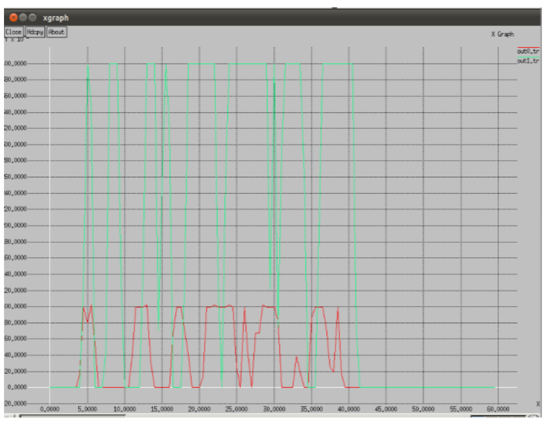
Figure.3 Distributed cross layer algorithm

4.2 ADVANTAGES OF PROPOSED WORK

This algorithm also helps in avoiding congestion control with the help of dual congestion control To reduce the run-time computation load, the fast greedy algorithm will be employed. Transfer the data packets**.** Each terminal finds the maximum quality factor for all its possible complexities, and the base station searches in the space of compression complexity. The parameters to be adjusted are source coding bit rates, compression complexity, and transmitter power for all users.

V. Graph

The graph shows that the throughput is high; also the time taken for delivering the packets is less. In this X-axis denotes the time and Y- axis denotes the number of packets.



VI. Conclusion

This proposed a cross-layer optimization scheme for multi-user video streaming using distributed cross layer optimization algorithm. The goal is to minimize total energy consumption of all users, including both video coding and wireless transmission energy, while satisfying video quality target. Source coding bit rates, and transmission power corresponding to the best compression complexity are taken together as the operating parameters. Since the energy consumption is reduced it achieves green computing.

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