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# Congestion Control for Multi-Path Transport Protocol Based Optimization Video Streaming

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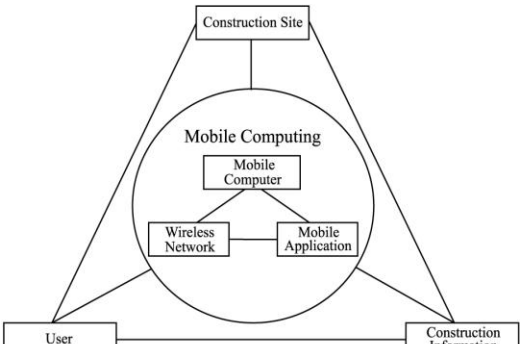
**Abstract:**
This paper presents a novel cross-layer optimization framework to improve the quality of user experience (QoE) and energy efficiency of the heterogeneous wireless multimedia broadcast receivers. User grouping is based on the respective UE resolution capabilities and received SNR. A UE capability is determined by the BS at the time of service subscription, when the UE sends its type information, i.e., the number of layers it wants to receive. The UE periodically updated its channel condition to the BS through the uplink channel. This joint optimization is achieved by grouping the users based on their device capabilities and estimated channel conditions experienced by them and broadcasting adaptive content to these groups. The adaptive multimedia content is obtained by using scalable video coding (SVC) with optimal source encoding parameters resulted from an innovative cooperative game. Energy saving at user terminals results from using a layer-aware time slicing approach in the transmission stage. Time slicing approach allows discontinuous reception at the UEs, thereby facilitating the UE to turn-off the radio when not receiving data bursts and hence saving energy. A trade-off between energy saving and QoE is observed, and is incorporated in the definition of a utility function of the players in the formulated heterogeneous user composition and physical channel aware game. An adaptive modulation and coding scheme is also optimally incorporated in order to maximize the reception quality of the broadcast receivers, while maximizing the network broadcast capacity. Compared to the conventional broadcast schemes, the proposed framework shows an appreciable improvement in QoE levels for all users, while achieving higher energy-savings for the energy constrained users.

**Keywords:** QoE - Quality of user experience, SVC - Scalable video coding, SNR – Signal to Noise Ratio

## I. INTRODUCTION

**Mobile computing** is human–computer interaction by which a computer is expected to be transported during normal usage. Mobile computing involves mobile communication, mobile hardware, and mobile software. Communication issues include ad hoc and infrastructure networks as well as communication properties, protocols, data formats and concrete technologies. Hardware includes mobile devices or device components. Mobile software deals with the characteristics and requirements of mobile applications.




Mobile Computing is "taking a computer and all necessary files and software out into the field". Mobile computing is any type of computing which use Internet or intranet and respective communications links, as WAN, LAN, WLAN etc. Mobile computers may form a wireless personal network.


**There are at least three different classes of mobile computing items:**

- Portable computers, compacted lightweight units including a full character set keyboard and primarily intended as hosts for software that may be parameterized, as laptops, notebooks, notepads, etc.

- Mobile phones including a restricted key set primarily intended but not restricted to for vocal communications, as cell phones, smart phones, phone pads, etc.
- Wearable computers mostly limited to functional keys and primarily intended as incorporation of software agents, as watches, wristbands, necklaces, keyless implants, etc. The existence of these classes is expected to be long lasting, and complementary in personal usage, none replacing one the other in all features of convenience..

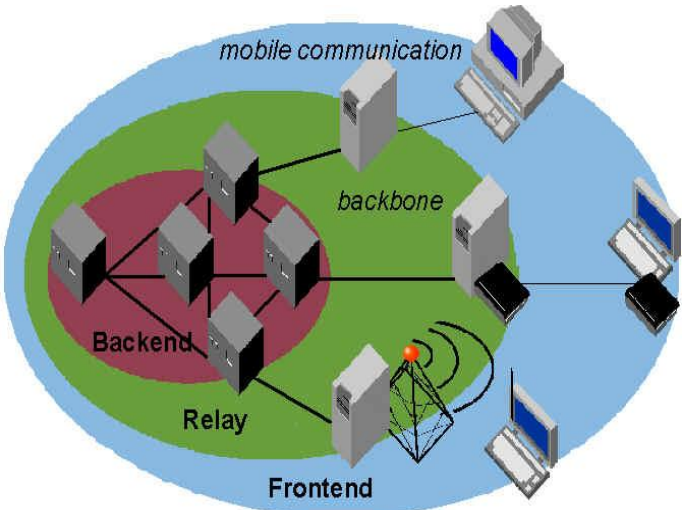
**DEVICES**

Many types of mobile computers have been introduced since the 1990s including the:

- Portable computer (discontinued)
- Personal digital assistant/Enterprise digital assistant (discontinued)
- Ultra-Mobile PC (discontinued)
- Laptop
- Smartphone
- Tablet computer

## II. SYSTEM OVERVIEW MOBILE DATA COMMUNICATION

Wireless data connections used in mobile computing take three general forms so Cellular data service uses technologies such as GSM, CDMA or GPRS, 3G networks such as W-CDMA, EDGE or CDMA2000.4G networks such as LTE, LTE-Advanced. These networks are usually available within range of commercial cell towers.




Wi-Fi connections offer higher performance, may be either on a private business network or accessed through public hotspots, and have a typical range of 100 feet indoors and up to 1000 feet outdoors. Satellite Internet access covers areas where cellular and Wi-Fi are not available and may be set up anywhere the user has a line of sight to the satellite's location, which for satellites in geostationary orbit means having an unobstructed view of the southern sky. Some enterprise deployments combine networks from multiple cellular networks or use a mix of cellular, Wi-Fi and satellite. When using a mix of networks, a mobile virtual private network (mobile VPN) not only handles the security concerns, but also performs the multiple network logins automatically and keeps the application connections alive to prevent crashes or data loss during network transitions or coverage loss.

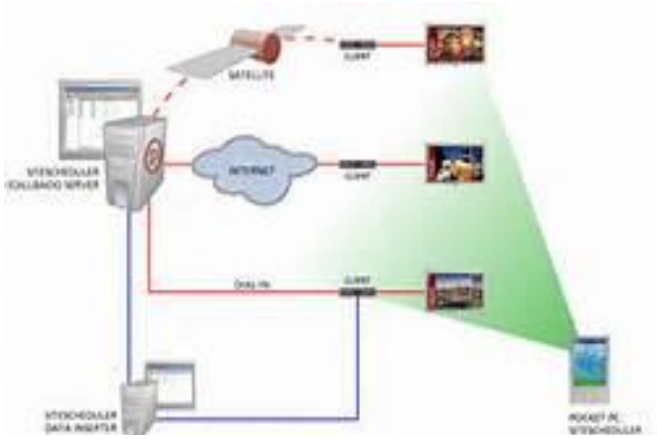
**WIRELESS MULTIMEDIA BROADCAST**

**Multimedia Broadcast Multicast Services (MBMS)**

Is a point-to-multipoint interface specification for existing and upcoming 3GPPcellular networks, which is designed to provide efficient delivery of broadcast and multicast services, both within a cell as well as within the core network. For broadcast transmission across multiple cells, it defines transmission via single-frequency network configurations. Target applications include mobile TV and radio broadcasting, as well as file delivery and emergency alerts.

**Wireless Multimedia Extensions (WME)**

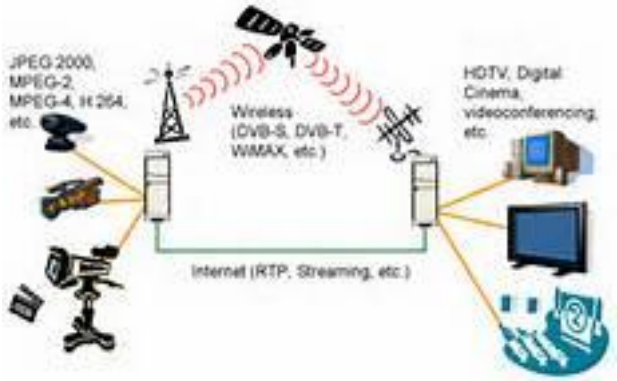
Is a Wi-Fi Alliance interoperability certification, based on the IEEE802.11e. It provides basic Quality of service (QoS) features to IEEE 802.11 networks. WMM prioritizes traffic according to four Access Categories (AC) - voice, video, best effort, and background. However, it does not provide guaranteed throughput. It is suitable for well-defined applications that require QoS, such as Voice over IP (VoIP) on Wi-Fi phones (VoWLAN). WMM replaces the traditional Wi-Fi DCF distributed coordination function for traditional CSMA/CA wireless frame transmission with EDCF, Enhanced Distributed Coordination Function, which according to version 1.1 of the WMM specifications by the Wi-Fi Alliance, defines four Access Categories (AC_BK, AC_BE, AC_VI, AC_VO) labels, for the EDCA Enhanced Distributed Channel Access parameters that are used by a WMM-enabled station to control how long it shall set its TXOP Transmission Opportunity, according to the information transmitted by the access point to the station, and is implemented for wireless QoS between RF media.



**Wireless Multimedia Broadcast**

In various embodiments, communication apparatus and methods for providing robust communications are disclosed. For

example, an exemplary communication apparatus for distributing media to one or more receiving apparatus may include receiving circuitry configured to receive a first wireless multimedia broadcast signal containing at least a first media stream, transmitting circuitry configured to wirelessly transmit one or more individual media streams simultaneously to the one or more receiving apparatus using one or more wireless transmit signals, and decision circuitry configured to control the transmitting circuitry to transmit the first media stream to at least one receiving apparatus using at least one wireless transmit signal type based on a forward-link data capacity of each wireless channel between the transmitting circuitry and each receiving apparatus.




The Wi-Fi Alliance has added Power Save Certification to the WMM specification. Power Save uses mechanisms from 802.11e and legacy 802.11 to save power (for battery powered equipment) and fine-tune power consumption. The certification provides an indication that the certified product is targeted for power critical applications like Mobile/Smart Phones and portable power devices (I.e Those that require battery or recharging such as smart phones.)

The underlying concept of WMM Power Save is that the station (STA) triggers the release of buffered data from the access point (AP) by sending an uplink data frame. Upon receipt of such a data (trigger) frame the AP releases previously buffered data stored in each of its queues. Queues may be configured to be trigger enabled, (i.e. a receipt of a data frame corresponding to the queue acts as trigger), and delivery enabled, (i.e. data stored at those queues will be released Maximizing the number of users served without affecting the Quality of user Experience (QoE). Clearly, attempting to receive a broadcast content irrespective of the device constraints is detrimental to battery resource efficiency, wherein the low-resolution mobile users suffer from redundant processing of high-end data that the device is not even able to use fully. Personal use is permitted, but republication/ redistribution requires IEEE permission

## III. SOFTWARE OUTPUT

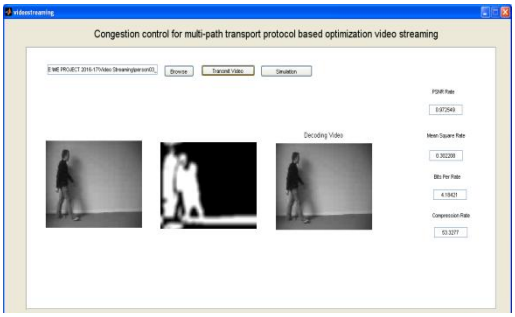



**Figure.1.ADMIT(transmission)**

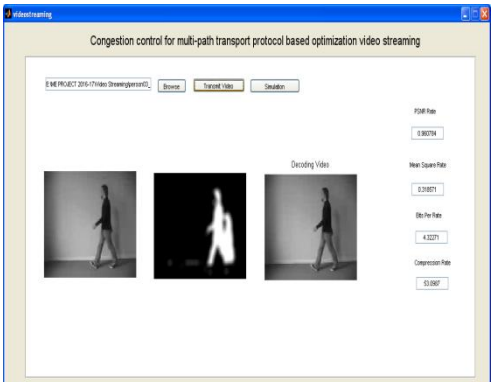



**Figure.2.ADMIT(transmission)**

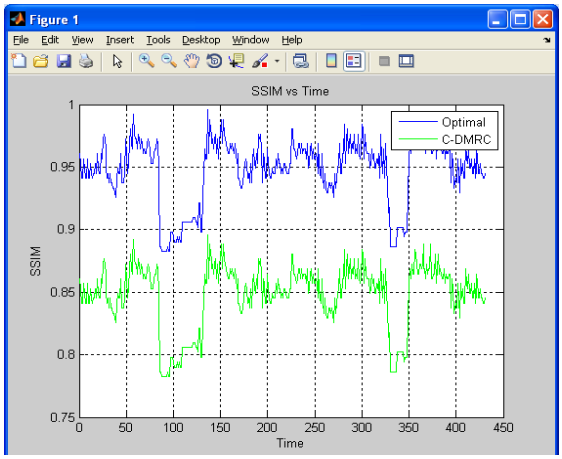



**Figure.3.Comparison of PSNR per video measured**

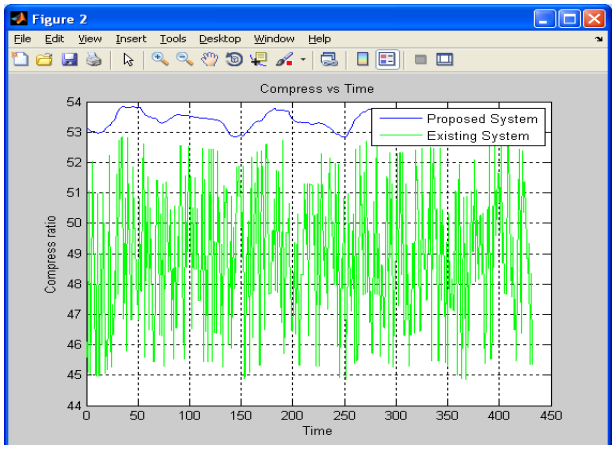



**Figure.4.Different sequence**

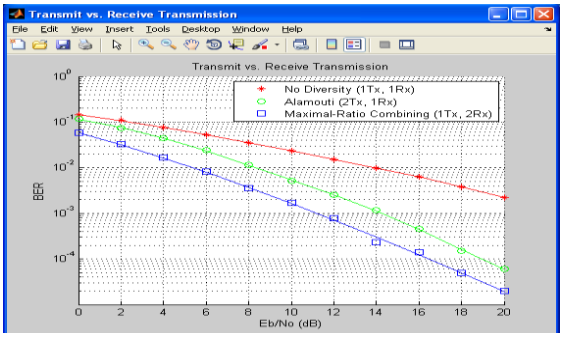



**Figure.5. Inter-packet delay (ms)**

## IV. CONCLUSION

The exponential growth of mobile video streaming over the internet has become a major driving force for multi home communication over heterogeneous wireless networks. Multipath TCP (MPTCP) is an important transport-layer protocol to enable parallel data transmissions over multiple communication paths.

## V. ACKNOWLEDGEMENT

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