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FLEXIBLE BROADCASTING OF SCALABLE VIDEO STREAMS IN BROADBAND WIRELESS SYSTEM

M.ShahidaBanu[1] ,P.Rajeswari[2]

II-M.E(CS)[1] , Associate Professor / ECE[2] , DhanalakshmiSrinivasan Engineering College, Perambalur.

Abstract—This paper presents a unique cross-layer optimization framework to boost the standard of user expertise (QoE) and energy potency of the heterogeneous wireless multimedia system broadcast receivers. User grouping relies on the several UE resolution capabilities and received SNR. A UE capability is decided by the SB at the time of service subscription, once the UE sends its sort info, i.e., the amount of layers it needs 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 supported their device capabilities and calculable channel conditions tough by them and broadcasting adaptive content to those teams. The adaptive multimedia system content is obtained by scalable video coding (SVC) with best supply cryptography parameters resulted from AN innovative cooperative game. Energy saving at user terminals results from employing a layer-aware time slicing approach within the transmission stage. Time slicing approach permits discontinuous reception at the UEs, thereby facilitating the UE to turn-off the radio once not receiving knowledge bursts and thence saving energy. A trade-off between energy saving and QoE is determined, and is incorporated within the definition of a utility operate of the players within the developed heterogeneous user composition and physical channel aware game. AN adaptive modulation and writing theme is additionally optimally incorporated so as to maximize the reception quality of the printed receivers, whereas increasing the network broadcast capability. Compared to the standard broadcast schemes, the projected framework shows AN considerable improvement in QoE levels for all users, whereas achieving higher energy-savings for the energy unnatural users.

Key words: -Adaptive multimedia broadcast and multicast, scalable video coding, adaptive modulation and coding, heterogeneous users, energy saving, quality of user experience.

1. INTRODUCTION

1.1 Multimedia Broadcasting

Multimedia broadcasting or knowledge casting refers to the utilization of the prevailing broadcast infrastructure to move digital info to a range of devices (not simply PCs). whereas the prevailing infrastructure of broadcast radio and tv uses analog transmissions, digital signals may be transmitted on subcarriers or sub channels. Also, each the radio and tv industries have begun a transition to digital transmissions.

Multimedia broadcasting are going to be developed in 3 basic dimensions. First, knowledge casting supports the transport of multiple knowledge sorts. this suggests that quite the normal period of time, linear, and prescheduled styles of audio and video programming are going to be accessible. Broadcast programming can become richer and a lot of involving by increasing its artistic palette to include totally different knowledge sorts and investing the process power of intelligent receivers and PCs on the consumer facet. Second, whereas a number of this knowledge are going to be associated with the most channel programming (i.e., typical radio and tv programming), different knowledge whole unrelated to traditional programming are going to be transported. And third, broadcast applications can interoperate seamlessly with different non-broadcast client-server applications like World Wide internet sessions.

1.2 Multimedia Broadcast Multicast Services (MBMS)

Is a point-to-multipoint interface specification for existing and forthcoming 3GPP cellular networks, that is meant to supply economical delivery of broadcast and multicast services, each among a cell moreover as among the core network.

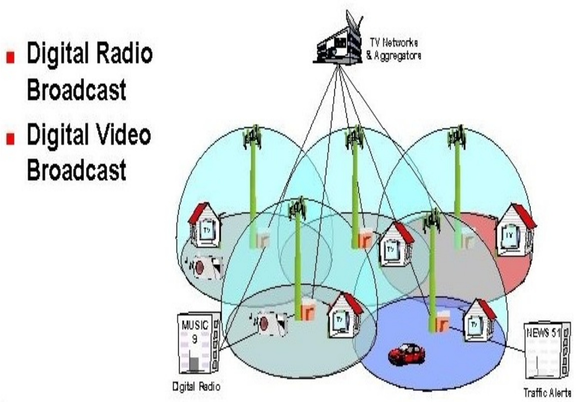

Fig 1. **Multimedia Broadcast Multicast Services** (**MBMS**)

For broadcast transmission across multiple cells, it defines transmission via single-frequency network configurations. Target applications embody mobile TV and radio broadcasting, moreover as file delivery and emergency alerts.

1.3 Evolved Multimedia Broadcast and Multicast Services (eMBMS)

Evolved multimedia broadcast and multicast services (eMBMS) deliver multimedia multicast streaming and download services in the long term evolution (LTE) networks. Although power and spectral efficient, power efficient high quality multimedia multicast in eMBMS is a challenge. As a multicast system with uplink feedback, the eMBMS performance is limited by the capacity of the poor

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receivers. This is because multicast systems choose modulation and coding scheme (MCS), and multicast transmission power based on the capacity of the poor receivers. MCS decides the transmission rate. Therefore, decided by the poor receivers, it prevents the users with higher capacity to enjoy higher reception rates. Naive power settings also increase transmission power to better cover the poor nodes. This results in increased power consumption and interference. There are two different categories of solutions trying to alleviate power consumption in high-quality multimedia multicast over wireless networks.

1.4 Motivation and Proposed Solution

In multimedia broadcast, one challenge is posed by user end heterogeneity (e.g., different display size, processing capabilities, and channel impairments). Another key component that consumers highly care about is the battery lifetime of their high-end mobile device. It is known that, real-time multimedia applications demand strict Quality of Service (QoS), but they are also very power-hungry. Given the above user-end constraints, a service provider would look for 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.

There have been a few recent studies that address receiver energy constraints, display limitations and channel dynamics, source and channel rate adaptation. Yet to our best knowledge, a comprehensive look into the optimal broadcast strategy that jointly caters to both user-specific constraints and network dynamics is still missing.

This paper presents a novel cross-layer optimization framework to improve both user QoE levels and energy efficiency ofwireless multimedia broadcast receivers with varying displayand energy constraints. This solution combines usercomposition-aware source coding rate (SVC) optimization,optimum time slicing for layer coded transmission, and a cross-layer adaptive modulation and coding scheme (MCS).

2. RELATED WORKS

In this paper [3] Faria, J. Henriksson, E. Stare, and P. Talmola offers a short review of the new Digital Video Broadcasting—Handheld (DVB-H) normal. this is often supported the sooner normal DVB-T, that is employed for terrestrial digital TV broadcasting. The new extension brings options that build it potential to receive digital video broadcast sort services in hand-held, mobile terminals. The paper discusses the key technology elements—4K mode and in-depth interleavers, time slicing and extra forward error correction—in some detail. It additionally offers in depth vary of performance results supported laboratory measurements and real field tests.

In this paper [5] C.-H. Hsu and M. M. Hefeeda GLATSB propose a brand new broadcast theme to attain energy saving diversity while not acquisition long channel switch delays, and that we sit down with it as Generalized Layer-Aware Time Slicing with Delay certain (GLATSB).The GLATSB theme is associate degree extension of the GLATS theme aims to cut back channel switch delays. The delay reduction is predicated on the subsequent observation. Long channel switch delays ar part thanks to the dependency among totally different layers.

In this paper [7] W. Ji, Z. Li, and Y. Chen propose a framework of broadcasting versatile rate and reliable video stream to heterogeneous devices. Our objective is to maximize the whole reception quality of heterogeneous QoS users, and also the resolution is predicated on joint temporal-spatial climbable video and Fountain writing improvement. Aim at heterogeneous devices characteristics together with various show resolution and variable channel conditions. we tend to introduce a hybrid temporal and special rate-distortion metric supported video summarization and user preference. supported this hybrid metric, we tend to model the whole reception quality provision downside as a broadcasting utility achieving downside.

In this paper [2] S. Parakh and A. Jagannatham propose a game suppositional framework for redistributed H.264 climbable video bitrate adaptation in 4G wireless networks. The framework bestowed employs a rating based mostly utility perform towards video streaming quality improvement. Associate degree rule is bestowed for unvarying strategy update of the competitive climbable coded video streaming finish users towards associate degree equilibrium allocation. during this context we tend to demonstrate the existence of Nash equilibrium for the planned video bitrates adaptation game supported the quasi-concavity of internet video utility perform. Existence of Nash equilibrium ensures economical usage of the 3G/4G information measure resources towards video quality and revenue maximization.

In this paper [1] IST Mobile Summit, Dresden, Germany, G. Xylomenos compares the cluster management mechanisms employed in the information processing and also the MBMS multicasting models. once outlining the look of every model, we tend to describe the cluster management protocols that they use. we tend to then examine however the information processing cluster management protocols will be tailored for MBMS and at last appraise the cluster management approach adopted by MBMS. Our main findings ar that IGMP v.2 is preferred to be used with MBMS, that the join/leave cluster management approach of MBMS outperforms the query/report approach of information processing which the reliableness of the MBMS approach will be increased by up calls.

3. OVERVIEW OF THE PROPOSED SYSTEM

A single-cell broadcast scenario is considered. Multimedia content delivery is done from the BS and managed jointly with a connected media server. The wireless user equipments (UEs) have varying display resolution and battery capabilities. Based on the users characteristics in the celland their SNRs, the media server suitably encodes the source content in H.264/SVC standard

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of DVB-H. The broadcast over the physical channel is OFDM-based. AUE, depending on its current status, may choose to receive all or part of the broadcast content (layers) by exploiting the timesliced transmission feature of DVB-H. Fig. 1 illustrates a representative system, where L layers and T user types are considered. For example, $L = 14$ in the standard 'Harbor' video sequence.

3.1 DVB-H System Framework

The proposed overall system architecture is illustrated in Fig. 2. The server encapsulates the SVC encoded data in real-time transport protocol (RTP) format to IP packets and sends them to the BS. The BS comprises of the IP encapsulator, DVB-H modulator, and the radio transmitter.

IP encapsulator puts the IP packets into multiprotocol encapsulation (MPE) frames and forms MPE-FEC for burst transmission as per the time slicing scheme.The DVB-H modulator employs an adaptive MCS selection for the layered video content and sends it to the radio transmitter for broadcast. The SVC encoding and MPE-FEC framing operations are inter-dependent and jointly optimized based on some underlying parameters (user, channel, and layer information). The optimized video encoding parameters are obtained through a game theoretic approach and stored in a central database. The UE and channel aware usergrouping is discussed in, and SVC parameter optimizationgame. The UE informs its capabilities while subscribing to the broadcast service and also time-to-time updates its signal strength to the BS. It also has a power manager that helps to take advantage of the time slicing scheme and save energy based on its remaining power.

3.2 PERFORMANCE MODELING AND OPTIMIZATION

3.2.1 Grouping of Users

User grouping is based on the respective UE resolution capabilities and received SNR. AUE 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.

3.2.2 Time Slicing as an Energy Saving Measure

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.

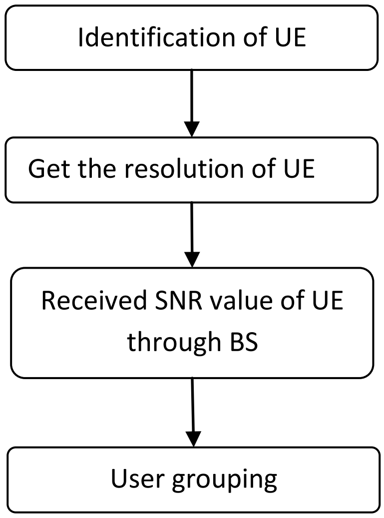

Fig. 2. Grouping of users

The broadcast channel rate is considered R (bps). The multimedia content is encoded into L layers. For decoding the layer l ($1 \le l \le L$) the UE first needs to correctly receive and decode all layers `$l$, $1 \le$ `$l < l$. Video layer l is allocated rate *rl*(bps), such that _*Ll*=1 *rl*≤ *R*.

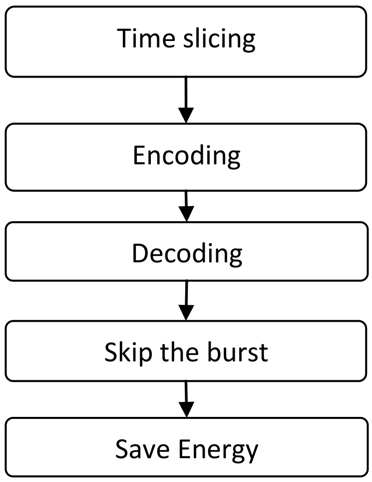

Fig. 3. Time Slicing as an Energy Saving Measure

In time slicing-based layered broadcast, the UEs know apriori the specific layer constituted in a MPE-FEC frame (burst). As shown in Fig. 4, each layer corresponds to a different burst within the recurring window. This allows a UE to safely skip the bursts containing the layers that are irrelevant to it, and thereby save energy. Each MPE-FEC frame consists of two parts: Application Data Table that carries the IP packet, and an R-S (Reed-Solomon coding) Data Table that carries the parity bits.

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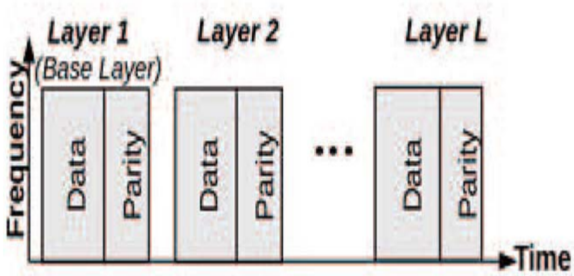


Fig. 4. Time slicing based DVB-H broadcast scheme

3.2.3 Video Quality Model

The video quality *Q(q, t)* is a parametric function that best approximates the Mean Opinion Score (MOS). MOS is a subjective measure that indicates the user QoE level. MOS to 'excellent' quality, 4 is 'good', 3 is fair, 2 is 'poor', and 1 is 'bad'. The parameters for the quality model arespecific to a video based on its inherent features.

3.2.4 Adaptive Modulation and Coding Scheme

In our approach, besides user-andchannelaware SVC rate optimization at the applicationlayer and time slicing at the link layer, at the physical layer adaptive MCS is applied which is optimized for enhanced energy efficiency and network capacity. Clearly, this adaptation is a function of the heterogeneous users composition in a cell and the dynamic physical channel rate constraint. Physical channel dynamics is accounted in a slow (shadow fading) scale to avoid high bandwidth overhead of frequent channel state feedback and computation of coding andMCS optimizations at the BS as well as the video server.

3.2.5 Video Reception Quality Measure

For a fair comparison of the quality of reception performance of the different competitive strategies, we define a video reception quality measure.

4. EXPERIMENTAL RESULTS

4.1 Energy-Quality Trade-Off Performance With Time Slicing Technique

For instance, 90% of type 1 users, the joint optimization approach results in energy saving of more than 90% for the UEs, with approximately 20% quality. This is because, more than 90% users are energy-constrained and the objective is to satisfy these users in terms of their energy-saving. It is also notable that, since each user has the independent control of time-sliced reception, even though the high-end users may not achieve the maximum desired quality due to the system optimization for large proportion of low-end users, they can improve the QoE by the time slicing flexibility.

4.2 Adaptive MCS Performance

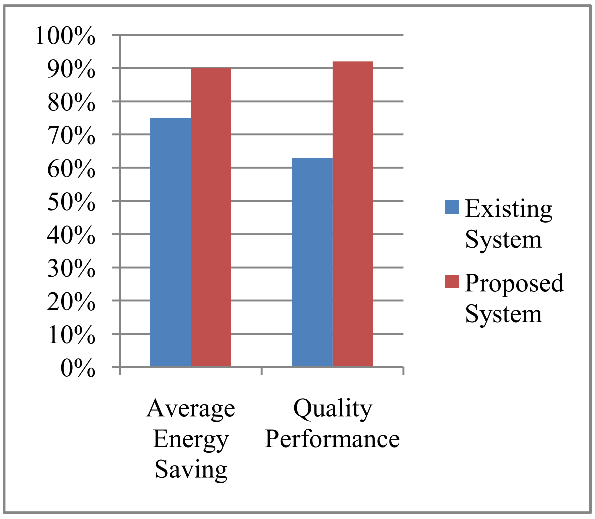
It can be noticed that the adaptive MCS outperforms the other two MCS schemes in terms of the number of served users. Moreover by using the adaptive MCS the received number of layers are very close to the requested number of layers, reflecting a higher amount of user satisfaction.

4.3 Energy-Quality Trade-Off With Optimized SVC and Adaptive MCS

Under the six user-heterogeneity scenarios with adaptive MCS, when compared with 'ES only' strategy, the 'ES+Q' strategy offers on average, about 43% higher quality. The corresponding trade-off on the amount of energy saving is only about 8%. With respect to 'Q only' scenario, the 'ES+Q' scheme offers about 17% extra energy saving as well as about 3.5% higher quality performance.

Performance comparison

Method	Average Energy Saving	Quality Performance
Existing System	75%	63%
Proposed System	90%	92%



Proposed cross-layer optimization solution to improve both the quality of user experience (QoE) and energy efficiency of wireless multimedia broadcast receivers with varying display and energy constraints. 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.

5. CONCLUSION

This paper presents a novel cross-layer optimization framework to improve both user QoE levels and energy efficiency of wireless multimedia broadcast receivers with varying display and energy constraints. This solution combines user composition-aware source coding rate (SVC) optimization, optimum time slicing for layer coded transmission, and a cross-layer adaptive modulation and coding scheme (MCS). The 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 optimization is a game theoretic approach which performs energy saving versus reception quality trade-off, and obtains optimum video encoding rates of the different users. This optimization is a function of the proportion of users in a cell with different capabilities, which in turn determines the time slicing proportions for different video content layers for maximized energy saving of low-end users, while maximizing the quality of reception of the high-

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end users. The optimized layered coding rate, coupled with the receiver groups' SNRs, adaptation of the MCS for transmission of different layers, ensure higher number of users are served while also improving users' average reception quality. Thorough testing has shown how the proposed optimization solution supports better performance for multimedia broadcast over wireless in comparison with the existing techniques.

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ShahidaBanureceived the B.E degree in Electronics and Communication Engineering from Anna University, India in 2013. She is currently pursuing M.E degree inCommunication Systems, Anna University,India. Her research interests mainly include wireless communication and broadcasting.

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