INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATIONS AND ROBOTICS
ISSN 2320-7345

IMPLEMENTATION OF SECURE AND ENERGY-EFFICIENT COOPERATIVE VIDEO DISTRIBUTION OVER WIRELESS NETWORKS

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Abstract

In a real-time video broadcast where multiple users are interested in the same content, mobile-to-mobile cooperation can be utilized to improve delivery efficiency and reduce network utilization. Under such cooperation, however, real-time video transmission requires end-to-end delay bounds. Due to the inherently stochastic nature of wireless fading channels, deterministic delay bounds are prohibitively difficult to guarantee. For a scalable video structure, an alternative is to provide statistical guarantees using the concept of effective capacity/bandwidth by deriving quality of service exponents for each video layer. Using this concept, we formulate the resource allocation problem for general multi hop multicast network flows and derive the optimal solution that minimizes the total energy consumption while guaranteeing a statistical end-to-end delay bound on each network path and secured video transmission.

Keywords*:* wireless fading channels, real-time video broadcast, statistical QoS guarantees, mobile-to-mobile cooperation.

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1. INTRODUCTION

The real-time nature of video broadcast demands quality of service (QoS) guarantees such as delay bounds for end-user satisfaction. Given the bit rate requirements of such services, delivery efficiency is another key objective. The basic level of quality is supported by the base layer and incremental improvements are provided by the enhancement layers. Deterministic delay bounds are prohibitively expensive to guarantee over wireless networks. Consequently, to provide a realistic and accurate model for quality of service, statistical guarantees are considered as a design guideline by defining constraints in terms of the delay-bound violation probability. For scalable video transmission, a set of QoS exponents for each video layer are obtained by applying the effective bandwidth/capacity analyses on the incoming video stream to characterize the delay requirement. The problem of providing statistical delay bounds for layered video transmission over single hop uni cast and multicast links was considered in this system. For general multi hop multicast network scenarios, it is inefficient to allocate resources independently among network links since the variation in the supported service rates among different links affects the end-to-end transport capability in the network. Cooperation among mobile devices in wireless networks has the potential to provide notable performance gains in terms of increasing the network throughput, extending the network coverage, decreasing the end-user communication cost, and decreasing the energy consumption. Minimizing energy consumption in battery-operated mobile devices is essential for the development of next generation heterogeneous wireless communications systems.

We model the queuing behaviour of the cooperative network according to the effective capacity link layer model. Based on this model, we formulate and solve the flow resource allocation problem to minimize the total energy consumption subject to end-to-end delay bounds on each network path.

The review of some Video distribution mechanisms and its pitfalls is presented in Section 2. The proposed scheme, the system architecture and its advantages is described in Section 3. In Section 4, different modules of proposed scheme are described. Finally, conclusions and future work of the proposed resource allocation and flow selection schemes are drawn in Section 5.

2. Related Work

A rich body of literature is focused on different mechanisms used for video distribution.The problem of transporting layered video over erroneous multi-hop wireless networks is presented in [3] and proposed a Distributed System; comprised of Distributed Control (DC), Distributed Buffer (DB) schemes. The DC scheme improves the efficiency of the network bandwidth usage and reduces the end-to-end delay of the streaming application. End-to-end delay jitter can be reduced by proper use of the DB nodes buffer. In [4], the authors propose distributed video scheduling schemes for multi-radio multihop wireless networks to minimize video distortion and ensure distortion-fairness sharing among multiple description video streams. The distortion model is constructed to provide a balance between the selfish motivation of minimizing video distortion and the global performance of minimizing network congestion. In [5], cooperative network architecture is presented and experimentally evaluated to reduce energy consumption in multi-radio mobile devices for video streaming applications. In [6], a comprehensive experimental study is conducted where results presented demonstrate notable energy reduction gains by collaborative downloading.

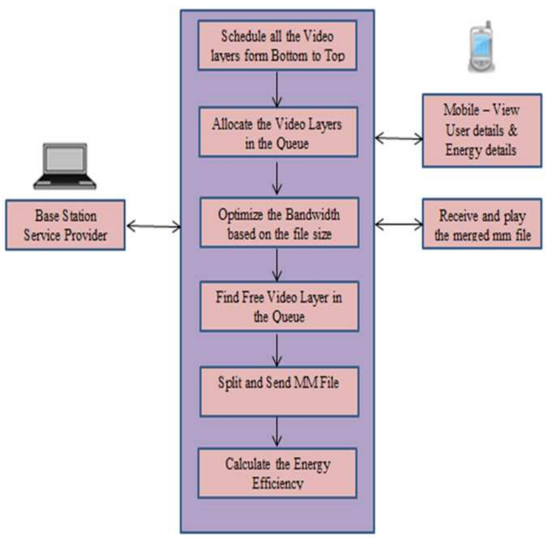
While the work in [4] addresses optimized rate allocation and routing over cooperative wireless networks, it is fundamentally different from our work since we consider minimizing energy consumption and transferring video file securely as the central objective, providing statistical delay guarantees, and capturing layered video content with QoS requirements per layer.

3. Proposed Scheme

The proposed system transfers the video file from base station to the remote user and enhances the Quality of Service by introducing the number of video layers. The security has been enhanced splitting each video file to many number of video frames so that if a hacker tries to get some of the frames he will not be able to extract the full video file. We formulate the resource allocation problem for general multi hop multicast network flows and derive the optimal solution that minimizes the total energy consumption while guaranteeing a statistical end-to-end delay bound on each network path. We also propose low complexity approximation algorithms for energy-efficient flow selection.

3.1 System Architecture

The architecture diagram of the proposed scheme is displayed here.



3.2 Advantages of Proposed Scheme

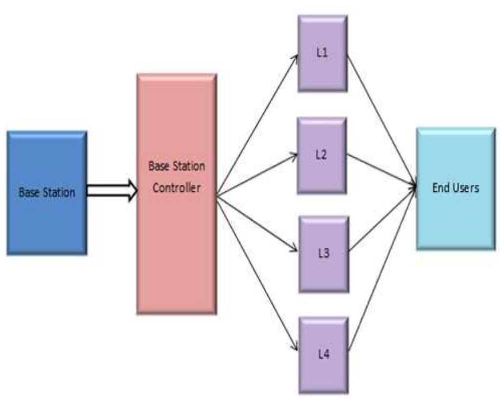
- The Proposed System provides Energy Efficient Resource Allocation and Flow Selection
- End-to-End Delay Bounds on Network Paths
- Queuing Network Model for Multi hop Layered Video Transmission
- The video stream generated by the scalable video code consists of 'N' video layers. Each layer maintains a separate queue at each node and has specific QoS requirements according to its relevance in the decoding process.
- Approximation Algorithms For Flow Selections
- Splitting of video files for security

4. Module Description

The proposed work is basically a framework designed in java swing with the following modules.

4.1 Slot Allocation and Flow Selection

The system need to inform the Base stations in which time slot their data frame transmissions allowed in one time slot is u and M! is the scheduling decision vector. If exactly u data frames scheduled Video frames should be transmitted. The maximum number of the simultaneous are transmitted in every time slot, number of all data frames can be easily determined in the video layers. However, if there are not so many data frames transmitted in video layer, the combined video frames of a video files varies with the number of data frames transmitted in the same time slot.



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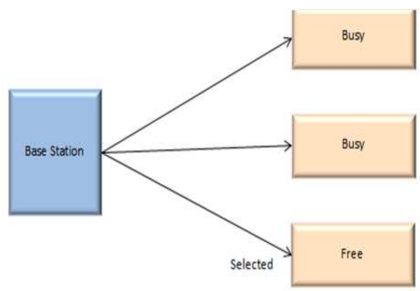
May-June: 2013

4.2 Queuing Analysis

Before presenting the optimization of the video data, we need to first analyze the average number of Video layers available in the Base Station. If a particular video layer is busy to transfer the data, then the another video layer is checking in the queue which is free. If the specified video layer is free then the data is sending via that video layer.

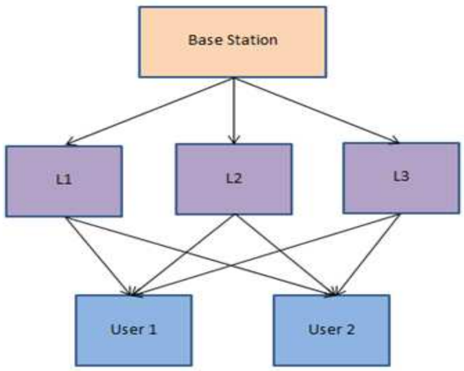


4.3 Effective Bandwidth/Capacity Model

The effective capacity channel model captures a generalized link-level capacity notion of the fading channel by characterizing wireless channels in terms of functions that can be easily mapped to link-level QoS metrics, such as delay-bound violation probability. Thus, it is a convenient tool for designing QoS provisioning mechanisms. The bandwidth optimization technique improves the Network QOS by optimizing the band width based on the file size.

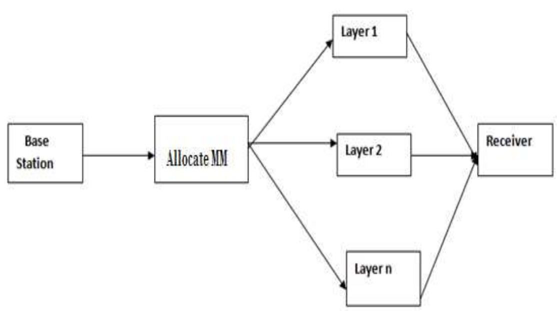
4.4 Approximation Algorithms for Flow Selection

Finding the globally optimal distribution strategy requires converting each of the N Video layers sequences into a spanning tree and finding the minimal energy consumption using that tree structure, then choosing the tree that minimizes energy consumption among all candidates, and allocating resources accordingly. Here, we propose two approximation algorithms to reduce the complexity involved in choosing the best flow for a given fading state. The objective of the proposed algorithms is to avoid searching through the exponential number of possible tree structures. The first algorithm uses negated SNRs as link weights on the complete network graph, and finds the minimum spanning tree using these weights. The second algorithm is based on selecting a set of dominant flows that are optimal for a large percentage of fading states for a given network topology.



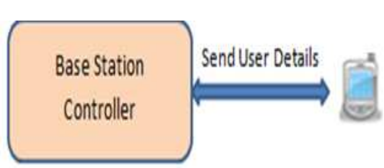
4.5 Video Broadcasting

The requested video is send by BS through the free video layer to users and the MM file can be viewed at receiver side without buffering. The network flow for video content distribution can be any sequential multi hop multicast tree forming a directed acyclic graph that spans the network topology. We mode the queuing behaviour of the cooperative network according to the effective capacity link layer model.



4.6 View User Details via Mobile

Each user details can be viewed by the administrator via mobile. Hence there is no need for the administrator to physically present in BS. Administrator can review the details in future.



5. Conclusion and Future Work

In this paper, we have presented optimal resource allocation solution for scalable video distribution over cooperative multi hop networks to minimize the total energy consumption subject to end-to-end statistical delay bounds per network path. The solution ensures secured reliable delivery of the video content to all requesting mobile terminals.

In future, we can apply ECC for Security, so that the video files will be encrypted and send by the base station. We can also generate the alerts about the users via hand held mobile devices.

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3 Video Streaming Over Multi-hop Wireless Networks

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