Independent Study report:
Instructor: Paul Amer
Student: Varun Sharma

Recent advances in technology have enabled battery powered portable devices to be equipped with wireless interfaces, enabling wireless communication while on the move. In comparison to wired communication, wireless communication is much harder to achieve due to interference, noise and heterogenous nature of the environment. There have also been significant advances in video coding technology which have given rise to a number of ubiquitous mobile media applications like group video conferencing between participants from multiple sites and live broadcast of the Olympic games to multiple devices in an airport lounge. Modern portable devices vary considerably with regards to network bandwidth, power consumption, screen resolution and decoding capabilities. Scalable video coding is being developed and researched to cater to the needs heterogenous clients for robust video delivery. The Scalable Video Coding standard facilitates the encoding of a video at different qualities within the same bit stream, which include different resolutions, different frequencies, different video quality. The advantage of multicast architecture to deliver scalable videos to a group of multiple heterogenous clients demanding varying video resolution can be exploited. Wireless video transmission pose several challenges like Delay-sensitivity, high data rate, limited battery span and limited wireless bandwidth. Numerous efforts have been taken in the area of energy efficient scheduling and resource allocation for video streaming over a constrained network. Current SVC streams consist of multiple layers which helps to boost spatial, temporal or image quality of the video. The open issue of resource allocation and scheduling in video over the resource constrained network is investigated and tackle the problem of minimizing the energy consumption of wireless devices and maximizing the video quality at the receiver.

The rest of the paper is organized as follows. A brief summary of the related works in the literature in section II. In section III the proposed design is described. In section IV the modules are described. In section V simulation results are presented and in section VI is the conclusion.

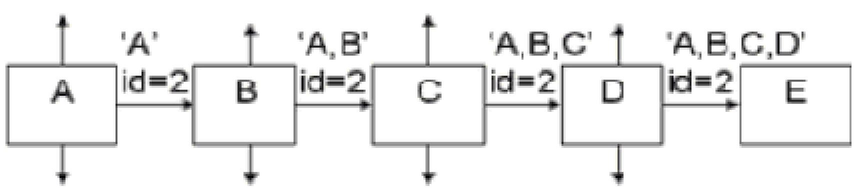
Section II: Related Work

Scheduling and multiuser resource allocation problem as been investigated to a great extent but these past studies [3,4,5] did not take into consideration energy efficiency during transmission. In mobile ad-hoc networks the problem of energy efficient transmission of video PDUs has been of a major interest recently. [6]have presented an adaptive mechanism for a time varying network link status for video transmission over wireless ad hoc networks. In their work they have also developed an adaptive scheme to reduce energy dissipation. [7] have successfully prolonged the battery life of a mobile device by taking into consideration the energy consumption of the video encoder, They further investigated the Rate-distortion behavior and provided a framework for performance optimization in mobile video communication under energy constraints.
Most of the wireless standards like the IEEE801.11 abd IEEE802.16 do not support random

transmission rates. The Modulation and Coding Scheme (MCS) have fixed the transmission rates to pre-defined values, however transmission power can be optimized as the mCS adapts to varying channel conditions.[8] have shown by constructing burst transmission schedules they have managed to reduce energy consumption without sacrificing the video quality.
At the same time several routing and scheduling algorithms have been developed to reduce energy utilization in wireless devices. [9] proposed energy-efficient algorithm for the video transmission scheduling in wireless P2P live streaming system, to minimize the playback freeze-ups among peers. [10] have proposed an energy efficient Wireless Sensor Networks (WSNs) routing protocol and a packet scheduling algorithm enabling the reduction of the video transmission rate with the minimum possible increase of distortion. In mobile ad-hoc networks, video multicasting is best-effort in nature which has limited channel access time and limited transmission energy. In the literature survey many of the techniques focus on reliable transmission of video packets in wireless unicast links. In this work the main focus is on wireless multicast of scalable video for a diversified set of clients.

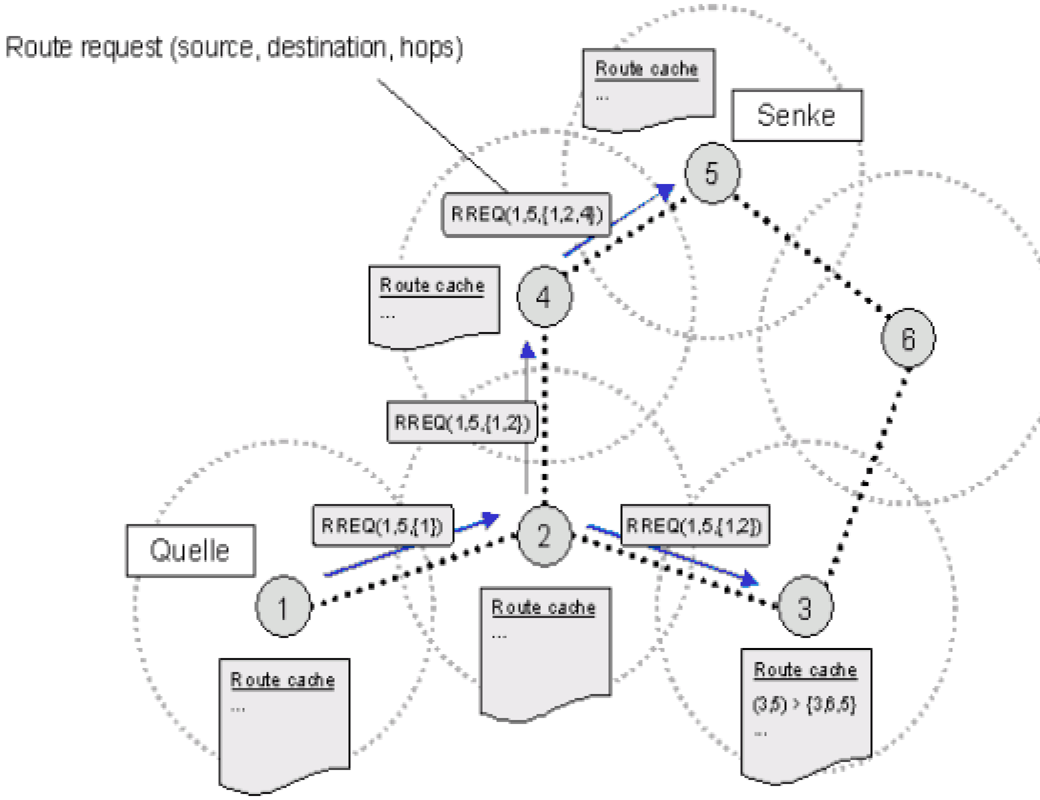
Section III: Proposed Design

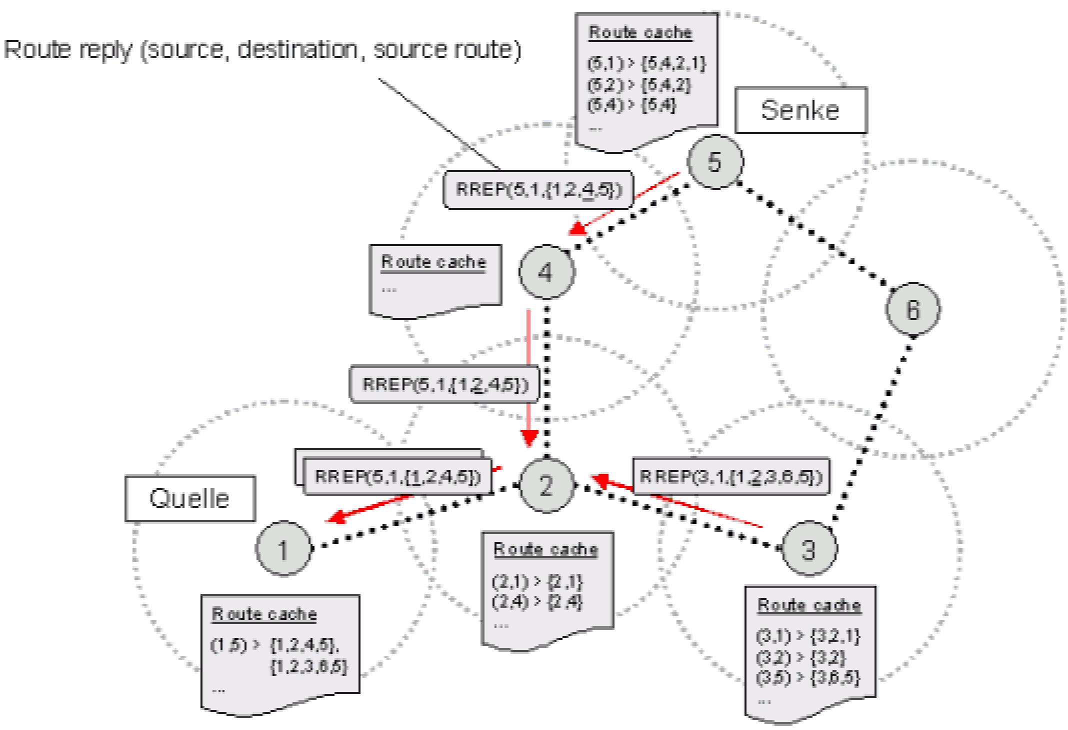
End devices have display units with varying video resolutions, SVC provide scalability in all three dimensions namely spatial, temporal and quality. In the proposed model the scalable videos are transmitted to users of a group on the basis of their requirements, hence I have decided to use the DSR protocol . The DSR protocol has two phases:
Route Discovery (find a path) :




If node A has in his Route Cache a route to the destination E, this route is immediately used.refer figure 1. If not, the Route Discovery protocol is started:

1. Node A (initiator) sends a RouteRequest packet by flooding the network
2. If node B has recently seen another RouteRequest from the same target or if the address of node B is already listed in the Route Record, Then node B discards the request.
3. If node B is the target of the Route Discovery, it returns a RouteReply to the initiator. The RouteReply contains a list of the “best” path from the initiator to the target. When the initiator receives this RouteReply, it caches this route in its Route Cache for use in sending subsequent packets to this destination.
4. Otherwise node B isn’t the target and it forwards the Route Request to his neighbors (except to the initiator).


Route request (source, destination, hops)
Route cache
...
Senke
5
RREQ(1,5,{1,2,4})
Route cache
...
4
6
RREQ(1,5,{1,2})
RREQ(1,5,{1})
2
RREQ(1,5,{1,2})
Quelle
1
Route cache
...
3
Route cache
...
Route cache
(3,5) > {3,6,5}
...


Route reply (source, destination, source route)
Route cache
(5,1) > {5,4,2,1}
(5,2) > {5,4,2}
(5,4) > {5,4}
...
Senke
5
RREP(5,1,{1,2,4,5})
Route cache
...
4
6
RREP(5,1,{1,2,4,5})
RREP(5,1,{1,2,4,5})
2
RREP(3,1,{1,2,3,6,5})
Quelle
1
3
Route cache
(2,1) > {2,1}
(2,4) > {2,4}
...
Route cache
(1,5) > {1,2,4,5},
{1,2,3,6,5}
...
Route cache
(3,1) > {3,2,1}
(3,2) > {3,2}
(3,5) > {3,6,5}
...

Route Maintenance (maintain a path): Route Maintenance is the mechanism by which node A is able to detect, while using a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. When Route Maintenance indicates a source route is broken, A can attempt to use any other route it happens to know to D, or can invoke Route Discovery again to find a new route. Route Maintenance is used only when A is actually sending packets to D.

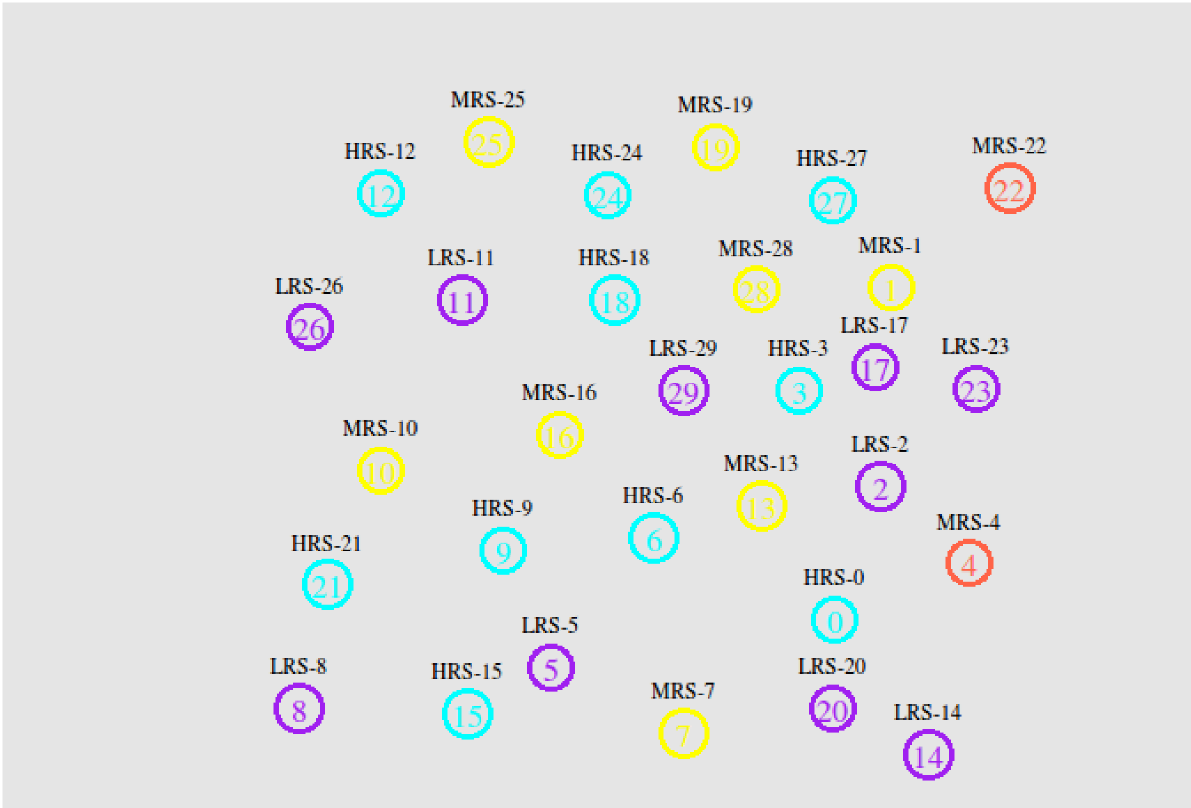
The simulator, simulates the optimal resource allocation problem by maximizing the video quality of the clients subject to transmission energy and channel access constraints. By imposing a quality-of-service (QoS) constraint on the packet loss rate, the original problem is simplified to a binary knapsack problem which is solved by a dynamic programming approach.

Section IV: Modules

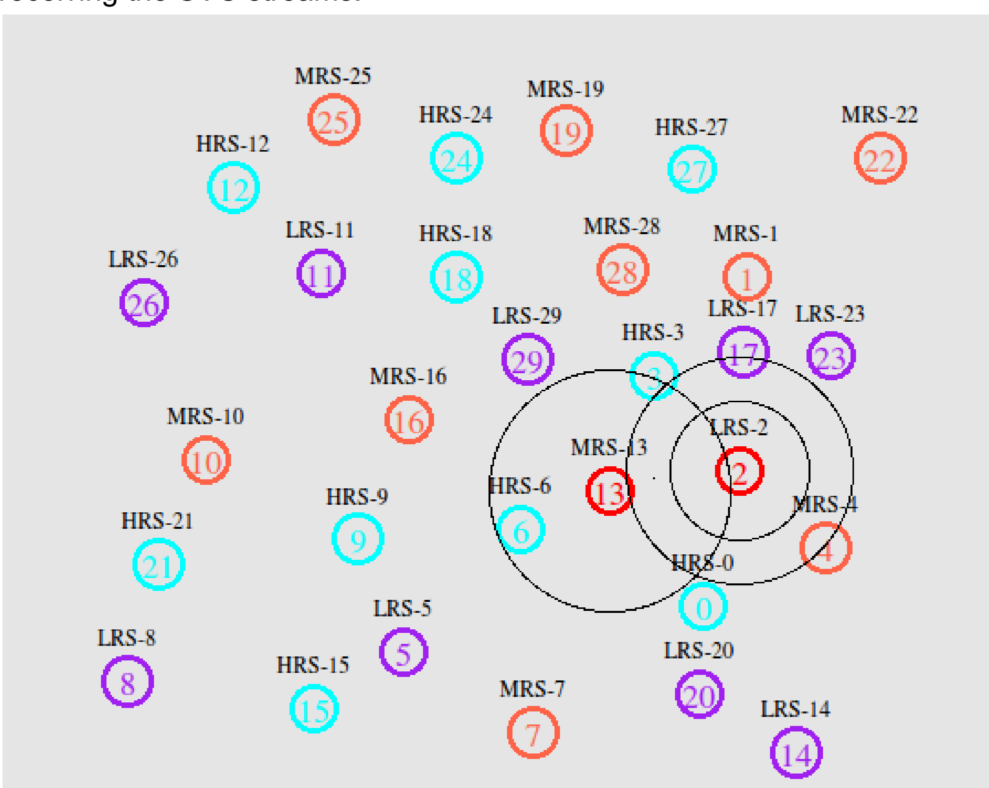
Node configuration setting: The nodes are designed and configured dynamically, the nodes are set according to the X, Y, Z dimension, they have the direct transmission range to all other nodes.
Ad-hoc protocol implementation:DSR is a reactive routing protocol which is able to manage a MANET without using periodic table-update messages like table-driven routing protocols do. DSR was specifically designed for use in multi-hop wireless ad hoc networks.For restricting the bandwidth, the process to find a path is only executed when a path is required by a node . In DSR the initiator determines the whole path from the source to the destination node and deposits the addresses of the intermediate nodes of the route in the packets.
Multicast wireless network: One element considered is the formulation of the problem of flow network which represents all possible routes that traffic can flow, without exceeding link capacities, in a multi channel WSN when utilizing all the orthogonal channels.
Video streams encoding: The video content is split into stream packets, based on the video quality, the video streams are classified into high resolution video, medium resolution video and low resolution video.
Quality scheduling algorithm: The categorized video streams are spread across the nodes in the network, based on the quality of video, the particular quality video is surfed across the nodes and aggregate the particular quality of video streams into single file and transferred in a multicast way to receiver end.

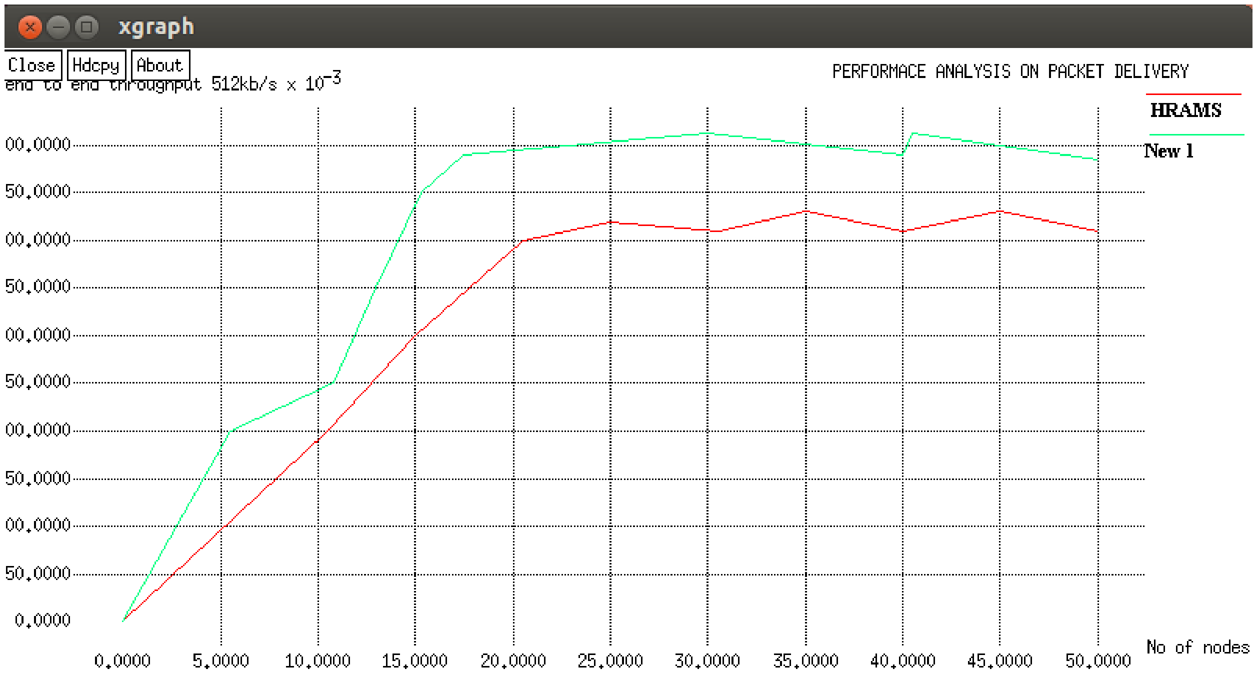
Section V: Simulation Results:

The first image represents the nodes arrangement in the wireless network.

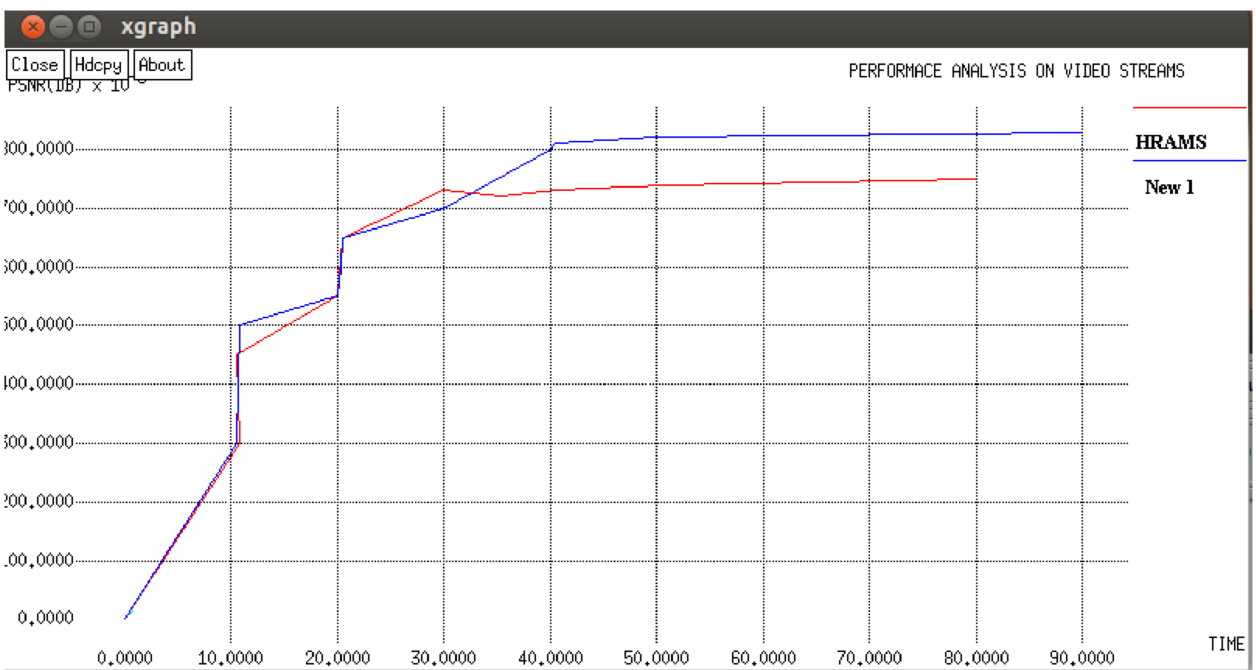



The second image is the communication process when the two nodes are transmitting and receiving the SVC streams.

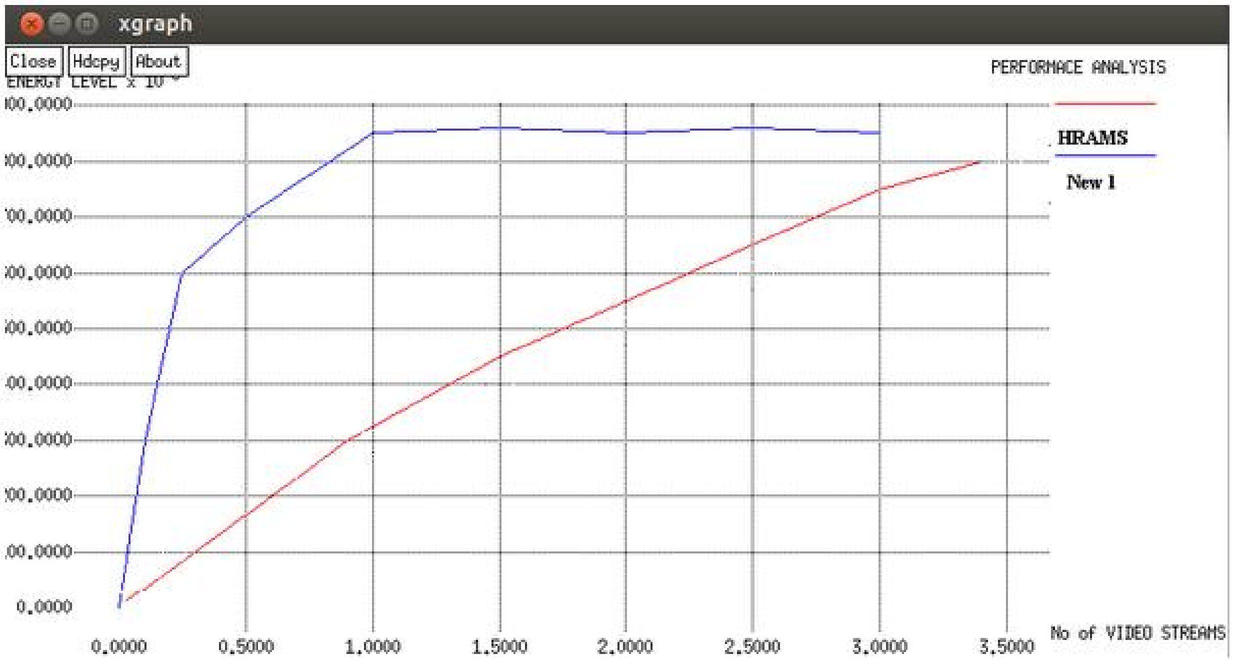





The 1st graph represents the end-to-end throughput between the communicating hosts between the new technique and the state of the art technique.




The 2nd graph depicts the relationship between the PSNR ratio and Time




The 3rd graph represents the relationship between the no. of video streams to the energy level of the node at a given instance of time. In order to do so I extended the energy model in ns-2. The old energy model did not have a sleep state. The physical layer has full control over radio states, and provides interfaces to put radio into sleep state and wake it up. It basically keeps track of the energy consumption at all times.

VI: Conclusion

In the independent study I have addressed the problem of resource allocation and believe to have also partially addressed the energy efficiency problem by taking into account the throughput , PSNR and delay elements into consideration. The resource allocation problem aimed to maximize the video quality of the client subject to transmission energy. Simulations were performed and compared to previous state of the art techniques, where the new method proved superior.

References:


[1]SVC bitstream adaptation in MPEG-21 multimedia framework

[2]Classification-based multi-dimensional adaptation prediction for scalable video coding using subjective quality evaluation

[3]http://www.ece.ubc.ca/~vikramk/MFNK09.pdf (Dynamic Resource Allocation for MGS H.264/AVC Video Transmission Over Link-Adaptive Networks)

[4]http://www.princeton.edu/~chiangm/SVC.pdf (Scheduling and Resource Allocation for SVC Streaming over OFDM Downlink Systems)

[5]http://www.vishvanaz.com/Peshala/Papers/IEEETrans2008ResAlloc.pdf (Resource Allocation for Downlink Multiuser Video Transmission Over Wireless Lossy Networks)

[6]http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=4607703&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F4599583%2F4607348%2F04607703.pdf%3Farnumber%3D4607703 (Energy efficient h.264 video transmission over wireless ad hoc networks based on adaptive 802.11e EDCA MAC protocol)

[7]https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/9306/PowerRateDistortionAnalysisWirelessVideoCommunication.pdf?sequence=1 (Power-Rate-Distortion Analysis for Wireless Video Communication under Energy Constraints)

[8]https://www.cs.sfu.ca/~mhefeeda/Papers/tom11_wimax.pdf (Energy-Efficient Multicasting of Scalable Video Streams Over WiMAX Networks)

[9]http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=4784766&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D4784766 (Energy-Efficient Video Transmission Scheduling for Wireless Peer-to-Peer Live Streaming)

[10]http://dl.acm.org/citation.cfm?id=1944096 (Energy efficient and perceived QoS aware video routing over Wireless Multimedia Sensor Networks)