Analysis of Residual Energy and SNR of DSR/AODV/RPAR Protocols in Wireless Multimedia Sensor Networks

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INTRODUCTION

In wireless multimedia sensor network (WMSN), the accessibility of low-cost components such as CMOS cameras and microphones has promoted to ubiquitously capture multimedia content from the environment, i.e., networks of wirelessly interconnected devices that are able to universally reclaim the multimedia content such as video and audio streams, still images, and scalar sensor data from the location (Sung-Keun Lee, et al., 2014).

WMSN applications, e.g., multimedia surveillance networks, target tracking, environmental monitoring, and traffic management systems, require effective harvesting and communication of event features in the form of multimedia such as audio, image, and video. WMSNs are capable of storing, correlating and fusing multimedia data’s initiating from several camera input sources. The main purposes of WMSNs are those that yield from distributed and multi-camera image systems.

In WMSNs Real time video streaming generally pretences two requirements:

1) End to end delay transmission:
   In real time video streaming environment, WSNs should always use the shortest path routing with the minimum end to end delay transmission.

2) Using multipath routing for video transmission:
   Video streaming data packets are generally large in size and the transmission necessities can be higher than the maximum transmission capacity of video sensor nodes (J. Zheng, et al., 2009). Thus multipath routing mechanisms should be used to improve transmission capacity in WMSNs (V. Naumov, et al., 2005). To this end, additional challenges for energy-efficient multimedia processing and communication in WMSN are the most important factor to be considered. Energy efficiency protocols are the extensive version of DSR and AODV.
Video Signal Compression Standards:
In recent times a number of dynamics have banned the widespread use of digital video. An analog video signal naturally occupies a bandwidth of a few megahertz.

On the other hand, when it is converted into digital form, at a comparable quality, the digital version naturally has a bit rate well over 100 Mbps.

Jpeg:
The Joint Photographic Experts Group (JPEG) standard depicts procedures for compressing still images or individual frames of video. A emblematic JPEG encoder compresses pictures by a factor of between 10 and 20 times without seriously tumbling the visual quality of the reconstructed image. For videoconferencing and videotelephony applications, the H.261 standard is used for supporting motion video coding. It is optimized for video contacts at the bit rates sustained by ISDNs. For very low bit rate videoconferencing (less than 64 Kbps) the H.263 draft standard are encouraged.

Motion JPEG:
A series of JPEG pictures are the representation of sequence of digital video signals. The advantages of motion JPEG are equivalent with single still JPEG pictures i.e. elasticity both in terms of excellence and compression ratio. The major disadvantage of Motion JPEG in view of the fact that it uses only a sequence of still pictures it does not use any video compression techniques (Zhan An-dong, et al.,2008). s The result is that somewhat lower compression ratio for video strings compared to “real” video compression techniques.

Motion JPEG 2000:
Similar to JPEG 2000 and JPEG, Motion JPEG (J. Zheng, et al., 2009) can also be used to characterize a video sequence. The advantages are identical to JPEG 2000, i.e., vaguely better compression ratio contrast to JPEG but at the cost of complexity. The disadvantage mends that of Motion JPEG. Because it is a still image compression procedure, it does not obtain any advantages of the video series compression. This results in a lower compression ratio when compared to real video compression techniques.

MPEG:
Motion Picture Experts Group (MPEG) standards deal with the issues of video coding for broadcast and entertainment principles. MPEG1 is optimized for coding of video and coupled audio for digital storage media for instance CD-ROM (S. Ponlatha, et al., 2014) MPEG2 augments the techniques of MPEG1 to support video coding for sort of video communication applications, together with broadcast digital television (at an comparable resolution and quality to analog television and also at higher resolutions). The MPEG4 proposal is addressing standard integrated video communications.

MPEG-1:
MPEG-1 is the first open standard of the MPEG committee. MPEG-1 video compression is similar to the technique that is used in JPEG (S. Ponlatha, et al., 2014). Additionally, it also comprises techniques for proficient coding of a video sequence (Shruti Prabha Shaktawat, et al.,2014).

In Motion JPEG/Motion JPEG 2000 every picture in the series is coded as a separate inimitable picture ensuing in the identical sequence as the unique one. In MPEG video only the latest parts of the video sequence is included mutually with information of the moving parts (S. Ponlatha, et al., 2014). MPEG-1 is purposeful on bit-streams of about 1.5. The focal point is on compression ratio fairly than picture quality.

MPEG-2:
MPEG-2 is the "standard Coding of Moving Pictures and allied Audio." The MPEG-2 standard is embattled at TV transmission and other applications competent of 4 Mbps and higher data rates. MPEG-2 has very high picture quality. MPEG-2 ropes interlaced video formats, improved image quality, and other characteristics aimed at HDTV (Shruti Prabha Shaktawat, et al.,2014). MPEG-2 is a attuned extension of MPEG1. MPEG-2 audio will afford up to five bandwidth channels (right, left, two enclose channels and centre), and an extra low-frequency enrichment channel. The MPEG-2 standard state combines multiple audio, video, and data into a single multiplexed stream and sustains a wide range of telecommunications, broadcast and storage applications. Therefore these characteristics are not appropriate for use in real-time scrutiny applications.

MPEG-4:
The most momentous features of MPEG-4, recitation to video compression are the support of even lesser bandwidth consuming applications. Major dissimilarity between MPEG-4 and MPEG-2 features is not related to video coding and thus not related to surveillance applications (Zhan An-dong, et al.,2008). MPEG involves fully on encoding only frames all the way through the JPEG algorithm and approximssate the motion changes.
between these key frames. Decoding is simple and can be done by desktop CPUs or with low rate decoder chips. MPEG-3 was fused into MPEG-2 and no longer survived.

**H.261:**

H.261 is the video compression standard used for videoconferencing standards. H.261 is a motion compression algorithm expanded especially for videoconferencing, though it may be engaged for any motion video compression task also.

**H.263:**

H.263 is another type for video compression standard initially designed as a low-bitrate compressed format for the purpose of videoconferencing (Zhan An-dong, et al., 2008). It was developed as one member of video coding standards in the H.26x family.

H.263 is an evolutionary improvement of H.261 which was developed based on the experience.MPEG-4 Part 2 is H.263 consistent in the sense that a basic H.263 bit stream is precisely decoded by an MPEG-4 Video decoder.

H.263 version 2 (also known as H.263+) is the second version of video coding standard of H.263. It contains the entire technical content of the original (D. Marpe, et al., 2003). H.263 version, but enhanced H.263 has the ability to progress encoding efficiency and provides other abilities to enhance toughness against data loss in the transmission channel.

**H.264 or Advanced Video Coding (MPEG-4 AVC):**

H.264 is also a video compression format which is one of the most widely used formats at present for video recording, solidity, and delivery of video content (I. E. G. Richardson, 2003). H.264 is basically used for lossy compression, even though the amount of loss may sometimes be indiscernible. H.264 is also capable of creating lossless encodings — e.g., to have restricted lossless-coded provinces within lossy-coded pictures or to support unusual cases for which the complete encoding is lossless. Thus H.264 AVC coding in MPEG-4 is efficient than other compression technique.

**Fig. 1:** H.264 Encoder Block Diagram.

As shown in fig.1, the new international standard is poised of several processing stages:

- Mode decision
- Transform
- Quantization
- Deblocking Filter s
- CAVLC

**The major goals of H.264 are:**

1) Implementation of this standard distributes an average bit rate reduction of 50% (Janio M. Monteiro, et al., 2008), with greater video quality compared among any other video standard.

2) Tolerable error echelon, so that the transmission over a various networks is efficient.

3) Uncomplicated syntax design that makes the operation simpler.

4) Precise match decoding, which describes exactly the numerical calculations so that error can be avoided.

**Advantages:**

The following are some of the prime advantages of H.264:

1. Bit rate savings: Compared to MPEG-2 or MPEG-4, undemanding silhouette, H.264 authorizes a bit rate up to 50% for an analogous degree of encoder optimization.

2. sky-scraping quality video: H.264 proposes unswervingly good video quality at high and low bit rates.

4. Network affability: In the course of the Network Adaptation Layer, that is the identical as for MPEG-2, H.264 bit streams can be easily elated over diverse networks.

The above advantages make H.264 an ideal standard for offering TV services over bandwidth restricted networks, such as DSL networks, or for HDTV.

Table 1: Comparison table of compression standards.

<table>
<thead>
<tr>
<th>ITU-T Recommendation</th>
<th>Resolution</th>
<th>Target bit rates</th>
<th>Target Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.261</td>
<td>352×288 (CIF)</td>
<td>40 kbps - 2 Mbps</td>
<td>ISDN videophones</td>
</tr>
<tr>
<td></td>
<td>176×144 (QCIF)</td>
<td></td>
<td>SD-HD Broadcast, DVD, HDV</td>
</tr>
<tr>
<td>H.262</td>
<td>720×480</td>
<td>1 - 25 Mbps</td>
<td>Videoconferencing</td>
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<td></td>
<td>720×576</td>
<td></td>
<td>MMS Streaming Internet Video</td>
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<tr>
<td></td>
<td>1280×720</td>
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<tr>
<td></td>
<td>1920×1080</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.263</td>
<td>128×96</td>
<td>20 kbps – 4 Mbps</td>
<td>Videoconferencing</td>
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<tr>
<td></td>
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<td></td>
<td>704×576</td>
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<td>1408×1152</td>
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<td></td>
</tr>
<tr>
<td>H.264</td>
<td>128×96</td>
<td>64 kbps up to</td>
<td>Videoconferencing Broadcast</td>
</tr>
<tr>
<td></td>
<td>up to 4,096×2,304</td>
<td>25 Mbps</td>
<td>Blu-ray Disc DV &amp; Mobile phone cameras</td>
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</table>

From table 1 (D. Marpe, et al., 2003), H.264 is preferred for compressing multimedia data since it is applicable for variable bit rate as well as broadcasting video traffic. Since our input traffic is video, H.264 is preferred as a compression standard (Jeng-Neng Hwang, 1994).

Node Deployment:

Node deployment approaches are classified into two major categories i.e. random deployment and deterministic deployment of node.

Random Node Deployment:

Random node deployment scatter the nodes on those locations which are tentative. Random node deployment are done by throwing sensor nodes randomly on the environment from air which produces incredible change in node density because some nodes are placed away from each other and some nodes are placed closer to each other. This type of node deployment method is done where the deployment area is unreachable such as dense forest, volcanoes, etc. A random node deployment plan can be lucrative only if it provides a considered necessary coverage i.e. to cover an area it should use minimum sensor nodes. But in general, it does not work properly because the prospect of throwing nodes on their accurate locations is very less.

Deterministic Node Deployment:

The positions of nodes are predefined in Deterministic node deployment i.e. the sensor nodes are deployed in the calculated positions only. The deterministic deployment are employed in operations where the deployment area is actually reachable. When compared to random deployment, this method uses lesser number of nodes to wrap an area. Therefore it is more preferable when compared to random deployment.

There are three major categories in deterministic node deployment method for deployment of sensor nodes i.e. triangle grid, square grid and a hexagon grid method are analyzed by considering number of required nodes, coverage, delay and energy consumption.

Triangle grid deployment:

In triangle grid deployment, the total coverage area is divided into small triangles where nodes are deployed at the corners of each triangle(M. N. Jambli, et al., 2011). All sides of the triangle are of equal probability.

Square grid deployment:

In square grid deployment, the total coverage area is divided into small squares where nodes are deployed at the edges of the square grid.

Hexagon grid deployment:

In hexagon grid deployment method, nodes are placed on the six edges of the hexagon.
Selection of Hexanode deployment:

The main advantage of hexagonal node is, more coverage area with less computational cost and less power consumption. The main limitation with multimedia sensor network is, when we increase the number of nodes, the coverage area and range error were reduced. To overcome this, the number of sides in the perimeter of entire coverage area has been increased by means of hexagonal deployment.

Fig. 2: A standard hexagonal grid based node deployment.

Routing Protocols:

AODV routing protocol:

The Ad-hoc On-demand Distance Vector (AODV) Routing Protocol (Pradeep Chennakesavula, et al., 2012) is also known as reactive protocol, i.e., a route is recognized only when the source node requires path for for transmitting data to the destination. It makes use of destination sequence numbers to discover the most up to date path. The foremost difference between AODV and Dynamic source routing (DSR) (F. Ullah, et al., 2012) is that DSR uses source steering in which a data packet broadcasts the complete path to be negotiated. Nevertheless, in AODV, the resource node and the midway nodes accumulate the next-hop information corresponding to each flow for data packet communication. In an AODV (N. Vetrivelan, et al, 2012), the source node inundates the RouteRequest packet in the system when a route does not exist for the required destination. AODV obtains numerous routes to different destinations from a single RouteRequest (C. Yin, et al., 2006). The foremost difference between AODV and other on-demand routing protocols is that it uses a destination sequence number (DestSeqNum) to determine the latest path to the destination (M. N. Jambli, et al., 2011). A node revises its path information only if the DestSeqNum of the existing packet received is superior than the last DestSeqNum stored at the node with smaller hopcount (Harminder S. Bindra, et al., 2010).

Advantages and disadvantages:

The main advantage of this protocol is that routes are recognized on demand and that DestSeqNum are applied to find the most recent route to the destination (M. Pandey, et al., 2011). Disadvantages is that intermediate nodes can lead to conflicting routes if the source sequence number is matured and the intermediate nodes does not have the latest DestSeqNum (S. Gowrishankar, et al., 2012). Another disadvantage of AODV is unnecessary consumption of bandwidth due to periodic beaconing.

DSR routing protocol:

Dynamic Source Routing (DSR) is similar to AODV (I. E. G. Richardson, 2003) is that, it forms a route on-demand when a transmitting node requests to transfer information to destination. However, it uses source routing whereby all the routing information is maintained instead of relying on the routing table at each midway node (S. Sathish, et al., 2011).

It has only two most important segments, which are Route Discovery and Route Maintenance. In the event of false information transmission, the Route Maintenance part is initiated whereby the Route Error packets (RERR) are created at that particular node (P. Loh, et al., 2009). The flawed hop will be deleted from the node's route cache; all routes containing the hop are pruned at that point. Again, the Route Discovery part is initiated to obtain the most feasible route (Harminder S. Bindra, et al., 2010).

Advantages and disadvantages:

This protocol uses a reactive method which eliminates the need to regularly flood the network with table update information which is required in a table-driven method. The intermediate nodes also make use of the route cache information efficiently to diminish the control overhead. The disadvantage of this protocol is that the
route maintenance method does not locally patch up a broken link. Also, extensive routing overhead is implicated due to the source-routing system employed in DSR.

**RPAR routing protocol:**

Real-time Power-Aware Routing (RPAR) protocol initiates the method of integrating energy efficiency parameter in real-time communication. RPAR attains end-to-end delay assurance at low power by vigorously adjusting transmission power and routing decisions packet deadlines [14]. RPAR also considers lossy links, limited memory, and bandwidth. The only one of its kind is forwarding policy and neighborhood management of RPAR, which together can introduce major power reduction consideration and hence results in extended network lifetime with required real-time guarantee.

Among other energy efficient routing protocols like SPEED, MMSPEED, DGR, ACM etc., RPAR is preferred for the proposed framework because energy efficiency, link reliability and also scalability are at the higher end (Jeng-Neng Hwang, 1994), (Pradeep Chennakesavula, et al., 2012).

**RESULTS AND DISCUSSION**

**Performance of YUV player:**

YUV Player Deluxe is a full-featured tool for playback of uncompressed planar YUV video files. It is intended for researchers in the area of video compression, developers of video codecs and video chips and for all specialists involved in video processing.

A number of unique features and a thoroughly designed interface make this program the helpful tool necessary when the playback of uncompressed YUV video files is required. Figure (3) shows the performance flow of YUV player.

YUV video compression is used for compressing video signals. It consists three types of signal. One signal is luminance used for brightness and other two signals are for chrominance which is used for colour quality.

![Fig. 3: Performance of YUV player](image)

**Main features:**

(i) Playback of raw YUV video files in different resolutions, pixel formats and frame rates
(ii) possibility to view separate (Y, U or V) components of video frames
(iii) possibility to create header (.hdr) file for any raw YUV file describing its properties possibility to save individual frames in 24-bit .bmp format.

The applied video traffic is converted into MP4 file using source file from YUV player. after the conversion, using NS2, Hexanode in combination with real time power aware routing protocol framework has been applied. And later on, the performance evaluation is done for the protocols, DSR, AODV and the proposed framework with the parameters, FDR, end to end delay and residual energy.

**NAM file output:**

NAM is a Tcl/Tk based animation tool for obtaining network simulation traces and real world packet traces. A network animator that provides protocol-specific graphs and packet-level animation to assist the design and sort out of new network protocols. Captivating data from network simulators (such as ns) or live networks, NAM was one of the prime tools to afford wide-ranging purpose, network animation, and packet-level before starting to use NAM, a trace file needs to create (The Network simulator-NS2). This trace file is usually generated by NS.
Fig. 3: Snapshot of the simulation in NAM with RPAR routing.

Fig. 4: Snapshot of the simulation in NAM with AODV routing protocol. Protocol (M. Pandey, et al., 2011).

Fig. 5: Snapshot of the simulation in NAM with DSR routing protocol (S. Sathish, et al., 2011).

Residual Energy:

Fig. 6: Throughput vs. Energy consumed.

As shown in Figure 6, as the throughput increases energy consumed by the nodes in the environment decreases.

Conclusion:

Existing WMSN have been constrained by limited battery energy and which leads to a limited lifetime of a network. This paper exploited a breakthrough in a wireless power transfer technology for a WMSN and shown that once properly designed, WMSN has got a potential to remain operational for a long time. In this paper, we proposed a new framework for improving network lifetime by exploiting the RPAR protocol in combination
with hexagonal deployment of nodes and also to validate its performance with the QoS parameters like Residual energy and SNR by supplying video signal as input which is compressed by MPEG-4 standard and found that the proposed work is superior to the models published previously and proved that the proposed framework outperforms than DSR and AODV protocols. The framework may be tested through heterogeneous traffic with mobile nodes.

**Signal-to-noise Ratio:**

![Time vs. SNR](image)

**Fig. 7: Time Vs. SNR.**

As shown in Figure 7, RPAR shows better SNR ratio when compared to AODV and DSR routing protocol.

**REFERENCES**


