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Enhancing the Performance of Wireless Mesh Network (WMN) for Video Traffic Transmission in Context with IEEE 802.11

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Abstract: In recent years, multimedia streaming has increased dramatically in wireless networks. Applications such as Video-on-Demand (VoD) and distributed file backup appear in wireless mesh networks (WMNs). These applications have strict requirements for quality of service (QoS) with bandwidth guarantees. Streaming video flows over WMN faces some challenges as bandwidth guarantee; High data rate flows over a shared medium in a multihop manner can increase the packet loss and delay significantly. Real-time live surveillance applications do not usually use retransmission error control, video contents can be lost, and the quality of the video can be altered. This paper discussed methodology of video transmission ways in WMN which aggregates bandwidths, increase delivery ratio and decrease end-to-end delay, which determine the quality of the delivered video, high quality multimedia deliveries over wireless mesh networks. And throughput of this methodologies & further improvement of its performance.

Keywords - Wireless Mesh Networks, Video transmission, Outcome evaluation, performance improvement.

I. INTRODUCTION

IN the modern society, large data delivery between wireless network devices puts an important pressure on network resources. For instance, it is expected that large amounts of continuous data such as multimedia streams to be transmitted through wireless network with strict timing requirements and support good user perceived quality at the remote device. In order to achieve this, the network architecture and the delivery solutions have to be capable of supporting and maintaining high throughput and low loss while cost-effectiveness and service stability are also essential factors to be considered. In the quest for offering the features mentioned above wireless mesh is one of the most widely-used network architectures., WMNs are suitable for both short-term small range applications (e.g. a concert, street fair), and long-term metropolitan service deployments (e.g. city-wide mesh network connecting citizens and public services). Characterized by multi-hop capabilities, WMNs can be used as well in areas with weak cellular coverage, such as rural zones. The tremendous growth experienced by these networks is also because they operate in the licence free ISM bands, reducing significantly the deployment costs compared to other technologies operating in licensed spectrum, e.g. LTE.

A typical WMN architecture comprises of three network elements: access points, clients and network gateways. The access points are a static set of wireless nodes, performing routing and radio-relay functionality, taking care of forwarding the traffic in a multi-hop fashion between the clients and the mesh network's gateway. The gateways enable access to the Internet or to another network. Clients include a wide range of mobile terminals, such as laptops, , video and data. When a WMN is used for surveillance video streaming, it is challenging to deliver the video without quality degradation, where the video quality can be severely affected by packet loss and delay. The challenge comes from the broad bandwidth requirement for the video traffic, and the use of wireless medium in a multi-hop environment. When multiple video flows are transmitted over the mesh network, they are aggregated near the gateways to reach the monitor. This traffic pattern can cause network congestion that causes buffer drops and packet collisions, resulting in an increase of packet loss. This paper surveys different ways of video delivery, output in terms of parameters and methods for performance improvement. Section2 gives the detailed information about various ways used for video delivery with

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challenges for video traffic over WMN. Performance in terms of parameters discussed in section 3. Section 4 discuss about different ways used to improve performance followed by conclusion section.

II. LITERATURE SURVEY

The quality of video delivery is strongly influenced by the data transport capacity of the wireless mesh network. In this section, we present the various ways of video delivery as A Bandwidth Reservation Protocol for Multirate any path routing in Wireless Mesh Networks (BREW), Field-based any cast routing (FAR), an Energy-efficient Cross-layer Solution for Video Delivery in Wireless Mesh Networks.

A. Brew

In wireless mesh networks (WMNs), more and more applications, especially Video-on-Demand (VoD) services, appear to have strict requirements on guaranteed bandwidth. We present The first bandwidth reservation protocol for multirate anypath routing in WMNs, namely BREW. BREW aggregates bandwidths from multiple anypath routes to improve the flow acceptance ratio and the system-wide throughput, and can be integrated with most of the existing opportunistic routing (OR) protocols, especially the most efficient multirate anypath routing protocols. BREW makes admission control and bandwidth reservation for each data flow. It aggregates bandwidths from multiple anypath routes to improve acceptance ratio of flows and the system-wide throughput The BREW has three connected components: (A) network pruning and multirate anypath routing module prunes away bandwidth exhausted nodes from the network and computes an optimal anypath route from the rest of the network; (B) anypath route capacity estimation module calculates the capacity of a given anypath route; and (C) admission control and bandwidth reservation module interacts with the previous two modules to decide Whether a coming data flow can be accepted or not. If yes, the module reserves the bandwidth for the coming data flow. The advantage of BREW is that it enables dividing We extensively evaluate the performance of BREW, and compare it with BORlAC. Our numerical results Show that BREW outperforms BORl AC, in terms of flow acceptance ratio and system-wide throughput. With transmission rate IMbps, 2Mbps, 5.5Mbps, and IIMbps, the flow acceptance ratio with BREW is up to 5.6, 3.6, 1.34, and 2.45 times that of BORlAC and the systemwide Throughput with BREW is up to 3.8, 2.29, 1.10, and 3.10 times that of BORlAC. a large data flow into several sub data flows whose bandwidths are reversed on different any path routes.

B. Field-based any cast routing (FAR)

Field-based routing, which is the basis of FAR, in this kind of routing, a steepest-gradient method can be applied, which is quite suitable for traffic delivery in mesh networks for a hub-and-spoke kind of service demands. In our approach, we use an electrostatic potential model to provide the field for routing metric, in a way where packets are forwarded along the steepest gradients of the field to the destination of the lowest field value. The proposed protocol FAR significantly reduces the complexity of ALFA , provides an effective tradeoff between shortest path routing and load balancing, it is compatible with any kind of coding and cameras unlike delivers both video and non-video traffic unlike . Moreover, it provides high resilience, on-the-fly rerouting in case of failure, and utilizes the concept of any cast routing to achieve gateway load balancing unlike all the aforementioned protocols.

1) Load balancing: After convergence happens, a network is ready to deliver traffic. When a surveillance camera that is connected to mesh access point A starts transmitting a video flow, the traffic follows the shortest path because at this point, the potential of each node is affected by neighbors' potentials, which reflects number of hops to a gateway. Assuming that there is another traffic flow from node C as in Fig. 1(a), the queue length of node C increases accordingly. After the next iteration, the new calculated potential of C increases according to equation (2). Therefore, node A changes its routing decision, and forwards packets to the new lowest-potential neighbor B, so that the flow follows the second shortest path, thus distributing the traffic on higher number of nodes and avoiding flow overlapping. Flow overlapping causes a significant increase in queuing delay due to long nodes' queues. Furthermore, it increases the chance of a buffer overflow resulting in a loss of frames in the received video. By balancing the flows over different paths the increase in delay is avoided, and frames are delivered on time, making the impact of flow addition unnoticeable by viewers. Moreover, load balancing reduces the possibility of collisions and interference due to traffic distribution over a larger area, making the flow less vulnerable to packet loss.

2) Congestion avoidance: Congestion situations are most likely to happen with video traffic due to the high data rates required. Congestion happens when a node receives forwarding packets in a higher rate than its transmission. This

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problem increases in WMN case where the gateways are the source of internet access, and therefore, all network traffic aggregates around the gateways' areas. When congestion happens at a node, the node is forced to drop packets from its queue to leave space for newly received packets. When transmitting many videos with high data rates, this dropping mechanism may cause a severe damage to the video quality, or even a video stoppage when using typical shortest path routing protocols or protocols that are not congestion aware. Similarly to the load balancing mechanism, FAR avoids forwarding packets to nodes that have high queue Lengths, by routing the traffic away from the congested node. The video flow can preserve its frames from being dropped, and gives the congested node a chance to transmit its own packet and relief the congestion.

3) Gateway load sharing: The capacity of a WMN is governed by the capacity of its gateways. Therefore, it is important to utilize the gateways efficiently in terms of throughput. In order to increase the efficiency of the network, traffic should be served by the nearest gateway. However, in case where most of the traffic is located around one gateway while other gateways are traffic free; a portion of the traffic should be served by a far gateway so that the high traffic can be shared to prevent congestions, interference, or long delays near the congested gateway.

4) Node failure: When an in-path node fails during a video transmission, it can cause a stoppage or halting in the video service even when a rerouting procedure exists. Video streaming is very sensitive to delay, however, current failure detection procedures such as, requires a relatively long time to detect the failure. In addition, the route re-establishment as well imposes an additional delay to report the failure and to discover a new route. The video packets sent during this time may be lost at the failed node, flushed from the queues, or delivered after their playtime deadline.

FAR provides a kind of built-in node failure procedure that can detect and avoid the failure without additional overhead and in a relatively short period. As shown in Fig. 1(c), when node E within the path A-C-E-H-G1 fails, FAR discover and reacts as follows. Each node is expected to receive a hello message from its neighbors within 100ms. FAR uses these hello messages as an indicator to node's connectivity. When node E fails, neighbors miss the hello messages from E, however, since it is possible for packets to be lost or collided, neighbors wait for 3.5 hello neighbors consider it a failure case. Then a simple action is taken to avoid forwarding packets to E. Since the forwarding rule is based on the lowest potential, we need to ensure that node E is not the neighbor with the lowest potential from the prospective of its neighbors. Therefore, a node C for example, assumes that a virtual node exists in the location of E, and that the potential of this virtual node equals the potential of node C itself. The virtual potential is included in the potential calculation of each node. It guarantees that neighbors will not transmit packets to the FAR supports this feature by utilizing the any cast-routing property with the congestion awareness. Fig. 1(b) shows a simplified example of how gateway loads sharing works. The difference between Fig. 1(a) and Fig. 1(b) is an additional flow that increases the potential of nodes in the area around G1 in addition to node D. The flow generated from node A avoids the whole area that is surrounding G1, where firstly, node A forwards the packets to node B, and node B in turn, stops sending to node D due to its potential increase and sends to node E. Thus, the nodes keep forwarding the traffic away from G1 until the traffic falls into the potential funnel of G2 which is traffic-free. This mechanism avoids a possible overflow on G1, and increase the overall network capacity, thus, allowing more flows in the network failed node, instead, the traffic will forward to D as shown in Fig. 1(c). This procedure requires a short time for detection. Neither time nor overhead is required for rerouting process. The procedure works on-the-fly, where all decisions including failure detection and rerouting is made by the node that exists before the failed node in the used path. Moreover, the packets that exist in the queue of node C when failure happens, do not need to be re-sent by A, but instead, are sent directly from C to D after the failure happens.

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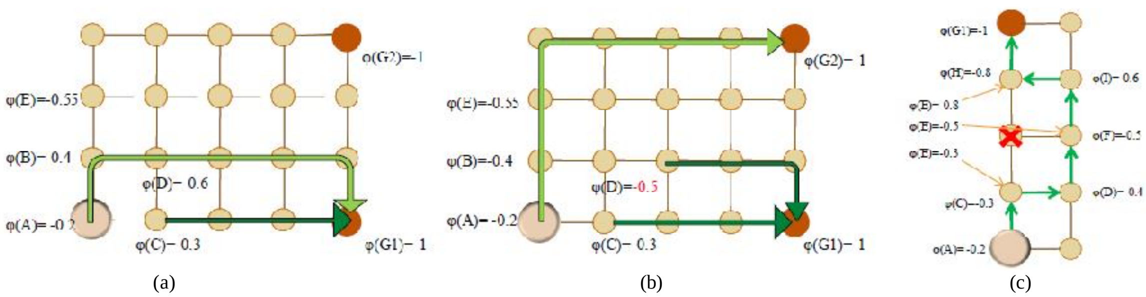

Fig.1. FAR routing a network portion: (a) load balancing and congestion avoidance, (b) gateway load sharing, and (c) node failure.

C. An Energy-efficient Cross-layer

E-Mesh, an energy-efficient cross-layer solution for video delivery over wireless mesh networks which provides a good balance between energy saving on one side and network delivery performance and user perceived quality on the other side. E-Mesh includes a novel MAC layer mesh point operation cycle management scheme, which adaptively controls the sleep/awake pattern for each mesh point in order to save energy. It also makes use of an energy-aware extension of the classic Dijkstra routing algorithm which enables video data from the server to the mesh client to use an optimal path through the mesh network, in terms of energy consumption and QoS. The E-Mesh network architecture contains one mesh source node which has the required data, N mesh routers for data forwarding and one mesh client. The position of each of these N routers is randomly distributed in a circular area with radius R. Some of the mesh routers will move with a random velocity inside the range of this circular area while others remain fixed. The mesh client is moving under a constant velocity, with its initial position to be set at the edge of the circular area. The location of the mesh data source is fixed at the center of acircular area of consideration. The architecture is shown in Fig. 2.

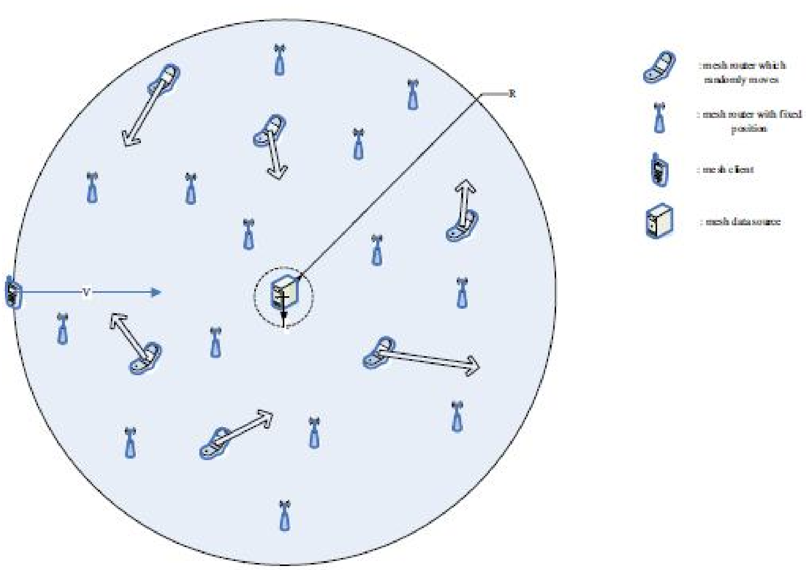

Fig.2. Architecture of the E-Mesh wireless mesh network topology

Video surveillance feeds are usually streamed from cameras through designated cables. With the rapid increase of surveillance cameras deployment, wiring each camera to the monitor or to the internet usually streamed from cameras through designated cables. With the rapid increase of surveillance cameras deployment, wiring each camera to the

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monitor or to the internet can be extremely costly, time consuming, and sometimes infeasible, especially when deployed over large-areas. A WMN comes as a solution to connect these cameras to the internet or to the monitor, in a fast and cost efficient manner. However, streaming video flows over WMN faces some challenges: High data rate flows over a shared medium in a multihop manner can increase the packet loss and delay significantly. Packet loss can be caused by buffer Overflow or collisions. Since real-time live surveillance applications do not usually use retransmission error control, video contents can be lost, and the quality of the video can be altered. Some surveillance situations are highly sensitive to delay, packets that miss their playback deadline cannot be included in the video streaming, and therefore discarded, inducing degradation in the video quality. Long delay can happen in large traffic situations due to queuing delay, or due to large number of hops.

III. OUTCOME EVALUATION

A. Brew

The average flow acceptance ratios of BREW and BORJAC are compared. Since BORJAC only works with single transmission rate, we separate the cases for BORJAC with different transmission rates, including 1Mbps, 2Mbps, 5.5Mbps, and 11 bps with standard deviations. The average flow acceptance ratios of BREW are always higher than those of BORJAC. The acceptance ratio of BREW is up to 5.6, 3.6, 1.34, and 2.45 times that of BORJAC with transmission rate IMbps, 2Mbps, 5.5Mbps, and IIMbps, respectively. The system-wide throughputs of BREW are always higher than those of BORJAC. The system-wide throughput of BREW is up to 3.8, 2.29, 1.1, and 3.1 times that of BORJAC with transmission rate IMbps, 2Mbps, 5.5Mbps, and 11Mbps, respectively. The performance of BORJ AC is greatly affected by the density of the nodes and the selected transmission rate, BREW achieves high performance in different environments. Comparison results show that BREW outperforms BORJAC in terms of flow acceptance ratio and system-wide throughput.

B. FAR

1) Traffic pattern: The results in two scenarios: scenario A where one video flow exists in the network and another scenario B where additional traffic flow is added between the video source and the gateway. The additional flow represents a possible congestion case. As the shortest path is able to deliver the video contents efficiently, FAR utilizes this shortest path to deliver 99.2% of the traffic. While a small portion of the traffic is sent. The utilization of shortest path is done by following the steepest gradient in nodes' potentials. In scenario B, a flow of 1.6 Mbps is added. In this case, can harm the video flow significantly. However, the load balancing mechanism in FAR reacts to this situation as follows: since the queue of the traffic source contains a number of packets, the potential of this source increases accordingly as calculating potential value. The increase in potential propagates partially to the neighbors and alters the routing decision by sending the traffic through different paths in response to queue lengths' change.

2) Delivered video quality: As an indicator for video quality, we used PSNR which is the most common video quality factor. For the non real-time PSNR- When using FAR, all packets are received by the gateways, therefore all video contents were delivered with a good quality. For the average real-time PSNR for different delay requirement, FAR shows better quality in all requirement intervals.

3) Node failure: We conducted a scenario which is similar to A; in this case however, the mid-node of the shortest path fails from second 115 to 116. Since no congestion exists, FAR delivers the traffic through the shortest path 2. At 115 second, the hop previous to the failed node misses 3 consecutive hello messages; therefore, it starts the node failure procedure. Forwarding-packets that exist on this node are kept in the queue due to transmission failure. After the failure decision is made, no need for a link re-establishment procedure, packet retransmission from source, nor queue flush as in some routing protocols. The packets are directly forwarded through another path and delivered to the gateway. The procedure is done on the fly without any packet loss. When the failed node functions again at 116, it directly starts transmitting hello messages, which will be heard by the neighbors. The neighbors start using the node's potential again in the potential calculation. After a few iterations, potential values converge and traffic goes back to utilizing the shortest path again as the best available path.thus, FAR delivers more video contents with lower end-to-end delay and better video quality.

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C. E-MESH

Two simulation scenarios are considered with the same Topology, as shown in Fig.2. The first scenario uses the Standard IEEE 802.11s protocol, while the second one has the proposed E-Mesh solution deployed. The energy Consumption in the E-Mesh scenario experiences a significant decrease of 13.3% in comparison with the value computed in the IEEE 802.11s scenario, while the throughput remains roughly the same. Although the loss rate increases with approximately 1.94%. the quality of the E-Mesh-based video delivery scenario has decreased with approximately 5 dB in comparison with that obtained in the IEEE 802.11s scenario, but it is still close to the "Good" level of user perceived quality

IV. PERFORMANCE IMPROVEMENT OF VIDEO TRANSMISSION IN WMN

This paper proposes a novel mechanism for providing enhanced QoS support to video services in multi-hop WMNs. The mechanism makes use of an innovative hybrid hierarchical architecture which combines centralized and distributed approaches. The proposed solution relies on performance monitoring at WMN nodes and performs load balancing by off-loading traffic from the highest loaded nodes to less loaded neighbours. Simulation based results presented outline the performance of our proposed mechanism in terms of QoS metrics (delay, throughput, and packet losses and PSNR) in different network load scenarios. The proposed load-balancing mechanism for improving QoS for video deliveries comprises of two components: monitoring and reporting component, which gathers information from the mesh nodes, information processing and decision dissemination component, which takes into consideration the received data, analyses it and re-routes the flows based on it.

A. Network Coding

In the last decade, many researchers tried to improve the performance of both Tree and Mesh peer-to-peer systems by introducing the new algorithm or enhancing the current methods. MDC is introduced to enhance error resilience over in live video streaming an intermediate node can create coded frames by combining these distinct frames and the destination extract required frames from them. According to Moore's low that indicates computational processing is become cheaper and therefore the bottleneck has shifted to network bandwidth, network coding which utilizes fair computational power can be used in order to increase throughput, network resource utilization, security on links and resilience to link failure as well as decreasing the absolute delay, especially in live video streaming. Network coding was first introduced by R. W. Yeung and Z. Zhang as an alternative to routing in 1999. Network coding has shown that it has enough ability to provide lower delay as well as higher bandwidth utilization, which both of them leads to better video quality in the receiver systems. Moreover, network coding reduces the undesirable effects of time-varying channels, peer churning, link failures and mobile users in live and VoD streaming over P2P and wireless mesh networks.

B. Extended Distributed Channel Switching Accessory Protocol (EDCAP)

EDCAP aim to increase throughput of network by decreasing extra traffic inside network, which is produce due to broadcast messages. The high throughput networks provide more bandwidth for video conferencing, VoIP (voice over internet protocol) and voice streaming application. It runs high bandwidth application simultaneously. The EDCAP combines distributed channel-switching accessory protocol (DCAP) with DSR (dynamic source routing protocol). It optimizes home channel discovery processes of DCAP protocol. The DSR has a route cache, that store route for future use. Therefore, it does not send repeatedly broadcast message for finding source route to destination node. The EDCAP use route cache and route discovery process of DSR protocol to find home channel, that results decrease extra traffic inside network.

V. CONCLUSION

Wireless mesh networking (WMN) for video surveillance provides a strong potential for rapid deployment in a large community, for which reliability and survivability for real-time streaming are the key performance measure. And also more and more applications, especially Video-on-Demand (VoD) services, appear to have strict requirements on guaranteed bandwidth. Devices in wireless mesh networks are often supplied with limited power resources, while also running complex applications with high energy requirements, such as high quality video deliveries over the network.

This paper proposes methodology like BREW, FAR & E-MESH for video transmission over wireless mesh network. Also discussed about throughput from different methodology, Challenges for video transmission in WMN and what would be mechanism to improve performance for video transmission. This survey will hopefully motivate future researchers to come up with smarter and more robust video transmission mechanisms and to achieve a better QoS for video transmission.

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