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Multicasting Video Streaming In Large – Scale Areas Using Wireless Mesh Networks

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Abstract

The wireless mesh network is an emerging technology that provides high quality of service to end users. Video streaming is a key technology for wireless mesh networks. Video multicasting provides efficient data streaming among a group of nodes. However, in the transmission process, interference severely limits network capacity. If two neighboring users are operate on the same channel and transfer data simultaneously, and then definitely they get interfere with each other. The network capacity and the performance of WMNs may degrade significantly because of this interference. In this paper we propose a centralized maxflow-based channel assignment (CMCA) algorithm. In this proposed algorithm, we exploit a maximum flow computation method to compute the maximum achievable throughput of the network, which does not need the knowledge of the traffic demands.

Index Terms: Wireless mesh networks (WMN), Centralized maxflow-based channel assignment algorithm (CMCA), Multicasting video streaming (MVS).

Introduction

Multicast is a key technology for future wireless networks that provides efficient transmission among a group of nodes, and reduces the bandwidth consumption of many applications such as service discovery, videoconferencing, distributed gaming, etc. Various challenges are encountered while distributing video packets over different internet hosts which are connected in a network [1]. In WMN, datapackets choosing internet access gateways for wide area video multicasting. Video streaming represents one of the fastest growing segments of traffic in the Internet today [2–4]. Concurrent transmission and display of audio-visual (AV) content is often referred to as streaming. Streaming eliminates the initial waiting time before video playback starts and the requirement for storing the entire video file as opposed to download and play schemes. The size of streaming systems can range from single sender and multiple receiver setups based on video-on-demand (VoD) service with thousands or millions of users streaming video concurrently. In large scale systems thousands or millions of users concurrently stream video. Service providers generally use a farm of video servers and very high speed data lease lines to accommodate large number of users that demand high quality video [7]. Furthermore, the demand for video content shows time varying behavior. Users may rush the system at particular days of the week, for instance when a movie is newly released, or at particular hours of the day. The system can be designed to work robustly at the worst case scenarios. In that case the wireless mesh networks traffic, and network performance maybe degrade because of large number of end users, changes infrequently and the packets was sending via multiple wireless hops. It causes the most challenging problem in network traffic classification [5].

To solve these to problems we propose a sub-flow selection behavior based centralized maxflow-based channel assignment (CMCA) algorithm. In this algorithm, we exploit a maximum flow computation method to compute the maximum achievable throughput of the network, which does not need the knowledge of the traffic demands and the number of users presents at online. The main purpose of CMCA algorithm is minimizing the overall network interference [8-10]. At the same time, we must guarantee the given set of flow rates is schedulable.

Previous Work Comparison

Much work has been done with primary objective to reduce interference or increase the total throughput of the system. Ian. F. Akyildiz has proposed a load-aware channel assignment algorithm (LACA) and allocates sufficient bandwidth to each wireless link through an iteratively adjusting manner. S. Avallone et.al has proposed a flow-based approach. This protocol in conjunction with rate controls, which assigns links with different transmission rates to proper channels and make a given set of flow rates schedulable [11]. W. S. Wong deals joint channel allocation, interface assignment, and media access control problem as a cross-layer network utility maximization problem, and propose a linear optimization model to enhance the global throughput. Devise a channel assignment strategy which assigns the channels in order to balance the traffic load between different channels [14-16]. L. Zhou, proposed a common channel assignment algorithm, which assign nodes with a common set of channels to preserve the connectivity between them. The above methods have some draw backs in interference and network traffic. To overcome these, we proposed a Sub-flow selection behavior based centralized max flow-based channel assignment (CMCA) algorithm, which does not need any knowledge of the traffic demands and number of users presents at online and the following two calculations are used for this technique.

(1) We calculate the maximum throughput that can be achieved in WMNs by the maximum flow computation method which does not require a given traffic profile.

(2) By allocating proper bandwidth for links with different flows that it can carry to balance the traffic load of network effectively, we can guarantee the communication successful and reduce the conflict. Thus, we use a greedy approach to assign a channel for the link with the maximum flow in all unassigned links in an iteration manner.

Research Methodology

Sub-Flow Selection

Streaming traffic classification schemes operate on the notion of network flows. A flow is defined as a series of packet exchanges between two hosts, with flow termination determined by an assumed timeout or by distinct flow termination semantics. For each flow, network monitors can record statistics such as duration, bytes transferred, mean packet inter arrival time, and mean packet size. Sub-flow is N consecutive packets taken for a flow. An initial sub-flow is the initial N consecutive packets from the point where communication established.

The applications provide users with various types of service. Each application starts from initial behavior and accepts various events, as instructions changing behaviors. Whenever the application accepts the event, it changes the next behavior and executes actions associated with the behavior. The applications provide users with various types of service. We define these events of each application as application behaviors that are expressible by finite state machine. Each application starts from initial behavior and accepts various events, as instructions changing behaviors. Whenever the application accepts the event, it changes to the next behavior and executes actions associated with the behavior. We assume that a sub-flow, taken from the transition point of the application behavior, is effective for the achievement of the desirable classifier. The rationale behind possibility of the classifier is the following. A sub-flow is N consecutive packets taken from a full-flow; therefore, two or more sub-flows can be taken from a flow. The sub-flow features have ability to distinguish each application, because the sub-flow contains a sequence exchanging control packets that are pre-defined messages in each application. We devise the classifier that added the function of sub-flow selection with application behaviors.

Centralized Max flow-Based Channel Assignment Algorithm

In this section, we discuss the centralized maxflow based channel assignment algorithm for the channel assignment problem defined above. Our goal is to minimize the overall network interference. At the same time, we must guarantee the given set of flow rates is schedulable. Therefore, the channel assignment algorithm must satisfy these conditions. This also means that the sum of the bandwidth of all links in the conflict domain should not exceed the capacity of the share channel. As pointed out before, some solutions may require the knowledge of the traffic demands. It may not suitable for dynamic environments. We found that the problem of finding maximum network throughput is a typical instance of a maximum flow problem in WMNs. Therefore, we exploit a maximum flow computation before a channel assignment. In our algorithm, we only need determine the capacity of each link firstly, and then the maximum flow of all links that can carry through the maximum flow algorithm. At last, we will assign a channel to each link according to its flow rate for the following purpose,

(1) We calculate the maximum throughput that can be achieved in WMNs by the maximum flow computation method which does not need a given traffic profile;
(2) By allocating proper bandwidth for links with different flows that it can carry to balance the traffic load of network effectively, we can guarantee the communication successful and reduce the conflict. Thus, we use a greedy approach to assign a channel for the link with the maximum flow in all unassigned links in a iteration manner.

The following is the pseudo code for the proposed centralized maxflow-based and channel assignment

Centralized Maxflow-Based andChannel Assignment) Scheme for Wireless Mesh Networks

```
Input: $G = (V, E), K, d(e), \beta$
$\forall u \in V$, radio (u) = $\Sigma e=(u,v) \in E d(e)\beta$
MCCA(G, K, d(e), radio(u)).
Create a graph G0 = (V0, E0) consisting of two kind of links for every single link e = (u, v) ∈
E - one link l = (u0, v0) with the chan(l) = chan(e) for every corresponding link e ∈Eassigned a channel and allocation alloc(l) = β (d(l) = 0); and a residual link lres = (u0, v0)with demand d(lres) = d(e) − β and chan(lres) = −1.
Create a set D of domains representing the total number of channels available such that|D| = K.
For each e0 ∈ E0, load(chan(e0)) = load(chan(e0)) + d(e0) such that chan(e0) 6= −128
Let L = set of residual links in G0sorted in decreasing order of demands such that d(l) > 0and chan(l) = −1, ∀l ∈ E0
while all links in L have not been visited do
Let l = (u0, v0) be an unvisited link
while d(l) > 0 do
C = ∪chan(l)
Cu0 = ∪chan(l0)|∀y, l0 = (u0, y) ∈ E0
Cv0 = ∪chan(l0)|∀y, l0 = (v0, y) ∈ E0
K0 = K − C − (Cu ∪Cv)
if |K0| > 0 then
Pick k ∈ K0 with least load(k)
Create link l0 = (u0, v0) with chan(l0) = k and allocation alloc(l0) = β
d(l) = d(l) − β
load(k) = load(k) + β
else
C0 = (Cu0 ∪ Cv0) − C
```

```
if C0=NULL then
Exit While
end if
Compute the number of conflicts for domains in C0 when new link added to a domain.
Pick $k \in C0$ with least number of conflicts.
Create link $l0 = (u0, v0)$ with $chan(l0) = k$ and allocation $alloc(l0) = \beta$
$d(l) = d(l) - \beta$
$load(k) = load(k) + \beta$
end if
end while
end while29
Assign remaining residual links (sorted in decreasing order of demands) in G0to domains with lowest conflicts.
Output G0
```

Consider a wireless mesh network represented as graph $G = (V, E)$ whereV represents the nodes in the mesh network and E is the set of links between nodes. A link $e = (u, v) \in E$ if nodes u and v are in the transmission range (TR) of each other i.edist$(u, v) \leq T R$. For clarity of presentation, we assume that the Interference Range (IR) is twice the transmission range i.e., $IR = 2T R$. Each edge is labeled by a demand $d(e)$ which is basically the amount of traffic or bandwidth that should be supported by this link e. Let mK be the total number of channels available for use. K should be equal to the number of orthogonal (non-overlapping) channels available. K is not limited to channels of one 802.11 technology, but can consist of the total channels available for the entire 802.11 architecture including 802.11a, b/g. The configuration of the WMN (G), the corresponding demands $d(e)$ in addition to the parameter K, serve as the input for Centralized Maxflow-based and Channel Assignment scheme. Let β be the capacity (maximum bandwidth) of a radio interface.

Given This Channel Assignment We Do Two Things

1. We create a new graph G0 (line 4) which will serve as one of the inputs for the Centralized Maxflow-based and Channel Assignment scheme. G0consists of two sorts of links - a allocated link and a residual link. A allocated link has the following characteristics: It is assigned a channel (via step 3) and has an allocation of β ($d(l) = 0$) while a residual link has no channel assignment i.e30chan$(lres) = -1$ and has a demand $d(lres) = d(e) - \beta$.
2. We create the domains. The idea behind the domains concept was discussed in the basic Idea section. In addition to its creation, domains are populated with links and their loads by associating links (having a channel assignment) to domains. (lines 5-6).The next step is to create a list L which basically consists of links in E0 sorted in decreasing order of residual demands such that $d(l) > 0$ and $chan(l) = -1, \forall l = (u0, v0) \in E0$(line 7).

The centralized maxflow-based and channel assignment scheme then visits all the links in L (lines 8-32) from the largest dl to the smallest dl such that $l = (u0, v0) \in L$ so that links with higher demands can be assigned to less contention. A while loop (lines 10-31) is run as long as the condition $d(l) > 0$ is satisfied. During each run of the while-loop, we first create a set C (line 11) which basically consists of the channels assigned to links that exist between the nodes u0 and v0 and within the transmission range of either u0 or v0. Sets Cu0 and Cv0 consists of the channels assigned to links emanating from u0 and v0 respectively (lines 12 and 13). A set K0 is calculated by performing the operation: $K0 = K - C - (Cu0 \cup Cv\ 0)$ (line 14).

If $|K0| > 0$, atleast one channel that has not be assigned to a link in the neighborhood around u0 or v0. We pick a channel $k \in K0$ such that load(k) is the least load among those in K0. Thereafter, we create a link $l0 = (u0, v0)$ with $chan(l0) = k$ and allocation $alloc(l0) = \beta$. d(l) is updated to $d(l) = d(l) - \beta$ and $load(k) = load(k) + \beta$(lines 16-19). If $|K0| = 0$ (lines 21-30), then we create a set $C0 = (Cu0 \cup Cv0) - C$. If $|C0| = 0$,we give up and exit the while-loop; otherwise we calculate the number of conflicts for the channels $c0 \in C0$ when a new link is added to that corresponding channel c0. By the number of conflicts, we mean the number of potential links that will interfere with a new link l0, when that link is assigned to the same channel as the potentially interfering links (A newly created link $l0 = (u0, v0)$ conflicts with link $l = (u, v)$ iffchan(l0) = chan(l) and (u0 or v0) lies in the interference range of (u or v)) (A node u lies in the interference range of node v if the Euclidean distance $dist(u, v) \leq IR$).

We then pick a channel c0from C0 with the least number of conflicts and create a linkl $0 = (u0, v0)$ with $chan(l0) = c0$ and an allocation $alloc(l0) = \beta$. d(l) is updated to $d(l) = d(l){-}\beta31$ and $load(c0) = load(c0) + \beta$ (lines 26-29).

Once the while-loop exits, then we traverse the list L once again to check if there exists any links that have non-zero residual demands. If so, we sort L once again in the same way as before, but by discarding links with zero residual demands (line 33). We again proceed in the same way by assigning channels in such a fashion to each of these residual links with the least number of conflicts. The centralized maxflow-based and channel assignment scheme is now complete and outputs the network G0 containing the newly created links along with their corresponding channels. The number of radio interfaces at a mesh router can be inferred from the number of distinct channel links emanating from that mesh router. Formally, the number of radio interfaces at a node u is given by the following:

{videos(u) = #channels assigned to links at node u}

If two or more links are on the same channel, we use only one interface at the two end points of the links.

Complexity analysis: We denote n as the number of nodes and m as the number of links within the WMN. Let K be the total number of non-overlapping channels available for channel assignment. The first phase of the Centralized Maxflow-based and Channel Assignment which basically involves initial channel assignment using MCCA, runs in O(mn2) time[13].

The most time-consuming operation of Centralized Maxflow-based and Channel Assignment, in addition to MCCA, is the two while loops between lines 8-32 and 10-31. In the outer while loop, we basically visit the links in the decreasing order of their residual loads. This takes O(m) time as this list can have at most m residual links. The inner while loop runs as long the demand is greater than zero. This takesO(Dmax) time where Dmax is the maximum residual demand in the list of residual demands. Within the inner while loop, the if − else statement takes the most time of O(mK). The if component takes O(K) time since we are basically finding the domain with the smallest load, while the else component takes O(mK) time. This is because we have to compute the number of conflicts for the domains in C0. In the worst-case, if |C0| = K such that each domain has at most m links, then running time is O(mK). Hence the total running time of the two32 while loops is O(m ∗Dmax∗mK) = O(m2DmaxK). Combining these results, we get an overall running time for Centralized Maxflow-based and Channel Assignment as O(mn2) + O(m2DmaxK).

Performance Evaluation

In this section, we presented numerical results that evaluate the performances of the system.. We implemented centralized max-flow based channel assignment algorithm with maximum flow improvement and the one without maximum flow improvement, which were denoted as MaxFlow and WMN nodes in the figures. All our simulation runs were performed on a 2.8 GHz Linux PC with 2G bytes of memory. The transmission range and interference range of each SS were set to be 500 and 1000, respectively. For RS and BS, the transmission range and interference range were 1000 and 2000. One base station was deployed at the center of the field.

The SSs were distributed randomly and uniformly in the playing fields. The data package requirement of each SS and the link capacity between it and its parent were randomly distributed in and respectively. First, we compared the minimum satisfaction ratios and the running times obtained by the WMN nodes formulation and our heuristic algorithm in a 1500 × 1500 sq. units playing field with 4 RSs. Due to the limitation of memory space, we set the number of timeslots and number of subchannels in a frame to12 and 5, respectively. In Fig. 1, the minimum satisfaction ratio decreased more sharply due to the increased number of hops and RS.In Fig. 2, we noticed that when the number of SSswas more than 15, the ILP formulation cannot provide solutiondue to the memory limitation. On the other hand, a good performance can be obtained from our heuristic algorithm.

For instance, it is still unclear whether the stringent latency constraint (usually less than a second) for video streaming can be met when packets needto be delivered over multiple hops of time-varying wirelesslinks in a mesh network. Conditions where multipath routing is beneficial for streaming need to be identified, as contention of video traffic along parallel paths may cancel out the path diversity advantage of robustness to packet losses. Typicallythe wireless network is shared by both video streaming and other applications such as downloading. The problem remains to be addressed as how to optimally allocate network resource among heterogeneous traffic types, each bearing adifferent performance metric (e.g., completion time for downloading versus video quality for streaming).

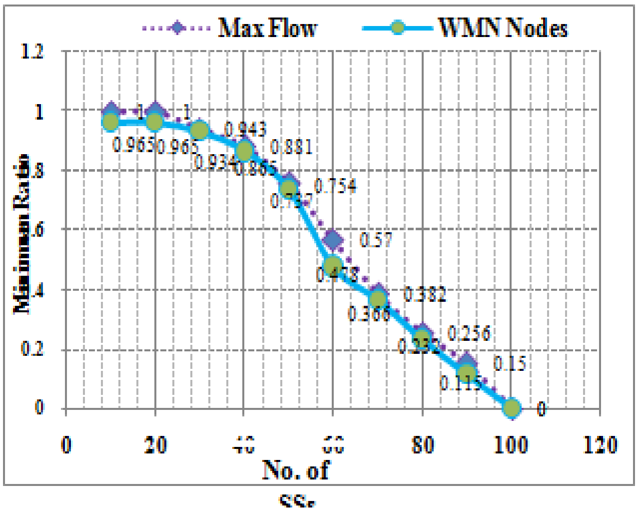

Figure 1: Video Streaming For Reducing The Time Delays

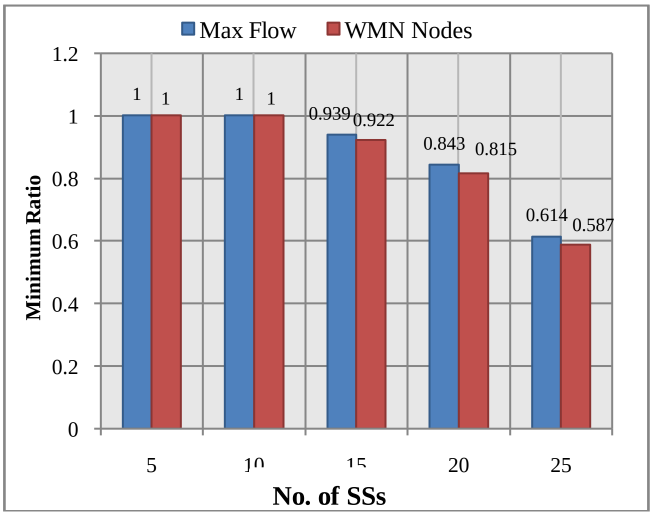

Figure 2: Minimum Satisfaction Ratio

Conclusion

In this paper we discussed the centralized max-flow based channel assignment algorithm for WMN's interference problem. Wireless mesh networks (WMNs) are communications network made up of radio nodes organized in a mesh topology. Wireless mesh networks traffic, being aggregated from a large number of end users, changes infrequently. It causes the most challenging problem in network traffic classification. In this paper, we propose centralized max-flow based channel assignment algorithm. CMCA works in maximum flow computation method to compute the maximum achievable throughput of the network, which does not need the knowledge of the traffic demands. We show that our method can achieve high performance video multicasting without traffic interference.

References

[1] Michele Rossi_, Michele Zorzi_, Frank H.P. Fitzek," Link Layer Algorithms for Efficient Multicast Service Provisioning in 3G Cellular Systems," Dec 2012.

[2] Arkadiusz Biernackia, Florian Metzgerb, and Kurt Tutschkub," On the Influence of Network Impairments on YouTube Video Streaming,"March 2012.

[3] Kazumasa Oida and Naoto Nakayama," Video Stream Identification for Traffic Engineering, Vol. 2, No. 4, August 2013.

[4] Zhou Ling1, 2 , Ding Wei-xiong2 and Zhu Yu-xi2,"Delay-constrained multicast routing algorithm based on average distance heuristic"vol2,No2,March2010.

[5] Teresa Albero-Albero1, Salvador Santonja-Climent1, Víctor-M. Sempere-Payá1, Jordi Mataix-Oltra2,"AODV Performance Evaluation and Proposal of Parameters Modification for Multimedia Traffic on Wireless Ad hoc Networks, Nov 2011.

[6] Basem Al-madani, Anas AI-Roubaiey and Taher Al-shehari," Wireless Video Streaming Over Data Distribution Service Middleware" 2012.

[7] Noam Amram {BoFuyGeraldKunzmannyTelemacoMelia ⋆Daniele Munaretto_ x Sabine Randriamasy ⋆ Bessem Sayadi ⋆ Joerg Widmerz Michele Zorzi_x"QoE-based Transport Optimization for Video Delivery over Next Generation Cellular Networks" Dec 2010.

[8] Almudena Diaz, Pedro Merino, Laura Panizo, Alvaro M. Recio," Evaluating Video Streaming over GPRS/UMTSnetworks: A practical case,"2011.

[9] Vishnu Navda, Anand Kashyap, Samrat Ganguly and Rufizmailovnec-labs usa, princeton, nj, "Real-time Video Stream Aggregation in Wireless Mesh Network," 2010.

[10] Beichuan Zhang Sugih Jamin Lixia Zhang,"Performance Evaluation of Multicast Video Streaming over WiMAX, Vol. 2, No. 4, August 2013.

[11] P. Sailaja, M. Rajeswari , D.L.K Vijai Bharrath," Efficient Bandwidth Video Multicasting on Heterogeneous Wireless Networks", Vol. 4 (4) , 2013, 569 – 571.

[12] Chien-Chi Kao, Shun-RenYang, Jia-Yun Wang," A Sleep-Mode Interleaving Algorithm forLayered-Video Multicast over Mobile WiMAX" 2011.

[13] Tiantian Guo, ChuanHengFoh," Performance Evaluation of IPTV over Wireless Home Networks" 2010.

[14] Ouldooz Baghban Karimi1, Jiangchuan Liu1, and Zongpeng Li2," Multicast in Multi-channel Wireless Mesh Networks" 2010.

[15] Supratim Deb, SharadJaiswal, KanthiNagaraj,” Real-Time Video Multicast in WiMax Networks,”2011.

[16] Somsubhra Sharangi, Ramesh Krishnamurti, and Mohamed Hefeeda,,” Energy-Efficient Multicasting of Scalable Video Streams Over WiMAX Networks,”, February 2011.

[17] Xu Li†, Wei Shu♦, Ming-Lu Li† and Min-You Wu†,”Vehicle-based Sensor Networks for Traffic Monitoring,”2010.

[18] Md. Ibrahim Abdullah1, M. Muntasir Rahman2, Ahsan-ul-Ambia3, Md. ZulfikerMahmud4,”Performance of Conferencing over MANET Routing Protocols,” VOL. 2, NO.6, JUNE 2012.

[19] Xiaoqing Zhu_ , PiyushAgrawal†, Jatinder Pal Singh‡, TansuAlpcan‡ and Bernd Girod,” Rate Allocation for Multi-User Video Streaming over Heterogenous Access Networks,”2010.

[20] Savera Tanwir and Harry Perros, Fellow,”A Survey of VBR Video Traffic Models, 2013.

[21] L. Leelavathy, Dr. E. D. Kanmani Ruby, Dr. N. Kasthuri,” Comparison & Packet Level Analysis of Routing Protocol for Video Streaming Traffic Over Mobile AdhocNetwork,”Volume 4, Issue 6, June-2013.

[22] Martin Ellis, Dimitrios P. Pezaros, Colin Perkins,” Performance Analysis of AL-FEC for RTP-based Streaming Video Traffic to Residential Users,” May 10-11, 2012.