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Multi Attribute Content Distribution and Replication Based Video Streaming in Wireless Networks for Qos Improvement

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Abstract*:* The growth of information technology has introduced various functionalities and services to support video streaming like video streaming and live streaming. There are many approaches has been discussed to support content delivery in wireless networks, but suffers with the problem of latency and quality of streaming which takes more time and the frequency of retransmission is high. To solve these problems, we propose a multi attribute location selection and distribution approach to select the location from where the video content has to be fetched and based on the multi attribute replication scheme new copy of the video content will be replicated in more locations according to various factors of quality of service. The proposed method maintains number of replicas of video content in different locations of wireless networks. The method selects the location of the video content or the node which has the requested data according to the delay present in the network and the user location. Also the number of replicas maintained is performed according to the spatial request factor which represents the number of request being received from different user from a specific spatial region and the other factors like delay, number of users and the traffic incurred in the network towards a video content. The proposed method reduces the overall latency present in the network and increases the efficiency of content delivery which supports multimedia data transfer. Also the proposed method reduces the overall time complexity and reduces the overhead introduced by data transfer.

Keywords*:* Location selection, Replica Management, Content Distribution, Wireless Networks.

I. INTRODUCTION

Wireless networks are the collection of nodes where each node has its own dedicated job. There are nodes which provide set of services which can be accessed by some other nodes. Also there are node which stored only the data or information called data nodes. Storing and retrieving the required information in the wireless network is the key issue here due to the large traffic and the client may be requesting the resource from some other network. So in order to obtain quality of service parameters the streaming of the data has to be performed in an efficient way. The streaming efficiency is depend on different parameters namely latency, continuity, availability, throughput and time complexity.

In order to achieve good efficiency in video streaming, the resource or the video file has to be scattered in different locations in the wireless network so that the clients or the users can retrieve the necessary file whenever they required. Similarly the files cannot be replicated blindly in many locations and there must be some constraints in replicating the files. In wireless networks the content present in the single node can be distributed to other nodes through some other neighboring nodes by performing some kind of routing. Based on the help of other nodes the content of the file will be distributed to the rest of the nodes of the network.

Replica is the copy of the file which is generated or stored or created in another node of the network which is located in different location of the network. The reason why the creation of replica is necessary is, sometimes more than one node may be looking to retrieve the content of the same file which leads in huge traffic in specific route or throughout the network. To avoid this same copy of the fie can be placed in

different nodes of the network and the nodes can retrieve from different nodes of the network. This approach is called replication and the management of the created duplication is called replica management.

Sometime the replica of the file may be available in different locations but the user can select a single location from where the file has to be retrieved. The selection has to be performed in efficient manner based on various constraints. This is called location selection in content retrieval and has to be performed in exact manner so that the retrieval time will become lesser.

Related works:

There are many approaches has been discussed earlier to perform content distribution and replica management. We discuss few of them here in this section.

HyMN-injection-based multimedia content distribution in hybrid wireless networks [1], present HyMN, a prototypically implemented hybrid wireless network system optimized for multimedia content providing. Within the ad hoc network, adequate devices are elected to maintain uplinks to a backbone, which can provide for instance multimedia news from certain sports events like Football Championships, Olympic Games and alike. In order to efficiently manage the ad hoc communicating devices, a weighted clustering algorithm is employed.

Impact of Different Content Placement and Delivery Strategies on Content Delivery Capacity of the Wireless Mesh Networks [2], present analysis of impact of content placement on nodes of wireless mesh network on the total streaming capacity of that network. Our analysis shows that network's streaming capacity, with respect to given topology and cached content, can be equally increased with content placement on access points of the network, as it would be increased with installation of additional gateways.

Adaptive Streaming of Combined Audio/Video Content over Wireless Networks [7], describes a method for robust streaming of combined MPEG-2 audio/video content over in-home wireless networks. We make use of currently used content distribution formats and network protocols. The transmitted bit-rate is constantly adapted to the available network bandwidth, such that audio and video artifacts caused by packet loss are avoided. Bit-rate adaptation is achieved by using a packet scheduling technique called I-Frame Delay (IFD), which performs priority-based frame dropping upon insufficient bandwidth. We show an implementation using RTP and an implementation using TCP. Measurements on a real-life demonstrator set-up demonstrate the effectiveness of our approach.

Opportunistic Content Distribution in Intermittently Connected Mobile Ad Hoc Networks [8], witnessed an explosion of content-rich services over the Internet, and thereby content distribution itself grows into one of the most important Internet applications. Content delivery networks or content distribution networks (CDNs) first emerged to address the efficiency of content distribution over the Web for the end users, since content delivery has become important for improvement of Web performance. In order to improve accessibility, decrease access delay, maximize bandwidth utilization, and maintain correctness for the users, CDN distributes content to a group of geographically dispersed cache servers.

Content-Aware Selective Retransmission Scheme in Heavy Loaded Wireless Network [11], propose a content-aware selective retransmission scheme which allows the retransmission of all packets when the risk of congestion is low, but as it rises the retransmission is disabled step-by-step, but not all at once, in order of packet importance. In this work the heterogenity of H.264 streams were utilized for the determination of packet importance. The advantage of this transmitter controlled procedure is that all the needed information is available at the source due to DCCP transport protocol and its congestion control algorithm. The effectiveness of the proposed method was examined in Ns2 network simulator.

All the above discussed approaches has the problem of distributing the content in efficient manner and struggles with the problem of accuracy and time complexity.

Proposed Method:

The proposed method has various stages of content distribution namely Preprocessing, Multi Attribute Content Distribution, Replica Generation, Location Selection, Request Handling. We discuss each of the functional components in detail in this section.

Preprocessing:

The user request has been received and the resource requested by the user is identified. From the identified resource, the method identifies set of location the resource available in the network. The identified resource locations are given to the request handling. The method extracts the set of locations the resource available from the resource details.

Algorithm:
Input: User Request UR, Service Details SD.
Output: Service Location Details LD.
Step1: start
Step2: Identify set of all locations the resource available.

LD = $\¿SD$

$$\int_{i=1}^{¿} ¿\sum Locations(SD) \times SD.Resource \in UR.Resource$$

Step3: stop.

Multi Attribute Content Distribution:
The method computes the multi attribute distribution based on different factors like number of locations the resource is available, the number of request rising for each location at each time window, average hops between the resource and the client , and so on. Based on the above discussed factors we compute the content distribution factor CDF. Based on the computed CDF value, if the CDF is greater than the threshold and the number of hops are far away then the replica generation is recommended.

Algorithm:
Input: Service History SH, Location Details LD.
Output: NULL
Step1: start
Step2: for each time window Ti
Identify set of access traces generated.

$$AT = \int_{i=1}^{¿} ¿\sum SH.Time = ¿Ti \quad \¿Tw$$

end
Step3: for each resource location L from LD
Compute total number of request being received.

$$Nor = \int \sum SH(i).L$$

Compute average hop count $Ahc = \frac{AT}{At}$

$$\int_{i=1}^{¿(¿)} \frac{\sum SH(i).hopcount}{¿(¿)}$$

Compute average delay Adelay = Ahc×0.8 seconds.

$$\text{Compute CDF} = \frac{Ahc \times Adelay}{Nor}$$

END

step4: retuen CDF.

Request Handling:
The user request received from the user is handled by this stage and from the user request the resource being requested is identified. The method identifies the set of location the resource is available and based on that we identify a single location based on the content distribution factor. If the selected location has more delay factor then a new replica is generated and the request will be handover to the location.

Algorithm:
Input: Request Req, Resource Details Rd.
Output:Null.
Step1: start
Step2: Perform service Selection.
Step3: Stop.

Location Selection:
The location selection is performed based on the content distribution factor computed and the first neighbor location where the resource is available. Also the method computes the number of hops the request has to be traversed to access the resource. If the number of hops is less than the threshold then the same location will be selected otherwise the replica generation will be called up to generate the new resource in a optimal location.

Algorithm:
Input: Location Details LD.
Output: NULL
Step1: start
Step2: Identify the location where the service available

$$L = \sum Loc(LD) \in Resource$$

Step3: for each location li from L
Compute CDF.
CDFS = content distribution factor(li).
End
Step4: Choose the lease CDF location.
Lmin = min(CDF).Location.
Step5: Identify number of hops to reach the location.

$$Nh = \sum Hops \in Location$$

Step6: if Nh>HTh //Hop threshold
Perform Replica generation.
else
Use the same location for streaming.
end.
Step7: stop.

Replica Generation:
The replica is generated according to the number of locations which has more average hop clients. We identify the client location from where the request has

been generated and identify its neighbors which has requested the same resource. Based on these information an middle node is identified and the copy of the resource is generated or replicated to service the clients.

Algorithm:
Input: User Location Ul, Resource Res, Request Details RD.
Output: Null.
Step1: start
Step2: Identify the set of neighbors of user location request the same resource.

Neighbors Ne = $\sum Neighbors(User) \in RD.Res$

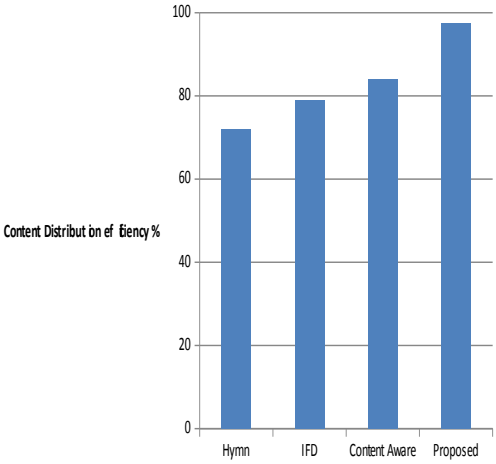
Step3: Identify the middle location for all the nodes

Middle location ML = $\sum \frac{¿NE}{Ne.loc}¿$

Step4: Generate replica in ML.
Step5: stop.

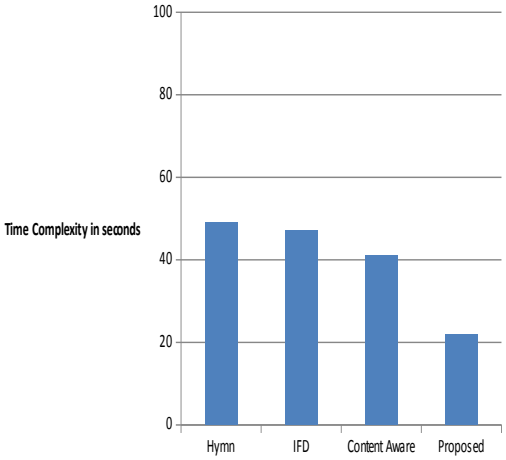
II. RESULTS AND DISCUSSION

The proposed multi attribute content distribution and replication approach has been implemented and tested for its efficiency. The proposed approach has produced efficient results in all the factors of content delivery in wireless networks.



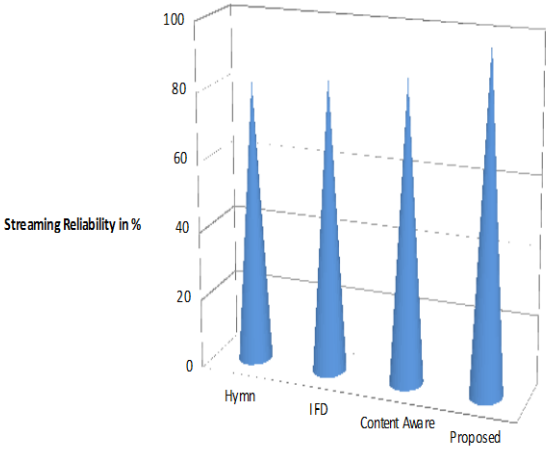
Graph1: Comparison of content distribution efficiency

The graph1 shows the comparative result of content distribution efficiency of different methods and it shows clearly that the proposed method has produced higher efficiency than other approaches.



Graph2 : Comparison of time complexity of location selection

The Graph 2, shows the comparison of time complexity produced by different methods on location selection for streaming by different methods. It show clearly that the proposed method has produced less time complexity than other methods.



Graph 3: Comparison of streaming reliability

The Graph 3, shows the streaming reliability achieved by different methods and it shows clearly that the proposed method has produced higher reliability than other methods.

III. CONCLUSION

We proposed multi attribute content distribution measure based replica generation and video streaming in wireless network. The method computes content distribution factor for each of the location for the specific resource being requested. Based on the factor computed a single location is selected and verified for

the threshold. If the value of CDF is less than threshold then the location is allotted for streaming otherwise the replica generation is performed to perform location selection and request handling. The proposed method has produced efficient results in all the factors of quality of video streaming and content delivery in wireless networks. The proposed method has produced less time complexity also.

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