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DASU: High Quality Video Streaming Over Multiple Wireless Access Network Using Real Time Adaptive Algorithm

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Abstract: ***Video streaming is gaining popularity among mobile users. Presently everybody has a hand held devices such as smart phones and tablets, all are equipped with multiple wireless network interfaces like Wi-Fi, 3G, Bluetooth etc. This Paper Dynamic Adaptive Streaming over UDP(DASU) mainly focuses on how efficiently and cost-effectively utilizes multiple links to improve video streaming quality. In order to maintain high video streaming quality while reducing the wireless service cost, in this paper the optimal video streaming process with multiple links is formulated as a Markov Decision Process (MDP). .The reward function is designed to consider the quality of service (QoS) requirements for video traffic. To solve the MDP in real time, this paper proposes a Real Time Adaptive Algorithm to obtain a solution. The proposed algorithm works well with the system by doing some evaluation to achieve the QoS such as the startup latency, playback fluency, and average playback quality.Experiment results demonstrate the feasibility and effectiveness of the proposed adaptation algorithm for mobile video streaming applications.***

Keywords: multiple wireless networks, DASH, video streaming

1. Introduction

VIDEO streaming is gaining popularity among mobile users presently. As we know that the mobile devices have limited computational capacity and energy supply, and all the channels used for wireless networks are highly dynamic, this paper is challenging to provide high quality video streaming services for mobile users consistently. It is a promising trend to use multiple wireless network interfaces with different wireless communication techniques for mobile devices. For example, smart phones and tablets are usually equipped with cellular, Wi-Fi and Bluetooth interfaces. Utilizing multiple links simultaneously can improve video streaming in several aspects: the aggregated higher bandwidth can support video of higher bit rate; when one wireless link suffers poor link quality or congestion, the others can compensate for it. High resilience to bandwidth variation and easy deployment are both important requirements for video streaming applications. Currently, progressive download, One of the most popular and widely deployed streaming techniques, buffers a large amount of video data to absorb the variations of bandwidth. Meanwhile, as video data are transmitted over HTTP protocols, the video streaming service can be deployed on any web server. However, the video quality version can only be manually selected by users and such decision can be error-prone. Since the smart phones only have limited storage space, it is impractical to maintain a very large buffer size. In addition, the buffered unwatched video may be wasted if the user turns off the video player or switches to other videos. Furthermore, progressive download typically does not support transmitting video data over multiple links. To overcome the above disadvantages of progressive download, dynamic adaptive streaming over UDP has been proposed. In a DASU system, multiple copies of pre-compressed videos with different resolution and quality are stored in segments. The rate adaptation decision is made at the client side. For each segment, the client can request the appropriate quality version based on its screen resolution, current available bandwidth, and buffer occupancy status. The two main contributions of this paper are. First, we formulate the video streaming process over multiple links as an MDP problem. To achieve smooth and high quality video streaming, we define several actions and reward functions for each state. Second, proposed a Real-Time Adaptive Algorithm(RTAA) .The proposed adaptation algorithm will take several future steps into consideration to avoid playback interruption and achieve better smoothness and quality

2. Objective

High quality videos without play back interruption are major needs in nowadays. Dynamic adaptive streaming over UDP (DASU) is a system which provides smooth, less delaying videos of higher bitrates using multiple links simultaneously. In this paper, the multi-link video streaming process we considered as reinforcement learning task. For each streaming step, we define a state to describe the current situation, including the index of the requested segment, the current available bandwidth and other system parameters. A finite state Markov Decision Process (MDP) can be modeled for this reinforcement learning task. The reward function is carefully designed to consider the video QoS requirements, such as the interruption rate, average playback quality, and playback smoothness, as well as the service costs. To make a trade-off between different QoS metrics and the cost, we can adjust the parameters of the reward function. To solve the MDP in real time, we proposed aReal Time Adaptive Algorithm (RTAA)to obtain a sub-optimal solution.

According to Real Time Adaptive Algorithm(RTAA) used here mainly use Wi-Fi and Bluetooth as two access path over a UDP protocol and it considers the Server which sends the video packets and the Client .Initially the Client request the video to the server over UDP through one link, then after receiving the request the server identifies the presence of multiple link. Receiving the replay, the client start downloading the packets from server through both links. Server sends the packets based on the current bandwidth calculated by the rate adaptation agent.

3. Problem Definition

Presently, progressive download was the most widely deployed streaming method which buffers large amount of video data. The smart phone have only a limited buffer size and if the watcher decided to stop watching the video, the buffered videos will be wasted and also it can't support multiple links. To overcome these disadvantages of progressive download the existing system called DASH(Dynamic Adaptive Streaming Over HTTP) with multiple links has been proposed. In a DASH system, multiple copies of pre-compressed videos with different resolution and quality are stored in segments. The rate adaptation decision is made at the client side. For each segment, the client can request the appropriate quality version based on its screen resolution, current available bandwidth, and buffer occupancy status. This pull-based DASH scheme can be extended to support multiple links, i.e., we can let the client request different parts of one segment over different links. Traditional streaming generally uses a stateful protocol, e.g., the Real-Time Streaming Protocol (RTSP): Once a client connects to the streaming server the server keeps track of the client's state until the client disconnects again. Typically, frequent communication between the client and the server happens. Once a session between the client and the server has been established, the server sends the media as a continuous stream of packets over either UDP or TCP transport. In contrast, HTTP is stateless. If an HTTP client requests some data, the server responds by sending the data and the transaction is terminated. Each HTTP request is handled as a completely standalone one-time transaction. According to the DASH system it will take an amount of time for waiting each request-replay communication.

The main aim of the research is to avoid delay between the playback and the start up one. Using UDP as protocol for streaming will no need excess amount of time for communication as in HTTP. Currently all hand held devices are equipped with multiple wireless links like 3G,WiFi,Bluetooth etc but all will use a single link for video streaming. High resilience to bandwidth variation and easy deployment are both important requirements for video streaming applications. While there occurs any variation in the bandwidth, the downloading will be interrupted and will affect the playback smoothness. Using multiple links can improve video streaming in several aspects: the aggregated higher band width can support video of higher bit rate and when one wireless link suffers poor link quality or congestion, the others can compensate for it.

4. Literature Survey

The paper named "**Dynamic adaptive streaming over HTTP –: standards and design principles" [1],** the author T. Stock hammer introduced some design principles for DASH. It has been a hot topic in recent years. There are many commercial products which have implemented DASH in different ways, such as Apple HTTP Live Streaming and Microsoft Smooth Streaming. Since the clients may have different available bandwidth and display size, each video will be encoded several times with different quality, bit rate and resolution. All the encoded videos will be chopped into small segments and stored on the server, which can be a typical web server.

HTTP-based progressive download does have significant market adoption. Therefore, HTTP-based streaming should be as closely aligned to HTTP-based progressive download as possible. The media preparation process typically generates segments that contain different encoded versions of one or several of the media components of the media content. The segments are then hosted on one or several media origin servers typically, along with the media presentation description (MPD). The media origin server is preferably an HTTP server such that any communication with the server is HTTP-based Based on this MPD metadata information that describes the relation of the segments and how they form a media presentation; clients request the segments using HTTP GET or partial GET methods. The client fully controls the streaming session, i.e., it manages the on-time request and smooth playout of the sequence of segments, potentially adjusting bitrates or other attributes, for example to react to changes of the device state or the user preferences. Massively scalable media distribution requires the availability of server farms to handle the connections to all individual clients. HTTP-based Content Distribution Networks (CDNs) have successfully been used to serve Web pages, offloading origin servers and reducing download latency. Such systems generally consist of a distributed set of caching Web proxies and a set of request redirectors. Given the scale, coverage, and reliability of HTTP based CDN systems, it is appealing to use them as base to launch streaming services that build on this existing infrastructure. This can reduce capital and operational expenses, and reduces or eliminates decisions about resource provisioning on the nodes. Scalability, reliability, and proximity to the user's location and high-availability are provided by general purpose servers.

The research paper named "**Qdash: A Qoe-Aware Dash System**" [2], authors R. Mok, X. Luo, E. Chan, and R. Chang proposed an enhancement to Dynamic Adaptation Streaming over HTTP (DASH) by the Quality of Experience (QoE) for users by automatically switching quality levels according to network conditions. Various adaptation schemes have been proposed to select the most suitable quality level during video playback. Adaptation schemes are currently based on the measured TCP throughput received by the video player. Although video buffer can mitigate throughput fluctuations, it does not take into account the effect of the transition of quality levels on the QoE. This paper propose a QoE-aware DASH system (or QDASH) to improve the user-perceived quality of video watching. It integrate available bandwidth measurement into the video data probes with measurement proxy architecture and found that the available bandwidth measurement method facilitates the selection of video quality levels. Moreover, it can assess the QoE of the quality transitions by carrying out subjective experiments. The results show that users prefer a gradual quality change between the best and worst quality levels, instead of an abrupt switching. Hence, the paper propose a QoE-aware quality adaptation algorithm for DASH based findings. Finally, it integrate both network measurement and the QoE-aware quality adaptation into a comprehensive DASH system. QDASH consists of two building blocks 1)QDASH-abw 2)QDASH-qoe.

QDASH-abw measures the network available bandwidth, and QDASH-qoe determines the video quality levels. These two modules can be integrated into existing DASH systems, while the modifications to the systems are kept to minimum. QDASH is designed for streaming H.264/AVC video clips, and aims at immediate deployment to current systems. As part of the investigation for optimal streaming strategy for DASH the paper named "Adaptive scalable video streaming in wireless networks,"[3] introduced a rate adaptation algorithm for video streaming in wireless network.Dynamic Adaptive Streaming over HTTP (DASH) which extends the traditional HTTP streaming with an adaptive component addressing the issue of varying bandwidth conditions that users are facing in networks based on the Internet Protocol(IP). Paper [5] **"A Proxy Effect Analysis and Fair Adaptation Algorithm for Multiple Competing Dynamic Adaptive Streaming over Http Clients**" concentrates on the negative effects introduced when multiple clients are competing for a bottleneck and how proxies are influencing this bandwidth competition. The clients request individual portions of the content based on the available bandwidth which is calculated using throughput estimations. A consequence of this requesting scheme is that only some parts of the content are stored on proxy servers, which are intercepting the connection between the client and the content server. This uncontrolled distribution of the content influences the adaptation process that assumes that the measured throughput is the throughput to the content server. The impact of this falsified throughput estimation could be tremendous and leads to a wrong adaptation decision which may impact the Quality of Experience (QoE) at the client. fair adaptation scheme (FAS) aims to address the problem identified in Section 3. Our first and probably simplest approach to decrease the frequent switching and as a consequence the negative effects, that could be caused due to that switching, is an adaptation logic with an exponential backoff. This approach decreases the number of switch up points if a switch down occurs. But this technique does not consider whether a bandwidth fluctuation is self-caused or networkcaused.

This paper named **"Using HTTP Pipelining to Improve Progressive Download over Multiple Heterogeneous Interfaces"[5]**authorD. Kaspar, present an improved version that utilizes HTTP's capability of request pipelining in combination with range retrieval requests. The use of very small segments no longer impairs the efficiency of throughput aggregation, which additionally makes the solution robust against link variances and agnostic to network heterogeneity. Major hurdle in the deployment of a multilink solution is the lack of server-side support. Although there exist suggested modifications to TCP standard transport protocols are unable to provide host-base aggregation of individual flows. Thus, a common approach is to provide specialized libraries for transparent partition of application-layer data into multiple independent transport streams. However, the implementation of such middleware requires software modifications to all involved clients and servers. In order to provide easy deployment and interoperability with existing server infrastructure, paper proposed a purely client-based solution for progressivelydownloading a single large file over multiple interfaces. HTTP pipelining is a method that "allows a client to make multiple requests without waiting for each response, allowing a single TCP connection to be used much more efficiently, with much lower elapsed time, in the absence of pipelining each range retrieval request must be sequentially handled by the server before the client can send the next request. Thus, for each request, an average time overhead of one round-trip time is incurred. For a large number of small file segments, this overhead significantly impairs the throughput of high-latency connections

Another paper named "**Quality-Adaptive Scheduling for Live Streaming over Multiple Access Networks"**[6] focus on achieving smooth and quality-adaptive streaming of live video. Paper present a client-side scheduler that retrieves segments of several video encodings over heterogeneous network interfaces simultaneously. By extending the DAVVI streaming platform with support for multi homing, the proposed scheduler's performance is experimentally evaluated. The results show that the scheduler reduces the video interruptions and achieves a higher and more stable average quality over multiple, truly heterogeneous wireless interfaces. This paper introduces an adaptive, pull-based scheduler that achieves smooth playback by scheduling requests for video segments of different quality levels over multiple interfaces simultaneously. Results show that the combined operation of multiple interfaces significantly enhances the quality of live video streaming. Even in a truly heterogeneous environment with WLAN and HSDPA links, the presented scheduler achieves an increased video quality and reduces playback interrupts.

"**Using Bandwidth Aggregation To Improve The Performance Of Quality-Adaptive Streaming**",Paper [7]focused on bandwidth aggregation on host multi homed devices. Even though bandwidth aggregation has been a research field for several years, the related works have failed to consider the challenges present in real world networks properly, or does not apply to scenarios where a device is connected to different heterogeneous networks. In order to solve the deployment challenges and enable the use of multiple links in a way that works in a real-world network environment, have created a platform-independent framework, called MULTI. MULTI was used as the foundation for designing transparent (to the applications) and application-specific bandwidth aggregation techniques. MULTI works in the presence of Network Address Translation (NAT), automatically detects and configures the device based on changes in link state, and notifies the application(s) of any changes. The application-specific bandwidth aggregation technique presented in this paper was optimized for and evaluated with quality-adaptive video streaming. The technique was evaluated with different types of streaming in both a controlled network environment and real-world networks. Adding a second link gave a significant increase in both video and playback quality. However, the technique is not limited to video streaming and can be used to improve the performance of several, common application types.

5. Proposed Approach

Dynamic Adaptive Streaming over UDP(DASU)with multiple link is a technique used for a real time Online video Streaming for mobile users. To avoid playback interruption and achieve better smoothness and quality the paper proposed a rate adaptation algorithm which takes several future steps into consideration. It is very challenging to provide high quality video streaming services for mobile users consistently. It is a promising trend to use multiple wireless network interfaces with different wireless communication techniques for mobile devices. For example, smart phones and tablets are usually equipped with cellular, Wi-Fi and Bluetooth interfaces. Utilizing multiple links simultaneously can improve video streaming in several aspects: the aggregated higher bandwidth can support video of higher bit rate and also when one wireless link suffers poor link quality or congestion, the others can compensate for it.

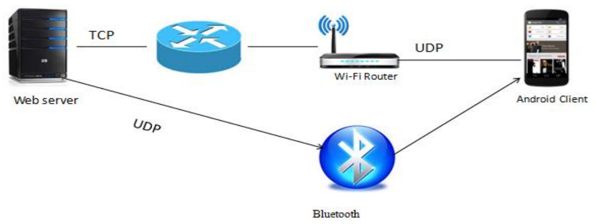

Figure 1: Architectural design

RTAA is a multiple wireless access protocol, connecting one mobile with a web server through multiple connections. In this work it creates a new protocol to send data through the network by UDP. For this server has number of data's and store with Verity of size and it can be downloadable by configuration varying mobiles and laptop's through internet. For getting videos through mobile it make proper connection and also registering multiple channels for transmit data over that connection. Making connection and transmitting through those channel. When all the transmitting is completed the records will be save. Making Evaluation with respect to connection delay, starting delay, packet transmitting etc.

DASU with multiple links is a live video streaming model which is capable for providing high quality video with a small startup delay. For this, paper introduces a rate adaptive algorithm which efficiently works with the varying bandwidth network conditions. It is a promising trend to use multiple wireless network interfaces with different wireless communication techniques for mobile devices. Smart phones and tablets are usually equipped with cellular, Wi-Fi and Bluetooth interfaces, here this work utilizing Wi-Fi and Bluetooth as network links. Its very complex to implement real system because no any android phone which use multiple link at a time currently. So the simulation model contains a Server node which provides the requested video as stream and an Android phone as a client node. There is another node which acts as a intermediary router in Wi-Fi link between Server and Client. User Datagram protocol (UDP) and TCP/FTP protocols are used for the efficient communication between the Server and Client. When the client node send UDP request to the server through the Bluetooth link, server identifies occurrences of two links. Server will provide response to the client through Bluetooth link in small delay and start sending packets. After a short time the intermediary node will make a hand shake using TCP with Server. Connecting Server to Client by same UDP will generate problem ,So after the handshaking server start sending packets to the node and the node will use UDP to send the packets to the destination through Wi-Fi link.The Aggregated band width can support video with high bit rate and when one link suffer poor link Quality the other can compensate for it

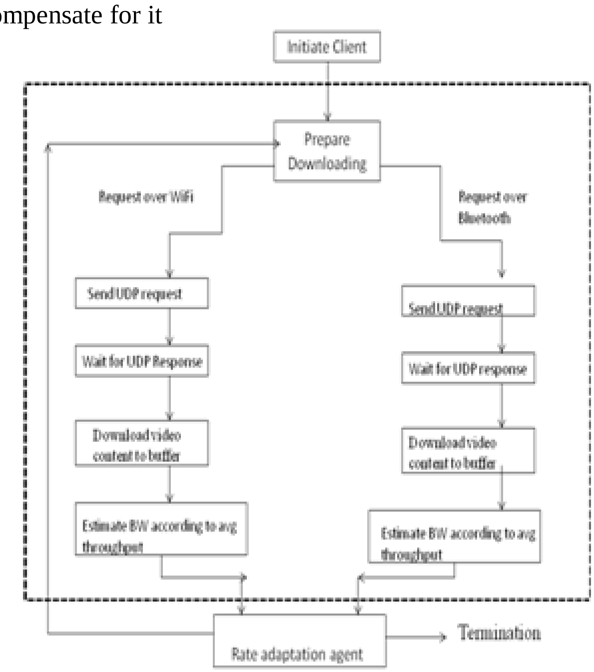

Figure 2: Architectural flow diagram of DASU

6. Algorithm

The proposed algorithm works with the following steps;
Step 1: Initiate Client Request by connecting to the Server with information about multiple connection links
Step 2: Server Receives Request and identifies the occurrences of two links
Step 3: Server response with Stream prepared message and start sending video packets
Step 3.1: After making connection the data send over the direct connection defined protocol and after that it makes data transmission through other connection
Step 3.2: Multiple connection processed by one another agent working as a forwarder node
Step 4: Client initiate Two separate Network data path
Step 5: Server initiate Band width measurement for each link
Step 6: Based on the Band width Server split the video content to separate stream and send through both link
Step 7: Client receives data coming through two link to a unique buffer
Step 9: Stop

7. Conclusion

This paper proposed a Real time Adaptive algorithm to adapt the bit rate based on the band width condition of network for high quality with less buffering video streaming delivery. DASU(Dynamic adaptive streaming over UDP) with multiple links is designed to interact with new and existing video streaming applications regardless of the selected scalability techniques or encoding policies. This approach is able to adapt to the varying band width condition of the network and eventually delivering smooth video. Through simulations in the work identified significant gains for DASU with multiple links in highly-multiplexed dynamic networks. Several performance evaluations made to achieve some Qos such as Start-up latency and average play back fluency. The corresponding performance studies reveal that the proposed rate adaptive scheme compares very favorably with throughput and delay mechanisms that explicitly address time-sensitive traffic. Finally, it demonstrated that DASU with multiple links effectively overcomes the progressive nature of HTTP and maintains friendliness with interfering traffic. Comparing to other heuristic approaches, RTAA algorithm is more stable and adaptable in dynamic situations, emphasizing the benefit of resource aggregation in multipath network scenarios. The obtained results encourage for further investigate the possibility of multiple wireless networks interconnecting towards the end users.

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