Dynamic Handoff Management for Synchronization of Multimedia Streams in Mobile Systems

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Abstract

The merging of wireless networking and Internet Protocol networking needs solutions for transferring video to IP enabled mobile devices and wireless networks. The mobility protocols like Mobile IPv6 (Perkins C. et al., 1996) provide catching and sending packets to mobile nodes, and possibly in the roaming node. It allows the devices to move within the Internet topology while being accessible and retaining Seamless networks, and provides mobility support for IPv6. In future this seamless handoff mobility across diverse networks will be taken for granted. The current research thrust is to ensure an uninterrupted multimedia transmission when the MH moves between networks or subnets. Ensuring uninterrupted multimedia transmission during handoff is challenging, because the MH is already receiving multimedia from the network to which it is connected; when it moves into another network, it needs to break the connection with the old network and establish a connection with the new network. TCP/IP is not support for this so that Mobile IP and SIGMA are handoff schemes are using at the network layer and the transport layer respectively. SIGMA is based on IP diversity and aims to improve the handoff performance over Mobile IP by reducing the handoff latency. In this research work the performance of the handoff schemes were compared in an experimental test bed. Results show that SIGMA has a lower handoff latency when compared to Mobile IP. Moreover, SIGMA can achieve a seamless handoff between two subnets.

Keywords: Mobile streams, MIP,MIPV6, HMIPv6

1.Intoduction to Mobility Management

The different mobility supported at the layer 3 (MIP) will permit Inter-mobility that the layer 2 and layer 1 will be entirely apparent. In this new generation of mobile data and media services the Mobile IPv6 (MIPv6) will be one of the key enabling technologies. The one most expected factor in future mobile networks is the provision of entire Internet Protocol (IP) architecture and connectivity to anywhere and at any time. MIPv6 and its Handoff (HO) extensions together will fasten the various wireless networks to offer widespread contact in the future to the Internet. In general, unbroken roaming means no connectivity loss or any obvious interruption is experienced by the Mobile node (MN). It is vital that a HO is devised in such a way that wireless network connectivity is retained for the longest possible duration of time, so that the packet loss and HO latency is diminished.

The furthermost important part of this mobility Internet Protocol is the HO. In this phase, the MN will not be able to send or receive information, and may lose a number of packets due to midway buffers or get delayed. This is often objectionable for video streaming. The Internet Engineering Task Force “MIPv6 Signaling and Handoff Optimization” working group has considered Fast Handovers for Mobile IPv6 (FMIPv6) (Rajeev Koodli 2004) for increasing the speed. The foremost aim of FMIPv6 is to decrease both the HO latency and the packet losses to zero.

MIPv6 handles macro-mobility and micro-mobility identically. As the mobility of the users is within the Home Network, a hierarchical system that splits inter mobility from intra mobility is desirable. Hence Hierarchical Mobile IP v6 (HMIPv6) (Soliman *et al.*, 2004) that divided local mobility from global mobility was designed. The Mobility

Anchor Point (MAP) divided inter mobility from intra mobility with the help of a midway mobility agent, and needed a Mobile Node spatial area[3]. It is known that HMIPv6 does not reach the fast HO provision defined in FMIPv6. This means that it is essential for a certain fast HO system in HMIPv6 based wireless networks.

2. A Synchronization System for Mobile Multimedia Systems

Synchronization of media objects among mobile clients is a complex design problem. Synchronization is needed to reduce the effect of delay suffered during the communication of multimedia streams[4] and to maintain the progressive relations between media objects in a media system. Distributed multimedia system (S.H.Azzedine Boukerche and Jacob T., 2001) consists of the following three components
(i) Scalable servers (ii) Mobile Node(MN) and (iii) Quasi-receivers (Base Stations).The existing synchronization algorithm is given below.

Mobile synchronization algorithm considers P servers (S), Q Base stations (BS) and R Mobile Node (MN). Where P, Q, R > 0.

2.1 Base Station protocol

This algorithm determines the difference among the MM object's arrival times and analyzes the Synchronization Point (SP) for the server to be the difference between the Tmax and Ti[1].

Here Tmax is the biggest surveyed delay Round Trip Time from the servers and observed Round Trip Time from server is Ti.

BS receives following messages from the two sources. (1) ON, OFF messages from the neighboring BS and (2) Request, Update and Done messages from mobile nodes.

i) *Request message*: If SP is less than δ then BS Requests the MM Unit without system synchronization. If SP is greater than δ then BS requirements dummy packets to create a fresh SP. Where, δ is Minimum delay time, Dummy packet is that includes simply the packet size, source address and destination address.

ii) *Update message:* BS obtains the message together with the difference between the arrival time and anticipated arrival time. If Result is δ then increases the number of delivered MM units. Otherwise number of delivered MM unit is the same as the previous value. Where,

   Result = New time difference – Last time difference.

iii) *Done message:* Terminates the MM service.

iv) *ON message:* The Base station knows existing on the adjacent BS to that the setup delay time.

v) *OFF message:* The BS knows that the setup time delay does not existing on the adjacent Base station.

2.2 Mobile Node protocol

To synchronize Multimedia (MM) objects received from MM servers, following values can be calculated. These are latest arrival time, Difference between every MMOs Buffer usage and arrival time = NMMUs * PT–CT+RT.

In this Number of MM units is NMMUs, Playout time for a MMU is PT, and RT is Time when mobile node request MM units and CT is Current time at Mobile Node. With this existing algorithm the synchronization of inter and intra MM streams were done effectively. This scheme can scope efficiently with jitter[5]. The performance of the algorithm was evaluated for the metrics such as Complexity of the message, how much buffer is used and Mobile Nodes buffer overflow and buffer underflow.

2.3 Server protocol

Receive following messages from BS to

i) Setup initial synchronization.

ii) Request single MM object and

NRequest is a Request of N Multiple single multimedia objects (MMO) and Interrupt (INT) delivery of N multiple MM objects. Where, INT terminates delivery of MMO and also all upcoming deliveries. NRequest makes deliverance of program for the Mobile Node and sends the first MM objects ahead of first deliverance receipt[9]. The server sends MM objects each round trip time.

2.4 Proposed Approach

The proposed approach is to provide continuous and guaranteed delivery of MM streams during dynamic HO using Mobile Synchronization algorithm. This scheme uses the client based HO methods that is the HO request will be initiated by the Mobile Node. The application detects the received data stream for triggers and loses a HO if loss rate in connection is completely down or very much high. The application used here is the video streaming application.

2.5 Server

The scalable servers are holding the MM units. The role of the server is to deliver the MM units to the requestor. When the request arrives from the base station it will send the dummy packets for calculation of delay time of the MM unit. Then it will start sending the packet to the mobile node directly. During this period if a HO occurs, it will update the active base station list and deliver the MM units accordingly.

SR1: On receiving, reply MM sub stream with MM index 1 to the base station (BSi).

SR2: On receiving, get the updated active base station list.

SR3: Upon request, start sending the MM units to the Mobile Node.

SR4: Save the Round time and Delay time and send the MM unit to the Mobile Node.

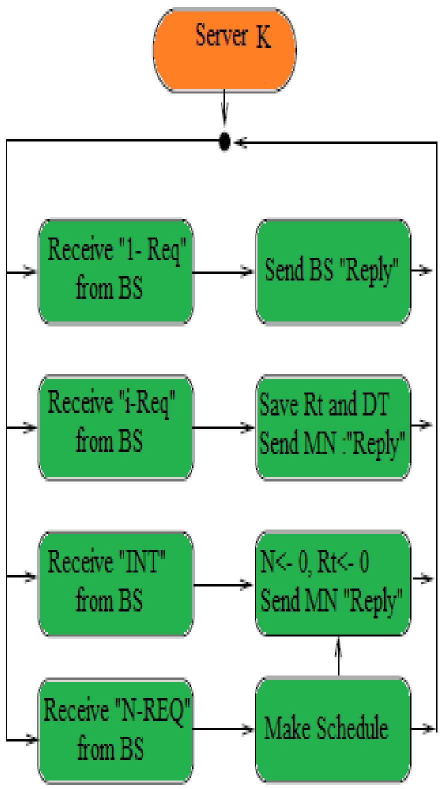

Figure 1 Server Protocol

2.6 Base Station

The base station works as a quasi-receiver. That is to get the request from mobile Node and forward it to the server asking for dummy packets to calculate the delay time of the MM unit[8]. If HO occurs then the active base station list is updated and sent to the server. It then calculates the synchronization point for future deliveries of MM unit. Then this management point is compared to the minimum handoff delay time (δ) assumed. If it fits in the range then the MM units are delivered, otherwise the new synchronization point is calculated.

BS1 : On receiving, if neighboring base station (BSn) is active then request the Delay Time (DT) for all servers (SRi_) to the neighboring BS.

BS2 : On receiving, the BSn (neighboring Base Station) will reply to the BSi with latest delay time (LDT). Otherwise, send the message to all servers (SRi_) requesting for MM streams with MM index 1.

BS3 : On receiving get the Time Stamp (T_S) for MM index 1, maximum time stamp (Tmax) and calculate the Delay time for

MM index 1=Tmax $-T_S$.

where ,T_S is time at which MM unit was received, Tmax is biggest surveyed Round Trip Time delay from the servers.

BS4 : On receiving, save the delay time.

BS5 : On receiving, update the information about the base station list.

BS6 : Now new base station (BSnew) becomes active.

BS7 : Update the information to the server so that new BS is included into the list of active base station.

BS8 : Calculate the synchronization point (SP)

Delay time of the current MM unit – Delay time of the previous MM unit.

BS9 : If Synchronization point is < minimum delay time δ then request the MM unit directly from the server without using quasi-receiver, where minimum delay time is assumed. Otherwise create new synchronization point (SPnew).

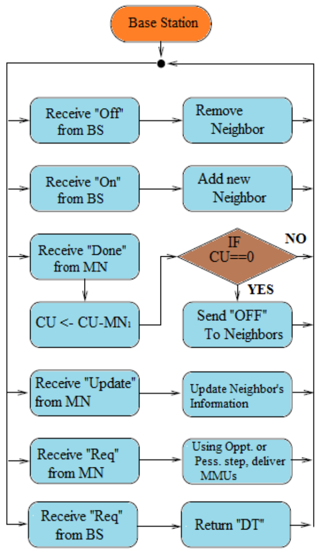

Fig.2 Base Station Protocol

2.7 Mobile Node

Mobile Node is a mobile user who is in necessity of service from the server. The requests from the Mobile Nodes are sent to the BS[6]. If the mobile is moving from current coverage area to another (or) when loss is too high then HO is triggered. The dynamic HO method for defining the start packet to be transmitted over the new connection is used. Finally, when Mobile Node requires terminating the service, it will send the done message to the base station.

MN1 : Request the MM unit having 'n' MM streams to Base station (say BSi).

MN2 : On receiving, send the update message to the base station along with MM sub streams and the delay time after all MM unit have been received. These MM streams will be stored in the mobile client's buffer.

MN3 : On receiving the HO Request the start packet is chosen. The start packet is the first frame (first sequence number) that is to be communicated over the new wireless connection.

MN3.1 : If link to the current base station (BScurr) is failed before new base station (BSnew) link is activated then the status to the base station (BScurr) is sent and it is called as old base station (BSold). New base station (BSnew) is assumed as current base station. In this case the first arrived frame (oldest frame in the buffer) is used as the starting packet.

MN3.2 : If the old base station (BSold) is to be disconnected in advance then new connection starting at appropriate position is sent with the last arrangement number to the buffer[9].

MN3.3 : The server is requested for MM unit over the new connection.

MN3.4 : When both connections are still sending, the first frame to be transmitted is chosen by the packet from

BSnew= first sequence numbered frame + round-trip time (RTT) between Mobile Node / average frequency(f).

MN3.5 : When old connections is still sending good quality packet then choose the first frame to be transmitted from BSnew frame that is anticipated to have reached last in buffer.

MN4 : Done message is directed to the present base station to terminate the service.

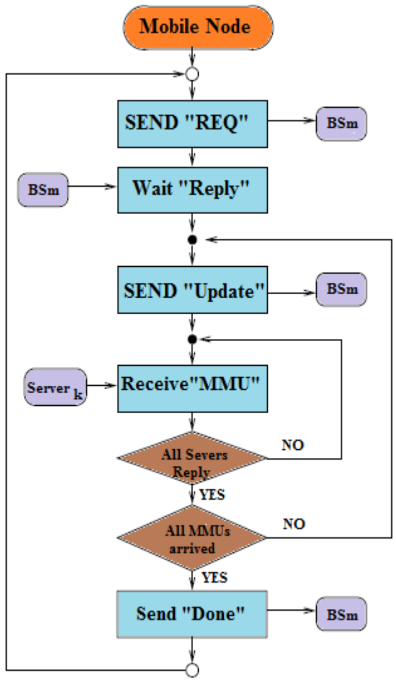

Figure 3 Mobile Node Protocol

3. Conclusions

Mobile Synchronization algorithm provides uninterrupted delivery of media streams to the Mobile Node. The HO latency, packet trace and throughput of MIP and SIGMA using mSCTP were evaluated, which gave the HO delay of MIP is 3.7sec and HO delay of mobile SCTP based SIGMA is 70ms. The reason for lower HO latency of SIGMA is due to its use of Internet Protocol diversity in which the Mobile Node makes the new path like registration etc. while still connecting over the old path. This removes the communication interruption between MN and CN during HO. As a result, there is a very low Handoff delay and seamless HO in the instance of SIGMA using mSCTP.

The network-based mobility management protocols were examined by using the NS-2. Performance evaluation was compared for performance parameters such as HO latency, throughput, packet loss, and video transmission quality. From this exploration and simulation results, it is shown that the integrated solution of FHMIPv6 (FHMIPv6-MIH) performs better than FHPMIPv6 in a network-based mobility management protocol. Future work should be aimed at improving the packet loss, HO latency, and also implementing the proposed FHMIPv6-MIH for real-time requests in a intra mobility area with a Mobile Node movement of very high speed.

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