Mobility Based Energy Efficient Mobile Handover for Improved Data Streaming in Mobile Networks

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Abstract:Data streaming has been identified as a key challenge in Mobile networks. Mobile handover is the key factor in maintaining data streaming and there exist number of approaches available which perform mobility handover according to energy, signal strength, and mobility speed. However, the methods suffer to achieve higher performance in data streaming. To handle this issue, an efficient Mobility and Energy based Streaming Model (MESM) is presented in this article. The method maintains the traces of streaming and network conditions like number of base stations with node details like energy, mobility speed and data rate received, signal strength, data rate required. Using all these details, the proposed model estimates Data Rate Factor (DRF) at each interval. The method identifies set of base station and routes to compute DRF factor according to the statistics. Based on the value of DRF value, the method performs handover with different base station. The proposed MESM improves the performance of handover and data streaming.

Keywords:Mobile Networks, Data Streaming, Mobile Handover, MESM, DRF.

1.Introduction:

The modern human society accesses various internet services through their mobile devices. Such access of on the fly services requires steady data flow for the better access of the services. For example, the users would access video files through their devices, which requires higher data rate. Also, the network service provider should provide seamless data transmission. In order to provide seamless transmission, the data rate should be higher. In reality when the mobile device is far away from the base station, then the signal strength will be less and affects the performance of data transmission.

The performance of data streaming is greatly depending on the signal strength and mobility speed, energy of the mobile device. Still, the performance of data streaming can be improved by performing handover with some other base station which is nearby. When the

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mobility speed of the nodes is higher, there will be increased frequency of routing and route discovery. This increases the latency of data transmission and affects the throughput performance. Similarly, when the energy of node is less, then it suffer with poor data rate. Both claims the performance of data streaming and increases the requirement of mobile handover.

Mobile handover is the process of performing handshake with the base station and moving to the control of specific base station for the better data rate and streaming. In general, the mobile devices handover when they have less coverage and increased distance from the base station. To perform handover, there exist numbers of approaches which consider only the speed and streaming performance, which suffer with poor performance in data streaming.

The problem of data streaming can be approached by choosing a transmission path which is having higher data rate or by choosing a base station with higher transmission range. With this consideration, a Mobility based Energy efficient Mobile handover model (MEMHM) is presented in this article. The model considers energy, mobility speed and data rate received, signal strength, data rate required. Using all these details, the proposed model estimates Data Rate Factor (DRF) at each interval. The method identifies set of base station and routes to compute DRF factor according to the statistics. Based on the value of DRF value, the method performs handover with different base station.

This article is organized to present the detailed introduction in Section 1, where the section 2 presents the detailed literature about the problem. Section 3, briefs the working of proposed model. The results and discussion is presented in section 4, with the conclusion in Section 5.

2.Related Works:

Numbers of approaches are described in literature towards mobility handover and data streaming. Such methods are discussed in detail in this section.

A session based cross layer scheme is presented in [1], for seamless connectivity in mobile networks. The method use a ID orient socket layer to maintain unique identifier at the transport layer to provide seamless connectivity.

A bittorrent orient on demand video streaming algorithm (BT-Manet) is presented in [2], which adapts direct flexible data streaming for the neighbors and use a sliding window control for other nodes to support efficient data streaming.

A real time peer to peer data dissemination scheme is presented in [3], which supports real time streaming in hierarchical infrastructure by clustering the peers to maximize network capacity and minimizing the traffic demands.

Towards improving the quality of video transmission in Manet, an efficient AQA-AODV routing scheme is presented [4], which is focused to improve the network conditions to support the video transmission.

A traffic aware rate adaption (TARA) algorithm is presented in [5], which computes the adaptive bitrate for the user application towards efficient data streaming.

A data usage aware short video streaming (DUASVS) algorithm is presented in [6], which learn the network characteristics in the past and train them to identify adaptive features to support video streaming.

A QoE-Aware video streaming and rate allocation scheme is presented in [7], which uses the traces of previous playbacks to be trained with actor critic based deep reinforcement learning towards efficient video streaming.

A particle swarm optimization (PSO) based video streaming model is presented in [8], which uses continuous vehicle information in deciding the streaming rate required to perform efficient streaming.

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A hybrid control scheme is presented in [9], towards efficient video streaming which uses segment level continuous bitrate and tile level bitrate allocation models to support video streaming.

An Edge assisted energy aware mobile video streaming (EdgeSaver) is presented in [10], which uses user retention scheme to provide efficient streaming and improving the user retention in the network.

A generalized random access channel (RACH) less handover scheme is presented in [15], to support seamless mobility and streaming in mobile networks.

A fast handover authentication protocol (FHAP) is presented in [12], to support handover problem in high speed mobile terminal. The method uses a prehandover authentication mechanism and Chinese remainder theorem is used to authenticate the access points.

A QoE driven intelligent handover mechanism (QoE-Driven) is presented in [13], which allows the access satellites can be selected by predicted service time and communication channel resources.

A Fuzzy-Based 3-D Stream Traffic Lightweighting scheme is presented in [14], which uses the front camera of a mobile device to track a user's viewing angle, and then calculates the currently needed 3-D stream to find the most suitable peer for video source supply.

Mobility and Energy Efficient Mobility Handover Model (MEMHM):

The proposed MEMHM model maintains the traces of streaming and network conditions like number of base stations with node details like energy, mobility speed and data rate received, signal strength, data rate required. Using all these details, the proposed model estimates Data Rate Factor (DRF) at each interval [11]. The method identifies set of base station and routes to compute DRF factor according to the statistics. Based on the value of DRF value, the method performs handover with different base station. The detailed working of the model is presented in this part [16].

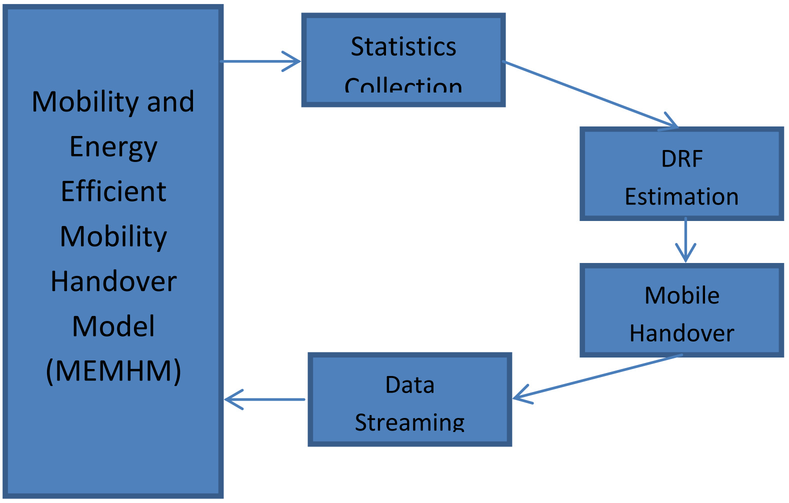

Figure 1: Architecture of proposed MEMHM Model

The architecture of proposed MEMHM model is presented in Figure 1, where the functional aspects are detailed in this section.

Statistics Solution:

The proposed model works according to the statistics of mobile node, network devices and histories. At each time interval, the method monitor the different features like energy, mobility speed and data rate received, signal strength, data rate required, number of base stations and so on. Such statistics collected are used to measure the Data Rate Factor against different base stations. Estimated data rate factor has been used to perform data streaming and mobile handover.

Algorithm:
Given: Statics Table ST, Node N, Transmission Trace TT
Obtain: Statistics Table ST.
Start
Read ST, N, TT.
While true
Extract mobility speed Mb = N.mobility speed
Extract Energy E = N.Energy

Extract Signal Strength ss = $\dfrac{\left.\sum_{i=1}^{size(TT)} TT(i).bitsreceived \right/ size(TT)}{Sum_{i=1}^{size(TT)}(TT(i).latency)}$

Data Rate Required Drr = $\dfrac{bits\ required}{\left.\sum_{i=1}^{size(TT)} TT(i).latency \right/ size(TT)}$

Base stations Bss = $\left(\sum_{i=1}^{size(TT)} TT(i).Basestation \cap Bss\right) \cup Bss$

ST = $ST \cup \{Nodeid, Mb, E, ss, Drr, Bss\}$

End
Stop

The above algorithm computes the mobility speed, energy, data rate required, signal strength and base station around the node. Updated statistics table has been used to support data streaming and handover.

DRF Estimation:

The data rate factor represent the efficiency of data streaming achieve at any point of time. The method estimates the DRF value at each fraction of the data transmission. It has been measured based on the entries available in the statistics table. The method computes Characteristics Support (CS) according to the mobility speed and energy. Similarly, the method computes the communication support (CoS) according to the signal strength, data rate required and data rate. Using these two values, the method computes the value of DRF for the specific base station. Estimated value of DRF has been used to support data streaming and handover.

Algorithm:
Given: Statistics Table ST, Base station Bs
Obtain: DRF
Start
Read ST and Bs.

Base Station trace Bst = $\sum_{i=1}^{size(ST)} ST(i).BaseStation == Bs$

Compute characteristics support cs = $\frac{\sum_{i=1}^{Size(BST)} BST(i).Ms \text{ where } BST(i).NodeId==NodeId}{Count_{i=1}^{Size(SBT)}(BST(i).NodeID==Nodeid)}$

Compute Communication support CoS = $\frac{\sum_{i=1}^{Size(BST)} BST(i).Ss \text{ where } BST(i).NodeId==NodeId}{Count_{i=1}^{Size(BST)}(BST(i).NodeID==Nodeid)} \times \frac{\frac{\sum_{i=1}^{Size(BST)} BST(i).Dr \text{ where } BST(i).NodeId==NodeId}{Count_{i=1}^{Size(ST)}(BST(i).NodeID==Nodeid)}}{\frac{\sum_{i=1}^{Size(BST)} BST(i).Drr \text{ where } BST(i).NodeId==NodeId}{Count_{i=1}^{Size(BST)}(BST(i).NodeID==Nodeid)}}$

Compute DRF = CS×CoS

Stop

The DRF estimation algorithm computes characteristics support and communication support for the node with the base station given. Estimated value of DRF is used to perform seamless transmission and handover.

Mobile Handover:

The proposed model performs handover at specific situation when a node suffer with poor streaming and signal strength. To perform this, the method monitors the data rate factor of the node in periodic way. If the DRF value of specific node is less than a threshold, the method computes the DRF value for various base stations and selects a optimal base station. Selected base station has been handshake with the mobile node to support further streaming.

Algorithm:

Given: Statistics Table ST and Base station set Bss.

Obtain: Null

Start

Read ST, Bss.

While true

Compute DRF = DRF Estimation.

If DRF < Th then

For each base station bi

DRF = Compute DRF Estimation(ST,Bi).

End

Bs = Choose BS with Maximum DRF value.

Perform mobile handover and continue streaming.

End

End

Stop

The above discussed algorithm computes DRF value with different base station and based on that mobile handover is initiated to set streaming in a efficient way.

Results and Discussion:

The proposed method has been implemented using Network Simulator 2 and its performance is measured and compared with the results of other approaches. The evaluation is performed at the presence of different number of nodes in the network. Obtained results are compared with the results of other approaches.

Factor	Value
Tool Used	Network Simulator 2
Number of nodes	200
Transmission Range	100 meters
Energy	200 joules

Table 1: Evaluation Details

The evaluation details used towards performance analysis is presented in Table 1. The performance of the methods is measured at the presence of number of nodes in the environment.

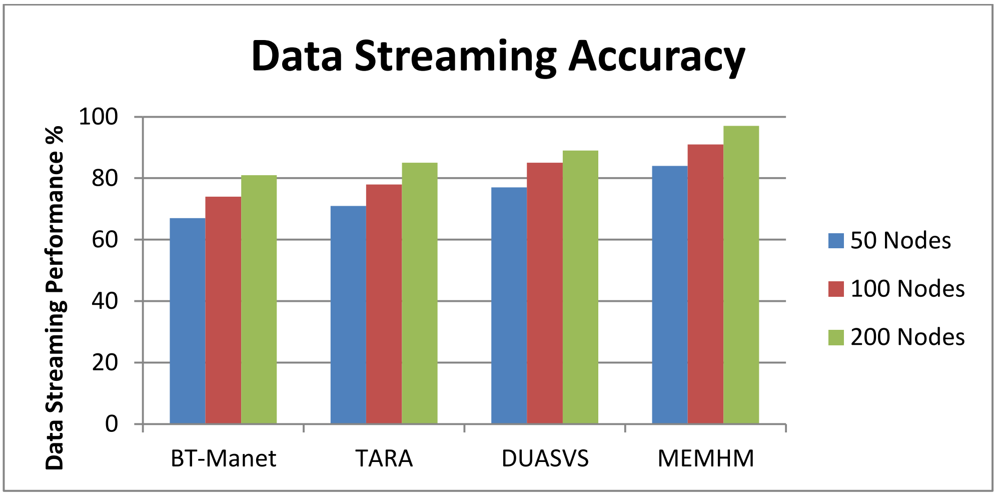

Figure 2: Analysis on Data Streaming Accuracy

The accuracy in data streaming has been measured for various approaches, where the proposed MEMHM model introduces higher streaming performance than other methods.

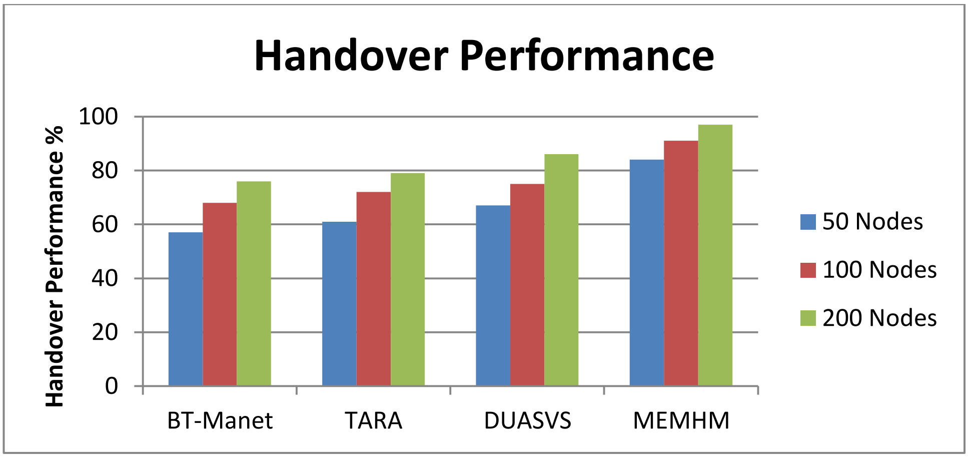

Figure 3: Analysis on Handover Performance

The accuracy in handover has been measured for various approaches, where the proposed MEMHM model introduces higher handover performance than other methods.

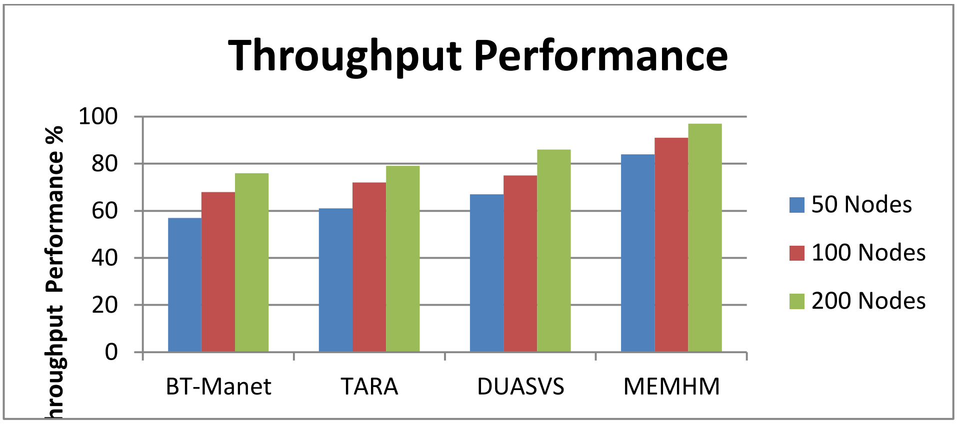

Figure 4: Analysis on Throughput Performance

The accuracy in throughput has been measured for various approaches, where the proposed MEMHM model introduces higher throughput performance than other methods.

3.Conclusion:

This article presented a novel Mobility and Energy Efficient Mobility Handover Model (MEMHM) towards efficient data streaming and handover in mobile networks. The proposed method collects the statistics about the nodes, their transmission and base station. Further, the method computes DRF factor for various base stations to select an optimal one. If the value of DRF is higher than specific value, the it has been used for data transmission. Also, the method identifies the base station with higher DRF value and based on that the method performs data streaming. The proposed MEMHM) model improves the performance of data streaming and handover of the nodes.

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