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Distribution of Streaming Media using Cache-and-Relay and Layer-Encoded Streaming Technique

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1. Introduction

In Peer-to-Peer media streaming, the peer receiving data relays it to other peers joining the network at a later point of time.

In this paper, we propose an efficient method of selecting peers, for relaying data, from a group of available peers by considering the *Network Proximity*. It also addresses the issues of Asynchrony in user requests and Heterogeneity in peer's network bandwidth, where Multicast cannot be considered as an efficient solution.

2. Cache-and-Relay and Layer-Encoded Stream--ing Technique

Cache-and-Relay technique addresses the issue of asynchrony in the requests of users. Since the size of streaming data is large, it is considered to be an inefficient method to store the entire data in a peer's cache. Hence, only a part of data is cached and relayed to the peer's joining the network at a later point of time.

Layer-Encoded Streaming technique addresses the issue of heterogeneity in a peer's network bandwidth. Here the streaming data is encoded into a single Base Layer and several Enhancement Layers. Minimum quality of data can be achieved by decoding only the base layer. Decoding with enhancement layers helps in achieving data of enhanced quality.

3. Terminology

Peers: S = {H_1, H_2,…, H_N}, Set of Supplying peers.
Layer-encoded stream {l_0, l_1,…, l_L}, with l_0 as base layer and others as enhancement layers.
Inbound bandwidth (IB) is denoted by the number of layers a peer can receive.
Outbound bandwidth (OB) is the number of layers a peer can transmit to other peers.
Supplying peer – Peer relaying data.
Receiving peer – Peer receiving data.

4. Layered Peer-to-Peer Streaming

This section explains the concept of Layered Peer-to-Peer streaming with a scenario given in Fig.1. H_3 joins the network at time 00.05.It requests the server and the server responses with the peer list S= {H_1, H_2}, peers already participating in the network. The IB and OB of the peers is shown in Table 1.

H_3 has an IB of 3, that is, it needs layers {0, 1, 2}. From Table.1, it can be seen that H_1 has OB of 2. Therefore, H_3 streams two layers {0, 1} from H_1 and the remaining layer {2} is received from the peer H_2.

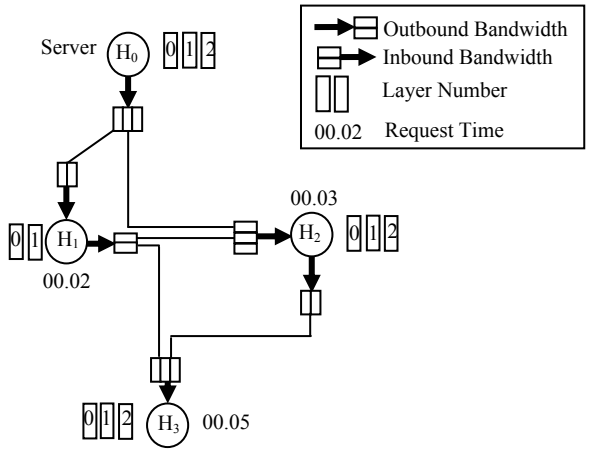

Fig.1. Layered Peer-to-Peer Streaming

Node-id	IB	OB
H1	2	2
H2	3	2

Table 1.IB and OB of Peers

5. Conventional Method

There are some algorithms[1] already proposed to select the supplying peers among the available peers, when layered peer-to-peer streaming technique is used. They are,

- *Basic Algorithm*
- *Enhanced Algorithm.*

Basic Algorithm

In this, the receiving peer can receive the stream from any number of supplying peers.

Overview

- Read the values of *S,IB* and *OB*
- Sort the peer list *S* according to *IB*.
- Start the assignment of supplying peers starting from the first peer in the sorted list.

Enhanced Algorithm

In this, the receiving peers can receive the stream only from finite number of supplying peers. *Supplying Peer Constraint 'C_k'* is introduced to achieve this. For example, C_k=2, implies that receiving peer can receive the stream only from two supplying peers.

Overview

- Read the values of *S*, *IB, OB* and C_k.
- Sort the peer list *S* according to *IB*.
- Find the peer H_m, which can send the largest number of layers from *S*.
- Based on C_k's Value, repeat the previous step with search starting from H_{m+1}.

Cache-and-Relay と Layered-Encoding 手法を用いたストリーミングメディアの配信に関する研究
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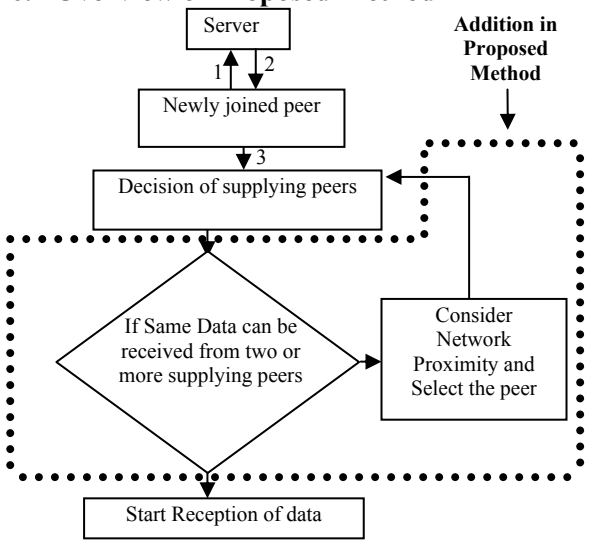
6. Proposed Method

In case where, the same data can be received from two or more supplying peers, the conventional method is designed to select the first supplying peer that it encounters during selection. Considering this situation, the proposed method uses the Network Proximity and selects the closest peer, thereby reducing the latency time.

The proposed method also introduces *Supporting Peer Constraint* P_k, which specifies the number of peers, a supplying peer is currently supporting. In this method, the supplying peer with minimum 'P_k', among other supplying peers, is selected.

6.1 Overview of Proposed Method



1) Requesting Server for the list of Supplying Peers.
2) Server selects Peers satisfying the constraint P_k, and responses with the list of available supplying peers, S.
3) Proposed algorithm is used and supplying peers are selected

Fig.2. Overview of Proposed Method

6.2. Conventional Method and Proposed Method – A Comparison

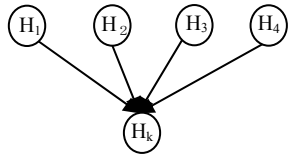


Fig.3. A Simple Overlay Topology

The node H_k, joins the network at Time't' and requests server for the list of peers. The Server responses with, S= {H_1, H_2, H_3, H_4}. Where H_1, H_2, H_3, H_4 are peers participating in the network already.

H1, H2, H3, H4 has {*IB, OB*} as {3, 2}, {5, 5}, {5, 5}, {9, 4} respectively.

The Basic Algorithm selects H_1, H_2, and H_4.

The Enhanced Algorithm, with C_k=2, selects H_2 and H_4 as its supplying peers.

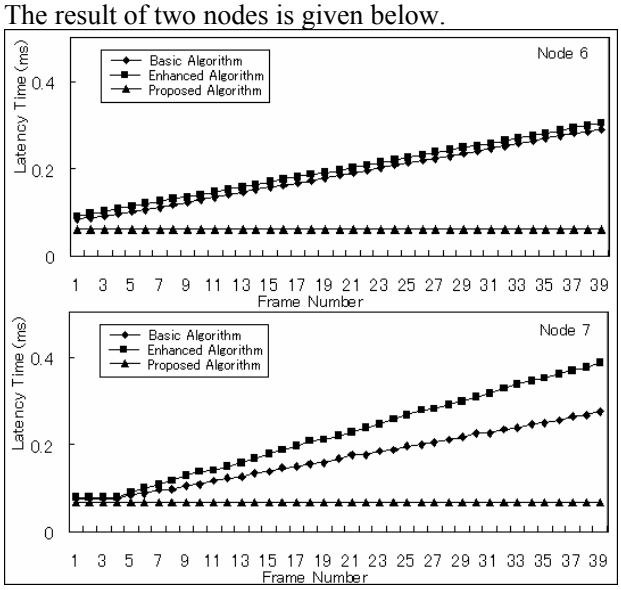
In case of proposed algorithm, we consider the network proximity by means of measuring the latency time between the supplying nodes and receiving node and P_k. The peers selected in case of Proposed Algorithm are H_3 and H_4.The result of this selection is the reduction in latency time.

7. Performance Evaluation and Discussions

Performance Evaluation was done using NS2. The Simulation environment consisted of 25 Nodes, with the nodes separated into three main classes namely, Modem, ADSL, Ethernet peers.

The three algorithms were compared by measuring the latency time involved in data transfer.

The result of two nodes is given below.



It can be inferred from the graph that the latency time for data transfer is less in case of proposed method compared to conventional method. The main reason behind this is the peers which proposed algorithm selected as supplying peers is closer to the receiving peer. Since it is obvious that, closer the peer, faster is the data transfer, the result is better compared to conventional method.

Presence of initial delay is a factor to be considered in the proposed algorithm. But this disadvantage can be overcome as time elapses.

For Node 6 and 7, the initial processing time taken is 0.15ms and 0.30ms respectively. But it can be seen from the graph that the latency time is considerably reduced by means of performing the initial processing.

8. Conclusion

It is inferred from the results that the latency time can be considerably reduced by considering Network Proximity.

Acknowledgements

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References

1. Y.Cui and K.Nahrstedt, "Layered Peer-to-Peer Streaming", Proc of Int.WS on NOSSDAV 2003.