Layered Peer-to-Peer Streaming

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Outline

- Introduction
- Problem Formulation
- Layered Peer-to-Peer Streaming Solution
- Performance Evaluation
- Conclusion and Discussion

Conclusion and Discussion

- This Layered Peer-to-Peer streaming solution addresses the asynchrony and heterogeneity issues in on demand media distribution.
- But large number of departing peer will make the quality bad!

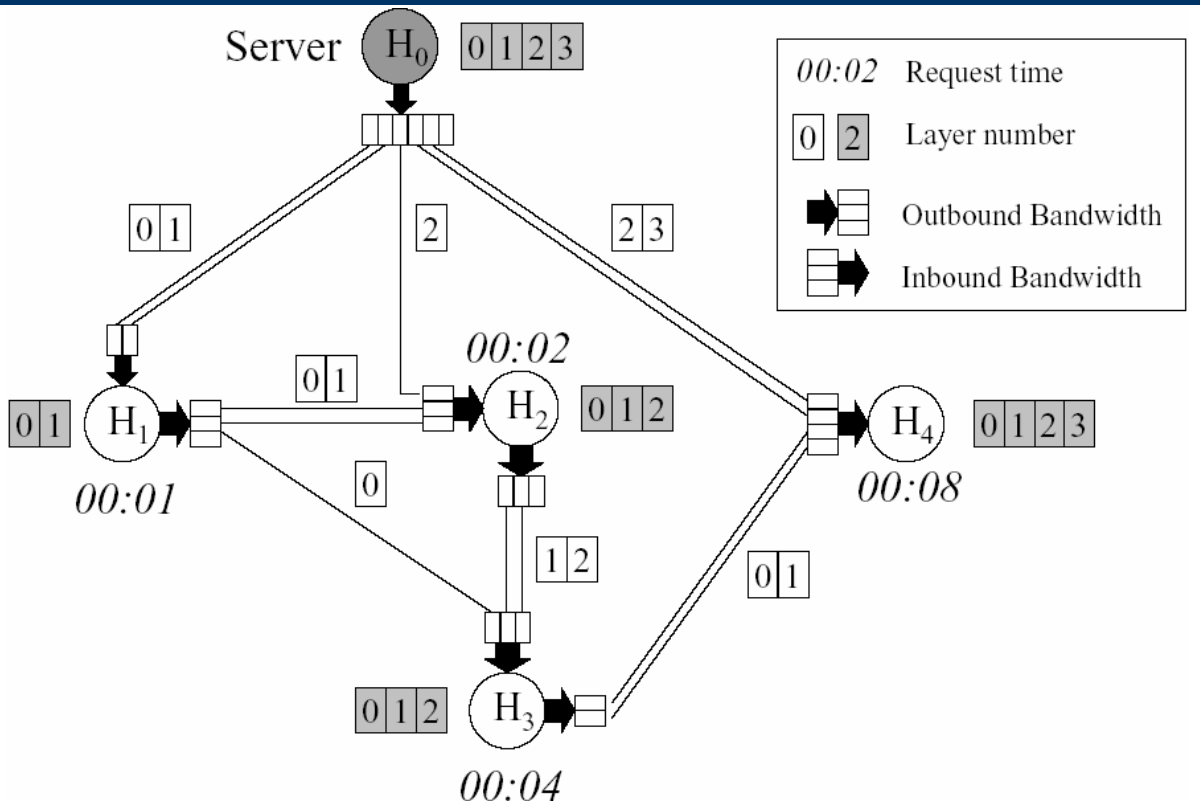
Introduction

- Large-scale on-demand multimedia distribution has been shown as one of the killer applications in the Internet.
- Multicast has been extensively employed since it can effectively deliver media data to multiple receivers. (minimizing server and network overhead)

Introduction(cont')

- Multicast is in conflict with two important features of media distribution
  - Asynchrony of user requests
  - Heterogeneity of client resource capabilities
- Layered Peer-to-Peer Streaming

Problem Formulation



Problem Formulation (cont')

- Layer-encoded Stream$\{I_0, I_1, \ldots, I_L\}$
- Peers $\{H_0, H_1, H_2, \ldots, H_N\}$
- Streaming Quality Q_k
- Layer Availability A_k
- Buffer Length B_k
- Request Time t_k
- Supplying Peer Constraint C_k

Problem Formulation (cont')

$$\textbf{maximize} \quad \sum_{k=1}^{N} (Q_k - Q_k^0)$$

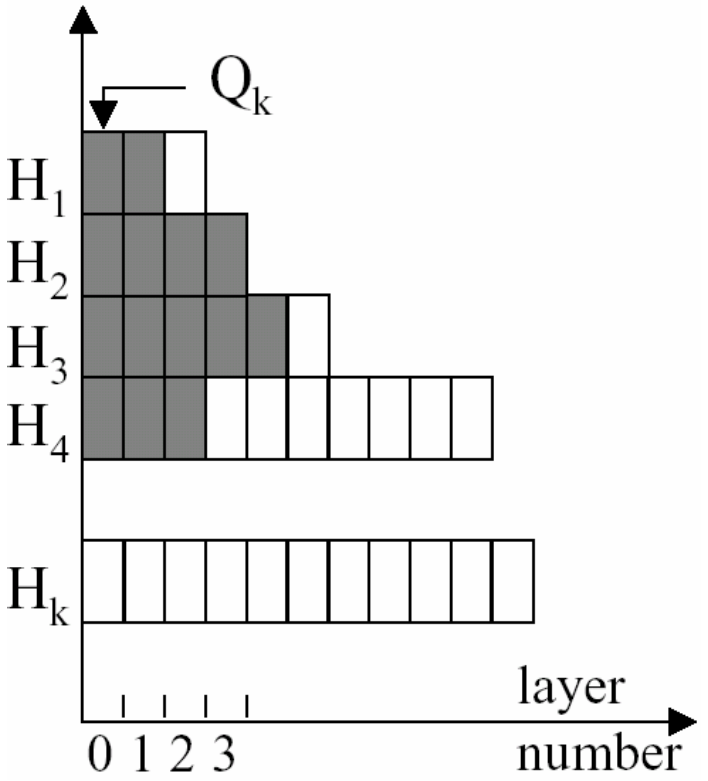
$$\textbf{subject to} \quad (1)\ Q_k \leq I_k (1 \leq k \leq N)$$
$$(2)\ \sum_{H_k \rightarrow H_m} Q_m^k \leq O_k (1 \leq k \leq N)$$

NP-COMPLETE

Layered Peer-to-Peer Streaming Solution

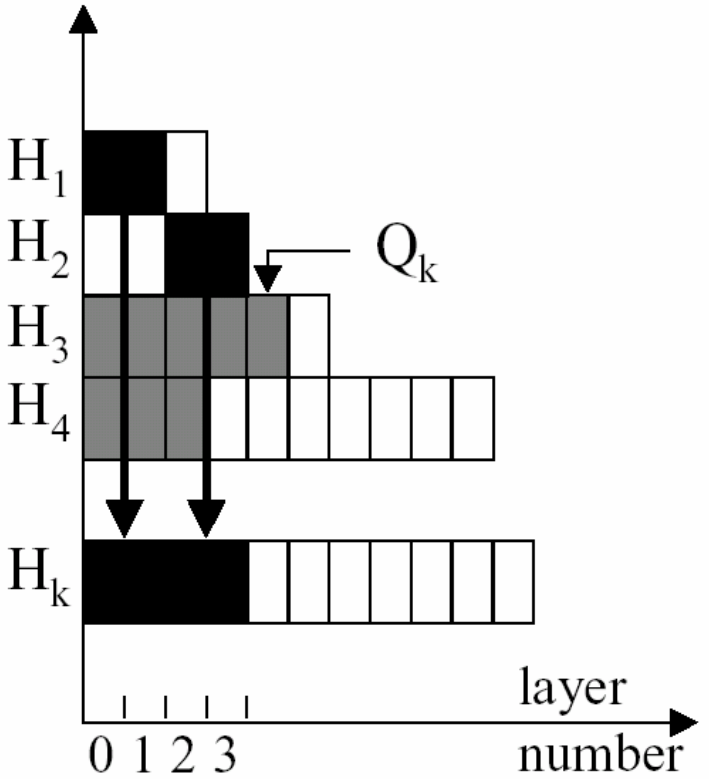
- Basic algorithm
- Enhanced algorithm
- Node departure

Layered Peer-to-Peer Streaming Solution Basic Algorithm



Q_k at H_k is0

Layered Peer-to-Peer Streaming Solution Basic Algorithm



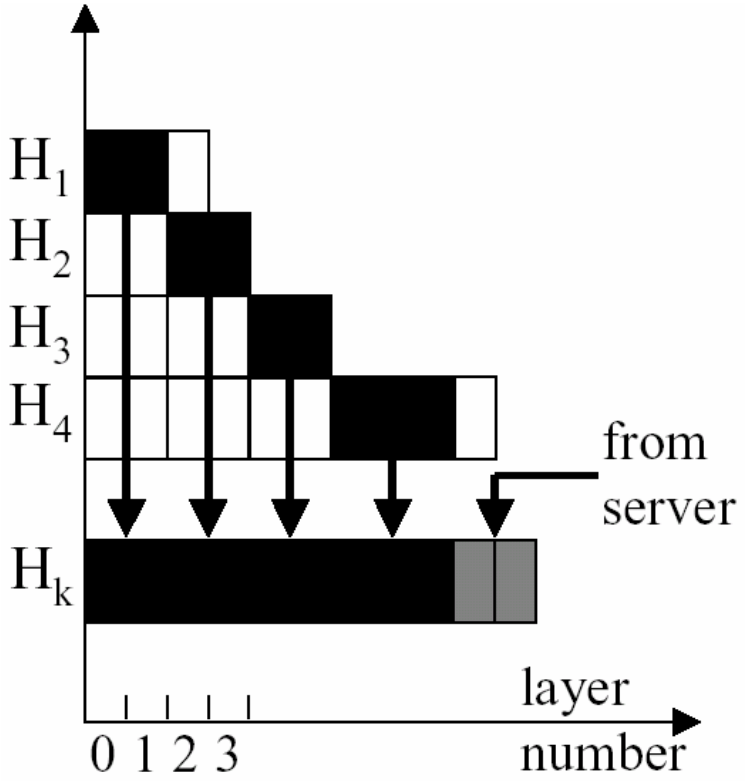
H_1 output two layers to H_k

Increase Q_k to 2

H_2 output two layers to H_k

Increase Q_k to 4

Layered Peer-to-Peer Streaming Solution Basic Algorithm



After H4 output three layers to H_k , H_k ask the server to sane the missing layers to H_k

Layered Peer-to-Peer Streaming Solution Enhanced Algorithm

- H_k can only stream from finite number of supplying peers. (S={H_1,…,H_m})

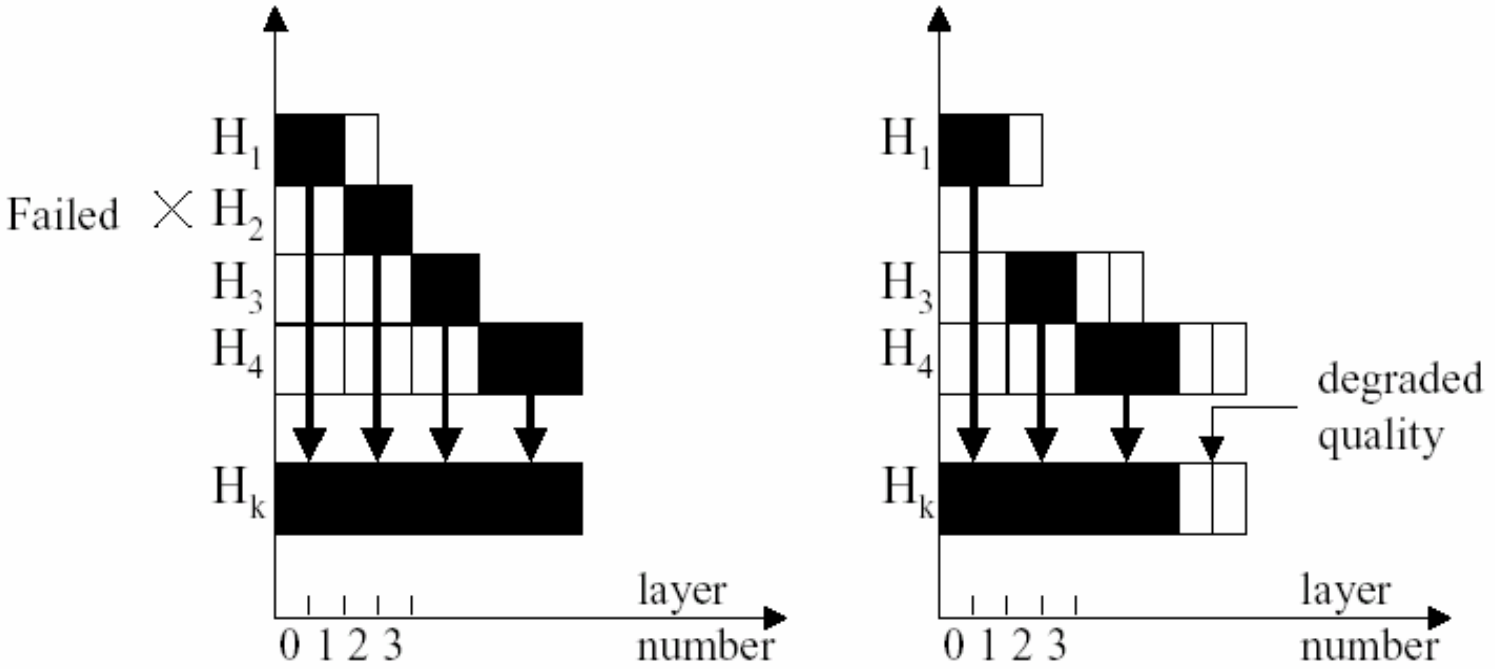
- $$Q_k^*(M, C_k) = \max_{C_k - 1 \leq m < M} [Q_k^*(m, C_k - 1) + Q_{max}(H_{m+1} \ldots H_M)]$$

- $O(C_k M^2)$

Layered Peer-to-Peer Streaming Solution Node Departure

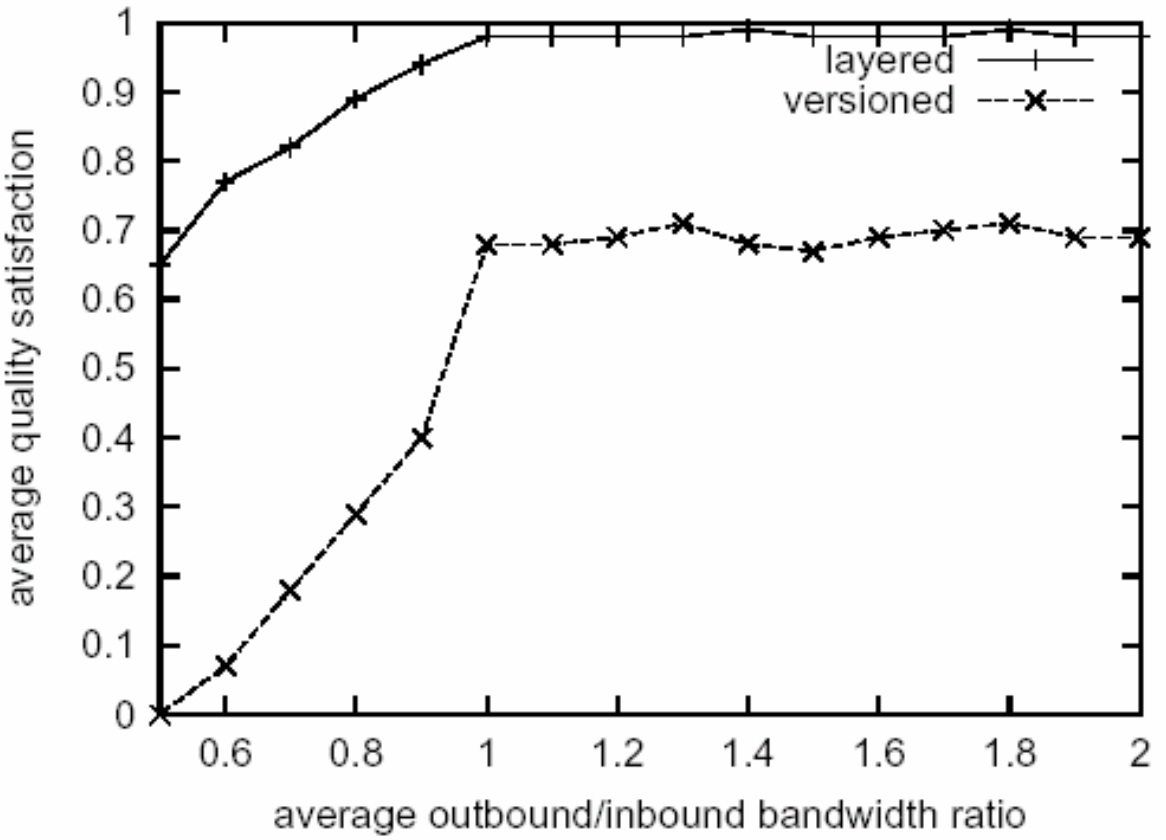
- If Hm departs normally
  - Hm continues to stream data remained in its buffer to Hk as normal
- If Hm fails
  - A. server acts as Hm
  - B. Graceful Degradation of Streaming Quality

Layered Peer-to-Peer Streaming Solution
Node Departure



Performance Evaluation

average quality satisfacation



Performance Evaluation
server bandwidth