A Review of Network Coding and Multimedia Traffic Over Wireless Networks

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ABSTRACT- Multimedia transmission over wireless networks has developed in recent years, so there is more attention from research community. Providing a high quality multimedia transmission over wireless is a challenge, as it is enclosed with strict timing constraint and high bandwidth demand. In addition, wireless communication is associated with demanding like limited bandwidth, interference and mobility, which make it more problematic and challenging. Network Coding is technique, which allows and encourages mixing of data at intermediate network nodes. A receiver sees these data packets and deduces from them the messages that were basically intended for the data sink. Many studies have been performed on video streaming over wireless networking. To increase the performance and capable of wireless networks in order to capture the highly increased data traffic requirement.

KEYWORDS: Inter layer coding, Intra layer coding, Multi layer video, scalable video streaming, and video on demand (VoD).

I. INTRODUCTION

Modern studies have shown that multimedia streaming produces a considerable partition of the traffic on the Internet. For example, 20–30% of the web traffic on the Internet is from YouTube and Netflix. Thousands of hours of videos are uploaded on YouTube every day, and millions of hours of movies are available on Netflix, Hulu, and iTunes sites. In order to provide a scalable and rugged infrastructure that will support large and diverse on-demand streaming, the concept of helpers has been introduced, and the design of multi-layer videos to provide a higher degree of scalable VoD systems. As both media content (e.g. you tube videos) over the Internet and wireless devices become growingly in demand, extensible delivery of rich media content over wireless links is instantly becoming one of the most important applications today. The essential reason that inter-layer coding enhance the number of decoded layers even for a single receiver is that it allows recover useful layers from more combinations of received transmissions. High continuous streaming rate for all users in all video channels in these systems is an objection issue because of time-varying popularity of video channels and restrained upload bandwidth of streaming servers. A well-known solution for this problem is accept the unused resources of so-called “helper” peers to facilitate the workload of streaming server and improves the quality of practice of end users. On one hand, helpers act as micro-servers to satisfaction the deficiencies in upload bandwidth of server and decrease the resource imbalance among the video channels. On the other hand, helpers as new service access points produce video streams to their connected peers. Network coding (NC) helps to simplify the content distribution problem, and solves it in an efficient way. It has been envisioned to increase throughput and convey higher data rates than conventional source coding or no coding. The overall intention of the algorithm is to maximize the aggregate rate to all the receivers. The problem is express as a linear programming optimization and solution from this optimization is used to commit the linear network codes to all nodes using the Linear Information Flow (LIF) algorithm.

Without Network coding With Network Coding

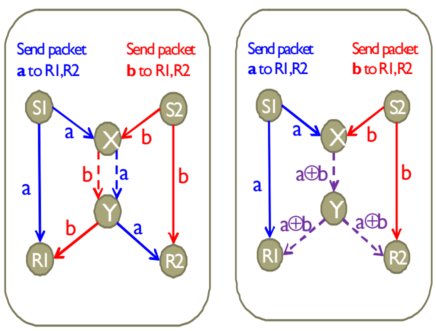


Figure 1: Network Coding Implementation

Bottleneck link (X, Y) requires two time units to transmit packets a and b. Bottleneck link (X, Y) requires two time units to transmit packets a and b. (X, Y) transmits a⊕b in a time unit.R1 decodes b from a and a⊕b.R2 decodes a from b and a⊕b. Allowing routers to mix the bits in forwarding messages can increase network throughput. The polynomial time algorithm for multicast to heterogeneous receivers using network coding. It has been proved to be an effective technology in solving network information flow problem, which is derived from traditional multi-commodity flow problems and have recently absorbed some ideas from information theory and coding theory. Our information network is directed acyclic graphs $G = (V; E)$. The vertex V consists of three disjoint subsets: source nodes S, target nodes T and inter-mediate nodes I. For each source node s, the messages it transfer through intermediate nodes to target nodes through edge set E are drawn from a fixed finite alphabet A with size $j A j > 1$. For each target node t, the message it requires is a subset of messages from source nodes. The intermediate nodes cannot only identical and forward messages they receive from in-edges, but also use arithmetical functions to compute these messages before forwarding them (the power of node's computability is unlimited). NC concedes nods to encode the entering information before sending it. Such coding is based on some arrangement, that make nodes code and decode data packets. Linear is the facile coding scheme, as it concerns a block of data as whole in a vector over a specific bas field. All nodes are granted to apply linear transformation to such vector before passing it on. Pointed out that linear network coding is confirmed to be an optimum scheme for encode information. The linear equations in network coding are explained by achieving Gaussian elimination, which is an algorithm for solving systems of linear equations in linear algebra. With random network coding scheme, the unlimited encoding vector (coefficients) is developed randomly from a finite field Fs, in a fully independent and decentralized manner.

II. RELATED WORK

Rate allocation problems are occurred in Peer-to peer (P2P) VoD streaming. To introduce a distributed rate allocation algorithm, this can reduce the unfriendly traffic to the Internet service providers (ISP), similarly inter-ISP Traffic, without much increase on the server load. In distributed bandwidth allocation in live P2P streaming is studied. To argue that less synchrony in the video contents shared by the users in VoD streaming makes the problem of slow down the server load streaming performance hard. In order to resolve this problem, each peer needs to commit a small amount of storage. To propose content replication, content discovery, and peer scheduling schemes. In the proposed method, each helper downloads one coded packet of the currently streamed segment. The simulation results show a significant increase in the streaming bit rate. To use helpers in a P2P VoD system to stream a single video, and propose a distributed bandwidth allocation algorithm for the helpers. In the role of coding in the design of a large-scale video on-demand (VoD) system is studied. The objective of the paper is to minimize the server load in the case of limited helpers' bandwidth and storage. To express the problem as an LP optimization, and propose a distributed algorithm to solve it. However, their distributed scheme oscillates among different solutions. As a result, it does not converge to the optimal solution. The other problem with the oscillation is that it can result in delay oscillation, which might cause playback lags. Error resilience through redundancy and retransmissions is extensively studied in multimedia streaming. On one hand, network coding can be joined with well-known approach, such as ARQ and FEC. Automatic Repeat reQuest (ARQ), also known as Automatic Repeat Query, is an error-control method for data transmission that uses acknowledgements (messages sent by the receiver intimating that it has correctly received a data frame or packet) and timeouts (specified periods of time allowed to elapse before an acknowledgment is to be received) to attain reliable data transmission over an unreliable service. If the sender does not receive an acknowledgment before the timeout, it usually re-transmits the frame/packet until the sender receives an acknowledgment or exceeds a predetermined number of re-transmissions. Forward error correction or channel coding is a technique used for controlling errors in data transmission over unreliable or noisy communication channels. The basic idea is the sender encodes the message in a redundant way by using an error-correcting code (ECC). It is a digital signal processing technique used to enhance data reliability.FEC provides the receiver with the ability to correct errors without a reverse channel to request the retransmission of data. On the other hand, network coding can be seen as an extension of Forward Error Correction, applied not only at the source but also at intermediate nodes. In that condition, peer-to-peer content storage and distribution, random network coding has been shown to be more robust than fixed FEC against failures or departures of nodes .The intuition is that, in case of a block being lost, network coding produces individual innovative blocks, while Forward Error Correction-based schemes can replicate the same block (original or redundant). The problem specific to peer-to-peer systems that use network coding and support video consists of: the need for low delay and continuous play out, the need for distant error protection and the interaction between video/FEC rates and the underlying rate region achieved by network coding. FEC codes generally detect the last set of bits to determine the decoding of a small handful of bits.

III. VoD WITH MULTI-LAYER VIDEOS

A) SYSTEM ARCHITECTURE

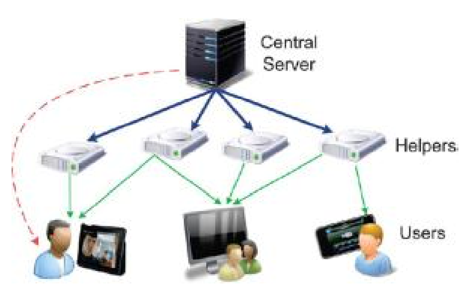


Figure 2: System Architecture

Helpers are micro-servers with limited storage and bandwidth resources, which can download and store requested videos to be able to serve user requests. The helpers work in conjunction with a central server, which provides users with video files that cannot be obtained from their neighboring helpers. It is clear that the central server will be able to serve more users, as long as we can provide more segments of the requested videos through the helpers. In addition to the use of helpers, we can benefit from multi-layer videos to provide a higher degree of scalable VoD systems. In multi-layer video, also called as multi-resolution codes (MRC) or scalable video coding (SVC).

B) CONTENT PLACEMENT

To studied the delivery cost minimization problem under a fixed topology by optimizing over content replication and routing. The investigated problem of maximizing the number of videos that can be simultaneously served by a collection of peers. Focused on minimizing the load imbalance of video servers while maximizing the system throughput. To label the problem of replica placement, client request routing, and multicast stream routing in media content distribution systems employing scalable streaming protocols. The authors formulated a simple optimization models for a variety of scalable protocols including hierarchical merging, patching, periodic broadcasts, and scheduled broadcasts. With the aid of additional constraints that must hold in the scalable delivery system solution, they showed that a variety of realistic scenarios can be solved exactly using available optimization software. They also showed that using the optimal conventional content distribution system for scalable delivery results in network costs. However, their setup is different because they acknowledge server placement rather than distributed caching. They also use a replication based storage scheme. In our scheme, we use coding and show that the performance is much better. We also consider topology selection in our system which they assume is fixed. Their goal is to enlarge the utilization of peers' uplink bandwidth resources. Optimal content placement strategies are identified in a particular outline of limited content register under the schema of loss networks. Their work assumes that the peers' storage capacity grows unboundedly with system size. In contrast, our work does not make any assumption on the storage capacities. We also take into account the combinatorial aspect of the node degree constraints that was not studied .To formulated the problem of content placement into a mixed integer program that takes into account constraints such as disk space and link bandwidth. However, they assume the knowledge of the content popularity and a fixed topology is given. The content placement problem is solved comparatively given the constraint that a video is either stored in its entity or not stored at all. In our work, we use a class of network codes that enables fractional storage, which helps convert an NP-hard problem to a convex problem that can be solved exactly in a distributed manner. We also do not assume the topology is fixed, and instead also optimize over the topology selections. Our scheme does not require any prior knowledge of the video demand distribution.

C) OPTIMAL BANDWIDTH UTILIZATION

With regard to network resource utilization, solved a link bandwidth utilization problem assuming a tree structure with limited depth. An LP is formulated and under the expectation of symmetric link bandwidth, demand, and cache size, a simple limited greedy algorithm is designed to find a close-to-optimal solution. To introduce an LP-based heuristic to determine the number of video copies placed at customer home gateways. Both works assume a tree network structure. In contrast, the network topology in our work is not constrained to be a tree, and the video request patterns can be arbitrary in distinctive network areas. To minimize the load imbalance among servers subject to disk space and network bandwidth constraints. However, they only consider egress link capacity from servers. In contrast, our formulation allows the link capacity constraints that may exist anywhere in the network. To introduce a heuristic algorithm for VoD systems that reduces the bandwidth requirement. The transmission policy for peer-to-peer systems to efficiently deliver video data by exploiting the multicast capability of the network. To avoid the disruption of services, the fault tolerance and recovery mechanism is also developed. They proposed a mathematical model to criticize the performance of their policies. However, the only consider upload bandwidth bottleneck. Our algorithm assumes arbitrary link capacity constraints in the network, and provides theoretical assurance of optimality.

IV) JOINT INTRA –LAYER AND INTER – LAYER CODING

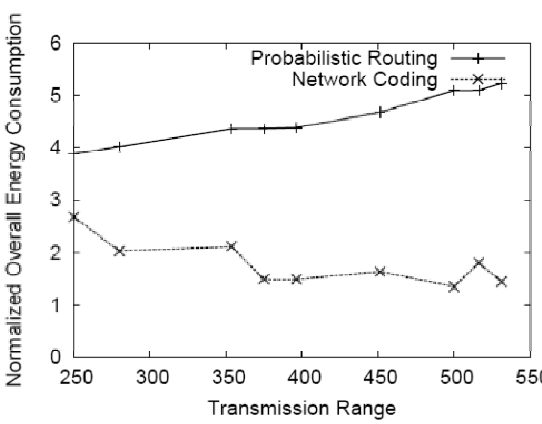
In multi-rate multicast, network coding can be implemented within a layer (intra-layer coding) or across layers (inter-layer coding). Intra-layer network coding is conceptually simpler than inter-layer network coding. Receivers are grouped into subsets that support the same rates. The rate of the base layer is selected such that it is platform by all multicast receivers, and a multicast network code for the base layer is formulated. The rate of the second layer is set such that, given the remaining capacity, it can be received by the bundle of receivers with the second lowest rate. Then a multicast network code for the second layer is designed and so on. Hence, each layer is transported in its own multicast tree. The procedure is reproduced until all receiver bundles are served or all capacity is used. In general, inter-layer coding outperforms intra-layer coding, but few practical heuristics for the inter-layer network coding problem exist. Both algorithms first determine the max-flow (equivalent to the minimal cut) value to each receiver, using some well known max-flow algorithm. To procreate the maximum layer constraints given by the max-flows of the receivers up coming the source, but they differ in how this is done. In the first algorithm called Min-Req, the receivers induce as rate requirement their max-flow value to their parent nodes. A node waits until it heard from all its children and then propagates the minimum of the max-flow values to its parents, and so on. The source then sends linear combinations on its outgoing links coded over as many layers are granted by the maximum layer constraints of those links. The rationale for increase up the minimum is that an interior node can simply code over all incoming links to generate a linear connection for an outgoing edge, without running the risk that a succeeding receiver may not be able to decode. In the second algorithm called Min-Cut, an interior node originates its own max-flow value instead of the minimum value of its children, in case that value is greater than the minimum of the children's max-flows. This grant the interior node to decode up to a number of layers corresponding to its own max-flow value. The decoded layers can then be recombined to serve linear combinations coded over distinct numbers of layers to different children in contrast to the first algorithm. While both algorithms are simple and can be performed in a distributed manner, they have some detriment. The Min-Req algorithm does not require decoding at interior nodes but since it propagates minimum max-flow values, its performance in topologies where receivers have heterogeneous max-flow values may be low. The Min-Cut algorithm fares better in such topologies as long as some of the interior nodes have sufficiently high max-flow values, but does require decoding at interior nodes. Decoding involves computationally excessive Gaussian elimination and storing data in its entirety before decoding is possible. The resulting complexity and delay are peculiarly undesirable at interior nodes (the routers) of the network, where processing overhead is one of the main bottlenecks. Furthermore, both algorithms transport traffic on all upstream edges of the receivers, independent of whether they are needed for the multicast or not. This not only enforces lower layers on edges where higher layers could be transported but, more essentially, wastes capacity and thus may prohibit their use in networks where links are shared with other flows.

V) PROPOSED SYSTEM

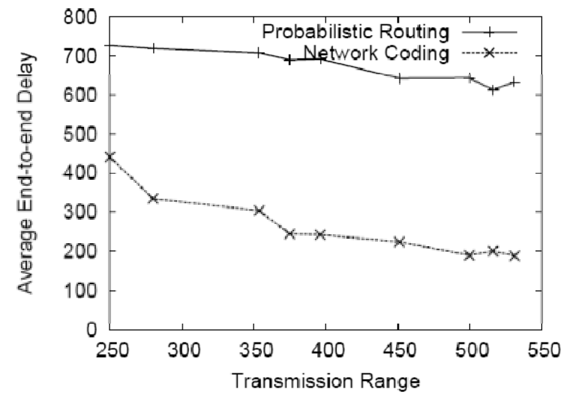
In the proposed system, to study the video streaming using helpers in the case of multi-layer multi-videos, and characterize the optimal solution using linear programming (LP).The problem of inter-layer NC is in general an NP-complete problem. The optimal solution in the case of using triangular inter-layer NC can be calculated in polynomial time. Distributed approach to optimally utilize the helpers, which adapts to the modulation in the requested videos and the joining or departure of the nodes (helpers and users).To empirically show the cases under which combining inter- with intra-layer coding provide benefits (reduced server load) over intra-layer coding. In contrast with the work to extend our solutions to consider the reliability of the links. In the DHT table whereby we create a track record of the data present the helper node this DHT table is maintained in sub server as and when the user request comes for a file the presence of data is checked in the sub server and there by forwarded to the respective helper node if the data is present in the helper node or else the data is sent from the main server. Network coding has been envisioned to increment throughput and deliver higher data rates than conventional source coding or no coding. Empirical evaluation of the proposed solution shows that all receivers can be given a rate equal to their max owns in all of the simulated instances. With the emergence of multimedia applications in business and entertainment, demand for real-time multi-point appliances such as multi-party gaming, video-conferencing and video on-demand services have expanded. Multimedia data transfers typically contain large volumes of data, and hence redundant unicast transmission of the similar data to multiple receivers is likely to consume excessive network resources. Conventional unirate multicasting is a solution to reduce the resource consumption. However, if the receivers in same multicast session modify in their max flow rate from the source, unirate multicasting either overwhelms slow receivers or starves the fast ones. In multirate multicasting where individual receiver rates depend on their max flow rates, is a preferred mode for distributing large content applications. One approach to achieve multirate multicasting is layered coding. In layered coding, the source encodes the data stream into a base layer and several enhancement layers. Receivers subscribe to a layer cumulatively. If a receiver subscribes to layer and it also receives layers. The layers are incrementally combined at the receiver to provide progressive refinement. Rate control algorithms for multirate multicasting strive to make efficient use of the network resources.

CONCLUSION AND SIMULATION RESULT

To study the problem of utilizing helpers to minimize the load on the central video servers. For this purpose, to formulate the problem as an LP optimization problem. This is done by using joint inter- and intra-layer NC.To discuss the advantages of joint inter- and intra-layer NC over just intra-layer NC, and through an empirical study, to found the cases in which joint coding reduces the server load. To use a lightweight triangular inter-layer NC instead of the general form of inter-layer NC, to reduce the time complexity of the optimization. To solve the proposed optimization in a distributed way, and evaluate the convergence and the gain of our distributed approach via comprehensive simulations. The future work is to consider the cost of helpers in the optimization and study the overhead that results from introducing the helpers.



Energy consumption: Number of Transmissions and Receptions needed to gather all the required packets.



Delay: Number of time units needed to decode all the required packets.

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