

## Method and apparatus for reducing network traffic over low bandwidth links

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### Abstract

In this paper, we present PACK (Predictive ACKs), a novel end-to-end traffic redundancy elimination (TRE) system, designed for cloud computing customers. Cloud-based TRE needs to apply a judicious use of cloud resources so that the bandwidth cost reduction combined with the additional cost of TRE computation and storage would be optimized. PACK's main advantage is its capability of of flooding the cloud-server TRE effort to end- clients, thus minimizing the processing costs induced by the TRE algorithm. Unlike previous solutions, PACK does not require the server to continuously maintain clients' status. This makes PACK very suitable for pervasive computation environments that combine client mobility and server migration to maintain cloud elasticity. PACK is based on a novel TRE technique ,which allows the client to use newly received chunks to identify previously received chunk chains, applications and network devices. Finally, we analyze PACK benefits for cloud users, using traffic traces from various sources.

Index Terms—Caching, cloud computing, network optimization, traffic redundancy elimination.

### INTRODUCTION

CLOUD computing offers its customers an economical and convenient pay-as-you-go service model, known also as usage-based pricing . Cloud customers pay only for the actual use of computing resources, storage, and bandwidth, according to their changing needs, utilizing the cloud's scalable and elastic computational capabilities. In particular, data transfer costs (i.e., bandwidth) is an important issue when trying to minimize costs. Consequently, cloud customers, applying a judicious use of the cloud's resources, are motivated to use various traffic reduction techniques, in particular traffic redundancy elimination (TRE), for reducing bandwidth cost. When redundant chunks are detected, the sender replaces the transmission of each redundant chunk with its strong signature. Commercial TRE solutions are popular at enterprise networks,

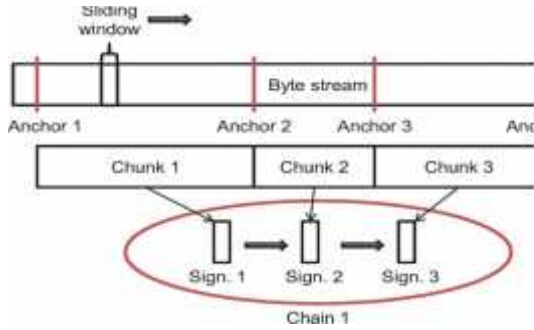


Fig. 1. From stream to chain.

PACK uses a new *chains* scheme, described in Fig. 1, in which chunks are linked to other chunks according to their last received order. The PACK receiver maintains a *chunk store*, which is a large size cache of chunks and their associated metadata. Chunk's metadata includes the chunk's signature and a (single) pointer to the successive chunk in the last received stream containing this chunk. Caching and indexing techniques are employed to efficiently maintain and retrieve the stored chunks, their signatures, and the chains formed by traversing the chain. In addition, the metadata of the previously received chunk in the same stream is updated to point to the current chunk.

## EXISTING SYSTEM

Traffic redundancy stems from common end-users' activities, such as repeatedly accessing, downloading, uploading (i.e., backup), distributing, and modifying the same or similar information items (documents, data, Web, and video). TRE is used to eliminate the transmission of redundant content and, therefore, to significantly reduce the network cost. In most common

## PROPOSED SYSTEM

In this paper, we present a novel receiver-based end-to-end TRE solution that relies on the power of predictions to eliminate redundant traffic between the cloud and its end-users. In this solution, each receiver observes the incoming stream and tries to match its chunks with a previously received chunk chain or a chunk chain of a local file. Using the long-term chunks' metadata information kept locally, the receiver sends to the server predictions that include chunks' signatures and easy-to-verify hints of the sender's future data. On the receiver side, we propose a new computationally lightweight chunking (fingerprinting) scheme termed *PACK chunking*. PACK chunking is a new alternative for Rabin fingerprinting traditionally used by RE applications.

## CONCLUSION

In this paper, we have presented PACK, a receiver-based, cloud-friendly, end-to-end TRE that is based on novel speculative principles that reduce latency and cloud operational cost. PACK does not require the server to continuously maintain clients' status, thus enabling cloud elasticity and user mobility while preserving long-term redundancy. Moreover, PACK is capable of eliminating redundancy based on content arriving to the client from multiple servers without applying a three-way handshake.

Two interesting future extensions can provide additional benefits to the PACK concept. First, our implementation maintains chains by keeping for any chunk only the last observed subsequent chunk in an LRU fashion.

