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Predictive Acknowledgement Using TRE System

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***Abstract* - In this paper as our title described An Approach to minimizing cloud cost and bandwidth by employing the TRE system where Cloud computing is run in order to mediate Traffic. Cloud computing provides customers with an affordable and accessible pay as you go, service model, also referred to as usage-based pricing. In this Research, we have introduced Predictive Acknowledgment where the impulsive Traffic Redundancy Elimination (TRE) is retrieved from Cloud Computing System. Through the usage of this Traffic Redundancy Elimination (TRE) Cloud Computing System in order to lower in cost of Traffic Redundancy Elimination (TRE) computation and storage will be increased. Cloud Computing Based on Predictive Acknowledgement can benefit from the fact that it can lower the workload of the Cloud server. So that we need to enhance the productivity of Server and decrease the workload. For studying prediction for Cloud consumers, the data transfer rate is an essential issue when we need to lower the costs in turn, by implementing a well-planned utilization of cloud resources, cloud consumers are motivated to make use of multiple Traffic Redundancy Elimination Systems, in Traffic Redundancy Elimination System (TRE). We suggest in this study new purposes for Lightweight Chunking Scheme. Lightweight Chunking Scheme is a new contribution to Rabin fingerprinting applied in Traffic Redundancy Elimination System (TRE). We can also make our server more efficient and lower the burden of our system. finally, we concluded Prediction Acknowledgement profit for cloud users from different sources of traffic traces.**

Keywords: Network Optimizing, Bandwidth, Signature, Cloud Computing, Traffic Redundancy Elimination.

I. INTRODUCTION

This research paper primarily focuses on the development of the Predictive Acknowledgment (PACK) System, an innovative approach to Traffic Redundancy Elimination (TRE). The PACK system is designed to empower clients to leverage newly acquired data chunks to identify previously transmitted chunk sequences, facilitating efficient referencing of subsequent data transfers through the application of a suitable predictor.

The core of this work introduces a novel receiver-centric methodology within the TRE framework. This approach is engineered to effectively manage and reduce redundant traffic flowing between cloud infrastructure and its end-users. In operation, the receiver first analyzes the incoming data stream. Subsequently, it endeavors to match its existing data segments with either a received chunk chain or a segment from an adjacent file. This meticulous process is designed to prevent or significantly minimize the computational overhead associated with the TRE system at the sender's end, particularly when traffic redundancy is not present. Should redundancy be detected, the sender is then prompted to explicitly transmit acknowledgments of these predictions to the receiver, a mechanism central to the system's efficiency.

Cloud service consumers are increasingly motivated to optimize their utilization of cloud resources, especially by employing various traffic reduction techniques, such as Traffic Redundancy Elimination, to mitigate bandwidth costs. The pervasive issue of traffic redundancy often stems from common user activities like repeated access, downloading, uploading, and distributing content. Even in conventional TRE solutions, both the sender and receiver typically engage in a two-step process: first, inspecting, and then verifying the signature of data chunks, which are defined based on the content itself, prior to transmission. Upon detecting initial redundant chunks, the sender replaces the transmission of each subsequent redundant chunk with its unique,

II. RELATED WORK

The field of Traffic Redundancy Elimination encompasses a variety of techniques. Prior investigations have explored protocol-independent TRE solutions. Notably, a Predictive Acknowledgment-level TRE has been outlined, leveraging specific algorithms. Furthermore, several dynamic TRE system solutions have been adopted, often integrating sender-based TRE mechanisms through recursive methods and alongside protocol implementations, particularly for optimizing middlebox solutions. Some research details a communication approach involving specific acknowledgments between the receiver and sender, contingent on ensuring and implementing a complete state of synchronization.

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III. CLOUD SYSTEM

The Predictive Acknowledgment (PACK) system employs a chaining mechanism where data chunks are interconnected based on their order of reception. The receiver within this system maintains a fixed-size cache, or "bit store," containing chunks and their corresponding signature data. Each chunk's data comprises its unique signature and a single reference to the ordered chunk within the previously received data stream that contains it. Efficient caching and retrieval methods are utilized to manage and access these stored chunks, their signatures, and the chains formed by following these chunk references.

Upon receiving new data, the receiver first identifies multiple signatures for the incoming information and then attempts to find a match within its local chunk store. If a chunk's signature is successfully identified, the receiver determines whether it belongs to a previously obtained chain or represents a new instance of data. If deemed beneficial, the receiver transmits a prediction to the sender for several anticipated subsequent chain chunks. This prediction typically involves signaling a starting point (offset) within the data stream and identifying the expected sequence of subsequent chunks (referred to as a PRED command).

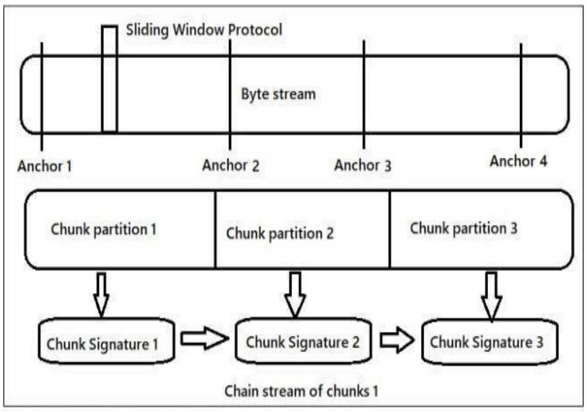

Figure 1: Conversion of chain from Stream

IV. CLOUD SYSTEM IMPLEMENTATIONS

This section details the implementation of the Predictive Acknowledgment system, its performance analysis, and the estimated server costs derived from experimental deployments. The system is compatible with both Windows and Unix operating environments, integrating with a web filter queue. For the server-side deployment, the setup utilized an Intel Core 2 Duo processor operating at 3 GHz, 2 GB of RAM, and an SSD1600AAJS SATA drive. Client-side operations were supported by portable computers equipped with Intel Core 2 Duo processors at 2.7 GHz, 4 to 8 GB of RAM, and SSD2500BJKT SATA drives.

4.1 Server Operational Cost

To quantify server performance and cost, we assessed these metrics as a function of data redundancy levels, aiming to evaluate TRE mechanisms in a real-world setting. To isolate the operational cost of TRE, we measured server traffic volume and central processor utilization at peak output without TRE functionality. These measurements served as a baseline, informed by Amazon EC2 pricing models. The total operational cost of the server encompasses both network traffic volume and central processor utilization, as determined through EC2 analysis.

4.2 Predictive Acknowledgment Effect on Client Central Processor

To estimate the central processor effort required on the client side, we evaluated a typical client in an environment mirroring the server-side cost assessment. In this scenario, the cloud server streamed videos at 9 Mb/s to each client. Such high-speed streaming is common in contemporary video servers that aim to provide consistent bandwidth for smooth playback. Our implementation leverages two currently idle Transmission Control Protocol (TCP) option codes for this purpose.

4.3 Message Format for Predictive Acknowledgment

The message format for Predictive Acknowledgment involves two primary components. First, a service option indicating that predictive acknowledgment is permissible is sent during the SYN phase, signaling its potential use if the connection is established. Second, a predictive acknowledgment message can be transmitted within an established connection once permission has been granted by both communicating parties.

The client initiates data download from a cloud-based server by clicking "Download Data." During the initial download of a file (e.g., "hello.txt") from the cloud, a "no copy" message is consistently displayed, indicating the absence of a local cached version. For subsequent downloads of the same data, the file is directly copied from the local cache, facilitated by the predictive acknowledgment mechanism. On the server side, administrators can monitor traffic volume and detected redundancy to ascertain the proportions of unique and redundant data.

The client can download the data from a cloud-based server to download the data and click on Download Data.

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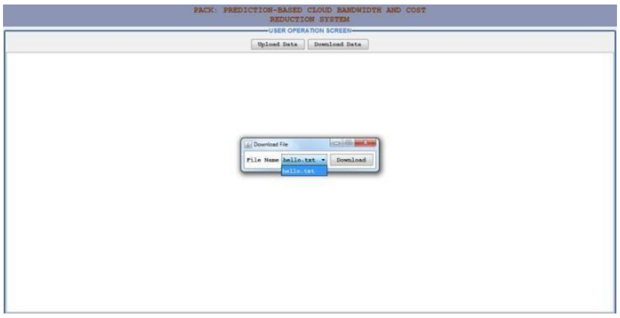
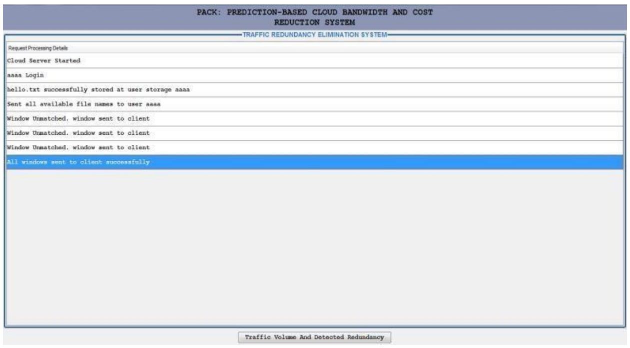


After downloading the file from drive:

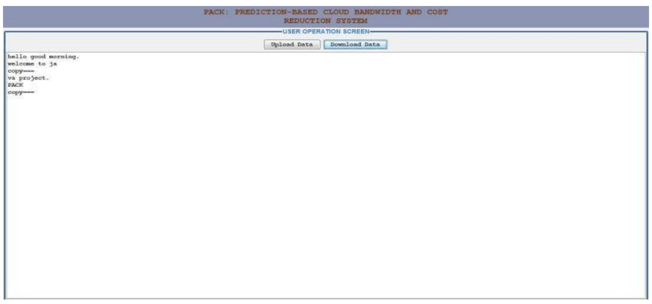
The first time we are downloading the data (hello.txt) from the cloud so there is always the message no copy

The server-side window for downloading the file:

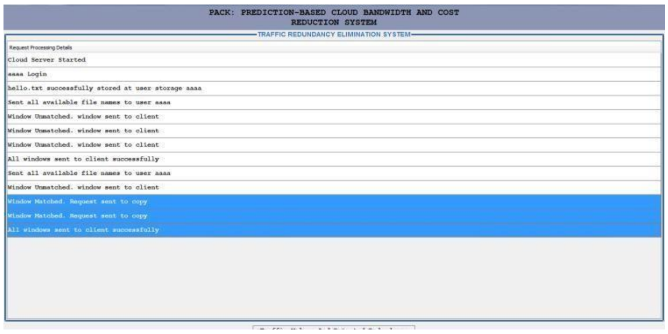


Download the same data for next time:

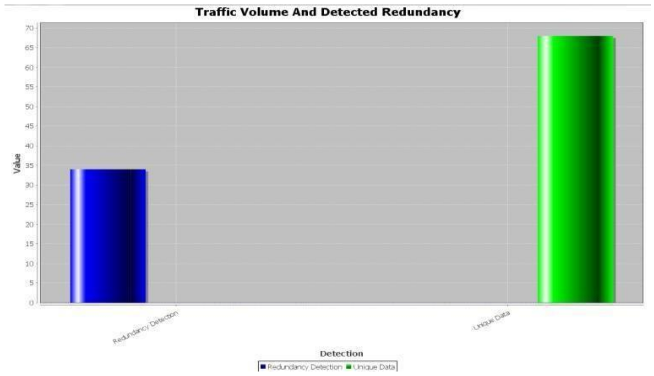
The same data is already there at the local cache so it copies directly from there with the help of predictive acknowledgement,



Server-side:



Server-side, click on traffic volume and detected redundancy to see how much the unique and redundancy data is there.



V. CONCLUSION

Cloud computing is poised to generate an immense demand for Traffic Redundancy Elimination (TRE) solutions, given the anticipated significant increase in data transfer between cloud services and their users. The nature of cloud environments necessitates TRE systems that render standalone middlebox solutions insufficient. Consequently, there is a growing imperative for TRE solutions that minimize cloud operational costs while simultaneously accounting for application latencies, user mobility, and cloud elasticity.

This paper introduces PACK, an end-to-end, receiver-based, and cloud-friendly TRE system. PACK is underpinned by novel speculative principles designed to mitigate latency and cloud operational expenses. A key advantage of PACK is that it does not require the server to continuously maintain client status, thereby inherently supporting cloud elasticity and user mobility, and enabling the maintenance of long-term redundancy. Furthermore, PACK is capable of eliminating redundancy in content delivered to the client from multiple servers without necessitating a three-way handshake.

Our research, utilizing a diverse array of content types, demonstrates that PACK successfully achieves its intended design objectives and offers distinct advantages over sender-

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dependent TRE systems. In the PACK system, the server is not burdened with constantly tracking client status. An intriguing avenue for future work involves the statistical analysis of chunk chains, which could unveil multiple possibilities concerning chunk order and associated predictions. The system could also be enhanced to generate multiple predictions simultaneously, where the accuracy of just one prediction would suffice for highly effective traffic removal, potentially achieving up to 97% traffic reduction.

Further extensions of the PACK concept could explore additional benefits. For instance, our current implementation preserves chains by retaining only the most recently observed subsequent chunk for any given chunk, following a least recently used (LRU) approach. A compelling extension would involve a more comprehensive statistical analysis of chunk chains, potentially allowing for a greater number of possibilities in both chunk ordering and related predictions. The system could also be designed to issue more than one prediction concurrently, with the effectiveness of traffic removal relying on at least one of these predictions being accurate. Another promising direction involves optimizing the operational mode of a hybrid sender-receiver approach, where shared decisions are made based on variations in receiver processing power or server costs.

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