Contact Information

Publications@ipcg.com

ipCapital Group, Inc.
400 Cornerstone Drive, Suite 325
Williston, VT 05495
United States of America
(802) 872-3200

TITLE

Client-Side Latency Synchronization System for Data Consistency in a Distributed Processing System

ABSTRACT

In a Distributed Processing Application, such as in online gaming or any other distributed groupware system, latencies of users interacting with one another are synchronized at the opening of the online interaction session. Synchronizing the latency values across the distributed system ensures data accuracy. Furthermore, in a gaming system, synchronized latency prevents any single user from gaining an unfair advantage through having a faster latency than other competing users.

1. BACKGROUND

Problem/Opportunity

The recent trend towards distributed systems in computing has produced a need for better real-time data synchronization techniques. For example, accurate data synchronization is required to ensure the fairness of online gaming. Due to the nature of online communications, latency times based on a user's geographical proximity to a server may produce an unfair advantage for users connected closer to the physical location of the server. Since the human eye is capable of noticing the effects of latencies as slow as 150ms, the data synchronization process must also be fast and efficient. Furthermore, current systems utilizing system clock synchronization and time-stamping for data synchronization are prone to hacking and abuse for the purpose of gaining an advantage on competition. Because of this, a system is needed that ensures data synchronization in such a way that promotes fairness despite latency issues arising from a user's geographical location.

Background Publications

Previous publications have attempted to address the data synchronization problems associated with distributed processing systems such as multiplayer online gaming applications. However, none of the previous inventions describe a system where real-time data communications are synchronized by synchronizing latencies.

Dane Stuckel and Carl Goodwin in their 2008 paper "The Effects of Local Lag on Tightly-Coupled Interaction in Distributed Groupware" discuss the effects of how locally controlled lag times affect the perceived system performance of a tightly-coupled distributed processing system. "Tightly-coupled interaction is shared work in which each person's actions immediately and continuously influence the actions of others. Tightly-coupled collaboration is a hallmark of expert behavior in face-to-face activity, but becomes extremely difficult to accomplish over distributed groupware. The main cause of this difficulty is network delay that disrupts people's ability to synchronize their actions with another person."[1] The paper concludes that implementing a local lag system, where individual lag times are implemented based on individual user's network latencies, prevents not only data synchronization issues, but also helps minimize issues resulting from users having different graphical experiences in tightly-coupled systems such as online games.

World Patent Application 2003084152 describes a system for dynamically allocating network resources. By allocating network resources based on network traffic, resources can be allocated more efficiently to various different types of data transmission, which eliminates many of the difficulties arising from multiple types of data sharing the same bandwidth. However, this invention does not contain any provision for dynamically allocating network latency.

2. SUMMARY OF THE INVENTION

Invention Summary

A Latency Synchronization Module residing in the Operating System of a User Machine uses latency data of the summation of machines connected to the same distributed system, and then creates an effect of "synchronized latency" across the entire distributed system by implementing "Local Lag".

The Latency Synchronization Module implements Local Lag by calculating the latencies of each individual User Machine connected to the distributed system, finding the longest latency time, and then delaying each packet transmitted by the difference between the longest latency time and each individual User Machine's individual latency time. In doing so, the User Machine with the longest latency time operates with zero delay, while the User Machine with the shortest latency time operates with the largest delay.

By implementing this system, each User Machine is provided with a connection equal in capability and delay between packets, ensuring data consistency in real time sufficient for online gaming and other distributed systems.

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1 Stuckel, Dane and Carl Gutwin. "The effects of local lag on tightly-coupled interaction in distributed groupware." Computer Supported Cooperative Work. *Proceedings of the ACM 2008 Conference on Computer Supported Cooperative Work.* San Diego, CA. 2008. pp 447-456

In the present invention, the Latency Synchronization Module automatically updates the synchronized latency in real time as network traffic changes. Alternatively, the Latency Synchronization Module can estimate an optimum latency value to be used for the duration of computation.

Unique Concepts

The unique concept of the present invention is that latency delay is dynamically calculated by the distributed system as User Machines connect. This allows for the packet delay to be dynamically adapted to network traffic.

3. DESCRIPTION OF THE INVENTION

Description of Elements of the Latency Synchronization Module in **Figure 1**:

User Machine (A, B, N) represents a plurality of computing devices, such as a desktop or laptop personal computers, mobile devices, or gaming systems, containing an Operating System such as Linux with network connectivity.

OS is an operating system, such as Linux, residing on a User Machine. The OS is responsible for managing all software and hardware processes.

The Network Interface is the component of the OS responsible for managing all network communication.

The Latency Synchronization Module is a module which calculates the User Machines latency and the associated local lag for packet transmission.

The Distributed System Server is a central server on a network or the internet connecting the plurality of connected User Machines to one another in a distributed system.

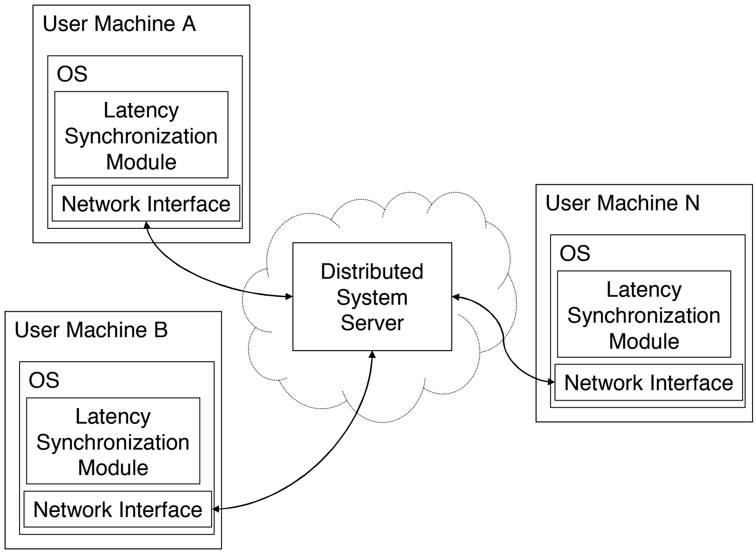

Figure 1. System Diagram of the Latency Synchronization System

Figure 2 depicts the method of the Latency Synchronization System.

In step 1, a User Machine connects to the Distributed System Server.

In step 2, the User Machine pings the Distributed System Server and determines its network latency.

In step 3, the User Machine sends its latency to the Distributed System Server. The Distributed System Server finds the longest (maximum) latency from the collection of latency values received from the User Machines, and transmits that value back to each connected User Machine.

In step 4, the Latency Synchronization Module on the User Machine calculates the difference between its own Latency against the longest latency value received from the Distributed System Server.

In step 5, the Latency Synchronization Module delays each packet being sent through the Network Interface by the calculated difference for the corresponding User Machine. Data is delivered to the Distributed System Server at the same rate from each User Machine.

In step 6, the method optionally updates the longest latency time. If the longest latency is recalculated during Distributed System operation, then the method returns to step 2. Otherwise, the method ends.

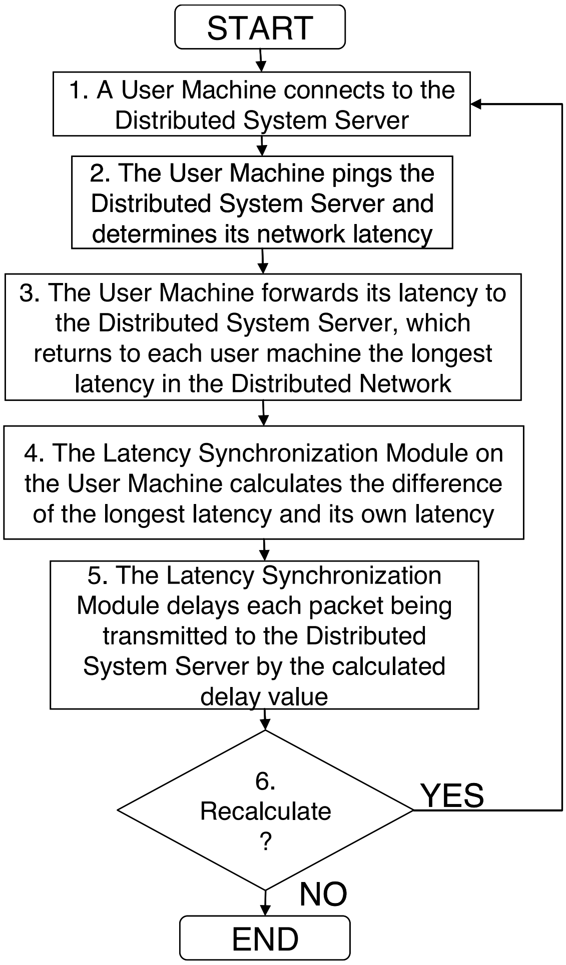

Figure 2. Method for synchronizing latency using Latency Synchronization Module