Guaranteed delivery of semi-synchronous IP-based communication

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Abstract— This research aims to find an empirical solution for guaranteeing the delivery of synchronous and asynchronous messages within a semi-synchronous IP-based communication domain. The communication infrastructure that is needed between the Deaf and hearing communities forms the application domain within which the research is situated. SoftBridging is a framework for multi-modal bridging as well as multi-user, multi-modal conversation sessions. An implementation of this concept called SoftBridge, is a communication platform that allows a hearing and Deaf person to communicate inside a single uniform space. The system is based on an asynchronous transport mechanism that makes use of various web services to do the actual data conversions such as voice to text and text to voice. Publish-subscribe systems are an emerging paradigm for building a range of distributed applications. The architecture of publish-subscribe systems make use of Message Oriented Middleware (MOM) to guarantee reliable delivery of messages within a communication domain. We will choose one of these systems and incorporate it within the overall architecture of a SoftBridge system. We will modify the existing architecture of a SoftBridge system to reliably transport synchronous as well as asynchronous data over a synchronous established session. We will use the Session Initiation Protocol (SIP) to establish a synchronous session between various users and a SoftBridge system. The system will then be used as a basis for developing a Deaf telephony application that guarantees the delivery of messages no matter the synchrony.

Index Terms – Asynchronous call handling, Soft Bridging, Synchronous call handling, Publish-subscribe systems, Deaf Telephony.

I. INTRODUCTION

This research aims to find an empirical solution for guaranteeing the delivery of synchronous and asynchronous messages within a semi-synchronous Internet Protocol (IP)-based communication domain. The communication infrastructure that is needed between the Deaf and hearing communities forms the application domain within which the research is situated [6]. SoftBridging is a framework for multi-modal bridging as well as multi-user, multi-modal conversation sessions [2]. An implementation of this concept called SoftBridge [5] is based on the Jabber protocol (*http://www.jabber.org)*, which allows communication to occur asynchronously. [5] makes use of various web services to do the actual data conversions, such as text to voice and voice to text. The semi-synchronous interaction between end users is due to the media adaptations that the system performs according to the media capabilities of the end user. The system would, for example, allow end users with different media capabilities, such as voice and text, to communicate with each other inside a uniform media space. The transport mechanism we will use will be synchronous to allow text and audio communication to occur real time. The solution will be incorporated within the architecture of a SoftBridge system such as [5]. We will then build a Deaf Telephony application to test the overall system.

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II. MOTIVATION

In an environment that can not guarantee reliable IP-based network communication, most services are based on asynchronous call handling. However, synchronous communication is perceived to be a better form of communication between end-users because of the fact that it allows communication to occur real time. There is thus a clear distinction between synchronous and asynchronous communication: Synchronous is best suited for real time communication and asynchronous for "reliable" communication. Synchronous communication does minimal error checking and needs a "clean" line of connection for data transfer. The motivation behind this research is related to the derivation of certain methods for relating asynchronous communication to synchronous communication. This relationship will allow a SoftBridge system to guarantee exactly-once, reliable delivery of messages within a communication domain irrespective of the synchrony with direct applicability to a Deaf Telephony domain. How does one allow a SoftBridge system to deal with most fault-related issues on the one side and guarantee message delivery on the other side? The main research question is asked: "How does one guarantee exactly-once delivery of synchronous and asynchronous messages within a communication domain?" At the moment the Deaf Community is faced with delays on a macro level. Most Deaf users in Cape Town use cellular telephones as a means of communication. This device does not guarantee the delivery of short messages sent. Those that do not have access to a cell-phone have to travel to the Deaf Community of Cape Town (DCCT) community center to access a public Personal Computer (PC). In most cases they have to wait to access a PC that have a set duration period assigned to it. The Deaf community needs an application that reliably transports messages to destinations whether the receiving party is connected or not.

III. RELATED WORK

[10] describes a mechanism for integrating text and audio into one Real Time Protocol (RTP) packet for transmission over a synchronous established session such as Session Initiation Protocol (SIP). [10] reconciles User Data Protocol (UDP) with Transmission Control Protocol (TCP) by using the fundamentals learnt in TCP, such as error correction, and applying it to RTP which is based on UDP. Publish-subscribe systems provide the capabilities of guaranteeing exactly-once delivery of messages between multiple end points. The system replaces the single destination in a point-to-point model with a content hierarchy, known as topics. Message distribution is handled by an underlying content based routing network [3]. These types of networks perform routing based on the data being transported in a message rather than on any specialized addressing and routing information attached to, or otherwise associated with, the message. Proteus [4] is a multi-protocol library for integrating multiple message protocols, such as Simple Object Access Protocol (SOAP) and Java Message Service (JMS), within one system while supporting the dynamic addition of protocols. The publish-subscribe system makes use of Message Oriented Middleware (MOM) [7] that acts as a broker, routing published messages for a topic to all subscribers for the topic. MOM is based on an asynchronous model. This allows for application and information dissemination to many users. [8] is another messaging system that incorporates JMS. It provides access to a MOM and provides message persistence and guarantee of delivery.

IV. RESEARCH METHODOLOGY

The research is based on the fusion of two methodologies. The first methodology is based on the common approach for experimental computer science research [9]. This is an iterative approach where the researcher uses the lessons from one cycle to improve the performance in the next cycle. Because the re-development of a SoftBridge system will involve the end user, it is appropriate to use this kind of methodological approach. The second methodology is based on the concept of Action Research [1]. This methodology is used to develop applications for targeted user communities and their needs. [6] used the concept of action research to build an automated Deaf Telephony bridging application with a SoftBridge platform.

V. TECHNICAL SOLUTION

Studying various communication systems revealed a precise, distinct, solution to the research question:

Move a SoftBridge system into a publish-subscribe domain that facilitates exactly-once reliable message delivery no matter the synchrony. We will modify the existing architecture of a SoftBridge system [5] to accommodate a reliable synchronous/asynchronous messaging system based on a synchronous transport medium for a Deaf Telephony application. The publish-subscribe domain will make use of a MOM infrastructure that deals with most of the network related issues. The system should deal with the following issues: 1) Simplify notification. A sending client simply sends a message and a receiving client simply receives a message. A sending client should not be blocked while a receiving client is busy accessing the message. 2) Simplify concurrent threading. Each broker associated with a client is responsible for updating its message thread. This will simplify message delivery within the broker cloud. 3) Simplify Remote Access. The client acting as either publisher or subscriber does not have to implement any remote methods. 4) Increase Reliability. The messaging infrastructure can be seen as a network of messaging channels. These channels are responsible for the delivery of messages under any condition. The protocol used by the publish-subscribe system should be tolerant to message drops, message reordering, node and/or link failures.

VI. CONCLUSION AND FUTURE WORK

We will redevelop a SoftBridge system [5] to guarantee the delivery of synchronous and asynchronous messages within the context of a Deaf Telephony domain. We will study various Publish-Subscribe systems and use the fundamentals learnt from each system to answer our research question. We will develop a Deaf Telephony application to test the overall feasibility of the system. The development of the system will iteratively involve the end-user and the overall system will be tested in the lab as well as the Deaf community.

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