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A Study of a Java based Framework for Telecommunications Services

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Abstract

In this report, we study some of the general issues surrounding the area of telecommunications service development including the history of telecommunications services, current service creation techniques and the network used by services. We also discuss the lack of service portability and reasons for it. The JAIN framework – a set of Java APIs for integrated networks – is introduced as an approach that elegantly addresses this. We present a survey of recent work in telecommunications services that relate to JAIN. This includes a discussion of the feature interaction problem, an overview of the Telecommunications Information Networking Architecture, in particular, its relationship with JAIN, and the rapidly advancing field of Internet Telephony. In order to demonstrate the effectiveness of the JAIN approach we present designs for two advanced services that use the JAIN framework. These services are Internet Call Waiting and Click-to-Dial. Finally, areas for future research are introduced.

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Preface

Motivation

I came across the early stages of the JAIN framework during the summer break of '98. I was attempting to find a research project that was sufficiently pragmatic as to allow me to receive funding under the GRIF program offered by the Foundation for Research, Science and Technology. I was interested in JAIN as I had previously enjoyed networking papers and systems development, and the JAIN website talked about the convergence between the Internet and traditional telephony in a standard manner. It struck me that I had no accurate idea of how the telephone network functioned. Furthermore there was very little easily accessible documentation on its workings. I was also interested in *standard* based environments such as various Unix systems, and decided that JAIN was attempting to achieve "a good thing".

The work presented in this dissertation is useful in several aspects. It presents a number of telecommunications related concepts in a single logical unit that are dispersed in many publications elsewhere. It explains the existing wired-line telephone network in depth and discusses the exciting area of Internet Telephony which we have all heard so much about, but seen so little. It *demonstrates* the value of a standard based approach by designing services and, as such, the reader may understand the framework in far greater depth than by merely reading specification documents.

Acknowledgements

First of all I would like to thank my supervisor, Dr. Anand V. Raman, for his invaluable advice during this project. Because of Anand's comments I believe that I have a far greater understanding of the scientific process, and a greater respect for academia than I had previously. Anand also helped me find a more fitting balance between an algorithm and an implementation. I am also grateful for his input as this project is not in his field of research.

I'd like to thank SolNet, especially Murray McNae, for allowing me do this project. Thanks go to the Foundation for Research Science and Technology for funding. Project funding was particularly helpful, and without it I would probably not have undertaken a Masterate degree.

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Last but not least I'd like to thank my family for supporting me during this project and encouraging me, particularly when I didn't want to tidy the dissertation! I'd also like to thank both Dad and Nicola for proof reading.

Overview of the contents

Chapter 1 introduces the concept of Telecommunications services and notes the problem of service portability. The JAIN framework is introduced as providing a possible solution to the problem of service portability. The objectives of our research are also presented. Chapter 2 discusses the technologies present in the current wired-line telephone network. This includes an outline of the evolution of the wired-line telephone network, an explanation of the current day architecture named the AIN – Advanced Intelligent Network – and an overview of the protocol stack used in the AIN. The JAIN initiative is then discussed and is followed by a survey of related work. Chapter 3 introduces related areas of work in both telecommunications services and recent network architectures. Other Java-based telephony initiatives are presented and discussed. Chapter 4 illustrates architectures for two JAIN based services: Internet Call Waiting and Click-to-Dial. A summary of the work presented in this thesis and recommendations for areas of possible future work is finally presented in Chapter 5.

Chapter 1

Introduction

1.1 Telecommunication services

Telecommunications service providers (hereafter referred to as carriers) traditionally supply the necessary infrastructure to enable telephone calls to be made. As a customer typically has a choice between many possible carriers, carriers are required to differentiate themselves from competition if they are to maintain their existing customer base or expand it. A method used by carriers to attempt to achieve this differentiation is by offering *Telecommunications services or features.*[1] Once subscribed to a feature the customer receives functionality that is not delivered in a normal call. From the carrier's point of view, the offering of features also has the beneficial side effect of creating new revenue opportunities.

[1]There is a distinction between a service and a feature. In both the ITU-T – International Telecommunications Union (ITU-T, 1992) – and Bellcore (Bellcore, 1991) standards, features are portions of services that the service subscriber can distinguish. Hence a service may contain several features. The terms *service* and *feature* are used interchangeably throughout the text

Some examples of services include:

- The voice mail service. This is a service where a caller is able to leave a message in the called party's *voice mailbox.*
- The 800-number service. This service allows people to dial a number toll-free. The called party is charged for the call.
- The calling card or alternative billing service. This service allows a subscriber to charge a call to a particular account regardless of the caller's physical location.
- Time based routing. This service allows a subscriber to have a call to a particular number redirected to another number based on the current time.

As many carriers provide services it is important for carriers that they are able to create and deploy services throughout their network quickly and cost effectively in order to maintain differentiation from competitors. This requirement has led to the introduction of a number of highly effective technologies. The network that provides call setup and termination is highly fault tolerant. At present, services can be rapidly created and deployed through the use of graphical representations of both components which may be pieced together to form services, and the network which the services are deployed on. Standards exist that ensure interoperability between equipment vendors.

1.1.1 JAIN

In spite of the many desirable aspects of current service creation techniques such as rapid creation, ease of deployment and inherent fault tolerance, they

suffer from the serious drawback of non-portability. While interoperability standards exist ensuring communication between services executing on different vendors' equipment, a service that is created on vendor A's platform would have to be redeveloped to execute on vendor B's platform. This is due to the lack of standard *programming* interfaces. The JAIN program (Sun Microsystems, 1999a, 1999b) is aimed at addressing this problem and extending the service creation paradigm. JAIN is a set of open application programming interfaces (APIs) for the Java programming language (Gosling et al., 1999) that both include and extend the scope of traditional telecommunications service development. That APIs are open means that their specification is in the public domain. Futhermore, they are *standard* extensions to the Java platform. Standardization is important as any implementation of a JAIN interface must pass a compatibility test suite ensuring that it functions as anticipated. The Java platform allows software written in the Java programming language to run on any combination of operating system and hardware without modification to the software. Services can now be written in Java to use the JAIN APIs and execute on any vendor's platform which supports both the JAIN APIs and Java run-time environment.

Our work considers the above issue of service portability in some detail and studies the JAIN approach through the discussion of services that use the JAIN framework. It includes a number of objectives. These are as follows:

- A survey of work relating JAIN to existing work in the field of telecommunications.

- Identification of alternative frameworks or architectures that are similar to JAIN.

- Discussion of other Java based telephony initiatives.
- Illustration of JAIN's suitability for the development of portable services by building one or more services that demonstrate the value of a vendor and platform independent framework.

An understanding of the workings of services in the present day wired-line telephone network and telecommunications service development in general will help in appreciating the value of a JAIN based approach. This is therefore discussed in some detail in the following chapter.