Computer Science

Michael Bergkvist

Walter Gorraiz

Technical evaluation of Generic Service Platform

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This report is submitted in partial fulfilment of the requirements for the Bachelor's degree in Computer Science. All material in this report which is not our own work has been identified and no material is included for which a degree has previously been conferred.

Michael Bergkvist

Walter Gorraiz

Advisor: Hannes Persson

Examiner: Stefan Lindskog

Abstract

The purpose of this thesis is to perform a technical analysis of the present and future standards concerning service environment in the area of telecommunication. The intention is to review some of the ongoing developments in standards and technologies that are expected to have an impact on future services creation. A Generic Service Platform (GSP) has to be developed for the building of these services. This issue is currently being addressed by a number of initiatives such as Third Generation Partnership Project (3GPP), Parlay and Java API for Integrated Networks (JAIN). This thesis also aims to provide an overview of ongoing activities in standards bodies such as European Telecommunications Standards Institute (ETSI) and Internet Engineering Task Force (IETF) to understand the importance of telephony and Internet convergence. The requirements and troubles concerning the creation of a GSP are also discussed.

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1 Introduction

The world of telecommunication is changing rapidly. This revolution is driven both by the technological progress and deregulation of the telecommunication market. These changes will allow a new type of actors, such as independent services providers, to deliver their own services using the existing network's resources. To make this possible, the network operators are required to open up their networks. Obviously, giving direct access to the existing networks is not feasible, for the reasons of network security. Network operators must be concerned with securing the network against malicious and/or misbehaving applications and protecting their existing investment. There are, however, ongoing efforts to standardise service delivery in a more generic and secure manner. This chapter is to give the reader a description of what a GSP is and why it is needed. First we explain some basic concepts that are necessary for the discussion. We then describe what a service in the telecommunication sector is and also the purpose, main questions and limitations of the thesis.

1.1 Basic concepts

- **Communication** includes the three sectors, telecommunication, Internet and broadcast sector. All sectors are delivery services over fixed or wireless networks.
    - **Telecommunication sector** contains both the traditionally telephony and mobile telephony.
    - **Internet sector** is the well-known world-wide computer networking.
    - **Broadcast sector** includes radio and television
- **Data** is all formats, except voice, of information that is transmitted over a telecommunication network.
- **Voice** is just oral talk.
- **Intelligent network (IN)** is a service-independent telecommunications network
- **Third party** is an independent service provider who is using the network operator's resources.

1.2 What is a service in telecommunication?

A telecommunication service is an application, which can be installed in a telecommunication network to provide value-added functions. The value-added functions are additional functionality beyond connecting caller to the called party, such as call waiting, follow-up of incoming calls, re-connection of incoming calls and three-party conferencing. [12]

1.3 What is a Generic Service Platform?

Traditionally services within the telecommunication domain are proprietary since there have not been any common boundaries between third party service providers and the telecommunication for deploying services. This has led to expensive proprietary services. The deregulation process of the telecommunication domain will open up markets to third party service providers to manufacture and sell different services. These services will reach out to the users or subscribers independent of which resources (computer, mobile, etc) they are connected to. The service must work, independent of which net operator you choose, without any change of the implementation code. For a better understanding we can draw a simple comparison: a service (application) can be understood as a computer program and the net operator's platform as an operating system. If the program can be installed in the operating system, the program can be installed on different computers running on the operating system. In the same way we will have the possibility to install a service into different net operator's platform without any changes. This is what we mean with a Generic Platform. To realise this possibility, a GSP is required from the net operators.

Recently, major companies within the telecommunication industry have taken the initiative to standardise how services shall be built. The main goals for these standards are to provide a generic way of interaction between services and different networks.

1.4 Purpose

The purpose of the report is to perform a technical evaluation of the present and future platforms concerning service environment. We will also investigate and identify the requirements for a GSP and then see if there is any platform that fulfils these requirements.

1.5 Scope

We will explain what a standard is and why it is needed. We will also present some of the different groups in the standardisation process, who they are and what they do.

This report will focus on the initiatives concerning the creation of a GSP and investigate if the platforms have the conditions required to be a standard in the future. We have chosen two of these platforms and described them in detail. The reason for this decision is to obtain deeper understanding of these two specific platforms, so that we can be prepared for comparing them against the requirements the service developers ask for.

We have searched for information for the report through open sources such as the Internet, written reports and we have also conducted 30 interviews via e-mail and letters to networks operators and service providers.

1.6 Overview

The rest of the thesis is structured as follows. In chapter 2 and 3 we describe standards in general, different telecommunication and Internet standards and also present and future standards service environments. In chapter 4 we introduce a technical analysis of JAIN and in chapter 5 we introduce a technical analysis of 3GPP. In chapter 6 we discuss requirements for a GSP. Chapter 7 contains the interviews conducted. The chapters 8 and 9 contain the evaluation and the summary of the thesis. A glossary and the questionnaire for the interviews are attached as an appendix.

2 Standards

In this chapter we will explain what a standard is, why it is needed and the importance of the convergence in the telecommunication and Internet standards. We will also try to give the reader an overview about some of the different organisations in the standardisation process; which they are and what they do. Standards from these organisations play a very important role for the industry initiatives, because their work to create a GSP is based on those standards. If a GSP in the future would be classified as a standard, it would be through these organisations the decision will come.

2.1 What are standards and why are they needed?

Standards are documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics. [12] Standards are needed to guarantee that those products, processes and services are fit for their purpose. Standards influence the design, the manufacturing and the marketing of many products world-wide. Standards, if adopted throughout the world, create a large market instead of many fragmented markets. Standardisation moves beyond product specifications and service requirements to include such broad domestic issues as the environment, safety and consumer protection programs.

2.2 Standards concerning convergence

When we talk about convergence, we mean the merging of telephony and Internet into a single network. Convergence technologies promise to combine the reliability and simplicity of telephony networks with the power and cost-effectiveness of the Internet. Convergence will also allow new applications to transform the way companies do business. Such applications can increase sales, improve productivity, speed up time-to-market, and build customer loyalty.

To have telephony and Internet on the same network is also attractive for service providers. By offering reduced tariffs and new applications, service providers can differentiate themselves from the competition and increase market share. With deregulation and the rush of competitors into this market, the question is who will be the one that prevails. The answer is those service providers, who are the first to meet the customers' growing demand for cost-effective and reliable converged services.

2.3 Telecommunication standards organisations

Governments and companies create standards nationally. They are working together in national telecommunication standards organisations (e.g., Alliance for Telecommunications Industry Solutions (ATIS), American National Standards Institute (ANSI), Committee T1 and European Telecommunications Standards Institute (ETSI)). The work from these organisations is then brought to the International Telecommunication Union (ITU), which is a governmental-based telecommunication standards authority [8]. Through the auspices of the ITU, governments and companies together create international standards.

2.3.1 ITU

The International Telecommunication Union is the specialised agency of the United Nations. The agency is responsible for the regulation, standardisation and development of telecommunications worldwide. ITU's membership includes 189 member states and more than 600 sector members representing a wide range of entities with an interest in telecommunication. ITU comprises a general secretariat and three specialised sectors dealing with radio communication, standardisation and development. The sectors are:

- Radiocommunication Sector (ITU-R)
- Telecommunication Standardisation Sector (ITU-T)

- Telecommunication Development Sector (ITU-D)

The ITU-T mission is to ensure an efficient production of high quality standards covering all fields of telecommunications. The standardisation work is carried out on 14 Study Groups and presently, more than 2600 recommendations are in force. [9]

2.3.2 Committee T1

Committee T1 was established in February 1984 and they develops technical standards and reports regarding interconnection and interoperability of telecommunication networks. Committee T1 is sponsored by ATIS and is accredited by ANSI. Committee T1 is an organisational partner of 3GPP. Committee T1 has six technical subcommittees that are advised and managed by the T1 Advisory Group (T1AG). Each subcommittee develops draft standards and technical reports in its designated areas of expertise. [1]

2.3.3 ETSI

The European Telecommunications Standards Institute is a non-profit making organisation whose mission is to produce telecommunications standards. ETSI consists of a General Assembly, a Board, a Technical Organisation and a Secretariat. The Technical Organisation produces and approves technical standards. More than 3500 experts are presently working for ETSI in over 200 groups. [3]

2.4 Internet standards organisations

The technologies that permit speaking over the Internet i.e. Voice over IP (VoIP) are making great strides toward satisfying the market requirements for a converged telephony and Internet architecture that is cost-effective and inspires new income-generating services. Practical problems such as how call transfer should be implemented are not standardised, which has led to multiple implementations among vendors. Many of those problems are being addressed in draft standards and it leads to intense efforts in the standardisation organisation. Opposite to the telecommunication sector, the Internet sector is a much smaller sector and therefore it has fewer standardisation organisations. Because of this reason we will only mention one organisation from this sector. The Internet Engineering Task Force (IETF) is the most important standardisation organisation. IETF is a independent and self-organised group of people who make technical and other contributions to the evolution of the Internet and its technologies. It is the principal body engaged in the development of new Internet standard specifications and some of theirs mission includes:

- Identifying, and proposing solutions to, bad operational problems and technical problems in the Internet.
- Specifying the development or usage of protocols to solve technical problems for the Internet.
- Making recommendations to the Internet Engineering Steering Group (IESG) regarding the standardisation of protocols and protocol usage in the Internet.
- Providing a forum for the exchange of information within the Internet community between vendors, users, researchers and network managers. [7]

2.5 Telecommunications and Internet - some differences

The information in this section is based on [18]. Telecommunications is still based on circuit switched technology and the use of conventional telephone numbers. Internet is based on a packet switch technology and uses the Internet domain name system for addressing global customers. However, the telecommunication sector is now undergoing considerable change particularly in the type of technologies being employed in access networks. For instance many companies are already at an advanced stage of integrating Internet Protocol (IP) technology into their existing telecommunication platforms.

While the telecommunication and Internet sectors are becoming closer in terms of the transport technology employed in the delivery of services, there are nevertheless fundamental differences between the two network cultures. Telecommunications is a much more controlled and regulated environment in which provisions are made for charging of calls and ensuring a minimum acceptable level of voice quality. Telecommunication networks are interconnected with each other at gateway or distinct boundary points in which procedures have been established to ensure that quality and charging aspects are under full control by the respective network operators.

Internet on the other hand is a much less controlled environment. It is nevertheless a very open environment that is highly attractive to many providers. Unlike telecommunications, there is practically no controls applied to charging or service quality at the gateway or boundary points between interconnecting domains, and therefore, there are no guarantees on call quality. The Internet is a complex environment involving many routers and the demand for access points continues to grow. The Internet does not have any usage charges other than local telephone usage charges. In the near future there will be a need to find technical solutions to the fundamental differences between the two network environments.

3 Initiatives to create a GSP

In this chapter we will shortly describe all the present and future initiatives to create a GSP that we have found during our investigation. In chapter 2 we described the work inside the standardisation organisations. Those organisations have also projects or initiatives concerning how services shall be built. The projects inside those organisations are The Telecommunications and Internet Protocol Harmonisation Over Networks (TIPHON), the Services and Protocol for Advanced Networks (SPAN) and the Public Switched Telephone Network(PSTN) to Internet Interworking and Services in the PSTN/IN Requesting Internet Services (PINT/SPIRIT) as we will describe below. From the industry sector we found initiatives that are created by a single company, namely, Syion 426 and GemMobile. We also found initiatives and projects that are supported by several companies and standardisation organisations, namely, JAIN, Parlay, 3GPP, the Telecommunications Information Networking Architecture Consortium (TINA-C), the Framework for Integrated Engineering and Deployment of Services (FRIENDS) and Symbian. We will in a later chapter choose two of these initiatives described here for a technical analysis.

3.1 TIPHON

The Telecommunications and Internet Protocol Harmonisation Over Networks is an ETSI project. It is a special project because it has brought together the telecommunication sector and the Internet sector. TIPHON will provide a chance to use the best of these sectors' technology, enabling manufacturers to offer new products and operators to provide new services. The project's objective is to support the market for voice communication between users and offer a new way to deliver real time voice communication over the Internet. It is working on schemes to permit network operators to implement IP telephony systems. The goal is to ensure that users connected to IP- based networks can communicate with users in the telephony network and vice versa. [4]

3.2 SPAN

The Services and Protocol for Advanced Networks is a technical committee in the ETSI. It is responsible for all aspects of standardisation for present and future converged networks. The organisational approach has been taken to develop the solutions chosen in IETF and ETSI TIPHON for incorporation in the European telecommunication infrastructures. Further, SPAN complements the 3GPP work, namely the area of fixed network. [20]

3.3 PINT/SPIRIT

The PSTN to Internet Interworking and Services in the PSTN/IN Requesting Internet Services are Working Groups in the IETF. PINT studies architecture and protocols that need to support services in which Internet requests initiate a telephone call to a PSTN. Examples of PINT services are Click-to-Dial, Click-to-Fax and Web access to voice content. These services may be used with a Web application such a Web-based Yellow Pages in the manner that this application will have the ability to initiate PSTN calls between customers and suppliers. [16]

SPIRITS Working Group addresses how services supported by IP networks can be started from PSTN/IN requests. In others words, SPIRITS is in some ways the reverse of PINT. Specific services to be considered by SPIRITS are Incoming Call Notification, Internet Caller-Id Delivery, Internet Call Forwarding and "Follow Me". Both working groups produce documents that describe current practices for supporting the services in question. [21]

3.4 Syion 426

Syndeo Corporation has created the Syion 426 platform**.** The platform is a multi-service software system and runs on the computing operative systems Solaris and Linux. It supports Internet and telephony protocols such as MGCP, SIP, H.323 and SS7. Syion 426 uses CORBA's Interface Definition Language (IDL). IDL allows developers to write applications in any language, including Java and C++. The Syion 426 also supports the JAIN API. The

JAIN interface enables the Syion 426 to support applications, service creation and Graphics User Interfaces (GUIs) that work with this standard based API. This adherence to industry standards means that any service provider can add features and functions to the Syion 426. [22]

3.5 GemMobile

Subscriber Identification Modules (SIM) is the smart cards used in GSM phones. The SIM card has a microprocessor and memory chip embedded and stores electronic information and programs. Gemplus is a French provider of smart card systems and has presented the GemMobile Remote Manager. Gemplus pronounced that GemMobile Remote Manager is a GSP, built with an open architecture that works with SIM cards. The platform runs on Unix Server over wireless networks with the Internet Protocol TCP/IP. When customers insert a SIM card into any SIM-compatible handset they are automatically authenticated. Therefore, they can receive and place calls, as well as access any special service they are entitled to, such as voicemail. [6]

3.6 JAIN

The Java APIs for Integrated Network (JAIN) is promoted by Sun Microsystems and have a membership of about 40 companies. They focus on the development of Java environment for creating and executing services over fixed and wireless networks. JAIN' effort promises to bring service portability, secure network access, and network integration to the world of telecommunication and Internet networks. The most important feature that JAIN will provide is a platform-neutral environment for services, namely the Java Virtual Machine (JVM). JAIN will standardise interfaces and programming models for Intelligent Network (IN) services. [2]

3.7 Parlay

The Parlay group is a non-profit corporation. Its membership includes a mix of network operators and network equipment vendors to create open technology APIs. The project of developing the Parlay API began in March 1998 with the goal to give independent service providers access to network information and allow them to use a range of network resources. The first specification of the Parlay API was published in December 1998 and addressed call control, messaging and security. The Parlay API 1.2 was published in September 1999 with focus on expanding the API functionality with concentration on fixed and wireless networks convergence. The API support creation of a service that integrates for example, location of a customer's wireless handset and information obtained from the Internet. The Parlay concept of an open and secure API supporting third party has recently been brought to ETSI and ITU. [15]

The Parlay API architecture consists of two categories of interfaces. Service interfaces, which will offer applications access to a range of network resources, and the Framework interfaces, which provide the resource location, authentication, and authorisation functions required for external applications to gain access to network. [14]

3.8 3GPP

Third Generation Partnership Project (3GPP) consists of 3 member categories, namely organisational partners, market representation partners and individual members. The partners have agreed to co-operate in the production of globally applicable technical specifications and technical reports for a third generation mobile system. It is based on evolved Global System for Mobile communication (GSM) networks and the Universal Terrestrial Radio Access (UTRA). They have also decided to co-operate in the maintenance and development of the GSM technical specifications and technical reports including evolved radio access technologies, e.g. General Packet Radio Service (GPRS) and Enhanced Data rates for GSM Evolution (EDGE). 3GPP has created the concept of an Open Service Architecture (OSA). Their work will result in a standard named the Universal Mobile Telecommunication System (UMTS). [25]

3.9 TINA-C

The Telecommunications Information Networking Architecture Consortium (TINA-C) is a worldwide consortium formed by about 50 member companies including network operators and computer equipment suppliers in the telecommunication and Internet sector. The consortium is working on the definition of software architecture to support the rapid introduction of new communication services, as well as on the ability to manage these services and the networks that support them in an integrated way. TINA-C has developed a specification called the Distributed Processing Environment (DPE), which outlines architecture for implementing services based on distributed computing and object orientation. The technical goal of the TINA-C architecture is to provide a set of concepts and principles to be applied in the design, processing, and operation of telecommunications services. [26]

3.10 FRIENDS

Framework for Integrated Engineering and Deployment of Services (FRIENDS) is a project with the goal to develop a software platform with integrated solutions for creating, deploying and using services for next-generation networks. The platform is based on the TINA-C [27, 28] architecture. The project has developed a service development environment that provides the service developer with graphical tools for service specification, modelling, and composition and testing. [5]

3.11 Symbian

Symbian owns, develops and licenses a software platform for next generation mobile phones. Symbian was established in June 1998 and is owned by Ericsson, Matsushita, Motorola, Nokia and Psion. The mission of Symbian is to license the Symbian platform to all mobile phone producers and to create a mass market for wireless information devices. The Symbian platform is a software platform, and manufacturers who deliver applications integrated with wireless telephony use it. It is also a platform for deployment of applications developed in a wide range of languages. The platform is a set of software developments to enable development of wireless information devices and application that runs on them. [23]

4 Technical analysis of JAIN

In this chapter we will do a technical analysis of Java Application for Integrated Networks (JAIN). The reason why we have chosen JAIN is that it is supported by several, about forty, large companies, e.g. Sun Microsystems, Motorola, Ericsson, Nokia, Simens, Telcordia, IBM, etc. Furthermore, JAIN is, with its Java technology (i.e. platform independent) one of the few front initiators developing a GSP.

The JAIN specification effort is divided into two areas of development. The Protocols Experts Group (PEG) specify APIs for protocols in the converged networks and the Application Experts Group (AEG) address the APIs required for service creation within a framework spanning across all protocols covered by the PEG APIs specification.

4.1 PEG initiatives

All facts in this section come from [10]. PEG is organised into a Signalling System 7 (SS7) subgroup and an Internet Protocol (IP) subgroup. The SS7 subgroup will focus on developing Java APIs for SS7 networks, Intelligent Network (IN) and wire-less networks. The IP subgroup will focus on developing Java APIs for Internet technologies. Within the SS7 and IP subgroups, there are Edit Groups that focus on specific protocols. Here is a brief list of the PEG Edit Group's initiatives:

JAIN TCAP
TCAP stands for the Transaction Capability Application Part, a protocol that adds functionality to the existing telephone network. It is designed for signalling related messages and manipulates information from one application at a switch to another application within another network entity. Examples of TCAP applications include Calling Name Delivery: a subscriber can see the name of a caller instead the caller id. Do Not Disturb: a subscriber can temporarily block incoming call and revert the calls to a voice mailbox.

JAIN ISUP

ISUP stands for the Integrated Services digital network User Part, and provides all the signals needed to set up, manage, and release trunk circuits that carry voice and data call over the PSTN.

JAIN MAP

MAP stands for the Mobile Application Part for GSM, and is the North American standard for cellular processing (IS41). This API handles text messaging to and from mobile terminals.

JAIN OAM

The JAIN OAM (Operations, Administration, and Maintenance) is a set of APIs for the management of network protocol devices.

JAIN MGCP

MGCP stands for Media Gateway Control Protocol. The MGCP controls gateways that interconnect the PSTN with packet networks. This API will provide a critical link for the control of voice-over-IP gateways.

JAIN SIP

Session Initiation Protocol (SIP) enables voice over IP gateways, client end points, Private Branch Exchange (PBX) and other communications systems to interface with each other.

JAIN INAP

INAP stands for the Intelligent Network Application Protocol. This API defines how different applications can communicate between altering elements of an Intelligent Network (IN). INAP API will be based on ANSI and ITU-T specifications.

JAIN H.323

H.323 is the ITU-T standard for packet-based multimedia communications systems and the protocols necessary to achieve the defined system.

JAIN MEGACO

Media Gateway Control (MEGACO) standardises the interface between the Call Control entity and the Media processing entity in the H.323 Gateway architecture. MEGACO has been proposed by ETSI TIPHON and adopted by IETF and ITU-T.

Before we continue with the explanation of the JAIN architecture and the AEG initiatives it is appropriate to illustrate how its architecture is defined. In the Figure 4-1 below we can see that JAIN approach integrates fixed (wireline), wireless, and packet-based (IP or ATM) networks by separating service-based logic from network-based logic. JAIN consists of two layers, application and protocol. In a more granulate picture we would see that there is a signalling layer between those two but it is out of the scope of our thesis. PEG standardises interfaces on the protocol layer and AEG on the application layer.

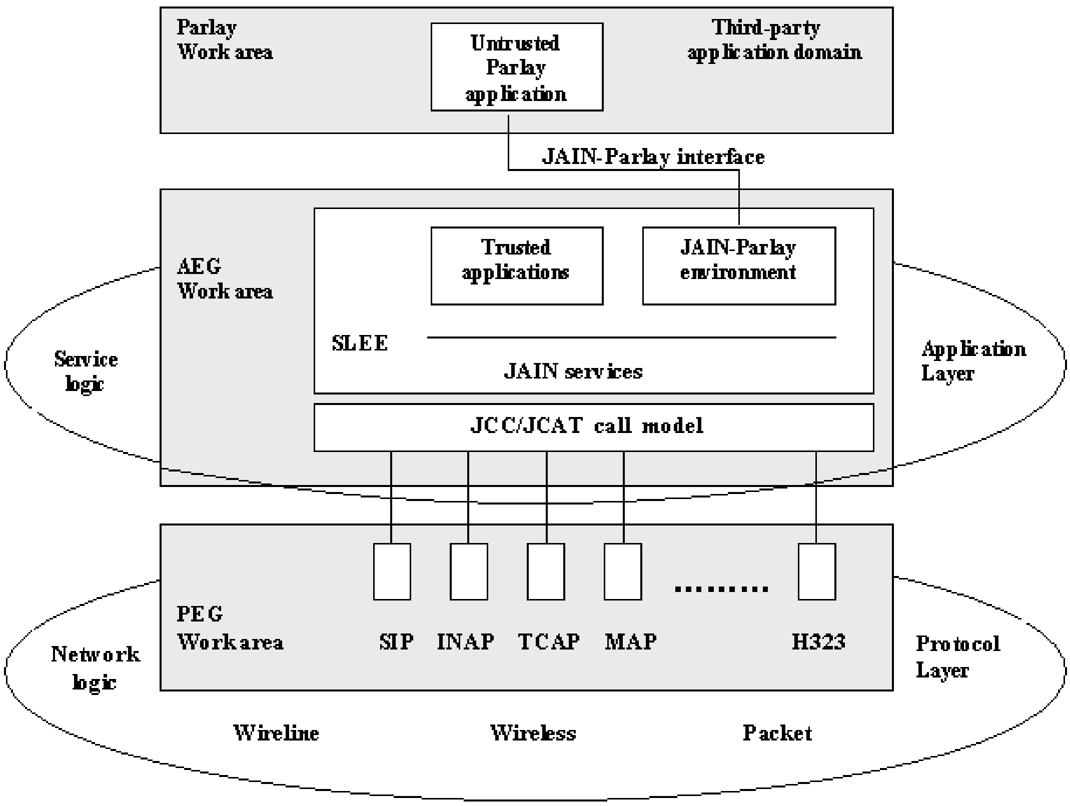

Figure 4-1: JAIN architecture [10].

Services can be written directly on top of the JAIN protocol layer APIs. It means that it is possible to write services for each specific protocol. Since our investigation deals with evaluation of GSP we considered it more interesting to see the service creation at a higher level of abstraction, namely the application layer APIs, because service developers shall not need to deal with of underlying protocols.

4.2 AEG initiatives

The AEG initiatives are at a higher level of abstraction than those of the PEG. The AEG efforts deal with those APIs and frameworks upon which developers will build services. On the application layer, AEG addresses recommendations and specifications for session and call control with JCC/JCAT, for secure access to network operators with JAIN-Parlay and a service creation and logic execution with JSC/SLEE.

JAIN JCC/JCAT

This section is heavily based on [13]. The Java Call Control (JCC) and the Java Co-ordination And Transactions (JCAT) APIs provide applications with a mechanism for interfacing with different underlying networks. It hides the multiplicity of underlying signalling protocol from the service programmer. The JCC/JCAT API consists of the JCC package and the extension JCAT package. The JCC API focuses on initiating and manipulating calls, whereas JCAT defines facilities for invoking applications and returning results during a call. We have seen the packages and documentation of the APIs in the java.doc files. We considered that it is out of the scope of this thesis to describe the methods and classes that the APIs contain. However, the APIs define four objects, which model the call processing manipulated by most services, see Figure 4-2. These are:

- **Call agent manage:** the “window” through which an application views the call processing
- **Call:** represents a call and is a dynamic “collection of physical and logical entities” that brings two or more end points together.
- **Connection:** represents the dynamic relationship between a Call and an Address.
- **Address:** represents a logical end point (e.g. address).

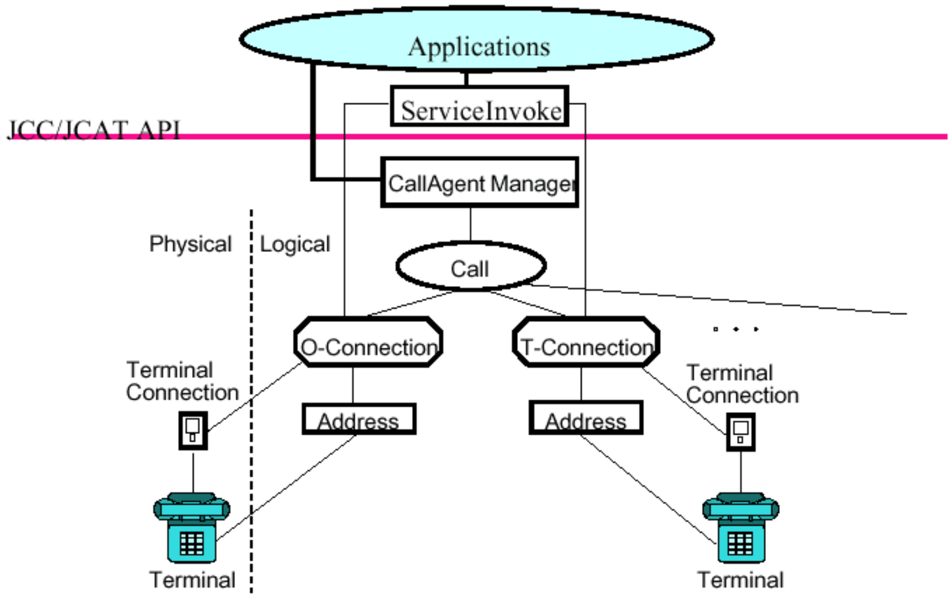

Figure 4-2: Call processing [13].

Several of these objects contain Finite State Machines (FSM) that model the state of a call and provide facilities for allowing applications to register and be invoked when relevant points in call processing are reached. The JCC/JCAT API is required to support a variety of services for example:

Voice virtual private network: This is a service that provides a way to link different sites with a uniform and private dialling plan, for example if a user dials 1 2001 and the application will translate this into the phone number of a remote site 1 973 829 2001.
Voice-activated dialling: allows users to initiate calls by speaking the name or number of the destination party.
Click-to-dial: is a hybrid Internet/PSTN service that allows a terminal user browsing WWW pages to request a call set-up by simply clicking a number or name displayed on the terminal.
Meet-me conference: This service allows users to participate in a pre-arranged conference by dialling into a conference bridge.

Telcordia Technologies Inc. is the leader of the specification of the JCC/JCAT API. They claim that are numerous issues that still needs to be addressed in the implementation of a platform that supports the API. These include reliability and availability issues that are of extreme importance, and it is expected that testing of the API will be a significant task.

JAIN SCE/SLEE

The information about SCE/SLEE comes from [12]. The Service Creation Environment (SCE) provides tools and capabilities for the service creation, and the Service Logic Execution Environment (SLEE) is the run time environment in which a service is executed. Services logic is developed on the SCE, and is then deployed on the SLEE. The SLEE starts and stops services, loads new instances of services, ensures that each service runs, and provides capabilities such as tracing, logging and other commonly required functionality to the services. A service uses the Call Control API to initiate and control calls within the network. After services are built, they can be tested and deployed in the SLEE.

The SLEE can be viewed as a set of subsystems, each of which is associated with one or more interfaces:

- Services deployment: deals with the service deployed roles and responsibilities, and SLEE interfaces available to the service deployed during loading, configuring and initialisation of a service.
- Service management: deals with management functions such as controlling the auditing, logging, alarm and performance monitoring functions. The interface is available to the service administrator.
- Service subscription: keeps track of which users are associated with services.
- Services dispatcher: acts on behalf of all services for event subscription and delivery. It has access to service subscription and act as a listener on behalf of services for all call control events of interest to services installed in SLEE.
- Alarm management: is a record of a system anomaly, failure, or state change, to be reported to a human operator or intelligent agent.
- Trace and event logging: it is desirable to keep track of significant conditions and actions of the services, whether or not they indicate an error.
- Resource usage monitoring is the collection of usage count from the services.
- Service trigger management: it distinguishes those events that bring an instance into being, and those events that are subsequently delivered to this instance. Produces the

information needed by JCC to install the actual triggers. It co-operates closely with the service dispatcher to do this.

- SLEE persistence and recovery capability is made available to services, so they can save information critical to their operations.

A service is managed through a well-defined life cycle, see Figure 4-3, that defines how it is loaded, configured and instantiated, and how it handles event notification from sources such as call control events. The life cycle is expressed in the API by the interface that a service must implement (service deployment and service description). Service life cycle states are persistent: if the SLEE is shut down and then restored to service, the services should restore to their previous states.

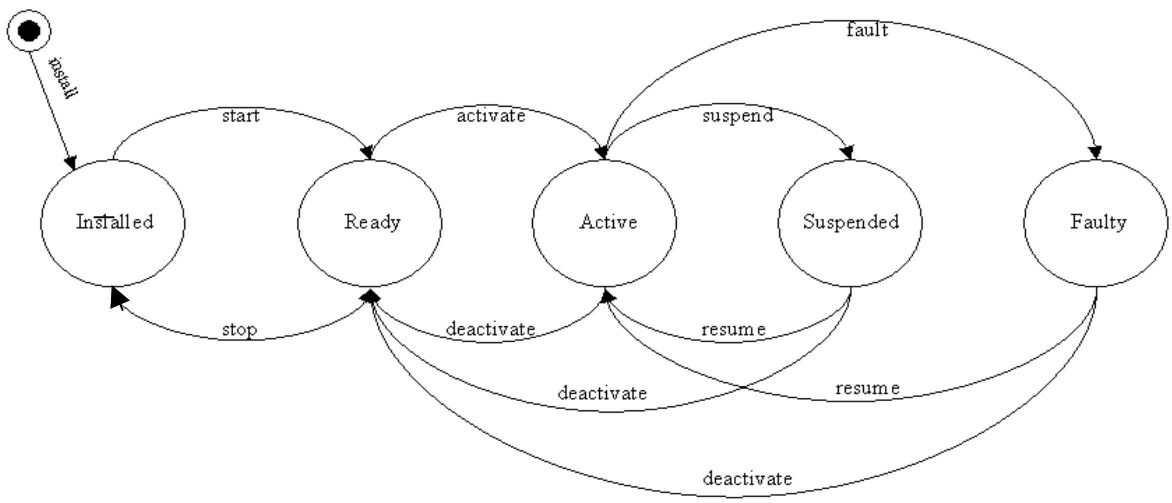

Figure 4-3: Service life cycle states in SLEE [12].

The JAIN-Parlay API

This part is based on facts from [14]. The Parlay API enables both third parties and network operators to build new applications that rely on real-time control of network resources. Third-party applications may be permitted to access services hosted by JAIN SLEE. Services and policies within the SLEE may be implemented using the Java component model. The last of these issues is the result of co-operation between the JAIN and Parlay Group to ensure convergence between these industries' initiatives. Within the context of the JAIN architectural framework, third-party applications are permitted to leverage network services to achieve the desired results. JAIN-Parlay acts as a firewall to protect the security and integrity of the integrated network. A task for the JAIN-Parlay Edit Group was to enhance the JAIN community architecture to support the Parlay API as its external API. This is illustrated in the Figure 4-4 below.

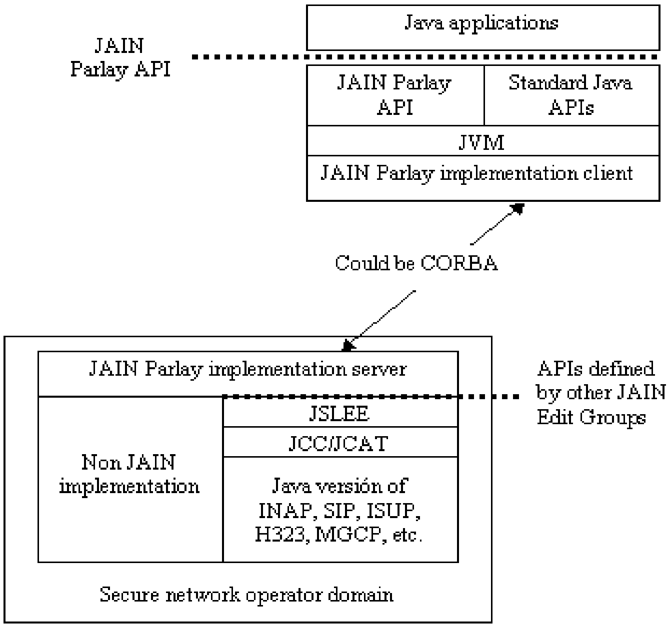

Figure 4-4: JAIN-Parlay API operating in the third-party client [14].

The JAIN-Parlay Edit Group Framework would interact with the SLEE to access features such as service subscription, while the JAIN-Parlay Edit Group GCCS would interact with JCC and JCAT to access call-related features. The JAIN-Parlay specification is based on the Parlay 1.2 specifications which itself abstracts the complexity of international standards and will permit that the specification API to be used in Europe and North America. Further investigation underway by Parlay and JAIN members will determine what further internationalisation will be required. Parlay 1.0 and updates, as they become available, are currently being down streamed into ITU and ETSI standards areas. [11]

5 Technical analysis of 3GPP

We have chosen to analyse the 3rd Generation Partnership Project (3GPP), since it is an alliance of the world's major standardisation bodies and industry consortia from around the world. The project is development of technical specifications for a 3rd Generation mobile communications technology.

5.1 Membership

This section is directly based on [30]. The membership in 3GPP consists of three different categories: organisational partners, market partners and individual members (e.g. companies such as Ericsson, Nokia, Motorola). The organisational partners, who are well-known standards development organisations with a national, regional or other officially documented status, that have the capability and authority to define, publish and set standards, nationally or regionally, are

- Association of Radio Industries and Businesses (ARIB), Japan
- China Wireless Telecommunication Standard (CWTS)
- The European Telecommunications Standards Institute (ETSI)
- Committee T1, USA
- The Telecommunications Technology Association (TTA), Korea
- The Telecommunication Technology Committee (TTC), Japan

The market representation partners is an organisation invited by the organisational partners to offer market advice to 3GPP and to bring a consensus view of market requirements e.g. services, features and functionality into 3GPP. These are:

- The GSM Association
- The Global Mobile Suppliers Association (GSA)

- The UMTS Forum
- The Universal Wireless Communications Consortium (UWCC)
- The IPv6 Forum

5.2 Groups

3GPP consists of a Project Co-ordination Group (PCG) and Technical Specification Groups (TSGs). These groups consist of the three different member categories presented in the previous section. For the year 2001, PCG consists of the organisational partners ARIB, T1 and ETSI. PCG is responsible for the management of technical work to ensure that the 3GPP specifications are produced in a suitable style. The development work considering technical specification within 3GPP is performed by TSGs. Each TSG consists of organisational partners and individual members and has the responsibility to prepare, approve and maintain the specifications, see Figure 5-1. [25]

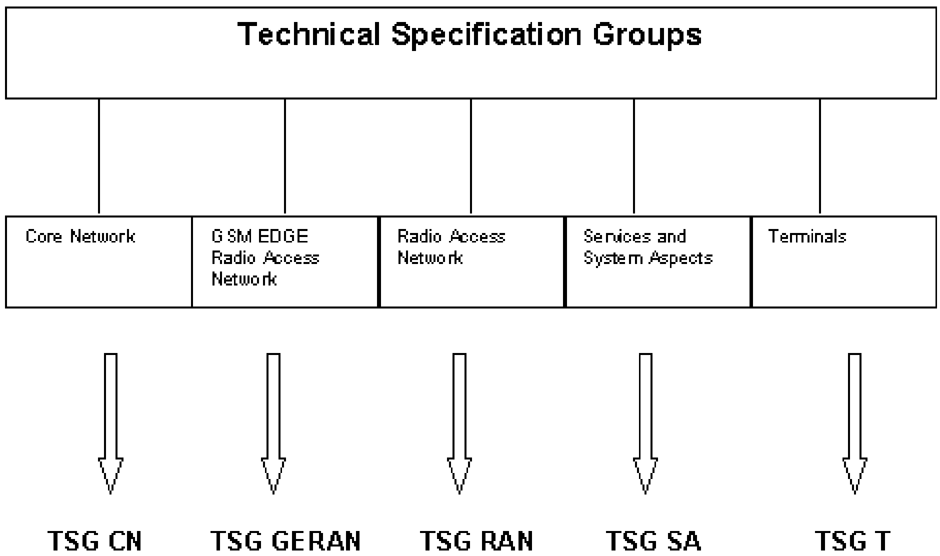

Figure 5-1: 3GPP Technical Specification Groups

- TSG- CN is responsible for the specifications of the Network part of systems.
- TSG-GERAN is responsible for the specifications of radio access part for GSM and EDGE.

- TSG-RAN is responsible for the UMTS Terrestrial Radio Access Networks (UTRAN).
- TSG-SA is responsible for the overall architecture and service capability of systems based on 3GPP specifications.
- TSG-T is responsible for specifying the terminal equipment interfaces.

5.3 Open Services Architecture

3GPP is formulating specifications for an architecture that allows third-party service providers to access network capabilities via an open and well-defined interface. Within 3GPP, this architecture is referred to as the Open Services Architecture (OSA). It builds on the Parlay framework to support a rapid design of new applications by third-party service providers. The APIs enable application developers to deliver applications without having detailed knowledge of the underlying network protocols and services. The OSA is organised into applications, a framework, and a set of defined Service Capability Features (SCFs).

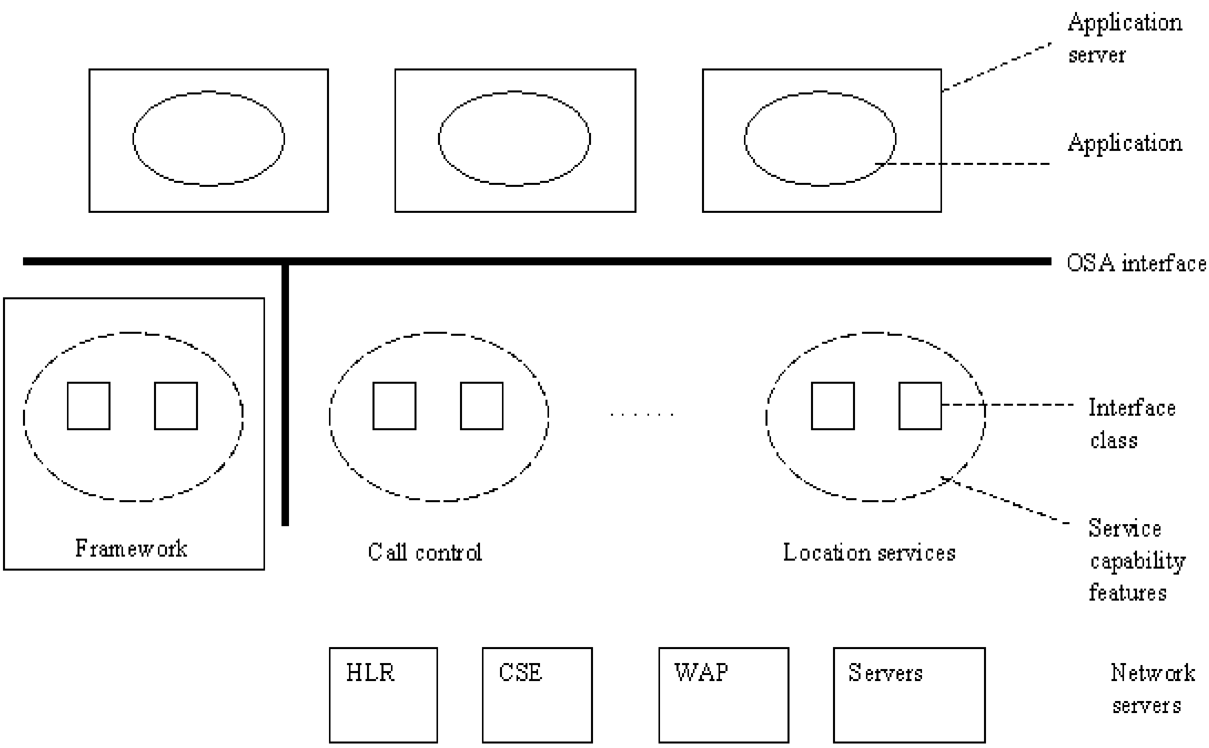

Figure 5-2: OSA overview [29].

HLR – Home location register
CSE – CAMEL service environment
WAP – Wireless application protocol
Servers – for example; MExE server or Mobility server

The Figure 5-2 above illustrates an overview of this architecture and describes the relationship between SCFs (bundle of interface classes), network servers, and applications. The framework cares for authentication and authorisation of applications and contains the basic mechanisms that enable applications to use the service capabilities within the network. SCFs provide applications with network services via abstract interfaces. Examples of SCFs are location services via the HLR, message transfer via SMS or Wireless Application Protocol (WAP), and call control via Customised Applications for Mobile network Enhanced Logic (CAMEL). Applications exist in application servers outside the network limits, providing value-added functionality for the carrier or telecommunications service. Such value-added functionality may be realised by using capabilities from other networks, such as the Internet. [17, 29]

6 Requirements for a Generic Service Platform

While different networks are more and more being interconnected, differences remain in capabilities and end-user interfaces. Creating and developing merge services often requires not only an understanding of the desired service capabilities but also a deep understanding of the differing protocols, data formats, end-user devices, and network capabilities as well as the customer or regulator requirements. API construction can easily grow out of hand if the basic requirements are not clear. Our intention with this chapter was to present the requirements that the net operators set for a GSP. Since we did not obtained the interview response we expected, we found it difficult to base the requirements on such a small material as the two interviews. Instead, we describe such difficulties, which have to be solved concerning the creation of a GSP. We will also discuss the requirements we found during our investigation, which we see as worth taking into consideration, in order for a platform to be accepted as a standard. In the last section we make a comparison between the platforms we chose in the previous chapter, namely, JAIN and 3GPP, in order to highlight the advantages or disadvantages of each platform.

6.1 Opening up networks

A standard mechanism must be created to enable third-party applications to access network services provided by the network operator. It would be much too expensive to integrate these applications with network services if each network operator had its own proprietary interface. The network operator must have the ability to set up and administer charging arrangements with both the end customer and the third-party application provider. Traditionally, the network operator has billed only the end customer, but now the network operator needs to extend the billing system. Network security must be strictly enforced, because opening up the network makes it vulnerable to malicious and misbehaving applications.

In the sections 3.1-3.11 have we described various initiatives of industries and standards bodies that address opening networks to third party application providers. These initiatives have similar architectures, such as providing a gateway between third party applications and network services. They also have common goals for delivering services from third parties using standard interfaces. Since these initiatives are under development, they have not declared some key requirements from network operators, namely, network integrity and the ability to charge for service access.

6.2 The services interaction problem

Different types of services implemented in different technologies and provided on different networks by different providers will probably never make a perfect combination. They may unintentionally inter-work with one another causing undesired effects called service interactions. The problem has been expressed in numerous publications by different researchers, e.g. The Feature and Service Interaction Problem in Telecommunications Systems: A Survey [31]. Even with great research efforts, the service interaction problem has not been solved in the existing telecommunication networks [19]. An effective interaction-handling mechanism in the protocols is a requirement to be considered for the creation of a GSP.

6.3 Distributed Processing Environment

The introduction of the GSP with APIs and the creation of advanced telecommunication applications will certainly introduce new dimensions to the service interaction problem. The use of object-oriented technology and Distributed Processing Environment (DPE) such as OMGs CORBA, Microsoft's DCOM or Java RMI opens up new possibilities to manage interactions between different service capabilities. The designer of a GSP is not constrained by the limitations of signalling protocols, and the information can be freely passed between different service capability servers and their internal processes. Therefore, several categories of interactions existing in current operators network (e.g. PSTN) can be avoided, and specialised components which detect and resolve undesired interactions could be provided in much easier way than in these networks. If properly designed, a GSP can hide the interactions from applications the same way it hides the complexity and variety of underlying protocols. [19]

6.4 A comparison between JAIN and 3GPP

In this section we will comment on some aspects of the two initiatives we have chosen for a technical analysis, namely JAIN and 3GPP. We do a comparison between their frameworks from a service environment perspective because we will point out that there are noticeable differences in coverage among these APIs.

Support for levels of abstraction

JAIN: Logical abstractions via JCC/JCAT or access to low-level protocol APIs.

3GPP: Provides an abstraction of the network-level resources, for user location and terminal capabilities.

Support for trusted or untrusted interfaces

JAIN: Trusted applications have a JCC interface to JSLEE containers with service beans. Untrusted applications have a Parlay interface to a Parlay server in a special container.

3GPP: Their focus is on untrusted interfaces.

Models of services and underlying environment

JAIN: A component based model abstracting away many of the complexities of the underlying network. Applications reside in containers, which provide an abstracted view of underlying network resources.

3GPP: Built on an object-oriented middleware platform, namely, CORBA. This allows 3GPP to integrate and use the services of CORBA, and it will hopefully lead to the delivery of clear and unambiguous specifications.

Support for handling service interactions

JAIN: SLEE has means for resolving certain service interaction. They define a central dispatcher that inspects between SLEE services and call control platform.

3GPP: None.

Interface with network connectivity layer

JAIN: SLEE interfaces with the network connectivity layer. Applications can also invoke some lower layer operations, but with loss of some benefits of abstraction.

3GPP: Adopted from Parlay, generic call control and enhanced call control.

Supporting for dynamically offering new services

JAIN: Yes, Java based. The SLEE provides deployment, provisioning, and subscription interfaces.

3GPP: Adopted from Parlay, but adds the ability for service providers to locate end users and query about their terminal capability.

Support for end-user subscription

JAIN: Yes, through the SLEE subscription interfaces.

3GPP: None

7 Interview with network operators

One part of our thesis was to interview different network operators. The purpose with the interviews was to find information from these operators about what kind of requirements they have on a GSP. When having received the answers from the network operators, our intention was to compare these against the JAIN and 3GPP initiatives, to see if they fulfil the requirements from the operators. We have divided the interview for the requirements into four sub-parts, namely, availability, maintainability, reliability and security. We have chosen these four sub-parts because our opinion is that these sub-parts cover the requirements of a GSP. The letter with the questions from the interview is enclosed in appendix B. The interview was sent as an email to thirty different network operators in different companies around the world. We have hoped to receive about seven or eight answers, but none of them answered these questions. We sent them a reminder and then we got five mails back. Some of them said that they did not have the time to answer our questions and some said that our questions were too complex for them.

After the unsuccessful attempt we got some help from Kipling with some names of people that work with development of telecommunication services and might be able to answer our questions in the interview. The first person was Mr Roger Schultz at Ericsson Infotech AB (EIN) in Karlstad Sweden. His opinion about the reliability was that there is a big problem when a service integrates with another service because the protocols place the restriction on integration. Only one service per terminated telephone call can be trigged and therefore a model must exist for how we can integrate two services in a specific node. Regarding the security aspects when Internet and telecommunication networks are integrated, he has no specific opinion for services, but according to him it will be actually as fast as the mobile gets an IP-address. About the availability aspects, which different services a GSP should support, he considers that it is only our fantasy that put up the limitations. Fixed, Mobile 2G and Mobile 3G are the different types of net that the platform should support. There are perhaps one million people who subscribe to a service today, and how many of these that can utilise the same service at the same time depend on the activity time for the service. For pre-paid services that are activated under the entire telephone call, there can be up to hundred thousand users at the same time. He said he has no need for a GSP because they build their own platform and earn money on that. He believes that a generic service platform is a utopia. If it will be a reality, everything must be standardised first and it will take a long time. But in the future, if the standardisations work proceeds as it does now, with small steps each time, and if the parts that are not standardised today will be standardised, it might become a reality. It depends on how interested the big companies and the expert groups are, and most of all it is about politics and money.

The second person to answer the questions in the interview was Mr Bo Hagengren, Product Manager at Ericsson Infotech AB. About the reliability aspects, he said that a service could integrate with another service on different levels (e.g. through APIs) or make use of the same function for presentation in a porch. There is always a problem to verify that services will work together. Updating is also a problem because newer version updates do not necessarily come at the same time. Then it is very important to have a stable standardisation interface. The security aspects are very important when Internet and telecommunication networks are integrated and it is something that develops continually by the international standardisation bodies. He also said that measures have been taken about new technologies like mobile Internet and safe payments. Many of the present applications involve requirements on new security solutions.

About the availability he says that 50-70 millions users can utilise a mobile or an Internet service depending on which country you are in, or what kind of service it is. If these users are connected at the same time, under the same sample, that is something we have to define first. We are often talking about "Busy hour" (i.e. times when the traffic is busy), and we believe that only a few percent of all users are making use of the service. Therefore, to make some general comments is difficult, but it handles about five to thirty percent. The trend is that we shall utilise the services independent of net and type of access, i.e. we shall have access to the same service independent of if we have a mobile, a PC or telephony. EIN is working hard on service platforms for 3G and to fulfil the requirements for the standards and trends of today. The maintainability is important when the number of users increases. The normal way is to have a redundant system i.e. system that works parallel with the main system, were you can introduce and test a new version before the traffic is released.

8 Conclusions of our work

Today, there is no GSP in the market but there is a lot of information about a possible GSP. The biggest problem we had when investigating the initiatives to create a GSP was that there are many different solutions in an enormous flood of information. It was difficult to sort out the relevant information. We established that the market in this area is confused and this was reflected in the articles that we read. We also had problems when searching for information because some sources required membership or password to access the information.

Another problem was that we only received two answers from the interviews and these answers where from people who work for the same company e.g. EIN. Therefore, we cannot draw any general conclusions about the requirements that the network operators consider that a GSP should fulfil. However, we received confirmation about some weakness in the development of a GSP, for example the service interaction problem described in chapter 6.

The initiatives we discussed have focused on important aspects of rapid service development and/or delivery for converged networks. However, there are noticeable differences in coverage among these APIs, and none of them address all the issues relevant to rapid service development and delivery. Some issues, such as prepaid service providing billing capabilities and policy management have still not been defined explicitly by any of these initiatives. We can however see hopeful signs. For example, the JAIN community is co-ordinated with other industry groups like the Parlay Group and 3GPP. A possible convergence of these initiatives will perhaps result in a GSP in the future.

We can also see that many industry and standardisation bodies tackle the development of a GSP from different perspectives. Some of them have solutions from an architectural point of view some have solutions from a protocol point of view and others from an API point of view. A global view of these aspects is often missing. Behind this, there are many actors with different economical and political interests, which could delay the development of the GSP.

However, proposals of new solutions are arriving all the time and we have noticed for example, that between May 21 and 23, 2001 a conference, “The evolution to ALL-IP Mobile Networks” was arranged at Excel conference centre in London [24]. Some of the headlines of the conference were “Working together for standardisation and specification”, “Convergence architectures for the wireless Internet”, “Using JAIN to converge IP and IN capabilities” and “Interfacing between call control and services and applications”. Beyond these headlines there several questions closely related to our thesis, since the participants at the conference discussed some of the questions we have tried to answer. There are no answers to these questions yet. The research is still ongoing, and for that reason, our thesis will not include complete answers.

9 Summary

A GSP will facilitate rapid creation of advanced telecommunication applications by providing technology and network-independent access to network resources and by hiding the complexity of the signalling protocols from the applications designers. This paper addressed different initiatives such as Parlay, Syion 426, JAIN and 3GPP. The last two have been analysed and also compared. The analysis focused on the architecture and the APIs of these platforms.

The convergence of mobile, fixed and IP networks facilitates hasten the development of a GSP. There are many open questions related to convergence, but there are also many ongoing efforts in standardisation organisations (e.g. ITU, ETSI and IETF) that attempt to facilitate the convergence process. We described the most important standardisation projects into these organisations and we pointed out some differences concerning standards between organisations in the telecommunication and the Internet sector as well.

Looking at current developments, one of the things we can be certain of is that the initiatives work to create a GSP will be present in future communication systems.

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Appendix A: Glossary

2G	Second generation wireless.
3G	Third generation wireless.
3GPP	Third Generation Partnership Project.
AEG	Application Expert Group.
AIN	Advanced Intelligent Network.
ANSI	American National Standards Institute.
API	Application Programming Interface.
ARIB	Association of Radio Industries and Businesses.
ATIS	Alliance for Telecommunications Industry Solutions.
ATM	Asynchronous Transfer Mode.
CAMEL	Customised Applications for Mobile Network Enhanced Logic.
CN	Core Network.
CORBA	Common Object Request Broker Architecture.
CSE	CAMEL Service Environment.
CWTS	China Wireless Telecommunication Standard group.
DCOM	Distributed Component Object Model.
DPE	Distributed Processing Environment.
DTD	Document Type Definition.
EDGE	Enhanced Data rates for GSM Evolution.
ETSI	European Telecommunications Standards Institute.
FSM	Finite State Machines.
GCCS	Generic Call Control Services.
GERAN	GSM EDGE Radio Access Network.
GSA	Global Mobile Suppliers Association.
GSM	Global System for Mobile Communication.
GSP	Generic Service Platform.
GPRS	General Packet Radio Service.
GUI	Graphics User Interface.
HLR	Home Location Register.

H.323	Defines a system for moving real-time bi-directional multimedia (video, voice, data, fax, etc.) across packet-based networks.
IDL	Interface Definition Language.
IESG	Internet Engineering Steering Group.
IETF	Internet Engineering Task Force.
IN	Intelligent Network.
INAP	Intelligent Network Application Protocol.
IP	Internet Protocol.
IPv6	IP version6.
ISUP	Integrated Services digital network User Part.
IS41	North American standard for cellular processing.
ITU	International Telecommunication Union.
ITU-T	Telecommunication Standardisation Sector.
JAIN	Java API for Integrated Networks.
JCAT	Java Co-ordination and Transaction.
JCC	Java Call Control.
JVM	Java Virtual Machine.
MAP	Mobile Application Part.
MEGACO	Media Gateway Control.
MexE	Mobile Station Application Execution Environment.
MGCP	Media Gateway Control Protocol.
OAM	Operations, Administration and Maintenance.
OMG	Object Management Group.
OSA	Open Service Architecture.
PBX	Private Branch Exchange.
PC	Personal Computer.
PCG	Project Co-ordination Group.
PEG	Protocols Expert Group.
PINT	PSTN/Internet Interfaces.
PSTN	Public Switched Telephone Network.
RMI	Remote Method Invocation.
SCE	Service Creation Environment.
SCF	Service Capability Features.
SG	Study Group.

SLEE	Service Logic Execution Environment.
SMS	Short Message Service.
SIP	Session Initiation Protocol, an emerging protocol that simplifies connections over the Internet for uses such as telephony and videoconferencing. Has the potential to lead to new classes of Net devices.
SPIRITS	Services in the PSTN/IN Requesting InTernet Services.
SS7	Signalling System 7 is architecture for performing out-of-band signalling in support of the call-establishment, billing, routing, and information-exchange functions of the public switched telephone network.
T1	Standards Committee T1 – Telecommunications.
TCAP	Transaction Capability Application Part.
TIPHON	Telecommunication and Internet Protocol Harmonisation Over Networks.
TSG	Technical Specification Group.
TTA	Telecommunications Technology Association.
TTC	Telecommunication Technology Committee.
UMTS	Universal Mobile Telecommunication System.
US	User Status.
USSD	Unstructured Supplementary Services Data.
UTRA	Universal Terrestrial Radio Access.
UTRAN	UMTS Terrestrial Radio Access Networks.
UWCC	Universal Wireless Communication Consortium.
VoIP	Voice over IP.
WAP	Wireless Application Protocol.

Appendix B: Interview

Karlstad 2001-02-13

Dear

We are two students at Karlstad University, Sweden and we are doing our Bachelor's Project in computer science at the company Kipling Mobile Business AB. Our task is to perform a technical evaluation of the present and future standards concerning service environments and platforms in tele- and data communication.

An important part of our project concerns the requirement for a generic service platform. We thought that the best way to identify such requirement is asking professionals in that area, i.e. You. We would appreciate your help. Please observe that Yours answers to the questions are to be used for research purposes in a comparative analysis. It is not our intention to probe into what You consider to be proprietary information. Please bear that in mind when answering the questions.

Once again Your help would be greatly appreciated. We will do our best to give you feedback of the results from the overall research in due time. We would like to have the answer mail back to us before **23/2**, if it's possible.

The head question is:

What are the requirements for a generic service platform?

It is divided into four sub-parts:

Reliability, availability, security and maintainability.

We have listed some questions below the sub-parts. These questions are intended to indicate different aspects that are of primary interest. If there are any other question You consider is relevant in this area please write Your answer to these.

Reliability.

- How a service can integrate with another service
- If there any problem with integrated service
- How debit works in general

Availability.

- Which different services do You consider that a generic service platform should have
- How many users will utilise the same service simultaneous
- What type of net should the platform support
- Which need do you have for a platform

Security.

- Internet and mobile/telephone networks are integrated

Maintainability.

- How can we add, change or upgrade a service without interrupt
- How can we perform a repair of a service without interrupt