Abstract

New technologies, built on the Internet and cellular mobile systems, are revolutionizing the way people communicate. A system that incorporates the advantages of the Internet (bandwidth, packet switched traffic) and the GSM system (mobility) has been realized. The Universal Mobile Terrestrial System, still in its infancy, will permit and improve mobile real-time multimedia communication. The UMTS communication systems on the market follow the Release '99 specification, meaning multimedia communication are still based on circuit-switched technologies. In the future, operators will gradually move to an all-IP system and open the system to the many services already available on the Internet that could benefit from mobility. For these reasons, the Third Generation Partnership Project consortium has standardized a new domain that will allow the provisioning of new mobile services.

In order to take advantage of the ever more sophisticated services, phones and computers are converging rapidly. PDAs and smart phones are already available and will eventually replace traditional cell phones. The technology is heading in different directions as multiple industries are interested in this new market. Microsoft is trying to enter this market, confident in its software expertise and operating systems background. On the other hand, traditional cell phone manufacturers such as Nokia, Ericsson, Motorola and Siemens are heading the Symbian consortium with the goal of developing their own operating system (Symbian) and applications for their multimedia phones.

The above scenario forms the basis for the following thesis. My work has been done in a partnership project between Siemens Mobile SPA and an Italian 3G Mobile Network Operator, the Exploit project.

One year spent at the *Strategic Product Planning – Research and Concepts* labs of Siemens Mobile Communications S.p.A. in Milan consisted of different phases:

- The first phase focused on the IP Multimedia Subsystem. I started learning about the architecture of the IMS and its components from various documentation. An understanding was gained of how the IMS service creation environment works, focusing on the Application Server and on the Presence Server. I learned about the technologies that have a role in the IMS: SIP, SIP Servlets, CPL and focused on the means by which these technologies are deployed. This phase was necessary to have a broad view of how the IMS works.
- The second phase consisted of learning which technologies were available for the terminal. The application targets the Compaq iPAQ 3630 and Fujitsu Siemens Pocket Loox, both powered by Microsoft's Pocket PC 2002. I investigated the different options available on the market in order to construct an IMS client. The first challenge was to understand which packages were available to construct SIP signaling, along with their advantages and drawbacks. The available packages were the JAIN SIP LITE (developed by a consortium) and Microsoft's RTC platform. The first was chosen, because of the many advantages provided by a java development environment (write once, run everywhere). The only available SIP Lite stack that could be downloaded from the Internet at that time was that provided by NIST (USA's National Institute of Standards and Technology). This is a still a beta release. The second challenge was to figure out how to support a real-time media exchange on a limited terminal such as a PDA. A

comprehensive solution (for capturing, RTP packet construction, coding, transmission and listening) was found in the Java Media Framework library. Unfortunately, platform dependent issues arose. The main drawback was that the JMF all-platforms edition does not support audio capturing and RTP transmission. A major strength of JMF, extensibility, lead to a solution: an extension for the Pocket PC environment that had been developed by Siemens Mobile in a past project.

- The third phase was the beginning of the EXPLOIT (EXPeriences on deveLOpment of Ims based applicaTions) Project. The objective of the project was to support a Mobile Network Operator in the verification, through demonstration applications, of the advantages of adopting an IMS platform. At the end of the project, a lab trial for the demonstration of the SIP-based applications was conducted. This phase of my thesis can be further subdivided:
    - **IMS Training and Technical Support**: In this period I learned how the IMS Experimental System provided by Siemens Mobile worked, by attending some courses and testing parts of its functionalities. In the same period, I learned how the IMS ES client worked and learned how to develop and deploy a test application. A solution to the challenges of using real-time media on the PDA was found internally at Siemens, thanks to an extension of JMF for PDAs developed previously. In addition, I tested capabilities that might be of interest to the IMS, in order to build the project's new services.
    - **Service Definition and Selection**: I took part in EXPLOIT's meetings and helped choose and investigate the services that would be developed.
    - **Design and Implementation**: My main tasks have been designing the architecture of the Exploit client and of an audio call solution and then implementing them. The IMS Experimental System came with an IMS Client that permitted the user to perform Instant Messaging, Chat and use the Presence service. The IMS ES client has been designed so that a plug in can be added. The main goal of my work has been to implement a common plug in that would perform the main tasks of Instant Messaging, Chat, Presence and Voice over IP, while being able to manage the messaging for multiple services. The Voice over IP solution is integrated into the Exploit client. The reasons for a new implementation of the basic services on top of the existing IMS Client are the demand for a SIP messaging protocol compliant with RFC 3261 (the latest standard for SIP messaging) and having an open interface over which new services may be implemented. The latter required the definition of the interfaces that permit the communications among the common plug in and Exploit services.
    - **System Test and Integration**: The Exploit Client has been tested with the IMS Client. The tests were performed first on the common plug in and, after integration, on the whole Exploit client. The new client permits the user to perform standalone communications and to take advantage of the communication means within a service. It now permits the user to make an audio call. A demo at the end of the

project showed the client worked within the whole system as expected.

The result of this work is a flexible architecture for running advanced multimedia SIP-based services on top of a PDA/java environment. The architecture has been designed to minimize the impact of integrating new applications on the client. In addition, the proposed solution makes RTP-based services possible on the PDA.