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Analysis of Future Mobile Instant Messaging Markets

Master's thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Technology

Espoo, 7 March, 2006

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HELSINKI UNIVERSITY OF TECHNOLOGY **Abstract of the Master's Thesis**

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Instant Messaging (IM) is widely used in the Internet and first Mobile Instant Messaging (MIM) services are on the market. Industry scenarios are constructed in this thesis to form six internally consistent views of the future of MIM industry. MIM is positioned in relation to other messaging services and underlying key technologies are studied in order to gain an understanding of the industry structure.

Interviews were conducted to find out the most important scenario variables affecting the MIM industry. The interviewees represent different actors on the mobile messaging markets: mobile network operators and mobile device manufacturers. Terminal support and interoperability were found as the most important scenario variables. Consequently, these variables were combined to build the industry scenarios. The resulting scenarios were described in terms of industry structure, structural attractiveness, sources of competitive advantage and competitor behaviour.

The scenarios show number of possible competitive advantages for the industry players. Cooperation between the mobile operators and the Internet IM providers, usability and competitors are the ones that emerge from multiple scenarios. These scenarios serve as a basis for constructing strategy.

Keywords:	industry scenarios, instant messaging, mobile instant messaging, messaging service

TEKNILLINEN KORKEAKOULU **Diplomityön tiivistelmä**

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Pikaviestintä on kasvanut erittäin suosituksi palveluksi Internetissä. Ensimmäiset mobiiilipikaviestintäpalvelut ovat saatavilla. Tässä diplomityössä on luotu kuusi toisistaan riippumatonta tulevaisuuden markkinanäkymää mobiilipikaviestintämarkkinoille. Markkinoiden rakenteen ymmärtämiseksi mobiilipikaviestintä on asemoitu suhteessa muihin viestintäpalveluihin sekä palvelun kannalta tärkeät teknologiat ovat esitelty.

Haastatteluja käytettiin hyväksi markkinanäkymien luonnissa. Haastatellut henkilöt edustavat mobiiliviestintämarkkinoiden eri toimijoita: mobiilioperaattoreita sekä laitevalmistajia. Laitetuki ja eri yhteisöjen yhteentoimivuus nähtiin tärkeimpinä mobiilipikaviestintämarkkinoihin vaikuttavina muuttujina. Näin ollen markkinanäkymät muodostettiin näitten muuttujien pohjalta. Tuloksena syntyneet näkymät esiteltiin markkinarakenteen, rakenteellisen houkuttelevuuden, mahdollisten kilpailuetujen sekä kilpailijoiden toiminnan kannalta.

Markkinanäkymät tuovat esiin lukuisia mahdollisia kilpailuetuja eri toimijoille. Mobiilioperaattoreiden ja Internetissä pikaviestintää tarjoavien toimijoiden yhteistyö, käytettävyys sekä kilpailijat nousivat kilpailuetujen osalta esiin useassa näkymässä. Luodut näkymät toimivat pohjana strategioiden rakentamiselle.

Avainsanat:	markkinanäkymä, pikaviestintä, mobiili pikaviestintä, viestintäpalvelu

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Espoo, 7 March, 2006

Matti Vesterinen

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TERMS AND ABBREVIATIONS

2G	Second Generation
3G	3rd Generation
3GPP	3rd Generation Partnership Project
8PSK	8-Phase Shift Keying
ADSL	Asymmetric Digital Subscriber Line
AIM	AOL Instant Messenger
AOL	America Online
BWA	Broadband Wireless Access
CDMA	Code Division Multiple Access
CS	Circuit Switched or Coding Scheme
CSD	Circuit Switched Data
D-AMPS	Digital Advanced Mobile Phone System
DECT	Digital Enhanced Cordless Telecommunications
DL	Downlink
EDGE	Enhanced Data rates for Global Evolution
EMS	Enhanced Messaging Service
FDD	Frequency Division Duplex
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HSCSD	High Speed Circuit Switched Data
HSPA	High Speed Packet Access
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
HTML	HyperText Markup Language
HTTP	Hyper Text Transfer Protocol
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IM	Instant Messaging
IMAP	Internet Message Access Protocol
IMP	Instant Messaging and Presence

IMPS	Instant Messaging and Presence Services
IMS	IP Multimedia Subsystem
IMT	International Mobile Telecommunications
IP	Internet Protocol
IS-	Interim Standard
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ITU	International Telecommunication Union
JEP	Jabber Enhancement Proposals
Mcps	Megachips per second
MIM	Mobile Instant Messaging
MIMO	Multiple Input Multiple Output
MMS	Multimedia Messaging Service
MS	Mobile Station
MSISDN	Mobile Subscriber ISDN number
MTA	Mail Transfer Agent
MVNO	Mobile Virtual Network Operator
NAT	Network Address Translation
OFDM	Orthogonal Frequency Division Multiplexing
OMA	Open Mobile Alliance
OPEX	Operating Expenditure
P2P	Peer-to-Peer
PDA	Personal Digital Assistant
PDC	Personal Digital Cellular
PDTCH	Packet Data Traffic CHannel
PoC	Push to talk over Cellular
POP3	Post-Office Protocol version 3
PS	Packet Switched
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RIM	Research In Motion

SIMPLE	SIP for Instant Messaging and Presence Leveraging Extensions
SIP	Session Initiation Protocol
SMS	Short Messaging Service
SMTP	Simple Mail Transfer Protocol
TD-SCDMA	Time Division Synchronous CDMA
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TIA	Telecommunications Industry Association
UAC	User Agent Client
UAS	User Agent Server
UE	User Equipment
UL	UpLink
URI	Uniform Resource Identifier
UTRA	Universal Terrestrial Radio Access
UWC-136	Universal Wireless Communication-136
VoIP	Voice over IP
WBA	Wireless Broadband Access
WCDMA	Wideband Code Division Multiple Access
WiBro	Wireless Broadband
WIGWAM	Wireless Gigabit With Advanced Multimedia Support
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network
WG	Working Group
XML	Extensible Markup Language
XMPP	Extensible Messaging and Presence Protocol

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1 Introduction

1.1 Context

Instant Messaging (IM) has become an extremely popular service in the Internet. IM enables users to send some content, usually text, to other users[1]. Presence service is usually part of the IM services as conversations happen in real time. Presence information makes the IM service more valuable since conversations can be initiated when the other party is available and willing to communicate.

In addition to the basic text messaging, Internet IM applications[2] can offer a wide variety of additional services such as file transfer, voice and video conversation, application sharing etc. Usually these services are offered free of charge and only premium quality services and calls to Public Switched Telephone Network (PSTN) are charged for. Advertisements are normally the main source of revenue for these applications. These kinds of multimedia services are not yet offered in the mobile domain but the basic IM service is already available. Mobile specific problems such as small and less powerful devices and costly transmission path need to be taken into account in mobile service planning. Consequently, it is challenging to make the services affordable for the end users and still profitable for the service providers or operators.

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[1] Usually one needs an authorisation from the other user in order to communicate with him/her; consequently, each user has his/her own personal buddy list.

[2] IM applications with extensive services are called messengers.

Main service of the current cellular networks is voice, which is currently offered mainly through the circuit switched (CS) domain. Separate Packet switched (PS) domain is used for Internet Protocol (IP) -based services like IM and browsing. While third generation cellular networks offer significantly faster data connection than GSM, the main service is still voice through CS. As voice revenues are predicted to decline in the future [Moon 2005], operators are looking for ways to get their revenues to grow again. Data service usage has so far been quite low and there have not been other killer applications besides Short Messaging Service (SMS). Mobile Instant Messaging (MIM) is one of the promising services and thus is topical to study.

There are several ways to offer MIM. They differ in technical and business aspects. Operators have a strong role in the mobile domain, especially when new services, such as MIM, are planned. The situation is totally different in the fixed domain where operators, namely Internet Service Providers (ISP), are mostly just bit pipes and third party services are used. Future will show if MIM will be the basis for other multimedia services like it has happened on the fixed side and what is the role of the mobile operators in MIM.

MIM is still in very immature state and no one has heavily promoted it yet. Research in the area has focused on the standardised technologies like Wireless Village, the Mobile Instant Messaging and Presence Services (IMPS) Initiative developed under the Open Mobile Alliance (OMA)[3]. Once 3G will be ubiquitous there will be an audience for a wide variety of multimedia services. Research focusing on the future structure of the MIM industry is scarce and most of the studies concern possible SMS revenue cannibalisation. This study gives a broader view of the future MIM industry.

[3] Open Mobile Alliance (OMA), Wireless Village initiative: http://www.openmobilealliance.org/tech/affiliates/wv/wvindex.html [Accessed 28.4.2005]

1.2 Problem Definition

MIM can be offered through several different concepts such as IP Multimedia Subsystem (IMS) [3GPP TS 23.228] and Wireless Village. Technical decisions differ in many aspects but so do possible business strategies. For the mobile operators and the service providers the chosen strategy will determine revenue shares, control and customer relations among other things. The research problem of this thesis is defined as:

What will the future MIM industry look like?

1.3 Scope

The focus of this thesis is on the mobile instant messaging service. Access network can be any mobile network albeit the focus is on the cellular networks. Consequently, ubiquitous access is presumed and technologies offering only nomadic mobility are considered to offer supportive access in specific spots. While the mobile networks are accessible with both mobile and fixed devices this thesis considers only handheld mobile devices. Laptop computers are out of the scope as their user interface is similar to desktop computers and they run real Internet applications.

MIM in this context is limited to sending and receiving text-based messages to or from other users. Richer content is out of the scope since they can be considered as separate services. However, presence enabled buddy list or address book is assumed to be used. The enterprise market is not excluded but the focus is mainly on the consumer markets i.e. an end user uses MIM for other than the work related reasons.

1.4 Research Method

The research method used in this study includes interviews, questionnaires and literature survey. External studies, analysis, user surveys and predictions as well as literature and industry standards are used for building an understanding of the

different MIM concepts and the factors affecting the possible business strategies. Industry scenarios are used to describe the future industry structure of MIM.

1.5 Structure

The structure of this thesis can be seen in a graphical format in Figure 1. Introduction chapter introduces the topic, defines the problem, the research method and the scope. Theoretical frameworks that are used in this thesis are presented in the second chapter.

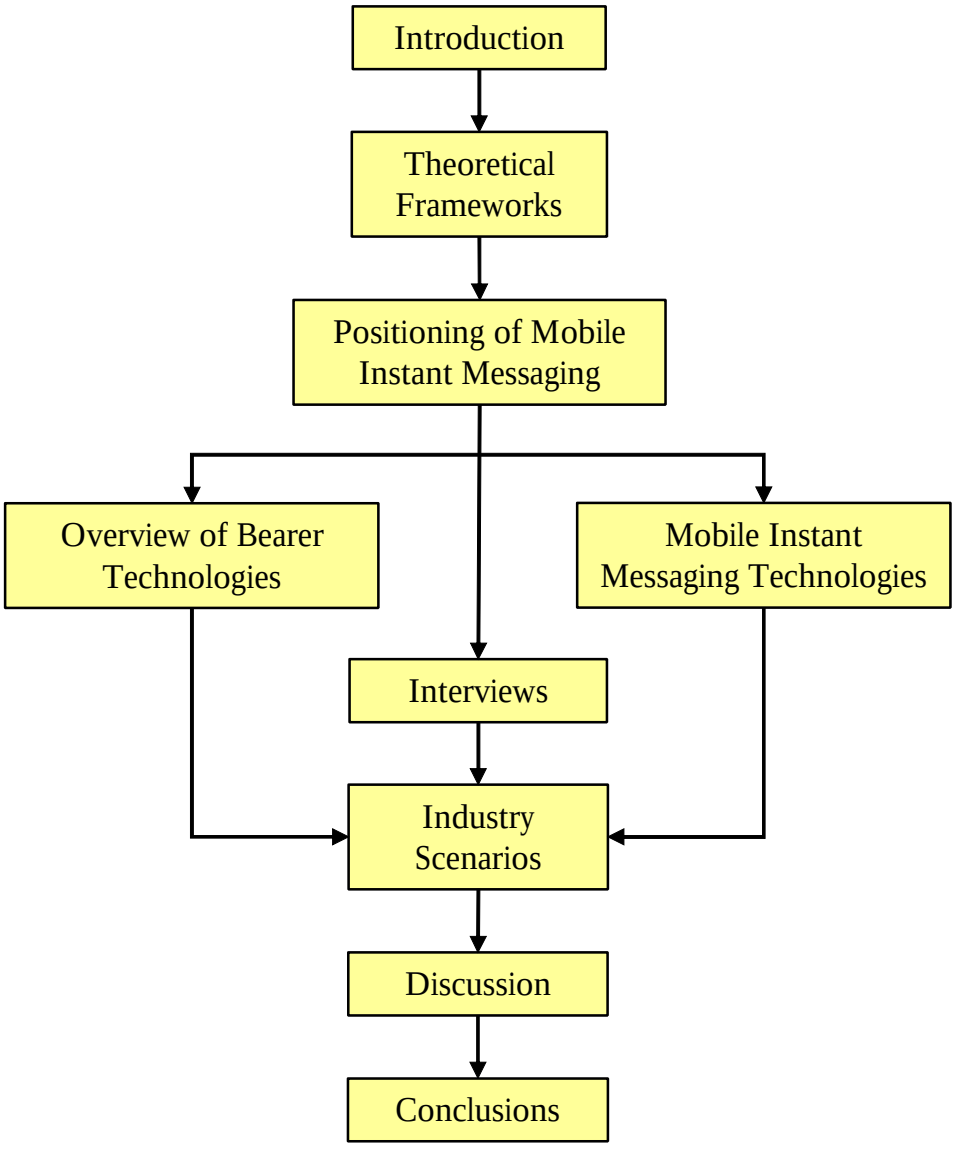

Figure 1: Study structure

The third chapter positions MIM in relation to other messaging services. Their success to date is discussed to obtain comparison points for the MIM service. In addition to the mobile messaging services also Internet IM is introduced. It is very likely that the Internet IM service providers will put more effort also on mobile instant messaging. Therefore, it is valuable to understand their backgrounds and business models as well as the services they offer.

MIM can run on top of different bearers. An overview of the different bearer technologies is given in Chapter 4. Cellular and wireless broadband networks are presented. Market situation and services are considered to clarify what will be possible in the future. Chapter 5 introduces mobile instant messaging technologies. Different ways of implementing instant messaging service in the mobile domain are presented. Emphasis is on the characteristics of these concepts.

Chapters 3-5 together with the conducted interviews form a basis for the industry scenarios that are constructed in Chapter 6. Discussion on study findings and further research is done in Chapter 7. Finally conclusions based on the industry scenarios are presented in Chapter 8.

2 Theoretical Frameworks

2.1 Five Forces

According to Michael E. Porter the state of competition and profitability in an industry depends on five basic competitive forces, which are shown in Figure 2 [Porter 1980]. In this thesis five forces analysis is used to find the uncertain elements of structure for the industry scenarios and also to determine the future industry structure under each scenario. Different industries have different structures and thus different sources of uncertainty.

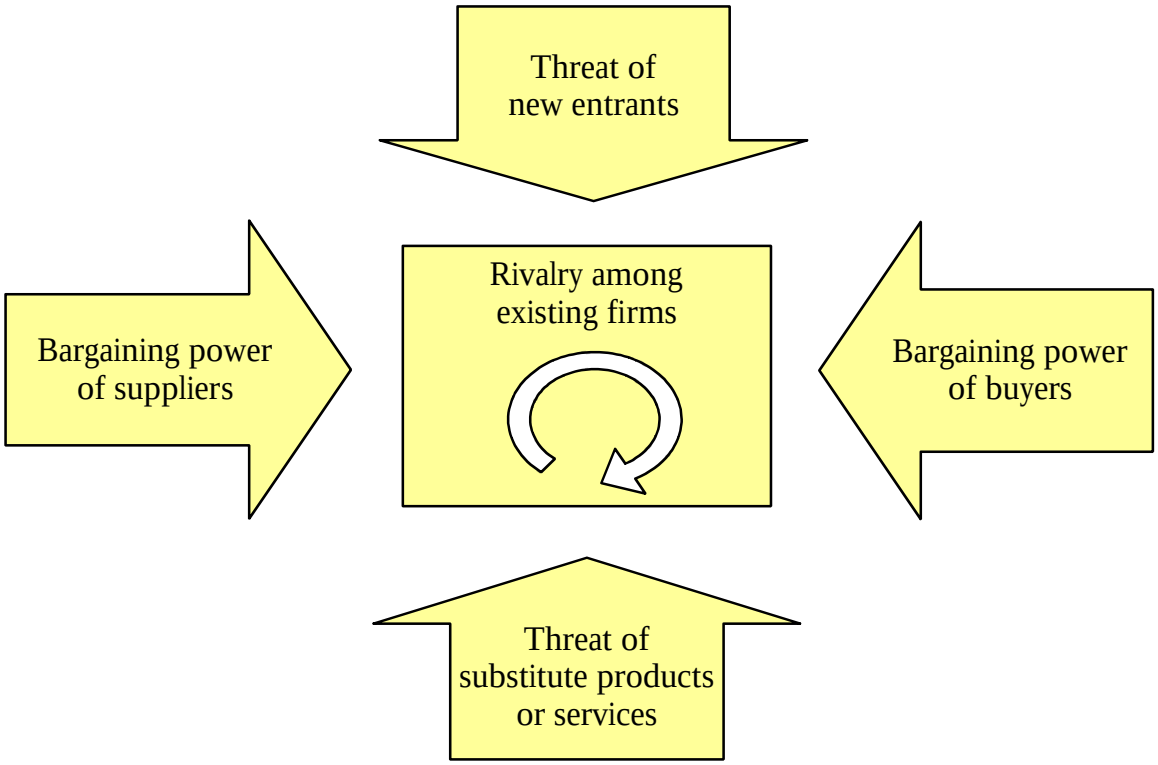

Figure 2: Porter's five forces [Porter 1980]

2.2 Industry Scenarios

Industry scenarios are used in this thesis to explore the possible consequences of different strategies. Porter defines scenarios as discrete, internally consistent views of how the world will look in the future [Porter 1980]. Porter mentions also that scenarios are particularly useful tools in emerging industries [Porter 1980]. MIM market is still in a very immature state; therefore, scenarios suit well for the future MIM industry analysis.

An industry scenario is one possible internally consistent view of the future structure and not a prediction [Porter 1985]. The process of constructing industry scenarios is presented in Figure 3.

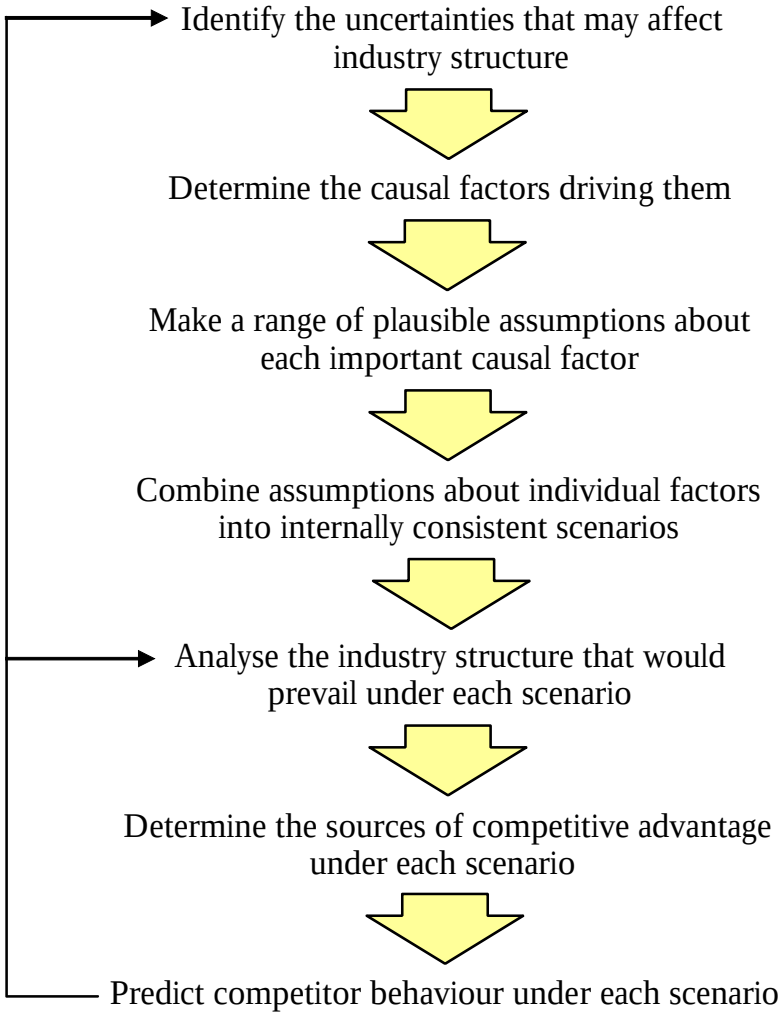

Figure 3: The Process of Constructing Industry Scenarios [Porter 1985]

2.3 Interview

Interview is a good way to approach difficult subjects. The researcher is in a direct verbal interaction with the interviewee, which makes it a very flexible method. Consequently, it is possible to direct the interview towards the wanted direction and find the motives behind the answers. Still the interviewee needs to be given an opportunity to express himself / herself as freely as possible. As a consequence interview is a useful method if the answers need to be clarified and profound information is needed. [Hirsijärvi et al. 2004b]

However, an interview takes more time and is more costly method to use compared, for example, to a questionnaire. In addition, skills and experience are needed from the interviewer. One problem is that the interviewees tend to give socially acceptable answers. Context and circumstances give their flavour to the collected material as well. These things need to be taken into account when analysing, interpreting and reporting the collected material. [Hirsijärvi et al. 2004a]

Research interviews are typically categorised by how structured they are. A structured interview has predefined questions that are asked in a predefined order. An unstructured interview is very similar to discussion. Open questions are used and the interview flows from one question to the other depending on the answers the interviewee gives. In a half-structured method some aspects of the interview are fixed. Thematic interview[4] is a half-structured method that is used in this thesis. [Hirsijärvi et al. 2004b]

Thematic interview goes along certain central interview themes. Questions do not have a predefined form and order like in the structured interview. Furthermore, it is closer to the unstructured than the structured interview but it is not as fully free as an in-depth interview[5] [Hirsijärvi et al. 2004b]. In this thesis interviews are used as part of the process of constructing industry scenarios. The most important industry

[4] Translated freely from Finnish term “teemahaastattelu”.

[5] Translated freely from Finnish term “syvähaastattelu”.

scenario variables are chosen based on the interviews. Thematic interview is appropriate for these kinds of interviews where the reasons behind the research object's choices need to be known while the themes need to be the same for all of the interviewees.

3 Positioning of Mobile Instant Messaging

MIM gets impacts from both Internet IM and adjacent mobile services. MIM originates from the Internet but has to find its place among other mobile messaging services such as Short Messaging Service (SMS), Multimedia Messaging Service (MMS) and mobile email. This chapter introduces the mobile messaging services as well as the major Internet IM services. Finally MIM is positioned in relation to the other presented services.

3.1 Mobile Messaging Services

The main purpose of the mobile terminals is to enable communication between the users anytime and anywhere. Voice is the traditional communication method but people are more and more using also messaging services. SMS is the most used messaging service [Delaney 2005a]. SMS is usually a point of comparison when messaging services are discussed. MMS is another service that originates from the mobile telecommunications. In short, MMS adds multimedia content to the text based messaging. Email is one of the most used services in the Internet and has been available also for mobile terminals already for a while[6]. Email has not been as successful within the cellular systems as it is in the Internet. IM is the most recent Internet service to enter the mobile domain. It remains to be seen how IM will succeed for its part. It is worthwhile to mention that email and IM are in some cases offered via SMS [MSN Mobiili 2005], which highlights the acceptance of SMS

[6] For example Nokia, the leading mobile phone manufacturer, has released 55 phone models that support mobile email (17.1.2006). For comparison 28.4.2005 the number was 29. See http://www.nokia.com/nokia/0,,62523,00.html for a list of models. [Accessed 17.1.2006 and 28.4.2005]

service and the fact that SMS is still the most viable way to send and receive messages with many of the existing mobile devices.

Table 1: Comparison of messaging services

Service	SMS	MMS	Email	IM
Message size (max)	160 characters per message	~100 kB (no max size in standard)	No limit	No limit
Message contents	Text, logos, ringtones, settings, etc.	Text & multimedia	Text & attachments	Rich text & in future files, voice, etc.
Can be sent to	Mobile numbers	Mobile numbers, email addresses	Email addresses	IM service users
Message delivery guarantees	Delivery report	Delivery report	Error messages	Tracking information
Bearer	Signalling channel, (data bearer)	Data bearer	Data bearer	Data bearer
Standardisation	3GPP	3GPP & OMA	IETF	Various
Share of global cellular consumer data revenues[7]	2004: 63,1 % 2008: 46,5 %	2004: 2,7 % 2008: 9,2 %	2004: 1 ‰ 2008: 2,5 %	2004: 0,2 ‰ 2008: 6,5 %

Table 1 summarises the main characteristics of the different messaging services. Each of them are handled more in detail in the following subsections. From Table 1 can be seen the main differences in the characteristics and also the past and the

[7] Raw data from [Munoz Mendez-Villamil 2005] and [Delaney 2005a]. MMS values include also revenues from long text messaging sent over MMS.

future estimated share of the global consumer data revenues for these services. Revenues here mean the money paid by the subscribers for the messages during the year. According to Ovum's estimation, SMS will hold its position for the foreseeable future as the most utilised messaging solution albeit the other messaging services are gaining on revenue shares [Delaney 2005a].

To put messaging into some perspective, consumer messaging brought 66 % of the consumer data revenues globally in 2004 and in 2008 it is estimated to bring 65 %. Of the total revenues consumer messaging took 8 % share in 2004 and should take 12 % share in 2008 according to Ovum [Munoz Mendez-Villamil 2005]. Hence messaging services revenues are estimated to increase but revenues from other data services should increase even faster.

3.1.1 Mobile Instant Messaging

IM has become a popular service in the Internet. Yahoo!, MSN, AOL and ICQ make up the big four and they all have their proprietary services. The big four have built a wide offering of services around IM. By pure IM it is meant sending rich text in real time from a user to another but in most cases IM includes presence as an inbuilt feature. Users can see their buddies' current status and thus start an IM session whenever the counterpart is available. There are several ways to implement MIM and they are presented in the Mobile Instant Messaging Technologies Chapter.

In the Internet IM spam, or spim as it is also called, has not been as big problem as email spam; however, few countermeasures have already been created [Mannan et al. 2005]. A problem from the MIM service success point of view is the fact that with the currently prevailing data usage based charging models the end user will pay for the received spim and thus may abandon the whole service as a consequence.

Strategy Analytics expected that in 2004 there were 6,0 million MIM users and correspondingly in 2008 there should be 121 million users [Taylor 2006]. Ovum estimates the global MIM via packet data revenues to 13 million $ in 2004 and 9 383 million $ in 2008 [Delaney 2005a]. Respectively Strategy Analytics estimates the global MIM revenue figures to be 25,2 million $ in 2004 and 1 006 million $ in 2008

[Taylor 2006]. Comparing MIM revenues to mobile email revenues it can be seen that Ovum predicts that in 2008 MIM will create clearly more revenues than email whereas Strategy Analytics predicts it the other way around. Either way both companies estimate heavy growth for the Internet messaging services. According to Ovum MIM took 0,2 ‰ share of the global cellular data revenues in 2004 as in 2008 it will be 6,5 % of the total data revenues [Munoz Mendez-Villamil 2005].

3.1.2 Short Message Service

Short Message Service (SMS) allows maximum of 160 characters[8] long text messages to be sent or received with mobile phones. SMS uses a store-and-forward technology that provides information on whether the message delivery succeeded or not [3GPP TS 23.040]. SMS was first thought to be a cheap alternative to the expensive voice calls for the youth but unexpectedly it has been adopted by users of all ages for all kinds of purposes. SMS is used for a lot more than simple text messaging. It is used for example as a bearer for delivering information services such as ringtones or information on news, weather, sports, etc. as well as delivering other messaging services like IM and email.

3rd Generation Partnership Project (3GPP) has developed a standard called Enhanced Messaging Service (EMS) that introduces graphic to the basic SMS messaging by adding formatting to the text. The message may contain animations, pictures, melodies, formatted text and vCard and vCalendar[9] objects [3GPP TS 23.040]. Interoperability between different terminal manufacturers' phone models depends on which of the features are implemented. If a phone does not support EMS then it treats EMS messages as SMS text messages and displays only the text part. Nokia introduced its own Smart Messaging concept around the same time that EMS was launched. Smart messaging services are comparable to what EMS offers. Lack of interoperability between these services made the EMS take off very difficult.

[8] More than 160 characters is possible with concatenated SMS.

SMS is so far the most used messaging service with expected 972 million users in 2004 and 1 713 million in 2008 [Taylor 2006]. Although the West European market is nearly saturated in terms of the number of users of SMS, there is a lot of potential in emerging markets like China and India. In market research firm Ovum's estimation the global consumer SMS revenues were evaluated to 37 781 million $ in 2004 and 66 887 million $ in 2008 [Delaney 2005a]. These numbers can be compared to the overall consumer cellular data revenues and it can be seen that in 2004 SMS took up 63,1 % share of the global data revenues and still in 2008 roughly 46,5 % of the total data revenues should come from SMS [Munoz Mendez-Villamil 2005]. Therefore, SMS is unquestionably a key application of the cellular networks.

It is difficult to find a service that could threaten the position of SMS as mobile operators' number one data service. Gartner did a user survey about mobile phones and services in Russia and Poland and one of the key findings was that SMS was one of the main considerations for people when buying a mobile phone [Garofano 2004]. In fact in Poland the SMS text messaging was found as the most important factor when choosing a handset and in Russia it was the second important factor after battery life [Garofano 2004]. This shows how vital it is for the users to have a SMS capable mobile phone.

3.1.3 Multimedia Messaging Service

MMS is a non real-time messaging service standardised in the 3GPP and the WAP Forum[10]. It supports different media types such as voice, video, images and audio. New media types will be supported as they become popular[11]. In addition to MSISDN[12] (Mobile Subscriber ISDN number), messages can be sent to and received from e-mail addresses. Interoperability is still a problem when sending

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[9] vCard is an electronic business card and vCalendar is an electronic calendaring and scheduling exchange format. Both are developed in the Internet Mail Consortium. See http://www.imc.org/pdi/ for more [Accessed 28.4.2005].

[10] Integrated into Open Mobile Alliance (OMA).

[11] See 3GPP TS 26.140 for a list of media formats and codecs.

[12] MSISDN is the telephone number that callers use to reach a mobile subscriber.

messages to other mobile subscribers and number portability has not made the situation any better, as the serving operator cannot be known by looking at the phone number. MMS is bearer-independent, but currently General Packet Radio Service (GPRS) is commonly used to deliver the messages.

Standard sets no upper limit for the message size but in practice operators have limited it to around 100 kB. For example if a user sends a picture that exceeds the given limit the picture size will be reduced to meet the requirements and even further reduced to meet the receiver's terminal capabilities. MMS was hyped a lot and it was expected to follow the steps of SMS but so far the service take off has been relatively slow. Picture messaging is the most significant use case for MMS. Strategy Analytics expected that in 2004 there were 80 million picture messaging[13] users globally whereas in 2008 there should be 329 million users [Taylor 2006]. Video messaging is the other remarkable use case of MMS. Strategy Analytics estimated 6,7 million video messaging users in 2004 and 87 million users in 2008 [Taylor 2006].

Ovum estimated the global MMS revenues to 1 501 million $ in 2004 and 10 747 million $ in 2008. These revenues do not include revenues from long text messages sent over MMS which are estimated to 92 million $ in 2004 and 2 463 million $ in 2008 [Delaney 2005a]. This assumes that the text messages sent over SMS and MMS will have the same price in 2006 [Delaney 2005b]. Now if the MMS revenues, including those from long text messaging, are compared to the overall cellular data revenues it can be seen that in 2004 MMS took up 2,7 % share of the global data revenues and in 2008 it will be threefold meaning 9,2 % of the total data revenues [Munoz Mendez-Villamil 2005].

On a concept level MMS has great potential but for example high message price and interworking problems are hindering the usage. At this point of time it would be important to familiarise users to MMS and show that it really works and gives added value. Some use cases of MMS are at risk to never become as widely used as they

[13] MMS is the principal bearer for picture and video messaging in most, but not all markets [Taylor 2006].

could. Other messaging services could be used instead of MMS for those use cases. Voice and picture messaging are examples of those services that may use other delivery channels than MMS[14].

3.1.4 Mobile Email

Email existed already before the Internet but in this thesis only the so-called Internet email is considered since that is the one used today. Messages can be sent over the Internet from one user to another by using email. Every user has a unique email address[15] that differentiates user accounts. User sends the message to the local Mail Transfer Agent (MTA), which finds the receiver's mail exchange server and then sends the message there. Simple Mail Transfer Protocol (SMTP) has become a de facto standard for the email transmission. Since SMTP is a push protocol there are other protocols that are used for retrieving the messages from the mail server to a local client. The most popular of such protocols are Post-Office Protocol version 3 (POP3) and Internet Message Access Protocol (IMAP)[16].

Email has quite fast become a commodity feature in the high end mobile phones and it is now being included more and more also in the middle range phones. This means that these phones support usually SMTP, IMAP and POP3 protocols. In addition web-based email accounts can be accessed with HyperText Markup Language (HTML) browsers.

There has been a new requirement for a push delivery of email messages to the mobile handsets. It is more convenient to have a notification of received messages automatically than to fetch the messages manually. The push delivery removes the need for polling the server for new messages in the mailbox. IMAP4 IDLE is one

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[14] See for example RFC 3773: High-Level Requirements for Internet Voice Mail.

[15] Internet email address is of the form localpart@domain.com. The local part is usually the username of the recipient and the domain.com defines the domain name. So e.g. teemu.teekkari@hut.fi.

[16] The basic difference is that with POP3 messages are usually retrieved from a server to a local client and deleted from the server where as with IMAP messages are left on the server and are only specifically deleted.

solution to do this[17]. Other service that does the same thing is the proprietary Research In Motion (RIM) Blackberry, which has become a popular service among business users especially in North America. The serving operator network must support RIM Blackberry and usually the service is offered through a subscription from the operator. Junk email or in short spam becomes extremely irritating if it is pushed to a mobile device. Thus, efficient methods for eliminating junk email are required.

Strategy Analytics forecast assumes 104 million mobile email users in 2004 and correspondingly 307 million in 2008 [Taylor 2006]. Ovum estimates the global mobile email revenues to 79 million $ in 2004 and 3 573 million $ in 2008 [Delaney 2005a]. Strategy Analytics estimates the global revenue figures to be 2 845 million $ in 2004 and 7 774 million $ in 2008 [Taylor 2006]. These differences between two different estimations show that the market is still immature and there is yet no common understanding. The same applies also to the other Internet messaging service, namely Instant Messaging. Using figures from Ovum it can be seen that in 2004 mobile email took up only 1 ‰ share of the global cellular data revenues whereas in 2008 it will take 2,5 % of the total data revenues [Munoz Mendez-Villamil 2005].

3.2 Instant Messaging in the Internet

3.2.1 Overview

IM is widely used in the Internet. There are already people who send more instant messages than emails [Shiu et al. 2004]. The big four IM providers Yahoo!, MSN, AOL and ICQ all have their proprietary services that do not interoperate except for AOL and ICQ that are nowadays both owned by AOL. Yahoo! and MSN announced an interoperability agreement on October 2005. Starting in the second quarter of 2006 this agreement should allow users of Yahoo! Messenger and MSN

[17] RFC 2177 defines IMAP4 IDLE.

Messenger to exchange instant messages, see presence, share emoticons[18] and add friends [Microsoft 2005b].

Instead of offering plain IM, the big four have built a wide offering of other services around IM. These services include voice, video, file transfer, white board, news, music, etc. Advertisements form the main income for these services but more and more revenue come also from paid premium services. The basic business idea is to keep the users longer on their sites and as a consequence sell more advertisements and get users committed to use the service.

IM has not been able to escape from spim. Spim means that unsolicited messages are sent out to the other users. First spim cases have already made it to the court in the U.S. [Roberts 2005]. It is highly unlikely that spam or spim would cease existing, for as long as these services are free there will be those who abuse them. So there will most likely be spam and spim also in the mobile domain.

Voice over IP (VoIP)[19] services have rapidly gained ground. Especially, a fully proprietary VoIP service, Skype[20] has got a lot of publicity for its quickly growing user base. Google has also launched their Google Talk[21] service that is based on the open standards and offers voice and IM services. The big four providers have as well put more effort on VoIP service, for example Yahoo! emphasises voice in its newest messenger 7.0[22].

3.2.2 Big Four Service Providers

The big four offer same type of services except for ICQ, which is targeted more towards simple chatting and does not have all the extra services that the others have.

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[18] Small characters that can be sent in a text message within an IM conversation.

[19] VoIP in this thesis means telephony type of voice service.

[20] eBay acquired Skype 14.10.2005 for approximately $2,5 billion, plus potential performance-based consideration. http://www.skype.com/company/news/2005/skype_ebaycompletesacquisition.html [Accessed 15.1.2006]

[21] Google Talk users can access the service and exchange instant messages using other clients that support the standard XMPP protocol: http://www.google.com/talk/ [Accessed 15.1.2006]

[22] Yahoo! messenger with voice 7.0: http://messenger.yahoo.com/ [Accessed 15.1.2006]

In addition to a messenger application, all of them have a web based IM service that can be used only when an Internet connection and a web browser is available[23]. MIM is also offered but usually services are mobile operator dependent; thus, they do not work in every case. Typically the service providers are charging for either the MIM usage or for the MIM application. The US is the main target market.

Microsoft

Microsoft has two different messenger applications. Windows Messenger comes preinstalled with Windows XP operating system whereas MSN Messenger can be downloaded from the Internet. Windows Messenger is a business application and does not have all of the features that MSN Messenger does [Ballew 2003]. Only Windows Messenger provides connectivity to instant messaging services in an external network and this must be done employing SIP technology.

These two applications are easily mixed. They can both be used to access the Microsoft Passport Network[24] online service; thus, often MSN Messenger statistics cover also the Windows Messenger users.

MSN Messenger is the most used messenger service globally with 189,7 million users compared with Yahoo! Messenger's 78,8 million users and AOL Instant Messenger's 64,4 million users, according to ComScore Networks Inc. [Media Metrix 2005a]. In April 2005 Microsoft announced that MSN Messenger has 155 million users each month and, collectively, they exchange over 2.5 billion instant messages daily [Microsoft 2005a].

Microsoft's mobile service is called MSN Mobile[25]. It offers among other things SMS based MIM for any mobile device with SMS support. The list of supported

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[23] AIM Express: http://www.aim.com/get_aim/express/aim_expr.adp?aolp=

ICQ2Go: http://www.icq.com/icq2go/

MSN Web Messenger: http://webmessenger.msn.com/

Yahoo! Web Messenger: http://messenger.yahoo.com/webmsgr/fmsgr.php [Accessed 2.9.2005]

[24] Same Passport Network account can be used to sign in to multiple Microsoft services including MSN Messenger, MSN Hotmail and MSN Music.

mobile operators is already extensive. Pocket MSN mobile application is available only for Windows Mobile Smartphones and Pocket PCs. It uses a mobile data connection instead of SMS to offer MIM and other MSN services.

Yahoo!

Yahoo! Messenger is one of the key services of Yahoo!. The company is constantly expanding its service offering and the messenger service is used as a platform for more advanced services like Yahoo! Launch online music service.

Yahoo! Mobile[26] offers some of the Yahoo! Messenger's Internet services for handheld devices. In some mobile operators' networks, a mobile browser can be used to access these services with a data connection. Depending on the mobile operator and the mobile device model also SMS based solution and pre-installed or downloadable applications may be available for the user.

Yahoo! Go Mobile[27] was launched in January 2006. It is the first mobile messenger type of application offering services beyond MIM. It is available directly on Nokia smartphones and through mobile operators AT&T and Cingular. The services include IM with presence, voice clips, emoticons and Audibles[28] as well as connection to the device address book, e-mail, messaging, address book and calendar applications.

AOL

Time Warner Inc.'s AOL Instant Messenger (AIM) is bundled with AOL's other products and it serves as an access point to the AOL community. The company and its services are heavily based on its home country, the US. AIM is the leading

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[25] See http://mobile.msn.com [Accessed 1.9.2005]

[26] See http://mobile.yahoo.com [Accessed 1.9.2005]

[27] Press release: http://yhoo.client.shareholder.com/press/ReleaseDetail.cfm?ReleaseID=183437

Yahoo! Go Mobile service: http://go.yahoo.com [Accessed 16.1.2006]

[28] Audibles are character animations with voice that can be sent in an IM conversation.

messenger service in the US with about 54,0 million unique visitors in July 2005 whereas MSN Messenger had 23,3 million, Yahoo! Messenger had 21,6 million and ICQ had 1,8 million visitors, according to ComScore Media Metrix's July report [Media Metrix 2005b].

Mobile AIM[29] is the portable version of AIM. Three options are possible for mobile AIM: preinstalled software, service via wireless web and via SMS. In addition IM messages can be sent and forwarded to mobile phone numbers. Outside the US, mobile messenger offering is limited and mainly software for PDAs (Personal Digital Assistant) is available.

ICQ

ICQ, short from "I seek you", was the first real messenger service. It was created by Mirabilis and released as early as in 1996. AOL acquired ICQ in 1998 and the two messenger services interoperate nowadays. ICQ is the smallest one of the big four but has its special role in the Internet IM thanks to its history.

ICQ Wireless[30] offers MIM applications for specific mobile phone models and PDAs. Like the other big four also ICQ offers SMS based IM but the availability is still restricted to just few cellular operators' networks. Also ICQ for WAP (Wireless Application Protocol) is available for some users.

Summary of the Big Four Service Providers

Table 2 compares the big four services. ICQ has not been able to keep up with the others but it still has a strong supporter base. AOL has traditionally been targeted mainly to the US market while MSN and Yahoo! have been able to serve users around the world. The big four service providers all offer web based IM but WAP and SMS based MIM solutions are mainly offered in cooperation with the mobile carriers and as a consequence are not widely available. MSN offers MIM clients only

[29] See http://aolmobile.aol.com/portal/mobileaim.do [Accessed 5.9.2005]

[30] See http://www.icq.com/wireless/ [Accessed 5.9.2005]

for PDAs running on Windows operating system whereas Yahoo! has clients only for Nokia smartphones.

Table 2: Comparison of the big four service providers

Service	MSN	Yahoo!	AOL	ICQ
Global user base[31]	189,7	78,8	64,4	-
Unique visitors in US in July 2005[32]	23,3	21,6	54,0	1,8
Web based IM	Yes	Yes	Yes	Yes
WAP based MIM	No	Yes	US only	Per carrier
SMS based MIM[33]	35 countries	18 countries	US only	4 countries
MIM clients	Pocket MSN for Windows PDAs	Go Mobile for Nokia smartphones	Preinstalled Mobile AIM available in US PDAs and series 60 terminals	PDAs, Nokia 9210 and series 60 terminals i-mode phones J2ME version for O2 UK/Germany

3.3 Positioning

Figure 4 illustrates the messaging services described in this chapter as they are used currently on the market. On the horizontal axis these messaging services are differentiated based on the content that they carry. The vertical axis divides the

[31] Millions of users, [Media Metrix 2005a]

[32] Millions of visitors, [Media Metrix 2005b]

[33] MSN: http://mobile.msn.com/signup/Signup2.aspx, Yahoo: from Yahoo! Messenger, AOL: http://mymobile.aol.com/portal/im/how_to_reply.jsp and ICQ: http://www.icq.com/sms/ [Accessed 14.2.2006]

services on the basis of communication type to non real time, near real time and real time communication.

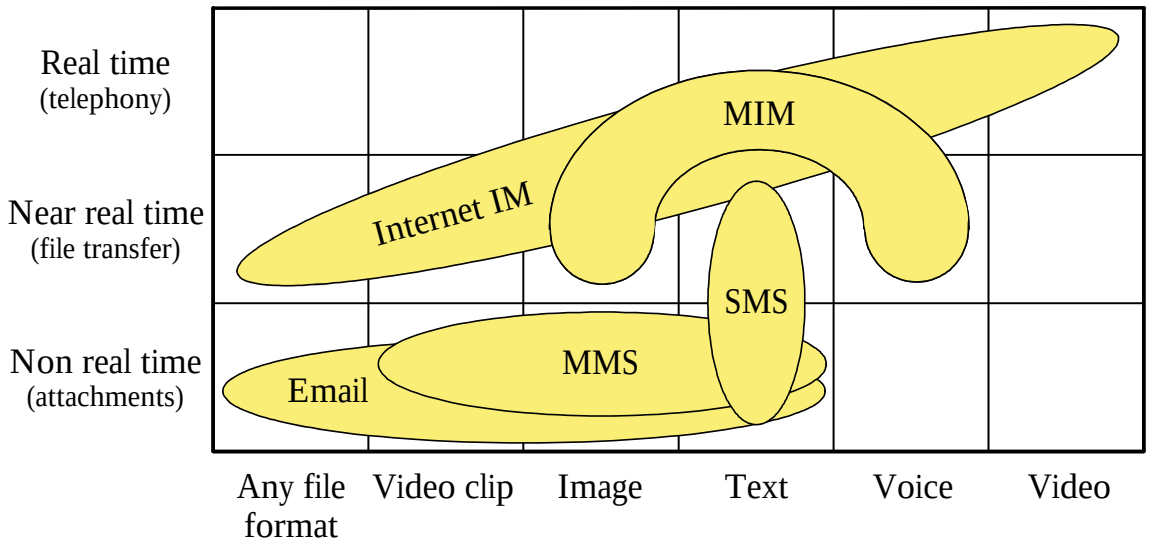

Figure 4: Positioning of messaging services

The traditional messaging methods namely SMS, MMS and email offer all non real time communication. SMS is in some cases also used in a near real time fashion, for example when it is used as a carrier to MIM service or in its own chatting applications. At the moment the distinction between SMS and MMS is quite clear. Although MMS can also convey text, the text in a MMS message is usually inserted only to support an image or a video clip. Email is mainly for communication towards the Internet domain and inherently assumes longer response times for messages. However, push delivery enables even real time usage of email.

Internet IM is predominantly used for real time content that is text, voice and video. However, file transfer is available and any kind of content can usually be transmitted. Big four players offer different kinds of file sharing features to make the file transfer process more convenient for the user and as a result the process has

also become more real time[34]. MIM offers real time text messaging and additionally some services offer image transfer and voice messaging[35].

Natural evaluation path for MIM would be to shift from near real time voice messaging towards streamed voice messaging and finally voice call. Adding file transfer feature is another possible future service for MIM. Another alternative evolution path would be to build communication services around the phone's address book. In that case presence, MIM and voice would be separate services accessible from the address book. At a functional level MIM is well positioned among the mobile messaging services. Technology-wise much is still unclear as MIM can be implemented in multiple ways and in addition different bearer technologies enable different set of services. Thus, next two chapters will provide insight to the bearer technologies and the mobile instant messaging technologies.

[34] Either a better user interface has made the usage faster and / or files such as photos are stored in a network server making the transfer faster.

[35] Voice message is recorded and sent to a recipient.

4 Overview of Bearer Technologies

Mobile phones have traditionally offered access only to the cellular networks[36]. This is slowly changing as the first dual-mode phone models are on the market and enable the usage of Wireless Local Area Network (WLAN) connections when available. Mobile terminals with multiple inbuilt radio transceivers will be more common in the future. Different bearer technologies enable different services. Therefore, this chapter presents the bearer technologies that are or will be available in the mobile terminals and the kinds of services these technologies enable. Furthermore MIM service aspects relating to each bearer technology are presented.

Table 3: Theoretical downlink data rates[37]

	CSD	HSCSD	GPRS	EDGE
Kbit/s	14,4	57,4	171,2	384
	WCDMA	HSDPA	WLAN	WiMAX
Kbit/s	2 000	10 000	54 000	100 000

Cellular networks are evolving towards broadband data rates with 3G technologies and their evolution phases. However, the cellular data rates will most likely never catch up with the data rates offered by the local networks whether wired or wireless. A gigabit per second WLAN system is already targeted in the Wireless Gigabit With

[36] However, access to the Internet has been possible through for example a GPRS access point.

[37] These data rates are theoretical maximum for the given technologies currently. For example maximum number of timeslots, coding schemes with highest data rates and a single user per base station / cell / sector are assumed where applicable.

Advanced Multimedia Support (WIGWAM) project[38] while the near future cellular networks are going to offer data rates that may reach couple of Mbit/s. Table 3 highlights the theoretical peak data rates for Global System for Mobile Communications (GSM) evolution and WLAN technologies. In this chapter the main focus in the cellular technologies is on the GSM evolution path.

The air interface causes some common challenges for all wireless access technologies. Shadowing, fading, etc. are problematic especially for real time services such as MIM. For example SIP session setup time is dependent on the wireless link conditions; consequently, some countermeasures might need to be considered in order to reduce the setup times [Fathi et al. 2004, Hesselman et al. 2005].

4.1 GSM and Mobile Instant Messaging

4.1.1 GSM Technologies

GSM, CDMA (Code Division Multiple Access), PDC (Personal Digital Cellular) and US-TDMA[39] (Time Division Multiple Access) networks are the most used second generation (2G) digital network standards. GSM is the most popular digital network technology with 77,9 % share of global users at the end of 2005 whereas CDMA is the second used technology with 13,4 % market share [EMC 2006]. Only the evolution path of the GSM data transfer technology is covered in this and subsequent sections but for example the data rates are comparable in many respects to what is achieved by the evolution paths of other digital network standards.

CSD (Circuit Switched Data) is a circuit switched technology for data transfer over a GSM network that enables the usage of one single time slot for data transfer. HSCSD (High Speed Circuit Switched Data) is a system similar to CSD but enables

[38] See http://www.wigwam-project.com/ [Accessed 9.6.2005]

[39] US-TDMA is also referred to as D-AMPS (Digital Advanced Mobile Phone System) or IS-136 (TIA Interim Standard 136). TIA (Telecommunications Industry Association) is a US non-profit trade association serving the communications and information technology industry.

the allocation of up to four time slots for one data call. In HSCSD the maximum data transfer speed with a 14,4 kbit/s bearer is thus 57,6 kbit/s and 38,4 kbit/s with a 9,6 kbit/s bearer [ETSI TS 122 034].

GPRS and EDGE (Enhanced Data rates for Global Evolution) are considered as 2.5G network standards for the GSM evolution path. They use packet switching technology which makes the radio resource usage much more efficient compared to the circuit switched technology. Data users no longer reserve a dedicated radio channel for a fixed period of time. Radio resources are only used when the users send or receive packets.

GPRS allows a maximum data transfer speed of 171,2 kbit/s when all eight available timeslots are used and radio channel conditions are good. One full rate Packet Data Traffic Channel (PDTCH) offers 9,05 kbit/s, 13,4 kbit/s, 15,6 kbit/s or 21.4 kbit/s data rate depending on the used channel Coding Scheme (CS) [3GPP TS 05.01]. The radio channel conditions determine the used CS. Terminal and network capabilities set limits for the actual transfer speeds. GPRS Class of the terminal refers to the timeslots allocated for downloading and uploading data. In general terminals limit the number of downloading slots to two to four and uploading slots to one to two. Networks specify how many timeslots are allocated for GPRS as in most cases circuit voice uses same timeslots and has usually priority over GPRS. In summary data throughput depends on the channel conditions, the terminal capabilities and the network settings. Consequently, actual data rates are usually between 28-64 kbit/s for downlink and 14 kbit/s for uplink [GSM World 2005].

EDGE introduces 8PSK (8-Phase Shift Keying) modulation, which enables each symbol to carry three bits instead of one as in GMSK (Gaussian Minimum Shift Keying) used in GSM. Therefore, EDGE offers roughly three times faster data rates compared to GPRS. Theoretical throughput of EDGE is 473,6 kbit/s although 384 kbit/s is more often used. Nine Modulation Coding Schemes (MCS) are introduced in EDGE with throughputs between 8,8-59,2 kbit/s [3GPP TS 05.01]. Actual data rates are determined in a similar way to GPRS. EDGE is also referred to as 2.75G as the data throughput is comparable even to the 3G networks.

4.1.2 Services in GSM

GPRS has enabled Push to talk over Cellular (PoC) and MMS services. Data connection has also made browsing and online gaming possible. Gaming has been available for a long time but the data connection is something that may bring extra value for the users. Playing a game against other users over the network or downloading new components to a game are value added features that require a network connection. Online gaming is a good example of a service that was not truly viable before the PS networks for services that need constant connectivity but send only little data are best suited for the volume charged domains.

Smartphones integrate personal information management and mobile phone capabilities into one device. They allow additional applications to be installed on the handheld device. Service supply is not solely dependent on the serving operator and the phone manufacturer as any developer may develop applications and distribute them to the other users. These applications may use the phone's data connection to connect to the Internet.

Although 2G and 2.5G technologies enable usage of wide variety of services the services that create most revenues apart from voice and messaging services are ringtones with estimated revenue of 6 299 million $ in year 2005, wallpapers and graphics 3 066 million $ and browsing[40] 12 359 million $ [Taylor 2006].

4.1.3 Mobile Instant Messaging Aspects in GSM

MIM is today offered through SMS and GPRS technologies. SMS offers a way to transfer text IM messages to almost all current phone models. Small multimedia attachments could be added by using MMS as a bearer but such offerings have not been visible on the market. One downside of SMS is that it causes undefined amount of delay to the transmission. Consequently, it limits the use case efficiently to non-real-time IM conversations. Another limitation of SMS is the short message

[40] Includes content consumed in all mark up languages [Taylor 2006]

length. However, messages can be concatenated to make them longer. The power of SMS is in its wide user base with estimated 1 267 million SMS users in 2005 [Taylor 2006]. SMS is the way to make a service available as widely as possible. For example AOL offers MIM through SMS by allowing their fixed service users to send instant messages to mobile phone numbers in the US, although these numbers have not been registered to AOL [AOL 2005].

GPRS enables real-time IM conversations. In addition to text, file transfer is possible. Transferred files can be for example pictures taken with the handset's camera. In case of large files the transfer time will become too long for a real-time conversation. The GPRS connection may get suspended during the file transfer as a consequence of an incoming call or a SMS message. This happens if the phone cannot have both CS and PS services active at the same time. It depends on which one of the three modes of operation the mobile station (MS) can operate in as described in the standard[41].

Streaming voice can also be transferred over GPRS but without a throughput guarantee. The minimum data rate requirement for PoC service is mentioned to be 7,2 kbit/s [PoC Release 2.0]. PoC service allows users to engage in a walkie-talkie type of communication with one or more users. PoC service is specified in the OMA[42]. Transfer network's Quality of Service (QoS) is not a critical factor if the voice messages are first recorded and then sent as voice files over the network. Agile Messenger is an example of an MIM application that has this type of a near real-time voice instant messaging feature implemented, working fine over a GPRS connection[43].

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[41] 3GPP: General Packet Radio Service (GPRS) Service description; Stage 1. TS 22.060

[42] OMA Technical Section - Push to Talk Over Cellular Working Group: http://www.openmobilealliance.org/tech/wg_committees/poc.html [Accessed 12.5.2005]

[43] See http://www.agilemobile.com/agile_messenger.html [Accessed 11.4.2005]

Current MIM services usually offer text-based IM and presence service. Additional services available through certain MIM solutions include avatars[44], PoC type of voice messaging and connections to multiple IM communities. No extra services have been introduced for EDGE users although the additional speed would enable new features like file transfer between peers. MIM in 2G and 2.5G is invariably regarded as messaging services although it typically uses a separate application compared to the phone's built in messaging services that normally include at least SMS, MMS and sometimes also mobile email.

4.2 WCDMA and Mobile Instant Messaging

4.2.1 WCDMA Technologies

IMT-2000 (International Mobile Telecommunications-2000) is the global standard for 3G wireless communications as defined by the International Telecommunication Union (ITU). ITU has approved the following five radio interfaces for the terrestrial component of IMT-2000 [ITU M.1457]:

- IMT-2000 CDMA Direct Spread:
  Radio interface is called Universal Terrestrial Radio Access (UTRA) Frequency Division Duplex (FDD) or Wideband CDMA (WCDMA).
- IMT-2000 CDMA Multi-Carrier:
  Radio interface is called CDMA2000.
- IMT-2000 CDMA Time-Code:
  Radio interface is called UTRA Time Division Duplex (TDD), where two options exist: 1,28 Mcps (Megachips per second) TDD called TD-SCDMA (Time Division Synchronous CDMA) and 3,84 Mcps TDD.
- IMT-2000 TDMA Single-Carrier:
  Radio interface is called Universal Wireless Communication-136 (UWC-136).

[44] Avatar is an icon, image, etc. representing a user in virtual communities like for example IM communities. TipicME is a MIM application supporting avatars: http://www.tipic.com/tipicme [Accessed 12.5.2005]

- IMT-2000 FDMA/TDMA:

  Radio interface is called Digital Enhanced Cordless Telecommunications (DECT).

Different technologies are used in different corners of the world. The most widely deployed solution is WCDMA that is used for example in Europe. WCDMA offers good quality and high speed data connections comparable to broadband connections. In theory up to 2 Mbit/s data transfer speeds can be achieved near the serving base station. Current data speeds achieved in WCDMA networks are around 384 kbit/s[45].

High Speed Packet Access is an evolution phase for WCDMA. High Speed Downlink Packet Access (HSDPA) will offer data transmission rates up to around 10 Mbit/s and later on with Multiple Input Multiple Output (MIMO) technology up to 20 Mbit/s. High Speed Uplink Packet Access (HSUPA) will be introduced after HSDPA and will offer enhanced uplink speeds up to 5.8 Mbit/s. HSPA technologies are sometimes referred to 3.5G, 3.75G or even 4G as they offer considerably higher bit rates than 3G.

4.2.2 Services in WCDMA

WCDMA has enabled rich voice services and video telephony. Asymmetrical data services such as TV and music download are suitable for HSDPA. Finally HSUPA will enable symmetrical real time services like video conferencing and collaborative applications. The available bandwidth will become a less restrictive factor in the future. Data pricing and service usability in the small device will be in more decisive roles when end users judge whether to take up new services.

It is common for operators to offer flat rate deals where 10 MB – 1 GB of data a month is included in the monthly fee. This amount of data is usually enough for

[45] For example in Finland Sonera offers at best 384 kbit/s data speeds for their 3G network customers: http://www.sonera.fi/artikkeli/0,3842,l-fi_h-11202_a-254154,00.html in Finnish [Accessed 20.7.2005]

reading emails and basic browsing but for example VoIP calls would drain the monthly data amount more quickly.

4.2.3 Mobile Instant Messaging Aspects in WCDMA

In addition to 2G and 2.5G MIM services, voice and even video can be streamed over the network and file transfer is also reasonable with the WCDMA technology. Incomplete WCDMA-network coverage may disturb some services as transfer speed decreases further away from a serving base station. Handover to the GSM network happens when the WCDMA radio link quality drops below a threshold value.

WCDMA data is still mainly charged based on volume and usually charging models are the same for both the GSM and WCDMA subscribers[46]. For MIM kind of services that use only little data this has no big impact. For example browsing may easily become much more expensive with a 3G phone as with a same amount of time one can browse through a lot more web pages and download big images on those pages.

4.3 Wireless Broadband Access Technologies and Mobile Instant Messaging

4.3.1 Wireless Broadband Access Technologies

In this thesis wireless broadband access technologies include all non-cellular technologies that offer high-speed wireless access to the Internet. The main access types include WLAN and Broadband Wireless Access (BWA) technologies. These technologies offer wireless access to data networks, which means that in practise no circuit switched connection is available and everything is transferred over IP, including voice. In most cases only nomadic mobility is offered i.e. users are able to access the network in specific areas like home and office.

IEEE (Institute of Electrical and Electronics Engineers) 802.11 standard sector known as WLAN encompasses several standards including 802.11b, 802.11a and 802.11g. Table 4 shows some characteristics of these WLAN standards. Indoor range is generally 10-100 metres depending on the propagation path and outdoor range is up to 300 metres. WLAN has become already a commodity and it is used not only to build hot spots for public places and enterprises but more and more to build small home networks as well.

Table 4: Main WLAN technologies

WLAN technologies	Frequency band	Data throughput
802.11b	2,4 GHz	Up to 11 Mbit/s
802.11a	2,4 GHz	Up to 54 Mbit/s
802.11g	5 GHz	Up to 54 Mbit/s

Examples of BWA technologies include IEEE 802.16 standard known as Worldwide Interoperability for Microwave Access (WiMAX), Wireless Broadband (WiBro)[47] and Flash-OFDM[48]. Typically multiple operating frequency bands are enabled on both licensed and unlicensed bands. Throughputs are usually reported per cell or sector and current maximum bit rates are roughly 100 Mbit/s depending on the used technology and provider. Network users will share the total bandwidth and as a consequence per user bit rates are around 1 Mbit/s downlink and 500 kbit/s uplink.

Four main use cases are targeted with BWA. The first one is broadband Internet access especially for rural areas, developing countries and also for small and medium size businesses. The second use case is to offer nomadic access in chosen places

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[46] See http://www.sonera.fi/artikkeli/0,3398,l-fi_h-11202_a-254154,00.html, in Finnish [Accessed 20.1.2005]

[47] Standard approved by the Telecommunications Technology Association of Korea. WiBro is a modification of IEEE 802.16e, which is the mobile variant of 802.16 standard.

[48] FLASH (Fast Low-latency Access with Seamless Handoff) OFDM (Orthogonal Frequency Division Multiplexing) is a proprietary air interface technology developed by Flarion Technologies.

comparable to WLAN hot spots. The third one is backhaul connection for other wireless accesses like WLAN and cellular. Private networks are the fourth main use case for BWA technologies. MIM might be offered in the first and second use case and possibly in the last.

4.3.2 Services in Wireless Broadband Access

Wireless broadband access technologies will offer accesses to any services available in the Internet. Most likely QoS will not be guaranteed and bit transfer will be best effort. Some services requiring high bandwidth may have disruptions or even total service breaks depending on how many users are sharing the cell or sector capacity at a given moment. Finally, mobility may cause dropping of a session, which will interrupt session oriented services like voice call.

4.3.3 Mobile Instant Messaging Aspects in Wireless Broadband Access

If wireless broadband access technologies will be flat fee based, used services will not differ much from the ones used with the fixed broadband access technologies such as Asymmetric Digital Subscriber Line (ADSL). The connection speed is high enough to support all of the features that are currently offered through the Internet IM services. However, device limitations may shorten the list of services that can be used. Other than flat fee charging models may further limit the set of services that are worthwhile to use.

Most likely the Internet IM services will be used instead of the MIM services. It may be possible in the future that users connect to their cellular operator's IM service through a wireless access offered by another operator. This way operator would offer access and operator independent services for its customers. In consequence, operators would become more of service providers in addition to being access providers.

5 Mobile Instant Messaging Technologies

5.1 Overview

IM is getting more popular also in the mobile domain. There are several different technologies that can be used to implement the service. Mobile operators have to decide which route to follow. Some solutions require smartphone capabilities and this limits the target group whereas some use SMS as a bearer, which makes the service quite expensive to use for an end user. Operators may for example decide to follow one standard track or several different tracks or even change the supported solution after some time. The chosen technology does not need to affect operator's MIM strategy but with some solutions it is easier to follow certain strategies. One big strategic question will be whether to co-operate with one or several of the Internet IM big four service providers.

5.2 Presence

Presence is a service that is usually bundled with instant messaging. Different IM solutions can have a bit different approach to tackling the presence and in some cases it can even be left out of the service. In mobile domain radio resources are limited and bits sent through the air interface are expensive. Presence information has to be updated often and this causes a lot of extra traffic. Also phone battery is drained more quickly as the terminal has to keep a data connection active constantly. This is especially the case when the client is connected to a presence and an IM server that reside outside of the serving mobile operator network. Typically firewalls and Network Address Translations (NAT) have to be kept open by

sending extra traffic. Depending on the charging model, presence information may be charged from the user separately or it may also be included in the MIM fees. Anyway presence has to be taken into account when planning a mobile instant messaging service.

5.3 SMS Based Solutions

Because of the ubiquity of SMS, also MIM is offered in many cases via SMS. End users are normally paying for both sent and received IM messages and sometimes even more than for the basic SMS messages[49]. There are usually certain SMS commands that result in wanted activities like receiving a buddy list etc. Presence information is not normally updated unless it is specifically requested with a SMS message.

Most SMS based solutions are offered by the big four providers in cooperation with cellular operators. As a consequence these services are only available for a limited number of users. Messages can also be transferred between a PC big four client and any cellular phone in a given network. The cellular user has to bear the costs of those messages. These services are generally available only in countries where the users pay for received SMS messages like in the US.

5.4 IP Multimedia Subsystem

5.4.1 Overview

IMS is a new mobile network subsystem defined by the 3GPP. It is designed to enable IP multimedia services like VoIP and instant messaging via mobile networks. IMS enables also connections to / from fixed networks. Most of the services that IMS offers can be offered also through any broadband Internet connection. What IMS offers is Quality of service (QoS), charging and integration of different services

[49] MSN IM messages cost 25 euro cents to receive and 10 euro cents to send in Sonera's network in Finland. See http://www.msn.fi/Mobiili/hinnoittelusonera/default.asp (in Finnish) [Accessed 6.9.2005].

[Camarillo et al. 2004]. These are not easily available for open Internet services; nonetheless they are important when the services are used in 3G networks. All of the services in IMS are provided using PS technology.

5.4.2 Session Initiation Protocol

Session Initiation Protocol (SIP) is the foundation of IMS. It is a session control protocol developed within the IETF[50]. In SIP users are identified using SIP URIs (Uniform Resource Identifier), which are similar to the email addresses[51].

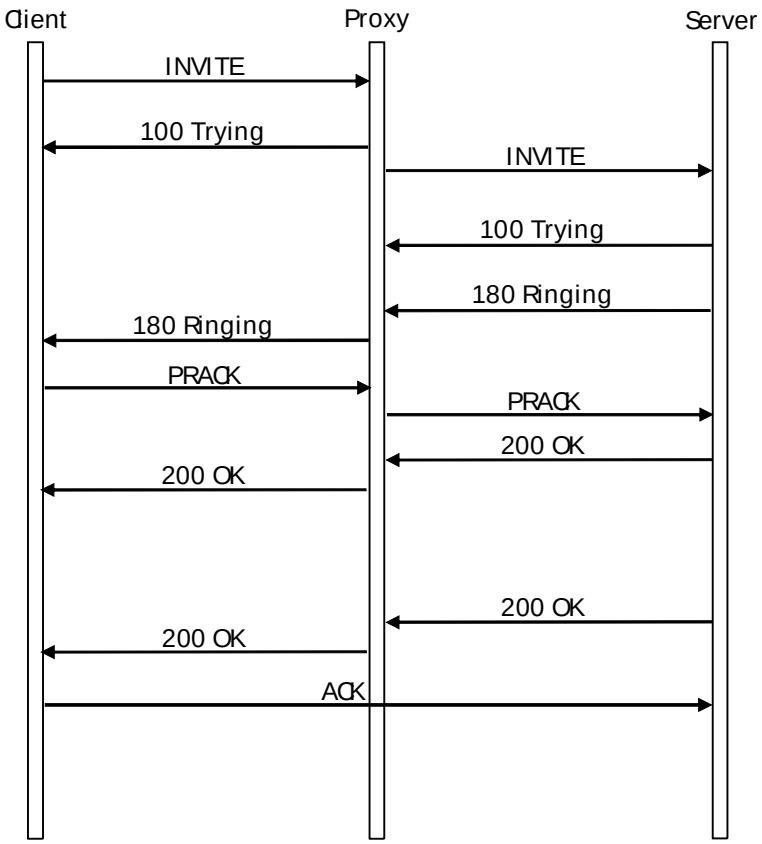

Figure 5: Reliable IETF SIP session setup

[50] RFC 3261 defines SIP.

[51] SIP URI is of the form sip:user@host. The user part is the recipient and the host defines the domain name. So e.g. sip:teemu.teekkari@hut.fi. Additional parameters can be included in the SIP URI.

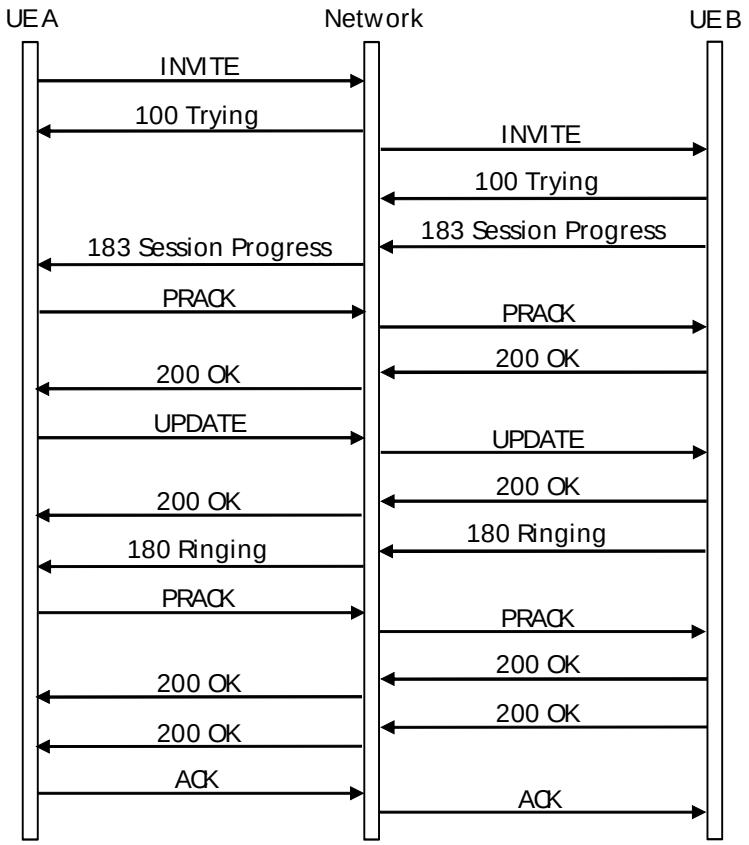

Figure 6: SIP session setup in the 3GPP

SIP has been extended in co-operation with the 3GPP to meet the stricter requirements of the mobile domain[52]. Figure 5 shows how a reliable SIP session setup is done between a user agent client (UAC) and a user agent server (UAS). Figure 6 shows how a basic SIP session setup is done in the 3GPP environment between user equipments (UE) A and B. The reliability in the SIP example of Figure 5 refers to the usage of PRACK (Provisional Response ACKnowledgement) messages. Provisional responses provide information on the progress of the request processing and are not required in the basic SIP[53]. Comparison of Figure 5 and Figure 6 shows the fundamental differences between the reliable SIP and the SIP that is used by the 3GPP; the 3GPP signalling process takes substantially more messages; therefore, takes more time to perform. The large number of messages and

[52] SIP for use in IMS is defined in TS 24.229, Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3.

[53] The core of SIP is defined in RFC 3261.

the number of network elements involved in the SIP session setup in IMS cause a considerable amount of signalling delay; however, a reduction in delay can be achieved with SIP message compression [Pesch et al. 2005].

5.4.3 Instant Messaging

IMS offers two modes of IM: a pager mode and a session-based mode. In the pager mode messages are sent independently of previous or following messages. It uses SIP MESSAGE[54] method extension to transfer the messages. In the session-based mode a session is established and the actual messages are then transferred with Message Session Relay Protocol (MSRP). Signalling flow does not have all the requests that are included in Figure 6: SIP session setup in the 3GPP, namely for example 183 Session Progress and UPDATE are excluded.

5.4.4 Other IMS Services

The main goal of IMS is to provide a platform for services. Some of the services need extra standardisation like IM, whereas some may be offered with the tools available in definition. Presence has a special role in IMS as it is envisioned to facilitate all mobile communication [Poikselkä et al. 2004]. IM takes the advantage of presence but so does voice call, Push-To-Talk, video, interactive gaming etc. Presence information may be embedded in the phonebook making it possible to choose an appropriate communication method in a given moment.

5.5 Wireless Village

Founded by Ericsson, Motorola and Nokia, Wireless Village, the Mobile Instant Messaging and Presence Services (IMPS) Initiative is developed nowadays under the OMA. Central point of a Wireless Village system is a Wireless Village server. It can offer interconnectivity with other IMPS services as well as IM networks in the Internet. It is composed of four Application Service Elements [OMA 2005]:

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[54] RFC 3428 defines MESSAGE.

1. Presence Service Element
2. Instant Messaging Service Element
3. Group Service Element
4. Content Service Element

Presence includes presence and location information. IM messages can be sent to an individual user or a group of users and several message types are supported. The group service enables for example chat rooms. Users can also share content while in an IM or a chat session. [OMA 2005]

There are number of embedded Wireless Village clients on the market already from different terminal manufacturers, for example from Nokia and Sony Ericsson. Also downloadable java and symbian applications are available for wide variety of phone models. However, all of the clients may not offer exactly the same service features as different phone models have different set of functionalities [OMA 2005][55]. Usually it is the serving mobile operator that operates the Wireless Village servers but third parties can operate them as well[56]. One problem for Wireless Village is the lack of running servers.

5.6 SIP/SIMPLE Based Solutions

SIP/SIP for Instant Messaging and Presence Leveraging Extensions (SIMPLE) standardisation is currently ongoing in the IETF. Typically IETF has specified the protocols and other organisations have used those protocols to create services. With SIP/SIMPLE the case is a bit the same as the 3GPP and the OMA are adapting SIP/SIMPLE for their needs. Most likely SIP/SIMPLE will be widely deployed by those service providers who use SIP today for VoIP service etc.

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[55] See also e.g. Yamigo forum for Nokia 6630 related problems: http://www.yamigo.com/component/option,com_simpleboard/Itemid,45/func,showcat/catid,3/ [Accessed 20.9.2005]

[56] 3rd party providers e.g.: Yamigo http://www.yamigo.com and Smart VAS http://www.smartvas.com/ [Accessed 19.9.2005]

The IETF SIMPLE Working Group (WG) focuses on adaptation of SIP to instant messaging and presence (IMP)[57]. SIMPLE goes beyond IMP as there will be components to other services, like PoC. SIP, Hyper Text Transfer Protocol (HTTP) and Extensible Markup Language (XML) are the three main technologies within SIMPLE.

There are good changes that SIP will be the winning standard in the communication field. With SIP it is fairly easy to implement interoperability between service providers and in addition if the 3GPP and the OMA will make their solutions SIP interoperable the standard will have a fairly widespread user base.

Some of the Internet services and clients already support SIP/SIMPLE although the standard is not fully ready yet. For example CounterPath's eyeBeam[58] softphone is one of these clients. Microsoft has extended SIP/SIMPLE for its messenger service; consequently, it is not interworking with other providers' services. Thus, at least modified SIP/SIMPLE should be used for MSN MIM services, like for example in the PC-to-mobile IM service that MSN has launched with the cellular operator Vodafone [Vodafone 2005].

5.7 XMPP Based Solutions

Extensible Messaging and Presence Protocol (XMPP) specifications were published as standards in 2004 (RFC 3920-3923) by the IETF. The core protocol was created by the Jabber open-source community[59] and was accepted to the IETF standards process in 2002. XMPP is a streaming protocol that enables the exchange of XML elements between any two points in a network. Basically one conversation is one large XML document that is extended with new messages. This makes XMPP easily extensible as the XML document can be extended with other things than simple IM

[57] The requirements for IM and presence are outlined in RFC 2779.

[58] See: http://www.counterpath.com/index.php?menu=eyeBeam [Accessed 16.1.2006], CounterPath Solutions was previously known as Xten Networks.

[59] Jabber Software Foundation: http://www.jabber.org/ [Accessed 21.9.2005]

messages as well. Jabber Enhancement Proposals (JEPs)[60] may be considered XMPP extensions although Jabber Software Foundation publishes them instead of the IETF XMPP WG. XMPP uses client-server architecture, though Jabber clients can negotiate also peer-to-peer connections but those need to be first negotiated within the context of the client-server framework.

XMPP does not specify interconnectivity to other IM services but many Jabber servers have gateways to some or all of the big four communities. XMPP MIM clients are typically downloadable clients and implemented with Java[61]. A significant proportion of XMPP client software is open source based. Google was the first really big player to start using XMPP for its Internet IM solution named Google talk[62]. XMPP fits well for IM and presence as the bandwidth usage is considerably smaller than for example in case of SIP and its extensions [Chatterjee et al. 2005]. There is an initiative to re-use the work done by SIP community on initiating and negotiating multimedia sessions[63]. Combining XMPP and SIP could be the right way to develop the best communication service with open standards. Gizmo[64] is an Internet VoIP client that uses standard XMPP for IM and standard SIP for VoIP. Also Google plans to support SIP in a future release of Google talk [Google 2006].

5.8 Java IM Clients

Most of the new mobile terminals support Java 2 Platform, Micro Edition (J2ME). With Java it is relatively easy to develop mobile applications like instant messaging applications. In theory J2ME is device independent and should work the same way in any mobile device. In reality different device manufacturers have different implementations of J2ME and in consequence J2ME applications usually need to be

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[60] Details on JEPs: http://www.jabber.org/jeps/ [Accessed 21.9.2005]

[61] Comprehensive list of Jabber clients: http://www.jabber.org/software/clients.shtml [Accessed 21.9.2005]

[62] See: http://www.google.com/talk/ [Accessed 21.9.2005], Apple computer has had their XMPP based messenger service iChat available for a few years but it is only available for Mac OS X operating systems. See http://www.apple.com/macosx/features/ichat/ [Accessed 23.2.2006]

[63] JEP-0111: A Transport for Initiating and Negotiating Sessions (TINS): http://www.jabber.org/jeps/jep-0111.html [Accessed 21.9.2005]

[64] See: http://www.gizmoproject.com/ [Accessed 16.1.2006]

modified to work as desired in different devices. Luckily the process is normally quite simple so the possible user base for a Java mobile application is huge.

There are already a number of J2ME MIM clients available for mobile terminals and more are coming all the time. In principle there are J2ME MIM applications for any MIM technology covered in this thesis. Advantage of J2ME is the wide terminal base. Downside is that it is almost impossible to make compelling user interfaces with J2ME.

5.9 Proprietary Solutions

Internet IM has been and still is very scattered protocol-wise. The players are not interworking with any of the others[65]. The big four are shifting towards open standards but they still deploy their proprietary extensions that make their services closed. Third parties have deployed gateways to access the big four communities but these gateways should be offered by the big four for an enduring solution or there should be cooperation agreements between third parties and the involved big four players.

In mobile domain third party gateways are even more common than in the Internet. Operators have not been eager to start creating their own MIM communities and even if they have they are not advertising their MIM services. Vodafone is one of the few ones to offer their own MIM service. Vodafone Messenger was originally a closed community but recently Vodafone and MSN launched interconnectivity between their services [Vodafone 2005].

Third party service providers have usually created their own MIM application and offer connectivity to the big four communities without having their own communities. A good example is Agile Messenger[66], which offers connectivity to external communities and is downloadable for a fee from the Internet; in addition it

[65] Excluding AIM and ICQ that are both owned by AOL and interconnect with each other.

[66] Agile Messenger: http://www.agilemobile.com/agile_messenger.html [Accessed 22.9.2005]

is also marketed for mobile operators. Big Internet players are as well interested in providing MIM clients of their own. As an example Yahoo! Go Mobile was launched in January 2006 and a mobile version of Skype was demoed in the 3GSM World Congress in Barcelona on February 2006 [Blandford 2006].

5.10 Summary of the Mobile Instant Messaging Technologies

This chapter introduced different MIM technologies. These technologies are summarised in Table 5. SMS and Java can be considered as enablers for MIM as SMS can be used as a bearer for MIM and Java can be used for making MIM clients. A MIM solution can basically be based either on Wireless Village, on SIP, on XMPP or on a proprietary protocol.

Table 5: Mobile instant messaging technologies

SMS	Available in almost every phone but the usage is expensive for end users. Used as a bearer in some MIM solutions.
IMS	Standardised in the 3GPP. IMS is targeted to enable IP multimedia services, such as MIM, via cellular networks.
Wireless Village	Clients are already widely available. Problem is the lack of running servers.
SIP/SIMPLE	SIP is mostly used at the moment for VoIP. SIMPLE standardisation is still ongoing and will mostly likely be adopted by the big IM players when ready.
XMPP	Standard has been ready for a while already but enhancement proposals are still made. Google was the first really big Internet player to start using this easily extensible protocol.
Java	Java can be used to implement MIM clients. It is widely supported in the current mobile phones. Compelling user interfaces are difficult to make with J2ME.
Proprietary	Mostly third parties offer connectivity to the big four communities. However, some big players like Yahoo! and Skype have recently developed their own clients.

Wireless Village is standardised in the OMA and is already widely available. SIP and XMPP are both IETF standards. In addition to the basic SIP and its extensions there are also extensions that are used by the 3GPP in IMS. These extensions are made to meet the stricter requirements of the mobile domain. XMPP was brought to the IETF standard process as a ready solution and was released as standards in 2004. XMPP is easily extensible and has substantially smaller bandwidth requirements than SIP. In practise all of the proprietary protocols originate from the Internet, meaning the protocols that the big IM players have created themselves. In some cases third parties use these protocols to access the big four communities but the big players have started to develop their own MIM clients as well.

In conclusion there is no one way to implement a MIM service but multiple technologies exist each having different advantages and disadvantages. An operator or a service provider has to consider what will fit their strategy the best and choose the technology accordingly. Once one technology is implemented it can be fairly difficult to switch to use another one so the chosen technology should be able to meet also the long-term objectives.

6 Industry Scenarios

The process of constructing industry scenarios is described in Section 2.2. This chapter describes how scenarios were constructed in this thesis.

6.1 Identifying Uncertainties

The list of uncertain elements of structure is shown in Table 6. The list is constructed using Michael Porter's five forces analysis described in Section 2.1. This list serves as the basis for creating scenarios that are truly important to strategy.

Table 6: Uncertain elements of structure

Entry Barriers
How big will the advantage be to have large volumes (savings in R&D, marketing, distribution, etc.)?
Will there be companies that occupy brand and / or know-how to enter the industry?
Will the established companies have superior brand identification and customer loyalties?
How high will capital requirements be to enter the industry?
Will it be possible to enter the industry through acquisition?
Would new proprietary solutions be able to offer something that the current solutions will not offer?
How easy will it be to develop and push new applications to the handsets?
How difficult will it be to offer MIM service without support from the mobile operators?
How difficult will it be to offer MIM service without support from the terminal manufacturers?
How difficult will it be to offer MIM service without support from the network (P2P type of solutions)?
Will there be interoperability among the different communities?
How will the existing companies react to new entrants?

Rivalry

What is the market balance between the big four and / or between the operators?
How fast will the MIM service growth be?
Will there be additional players?
Will the Internet IM providers / mobile operators be committed to MIM?
Will there be significant differences between the MIM services offered through the different standards (Wireless Village, SIP/SIMPLE, XMPP-Jabber, proprietary, etc.)?
How easy will it be to expand the service (geographically, feature-wise)?
What are the incentives to offer MIM (e.g. big four vs. operators)?
How high will exit barriers be for MIM?

Substitutes

How popular will the other mobile messaging services be (SMS, MMS, email)?
What will be the price level of the other mobile messaging services?
Which messaging services will the mobile operators focus on (e.g. email vs. IM)?
Will other services include IM capabilities (e.g. PoC)?

Buyers

How high will the user demand be?
How many users will the mobile operators vs. the other MIM providers have?
Will there be significant differences between the MIM services of different providers (pricing, features, advertisements, etc.)?
What kind of pricing models will be deployed?
How popular will enterprise MIM be?

Suppliers

Will operators create MIM services in-house?
What will be the role of the big four?

Only independent uncertainties are qualified as scenario variables since dependent uncertainties will be resolved once the independent uncertainties are solved [Porter 1985]. The elements that are independent and are able to affect the industry structure are listed in Table 7. The outcome is a list of possible scenario variables.

Table 7: Possible scenario variables

SCENARIO VARIABLE	CORRESPONDING UNCERTAINTY
New proprietary solutions	Would new proprietary solutions be able to offer something that the current solutions will not offer?
Operator support	How difficult will it be to offer MIM service without support from the mobile operators?
Terminal support	How difficult will it be to offer MIM service without support from the terminal manufacturers?
Network support	How difficult will it be to offer MIM service without support from the network (P2P type of solutions)?
Interoperability	Will there be interoperability among the different communities?
Commitment	Will the Internet IM providers / mobile operators be committed to MIM?
Technical solutions	Will there be significant differences between the MIM services offered through the different solutions (Wireless Village, SIP/SIMPLE, XMPP-Jabber, proprietary, etc.)?
Service expandability	How easy will it be to expand the service (geographically, feature-wise)?
Provider incentives	What are the incentives to offer MIM (e.g. big four vs. operators)?
User demand	How high will the user demand be?
Service description	Will there be significant differences between the MIM services of different providers (pricing, features, advertisements, etc.)?
Pricing model	What kind of pricing models will be deployed?
Clientele	How popular will enterprise MIM be?

6.2 Determining Causal Factors

It must be verified that the possible uncertain elements of industry structure presented in Table 7 are suitable scenario variables i.e. not dependent elements. Identifying causal factors of the uncertain elements is the way to do this [Porter 1985]. The causal factors will also help in determining the range of assumptions that will be made about each scenario variable [Porter 1985]. Table 8 lists the causal factors for the selected scenario variables. The causal factors are divided into industry external and internal ones.

Table 8: Causal factors of chosen scenario variables

SCENARIO VARIABLE	CAUSAL FACTORS
New proprietary solutions	*External to the industry*
	Regulations
	Internet solutions (proprietary or not)
	Overall technology development
	Internal to the industry
	Capabilities / restrictions with the available solutions
	Selection and success of open standards
	Number of available standards
Operator support	*External to the industry*
	Regulations
	Buying habits of end users
	Popularity of service bundles
	Popularity of subsidisation
	Development of charging and billing methods
	Internal to the industry
	Policies of the players
	Technology development
Terminal support	*External to the industry*
	Regulations
	Usage habits of end users
	Overall technology / service development
	Power of the mobile operators over the terminal manufacturers
	Internal to the industry
	Policies of the players
	Power of the service providers
	Technology development
Network support	*External to the industry*
	Regulations
	General success of P2P services / technologies
	Development of charging and billing methods
	Overall technology / service development
	Internal to the industry
	Technology development
	Availability of P2P MIM solutions

Interoperability	*External to the industry*	
	Regulations	
	Overall technology / service development (interoperability among the VoIP players, etc.)	
	Internal to the industry	
	Interoperability policies of the players	
	Standardisation work	
	Popularity of common standards	
Commitment	*External to the industry*	
	Regulations	
	Success of the Internet services (especially IM and email)?	
	Overall technology development	
	Success of other (messaging) services	
	Development of overall pricing structure	
	Internal to the industry	
	Attractiveness of MIM potential	
	Economic situation of the MIM service providers	
Technical solutions	*External to the industry*	
	Regulations	
	Social trends	
	Overall technology / service development	
	Needs / possibilities aroused from the Internet domain	
	Internal to the industry	
	Standardisation	
	Mobile specific needs / possibilities	
Service expandability	*External to the industry*	
	Regulations	
	Social trends	
	Availability of required technologies / infrastructures	
	Price of devices and usage	
	Available money to be spent on MIM	
	Internal to the industry	
	Mobile operators' policies	
	Mobile operators' area of operations	
Provider incentives	*External to the industry*	
	Regulations	
	Popularity of Internet IM	
	Competition in the Internet IM market	

6.3 Making Plausible Assumptions

Based on the possible scenario variables listed in Table 7 and the corresponding causal factors listed in Table 8, interviews were conducted in order to find the most important scenario variables. The interviews were carried out separately in Helsinki metropolitan area. The interviewed persons were Pertti Kasanen, Director, End User Services, Nokia Networks 29.6.2005; Marja Räisänen, Development Manager, Messaging & 3 Party Applications, TeliaSonera Finland 28.8.2005 and via email Panu Lehti, Chief Operating Officer, Saunalahti 28.6.2005. Finnish was used in all of the interviews; thus, quotations are translations into English.

The interviewees were given an introduction to the process of creating industry scenarios. Then each of the scenario variables was discussed one by one. Finally the interviewees were given a task to name the three most uncertain but the most important scenario variables. Given list of causal factors were consulted to give more perspective for the choices.

6.3.1 Interviews

New proprietary standards

Panu Lehti listed problems that the proprietary standards face: terminal compatibility, interconnectivity between operators, uncertain factors relating to service continuity and impossibility to do competitive tendering for platforms and software. Pertti Kasanen saw that it is very important to connect to the Internet IM communities. According to Kasanen a probable scenario will be that the PC users will grab the service to their pockets. He also pointed out that the number of smart phones is too small to create any big movements. Marja Räisänen emphasised the need for uniform services to the terminals; it does not matter whether it is proprietary or not but how the customers see the service and what they are willing to pay for it are important.

Operator support

According to Lehti, operators are in a key role to provide the MIM service because of the user preferred way; transaction based pricing of the services cannot happen otherwise. Räisänen pointed out that operators need skilful partners that focus on certain areas, nonetheless operators have the customer connection and that is essential. She stressed that without the operator support it is fairly difficult to offer services; however, ports are open and good services are always needed. Regarding operators owning the customers' addresses, Räisänen noted that the operators do not necessarily even want to own these addresses. She pointed out that to some customer segments the operator may be the first contact and as a consequence may sell them a whole product. Kasanen, on the contrary, said that the mobile operators are easy to bypass and they will have to open their GPRS traffic to anything. Except for mega operators the walled gardens will not live long remarked Kasanen. He also noted that the operators have a really good billing machine; they are able to send a bill once a month.

Terminal support

Lehti saw that it is impossible to produce MIM services without the terminal support. Kasanen had same kinds of thoughts as he pointed out that it is decisive what is put into the mainstream phones. Räisänen said that the current preinstalled services do not compare with the downloadable applications that the first real users use. She stressed the importance of having a preinstalled, easy to use product on the mobile phone by saying that the mass does not load applications from the Internet to their mobile phones. She also pointed out that consumer market has to be considered as a bulk although services are made for certain niche groups.

Network support

Lehti pointed out that without the network support a service provider cannot offer transaction based billing of services. Kasanen considered a bit-pipe model feasible but saw that, for the IM service, a server is needed somewhere in the network; although the requirements for the server are not significant. Räisänen emphasised

the importance of security especially on the enterprise domain and as a consequence thought that it would be more difficult to launch a mobile service without the network support.

Interoperability

Lehti hoped there to be interoperability among the different communities. Räisänen saw connected communities as a vital condition for MIM. She considered interconnectivity towards the Internet communities also important but emphasised that the services and usage might be slightly different in the mobile and the Internet domains. Räisänen noted as well that a single service needs to be really good to succeed in the future and there will be more alternative communication services than just one service replacing SMS. According to Kasanen, interoperability is possibly the biggest open question in the IM world. Kasanen explained the possible architectures to solve the problem: the clients connect to several communities, the big four players exchange messages directly or a mediator handles the interoperability. Kasanen emphasised that if an operator will have a role in MIM it will connect its subscriber base with the ones of the Internet players.

Commitment

Regarding commitment Kasanen thought that the Internet players are surely interested in the mobile domain. He also stressed the importance of having the customer lockup; the one who looses that will be an access provider that is a bit-pipe. He encouraged taking a look at what happened with ISPs[67]. Räisänen also thought the Internet players to be very interested in MIM and the mobile operators as well since MIM should bring revenue and profit to the operators. She considered that it is merely a question of time when MIM will become a real business.

[67] Users moving from the ISP provided services like email to the Internet based services. Consequently, ISPs lost part of the customer lockup and the users were able to change their access provider more easily.

Technical solutions

From the technical perspective Lehti saw the biggest differences in the interoperability, service interconnectivity and possibly in the offered transaction based pricing models. Kasanen pointed out that the users would get the same features despite of the technology. He saw the architectural differences affecting somewhat OPEX (Operating Expenditure). Marja Räisänen considered the enterprise and consumer markets as different cases as for a large enterprise or for a small market one may sell a purely proprietary solution but for the consumer market interoperability is important in order to find the needed user base. Räisänen noted that MIM should be available as widely as possible in the upcoming terminals rather than the MIM solutions supporting the old terminal models currently on the market.

Service expandability

Lehti did not see a problem in expanding the standard based services. Also Kasanen thought that the MIM services should be easily scalable although he remarked that IM is very different from many other services as users may be logged in but stay idle for a long time. Räisänen saw that in the mobile domain it is more likely that the communication relies on the address book of the terminal and users can then choose which communication method to use; voice, SMS, MMS, MIM, PoC, email, etc. She stressed that in many user groups the choice is based in the end on price. She saw geographical expandability essential for the multinational operators like TeliaSonera.

Provider incentives

Lehti considered PoC and MIM services especially important for the operators in the competition against among others Skype and Microsoft. Räisänen stressed that all services that tie up customers to the operator are more precious than gold. She pointed out that an operator should link to the existing communities and services in order to lower the barrier for the customers to start this new thing. Räisänen described the operator's task to enable communities and allow them to grow as they grow and finally link the related new services to operator's core services. Kasanen

did not see currently a clear incentive for the mobile operators to offer MIM; in fact almost on the contrary the operators have an incentive to protect their SMS revenues. In the future Kasanen thought MIM would give a competitive advantage against the other local operators. Kasanen emphasised that SMS is a surprisingly widely spread service considering how awkward it is to use; consequently, giving a lot of competitive edge to other ways to do the same thing. He also pointed out that the US market has money to be shared as the message recipients pay as well.

User demand

According to Lehti the biggest problems hindering the MIM take off are terminal penetration and missing interconnectivity arrangements between the operators. He saw that the user demand already exists and the user base grows all the time. Kasanen predicted that, as in the Internet more IM messages are currently transferred than emails, it would not take too many years before more MIM messages are transferred than SMS messages. Kasanen stressed that without the Internet IM it would take couple of years more for MIM to exceed the critical mass; now one does not have to wait until the mobile domain alone has the critical mass. Räisänen saw that once the terminals are available and MIM takes off somewhere, it will grow fast and it will become popular. Räisänen pointed out that MIM is not a service for marginal groups. She discussed the future circumstances where more and more products and services will be available and as a consequence the usage and revenue share for a new product or service will be presumably smaller.

Service description

Lehti saw that the service description of the different service providers would be similar in the long run. According to Kasanen at least pricing will have even big differences. He also emphasised that if there will be differences in with whom one can communicate with it is clear which service provider will be chosen. Räisänen saw the service providers having different kinds of offerings to different target groups. She envisaged service packets to be common in the future.

Pricing model

Kasanen saw MIM as a good candidate for a flat fee based pricing model but adds that these issues are not that self-evident. He also saw the data usage based pricing feasible as the MIM service consumes very little data. Kasanen discussed the transaction based pricing and asked whether it makes sense as production costs would rise enormously; consequently, it leaves room for the other players to make better margin with the same price. He noted that it might still happen in some countries and under some circumstances. Räisänen pointed out that probably a single operator would have several pricing models. She thought SMS price would be too expensive for MIM. She discussed the problem of setting an appropriate message price to make MIM profitable to an operator, if the transaction based pricing would be chosen, as for example having the presence information costs money to the operator.

Clientele

Lehti pointed out that generally enterprises take services into use slower than consumers but most of the popular services will be taken into use very widely. Lehti saw that there would be demand for MIM in the enterprises since it helps them to make internal communications more effective. Kasanen remarked that the enterprise MIM popularity has huge differences between the countries with the US leading the way and the others coming way behind. Especially Kasanen noted the effect Microsoft will have on this; they are very strong on the enterprise IM, they are driving it hard and their Communication Server is so good that the others will have a hard time keeping up. Räisänen pointed out that she has not got expertise in the enterprise domain but believed that the deployment of MIM would be easier to start from the enterprise side as communities and use cases are readily in place and such new services are easier to push for the enterprise employees. She hoped that the enterprise users would take new services like MIM into use and as a consequence start using them also when in consumer roles. Thus these services would spread out to the consumer domain.

Choosing the most important scenario variables

The interviewees were given a task to choose the three most important scenario variables. The two most voted variables are chosen as a basis for the scenarios. Table 9 presents the choices of the interviewees. Terminal support and Interoperability were the two variables that were given two votes each. It is worthwhile to notice the wide dispersion among the choices. This can be taken as an argument stating that MIM is in an immature state and its future is still open.

Table 9: Most important scenario variables

SCENARIO VARIABLE	KASANEN	RÄISÄNEN	LEHTI	OVERALL
New proprietary solutions				
Operator support	X			1
Terminal support	X	X		2
Network support				
Interoperability		X	X	2
Commitment			X	1
Technical solutions	X			1
Service expandability				
Provider incentives				
User demand		X		1
Service description				
Pricing model			X	1
Clientele				

6.3.2 Assumptions

According to Porter there are four factors that should govern the choice of the assumptions: the need to bound the uncertainty, regularity of the impact on the structure, managers' beliefs and practicality [Porter 1985]. Assumptions are next made from the two chosen scenario variables: Terminal support and Interoperability.

Terminal support

The two extremes are clearly that there either is support from terminal manufacturers or there is not. The third option is that part of the manufacturers support but the rest do not. But as the impact on the structure is predictable between the two extremes this option may be left out. Consequently, the extreme assumptions are enough to cover the implications for the industry structure.

Interoperability

Once again there are two extremes, namely there is interoperability among all the communities or there is no interoperability. There are other major discontinuities as well. There can be interoperability among all or part of the Internet IM providers. Correspondingly there can be interoperability between the mobile operators' communities.

Resulting four assumptions for Interoperability are:

- No
- Among mobile operators
- Among Internet communities
- All

6.4 Combining Assumptions into Internally Consistent Scenarios

A scenario should be an internally consistent view of what the future industry structure could be [Porter 1985]. Qualifying only the independent uncertainties as the scenario variables was the first step towards internal consistency. Another step is to consider which of the combinations of the assumptions are internally consistent. Two scenario variables were chosen so their assumptions will be compared.

All of the combinations of the assumptions are not mutually consistent as shown in Figure 7. There are two combinations that are eliminated. In most cases the mobile operators have power to control what is preinstalled on the mobile terminals. That is why it is unlikely that the operators will have interoperability in large scale without terminal support. This eliminates the combinations of interoperability among

mobile operator communities without terminal support and interoperability among all players without terminal support. Six consistent scenarios are left for further analysis.

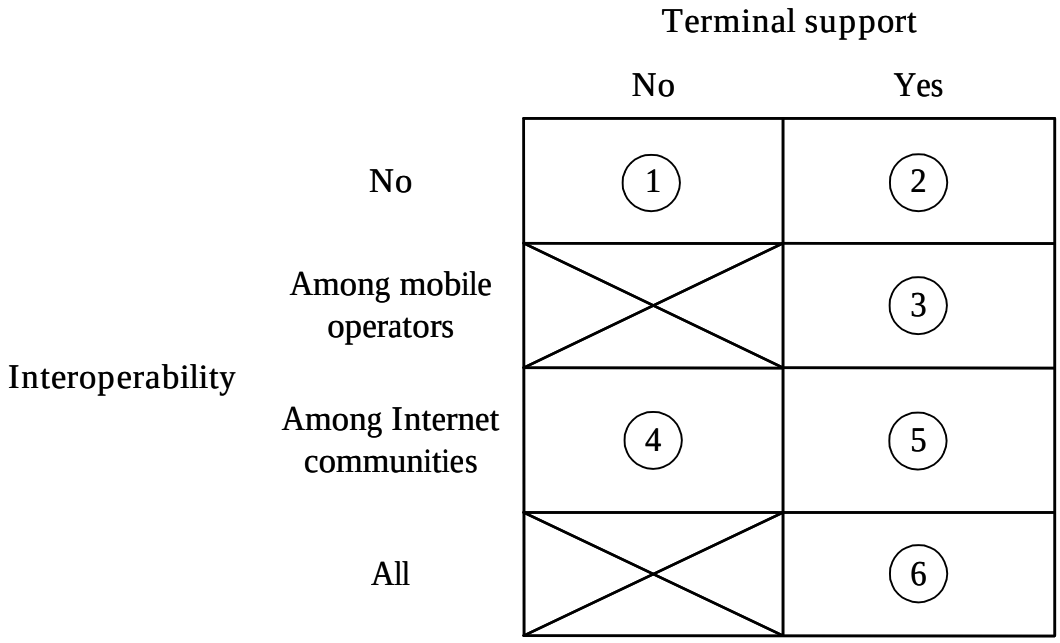


Figure 7: Consistent scenarios

6.5 Analysing the Industry Structure

Scenario analysis is started with analysing the future industry structure and the industry structural attractiveness under each of the six consistent scenarios. Michael Porter's five forces analysis is used to determine the future industry structure under each scenario.

Scenario 1 "Niche service"

MIM would be a lot like it is currently. Market opportunity exists for new entrants through service differentiation while an acquisition is a possible method of entry. MIM is an opportunity for operators that are seeking expansion and first mover advantage is still available. However, substitute services like for example chat exists as part of the other services such as PoC. Offered services need to meet the user expectations as users are likely to switch to a better service if one comes available.

All things considered the industry structure is not sustainable if unsatisfied players exist. The structural attractiveness is high especially for the players that are seeking new opportunities.

Scenario 2 “Isolated islands”

MIM communities would remain mostly isolated islands, meaning that communication between the different communities would not be possible. Terminal support creates entry barriers; consequently, existing large clientele is needed to enter the MIM market. Cooperation may bring new customers and more usage but may also lead to a fierce market share game. Yet switching costs are high if preinstalled services are satisfactory. The big four players are powerful especially when the terminals support their services. In summary the structural attractiveness is low.

Scenario 3 “Operator communities dominate”

Operators would have a strong position and MIM would be a true mobile messaging service like SMS and MMS. Offering access to the Internet communities is an opportunity for new entrants. The big Internet players see MIM as a potential access method to the mobile domain; therefore, acquisitions especially by the Internet players are possible. Mobile operators that are seeking disruption may start to compete with price or connect their communities with the Internet players and as a consequence unbalance the market. Most of the users are likely to use the preinstalled service; consequently, the big four players have little power over the mobile operators. The structural attractiveness is moderate.

Scenario 4 “Privilege of few”

The Internet and the mobile domains would continue to evolve apart. Exploitable potential exists in MIM and the Internet communities create an opportunity for new entrants. Even the small operators can create disruption by connecting their users to the Internet communities. As MIM is not widely available, SMS chat is a substitute

service for the cellular customers while switching costs are low. The structural attractiveness is high.

Scenario 5 "Mobiles access Internet communities"

Users would be able to connect to the Internet IM communities with any device and any access. The big four players are powerful as huge communities are needed; therefore, entry barrier to the industry is high. User's choice is based on price and service characteristics. The structural attractiveness is moderate.

Scenario 6 "All access"

Mobile operators cooperate with the Internet players to offer truly global and access independent IM service. Entry barriers are high and rivalry shifts towards price war. As no big differences exist on service pricing, active users search for the best overall offering. The Internet players become more powerful over the time due to the service portability. The structural attractiveness is low in the long run.

6.6 Determining the Sources of Competitive Advantage

Scenario 1 "Niche service"

The sources of competitive advantage are basically the same as currently. More usage can be gained through service differentiation and in particular through attractive pricing. "Good" competitors[68] share the costs of market development for example through battling substitutes. Competitors can also benefit from each other's advertising. The consumer market can be accessed with a better usability, which will lead to shift towards Scenario 2.

[68] Porter describes "good" competitors as the ones that can serve a variety of strategic purposes that increase a firm's sustainable competitive advantage and improve the structure of its industry [Porter 1985].

Scenario 2 “Isolated islands”

High initial market share and national economies of scale are the sources of competitive advantage. Choosing the target segment and differentiating accordingly through features, usability and level of service is important. The cost of differentiation should nevertheless be kept as low as possible especially as the markets are limited. Competitors can be valuable if they serve different segments and also if they together can drive the market demand.

Scenario 3 “Operator communities dominate”

Pricing and national scale economies are the main sources of competitive advantage. Usability should be at least on the level of SMS and MMS services in order to drive the usage. Common user interface for all messaging services can be a source of competitive advantage for the mobile operators and also for the terminal manufacturers. Operator’s experience and know-how from other mobile services may help to go down the learning curve faster. Finally advertising benefits all operators on the market.

Scenario 4 “Privilege of few”

Usability and proprietary extra features are the sources of competitive advantage for the Internet players. Ability to communicate with as many methods as possible with other devices in the Internet than just the mobile terminals is important. Low cost structure is required in order to generate profit from the relatively small-sized clientele. Operators’ competitive advantage can be either to invest in substitute services or to cooperate with the Internet players while keeping the customer lockup.

Scenario 5 “Mobiles access Internet communities”

Competitive advantage is based on attractive pricing and usability. A possible differentiating factor can be attaching MIM more closely to the operator’s other

services. A massive community is a requirement in order to connect it to the interoperable domain. Furthermore, global coverage gives strategic advantage.

Scenario 6 "All access"

Low cost structure and high market share are the fundamental sources of competitive advantage. Global scale economies are needed for example in advertising. Potential new entrants may abandon the entry if they see strong players blocking the paths to enter the industry. For an operator finding the right target segment matching its capabilities and overall strategy is essential as certain segments can be packed with competition. However, skilled and motivated employees can create innovative features that help to attract and sustain users.

6.7 Predicting Competitor Behaviour

Competitors affect the MIM industry structure; consequently, competitors need to be taken into account when analysing scenarios. The future industry structure under each scenario will usually have different consequences for different competitors [Porter 1985]. The major competitor uncertainties under each scenario need to be studied in order to cover all the industry outcomes that might occur.

Scenario 1 "Niche service"

The market situation is unstable and the entry barriers are low; therefore, the mobile operators that seriously offer MIM service might be unsatisfied with the market situation and as a consequence would want to change the market dynamics.

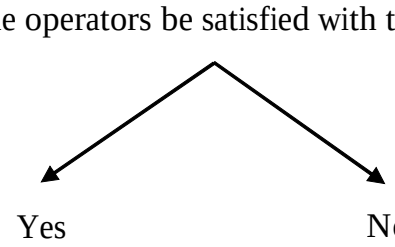


Figure 8: Major competitor uncertainty under Scenario 1

Scenario 2 “Isolated islands”

The big four have the needed resources to invest in the mobile domain in large scale. Especially as no MIM interoperability exists, the big four may see this as their opportunity to enter the mobile domain.

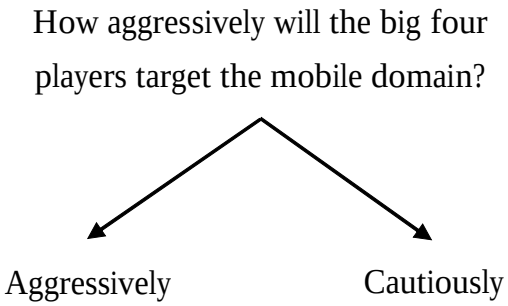


Figure 9: Major competitor uncertainty under Scenario 2

Scenario 3 “Operator communities dominate”

Traditionally the mobile operators have been competing on voice call and SMS message prices. MIM would be a natural next step to compete on for the operators that are operating on a low cost structure.

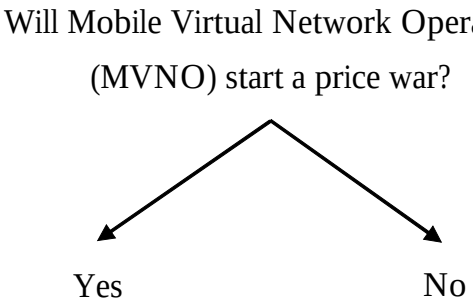


Figure 10: Major competitor uncertainty under Scenario 3

Scenario 4 “Privilege of few”

As exploitable potential exists in MIM, the big four players may try to bypass the mobile operators and start a direct co-operation with the terminal manufacturers in order to drive their service offering also for the mobile domain.

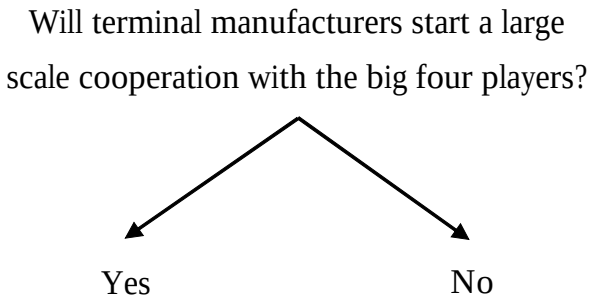


Figure 11: Major competitor uncertainty under Scenario 4

Scenario 5 “Mobiles access Internet communities”

Mobile operator’s role is questionable if they cannot bring additional value for the MIM service. Their most valuable asset in this case is their billing relationship with the consumer. From the user’s perspective it makes a notable difference whether they have to pay the operator for the MIM service or whether the service itself is free and they pay only for the used data connection. Consequently, the user groups and the usage patterns will depend on the charging schemes.

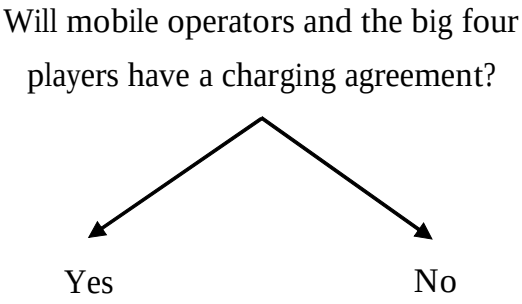


Figure 12: Major competitor uncertainty under Scenario 5

Scenario 6 “All access”

New features and services become more important through a possible price war. The big four players may try to exploit their broad Internet service offering and port these services to the mobile domain. This could affect the mobile services beyond MIM and change the relative strengths of the big four and the mobile operators.

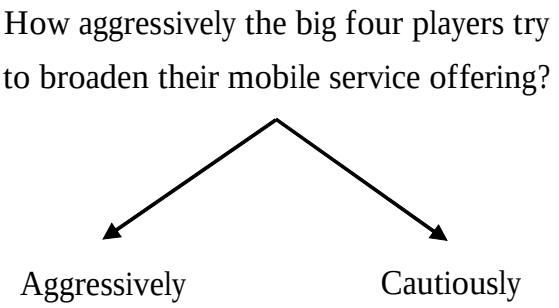


Figure 13: Major competitor uncertainty under Scenario 6

SCENARIO 1
"Niche service"

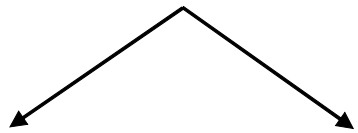
Future Industry Structure	Market opportunity for new entrants through service differentiation. Acquisition a possible method of entry. Expansion an opportunity for operators. First mover advantage available. Substitute services like for example chat as part of other services such as PoC. Users likely to switch to a better service if one available. All things considered the industry structure not sustainable if unsatisfied players.
Structural Attractiveness	High especially for players seeking new opportunities.
Sources of Competitive Advantage	Basically same as currently. Service differentiation. Attractive pricing. "Good" competitors benefit the whole industry. Consumer market accessible with better usability, which will lead to shift towards Scenario 2.
Competitor Behaviour	Will mobile operators be satisfied with the situation?  Yes No

Figure 14: Analysis of Scenario 1

SCENARIO 2
"Isolated islands"

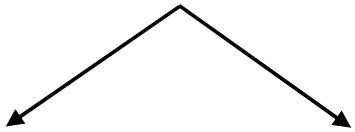
Future Industry Structure	Terminal support creates entry barriers; consequently, economies of scale needed to enter the market. New customers and more usage through cooperation – fierce market share game. Switching costs high if preinstalled services satisfactory. The big four players powerful in case the terminals support their services.
Structural Attractiveness	Low
Sources of Competitive Advantage	High initial market share. National economies of scale. Choosing target segment and differentiating accordingly. Keeping cost of differentiation low. Competitors serving different segments.
Competitor Behaviour	How aggressively will the big four players target the mobile domain?  Aggressively Cautiously

Figure 15: Analysis of Scenario 2

SCENARIO 3
"Operator communities dominate"

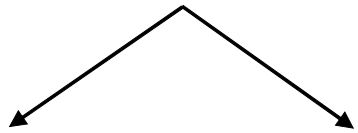
Future Industry Structure	Offering access to the Internet communities an opportunity for new entrants. Especially acquisitions by the Internet players possible. Disruption through price competition and connecting to the Internet players. Most users use preinstalled service. The big four players have little power over the mobile operators.
Structural Attractiveness	Moderate
Sources of Competitive Advantage	Pricing. National scale economies. Usability on the level of SMS and MMS. Common user interface for all messaging services. Know-how from the other mobile services. Advertising benefits all operators on the market.
Competitor Behaviour	Will Mobile Virtual Network Operators (MVNO) start a price war?  Yes No

Figure 16: Analysis of Scenario 3

SCENARIO 4
"Privilege of few"

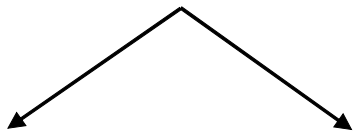
Future Industry Structure	Exploitable potential in MIM. Internet communities an opportunity for new entrants. Disruption by connecting an operator community to the Internet communities. Substitute services offer chat service for cellular customers. Low switching costs.
Structural Attractiveness	High
Sources of Competitive Advantage	Usability. Proprietary extra features. Ability to communicate broadly also with Internet devices. Low cost structure. Operators' can invest in substitute services or cooperate with the Internet players while keeping the customer lockup.
Competitor Behaviour	Will terminal manufacturers start a large scale cooperation with the big four players?  Yes No

Figure 17: Analysis of Scenario 4

SCENARIO 5
"Mobiles access Internet communities"

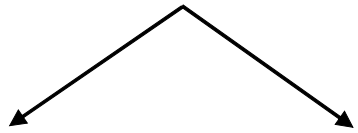
Future Industry Structure	High entry barrier. MIM closely connected to the operator's other services. User's choice base on price and service characteristics. The big four players powerful.
Structural Attractiveness	Moderate
Sources of Competitive Advantage	Attractive pricing. Usability. Attaching MIM more closely to the other services. A massive community needed to connect it to the interoperable domain. Global coverage.
Competitor Behaviour	Will mobile operators and the big four players have a charging agreement?  Yes No

Figure 18: Analysis of Scenario 5

SCENARIO 6
"All access"

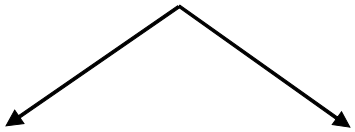
Future Industry Structure	High entry barriers. Rivalry shifts toward a price war. Active users search for the best overall offering. Internet players become more powerful over time due to the service portability.
Structural Attractiveness	Structural attractiveness is low in the long run.
Sources of Competitive Advantage	Low cost structure. High market share. Global scale economies. Blocking paths for new players to enter the industry. A right target segment matching capabilities and overall strategy. Innovative features – Call for skilled and motivated employees.
Competitor Behaviour	How aggressively the big four players try to broaden their mobile service offering?  Aggressively Cautiously

Figure 19: Analysis of Scenario 6

7 Discussion

Each of the six industry scenarios constructed in this thesis describes different future industry structures. Naturally these scenarios are not equally likely to happen in the future. After constructing the scenarios, the interviewees were asked to rate the scenarios in relation to how probable it is that they become reality in the future. Only one interviewee was able to give the probabilities. Scenarios 5 and 6 were the most probable ones with 30 % and 50 % of the total share correspondingly. All the other scenarios got under 10 % shares; scenario 4 having the lowest probability with two percent share. These probabilities imply that interoperability will most likely happen. The interviewee also noticed that in addition to the geographical location of the market also the price category of the phones has an affect on the probable industry structure.

The evolution path that a MIM industry may take can be discussed as well. Some of the industry structures are less probable to sustain in the long run than the others. For example the industry structure that prevails under the scenario 1 is not sustainable if unsatisfied actors exist. Generally a shift is more likely to happen towards the scenario 6 where there is interoperability among all communities and terminal support than towards the scenario 1 where there is neither interoperability nor terminal support. It is also probable that there will be shifts in all of the markets, meaning that the industry structure evolves from one scenario to the other and so fort.

Many of the issues affecting MIM can be generalised to all mobile data services. These issues are mostly not handled in this thesis. One of these issues is always on connectivity with the minimal bandwidth requirements, which is problematic for the

mobile operators. The cellular networks are not designed for connections that are always active. Furthermore, persistent connectivity drains the battery swiftly in the mobile devices. Another issue is that currently only the smartphones are capable of running applications and a data connection in the background constantly. Therefore, most probably it will take some time before MIM takes off at least among the low end phone owners. Finally WBA technologies have usually a flat rate or a time based charging meaning that it does not matter how much bandwidth is used. However, mobile applications are optimised for the cellular networks where the charging is mostly based on the used bandwidth. Therefore, the mobile phones have services that are not designed to benefit from the possible broadband access. Presence is a good example of that kind of service. It has to be minimised for cellular access but could be exploited once WBA is used.

The mobile operators' have a decisive role in the future of MIM. If mobile operators start driving the usage, MIM sessions may be initiated directly from the phone's contacts like phone calls or text messaging. Having the MIM service as a separate application in the phone will prevent the service from succeeding in the mass market. Needed configuration should be on the level of the Internet messenger applications[69] in order to lower the threshold of starting the usage. In most markets the mobile operators have control over the mobile phones and as a consequence can influence strongly these matters.

[69] Username and password.

8 Conclusions

Instant Messaging is widely used in the Internet but has not yet penetrated the mobile domain. Some service providers have started offering Mobile Instant Messaging but the take off has still been low. The research problem of this thesis was to predict the future MIM industry. To attain this problem, six industry scenarios for Mobile Instant Messaging were constructed. Based on the conducted interviews, terminal support and interoperability among different communities were found as the most important scenario variables affecting the future MIM industry.

The resulting industry scenarios show that the big four service providers' role is likely to increase in relation to the amount of interoperability there is among the communities. This does not mean that the mobile operators should avoid the Internet communities in order to keep control over their customers. On the contrary, the scenarios show that cooperation with the Internet players is a source of competitive advantage for the mobile operators under certain industry structures. Service usability is an important aspect especially till the MIM service gets popular. The results also highlight that competitors can be beneficial to the whole industry particularly when the industry is still immature. Entry barriers are lowest when the terminals do not support MIM.

The industry scenarios presented in this thesis can be used for constructing more specific strategies for example at a company level. This thesis gives six possible future views for building the strategies. These scenarios, although not specifically made for a certain market or region, are made from a Finnish viewpoint. However, the results should be applicable almost directly to at least West European markets where the market situation and culture are similar to Finland.

The industry scenarios framework used in this thesis is developed by Porter. The framework is well-established and leaves little room for interpretation. Three interviewees were used in this thesis to find the used scenario variables. Conducting more interviews could give a more comprehensive picture of the industry. However, if the purpose is to understand a certain situation more thoroughly interviewing a couple of persons can bring significant information [Hirsijärvi et al. 2004b]. The interviewees represent different actors on the mobile messaging market; consequently, they give a broad view of the industry.

In the future more extensive research could be made by choosing more or different scenario variables. That would probably give somewhat different set of consistent scenarios. Also the number of assumptions has an effect on the resulting scenarios. Required level of detail should determine the number of chosen variables and assumptions.

An interesting future research topic would be to study how revenue from the other mobile services, especially the mobile messaging services, would be affected under each of the six scenarios constructed in this thesis. However, these studies would be strongly dependent on the mobile operator or the service provider in question.

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