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WAP OFF - Origin, Failure and Future

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Background

There are altogether 640 million GSM subscribers in the world and one tenth of them have Internet-enabled WAP phones although they rarely use their phones to access mobile Internet, although the use of SMS has become prevalent among users. KDDI in Japan has some 7 million WAP users and this number may actually equate the number of active WAP users outside Japan.

Should this be considered a failure, which is not admitted by the WAP proponents? NTT DoCoMo in Japan, by contrast, already has 22 million active users of mobile Internet – through its i-mode services, which are expected to yield 16 per cent of total revenue during the ongoing fiscal year.

The demand for increased mobility has become greater than ever before over the last few years and almost all countries are now experiencing phenomenal growth in the mobile communication sector. Sweden and Finland are often seen as being at the forefront of developments of mobile telecommunications but has hardly been in the vanguard in the development of user friendliness in mobile Internet and wireless applications.

Mobile Communication comprises services, information, products and technology that reduce our dependence on place, time and equipment. Some futurists suggest that in a few years many of us will be permanently connected to the Internet as a result of the next generation of mobile phones or other mobile devices. This in turn will generate a high increase in demand for products and services within e-commerce, finance, media, entertainment etc.

The global market for providers of e-commerce solutions and information for the mobile Internet will be around US\$ 300 billion per year by 2005, according to a Merrill Lynch estimate. The same source suggests that mobile Internet has the potential to generate an increase in revenue of around US\$ 180 billion per year for operators, and that the number of global users of wireless Internet could expand from 25 million users in late 2000 to 1.5 billion by 2005.¹

The introduction of WAP – Wireless Application Protocol – was by many seen as a first important step to enter into the mobile Internet era. This belief was further strengthened by a presence of two promoters of the WAP concept – Ericsson and Nokia - already so successful of promoting the GSM standard not only in Europe but also in many other parts of the world.

Nothing can beat a successful defacto standard. The audio cassette developed by Philips and Sony, the VHS video standards from Matsushita and GSM developed among European telecom companies are striking examples. The founders of WAP Forum in originally thought that they had created another successful defacto standard.

¹ Merrill Lynch; Mobile Industry Update, September 2000

Wall Street Journal in late 1999 optimistically described the background of WAP and offered the following comments.²

Certainly, WAP-ready phones won't be widely available overnight. The services available to them still are relatively few, and wireless operators will need to upgrade parts of their networks so that downloading a Web page over the airwaves doesn't require a long wait. But industry expectations are high, as scores of companies race to become part of the WAP world.

The Wireless Application Protocol (WAP) is the outcome of efforts undertaken by a small group of companies organising an industry that has become known as the WAP Forum. The objective of the forum has been to create a license-free standard that makes available information and telephony services to wireless devices. To access these services WAP utilises the Internet and the World Wide Web concept.

The far-reaching deregulation of the telecom market in EU in 1992 changed the market situation for mobile telephone operators. They were looking for possibilities to compete with services and not on costs that would force them to major reduction in their staff employment. Around 1997 there were three rudimentary and competing technologies that were the forerunners of WAP.

Ericsson in 1995 started a project with the objective to develop a general protocol, or rather a concept, for value added services on mobile networks. The protocol was named Intelligent Terminal Transfer Protocol (ITTP), and would handle the communication between a service node, where the service application is implemented, and an intelligent mobile telephone. Ericsson at the time had the ambition to make ITTP a standard for value added services in mobile networks.

Unwired Planet, Nokia and several other companies developed and launched during the following years, 1996-97, additional concepts for value added services in mobile networks. For example Unwired Planet presented Handheld Markup Language (HDML) and Handheld Device Transport Protocol (HDTP).³ Nokia had also been very active and in March 1997 presented their Smart Messaging concept, which was an Internet access service technology that was specially designed for handheld GSM devices.⁴ In the Nokia concept Short Messages Services (SMS) was used for the communication between the mobile user and the server containing Internet information. Furthermore, Nokia used a markup language Tagged Text Markup Language (TTML) that similar to HDML was adapted for wireless communication. It existed only as narrowband connections. So, in early 1997 there existed at least three concepts which all had the objective of offering Internet services to users of mobile devices.

² That's a WAP – How the Cell Phone and Web Contracted an Arranged Marriage, Gautam Naik, Wall Street Journal, November 10, 1999

³ The HyperText Markup Language (HTML) is used on the WWW, while HDML is used for describing content and user interface optimised for wireless Internet access from handheld devices, which have small displays and limited input facilities. Thus, Unwired Planet argued that their HDTP could be considered to be a wireless equivalent of the HyperText Transport Protocol (HTTP), which had become the Internet standard. The expectation was that HDTP would be the lightweight protocol to perform client-server transactions.

⁴ WAP White Paper, AU-System Radio, February 1999

1. Ericsson had developed ITTP with a strong bearing on voice communications, which reflected that the company was telecom-oriented with a focus on remote control through the network where the operators of mobile telephony were in charge.
2. Nokia started developments at an early stage but Smart Messaging, a service similar to SMS, was announced rather late in the day. The approach was based on telephone-to-telephone relations.
3. Unwired Planet (UP), a small start-up company with some 40-50 people, located in RTD in California, had developed the HDML concept, which was basically a browser, based on the Internet paradigm. UP had approached AT&T, Motorola, Alcatel and Mitsubishi and the first two entered into partnerships with UP.

Thus, there existed a considerable risk that the market for mobile Internet would become fragmented as a multitude of concepts might be promoted. The key contenders realised that they would not benefit from such a development, and the stage was set for an intensive series of meetings and discussions that would eventually and also quickly lead to a common approach – The WAP Forum.

Ericsson was faced with a serious dilemma. With 280 mobile operators at the time Ericsson would have to develop unique services for all of them if Ericsson wanted to remain in a global market to serve telecom operators with systems for the future. This would require in the region of some 5,000 engineers within Ericsson (20x280) to develop unique services for each operator. Ericsson realised that it would be desirable to provide a common platform for applications – similar to the situation for personal computers – as more and more operators were entering the market. Thus, Ericsson at the end of 1996 decided that it should try to merge the different approaches. Ericsson made an assessment of the three major approaches and wanted to find a solution that would combine three perspectives:

- Operator perspective
- Telephone-to-telephone
- Content

The Prophets and the Creation of the WAP Forum⁵

Concept Development at Unwired Planet

In the process leading up to the WAP Forum there was two sets of drivers. The smaller one was the group of management and business people and there were four key people - from Ericsson, Unwired Planet (now Openwave), Nokia and Motorola. The larger group was composed of some 20 engineers from the same companies. All major makers of mobile handsets had since the mid-1990s actually been looking for a

⁵ This article owes its existence to an interview in March 2000 with Mr. Joakim Nelson, then at Ericsson, who gave an illuminating account of the early stages in the creation of the WAP Forum. Before finalizing this article he gave me additional insights and also suggested other principal actors in the process. On his advice I had the opportunity to interview Mr. Chuck Parrish one of the two founders of Unwired Planet, Per Ocklind formerly at Ericsson and Mr. Ilkka Raiskinen of Nokia Mobile Applications. In the meantime I had the privilege of being guest researcher at the National Institute for Science and Technology Policy (NISTEP) in Tokyo, which gave ample opportunities to meet many of the actors that have propelled Japan to the frontline of mobile Internet.

viable Internet concept and Unwired Planet had established contacts with all of them. Ericsson in 1997 initially took a leading position that made a major contribution to the formation of the WAP Forum the following year – with full participation from Nokia and Motorola.

Alain Rossman and Chuck Parrish had created the Unwired Planet (UP) company in June 1995 at the time when Internet was emerging at the horizon – preceded by Mosaic and a little later with Netscape that for some time would become the dominant Internet browser. UP started to create the architecture and to develop a protocol for mobile Internet, and obtained a patent for a browser that could be included into a mobile phone. AT&T became the first customer for Unwired Planet, followed by GTE, which was part of Bell Atlantic, and UP started to look for European customers.

Selling the Concept to Equipment Makers

Unwired Planet's engineers at the outset had a dream creating a "minibrowser" for cell phones and laboured to write the complex software that was required. Then Netscape Communications Corp. started to market an easy-to-use Web browser for PCs. Suddenly the Internet was available to anyone with a moderately powerful computer and a clear phone line. This spurred Unwired Planet to look for a global market.

However, many others identified the need to connect mobile devices to the Internet. Ericsson had started early and their engineers were busy to create their own software for Web phones. The efforts had sparked a heated debate within the company. Would it make sense for Ericsson, with 45% of the market for cellular gear based on the dominant European standard, to use its pull to promote its own technology as a global standard. The critical crowd within Ericsson brought forward two arguments. First, Unwired Planet already had a sophisticated system. Second, a cooperative effort would yield an open standard and create a much bigger market for everyone. Before making their decision Ericsson invited Rossman and Parrish of Unwired Planet to come to Stockholm for an open discussion.

This very first meeting between Ericsson and Unwired Planet, in the spring of 1997, was friendly⁶, if occasionally tense⁷. The entrepreneurs, Rossman and Parrish, met with several Ericsson product managers and took turns walking up to whiteboard and drawing elaborate pictures of their companies' approaches. It turned out that Ericsson people were impressed by UP achievements, and offered a proposal. Would Unwired Planet be willing to work with Ericsson to create a global standard? Ericsson would contribute some of its proprietary technology and also would persuade its Finnish rival Nokia and others to join the efforts.

⁶ The account of the early Stockholm meetings is based on the Wall Street Journal article of November 10, 1999.

⁷ WSJ reports

The proposal took the two California entrepreneurs by surprise. "We were a young company, and Ericsson was a giant. I wondered whether we were going to get crushed," says Mr. Rossman, chief executive of Unwired Planet. Adds Mr. Parrish: "It was a big decision: Did we want to contribute our crown jewels to a public standard?" Christer Erlandsson of Ericsson Infrastructure was one of the participants.

The two managers from Unwired Planet asked for a break, and during a 20-minute walk along the corridors of Ericsson's office, they came to a conclusion. If they didn't collaborate, big manufacturers might create a global standard anyway, and Unwired Planet would be entirely locked out. So, Unwired Planet agreed to collaborate with Ericsson to create an open standard. But an even bigger hurdle lay ahead. Ericsson had to persuade Nokia to join. As Nokia was already the world's No. 1 cell-phone maker, Nokia wielded tremendous clout in the wireless industry and the Finnish company didn't exactly like the Ericsson plan. One reason was that Nokia had quietly developed its own micro browser, Smart Messaging, and already launched a Web phone. Its 8110 model, unveiled in March 1996, impressed the industry as rivals got a glimpse of where wireless was headed.

Unwired Planet based in California had previously established contacts with Ericsson in Research Triangle Park, where Parrish and Rossman had met with Nils Rydbeck in charge of handset development and his collaborator Billy Moon. The concern at Ericsson at the time was the need to find a way to link the infrastructure system with the cell phones and the company had for some time been developing ITTP, which could be incorporated as an agent inside the handset. However, Ericsson was concerned about the risk that there would be a multitude of approaches, as Ericsson wanted to have only one generic client installed into the handsets.

Smart Messaging, developed by Nokia, was in certain ways better than ITTP but many features were missing. However, there was little overlapping between the three approaches and Joakim Nelson (JN) of Ericsson discussed the matter with Janez Scubik who was responsible for strategy at Ericsson Infrastructure Technology. They came to the conclusion that it might be possible to combine all three approaches.

Thus, (JN) approached the other contenders and Rossman and Parrish of Unwired Planet immediately agreed to come to Stockholm (Kista) for further discussions⁸. UP had already been in discussion with Nokia and Motorola, as the previous meeting in March 1997 had been an encounter only between Ericsson and Unwired Planet. UP agreed, after the discussions referred to, to join forces with Ericsson to develop an open standard, on the assumption that other key actors would also join. Following this tentative agreement for an open standard Joakim Nelson contacted Björn Kylander at Nokia who agreed to send people for a joint meeting. This get-together took place very shortly afterwards – in spring 1997, and Mr Pitälä participated as the key negotiator from Nokia. However, Nokia remained sceptical to the proposal from Ericsson and Unwired Planet.

Acceptance by Ericsson and Others

In May, managers from Ericsson and Nokia met to explore the global standard idea. Mr. Mikko Terho, the chief Nokia negotiator and vice president for wireless data, was very reluctant to join and argued that his Smart Messaging developed by Nokia could do everything Unwired Planet's system promised. He was also against the business concept proposed by Unwired Planet to charge wireless providers \$1 for each handset

⁸ Christer Erlandsson of Ericsson Infrastructure was one of the participants.

that included its technology,⁹ and for some time Nokia remained very doubtful about joining the proposed consortium. But the balance of power shifted a few months later, when Motorola joined the Ericsson-Unwired Planet team. Moreover, Ericsson was able to bring in more supporters, including Alcatel in France and Matsushita Electric Industrial in Japan. Ericsson was very dedicated to establish an open standard and reasoned with Nokia in the following way. “Either join or risk being out of the biggest thing to happen to wireless industry in years.”

Nokia remained undecided, when the creation of the new wireless club, WAP Forum, was about to be announced. So, two separate news releases were prepared - one that included Nokia's name and one that didn't. Only minutes before the announcement, Nokia decided to join.¹⁰ However, the battle was not yet over as Microsoft remained outside. Naturally the dominant software company was keen to provide new software products for the new breed of Internet cell phones. The WAP proponents were worried that if Microsoft didn't join, the entire project could come to a standstill.

In the autumn of the same year AT&T hosted a meeting in Seattle where both engineers and business people from the main contenders assembled. After a struggle which lasted for several days the four companies and some 20 engineers reached an agreement on the architecture. These results were at an open meeting in Vancouver in April 1998 announced as the WAP Forum that was soon afterwards followed by the official launching in London.

It did not take long before Motorola formally joined the three early promoters and a news conference was held in London in spring of 1998, attended by some 150 journalists – to announce the establishment of the open WAP Forum. At the time WAP basically consisted of only concepts with very little specifications. It was necessary to open up the WAP Group in order to avoid anti-competition litigation. So, it was essential to find a proper form of organisation to promote WAP. The operators had already become concerned and demanded that WAP should be included in the normal telecom standardisation procedures. Thus, the early promoters realised that it would be necessary to establish a company – WAP Forum¹¹ Ltd (UK) – that originally had four directors with limited liability (only £1 each).

In October 1998 Cameron Myrsvold, then vice president of Microsoft's Internet customer unit, explained that his company didn't want to join WAP because the WAP idea was only for cell phones. Microsoft preferred a standard that could also link the Internet to a host of other devices, from TV set-top to game consoles.¹² At the same

⁹ Ericsson made it all clear to UP from the very beginning, that Ericsson would never accept a business concept including license fees as Ericsson only could accept a "free protocol", and Nokia strongly supported this viewpoint. Subsequently Unwired Planet later dropped the idea, deciding instead to make money by developing Web-phone services. (That's a WAP – How the Cell Phone and Web Contracted an Arranged Marriage, Gautam Naik, Wall Street Journal, November 10, 1999)

¹⁰ WSJ

¹¹ This type of organisation represents pre-competitive co-operation. Patents are owned by individual firms but may not block WAP and must be made available on fair and reasonable terms, which means that patents costs may not exceed 3 per cent of product price. (cf ETSI rules). There are two types of patents. One is essential patents that control methods.

¹² WSJ

time Microsoft conceded that WAP had achieved "a tremendous amount of momentum, it was a very difficult decision".¹³

The WAP group agreed to a compromise and offered WAP to become compatible to technology devised by an Internet standard-setting body called W3C. Thus, WAP would become part of a much larger universe of devices that could be linked to the Internet. Subsequently Microsoft agreed in May 1999 to join the WAP Forum and contribute to its efforts. It should also be mentioned that NTT DoCoMo is a member of WAP Forum, and in fact even have a seat at the Board of Directors

Launching of WAP Forum and its Evolution

On June 26 1997 four companies – Ericsson, Motorola, Nokia and Unwired Planet took the initiative to start a speedy creation of a standard that would make Internet services available to users of mobile devices .In the following December the WAP Forum was formally established, and the Forum was open to all members after the release of the WAP 1.0 specifications in April 1998. In early 1999 the WAP Forum had enrolled close to 100 members. The main objectives of the WAP Forum are

- To be open to all parties
- To be in direct relation to the relevant standard bodies
- To be independent of wireless network standards
- To enable applications to be scaled across transport options such as GSM, IS-95 and PDC
- To enable applications can be scaled across various mobile devices such as cell phones, PDAs etc.
- To become extensible over time to new networks such as 3G

The Wireless Application Protocol (WAP¹⁴) is an open, global specification that permits mobile users with wireless devices to access and interact with information sources and services. The primary goal of the WAP Forum is to bring together companies from all segments of the wireless industry wireless industry value chain. The Forum members represent more than 95 per cent of the global handset market, and carriers with more than 200 million subscribers have become members.

The WAP Forum began with four founders and has in mid-2001 grown to more than 500 members that include all major telecom companies, IT and software companies from around the world. WAP Forum provided the catalyst for this particular area of convergence and very quickly attracted many innovative organisations. The WAP Forum states that¹⁵

By having a board structure well balanced between carriers and vendors representing major regions and technologies, WAP Forum has been successful in avoiding standards conflicts and the resulting fragmentation of the wireless Internet. If there is a browser war, adoption will slow at all levels. If the application space is fragmented, content providers will not deploy as much

¹³ Comments by Kevin Dallas, head of Microsoft's wireless-phone business unit, according to WSJ article

¹⁴ <http://www.wapforum.com/faqs/index.htm> June 29, 2001

¹⁵ F&Q Extracts from WAP Forum web site, June 29, 2001

content. Carriers will have to worry about supporting incompatible phones and manufacturers will either have to build redundant technologies at a higher cost or address only a portion of the potential market. WAP Forum is on track to avoid fragmentation through building strong wireless industry consensus.

WAP is a communications protocol and an application environment and can be built on almost any operating system. The WAP Forum states that its number one goal is to foster the implementation of one compatible, global Internet standard for small handheld devices in all wireless networks. It has established strong relationships with W3C and ETSI and has also ensured support in Japan where one of the three cellular operators is using the WAP protocol in its mobile Internet services.

On the future and the after 3G introduction the WAP Forum has the following to say¹⁶

Even as bandwidths increase, the cost of that bandwidth does not fall to zero. These costs result from higher power usage in the terminals, higher costs in the radio sections, greater use of RF spectrum, and increased network loading. In addition, the original constraints WAP was designed for -- intermittent coverage, small screens, low power consumption, wide scalability over bearers and devices, and one-handed operation -- are still valid in 3G networks. Finally, we can expect the bandwidth required by application users to steadily increase. Therefore, there is still a need to optimize the device and network resources for wireless environments. We can expect WAP to optimize support for multimedia applications that continue to be relevant. If WAP is very successful in mass-markets on 2.5G networks, 3G networks may be needed purely for capacity relief.

WAP in the World and its (early) failure in Europe

Shortcomings

There are a large number of WAP enabled telephones among the more than 600 million GSM cell phones that are presently operated all around the world. However, only a small percentage of them are actually used for accessing Internet services¹⁷. This situation contrasts with the situation in Japan where in early 2001 almost two thirds of all mobile subscribers were also active user of mobile Internet services. Furthermore, by Summer 2001 basically all new telephones in Japan are Internet-enabled. Thus, it is of great interest to find out why WAP that has been hailed with great fanfare in Europe has performed so miserably. One of the prophets of the WAP Forum, at the time at Ericsson, offers the reflection on the situation in early 1997.

¹⁶ <http://www.wapforum.com/faqs/index.htm> July 11, 2001

¹⁷ When in September 2001 attending a conference in Stockholm on Seamless Mobility I asked in my evening talk how many in the audience of 50 people possessed a WAP-enabled cell phone and how many were actively using WAP services. The result to my question was astonishing although not surprising. There were altogether 18 participants with WAP phones – and only a single one professed to be an active user of WAP services, but complained that connecting time was a hurdle with an average time of at least one minute.

His reminiscence reveals that there was hardly any vision of a mobile Internet future at the Ericsson handset laboratories in Lund, where he worked, or elsewhere within Ericsson worldwide. Nobody at the time envisaged that mobile Internet would become a great thing. He and his colleagues saw a great opportunity to establish an open standard that would become WAP, from a wholly pragmatic point of view. The Ericsson company desired one single generic standard that would minimize the engineering efforts to meet the requirements from a huge number of operator customers. The situation at Motorola, at the time the biggest actor in mobile telecommunications, was similar and that company was already leaning towards the concepts developed by Unwired Planet. Nobody had a clear picture of an emerging mobile Internet and efforts were limited to the following areas.

- some functions so that Internet could be controlled from a cell phone
- browser function
- good function for SMS that the Nokia approach already provided

All companies in late 1996 and early 1997 shared a feeling of urgency as they sensed that mobile Internet needed to find a way into the future and it was only natural that mobile makers were in the frontline. Everyone was already aware that Internet had come to stay and that it was urgent to find a common standard for mobile Internet, as competing standards were already emerging. Nokia realised that it was not able by itself to take an initiative to promote a global standard. This concern existed at Nokia already at the end of 1996 or even earlier and Nokia realised that it was necessary to make a good and functional standard freely available. The situation at Nokia was different from Ericsson as a group of people at Nokia was aware and knew the key people at Unwired Planet from the very beginning – at the time when Rossman and Parrish established the company, and there had been company-to-company discussions between UP and Nokia.

These early contacts were not surprising, as the Nokia Communicator that was released in March 1996 had attracted worldwide attention, using the standard Internet markup language - HTML. Ericsson had in fact at approximately the same time developed a mobile handset, which contained many of the features that characterised the Nokia Communicator, but the Ericsson decided not to release its product. The early contacts between Nokia and UP is not surprising from another perspective, as there were at the time only a very small number of actors in the “wireless space”, which at the time included General Magic and Geoworks.

The development, from 1995 and onwards, of the Intelligent Terminal Transfer Protocol ITTP at Ericsson was done within the system division with the intention that it should be used for the handsets. A different approach in development at Nokia that led to the Smart Messaging protocol – with a focus on SMS – started already around 1992-1993 and went through a number of trials with some features incorporated in the Nokia Communicator of 1996. Once it was realised at Nokia, at an early stage, that Smart Messaging had the potential of becoming an important protocol the undertaking expanded into a significant development project within the company. One line of development took place in collaboration with Intel that developed a Narrow Band Socket while TTML as markup language was developed inside Nokia.

The coordination project at Ericsson that would lead to the WAP Forum was not actually an example of skunk works but formal decisions were never taken at the top

level. Joakim Nelson discussed with his manager who discussed the matter at the next management level, although not at top executive or technology levels. Nils Rydbeck in charge of handset development at Ericsson in the Research Triangle Park (RTD) in North Carolina was in the picture and gave his OK and was also in contact the manager in charge of the business unit for systems. Joakim Nelson summarises the situation in the following words: “We were passionately and single-minded pushing the technology but none of us realised that it would be a great thing”.

The dissatisfied users in Europe

The following section summarizes the results of a field study to identify and characterize the usability of WAP phones.¹⁸ In the fall of 2000, Nielsen Norman Group sponsored a field study of WAP users in London. Twenty users were given a WAP phone and asked to use it for a week and record their impressions in a diary. Traditional usability tests with users were carried out at the beginning and end of the field study. Half of the users operated an Ericsson R320s and the other half a Nokia 7110e.

When users were asked whether they were likely to use a WAP phone within one year, a resounding 70% answered **no** - a finding, which was recorded after respondents had used WAP services for a week. When users were asked whether they might get WAP within three years, the "no" responses dropped to 20%. Obviously users in Europe see potential in the mobile Internet, although it has not yet arrived. The conclusion is that mobile Internet will not work during 2001, but in subsequent years it could take off – also in Europe.

A major reason why WAP doesn't work lies in the time needed to perform standard tasks. See table below.

	<i>Task time in minutes (mean)</i>	
	Beginning of the study	End of the study
1. Read world headlines (from built-in portal)	1.3	1.1
2. Retrieve <i>The Guardian's</i> headlines	0.9	0.8
3. Check local weather forecast	2.7	1.9
4. Read TV program listing	2.6	1.6

The Nielsen report concludes that:

WAP usability fails miserably; accomplishing even the simplest of tasks takes much too long to provide any user satisfaction. It simply should not take two minutes to find the current weather forecast or what will be showing on BBC 1 at 8 p.m. We informally asked a group of Internet experts how long they thought these tasks should take (before showing them our data), and most estimated a task time of less than 30 seconds. Considering that WAP users pay for airtime by the minute, one of our users calculated that it would have

¹⁸ WAP Usability – Déjà Vu: 1994 All Over Again, Report from a Field Study in London, Fall 2000, Nielsen Norman Group (<http://www.Nngroup.com/reports/wap>)

been cheaper for her to buy a newspaper and throw away everything but the TV listings than to look up that evening's BBC programs on her WAP phone.

A second conclusion is that good user interface design can alleviate some of the problems. It was notably faster to retrieve current headlines from *The Guardian* newspaper's website than it was to use the standard portal provided with the WAP phones. It may be that these built-in portals feel secure in their monopoly position and thus don't allocate as many resources to usability as an independent service. However, in the long term, users will go where they are well treated and they may decide to bypass the "walled garden" completely if it doesn't provide sufficient quality.

A final conclusion from the task times is that after using the system for a week, users' performance improvements were appallingly low. In most other user interface research, users typically perform poorly when exposed to a new design. After all, they have to learn it first. After a period of experience, however, users typically achieve a much higher level of mastery and accomplish the same tasks up to 10 times faster. In contrast, WAP seems to be so mysterious and impenetrable that users don't learn much even after substantial use.

The Nielsen study did not identify any serious shortcomings in the design of telephones – neither from Ericsson nor Nokia. The users had no trouble using the telephones, which means that the usability problems were intrinsic to WAP and cannot be fixed with a new phone design.

In conclusion the Nielsen reports states that:

The main problem with the WAP phones was not their design but the very fact that they are telephones. The user experience will be much better on devices that are constructed with information display and manipulation as the main design goal. For example, direct manipulation is a dramatically better way to pick from menu choices and pop-up menus than a scroll wheel or indirect buttons that are placed away from the screen. Improved mobile devices with a deck-of-card form factor and the entire surface area dedicated to screen space will hopefully start shipping in 2001.

WAP in Japan – KDDI pursues the Success of NTT DoCoMo

In 1999 DoCoMo suffered from loss of market shares following the start of CDMAone services from DDI and IDO – now merged into KDDI. Reacting to the success, these two operators, who merged in October 2000, have also launched a WAP-based service, EZweb. Japan Telecom's J-Phone – the third major mobile telecom operator in Japan - offers its J-Skywalker service based on its own protocol called MML (mobile markup language), with e-mail at ¥ 10 per message and web access at ¥ 2 per request.

KDDI is bringing mobile telecommunications services to consumers all over Japan under its national brand. It is called "au". The origin of the name is the combination of the first letters of the many keywords that symbolize the direction of our mobile

business: "A" for "Access", "Always", "Amenity", etc., and "U" for "Unique", "Universal" and "User-oriented". EZweb, KDDI's mobile Internet connection service, has adopted WAP. Offering access to a diversity of sites and a large menu of services, the number of EZweb users has been growing rapidly.

Ezweb¹⁹ is based on the WAP standard and KDDI will be the first operator in the world to use WAP 2.0. As a markup language, XHTML will be used in Ezweb and there could be more similarity with regular HTML or C-HTML. By the use of Cascade Style Sheet in WAP 2.0, user interface may be significantly improved. XHTML and wireless TCP enables an efficient data transfer in case of rich content application like video or music. Maximum packet data speed will be improved from 64 K to 144K in 1X. In JAVA service, KDDI made a decision to use world standard MIDP. KDDI and J-Phone have a common handset environment named Jblend. This means third party software can be used easily and developers can provide same software to two companies.

In the future KDDI will be working with a variety of partners and actively pursuing development in a multitude of areas. From the development of innovative content that uses new technologies such as JavaTM and GPRS to the exploration of large-capacity multimedia contents such as video and music that can take advantage of an environment of higher speed data transmission, KDDI is expanding the boundaries of mobile telecommunications.

In January 2001 EZweb of KDDI offered 659 sites in its portal of which 194 were fee-based such as ringing melody download, wall paper download etc. The majority of sites, non-fee based, offered services such as sport news, general news, ticket reservation, mobile banking etc. EZweb started in April 1999 only a few months after i-mode and registered 6 million users by the end of January 2001.

KDDI uses WAP for its EZweb and there are several factors that made WAP successful in Japan. First, there was a strong tradition to use pagers for messages – in particular among young people and Internet would make it more convenient for sending SMS, which still dominates EZweb. A second factor was a basic difference in markets structure compared with that of Europe. The operators in Europe only provide (simple) services while the operators in Japan not only provide services but also the handsets, which constitutes a major differentiation. “We provide terminals with Internet functions”, says Satoshi Onishi of KDDI²⁰. If you want to use Internet with your mobile phone in Europe you have to buy special more expensive handsets. Control of the handsets is an integral part of the KDDI business model. Operators in Japan, with their interest in packet switching, have forced the makers to provide proper handsets. All new KDDI handsets are prepared for mobile Internet – altogether 10 models.

The third factor was circuit switching which was introduced 6 months after KDDI introduced mobile Internet. However, the Tu-Ka service, also belonging to the KDDI group, has continued with circuit switching and mobile Internet on its PHS system.

¹⁹ Communication from Ikuyoshi Inoue of KDDI

²⁰ Interview, March 2001

Another factor was a more firmly established Internet usage via fixed lines net in Europe, with a much lower penetration in Japan. Today this has favoured the creation of portals in mobile handsets with a dominance for mobile Internet service providers. Onishi argues that contents will be different in Europe but suggests that business models will become similar after the introduction of packet switching in Europe – with operator portals and billing system through the operator.

Mr Satoshi suggests that DoCoMo may become successful abroad in its partnerships, even if WAP has experienced a failure in Europe with its immature business models. DoCoMo will be successful if it can understand culture in EU and Asia and develop appropriate business models. However, it is a problem for DoCoMo that EU operators are still using circuit switching for its Internet services, but GPRS might provide a boost when it becomes more widely available onwards the end of 2001.

Lack of a Business Model - outside Japan

When reflecting on the present “failure” of WAP a Nokia manager says that marketing of WAP could have been done differently and the early consortium and the subsequent WAP Forum fatally missed the opportunity to communicate the WAP concept to operators, content providers and users, and different expectations were created that could not actually be fulfilled as realistic business models were not developed. There was also a lack of understanding that mobile Internet was different from the ordinary Internet that was rushing ahead. The mobility – in time and location – is fundamentally different from ordinary Internet and was not translated into new business models.

There are 640 million GSM subscribers of which some 10 per cent have WAP-enabled phones. This number is higher than the total number of cell phone subscribers in Japan who exploit mobile Internet services - even when the mobile Internet users of the other two operators, J-Phone and KDDI, are included.

However, there is one distinct difference between Japan and the overseas GSM world. The 35 million Internet subscribers in Japan are actively using many of the available services while very few of GSM subscribers with WAP phones are exploiting Internet services, and the reasons are threefold. First, it is still cumbersome to use a WAP phone for accessing Internet. Second, the available services are still very limited compared with what is offered in Japan. Third, the WAP phones are still based on circuit switching, which will only change when GPRS phones are introduced.

In contrast, Internet phones in Japan are easy to use and soon it will be impossible to buy cell phones that are not Internet-enabled. Furthermore, a very wide range of Internet services are available and i-mode was from the very beginning based on packet switching. This has generated an important and expanding revenue stream for NTT DoCoMo that last year produced some 10 per cent of total income – a share that is expected to increase to 16 per cent during the present fiscal year.

In order to understand the great differences between Japan today and the GSM world it is important to recognize the interaction of the three different value chains that compose mobile telecommunications²¹.

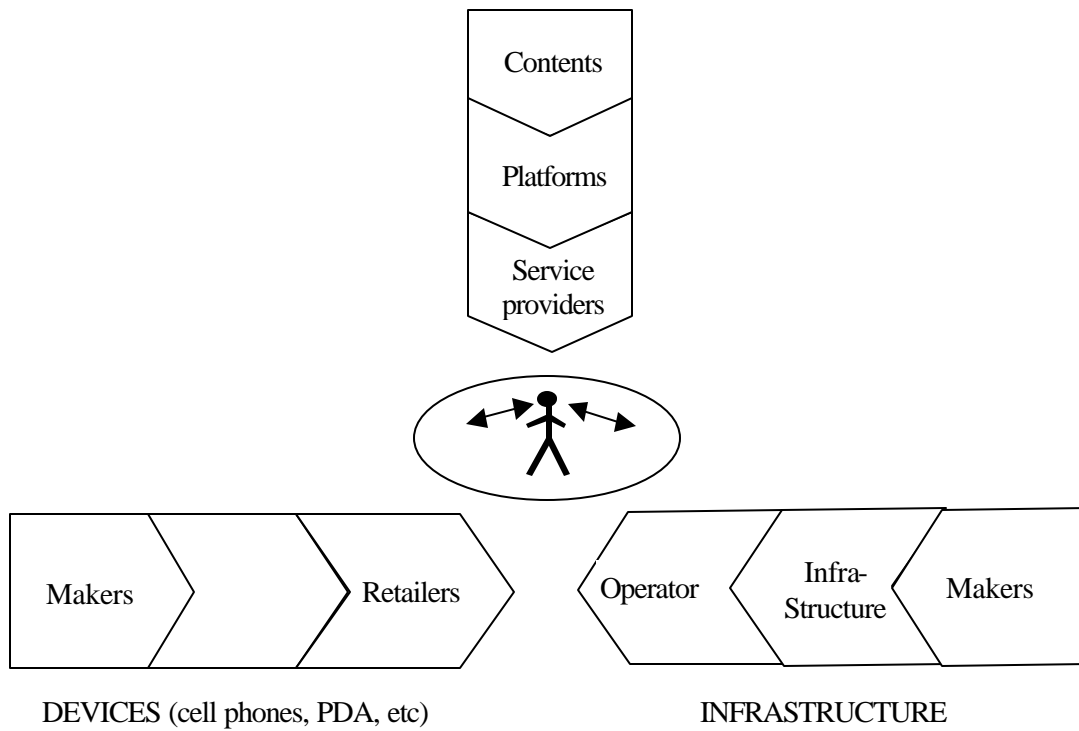
- Devices - with cell phones, PDA, etc. where the markets are controlled by makers and retailers of cell phones
- Infrastructure which is dominated by the makers and the operators of mobile telecommunications
- Services, where various categories of content providers play an important role.

Service providers have not yet been successful to establish themselves in a major way, neither in Europe nor in the US, while Japan offers a manifestly different situation. In order to understand these conditions it is necessary to look more deeply into the business model of NTT DoCoMo. Only DoCoMo has been able to integrate the three value chains through the control of operator infrastructure, its control of specifications for cell phones and control of retail through its own chain stores, as well as control of content providers that have to meet strict specifications to be included in the DoCoMo portal. As a consequence operators in Europe have not been able to generate new markets. The diagram below shows symbolically the three value chains.

²¹ I am indebted to Joakim Nelson for sharing his insights on the characteristics on a viable business model.

WAP in the cross-stream of value-

SERVICES/CONTENTS



It is important to understand the interaction of the three different value chains that compose mobile telecommunications

- devices
- infrastructure
- services and contents, which have not been successful to establish themselves neither in Europe nor in the US.

DoCoMo has been able to integrate the three value chains through the control of system, retail of cell phones and contents while operators in Europe have not been able to generate new markets. The reasons are manifold and it will take some time before operators in Europe have developed business models that will exploit the mobile Internet possibilities. The problem in Europe is that the continent does not constitute a singular market and will not for some time. The US offers a large integrated market with a high standard of living, but is faced with other structural problems. However, the Minitel in France is an interesting predecessor when France Telecom and IBM created a platform that for a long period of time was very attractive – although only in France.

The Future of WAP

The mobile Internet-related start-ups in Sweden show strong signs of growth and development despite unfavourable changes since the excitement of 2000 and a tougher venture capital climate. The delay in introducing GPRS has affected the business climate and small companies will have to find alternative ways of bringing their products and devices to the market. However, the early and rapid development of the Nordic region has enabled a substantial share of start-ups to establish an international presence. Network Access Providers (operators) are targeted by many of the start-ups. There is a strong trend to transform the offerings of many companies from a service into a product – often as a mobile middleware/platform solution. This is a reflection of the fact that operators in Sweden resist sharing traffic revenues.

There were early efforts to introduce WAP technology in Sweden, other Scandinavian countries and also elsewhere, which implied a period of testing and evaluation. WAP is a protocol standard by which the telecom industry is united, in contrast to many other prevailing protocols. WAP was announced by the telecom companies and media as a definite solver of any problem, although there were several clearly recognised shortcomings such as security issues, which are being solved, and support for push mechanisms.

However, it is not the protocol itself that is the cause of problem but the use of WAP over circuit-switched GSM networks. Almost all users have been deeply dissatisfied, as the terminals lack cache capacity for already visited pages and poor interface in WAP pages. These are signs of the immaturity of a new technology which will eventually be forgotten when WAP is run over packet switched GPRS networks with better services and improved terminals. This new situation can be expected to release mass markets for non-voice traffic. With an ongoing shift from 2G to 3G many operators are reconsidering their business models and the opposition against virtual operators leasing surplus capacity in the networks has become subdued. Obviously the

existing operators should aim for virtual operators that are targeting a customer segment that would complement the existing ones under the control of an actual operator, and thus create value-added to a total customer base.

However, the anticipated mass market for new service will require new versions of handsets. Asian manufacturers with facilities for mass production, in particular from Japan and Korea, will enter the European market and gain from their early experience (mainly from 3G and advanced understanding of user interfaces). It is expected that large operators with global presence will control the availability of handsets with certain specifications, which would partly follow the business model that has made NTT DoCoMo so successful in Japan.

The 3G systems may be challenged by technologies that have their origin in the computer communications industry. Such technologies operate in un-licensed frequency spectrums and users can have full broadband access from a laptop computer or any other device that is equipped with a suitable transceiver. Wireless Local Area Networks (WLAN) is one such technology that has become particularly popular in the US.²² The future success of alternative and competing technologies have to be understood in the context of the massive investments that have already been made or commissioned for the 3G networks. The operators and users will contend whether the upper hand will go the ability to communicate when in motion or to globally roam with a single handset.

The proponents of WAP perceived GSM to be an extremely strong standard onto which WAP could be easily grafted and rapidly becoming attractive to large numbers of GSM customers. This will happen only after the networks offer GPRS, which will replace circuit switching; a change that WAP proponents thought would come much earlier. They also expected that connecting time on GSM networks would be much shorter than has actually been the case.

Unwired Planet changed its name to Phone.com at the IOP in 1999 and was later on merged with a similarly sized company Software.com to become **Openwave** that is now offering M-services. They will enable vendors to provide same services on all types of phones.

The GSM Association has initiated Mobile Services Initiative (M-Services), which includes a handset reference guideline. This initiative was created to accelerate deployment and adoption of mobile Internet services within the GSM community during 2001. Openwave has contributed important elements of the M-Services guideline to enable richer, more compelling revenue-generating mobile Internet services like those that have proven to be successful in Japan²³. Handset vendors

²² WLAN is based on the 802.11b standard that enables transmission rates of up to 11 Mbit/s.

²³ Openwave Intellectual Property contributions include two key components: first, WML extensions enabling a highly intuitive graphical user interface (GUI), and second, an end-to-end architecture, called Download Fun, supporting the secure download of consumer-oriented content, such as ring tones, images and wallpapers. "The combination of packet data, GUI and the download fun service have proven to be a great combination in Japan," said Mauro Sentinelli, managing director for TIM. "This initiative with the collaboration of all the major operators in Europe, holds the promise to deliver the broad adoption of the consumer mobile Internet market later this year." "M-Services is an unprecedented industry initiative by the GSM Association to enable GPRS users to experience a new level of consistent, globally available services through the mobile Internet," said GSM Association

including Alcatel, Sagem, Samsung, and Siemens have committed to support the M-Services initiative and will commercially ship M-Services phones using the Openwave™ Mobile Browser, with the first handsets scheduled to ship in the summer of 2001.

The evolution of mobile Internet within the GSM world could possibly have evolved differently if the GSM Association at an early stage had been able to bring out reforms to harmonize end-user experience by bringing operators and phone makers into closer partnerships.

However, the Japanese successful approach propagated by DoCoMo may share similarities with the Mac niche while GSM resembles the PC development. The emergence of multimedia services (MMS) and the introduction of GPRS may redraw the global picture of mobile Internet in which Asian countries may be in the forefront because of their low level of fixed-line penetration.

Mr Parrish, one of the prophets of WAP, suggests that soon every mobile phone will be a WAP phone once GPRS is introduced and expects that WAP services will take off as once SMS did. But the phone makers have to offer larger screens in full colour and high resolution that can compete with the best PDAs but easily fit into the pocket.

However, the real future of WAP lies in the introduction of WAP 2.0 that offer backward compatibility with WAP 1.0 and I-mode in Japan. However, there are indications that WAP 2.0 will only introduced after a considerable delay as no deadline has been announced in mid-August 2001. The situation is serious as 3G will require a well functioning browser that meets the expectations of substantial customer segments.

A New Generation of Mobile Operators - in Europe

There are a number of factors, which together explain the success of I-mode in Japan.

1. The immediate and initial introduction of packet switching may possibly be the single most important factor, as subscribers would be less concerned with lengthy connections if they were not charged for the delay in connecting. KDDI has been successful with its mobile Internet services delivered via the WAP 1.0 protocol, and packet switching may actually be the single most important factor.
2. DoCoMo exercised a great influence on handset makers because of its large numbers of subscribers and its dominant position in the Japanese market – and was able to decide that their telephones should have an I-mode button.
3. Handset makers in Japan have been very responsive to expectations from customers and an early stage introduced screens with large sizes and in colour, which favoured introduction of colour pictures.
4. I-mode basically provided an open interface that made it very easy for many content providers to deliver their services.

There are also other factors that have influenced the success of I-mode in Japan and the apparent failure of WAP in Europe. Unwired Planet had already selected a new markup language for its concept while DoCoMo decided to use a variant of HTML that enabled easy access to lots of contents that was already available on fixed-line Internet. Naturally the choice of markup language for WAP has enabled technically elegant solutions, and there is little doubt that very experienced technicians drove WAP that included Chuck Parrish of Unwired Planet and several people at Ericsson and elsewhere.

Thus, there emerged a basic difference between GSM terminals and those used for I-mode services. The latter ones were specifically designed for easy Internet use and offered packet switching from the very first day. Aside from simplicity in use many I-mode terminals were also offered with colour screens. The question to be addressed is why did this development take place in Japan and not elsewhere. To find the answer it is necessary to identify the different roles played by operators and terminal makers in Japan.

In the GSM world of mobile telecommunications the Subscriber Identity Module (SIM) card has created a separation between makers and operators that did not exist in the old days when the PTTs dominated the development of telecommunications. GSM has created a new tradition on how to govern telecom companies. Many new, and often very large, operators of mobile telecommunications have emerged from completely different business segments and traditions. For example the steel and engineering company of Mannesmann established itself as a leading operator in Germany. In Sweden the Scandinavian Airlines System, Trelleborg AB in mining equipment, SpectraPhysics in advanced medical engineering established a leading mobile carrier, Europolitan, now controlled by Vodafone (Airtouch).

The newcomers produced a generational shift with an operational gulf emerging between makers and operators with the latter ones having negligible R&D resources compared with traditional PTTs that often used to be technology drivers. The result has been that WAP and other developments of significance for mobile telecom users have been driven by the telecom makers – except in Japan. DoCoMo in Japan still maintains very large R&D resources, which were used instrumentally for the development of i-mode at a time when the new operators in Japan did not yet force the generational change that was taking place outside the country.

A top manager at Telia Mobile reflects that there existed at the time of WAP conceptualisation a wide gulf between the operators and the makers. This gave him and others the impression that the makers of handsets were interested to develop a proprietary standard that would cover parts of the interface protocol. He says that there is a little doubt that the future development and introduction of WAP would have benefited from an active participation of the operators and their subscribers. He also ventures the opinion that the role of operators within the WAP Forum has basically been neglected.

Telia Mobile in Sweden at an early stage developed an understanding of the future role of possibilities of mobile Internet and introduced DOF – Department of Future. DOF was a Telia Mobile service that included a number of services such as e-mail, messaging services and “unified messages”. DOF was not directed to the general

subscriber but to a select group of committed and highly interested users. However, the number of such people turned out to be less than expected but their usage of the DOF far exceeded the estimates of Telia Mobile. The hurdles for using the services were quite high but services were highly appreciated until they were closed down in 2001. In 1999 Telia introduced MyDof that was based on WAP, at approximately the same time when I-mode was introduced in Japan – with its own presentation at the GSM Forum in early 1999.

In sum, when comparing mobile Internet in Japan and elsewhere it becomes very obvious that operators in the GSM world were far from adequately involved in conceptualising and developing WAP, and an important explanation lies in the multitude of various and diverging interests. Telia Mobile and other operators could possibly have influenced or re-directed the development of WAP in a more user-friendly way but this would in all likelihood have required the creation of an alternative consortium, which would have been difficult to establish.

A very important factor is that the speed of technical change has shifted the locus of standardisation from the telecom operators to the makers of telecom equipment. The operators did not fully realise new possibilities and one contributing factor was that they were no longer in the driver's seat of technological development and had only limited influence on setting standards. The operators continued to have their focus on standardisation procedures within ITU. But the IT sector had in the meantime taken the lead of setting de-facto standards, which took concepts from the computer and Internet world. At the time the operators readily accepted only simplistic use of Smart Messaging like logos and ringing tones.

Finally, early introducers of WAP services also suffered from the absence of terminals, which was very puzzling considering that the makers were the driving forces behind WAP. The Swedish Telia Mobile in 1999 procured Motorola terminals while Ericsson WAP terminals did not become available until late 2000. There is a general notion that WAP means "Where Are the Phones?"

Competing technologies

De-facto Standards

The industrial scene is increasingly characterised by companies that operate in a networked economy. Important knowledge sources exist in relations with companies that supply materials, components and sub-systems to larger companies, and also provide various consultancy services. Thus it is essential to grasp an understanding on the utilisation of R&D results and knowledge resources that originate outside the company - and how mechanisms of exploitation are changing over time.

It has been the conventional wisdom that companies should seize scientific and technological knowledge from their innovative activities for proprietary use, thereby

achieving higher levels of innovation than their competitors and thereby earning higher innovation rents.²⁴

This resource-based view of the firm argues that a company should not openly share resources that are valuable, rare, not easily imitated and hardly substitutable. However, the nature of competition changes of the course of innovation and technological development leading up to commercialisation. It is generally observed in many technological fields that pre-paradigmatic competition is exceptionally intense as technological progress is often path-dependent. The technological paradigm may define a single product architecture that will dominate a certain set of applications.

The establishment of a paradigm - later to become de facto standard - is a critical step that requires complementary resources and investment in infrastructure that is outside the scope of a single innovating firm - even a very large one. Thus, the competition in the pre-paradigmatic phase is likely to follow technological trajectory where a critical mass of companies can jointly mobilise resources. This argument is supported by empirical studies in the global flat panel display.²⁵ Similarly, the Canon company argued that its failure to bring the alternative ferro-electric crystal display to a full market success was to a considerable extent due to the lack of a technology family of firms working towards the same goal, as was the case for thin-film-transistor (TFT) technology that started much earlier²⁶.

Spencer argues that firms could share knowledge within either a national innovation system (NIS) or a global innovation system (GIS). She argues:

In the context of technological innovation, the notion that institutional environments vary cross-nationally holds important implications. If distinctions in countries' national innovation systems cause evaluation standards to vary cross-nationally, then a different technology may well win out as paradigm in different countries. If countries' dominant designs emerge independently on one another, then a firm will find its best interests served by tailoring its knowledge-sharing strategy on only one country. There are reasons to believe that in many high technology industries, an innovating firm must participate in institution-building activities within its GIS as well as in its own NIS.

The development of the GSM system for mobile telephony illustrates that two of the now dominant firms - Ericsson and Nokia - based their innovations on both national and European networks where ETSI played an important role. The same two actors are involved in a much broader network in the pre-paradigmatic phase for the 3rd Generation Mobile Telephony System. Obviously, any firm that wants to influence the emergence of technical and evaluation standards in a global industry will have to influence the global, and not only its national or European, institutional environment.

²⁴ This paragraph is based on Jenifer W. Spencer, *Firms' Knowledge Sharing Strategies in the Global Innovation System*, Carnegie Bosch Institute Working Paper, February 25, 1998

²⁵ Jenifer W. Spencer, *Firms' Knowledge Sharing Strategies in the Global Innovation System*, Carnegie Bosch Institute Working Paper, February 25, 1998

²⁶ Jon Sigurdson, *From Sweden to Japan: The case of Canon and Ferroelectric LCDs*, in *Industry and Innovation Journal* (Special issue on Global LCD Industry), Volume 5, number 1 (June 1998), pp 73-91

Spencer suggests that the extent of knowledge sharing could be measured by volume, quality and breadth, and argues that the importance of having critical mass competitors on the same technological trajectory extends well beyond firms operating in networked industries.

Occasionally a high technology firm can shape the institutional environment in favour of its technological trajectory but knowledge sharing will, according to Spencer, help a firm influence the institutional environment through two mechanisms.

1. A firm can attract competitors to its own technological trajectory to form a critical mass of firms with a vested interest in the success of the new technology.
2. A firm can promote the emergence of favourable standards if it can influence scientists' perceptions concerning the most critical obstacles to overcome before commercialisation and the appropriate criteria to judge the merits of the innovation.

Thus the primary objective of a knowledge-sharing strategy lies in increasing the probability that the firm's technology will become dominant in large commercial markets. Consequently, a firm pursuing such a strategy is likely to strengthen its competitors but at the same time increase the total size of its technology's potential market. National markets are no longer the "principal entities" of the world economy. The dramatic increases in the scale of technology in many industries--its cost, risk and complexity--have rendered even the largest national markets too small to be meaningful economic units, and markets have been *fused* transnationally rather than linked across borders.²⁷

In a number of critical industries, the scale of production and/or technology has now increased to the point where fixed costs must be amortised over a larger market base than is available in even the largest national markets and this has led to globalisation.

The trend to globalisation of innovation that has been well documented does hardly diminish competition among states. However, the emergence of corporate innovation systems (CIS) that are partly independent of national innovation systems, and a more universal global innovation system (GIS) make it more difficult for a state to control where the innovation rents are distributed. The development of human resources in science, engineering and more generally in higher education is obviously an area where a state still has a large measure of control which is also true for various infrastructure that is needed in innovation activities.

The development of second generation mobile telephony provides an example where the countries which today constitute the EU took a lead to set the standards with major R&D efforts by "national" companies while in Japan the 2G standard remained a purely national effort with the consequence that equipment makers in Japan were excluded from global markets. The recently concluded development of 3G standards has taken place across not only national borders but also across continents, and WAP is another example of the emergence of a Global Innovation System (GIS).

²⁷ Stephen J. Kobrin, *Beyond Symmetry: State Sovereignty in a Networked Global Economy*, Carnegie Bosch Institute, Working Paper 95-8

I-mode Launch in Japan

NTT DoCoMo has with i-mode created an identity, distinctly different from NTT itself, which is still the holding company for DoCoMo and several other companies. DoCoMo was spun off from NTT in 1992. At the time most staff was reluctant to leave the main company, still considered to be a national platform for advanced technological development while cellular telephony was seen as technological backwater. The president, Mr. Oboshi, at an early stage took several initiatives, which would lead, to a new a distinct DoCoMo business strategy. A number of daring people were brought in from the outside, which included Ms. Mari Matsunaga and Mr. Takeshi Natsuno. These two people have played an outstanding role in the early development of i-mode with the former one in marketing and the latter in charge of technology development.

Developments similar to those of European and American makers of mobile telecommunications also took place in Japan, but with a distinct difference that has had far-reaching consequences. The development of mobile Internet services in Japan has been dominated not by makers but by a dominant mobile carrier – NTT DoCoMo. This company launched its concept – i-mode in February 1999 and very quickly realised, much to the surprise of the outside world that it had created a commercial success.

Natsuno²⁸ was brought from an Internet start-up company in 1997, and today has the position of media director for the gateway business department at NTT DoCoMo. He mentions that he spent a lot of time browsing Internet services in the US, and borrowed ideas from AOL, which he perceived as a model. The decision by DoCoMo to deploy its own technology for i-mode by using compact HTML was critical as it used a subset of web programming which is very similar to text version of web pages that existed on the Internet. He says that the business model rather than the technology was the starting point and stresses that DoCoMo had little choice as the wireless application protocol (WAP) option, which uses its own markup language, WML, was not feasible. So, DoCoMo decided to implement its own solution, based on a subset of Hyper Text Markup Language – now usually referred to as compact HTML (c-HTML).

The proponents WAP technology argue with considerable justification that their protocol is more sophisticated as it can handle most of the irregularities that occur in mobile telecommunications, although they realise that DoCoMo has already established a market position that it will take WAP many years to reach. Furthermore i-mode was initially introduced with packet switching, while WAP started with circuit switching which only GPRS will eliminate.

A complete duplication of DoCoMo's approach outside Japan is unlikely as no other country today offers the highly vertically integrated market that exists in Japan – with NTT at the centre that could enter the market with its own version of the Internet and support it with attractive, affordable phones. However, there is little doubt that DoCoMo has been helped by Japan's relatively low level of PC penetration and low

²⁸ The views referred to Mr. Natsuno are based on an interview in December 2000.

Internet use over fixed lines. Other important success factors include pricing of i-mode services, which have been affordable to almost everyone and an astute business judgment to use the familiar mobile phone, rather than introduce a personal digital assistant (PDA) or some other device.

The i-mode idea originated as a mobile Internet concept around 1995-96 and studies were initiated in the Service Development Division NTT DoCoMo. Initially there was no discussion on packet contra circuit switching and no discussion whether to use HTML markup language of Internet or the HDML markup language of WAP. The focus was on how to efficiently use a signal, which was limited to 9.8 kbit/s. However, on the signal protocol function WAP is much closer to Internet. WAP is actually a good protocol but its Internet functionality has become doubtful in Europe, and WAP will spread only slowly and become significant only after 2005 - in the opinion of many Japanese observers.

A committee project was established before i-mode started and NTT DoCoMo engineers were engaged in heated discussions inside the company, but also with counterparts at Ericsson and Nokia. However, there was never any support for using WAP and the decision to use HTML as markup language was taken very early, says Mr Natsuno who was the technology leader of the i-mode project.

In the early start-up phase it was difficult for DoCoMo to enlist content providers, while the main problem now lies in the selection of very willing content providers. In the development of a suitable browser for i-mode a small company without any earlier direct relation to NTT DoCoMo, Access, played an important role for DoCoMo and there was never any discussion to involve foreign companies such as Microsoft or Netscape.

Access Corporation²⁹ is primarily a solution provider for handsets, which completely dominates its business. The company is also providing solutions for servers operated by the content providers who are not fully aware of technical solutions. 40-50 per cent of Access activity is geared to i-mode empowered cell phones. Income comes from initial fee plus royalty of installed software components, e.g. browsers.

Access, founded in 1979, is still a small company with some 200 people. However, the company has become a major supplier of non-PC browsers with its two main products – NetFront and CompactNetFront.³⁰ Compact Netfront is optimal for small, mobile communication devices using originally monochrome small liquid crystal screens as cellular phones, PHS, pagers, watches and radio/cassette players. Access has been successful in developing embedded software that is copied into read-only-memory³¹.

²⁹ Information from interview with Mr. Toshihiko Yamakami of Access Access November 28 2000

³⁰ Information from IEEE article: Yamakami, Toshihiko, E-Commerce Enables Information Appliances: A Japan-initiated Challenge in Wireless Internet

³¹ Technologies for embedded software face a number of challenges. First, limits in CPU and memory force embedded software to provide special functions for devices to become useful for customers. Costs for CPU and memory must be kept low in order to manufacture low-cost devices and embedded software has to highly functional rather than providing general-purpose functions. Furthermore,

The number of licenses was still negligible in 1996-97 and only reached one million in 1998. However, in 1999 the Internet-empowered game consoles and Internet-empowered cellular phones boosted the growth of licenses. A major reason is the use of CompactNetFront as a micro-browser for cellular phones in Japan with the expectation that this trend will be duplicated elsewhere in Asia and in Europe. The company entered into an agreement with Sun Microsystems in 1984, and has close contacts with the WAP Forum. . Access has provided the browser for the Nokia handset that was introduced in the Japanese market.

Access has reached the top position of providing no-PC browser and expects that number of new markets will soon develop in areas such as car navigation systems and power meters – with the introduction of Java. Access has 8 units (subsidiaries) in Japan and in November 1999 established a unit in San Francisco which was followed in November 2000 by a European unit located in Duesseldorf, where also NTT DoCoMo decided to locate its European development centre.

Mr Natsuno stresses that the i-mode factor from Japan has greatly influenced Internet³². The new Internet services are not only a question of standardisation. People from the Unwired Company came many times to DoCoMo as evangelists for their approach. They argued that wireless Internet would be distinctly different from wired Internet but failed to persuade the DoCoMo group to actively develop their concept of mobile Internet in Japan, as the DoCoMo project remained under the strong leadership of Mr Inoki.

Unwired Planet originally opted for a completely new markup language while NTT DoCoMo in Japan decided to use a subset of HTML to which was added a number of extensions. The success of DoCoMo's i-mode does not rest in the choice of technology, architecture or markup language. The magnitude of DoCoMo success is contained in the company's ability to develop a complete and inclusive solution, which covered handsets, contents, pricing and marketing as key features. All of them had to be offered at a high level of relevance in order to attract the customers. DoCoMo was greatly helped by a market heavily concentrated with only a few operators. Furthermore, the company controlled the vendors that sold its cell phones and were also able to dictate to the makers the specifications of the handsets and was able to exercise a tremendous power in the market place.

Natsuno emphasises that he comes from the Internet³³ world where he developed services – where it is possible to understand the system as a black box. He also disregards the notion that content providers are culturally biased. The conceptual plan for i-mode was prepared in September 1997, and dated September 12 in the recently published book "I-Mode Strategy"³⁴. DoCoMo in December 1997 organised a final

additional software will not be downloaded and required expandability must be provided from the beginning.

³² Natsuno, Takeshi, *i-mode sutorateji (I-mode Strategy)*, Tokyo, 2000

³³ Natsuno was manager in an Internet company – HyperNet – that took an early approach of becoming of a free Internet Service Provider, although the company has since failed.

³⁴ Natsuno, Takeshi, *i-mode sutorateji (I-mode Strategy)*, Tokyo, 2000

fact-finding mission before deciding its own strategy to move ahead – according to the September Concept Plan. A group of some 20 people went to San Francisco to hear comments and ideas from everyone of importance – including AT&T that had been strong advocate of an alternative approach. The group consisted of DoCoMo core people and 1-2 people from each of a number of important (handset) makers. The DoCoMo group found that contents were very poorly developed and would remain poor for alternative approaches – and only confirmed their earlier misgivings that had materialised long before the September Concept Plan. So, choosing HTML, also advocated by Access, became evident in the final DoCoMo evaluation. A major reason being that contents readily available in Japan was equally meagre, but the choice of HTML would speed up the process of early delivery of attractive contents that was available for fixed-line Internet in Japan. In the early stage of I-mode financial, news and other time-honoured services dominated, a supremacy that was soon to be taken over by “entertainment” services.

The Concept Plan had two main features, according to Natsuno. First, it was idealistic. Second, it was based on a step-by-step approach with intent to learn from Internet. Three stages were foreseen

- before one million subscribers
- before ten million subscribers
- after ten million subscribers

Reaching one million people after six months more or less corresponded to the expectation in the original plan but reaching 4.5 million after one year exceeded the expectation with some 50 per cent. Relations with third party companies were clearly identified as critical from the very beginning since DoCoMo had decided against bringing in its own contents. Share of entertainment services was quite low in the early stages and DoCoMo initially based its reputation on enlisting banking and financial services as well as news services. Financial contents were actually the basis in the initial stage.

The i-mode group at DoCoMo was confident about their i-mode business plan but top management remained sceptical even as late one week before the launch of the services - that would set DoCoMo on a completely new track after only a few months. Mr. Mitoshi Hirokane, now senior manager in DoCoMo Marketing Headquarters was one of the sceptics, and R&D people also remained sceptical. However, the i-mode team was able to move forward against the many critical managers as the project had the blessing from the very top. Mr Obochi, then CEO of DoCoMo, had in January 1996 given the assignment to Mr Inoki – the overall project manager for i-mode and told him “you can do anything you should find good people”. A special department was established in July 1997 and Inoki started to recruit key people who soon included Matsunaga-san who came with broad marketing experience of popular and low-cost magazines, and soon afterwards Natsuno-san was recruited to lead technological development. The basic elements of the service concept and the now very familiar logo, which now everyone in Japan recognises, were decided early on by a very small group of people. In September of 1997 the group consisted of only 14 people, which had expanded to 60-70 a year later, and about 100 in late 2000.

Natsuno stresses that positive feedback loops in developments of complex systems, with which he was familiar with from the Santa Fe Institute, are important in order to

provide a basis for increasing returns. He argues that he was able to incorporate this in the original business plan and emphasises that the technology platform of i-mode has allowed great creativity among the contents providers.

The sites for fishing, and the success of introducing Pokeman figures exemplify this. Such creative results were far beyond expectations. There has also been extremely favourable feedback loop from the rapidly increasing number of subscribers to support more content providers and stimulate quality and attractiveness of contents. Mr Natsuno, in the interview, again emphasised that the surge in contents has been a surprise – even to him – when reflecting on the situation in late 2000. He says that the same favourable surprise also applies to development of mobile advertising.

I-mode is, according to Natsuno, undergoing two important transitions, which in a major way will provide benefits to DoCoMo customers – a vertical transition and a horizontal transition. The first is exemplified by Java functions, which means that software can be downloaded and made operational inside the handsets – thus creating smart phones. The plan to introduce Java was already articulated in December 1998 and a contract was signed with Sun Microsystems in March 1999 to develop Java for DoCoMo cellular phones.

The second transition has its basis in the concept of packet delivery and storage. Mobile telephone customers will soon be able to connect their phones to CD-ROM and to various Sony devices via cable. Ability to connect with Sony Playstation and TV monitors will follow, and Playstation connectivity was made available in February 2001. Another future possibility is to connect the mobile phones to car navigation systems and GPS. Another important element of DoCoMo business strategy is “point and mobile” that will be available through an agreement between DoCoMo and Lawson that has more than 7,500 convenience stores located all over Japan, similar to 7-11 chain stores. These stores will become pickup points for goods and services that customers order through i-mode.

An Enormous Success of mobile Internet in Japan

DoCoMo has already written history by being the fastest-growing cellular data service ever, and the company has in the process become the most highly valued telecom company. This success story is being watched by all other telecom companies that as soon as possible want to find out what the consequences are for the world outside Japan. To what extent can the i-mode be copied or at least adapted outside Japan where industry structure and demographics are unique. WAP is the competing technology and business managers everywhere are formulating and discussing business plans that by necessity make reference the i-mode approach.

The situation was less rosy in the past when the DoCoMo and the makers of mobile telecom equipment realised that they had missed out on much of the second generation cellular boom around the world by its focus on narrow proprietary standards such as PDC and PHS which never attracted any following outside Japan. By having succeeded in rapid establishment of a de-facto standard for services, NTT DoCoMo and other Japanese companies, small and large, are now determined not to miss out again. DoCoMo has taken minority equity stakes in a number of telecom

companies outside and made a first acquisition in December 1999 when it bought 19% of the biggest Hong Kong operator, Hutchison Telecom followed by a 20% equity stake in Hutchison 3G in UK.

The introduction of i-mode services by NTT DoCoMo in February 1999 has created a paradigm shift in mobile telecommunication. Its success is based on customisation and rapidly expanding host services that attracted many people by removing restrictions in place and time. DoCoMo was in a special situation as it controlled more than 50 percent of the subscriber market for mobile telephones in Japan.

The immediate use packet switching for i-mode services enabled an attractive pricing system, which found favour with most users. The earlier and remaining close relations to makers of infrastructure and handsets, based on highly competent engineers at NTT DoCoMo, also contributed to the introduction of very user-friendly handsets which pushed a rapid introduction and expansion of i-mode services, which has initially taken root among younger age groups – with a pre-dominant private use.

NTT DoCoMo started to offer i-mode services on February 22, 1999 and became in the same year the biggest Internet Service Provider (ISP) in Japan. It has surprised the whole world that NTT DoCoMo has managed to launch a mass market wireless data service and that it has become notably profitable in a very short time - in a time of shrinking margins for cellular telephone companies.

Goldman Sachs³⁵ had forecast in early 2000 that i-mode would by March 2002, have more than 10 million customers, or nearly one third of all DoCoMo users. That figure was reached already by the middle of 2000 year and the total number of i-mode users had already reached close to 20 million by the end of 2000. By that time DoCoMo had already decided that all their new telephones would by early 2001 be equipped for i-mode.

I-mode is presently used primarily for short messages and e-mail, followed by music download, trailed by a host of other services. In this way i-mode has drastically challenged the conventional wisdom that the combination of Internet and mobile phones require substantial bandwidth to satisfy customers. The delivery of i-mode contents is delivered at the slow speed of 9,600 bit/s, although DoCoMo's packet network, DoPa, an overlay of DoCoMo's PDC system, can actually support speeds of up to 28,800 bit/s. However the midsize of the display means only limited bandwidth has been required to initially attract customers. The average homepage size is 1,200 bytes and e-mail messages are limited to 500 bytes, with each phone being able to store up to 100 messages. Equally important is packet switching, which means that the device is always connected with the customer being charged only when packets are transmitted.

I-mode has become most popular in the age brackets from high teens to 35 years, although market research indicates that the most enthusiastic on-line users are women in their late 20s. This reflects a demographic fact that the average age for marriage is

³⁵ Reported in Robert Clark, *The future of wireless?* Wireless Asia (telecomasia.net), February 20, 2000

around 30, and un-married young women have become a large consumer segment with high disposable incomes.

Revenue for DoCoMo is generated in three ways - subscriptions and carrying packets of data and, increasingly, from e-commerce – collecting commissions on transactions over the network. DoCoMo deducts 10 per cent from the charges that customers pay to the content providers. In Spring of 2001 the number of i-mode subscribers had reached 22.5 million with average revenue per user (ARPU) of Y8,650 per month (US \$70) with 10.2 per cent generated from i-mode services. The revenue forecast for the ongoing fiscal year indicate the same level of ARPU, although 16.6 percent is expected to be generated from i-mode services.

The success of I-Mode has propelled market evaluation to astronomic heights and was in November 2000 US\$350 billion, which far exceeds the valued of NTT, parent company, and all other telecom companies outside Japan. After licenses being granted for 3G services, in July 2000, DoCoMo has embarked on a massive investment program for the W-CDMA system, which will be the first in the world, with expected national coverage of 90 per cent in 2003. Initial 3G services were launched on a small scale by the end of May 2001, with a full-scale introduction postponed until October when DoCoMo expects that all software glitches in the radio access networks will have been weeded out.

Merging of mobile Internet platforms

The failure of WAP cannot be understood when not considering the emergence of the GSM standard and its success. The GSM Association is the world's leading wireless industry representative body consisting of more than 535 members - second and third generation wireless network operators and key manufacturers and suppliers to the wireless industry.³⁶ Members of the association span 168 countries of the world. The GSM Association is responsible for the deployment and evolution of the GSM family of technologies; GSM, GPRS, EDGE and 3GSM (or W-CDMA) for digital wireless communications. The association members provide digital wireless services to more than 537 million customers, collectively (as of end May 2001). The GSM platform accounts for approximately 70% of the total digital wireless market. The actors that created the GSM world and its members felt confident that WAP could be grafted onto existing systems – without any major changes in technology or business models.

In contrast to WAP in Europe KDDI in Japan, or rather the predecessors of the present company, was very quick to configure its network system including the handsets, and also provided a user-friendly starting page for mobile Internet. In Europe the operators considered WAP services to be a luxury and nothing much will happen until GPRS becomes widely available. The successor of 2G is W-CDMA in Japan and its equivalent in Europe is IMT-2000 that is expected to replace GSM during this decade. It is not yet clear whether 3G will fully replace GSM and other parallel 2G systems and this has a distinct bearing on the future of mobile Internet. Many observers argue that 3G systems will in no way be equated with mobile Internet as it will become operational too late, is too limited and has received only very limited

³⁶ <http://www.openwave.com/m-services/faq.html>

stimulus from the users. Mobile Internet, these critiques argue will appear later when manifold approaches will exist and almost everyone can become an operator. This real first generation of mobile Internet would have the following characteristics

- less complex
- more user influence
- new open business models
- proliferation of non-licensed space
- open networks

When reflecting on the WAP Forum today Joakim Nelson says that he and others only saw the open standard as a protocol, and completely disregarded the users. “We were technology drivers”. A key manager at Nokia calls attention to the failure of WAP, which followed from the success of GSM, but stresses that WAP is today one of mobile Internet standards that customers recognise. WAP already has a number of interesting applications, in particular vertical business applications and the next major development is to make WAP available to ordinary customers as soon as GPRS is ready, which will happen by end of 2001. However, a step-by-step development will be needed for customers to accept WAP.

There are a number of reasons for the failure of WAP in the West, as opposed to Japan.

- First, the networks were originally not designed and have not yet really been converted for handling mobile Internet, of which the persistence of circuit switching is a very important factor.
- Second, connecting time for WAP and also downloading time is unduly long.
- Third, the operators outside Japan have not yet developed any strong business models for introducing WAP services.
- A basic reason for this failure lies in the way the WAP Forum was created when little was done to involve the operators and their networks and optimise their activities towards mobile Internet.
- The specifications for the WAP protocol were quickly done but there were hardly any attention to products – neither services nor handsets.

Thus, both Nokia and Ericsson were very late in developing and marketing their WAP phones. However, the WAP Forum is moving ahead and both operators and makers suggest that WAP has a bright future, as news, games and other wireless services will increasingly demanded by users of mobile handsets. Nokia and other makers have already introduced browsers in a number of their handsets - but not yet in every single new handset as in Japan.

However, in the future mobile Internet will not be dominated by a rigidly specified browser as was originally conceived in the WAP protocol and later on advocated by the WAP Forum. WAP is again changing the situation, as version 2.0 will remove many of the strict preferences of the first version and introduce a browser based on Internet standards. Services will become dominant and their development will take their impulses from the computer world. Java applications will play an important role as they will shift the intelligence from servers to the handsets. Much of mobile Internet applications will in the future emerge outside the browsers, as many applications do not actually need a browser, such as payments. It is rather enablers

that will bring a new dimension to mobile Internet, and downloadable applications will become very important.

Operators no longer need to be heavily involved in setting telecom standards although they have not fully realised the new situation. All standard setting for services have basically moved to the web domain. As a result (mobile) telecom standardisation has moved into Internet and the operators are not at in the front line in the development of Internet. One important reason is that they no longer control enough R&D resources to be able, in a major way, to participate in this development. The situation in Japan is different where NTT DoCoMo has been in control of total orchestration and has with its internal R&D resources been able to control both the development of handset configuration and the delivery of services.

A global mega-operator could possibly take on a similar role outside Japan – although it is more likely that a new industrial structure will emerge³⁷. The technical changes of making telecommunications based on Internet protocol will change the telecom landscape. Multiple services can be used and the customers will in the future be able to easily shift from one operator to another – and airtime may in the future be auctioned in real-time. Solutions such as SIP (Session Initiation Protocol) will in fact loosen the control of individual operators and a diversity of operators will emerge, where some will take on the role of chief transport providers while other operators may become more specialised.

Wireless LAN (W_LAN) is another important factor that could greatly affect our perception of mobile telecommunications and drastically change business models. Public Wireless LANs, usually referred to “Hot Spots” are rapidly spreading into places like hotels, restaurants, airports and railway stations. This is happening in many countries although the US, Scandinavia and Japan are in the forefront. These hot spots have the potential to offer high capacity – up to 11 Mbit/s – in two-way communications for users of almost any kind of digital devices. The expansion is likely to come very quickly as many lap top computers and PDAs are already fully equipped for using W-LAN following the same international standard – 802.11b – which is already widely used in offices and universities. However, there is an important barrier to a wider use as prices of laptop computers and PDAs are too high to trigger a mass market for non-business users.

Can the merits of high capacity at low costs of W-LAN be combined with the merits of 2.5 networks rapidly providing wide coverage inside a great number of countries and between them? This could become a powerful combination and actually create 4G networks long before 3G becomes fully operational. This could be the death of 3G as such a combination would diminish revenue streams for 3G operators. It could also provide the basis for a more healthy telecommunication industry by combining various systems and 5G could emerge from 3G. Ultimately, the answer lies with the

³⁷ Changes can be seen at the horizon for which the following comment provides an illustration. “Until now, the privatisation of formerly state-owned telecoms businesses has led to the search for lower costs, the occasional change of management and some mergers. The phase we are now moving into is likely to lead to more radical changes: leveraged buy-outs, wholesale dismemberments of some businesses, more widespread consolidation. ... once an industry loses control of its destiny, the outcomes for individual companies are often ones that neither managers nor shareholders would have predicted.” By Martin, Peter, To loose a grip on destiny, Financial Times July 31 2001

users whether they find that new services and applications are worth paying money for.

List of Acronyms

1G - First generation of mobile telephone systems - analogue

2G - Second generation of mobile telephone systems – digital. The most widely used standard is GSM.

2.5G - The generation between 2G and 3G, with speeds enhanced by GPRS and EDGE.

3G - Third generation mobile telephone systems that will combine voice and high-speed data services and offer a wide range of multimedia services when fully developed. W-CDMA as part of generic UMTS making this possible.

AOL – America-On-Line, largest Internet service provider in the US

ARPU - Average Revenue Per Unit. One indicator of a wireless business operating performance. ARPU measures the average monthly revenue generated for each customer unit.

ASP - Application Service Provider. A business that hosts business software applications on its own servers and rents them out to clients via the Internet.

B2B - Business to Business. Refers to one business communicating with or selling to another.

Bluetooth - Bluetooth developed by Ericsson and now established as an open global standard is named after a Viking ruler is a technology that allows low-cost and short-range – some 10 metres - high frequency radio links between laptops, mobile phones and other portable devices.

CDMA 2000 - Code Division Multiple Access 2000, is a radio transmission technology for the evolution of narrowband CDMAOne to third generation adding up multiple carriers.

CDMA - Code Division Multiple Access. A wide band spectrum (1,250 kHz) technology that allows multiple conversations across the broadcast spectrum.

CDMAOne - Code Division Multiple Access One, is the interim standard, IS-95, for CDMA.

CIS – Corporate Innovation System

c-HTML - Compact Hypertext Markup Language. The language in which NTT DoCoMo developed its i-mode services.

Content Provider - An enterprise whose products are information-based, that is content owned or managed for third parties. Content providers often include services to access and manage content.

DDI - Cellular operator, using the CDMAone standard that has been merged with other companies into KDDI, now one of the three cellular operators in Japan

ETSI – European Telecommunications Standardisation Institute

EDGE - Enhanced Data for Global Evolution, is a faster derivative of GSM. It enables multimedia and broadband functions to be performed on mobile phones.

EZweb– Mobile Internet services offered by KDDI, based on the WAP protocol, have been able to achieve the same penetration in its customer base, as has DoCoMo for its i-mode.

GIS– Global Innovation System

GPRS - General Package Radio Service. An extension for adding faster data transmission speed to GSM networks. It is a package-based technology.

GPS - Global Positioning System. A system, which uses a satellite to confirm a user's position on the earth surface.

GSM - Global System for Mobile Communication. The European Telecommunications Standardisation Institute (ETSI) and various EU research programs, such as RACE, played an important role in establishing this standard.

HDML – Handheld Markup Language, developed by Unwired Planet, preceding WAP

HTML - Hypertext Markup Language, the language in which web pages are presently created.

HDTP - Handheld Device Transport Protocol, developed by Unwired Planet preceding WAP

i-mode - NTT DoCoMo's Japanese Mobile Internet service.

IDO – Cellular operator, using the CDMAone standard that has been merged with other companies into KDDI, now one of the three cellular operators in Japan

IS-95 – Interim standard of the CDMA family and the basis for CDMAone

IMT-2000 – The standard for the third generation mobile phone system in Europe

ISP - Internet Service Provider. A company, that provides access to the Internet.

ITTP – Intelligent Terminal Transfer Protocol, developed by Ericsson, preceding WAP

Java - A high-level object-oriented language, allowing applications to be written once, run anywhere, whatever the platform is.

J-Phone – One of the three large cellular operators in Japan in which Vodafone has taken a large equity stake.

KDDI – One of the three cellular operators in Japan. KDDI is offering two mobile services, TU-KA and Au, with EZweb being the mobile Internet service that is offered to Au customers.

MPS - Mobile Positioning System. Positioning system used in the GSM networks for locating a mobile subscriber.

MML – Mobile Markup Language used by J-Phone, one of the three cellular operators in Japan, in its mobile Internet service - J-Skywalker

NIS – National Innovation System

NTT DoCoMo – The largest cellular operator in Japan, still member of the NTT Group that maintains a majority equity stake in NTT DoCoMo.

PDC - Personal Digital Communications. The digital wireless transmission standard used for Japanese mobile phones. Transmission speed is same as for GSM, but the standard is only used by Japanese operators inside Japan.

PHS – Personal Handy System is a mobile micro cell system, developed in Japan, with much higher transmission speed than PDC

Portal - A website, which uses a wide range of content, services and vendor links to attract a high degree of traffic.

RTD – Research and Technological Development

SMS - Short Message Service. Method within the GSM-telephony for sending short messages from and to mobile phones.

TDMA - Time Division Multiple Access. A digital interface technology used in cellular, PCS and ESMR networks. TDMA works by dividing a radio frequency into time slots and then allocating slots to multiple calls. In this way, a single frequency can support multiple, simultaneously data channels.

TTML - Tagged Text Markup Language, developed by Nokia, similar to HDML developed by Unwired Planet

UMTS - Universal Mobile Communications System. The third generation mobile phone system.

UP – Unwired Planet changed its name to Phone.com at the Initial Public Offering (IOP) in 1999 and was later on merged with a similarly sized company Software.com to become Openwave that is now offering M-services.

Visual Phone - A cellular phone with a digital camera capable of sending and receiving snap shots, first introduced by J-Phone in the autumn of 2001.

W3C - The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential as a forum for information, commerce, communication, and collective understanding.

WCDMA - Wideband Code Division Multiple Access. One form of multiple access in the wireless communication field. The basic technology does not differ from CDMA, but WCDMA uses broader frequency bandwidth waves.

W-LAN – Wireless Local Area Network, commonly used in offices in the US, is seen as an infrastructure that has the potential to compete with 3G networks by offering local access users of mobile devices.

WML - Wireless Mark-up Language. The language, a browsing language similar to Internet HTML is part of the wireless application protocol governing the delivery and display on mobile phones.

XML - extensible Mark-up Language. A next generation mark-up language of which WML is a subset.

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