Diffusion of internet for mobile devices in Sweden



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ABSTRACT:

Diffusion of mobile internet is presently taking place and the mobile phone is being transformed from a predominantly communication device into a multimedia device that can be used for mobile internet. This paper outlines empirical arguments why usage is a more preferable measure than ownership of devices. Diffusion of mobile internet in Sweden between 2006 and 2007 is analysed and the characteristics of the early-adopters are identified. Furthermore, the paper provides explanations for the rate of diffusion via an analysis of attitudes towards different attributes of mobile internet services.

KEY WORDS

Diffusion, adoption, mobile phone, internet, multimedia

1. INTRODUCTION

The mobile handset is no longer just a phone; it has become a personal mobile device that integrates both personal communication and multimedia. Continuous innovations in mobile devices and new functions such as internet, cameras and GPS have been developed and integrated into handsets. The term mobile device is used here to refer to what has commonly been known as a mobile phone, with this new terminology being used to emphasise that the handset has become a device that integrates multimedia functions. Multimedia technology enables content and information processing through audio, video, graphics, text and animation in an interactive manner.

The widespread diffusion of internet for computers over the past decade has not only changed how people communicate with each other, but also how they inform and present themselves. Sweden is among the most developed countries in the world regarding use of internet and telecom. The development of broadband, as well as mobile internet, constitute important extensions of the digitally networked society. Swedes can use the internet more-or-less anywhere and anytime, using different types of devices, such as laptops, PDAs and mobile devices.

This paper analyses the diffusion of internet for mobile devices. The analysis is based on representative data on the Swedish population from 2006 and 2007. The analysis shows important differences between specific groups, but indicates important differences in measurements of diffusion that are based on possession or on use of mobile devices. The paper contributes to our knowledge of the nature of diffusion of mobile internet. Early-adopters are the main focus here; however, this study also contributes to our understanding of rejection of an innovation.

As for the other Nordic countries, Sweden has a high penetration rate of mobile devices. These are so far mostly used for voice calls and SMS (Bolin, 2005; 2006; 2007) although there is a slowly increasing usage of internet services such as for news (Westlund, 2007a; 2007b; 2007c). Sweden is an interesting case study because the ICT and mobile telecom sectors are well developed, having great coverage of broadband and 3G-networks.

The paper analyses diffusion of mobile internet among different groups between 2006 and 2007. The statistical data are based on three nationally representative quantitative surveys

carried out in 2006 and 2007. Two surveys, the SOM-surveys from 2006 and 2007, are used for the analysis of diffusion (measured as usage). The third survey, The Mobile Barometer, is used for supplementary analysis of usage based on a few variables unique to that survey. The Mobile Barometer is, moreover, used for an analysis of attitudes in relation to adoption criteria. It should be noted that there are differences in the age composition of the SOM-surveys (15-85 years) compared to the Mobile Barometer (16-65), which may affect the outcome of the results.

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The national SOM[1] survey has been carried out annually since 1986 at the University of Gothenburg. Each fall, 2x3000 independently and randomly chosen Swedes at the age of 15-85 years receive the SOM survey by post. The net response rate for the 2006 survey was 60 percent and for the 2007 survey 63 percent. The two SOM surveys are carried out simultaneously for comparisons, but the question about mobile internet usage is only addressed in one of them. The total number of respondents in the survey that could be used in 2006 was 1569 and in 2007 the figure was 1630.

The analysis of usage is based on another survey called the Mobile Barometer, which was carried out during the fall of 2007. The Mobile Barometer is administered by Oscar Westlund and Professor Erik Bohlin at the Department of Technology Management and Economics, Chalmers University of Technology. The survey was sent by post to 2000 randomly chosen people aged 16-65 in Sweden. The net response rate was 39 percent and there were a total of 764 respondents.

[1] SOM means Society, Opinion *and Media and refers to the focused areas of the survey, and the three departments at University of Gothenburg, which are involved in conducting the survey.*

2. DIFFUSION OF MOBILE INTERNET – IS IT A MATTER OF POSSESSION OR USAGE?

Diffusion researchers focus on the process by which an innovation is diffused; how it is communicated over time among members of a social system. A categorisation of society into five groups of adopters is commonly applied: innovators, early adopters, early majority, late majority and laggards. The categorisation focuses on the speed of adoption, and special attention is often given to innovators and early-adopters, which influence others in the adoption process. The diffusion process is affected by the characteristics of the innovation and the adopters, such as socio-demographic factors (Rogers, 2003). How then can diffusion be studied? Traditionally, diffusion studies are carried out retrospectively by asking people about their adoption and usage in the past for innovations that have become successful. This article avoids such recall problems and pro-innovation bias towards successful innovations (Lennstrand, 2001; Lievrouw, 2006). Rather it surveys representative samples of the population during different phases of the diffusion process.

Within diffusion studies, researchers often analyse the spread of an innovation measured as possession. Concerning the diffusion of internet for computers in Sweden, there has been a rather close match between possession and usage. Swedes with computers have for the most part also acquired internet, and are in fact using it (Carlsson & Facht, 2007). This starting point may be adequate for some innovations, but less adequate for others. This measure can be misleading if the ambition is to gain knowledge about an innovation for which possession is high but usage is limited.

The mobile device can be compared to a digital version of a Swiss army knife – as it unfolds one finds a variety of advanced functions. Currently, most retailers only offer the rather advanced products. Even the least advanced mobile devices incorporate functions that were top of the line just a couple of years ago. As a result, when a person purchases a mobile device to make voice calls, their product will likely also have SMS, MMS, calendar, camera and access to mobile internet. Adoption of these functions may not be a conscious or need-driven choice. Therefore, whether or how these functions are being used offers a more accurate measure. Although this paper prioritises analysis of usage, the relation between possession and usage for mobile internet within specific groups is also analysed.

There are a few examples of the gap between possession and usage regarding the diffusion of mobile internet. The Online Publishers Association (OPA) has studied mobile internet penetration among the five largest countries in Europe. They conclude that although seven to eight out of ten users have the possibility to use their mobile devices for internet, about only half of them ever actually will. The United States also was included in the study, showing similar patterns with 71% having access to mobile internet, but only 41% having used it (OPA, 2006). A different study documented that one of every five Italians use their mobile device to download data, and that the average amount of downloaded data is more than for any other European country. Swedes and Spaniards download about half the amount of the Italians, followed by the French and British. According to the same study, a quarter of Swedes use mobile internet, which is the highest proportion of users in Europe (Telephia, 2006). Although many European countries have a well-developed telecom infrastructure, adoption of mobile internet is low compared to Japan. In 2002, four out of five Japanese had an internet subscription for their mobile devices (Matsuda, 2005a). The Japanese are more accustomed to using mobile internet, and in 2006 about half of the population had acquired 3G handsets that enable faster internet services (Screen Digest, 2007). For the same year, a similar amount of people expressed that they also use their mobile devices for internet (Yang, 2007).

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3. EARLY ADOPTERS OF MOBILE INTERNET

Rogers (2003) has drawn the conclusion that early-adopters in general are opinion leaders, serving as role models for many other members of their social system. In relation to others, early-adopters have more years of formal education, higher social status, are more open-minded, have a more favourable attitude toward change and are more engaged in social participation. However, early adopters are no different from others in terms of age. These generalisations are valid for adoption of innovations in general. Different innovations have specific characteristics that are appreciated and needed by different people. The more important question is which groups of people constitute early-adopters of mobile internet.

The diffusion of mobile internet services worldwide is often viewed as comparatively limited (Wilson, 2006; OPA, 2007). Users of this current phase can be viewed as early-adopters. Several researchers have concluded that early-adopters of internet related services for mobile devices are men, mainly young adults, but also people with a high income and educational level (Matsuda, 2005b; Versakalo, 2006; Ohlsson, 2007; Kivi, 2007) and sometimes also with an above average interest in technology (Constantiou, 2006; Westlund 2007e).[2] An extensive study of the global use of mobile internet users also shows that early adopters are most often are young males with an above average income (OPA, 2006). One exception to these results comes from a Japanese study which indicates that among Japanese youth, women are actually the most frequent users of mobile e-mail (Miyata et al., 2005). The paper's empirical results may strengthen or reject the current notion that early adopters of mobile internet are predominantly men, young, with high incomes, high educational levels and greater interest in technology.

The diffusion of mobile internet is related to the individuals' innovation-decision processes. First, the individual obtains knowledge about an innovation. Then he or she forms an attitude toward the innovation and also makes a decision to adopt or reject it. Adoption means that it will be implemented and, subsequently, the individual will seek confirmation of this decision (Rogers, 2003). The innovation-decision process is related to the characteristics of the innovation. Within diffusion research, it has been emphasised that five characteristics of the innovation are especially important: relative advantage, compatibility, complexity, trialability and observability. Innovations that are perceived as having these characteristics, especially the first two, are more likely to be adopted (Rogers, 2003). Does internet for mobile devices have a perceived relative advantage in relation to computers? Do people find mobile internet compatible with

[2] Some of these *researchers do not have diffusion research as an explicit theoretical departure point, but undertake similar types of analyses.*

their needs, values and lifestyle? To what extent do people find the use of mobile internet complex? Is there a fair degree of trialability? If people easily could try the use of mobile internet, the level of uncertainty would decrease. In terms of observability, when an innovation gains increased visibility more people can see its qualities.

Related research about innovation characteristics comes from adoption researchers who seek to understand adoption via decision processing theories (Fishbein & Azjen, 1975; Azjen, 1985; Davis 1989) applied to the adoption of mobile services (Pedersen, 2001; Pederson & Ling, 2002; Green et al., 2001; Pedersen & Methlie, 2004; Teo & Pok, 2003). For example, Nysveen, et al. (2005) concludes that attitudes, normative influence and feeling of control are the most important criteria for influencing the adoption of mobile multimedia services.

Regarding the diffusion of mobile internet, Pagani (2004) has studied the adoption of 3G services in six countries, concluding that usability, user-friendliness, price and transfer speed are determining criteria for adoption. A report from OPA (2006) concluded that the three major sources of dissatisfaction for mobile internet users in the world are the time it takes for the site to load; poor site navigation; and lack of user friendliness. Pedersen & Methlie (2004) argue that services should be useful, functional and easy to use. There must be a balance in complexity and usefulness, as well as variety in the amount of available content and functions. A conclusion is that attributes such as transfer speed, usability and user friendliness are important factors. Besides these characteristics of the innovation one should also take the different attitudes of people into consideration. It has been concluded that some groups of Swedes regard the mobile device only as a interpersonal communication tool, not as a multimedia device (Westlund, 2007a), whereas the Japanese tend to view the mobile device as a multimedia tool that can be used for internet (Okzari, 2006; Ito et al.; 2005).

4. DIFFUSION OF MOBILE INTERNET SERVICES IN SWEDEN 2006-2007

Infrastructure for mobile internet services in Sweden is well-developed. The roll out of 3G started in 2001 and was finalised in 2006. Since then the networks have been upgraded to handle high speed packet access (HSPA) for faster mobile internet access. Virtually all Swedish inhabitants, except younger children and those aged over 75, have a mobile device (Bolin, 2006). However, the empirical results from 2006 in table 1 illustrate that few people used their mobile device to browse internet. The Swedish population used mobile internet rather little if compared to how often people make voice calls and send SMS, but also in comparison to the frequency of internet usage.

Usage at least once a month can be used as a defining criterion of mobile internet users. This measure includes people who use mobile internet often as well as people who use it only every now and then. In 2006, 12 percent of the Swedish population aged 15-85 years used internet services with their mobile device at least once a month. By 2007, there had been an increase to 16 percent. Among these mobile internet users, rather few are more frequent users. In 2006, four percent used the mobile for internet services at least once a week, while only one percent did so daily. An increase took place for 2007, as seven percent had become weekly users and three percent used it daily. A conclusion is that although the increase in the number of users is relatively small, much of the increase takes place among weekly and daily users.

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Twice as many men as women had started using mobile internet services in 2006. Men were also more frequent users - seven percent of men used internet services at least once a week, compared to two percent among women. The gendered difference was kept in 2007, as 21 percent among men were using mobile internet, compared to 11 percent among women. More men than women increased their frequency of usage, as 11 percent of men used mobile internet on a weekly basis, compared to four percent among women.

	Never		Every month		Every week		Daily		n	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Everyone	88	84	8	9	3	4	1	3	1569	1630
Gender										
Man	84	79	9	11	5	7	2	4	811	811
Woman	92	89	6	8	2	2	0	2	758	853
Age										
15-19 years	77	70	14	17	7	8	2	6	119	143
20-29 years	75	71	12	18	10	7	2	4	181	204
30-39 years	78	71	16	17	5	6	2	6	243	232
40-49 years	89	83	7	8	2	7	1	1	263	287
50-64 years	94	90	3	6	2	3	1	1	311	297
65-85 years	98	95	1	2	1	1	1	1	376	407
Educational level										
Low	95	89	3	7	2	3	1	1	352	368
Middle-low	86	82	9	10	4	5	1	3	532	564
Middle-high	89	84	6	12	5	3	1	1	333	311
High	85	82	10	9	3	4	2	5	330	387
Payment model										
Private pre-paid	93	90	5	5	2	3	1	2	738	730
Private subscription	84	81	9	12	5	5	2	3	664	720
Employer-paid	83	75	9	13	6	7	2	5	381	382

Table 1. Use of internet services with mobile devices among different groups in Sweden 2006-2007 (percent). Source: SOM-survey 2006 and 2007.

The relatively largest number of users is found within the ages of 15-39 years. In 2006, there was an indication that young adults in the age of 20-29 years were most keen to use mobile internet, but in 2007, the 15-19 and 30-39 age groups had reached a similar level. Actually, 14 percent of people aged 15-19 used mobile Internet on a weekly basis, which is slightly more than the other age groups. This can be compared to the true laggards, i.e. people aged 65-85 years, among whom only 2 percent were weekly users, while 95 percent never used the mobile for internet at all.

The educational factor empirically distinguishes those with a low education from the other educational groups. People with little education were the least keen on using internet services, while there were few differences between other levels of education. An explanation to the low usage among the least educated is that this group of people is over-represented among the elderly.

People with pre-paid as a payment model used internet-services more seldom than people who have other payment models. Pre-paid users usually have a lower income, and are also more cautious with the costs of their usage. The table also illustrates that there are some differences between those with a private subscription compared to those with an employee subscription. The fact that the number of users is slightly higher

	Never, and I wouldn't like to	Never, but I would like to	Less than once a month	At least once a month	At least once a week	n
Everyone	52	18	16	5	8	731
Man	43	18	20	7	13	335
Woman	60	18	14	3	5	396
16-29 years	38	20	23	7	12	173
30-49 years	46	19	18	7	11	285
50-65 years	68	17	11	1	3	269
Private pre-paid	68	15	10	4	3	229
Private subscription	48	20	20	5	7	300
Employee subscription	39	20	17	7	17	161
Employed	54	19	13	5	9	479
Students, unemployed & others	48	18	22	5	7	252
Low income	53	18	19	5	5	204
Middle income	51	18	18	4	9	239
High income	51	19	15	5	11	254
Great interest in society issues	51	22	14	4	8	409
Great interest in news	52	21	15	4	8	499
Great interest in politics	49	24	15	5	7	249
Great interest in local society	55	22	14	4	5	332
Great interest in entertainment	48	21	18	4	9	387
Great interest in technology	36	24	20	7	14	292
GSM/GPRS	47	21	20	6	6	381
3G	28	14	24	9	26	[93]
Do not know	71	16	9	3	2	238
Has internet	31	15	29	9	17	350
Has WLAN	17	8	23	10	42	[48]

Table 2. Use of internet services with mobile devices among different groups in Sweden 2007 (percent). Source: Mobile Barometer 2007.

among people with an employee subscription has most likely to do with two factors. The first factor is that the need for mobile internet is higher among this group, secondly that they care less about the costs of usage since their employer pays.

Table 2 illustrates differences depending on which type of network is being used, based on the results from the Mobile Barometer survey in 2007. In accordance with previous studies that have identified 3G as an important driver for mobile internet usage (Versakalo 2006), the 2007 results show that weekly usage is much higher among 3G users (26%) than among GSM users (6%). Among those who do not know their type of network, only 2% are weekly users. The general pattern is, in fact, that the number of mobile internet users is higher among people who use the 3G network.

In the Mobile Barometer survey, the respondents were asked if their mobile device can be used for internet. 47 percent expressed that it could. This result should be interpreted as the number of Swedes that are aware that their mobile device can be used for internet, rather than the actual diffusion. In fact, it is most likely that the diffusion of internet-enabled mobile devices is higher. It can be taken into account that more than nine out of ten possess a mobile device and that most people possess a rather new device. Table 2 illustrates to what extent this group is, not only, aware that they have internet in their

mobile, but also in fact use this function. A striking majority has not started to take advantage of this opportunity: 46 percent never do so and 20 percent do so more seldom than once a month. This result shows clearly the gap in diffusion for mobile internet services when comparing possession and use. Still, the use is more developed than among Swedes in general. The number of weekly users is 14 percent, which is about twice as many as among the Swedish public. Being aware that the mobile can be used for internet and using it for such functionality is related to people's interest in technology. The results in table 2, furthermore, show that among people with a great interest in technology, 14% use internet services weekly. Interest in technology may stimulate users to purchase a new mobile device more often, increasing the chances that it is a 3G-enabled device.

5. ATTITUDES TOWARDS INTERNET SERVICES

Studying attitudes towards a phenomenon contributes to the understanding differently than do studies of behaviour. The previous discussion showed that usability, user-friendliness, price and transfer speed have been shown to be important criteria's for adoption in other studies. Diffusion researchers have emphasised the importance of relative advantage. The Mobile Barometer questions included statements about costs and user-friendliness, but also the perceived relative advantage in relation to computer internet. There were seven statements and the respondents could mark 0 (not agree at all) to 10 (fully agree), but also "do not have an opinion' as an answer. There was a high proportion of people without an opinion for some statements. Regarding speed of internet and knowledge about costs for usage, about half expressed that they do not have an opinion. This high degree of uncertainty is clearly an interesting result – illustrating quite well that many people lack personal experience from browsing internet with their mobile device. In the analysis those who lacked an opinion have been excluded – which means that the results might be somewhat skewed since people who have an attitude are likely to have some personal experience.

Three out of four Swedes do not know how much it costs them to use mobile internet service. This probably has the consequence that people will refrain from using internet services since they want to know and feel secure about the costs (Westlund 2007a) which is avoided with flat-rate pricing models (Mitomo 2007). However, in Sweden only about one out of ten actually perceive that they know how much internet services cost. About half of the Swedish population would use internet services more often if they could use a flat-rate price model. On the other hand, 35% claim that they would not increase their usage. These people probably have no interest at all – no matter its costs or quality. They simply do not have an interest in using mobile internet services at all because they are content with their media usage patterns as they are (Westlund 2007a). This is related to the perceived relative advantage – that these people do not feel that the mobile device provides a killer application different from other media.

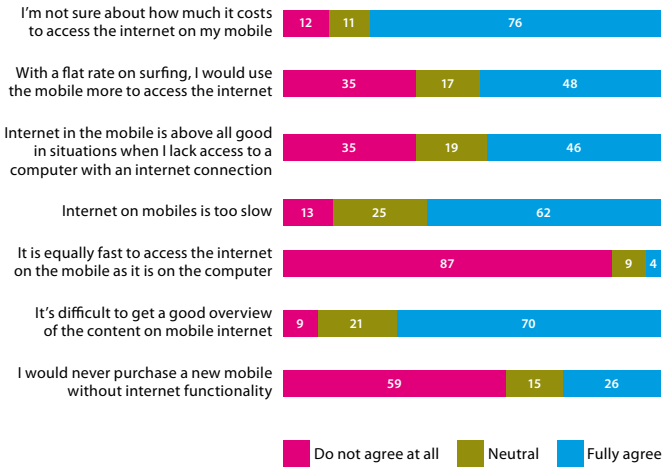

Figure 1. Attitudes towards internet for mobile devices among Swedes in 2007 (percent)
Mobile Barometer 2007. Number of respondents varies between 292 and 562 for the different statements. The figure shows only those people who have expressed an opinion. The scale varied from 0 to 10. The range 0 to 3 signifies "do not agree at all", "neutral" means 4 to 7, and 8-10 means "fully agree".

Will internet for mobile devices be a complement or replacement to computer internet? Every other Swede expresses that mobile internet predominantly is suitable for situations without access to a computer with internet – constituting a complement to the computer. This is partly explained by perceived quality of the user experience, for example, about three out of five people perceive mobile internet as too slow. It should be kept in mind that they have different experiences of internet speed from both computers and mobile devices. Half have GSM/GPRS, 17% have 3G and the rest do not know. Only 13% do not believe that mobile internet is too slow.

Although Rogers argues that it cannot be generalised that the youth and young adults are early-adopters for all types of innovations, this paper provides support that these age groups are early adopters when it comes to the specific innovation of mobile internet.

Besides transfer speed, another user-friendliness dimension concern whether it is possible to get an overview of the content on mobile internet. Only one in ten do not perceive this as difficult, whereas seven out of ten fully agree that it is difficult to get an overview. This is most likely related to the screen size and the format of the internet content for mobile devices. The final statement shows that only one in four value mobile internet so much that they would agree to never buy a new mobile handset without internet functionality. This implies that the importance of internet services for the future adoption of mobile devices is likely to only increase slightly.

A final comment on the subject of attitudes is that knowledge about costs is limited and that the quality of service measured by transfer speed and overview is low. People value the mobile device as inferior in relation to computer internet in terms of transfer speed and overview functions.

6. FINAL DISCUSSION

The paper confirms the hypothesis that the diffusion of mobile internet in Sweden is much lower when analysing levels of usage compared to the level of possession of mobile internet devices. The paper further confirms previous research on diffusion which observes that the early adopters to a great extent are men, teenagers and young adults, and people with an above average interest in technology. Although Rogers (2003) argues that it cannot be generalised that the youth and young adults are early-adopters for all types of innovations, this paper provides support that these age groups are early adopters when it comes to the specific innovation of mobile internet. The paper identifies further factors that differentiate early adopters from the current rejecters. Such factors are type of employee contract and the possession of a 3G device. In conclusion, it is evident that among the laggards we find people with pre-paid, low educational level, women and people aged more than 50 years.

The identified early adopter group is a concentration of men with higher resources, but spread across a wider age range. This means that usage has penetrated to different user segments. The use of mobile internet services is also gaining more observability and trialability (Rogers, 2003). In the diffusion of innovations, there is no smooth transition from early adopters to other groups in society. Moore (2002) has criticised the diffusion S-curve by arguing that it has to cross the chasm between the different user groups. Different adopter groups have specific characteristics, and do not always help in transferring an innovation to other groups. Currently, there is a digital mobile divide between those who use their mobile device for multimedia, and those who use it only for interpersonal communication.

Limited knowledge about costs and an attitude that the mobile device lacks important quality features, especially in comparison to PC-based access to the internet, are both barriers for diffusion. Early diffusion of computer-based internet may have actually created a barrier for adoption of mobile internet. Swedes have become accustomed to the user-friendliness of computer internet, and think that the screen and keypad of mobile devices are too small. Swedes might thus refrain from using mobile internet due to their high expectations on transfer speed and usability. Of course other factors are also important, such as costs, available content and services, as well as quality of handsets and networks (Westlund, 2007a; 2007b). A broader diffusion will take place if the mental and economic barriers for adoption decrease. ●

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