

# Acceptable Download Times in the Mobile Internet

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## Abstract

The web is becoming more and more graphical and the average size of pages has been growing during the years. Most users enjoy fast download of heavy pages, and the experience of using the web is highly visual. The mobile Internet, e.g. WAP or i-Mode, provides a considerably more limited environment for Internet usage. Although bigger colour displays are rapidly becoming more common with mobile devices, the network bandwidth still is limited. An interesting question for the mobile Internet site developers is: What is more important for the mobile Internet users, a graphical user interface with images, or quick download times? Users are used to have both of these on the fixed web, but in the mobile Internet, you need to select one or the other. Nokia Research Center conducted usability tests where we found that quick download time is more important than visual look of pages when it comes to subjective satisfaction of the users.

## 1 Introduction

The Internet has been a great success for fixed network access, whereas WAP (Wireless Application Protocol) for mobile access still has not fulfilled its promise. However, now the analytics have stated a belief in the success of mobile Internet access. WAP 2.0, with XHTML Mobile Profile (XHTML Mobile Profile Specification) as its standard language, will enable sites that function in a controlled way both in the fixed and wireless world. Although the barrier between mobile and fixed web content is starting to fade with XHTML, the network and device remain to be very different.

Looking at download times, mobile access today resembles fixed access years ago. General Packet Radio Service, GPRS, is a 2.5 generation network technology used by many new mobile phones for Internet connections. The speed of the GPRS network is comparable to a 28.8kbps modem, in many circumstances GPRS is even slower. Pages with graphics take a long time to download, and content developers for mobile access are constantly reminded about page size. At the same time, the fixed network access shows increased use of graphics and animations with increased bandwidth. Users that are accustomed to graphics on web pages expect these to be available over the mobile network as well. Most mobile Internet sites are, however, very much text based. Users are also accustomed to fast download times on the fixed network, and providing the same graphics in the mobile network would make the download times considerably slower. The results of our study help in answering the question: What is more important for the mobile Internet user: The similar look, or the speed, with the fixed web?

Jared Spool et al (1999) claim that neither the graphics nor the download time affect site usability when using a 28.8kbps modem for information retrieval. We wanted to find out if that is the case in mobile Internet use as well. We will analyse our findings together with Jared Spool's findings on download time and the effect of graphics.

## 2 Method

The goal of our study was to produce usability guidelines for mobile application developers for inclusion into the XHTML Guidelines (2002). Our original focus was *not* to study the download times, however. Only during the tests we noticed the important role of the download time for users' subjective satisfaction. We were also surprised about how clever the users nowadays are in estimating whether the download delay is acceptable or not.

We conducted two tests that were both carried out with Nokia mobile phones running a prototype version of the Nokia mobile XHTML browser. The first test was carried out with Nokia 6510 in Europe and 6590 in the US. The display on these phones is monochrome and tiny (figure 1). For the second test we used Nokia 7650 that has a bigger, PDA-like colour screen (figure 2). The display resolution was 176x208, with 4096 colors. The applications were implemented using pure XHTML Mobile profile and were accessed as WAP services over a GPRS connection.



Figure 1: Screen view from Nokia 6590






Figure 2: Screen capture from Nokia 7650

We used 20 participants for the first test: 12 located in Helsinki, Finland, and 8 in Boston, MA, USA. The participants in Finland originated from various European countries and from Japan. The experience of the participants varied from active users of the current mobile Internet to ones that had never used it. All but one user knew, however, at least the principle of either WAP in Europe/USA or Japanese mobile Internet (i-mode, J-sky or EZ-web).

For the second test, we used 10 participants. Eight of them were Finnish, one was Romanian and one Indian. We wanted to have participants from many parts of the world to see if there are dramatic differences between the different cultures in using WAP services. We did not notice any cultural differences in the way that the users interacted with the system, however. There most likely are cultural differences in the preferences of graphics and images, but because of the small number of subjects, no cultural conclusions can be made based on this study.

Users were asked to think aloud during the task execution. The picture of the mobile phone screen was captured with a mini-camera that was attached to the phone. The test moderator could follow the exact user's actions from the LCD screen of the video camera.

The user interfaces for the tests were specifically designed and developed for this study, and only the parts needed to carry out the test tasks were implemented. All the user interfaces contained the same data, but the way the data was presented, navigation, and the usage of the elements varied in each user interface style. To avoid associations that would make one style better than another, we named the styles according to fruits, as can be seen in table 1.

	<b>Banana</b> “long content”	Long pages, flat hierarchy; Selection lists; Layout tables; Images
	<b>Orange</b> “slices”	Short pages, deep hierarchy; Multi-page forms; Choice for text input or value selection; Data tables; Small images
	<b>Apple</b> “for experts”	Keyword search prioritized; Accesskey shortcuts; Textual input; No images

**Table 1: Characteristics of the three different user interface styles**

The applications in both tests were almost the same. Obvious flaws from the first test were fixed for the second test, such as too short pages in the Orange style. Furthermore, images were added on Banana and Orange pages only in the other test. In the Banana style, the user could not leave the page until the images were downloaded.

The subjects were asked to interact with two services, a News service and an Auction service, for the study. The News service was designed for information retrieval, while the Auction service provided a more interactive interface with forms and transactions. The order of the services and user interface styles was counterbalanced.

The tasks were quite complicated, so the users needed to download several pages to reach the target page. The tasks for the News service:

1. Finding the weather forecast for specified location and specified time
2. Finding information about the performance of one basketball player in a specified match

Tasks for the auction service:

1. Deleting an offering from the list of user’s offerings
2. Modifying an offering on the list of user’s offerings

Each user performed all tasks three times, once for each of the different interfaces. The time limit for the study was 2 hours but there was no time limit set for the tasks. Most users managed all tasks within the set time, however 4 did not have time to complete all of them. The reason for running out of time was more because of the duration of discussions or technical difficulties than of the difficulties in task execution.

After going through all tasks for a Service using a specific interface style, users were asked to rate the style on a scale from 1 to 5, where 1 is bad/difficult and 5 is good/easy. The questions were:

1. Did you always know how to proceed?
2. How easy it was to locate/ recognize components?
3. How quickly did the system let you execute the task?
4. Did you like the visual presentation?

The last two questions are the most interesting ones for the speed / look analysis of this paper.

We analyzed the times taken for specific tasks and the user satisfaction ratings, and we performed a qualitative analysis of the user comments and performance in test tasks.

### 3 Results

We did not originally focus our study on download times, that is why we did not measure them exactly. The total task execution times and the subjective ratings are in line with users’ comments.

For the first test with small screen phone, Orange user interface style with split pages was significantly slower than Banana and Apple styles in the News service. The average times and deviations can be seen in table 2. The differences in the Auction task times were not statistically significant, this was because the Orange pages were not so short in the Auction service.

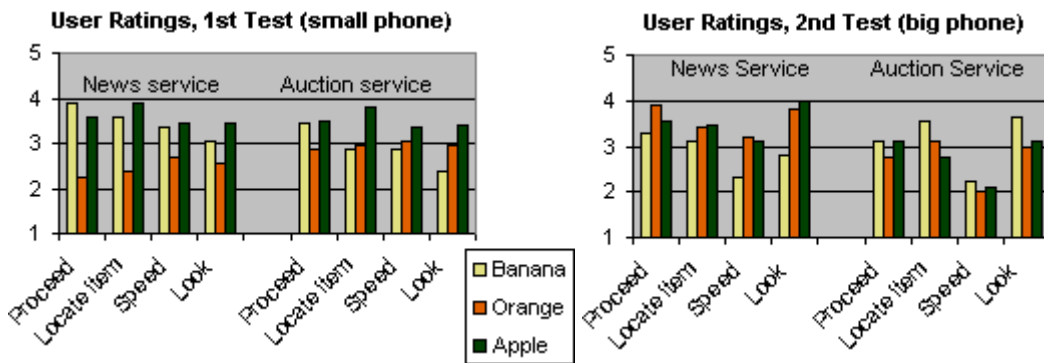
Small screen phone	Banana News	Apple News	Orange News	Banana Auction	Apple Auction	Orange Auction
Average (sec)	291	249	<b>789</b>	450	388	326
St.deviation	109	85	418	216	140	124

**Table 2: Task execution times with the small screen phone (1<sup>st</sup> test)**

The average execution time of Orange News task is long because of two reasons. First, it was slow to wait for each piece of page to download separately. Second, users spent some time figuring out the logic behind the user interface.

The sliced pages of Orange News service performed so poorly in the first test that we combined the pages to a bit longer ones for the second test. After this change, there were no significant differences in task execution times between the different UI styles.

Although we cannot count too much on the task execution times here, it was clear from the subjective comments of the users that the download times were seen too long in two cases: the Orange News of the first test, and the Banana News in the second test. This can be seen also from the numeric ratings by the users (Figure 3). The speed and look criteria, questions 3 and 4 on the previous page, are the most interesting ones when investigating the effect of download times.



**Figure 3:** Subjective ratings of the user interface styles in the two tests. See the previous page for exact rating questions.

The reasons for the poor ratings of the Orange News service here are the same as the reasons for the poor execution times: it was both hard to understand the UI logic and to download each piece of the page separately. For the second test, it is very interesting that the visually appealing Banana style was ranked poorly for the look in the News service. Users saw that the main page looked fine (Figure 2), but after that the icons only slowed down the task execution and scrolling, and did not provide enough of added value. Since the users were irritated after a too long wait, the images did not attract them. Banana Auction did provide added value with the images by presenting the stamps being sold, so the users wanted to wait for the images and rated the look here much higher. The speed of all styles in the 2<sup>nd</sup> test Auction service was poorly rated by the users. This was more because of the site and page structure than of the download delay: the Apple pages downloaded quickly, but the users had to scroll extensive textual pages to find the item they were looking for.

## 4 Conclusions

During the first test, the users seemed to cleverly estimate the acceptable download time of pages, allowing for longer download times for information-rich pages or pages requiring server processing such as search. A significant, download related result from the study was that a little scrolling is better than frequent downloading [Kaikkonen & Roto 2003]. When users knew that they are waiting only for one screenful of data, they were very irritated of the normal download delay.

For the second test, we used pages that were more like the pages of the fixed web, when it comes to the amount of images. The Banana style that counted on graphics and did not always let the user proceed until the images were downloaded, was clearly the least preferred one (figure 3, 2<sup>nd</sup> test, Banana News). When we asked why, the users commented very clearly that the images took all too long to download. The Banana Auction service did much better since the images were essential for the service.

Images did not disturb the users, if the users were able to proceed even before the images downloaded, if images provided added value, and if they did not take up much screen space. This was the case with the Orange News service: small icons in front of a text line were fine.

Our results do not support the finding by Jared Spool about download time not being an issue, because our subjects were really irritated to wait for too long. Instead, the acceptable waiting time seems to correlate with the page content. Our findings do support Spool's statement about the added value of the images: "when the users thought an image would have interesting content, they would wait for it to download. When they thought the image was purely decorative, they were less patient."

In our study, download times were more important than graphics for the satisfaction of current mobile Internet users, when using mobile Internet pages over a GPRS connection. When developing Internet sites for mobile access, we recommend that designers remember and follow the rules used years ago by web page designers for the fixed network – keep the image burden minimal to provide quick page download.

## 5 Future Work

Our study could not give an exact answer to the question of acceptable download time on mobile Internet pages, since the test setting was not optimised for studying the download times. It would be a better test setting to take the users to a real mobile usage context, measure the exact download times, observe users' focus of concentration, and ask them whether they saw the page download time acceptable. It would also be interesting to study the effects of long-term use: will experienced users tolerate longer download times as they get accustomed to the speed of the wireless network, or will they ask for quicker feedback as they become quicker users themselves? This leads easily to the question to the applicability of the response time rules by Miller (1968) and Card et al (1991) to the mobile context. We look forward to see further studies on this topic.

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