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## 1 Executive summary

In a pilot study, visitors to the Historic Museum in Stockholm were given the opportunity to receive extra spoken information about the historic objects through their private mobile phones. The visitors could use an interface they are used to (their mobile phone) and the museum need not lend and maintain expensive terminals. During our trial in the summer month of 2005, about 66 visitors tried the service. Most visitors liked the service and most of them were willing to pay between 10 and 20 SEK for using it. The few complaints were almost all due to technical trouble. The service was compared to the mp3-based audio guides which also were provided for free by the museum. The mp3 based solution were used a lot more than the mobile phone based solution. The major reason for this is very likely that the mp3 service is a well established and an expected service in today's museums.

In the future it can be envisioned that the service will be enhanced by giving the visitor the possibility to personalize the information to suit the needs of the visitor concerning amount, depth, choice of language, speech tempo etc.

## 2 Background

Today many Museums have Audio Guides in different languages that visitors can rent/borrow and listen to information about objects; this kind of service does the Historic Museum offer as well. But it costs money and time to handle these Audio Guides; update the devices with correct information (you can't distribute the information to all Audio Guides at the same time, you have to pick them one by one), battery charging, ID control to prevent theft before lending the guide etc. Therefore they wanted to test something new, a Guide that uses mobile communication and above all that the visitors use their own mobile phones.

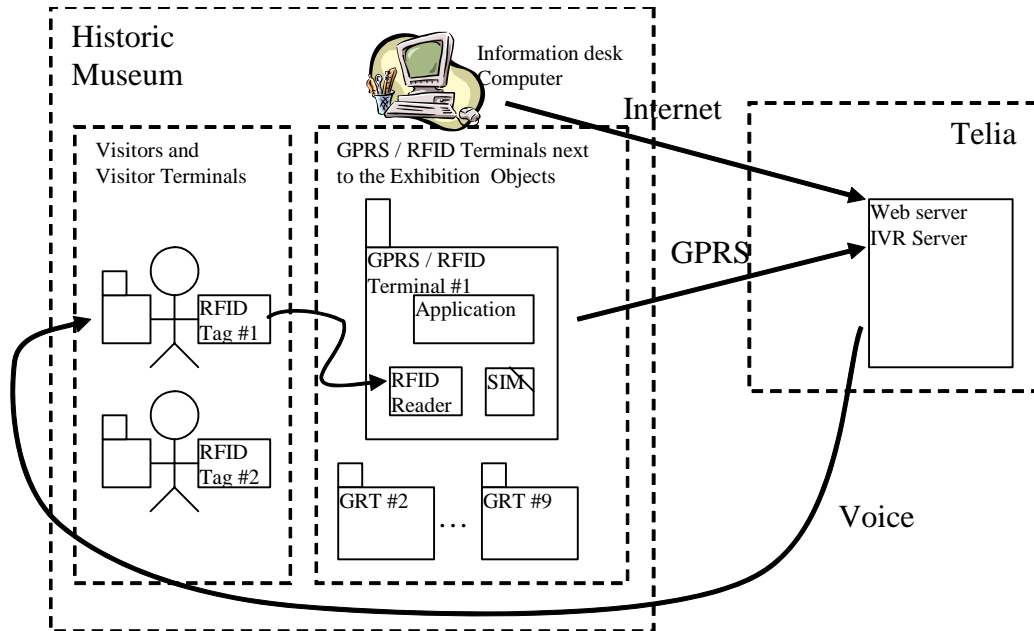
The purpose for TeliaSonera, Research & Development, with the project was to test the idea and the user acceptance of a position based communication service using RFID for positioning and of course, to test the technology.

## 3 Technical solution

This project was a Research & Development project within TeliaSonera. The aim to the project was to test the idea that a short-range machine-to-machine communication between an RFID-tag and an RFID-reader automatically initiates multimedia communication in some form to (and/or from) a mobile phone that is physically or logically linked to one of the RFID-tags.

### 3.1.1 Terminal Software Requirements

Domain picture with all different equipment needed, this chapter describes the requirements for the application in the terminal, and an overview of the requirement for the whole service.



**3.2 Scenario for the whole service**

The pre conditions are:

1. The Information desk computer connected to Internet is at the information desk at the Historic museum. The computer can contact the web server/ IVR server at Telia.
2. The personnel at the information desk handle all RFID tags (chip card).
3. At each exhibition object is a GPRS / RFID terminal with a built in RFID reader (Nokia 5140). There are nine objects.
  - Each GPRS / RFID terminal has a SIM card.
  - A started Java MIDP 2.0 application is running in each GPRS / RFID terminal.
  - Each application has been configured with the identification number of the exhibition object (#1, #2 and #9 in the picture).
4. Each visitor has borrowed an RFID tag with a unique number.
5. Each visitor must have a mobile phone (called visitor terminal).
6. A web server / IVR server is located at Telia. It can be accessed over Internet / GPRS. It can call the visitors' terminals. The web server / IVR server may be located in the same server, or may be different servers.

**Scenario:**

1. The visitor borrows an RFID tag
2. The visitor's terminal number together with RFID tag number is manually registered using the information desk computer. The information is stored in the Web server / IVR server.
3. The visitor put the RFID tag close to the box that contains the GPRS / RFID terminal (acts as a reader) at an exhibition object.

4. The web server / IVR server calls the visitors phone and plays the pre-recorded information about the exhibition object. The information is selected using the exhibition object number.
5. Step 3 to 6 is repeated depending on the visitor's choice.
6. The visitor returns the RFID tag to the reception.
7. The visitor's terminal number and the RFID tag number is removed from the web server / IVR server using the reception computer.

Post conditions:

- Information about the RFID tag number and the visitor's terminal number is removed from the web server / IVR server.

## 4 The Solution

### 4.1 Requirements for a solution

- It should be simple for the user. It is not acceptable with solutions that require a lot of actions for the user to install and configure software or going through long menu trees.
- It should work on almost any phone on the market. It is not acceptable with specific requirements on hardware that excludes large user segments
- Response times must be reasonable. A user can accept to wait for a few seconds at most for a file transfer to be completed.
- The service must be reasonably cost efficient. Value added to users is limited and so is their ability/willingness to pay.
- Simplicity makes everything possible. For example, this ambition could be satisfied by our new service giving the visitors the right types and amount of information at the right time and place with a minimum of effort.

### 4.2 The chosen solution

The users shall use their own private mobile phones which they are accustomed to. The visitor gets an RFID-tag at the entrance and provides his/her mobile phone number. The tag number and the phone number are temporarily linked in a database. When the user is interested in a particular exhibit, he holds his tag close to a marked RFID-reader. The system recognizes his tag number and a server calls his/her mobile phone to provide a voice message describing the exhibit in front of him/her. It is simple for the users to use their own mobile phone as the service resembles an ordinary phone call.

This solution is simple for the user; it works on all phones on the market.

## 5 Result from the questionnaire

### 5.1 The visitors opinion

According to the questionnaire most of them were satisfied or very satisfied with the service. On the question "What do you think about using your own mobile phone to get

information about the Viking artefacts?" Out of 58 visitors 52 answered that it was a good to a very good idea using their own mobile phone.

Over half of them were willing to pay (around 10-20 SEK) for using the service. A more thorough analysis showed that there was some correlation (0.39) between the degree of satisfaction and the willingness to pay – not surprisingly perhaps. The overall satisfaction with the service was good to very good (4 of a 5 grade scale).

A few visitors reacted on the speaker's dialect, making it slightly difficult to comprehend. The younger visitors commented that some words were difficult to understand.

This implies that a number of versions should be available to suit different needs like young people, immigrants, senior citizens, foreign tourists (of course) and people with special needs e.g. hard of hearing, people with slow comprehension and people with low visual acuity.

**5.1.1 The degree of satisfaction does not vary much over the background variables sex, age, education and historical interest.**

Education level	Average customer satisfaction	Number of respondents
<9 year compulsory school	4	3
9 year compulsory school	4,17	6
Upper secondary school	3,8	15
University education	3,79	34

Sex	Average customer satisfaction
Male	3,78
Female	4,03

Females seem to be somewhat more satisfied with the service – the difference is unlikely to be statistically significant.

The age of the visitors varied between 8 and 61 years. A linear regression analysis of satisfaction vs. age gave a very low R2 (0,0086) and showed that very little of the variation in customer satisfaction could be explained by age.

A linear regression of satisfaction vs. historical interest also produced an extremely low R2 (0,0008) indicating that variations in historical interest does not explain variations in customer satisfaction.

**5.1.2 The degree of satisfaction is determined more by whether things worked in the museum than on the perceived quality of the instructions for using the Mobile Guide.**

The correlation between the perceived technical functionality and customer satisfaction is pretty high (0,63). This implies that the sound quality is a very important factor for the visitor’s satisfaction. This is inline with previous knowledge. The correlation between perceived simplicity of instructions and customer functionality is lower (0,17) and maybe not statistically significantly different from 0. The rated simplicity of the instructions received a 4,34 on the 5 point scale.

### 5.1.3 The willingness to pay is partially determined by the level of customer satisfaction

When asked, 58% of our visitors testing the Mobile Guide reported that they were willing to pay for the service. Correlation between customer satisfaction and willingness to pay is 0,39 which is reasonably high. It is not surprising if those who are satisfied with the service also are more likely to be willing to pay something for it. Some visitor reported that hands-free ear-phone should be available at the counter. Two reasons were given: 1: To make the listening more private and more intelligible and 2: to reduce the exposure to radiation from the mobile phone.

### 5.1.4 Should this service be introduced in other museums?

Out of the total number of visitors evaluating our service, 93% were of the opinion that this was a proper technique that should be used in other museums. One comment was: "The children thought it was exiting and was listening". As mentioned above, for the museums to have different versions of the same content with different wording, speech tempo and other languages would be considered of value to suit all visitor groups.

For very interested to receive additional information about the artefacts by pressing "More information" could be of interest.

## 5.2 The personnel's opinion

The overall opinion from the personnel is that it was a successful pilot. The visitors that have tried the Mobile Guide have been very positive. They liked the idea with the concept and that the Historic museum tries new technology.

The RFID phones (readers) have sometimes not been working properly. The personnel at the information desk are not able to leave their place to get things in order; therefore it is necessary to have some sort of support and maintenance.

We asked the personnel why not more than 66 persons of potentially thousands have tried the service. They were not sure but maybe it was because the Audio Guide is well-known and widely spread and it is easier to ask for something you are familiar with. One of them thought that several people had used the Mobile Guide if they had already known about the service when they arrived.

The poster board describing the service was placed in front of the information desk. Many visitors have read the information but only the ones that wanted to try the service have asked questions and spontaneously said that they wanted to try the service.

## 6 Results from database over phone calls

### 6.1 Sixty-six persons tried the Mobile Guide

During an 11 week long trial (from mid June to end of August) period 66 people tried the service. This is less than one per day. It could be estimated that the museum during this time had about 30000 visitor – thus around than 0,2 % tried the service.

The trial persons tended to come in groups (on average 2, 83 persons per group), which meant that many days no one tried the service.

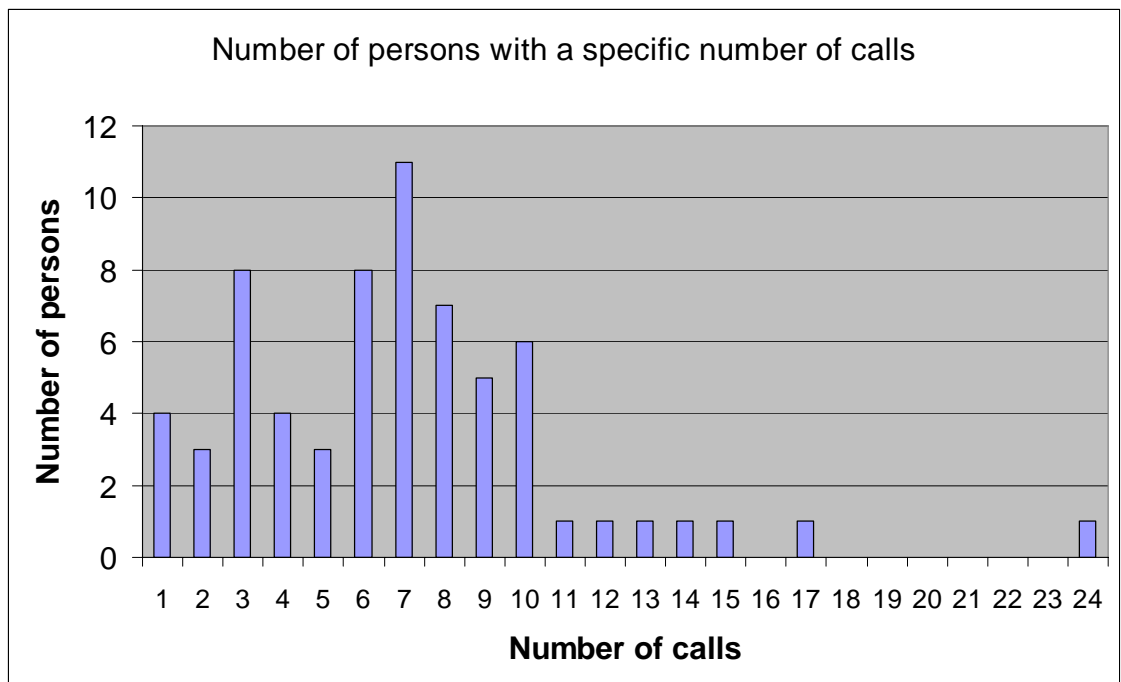
**6.2 There were few clear patterns in usage**

There was no significant variation depending on the day of the week. The usage intensity in July was the highest, followed by August. June had about half the usage intensity of July. Evidently the Swedish tourists did not come until July and the foreign tourists were excluded from the trial. One week in late July had pretty good usage. Evidently the museum had a lot of visitors that week due to the bad weather.

**6.3 The number of calls for a user varies a lot.**

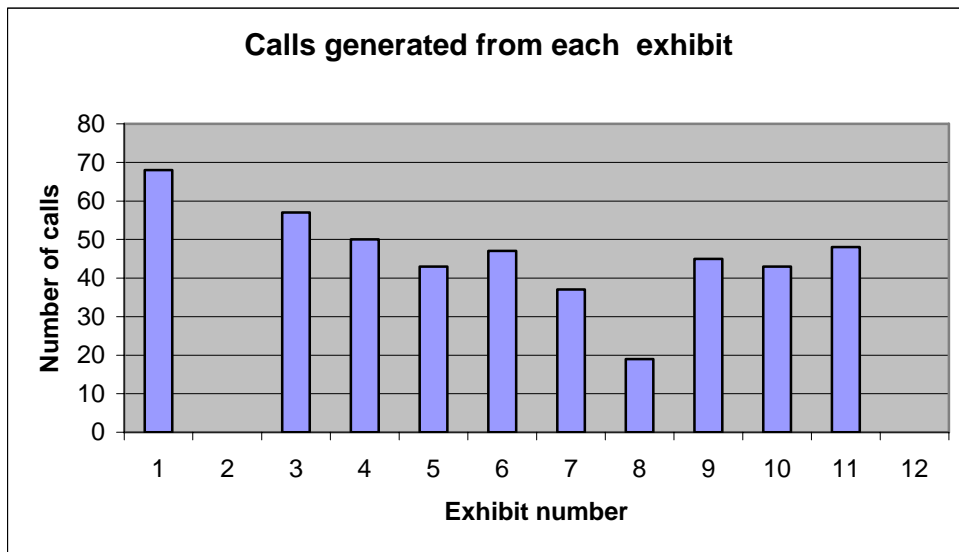
There were 10 stations (incl. the first one used for registration) and one would have expected most of the users to have had 10 calls as a majority of them said that they had listened to all stories. However, as the diagram below shows

- One third of users listen to description of half or less than half of the exhibits
- Only 20 % of them had 10 calls or more
- One of them had 24 calls – indicating perhaps two persons with one mobile phone walking together around the exhibition and each listening to a description of the exhibits.
- Average number of calls per user was slightly below 7. Most visitors were satisfied although they did not visit all artefacts in the Viking exhibition.



**6.4 One exhibit did generate fewer calls than the others – there could be several reasons**

The diagram below shows that the exhibit with ID number 8 generated a lot fewer calls than the others. No exhibit had ID number 2.



The reasons for the fewer calls from exhibit 8 could be

- Technical malfunction
- Less interesting exhibit
- “Hidden” exhibit
- Visitor fatigue towards the end of the visit

Analyzing the questionnaire we are quite certain that the reason is technical malfunction. Known problems were Lightning, electrical charging problems, tampering and congestion in the net.

**7 Result**

Audio guides have been around for about 40 years. At the beginning of 2003, virtually every major and middle-sized art museum in the world had an audio guide for its permanent collection, often in several languages. Although some museums report that visitors do not take advantage of audio guides even when they are offered free-of-charge, in other museums they are extremely popular. Normal price for renting an audio guide is 40-60 SEK unless the rental is bundled with the entrance fee.

In MoMA (New York Museum of Modern Art) about 33% of the visitors are using the audio guides when they are offered for free. When the price was the normal around 5\$ only 5% used the guide.

Though popular with many museum visitors, the management is a major undertaking for the museum. The digital players employed for audio tours require constant maintenance for repairs, recharging, replacement, etc. The main source of cost and frustration with museum audio tours is the rental and continuous upkeep of the audio player hardware. Large exhibits can require hundreds of these machines. Thousands of visitors of all ages, interests, and technological know-how rent and use the players, carrying them throughout the museum every week. Commercial vendors have developed heavy duty players but accidents, careless handling, and absent-minded visitors still result in damage and loss. Because exhibit information is stored directly on each machine, updates must be accomplished individually. Sophisticated storage racks can facilitate the updates and recharging, but maintenance is still a time consuming operation.

Stelacon investigated advanced mobile services of interest to future 3G subscribers in 2003.

Tjänst	Rangordning
Tjänst som visar geografiskt närliggande platser, t.ex. restauranger, bio samt visar resväg dit	1
Aktuell trafikinformation från lokaltrafiken	2
Fotografera och spela in videosekvenser för att sedan skicka dem via mobilen	3
Videotelefoni, dvs. att kunna se den ni pratar med	4
Positioneringstjänster, att veta var vänner och bekanta befinner sig	5
Se biotrailers och boka biljetter	6
Virtuella guider för turism, museer etc. där man kan få information om och se smakprov från pågående utställningar	7
Se highlights från sportevenemang	8
Ladda ner och spela spel i [real tid]	9
Titta på musikvideo	10

Ranking of potential 3G Services. A focus group study made by Stelacon 2003

This shows that museum guides are only number 7 on a top-10 list. Real time local traffic information is number 2 on the list and if the RFID-based congestion fee trial becomes permanent one could well envisage a Mobile Guide-service providing the motorist with individualised traffic information depending on his position and his destination.

**7.1 Pilot users compared to the population as a whole**

The pilot users are pretty much like the population average. They are slightly younger, have a little bit more education and have little more females and visit museums much more than the average population. The figures are shown in the table below.

	<b>The pilot users</b>	<b>Population average</b>	
Per cent women	53	51	
Education	2,3	2,1	(2= upper level secondary education, 3=university)
Average age	36	40	
Number of museum visits per year	>4	1,8	

There is also material available in "Kulturbarometern" which indicates for all museum visitors that

- They are younger than the average population (smaller proportion of old age people have visited a museum)
- Are somewhat more educated than the average (the higher the education level the more visits to museums)
- Have a slight overweight of females

Therefore it seems that those who have chosen to try the pilot did not differ significantly from the average museum visitor in terms of sex, education and age.

Still the share of total visitors is so small that it would be dangerous to generalize the results to all museum visitors.

**8 Discussion & Conclusion**

The main conclusion is that the visitors like to use their own mobile phones which they are accustomed to, to request and receive needed and relevant information.

For the information provider it was advantageous to deliver information to the users own mobile phones as the information provider doesn't have to invest in terminals and own infrastructure.

For the network operator like TeliaSonera this is somewhat uncertain business opportunity as the control and initiative lies with the information providers and terminal manufacturers.

## 9 Abbreviations and acronyms

RFID	Radio Frequency Identification
GPRS	General Packet Radio Service
ISDN	Integrated Services Digital Network
IVR	Interactive Voice Response
Java MIDP	Mobile Information Device Profile

## 10 References

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