



Blog post

By [Tobias Nilsson](#) November 11, 2011 14:00



Indoor maps save money and add extra value

Do you work in a large building or in a complex of buildings? Are you new to work and having a hard time finding your way around? Are your colleagues or visitors ever late for your meetings because they couldn't find the right conference room? If so, then it might be a good idea to setup an indoor map service. At Sony Ericsson, that is precisely what Magnus Persson and his colleagues have done. Read the rest of the story to find out why indoor maps are useful, and how to get started in creating your very own indoor map.



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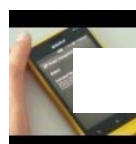
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My name is Magnus Persson, and I work as a Positioning Specialist at Sony Ericsson. Over the years, my colleague Erik Zivkovic and I have enthusiastically been driving the idea of creating an indoor map service at Sony Ericsson. We wanted to do this because of three main reasons. First of all, we wanted to do it as a benefit for the company and for all the employees who have trouble finding conference rooms and desks of colleagues, especially since our collection of Sony Ericsson's office buildings in Lund, Sweden is quite complex. Secondly, we were eager to try out some ideas on how to do this on a technical level.

And thirdly, and perhaps most important, we thought it would be really fun to create such a service. If you're thinking of doing something like this at your workplace or building, we encourage you to read further, see what we did, and try it out for yourself. You don't have to be the owner or facilitator of the building (even though you might have to get some permits) – in fact, most facility owners should be really happy to get someone to drive this kind of initiative.

Aren't the major map companies doing indoor maps already?

It is true that several of the big players working with maps, navigation, and location-based services are already looking into the concept of indoor maps, but in most cases, they are limited to public buildings. There are several buildings where these companies will not and cannot create maps. One reason could be because the building owners or renter does not allow public access.

But it can also be because the map providers do not find it interesting enough to do the investment to create the maps due to the limited amount of people accessing the buildings. However, it might still be important for the people working in these building to have some sort of navigation tool. And if you work in such a building where an indoor map would be useful, then you have the chance to do something about it yourself.

Can my company save money on this?

Now the next question is obviously if this is worth doing – is there a business case in creating indoor map services for these limited amounts of people in closed buildings? Well, I think there are two things to keep in mind here. First, we have the obvious math. Consider that one person is ten minutes late to a meeting with five colleagues due to not being able to find the meeting room. In the worst case, it equals one hour lost working time for the company. If that happens regularly, then there could be considerable cost savings in having an indoor map service.

Secondly, there could be a value in doing this that is much harder to measure up front in money, but it can create long term positive effects. I'm talking about a rather common scenario where delays and late colleagues create a frustration, which in turn leads to less effective meetings and collaborations. Having a positive climate without apparent wastes of time and energy will create a more productive working environment.

One major solution to these problems is to create a fast, reliable and environmental friendly service to help people find their ways to meeting rooms, and other venues in the building.

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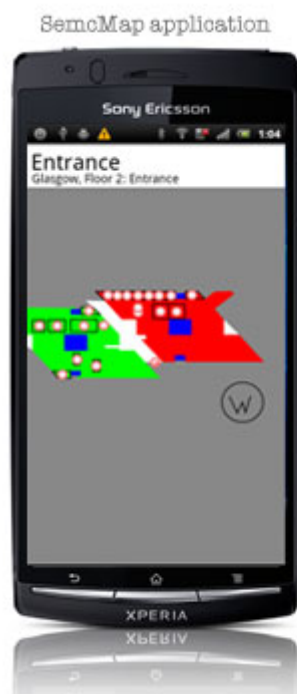
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Indoor maps at Sony Ericsson

At Sony Ericsson, we have created two different apps for indoor maps. The first one, **SemcMap**, was created by my colleague Erik Zivkovic, who was tired of getting lost all the time. It's a light-weight app with maps built up by polygons and which supports panning and zooming on different floors, as well as searching for meeting rooms and having them displayed on a map. It also has an online Wi-Fi® positioning solution that I will explain later.

The second app, **Indoor Finder**, was developed together with Ericsson Research. The Indoor Finder app supports getting walking directions, voice guidance, an augmented reality view and much more. But the most important difference is the more advanced way to handle the map creation, maintenance and distribution to the app developed by Ericsson. The Indoor Finder application has a local positioning engine using Wi-Fi® and Bluetooth™.

Will people use an indoor map service?

Looking at the statistics for our Sony Ericsson apps gives some interesting facts. But before that, I'd like to point out some details about the user group who tested our apps.

At the Sony Ericsson buildings in Lund, there are about 3600 employees. I think we are slightly more technology-oriented than your average business office, and the penetration of Android phones is also a bit bigger. But on the other hand, people here change phones very often since we're trying out new phones and software all the time, and when doing that, we need to re-install all apps. Hence, most employees end up with only a limited set of favourite apps that are worth re-installing.

Another thing is that we didn't publish these applications on Android Market™ for various reasons, among them being that we wanted to see how much people really wanted this kind of application and what they would be willing to do to get access to them.

Due to the constant changes of phone and multiple downloads to each phone, we haven't looked at the normal metrics for applications, phone installations and downloads. Instead, we have used SIM card information to identify a unique user.

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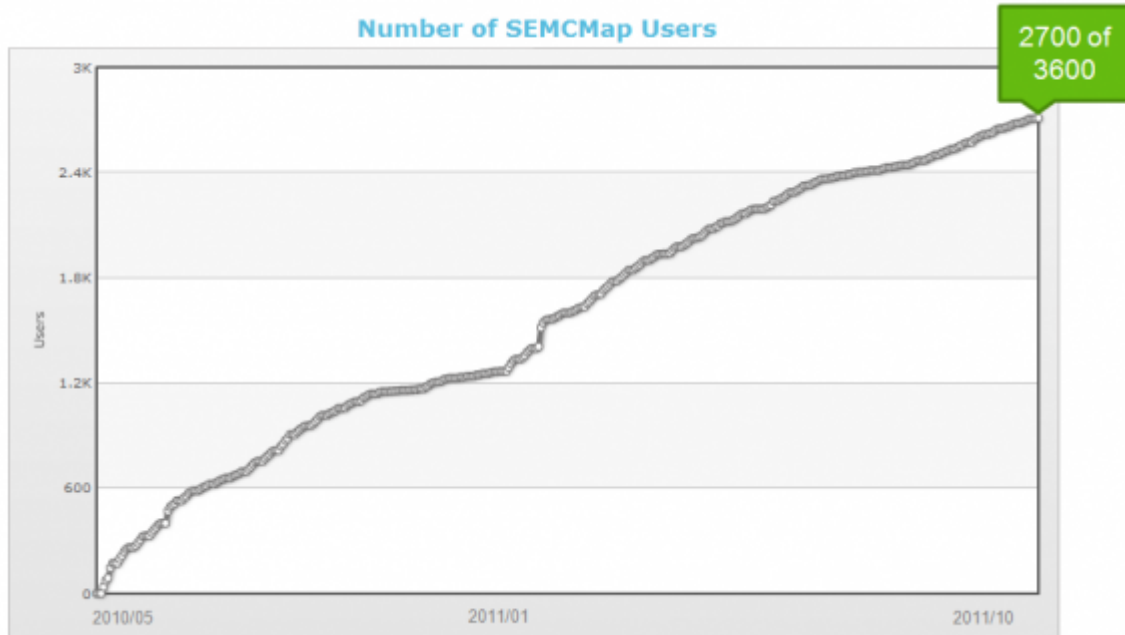
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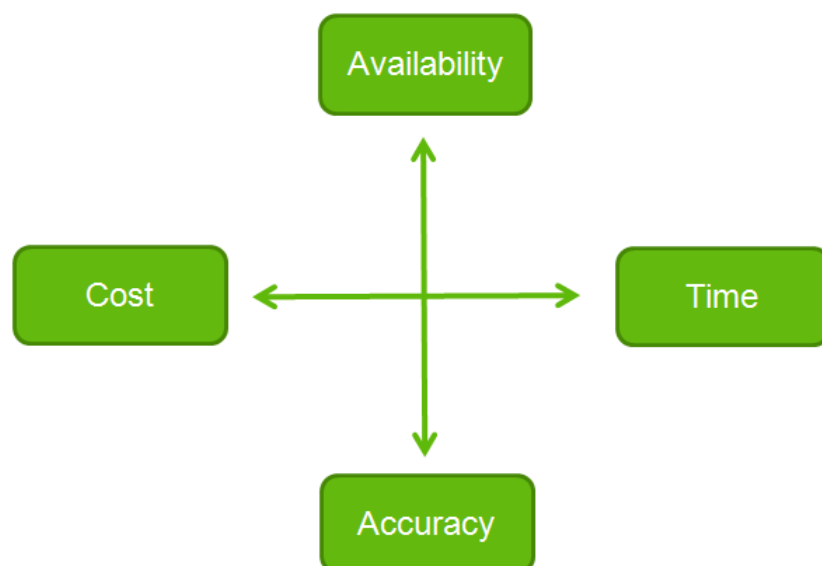


For the first **SemcMap** application, 2700 out of 3600 potential users had downloaded, installed and launched the **SemcMap** application until first of October 2011. That equals more than 75%!

The number of users per day is also a very interesting figure. It is quite stable at 220 unique users per working day that start the application to help them find their way to a meeting room or particular office location. When it comes to the number of activations, we can see about 350 starts per day. That means that each active user starts the app on average 1.5 times per day.

The Indoor Finder application was launched about one year later and shows similar trends as the **SemcMap** app in number of installations. The usage of the application is however not increasing as fast, most likely because **SemcMap** is more focused on the key use case to find a meeting room, and it was launched first.

Getting started: selecting a positioning technology



Criteria for selecting a positioning service.

So if you're thinking of setting up our very own indoor map service, there are several aspects to think about when selecting among the numerous different technologies available to perform indoor positioning. In our experience, we found the four most important aspects to consider for an Indoor Finder type of application to be:

Availability – Is the infrastructure needed already available? Is everything that is needed already available in the devices that will run the applications or do we need new devices or even wait for next generations of devices?

Time – How much time will it take to setup the positioning system? And just as important, how much time is needed to maintain the system, changing batteries and so on?

Accuracy – You need to evaluate what kind of accuracy is actually needed by the application to get a good user experience in that specific building, but you also need to make sure that you don't overdo it. Once you have proposed setups and systems, it is important to find out what kind of accuracy can be achieved by each proposed system.

Cost – Obviously it is important to value both the initial cost and maintenance cost in relation to the benefits achieved.

Setting up Wi-Fi® positioning

The **SemcMap** application uses online Wi-Fi® trilateration positioning. The locations of the already existing Wi-Fi® access points in the buildings were stored on a server in advance. A device that wants to know its position performs a scan for access points, and sends their IDs and signal strength to the server that returns a position estimate. This works quite well and delivers a reliable positioning solution that is not affected by reorganizations in the buildings as long as the access points are not moved. The main two drawbacks with the solution are the speed and the accuracy.

The speed problem is mainly caused by the delay in the communication with the server, where you want to have position updates as often as every second. This was solved in the Indoor Finder application by creating a local positioning engine instead, which downloads the Wi-Fi® database for the current building to the device in advance.

The accuracy limitations are a bit harder to address. A lot of research papers show that if you want to have good accuracy using an existing Wi-Fi® infrastructure, then fingerprinting is a good way to go. With fingerprinting, the mobile device is used to listen to signals from surrounding networks. Then the unique signal strengths are used to identify a specific spot indoors. The problem with fingerprinting is however that you need to collect a lot of reference data. If we wanted to use a basic fingerprinting algorithm, we would need to gather more than 6000 reference points, instead of the just getting the location of the 50 access points. This was too much for our resources, and we instead looked at other technologies to complement the Wi-Fi® trilateration system, and be able to achieve room level accuracy. The decision led to a technology that is available in even more devices than Wi-Fi®, namely Bluetooth™.



Modified Bluetooth™ beacon.

Setting up Bluetooth™ positioning

To achieve room level accuracy, we plugged a small Bluetooth™ beacon (in our case a rebuilt LiveView™ unit) into a power outlet in each major meeting room, and stored their IDs and locations on the main indoor map server. The phone performs a Bluetooth™ scan and as soon as one device of type beacon is found, the scanning is cancelled, and the location of the beacon is looked up locally or on the server. We created this setup so that only one Bluetooth™ beacon at a time could be in range at any location in the building. This turned out to work really well since a complete Bluetooth™ scan can take up to seven

seconds to perform, but since we knew that only one beacon could be in range, we cancel the scan once a beacon is found. This was a key to get a reasonable position update speed.

The performance of these kinds of systems will increase a lot when the next version of Bluetooth™ is supported, including Bluetooth™ Low Energy. This is because the scanning will be much faster, but also because the beacons can be battery powered and does not have to be plugged in a power outlet. However, they are still quite time consuming and boring to setup. And since another radio needs to be running, it might make more sense to use additional Wi-Fi® transmitters as beacons instead.

Another option: sensor positioning

Another option for positioning is sensor positioning. Motion sensors in the device are very attractive to use, since they don't require any infrastructure, and they are available in most smartphones. The problem with the motion sensors is that the accuracy and resolution received is not enough to create an indoor map service that operates solely based on the motion sensor data. And of course, any sensor based systems needs to be fed with the initial location before they can start estimating the current position.

In our tests, we have found the sensors to be very valuable in helping generate Wi-Fi® based positioning. Both in creating automatic collecting methods (check out this [master thesis](#) for more information on using smartphones to localise Wi-Fi® access points), but also when acting as a filter for the reported positions.

Key takeaways

So, what have we learned from doing this? What is important to think about, if you would like to create a similar indoor map service? Well, our best tips and conclusions are:

Anyone can do it! – It doesn't have to be the building owner or facility manager. In fact, it may be better if it is not. Anyone who thinks this sounds fun and has the basic knowledge needed can do it.

Right formats – Before you do the work to translate a fire map or similar into a digital map, it is important to spend some time making sure that you select the right tools and formats for storing the map data. Then you make sure that the time you put into this will not be in vain, in case you would like to use the map data with other tools or for other purposes in the future.

Good enough positioning – Don't create a positioning system that provides sub meter accuracy unless you really need it. Wi-Fi® trilateration provided a good enough experience for us with very limited setup and maintenance effort needed.

Time – Make sure you select tools that are easy and fast to use. We are confident that it should **not take more than two days to create a complete map and positioning solution** for a normal size office building.

I hope that this has given you the inspiration to try this out. At finally, a very good tip to get started on is Ericsson Labs new Indoor Maps and Positioning API. It contains a lot of useful tools, documentation and videos helping you to create your own indoor map service.

If you have any questions about our work in this area, feel free put in a comment below. Good luck with your indoor map service!

Magnus Persson
Positioning Specialist
Sony Ericsson

More information

Learn how [sensor equipped smartphones can be used to localise Wi-Fi® access points](#) .
Check out Ericsson Labs' [Indoor Maps and Positioning API](#) .