The keyword of wireless technology is 'Wireless', without wire how can we get hold of other people? What is the media to connect your mobile phone and other devices? The answer is wireless channels, which are everywhere, and they are untouchable and invisible to naked eyes. But can the wireless channel be visible and touchable in some situations? Wireless channel measurement answers this question and it also provides a close-to-true measure to it. However, due to the change of the wireless channels from environment to environment, to perform measurements for all scenarios requires huge data storage and great effort, which is not practical. Therefore, it is essential to understand the wireless channel behaviors and capture their characteristics as much as possible, and consequently model them in a realistic way, where the untouchable and invisible channels can be modeled with certain visible parameters and represented by touchable mathematical models.

Wireless channel models have attracted high attention since they can highly reduce the time of developing wireless devices and systems. As the number of users and service stations has significantly increased in the last decades, systems and wireless channels have become more and more complicated. How to guarantee user satisfied service when lots of users are streaming media at the same time, and how could the users always stay with a good service provider has become hot topics. Channel models in such situations give people valuable insights. For example, when planning the wireless system, the channel model can help predict the communication quality when high data traffic is present. Thus a system margin can be reserved to give user better services. The COST 2100 channel model is one well established wireless channel model that can be integrated with current and next generation wireless systems. It provides statically close-to-true descriptions of wireless channels both for indoor and outdoor scenarios. However, the COST 2100 channel model implementation is still under development and needs more efforts, such as parameters for some typical scenarios, especially when more wireless terminals are presented.

Can the wireless channels be visualized in some scenarios? The answer is definitely yes. First, efforts have to be made to measure a wireless channel and to connect the channel data. To be able to visualize the wireless channel, detailed floor plan of the measured scenario, such as the walls, advertisement board, decorations, etc., should be well described. Paths from one terminal to another can be visualized in a similar manner as your GPS is determining the driving route from Lund to Stockholm. However, to be able to visualize channel behaviors, efforts have to be made. First of all, wireless channel measurement campaigns are extremely laborious and expensive; we cannot measure all the possible scenarios. Secondly, to get the detailed floor plan is not a simple task especially when the communication scenario becomes more and more complicated. Thirdly, to find the most likely paths needs large
numbers of computation capability.

Position based services, such as navigating, tracking or monitoring, have attracted great attention both in industry and in the academic world. The most frequent used and successful positioning system is the GPS, where the satellite signal is used. Have you tried your GPS when you were walking inside a building? Imagine yourself as a patient, but you are not familiar with the layout of the hospital, how can you efficiently get access to the right building/floor? The GPS system cannot work efficiently now due to a significant shadow the building have on the signal. Therefore, indoor positioning technology is under desirable. There have been extensive indoor positioning discussions and applications in the past decades, like Google indoor maps, where the Google application suggests its users to report their detailed floor plan and the positioning accuracy is highly relied on the floor plan. It can be noted that the major challenge of indoor positioning is the accuracy, where down to meters even centimeters is desirable for piratical applications. Wireless channels bring a new opportunity for indoor high accuracy positioning as the wireless signal can give a distance measure with accuracy down to centimeters.

Overall, in this thesis, the author have studied the COST 2100 channel model thoroughly and provided parameters for some typical scenarios, i.e., sub-urban and urban scenarios, which makes the model suitable for outdoor wireless system planning. This thesis investigated channel characterizations when more than one servicing station is present with wireless channel measurements performed in Kista, Stockholm. To understand the relation between the channel models and physical realities, a measurement based ray launching tool for visualizing the wireless channel on top the floor plan has been developed in this thesis. More specifically, the thesis was able to visualize the wireless channels together with the channel measurements for sub-urban and urban scenarios, where valuable insights have been obtained for channel modeling basis. Last but not least, in this thesis, positioning accuracy down to centimeter is observed together with the distance measures from wireless channels, which is a promising result for position based services.

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