The WiFi Site Survey with Ekaua Site Survey and its Comparison with other WiFi Survey Tools

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Abstract*: This article introduces the reader to the basics of WiFi network surveys. In this work the first floor of Mendel University in Brno is mapped using the Ekahau Site Survey. Basic concepts and values that will be measured are explained. Then the mapping is done and the results are displayed graphically for several types of connections. Furthermore, other tools which can be used for WiFi mapping are mentioned. These tools are compared with each other.*

Keywords*: WiFi, network, WiFi mapping, Ekahau Site Survey*

INTRODUCTION

Nowadays WiFi technology holds a very important role in the transmission of data. The main advantage of this technology is data transmission using electromagnetic waves without using cables. Students and staff of Mendel University in Brno are limited only by the quality and the size of the university Wi-Fi network. This network allows them quick access not only to the University Information System (UIS), but also further into the Internet. WiFi technology can also be used to operate wireless IP phones, which allow us to voice communication in areas covered by our wireless network. However, the service generally puts higher requirements on individual parameters of our WiFi network.

Unfortunately, this technology also has disadvantages. Nowadays it is mainly the big boom of various wireless devices such as wireless baby monitors, wireless cameras, as well as other users who are not familiar with wireless networks and who recklessly use such devices for their household appliances. All this has resulted in a large interference and the inability to deploy a wireless network in such an interfering environment.

Objectives

The aim is to measure the quality and coverage of the WiFi signal in building A at Mendel University in Brno using Ekahau Site Survey, then to analyse these measured characteristics in order to detect weaknesses and problematic areas in the network. Another aim is to compare the Ekahau Site Survey tool with other available tools for mapping WiFi networks. Subsequently, possible solutions, later on implemental verified, will be suggested.

The measured characteristics of the network with Ekahau Site Survey

Signal strength and RSSI (Received Signal Strength Indication)

The signal strength is one of the fundamental characteristics. It shows us the received signal, which is given in dBm. The performance of the active element is given relative to 1mW (0dB). In the Czech Republic, the maximum permitted radiated power (EIRP) of the entire transmit chain (transmitter + transmitter antenna lead + antenna) given by the law is 100 mW, ie. 20dBm. (Carroll, 2011).

Wireless network cards are able to receive and diagnose certain signal parameters, including RSSI, which is the abbreviation for Received Signal Strength Indication. The basic unit of RSSI is measured in dBm, but it can be indicated in mW. It is not a standardized unit where the scale is given precisely but each manufacturer uses its own evaluation. Program Ekahau Site Survey indicates this value in the range of - 100 dBm (weak) and - 10 dBm (strong). When assessing basic and high-speed connectivity different values are required. This can be seen in Table. 1, which shows the different requirements for basic and high-speed connectivity. (Carroll, 2011).)

SNR (Signal to Noise Ratio)

This is an abbreviation of Signal to Noise Ratio, which means the relationship between the received WiFi signal (RSSI) and interference, expressed in dB. Under appropriate

conditions, the SNR value should be close to RSSI. If the SNR value is near zero, there is an increasing interference and network ceases to work in these places. (Cook, 2009) Program Ekahau Site Survey calculates SNR according to the following formula:

$$SNR = RSSI - noise\ level.\ (Ekahau,\ 2005) \qquad\qquad [1]$$

Interference

Interference can have many reasons, but in general, they can be divided into WiFi and non-WiFi. The first group includes mainly co-channel interference. This interference comes from the fact that the 2.4 GHz band offers 13 channels, only 3 of which do not overlap. If we did not meet proper distance (at least 5 channels), there would be interference and network might not work at all. Thus, if in our area starts broadcasting access point that broadcasts eg. on channel 3 and our access point is set to channel 1, it will result in interference and neither access point will function correctly. The second group primarily includes microwave ovens (2450MHz), wireless mice and keyboards, bluetooth, garage door remote control, wireless cameras and last but not least wireless baby monitors. All these things can seriously disrupt the functioning of WiFi networks in the area. (Caroll, 2011)

Number of APs

After measuring the specified area the Ekahau Site Survey is able to place positions of individual access points caught with their SSID (Service Set Identifier) and MAC address rather accurately into the building plan. SSID is a unique identifier of the wireless networks within the range that we see in the capture of wireless network eg. Eduroam. SSID broadcast can be switched off from safety reasons and the potential user must know the SSID. The MAC address is a unique 48-bit address, which consists of hexadecimal characters. This address was assigned to devices already in production and it is unique. (Ekahau, 2005) The placement of individual APs is based on the intensity of the received signal. If Ekahau evaluates the signal strength access point as low, the access point is not included in the floor plan. (Ekahau, 2005)

Packet loss

This phenomenon can be defined as a failure, in which one or more packets do not arrive at their destination and it is expressed in percentage. This situation can occur not only due to an unexpected error, but also because of possible interference. In case of large packet loss, our network can stop working in this location. Ekahau Site Survey defines allowable values as 10% for basic connectivity and 5% for high-speed connectivity. (Ekahau, 2005)

RTT (Round Trip Time)

In our case, round trip time can be defined as the time it takes to send a packet from our laptop to the destination and back. In this case, the destination is the default gateway that receives the packet and responds. Round trip time is measured in milliseconds (ms). (TechTarget, 2012). According to the Ekahau Site Survey, acceptable values are 500 ms for basic connectivity and 300 ms for high-speed connectivity. (Ekahau, 2005).

Identification of problems on the 1st floor in Building A

In the following table limit values which are required for a given degree of connectivity can be seen.

Table 1 Categories and parameters according to the Ekahau Site Survey

Parameters	Basic connectivity	High Speed connectivity
Signal Strength	min. -85 dBm	min. -75 dBm
SNR	min. 5 dB	min. 10 dB
Speed	min. 1 Mbps	min. 11 Mbps
Number of APs	min. 1	min. 2
Ping RTT	max. 500 ms	max. 300 ms
Packet loss	max. 10 %	max. 5 %

For better orientation in the resulting figures a simple table with used colors and their explanations is used.

Table 2 Legend

Color	Abbreviation	Annotation
red	S. Str	signal strength
yellow	APs	missing Access point
blue	Data	data permeability
purple	SNR	signal to noise ratio
green	RTT	round trip time
gray	Loss	packet loss

1st floor in building A

On the first floor of Building A, there is the largest lecture hall of the building marked A01. On the left side, there is the Institute for Scientific Information. In the right wing there are laboratories where access is limited. Physically, this floor does not even have one access point. Coverage is ensured by access points located in the reading room in the basement and access points located on the second floor of the building. In the following table we can see a detailed overview of access points that cover the 1st floor of building A.

Table 3 Overview of captured APs

| Name of the AP	Location	Floor	Norm
Cisco: a - A13	end left wing	2nd	802.11g
Cisco: a - zo	the rear part of the left corridor	2nd	802.11a/g
Cisco: a-study room	the front part of the left corridor	1st	802.11g
Cisco: a-rectorate 1	front right part of the corridor	2nd	802.11a/g
Cisco: a- rectorate 2	the central part of the right corridor	2nd	802.11g
Cisco: a- rectorate 3	The rear part of the right corridor	2nd	802.11a/g
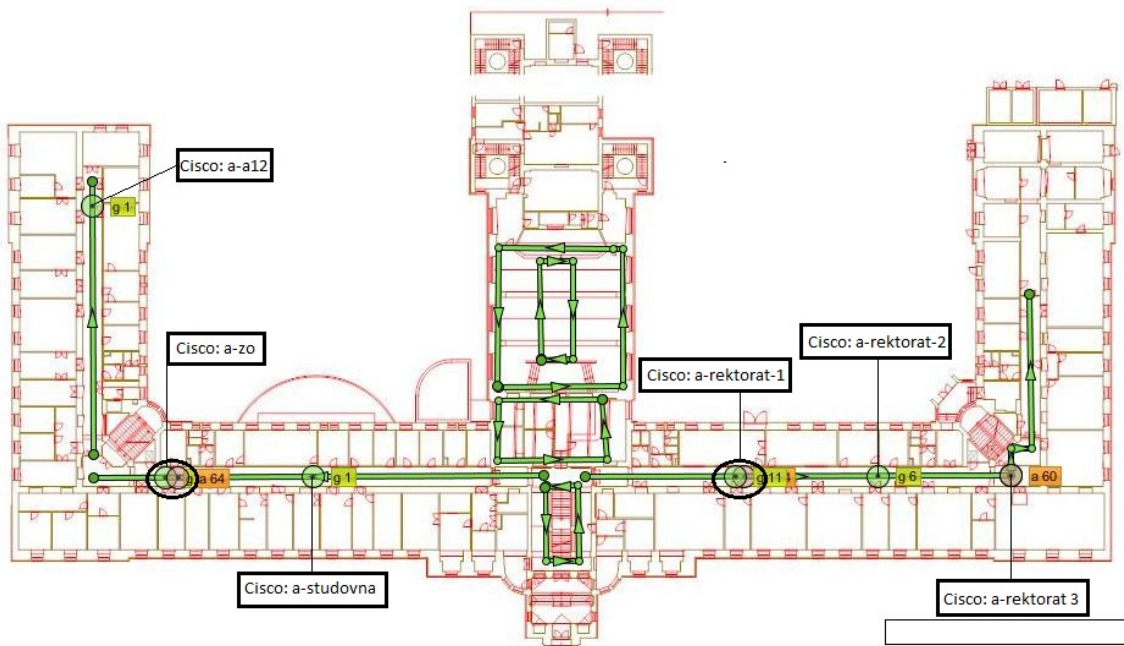
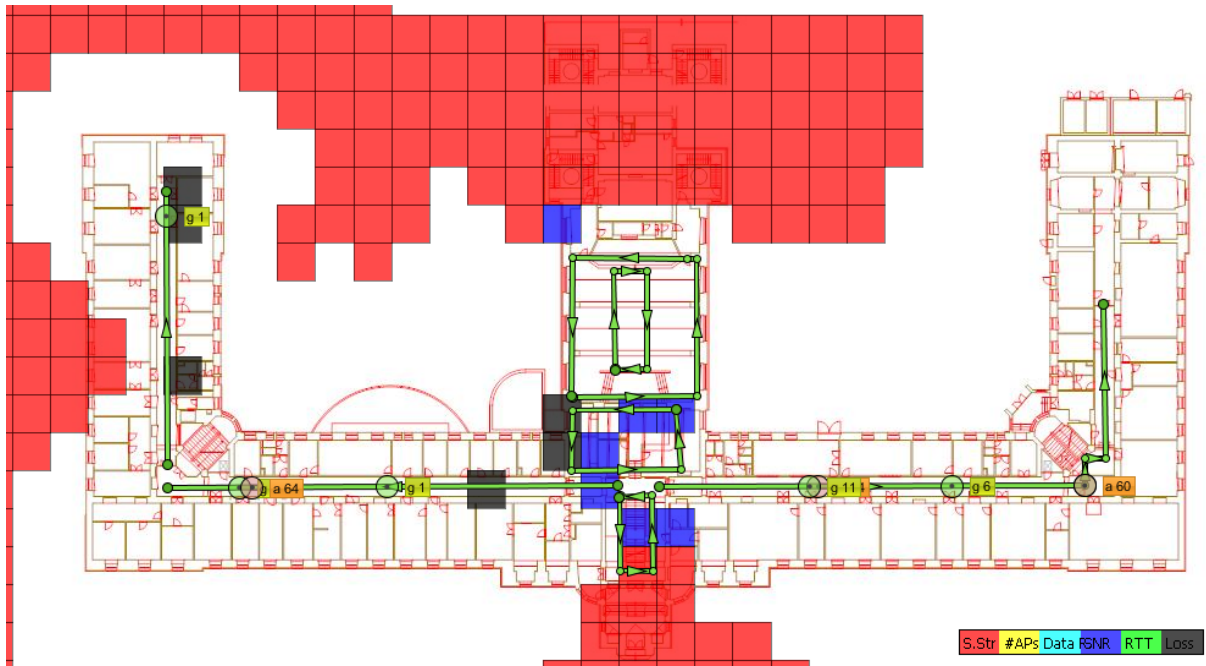

Fig. 1 Route survey

Fig. 2 High Speed connectivity issues
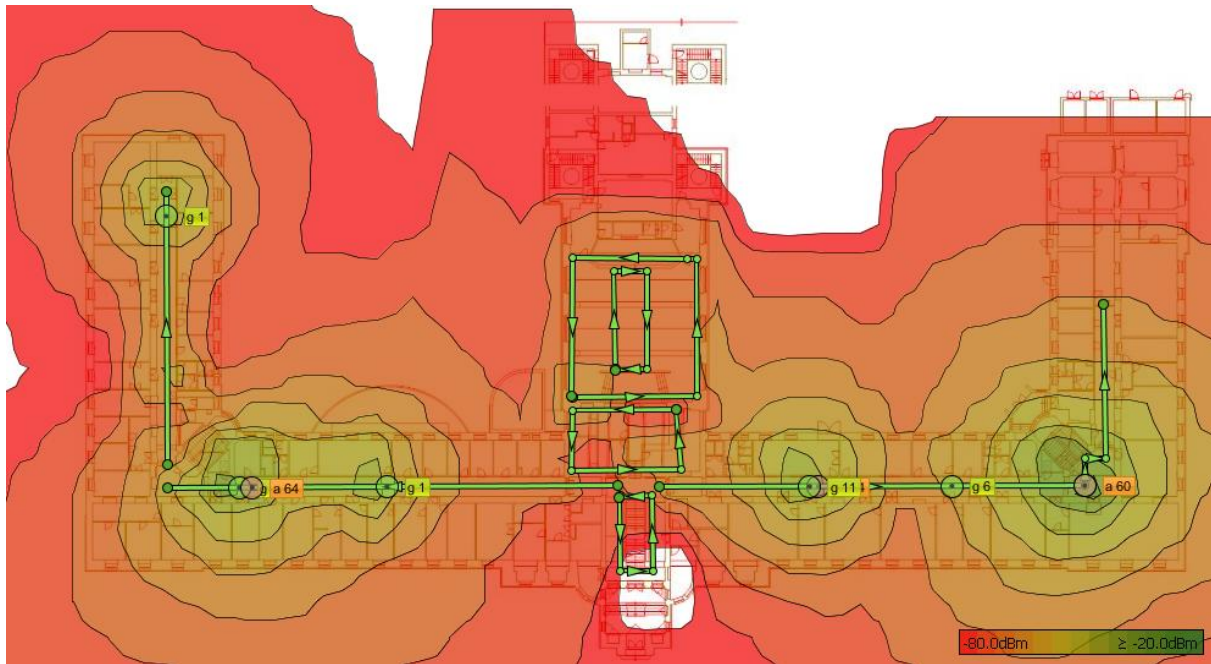

Fig. 3 Basic connectivity issues

Fig. 4 Signal strength on the 1st floor

Evaluation of the conditions for 802.11g and its comparison with other tools

As shown in Fig. 3, the coverage for basic connectivity is sufficient in the first floor. However, there are problems with packet loss. In the central part this phenomenon is caused by the low signal strength, as we can see in Fig. 3. In the rear part of the left wing the reason for packet loss is unknown. High Speed coverage of the area of the first floor is also the most problematic in the lobby, lecture room A01, as we can see in Fig. 2. For high-speed connection SNR is too low, which is again due to the low signal strength. Again, there is a problem with signal strength in the area of staircase.

For mapping WiFi networks other tools are also available, for example CommView for WiFi. This tool is designed primarily to display all APs that were within the range of the signal being broadcast. Furthermore, for each AP it can obtain important information such as manufacturer, MAC address, SSID and signal strength. Its advantage is that it can see users who are around the signal. (Konečný 2011).

Another software that allows us to map the Wi-Fi networks is NetStumbler. It is a program that allows us to monitor and detect WiFi networks. It supports 802.11b wireless cards, such as 802.11g and 802.11a. This program can monitor the signal strength of each AP as well as clients and the results can then be displayed both numerically and graphically. It can display the MAC address of the AP, the bit rate, type, manufacturer and the type of encryption protocol. (Spurná, 2011)

Another software tool is NetSurveyor 2.0, which enables us to monitor networks that are based on the 802.11 standard. It allows you to find the surrounding networks and build its own network so that it is not disturbed. NetSurveyor is a tool used for creation and setting of the parameters of own network. To view the data diagnostic reports and graphs are available. (Spurná, 2011)

The last comparative SW tool is the Xirrus Wi-Fi Inspector, which is available as a standalone program or as a gadget for Windows Vista Toolbar. It provides a complete management of wireless WiFi networks. It looks for wireless networks in your area and lists a summary of their parameters (network name, adapter, signal strength, network security). It is possible to track the signal strength using a graph on animated radar. (Kubeš, 2010)

Compared with these programs, however, our program Ekahau Site Survey provides a wide range of extra options. It allows us not only to show the signal strength of each AP, but also to virtually eliminate the AP virtually and check what impact it would have on our network. In addition, it also allows us to load a floor plan view and indicate exactly where we are in the exploration, enabling us to detect the position of each AP more accurately. Last but not least, we can also define the characteristics of particular materials in our plan and thus much more precisely provide the results. Another advantage of this program is the ability to virtually add a single AP and to monitor the impact on our network. It is very useful if we perform an analysis of the WiFi network and we plan to strengthen its infrastructure. This option is not offered by any of the above mentioned softwares.

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