Optimal Placement of Your Analyzer

Introduction

Capturing *Bluetooth* traffic with a whole-band sniffer is a piece of cake: just turn on your analyzer, start capturing and your traffic is displayed right away.

However, with any wireless technology, some care must be taken to ensure that the analyzer is placed in an ideal position in order to robustly capture the traffic. This paper provides some good practices and explains a few pitfalls to be avoided.

Positioning the setup

The **analyzer** should preferably be positioned **in between** the devices to be captured, with the devices not too close to the antenna. Ideal distance is about 1 meter / 40 inches between the analyzer and each device.

The **worst possible setup** is placing the devices very close to each other, with the analyzer far away. In this situation, the devices will reduce transmission power to the minimum, and the analyzer will receive a very small signal, which is therefore increasingly subject to interferences.

Taking care of antennas radiation pattern

Having a minimum understanding of each device's antenna radiation pattern is quite important. This often-misunderstood concept can lead to very poor wireless quality, and is difficult to detect as it is usually counter-intuitive.

In a few words, an antenna will not equally transmit power in all directions, and most of the time, none or little power will be transmitted into blind spots. Take a mobile phone for example: it will transmit nicely in front and behind its screen, but will transmit a poor signal on its sides. If you place this mobile phone flat on a table, it will typically provide poor transmission quality. The receiving device will get a small signal, so it will ask the mobile phone to increase its power level. This will make the situation even worse, as power transmitted into these blind spots is not only attenuated, but also distorted. The devices will manage to see each other and will likely be capable of communicating, but with a high retransmission rate. Capturing such traffic flawlessly is not possible though, as the analyzer cannot ask for retransmission, and the resulting trace will be of poor quality.

For more details about radiation patterns and antenna's types, please consult the "Understanding Antenna's Radiation Pattern" Expert Note.

Avoiding Interference

Interference is another source of issues when taking captures, and it is not always intuitive in determining the sources of interference.

Take a simple example. You have your analyzer next to your notebook on the table, with your devices on the left and right of the notebook. This looks fine but it isn't. WiFi antennas are usually mounted along the edge of notebook screens. Having the analyzer close to the notebook screen with WiFi turned on is actually pretty bad, as the WiFi will transmit strongly into the analyzer's antenna. As the *Bluetooth* devices are further away, the WiFi may not disturb them that much, so they will not avoid this frequency area, making the situation even worse.

Screens are also very good wireless shields, so it is a good practice to avoid placing a screen in between your devices and the analyzer.

Positioning Examples

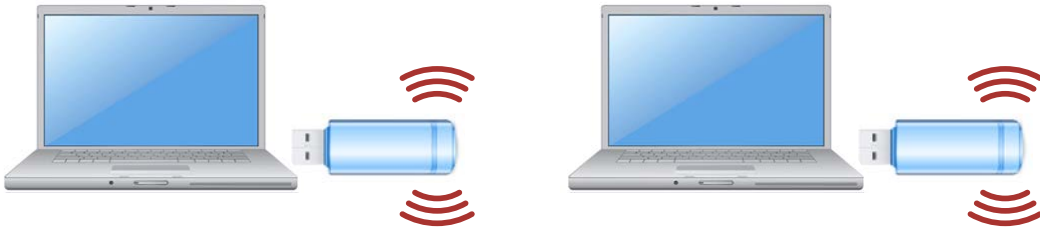
The following illustrations show examples of good and bad positioning. Please note that these drawings are conceptual examples and may not be correct with all such device models. Some mobile phones may be designed to work perfectly when lying flat on a table, while others may have awful performance in the same situation.

Recommended setup: Placing the analyzer in between the devices to be captured, with the devices placed approximately 1 meter / 40 inches from either side of the analyzer is a good initial setup. Make sure the radiation pattern of the devices is correct.

Mobile phones lying flat: These two mobiles phones are lying flat on a table. If the chip antenna is not specifically designed work this way, these mobile phones will have a hard time communicating.

Standing mobile phones: In this case the mobile phones are standing, which places the antennas in the most ideal position.

Horizontal dongle: Most dongles use a chip antenna, and most chip antennas have a good radiation pattern when vertical. When used horizontally however, most dongles provide poor performance, which is counter-intuitive as dongles *seem* to be designed to work that way.



Vertical dongle: In this case the dongle is connected to the notebook with an adapter enabling the dongle to be operated vertically, thus positioning the antenna in its optimal position.

Fake antenna dongles: A quick note on the following *Bluetooth* dongles. This model looks good with its movable antenna, allowing it to always be positioned in the best possible way. Unfortunately, the antenna is a fake. It is just a piece of plastic with any metal or wire to the radio chip, making it completely useless.

WiFi interferences from laptop screen: In the illustration below, the analyzer is placed close to the laptop. This looks just fine, but the laptop's WiFi antenna, placed right at the edge of the screen, is smashing the lower intensity signal from the mobile phones.

Wireless shield: A laptop screen is a pretty good wireless shield. In this example, it will likely interfere with the two devices, reducing the transmission quality.

Close devices, analyzer far away: These two mobile phones, placed closely to each other, will reduce their transmission power to the strict minimum. The analyzer, placed far away, will receive this traffic weakly, so it will be much more sensitive to interferences, increasing the capture's error rate.

Feedback

Feedback on our Expert Notes is always appreciated. To provide comments or critiques of any kind on this paper, please feel free to contact us at expert@ellisys.com.

Other interesting readings

- EEN_BT02 - Bluetooth Analysis Tutorial
- EEN_BT03 - Your First Wide-Band Capture
- EEN_BT04 - Optimal Placement of Your Analyzer
- EEN_BT05 - Understanding Antenna's Radiation Pattern
- More Ellisys Expert Notes available at: http://www.ellisys.com/technology/expert_notes.php

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