



Technical Information

SwissCovid app: Threshold Change

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Background information and technical explanation:

How is the risk of infection measured and evaluated using Bluetooth? Why are these configurations adapted?

The following explanations are a simplified presentation of the scientific analysis for interested laypersons, which can be found here: <https://github.com/admin-ch/PT-System-Documents/blob/master/SwissCovid-ExposureScore.pdf>. It serves as a reference for the adjustment made.

Connection between the transmission of the new coronavirus and the SwissCovid app

The new coronavirus is mainly spread by droplets. The risk of infection therefore depends on the proximity between infected and healthy persons and the duration of a close encounter. Classical contact tracing also works according to these criteria when it identifies persons at risk. The SwissCovid app supplements the notification of persons at risk with digital proximity tracing. This also identifies possibilities of infection that were not consciously perceived.

In its ordinance on the use of the SwissCovid app of 24 June 2020, the Federal Council stipulated that a spatial proximity of 1.5 metres or less within a total period of at least 15 minutes should be taken as the basis for triggering a notification of a possible infection.

To implement these parameters technically, experts from EPFL and ETH Zurich were called in.

How is Bluetooth technology used?

The SwissCovid app uses Bluetooth to evaluate the spatial distance between healthy and infected persons. Bluetooth Low Energy (BLE) with a frequency of 2.4 GHz is used for the communication between mobile phones over short distances. This is done by exchanging so-called BLE beacons (information packets) via radio waves. The radio waves have a signal strength that weakens with increasing distance. BLE cannot actually measure the distance, but it can be estimated from the signal strength and its attenuation.

Evaluation of the signal attenuation

The attenuation of the signal through which the mobile phones exchange BLE beacons with other mobile phones is evaluated as follows:

strength of the transmitted signal - strength of the received signal = attenuation.

Mobile phones have different transmission powers and different measurements of the received signal strength. For this reason, EPFL and ETH Zurich have carried out extensive field tests and experiments to develop a uniform calibration that can evaluate the attenuation and thus the distance independently of the mobile phones used. The researchers have also taken into account that BLE is susceptible to interference factors that amplify the attenuation and thus suggest a greater distance.

The evaluation of distance using the attenuation is always an approximation, an estimation. Attenuation thresholds are defined as an auxiliary tool to find out whether the mobile phones within the defined distance of 1.5 metres detect the signals of the majority of other mobile phones within this distance.

The SwissCovid app uses two thresholds (new: 55/63 dB). Up to the first threshold value of 55 dB, the total measured time is taken into account during which BLE beacons are exchanged. Between the first threshold value of 55 dB and the second threshold value of 63 dB, only 50% of the measured time is taken into account. The total time during which BLE beacons are exchanged is therefore halved when assessing a possible infection. If the total time calculated according to these two principles exceeds 15 minutes within 24 hours, the app will trigger a message.

The following concepts are important for this:

- Precision: proportion of BLE beacons for which the attenuation thresholds correctly identified the distance of 1.5 metres.
- Recall: Proportion of BLE beacons from mobile phones within the distance of 1.5 metres for which the attenuation is equal to or less than the attenuation thresholds.

The influence of threshold values on precision and recall

To increase precision, the threshold of attenuation has to be reduced. However, as the precision increases, the value of the recall, i.e. the proportion of mobile phones that were within this distance and whose BLE beacons had an attenuation less than or equal to the threshold value, decreases. The BLE beacons considered for a message show a higher precision at lower threshold values, but are accompanied by a lower recall, i.e. a lower proportion of considered BLE beacons within the defined distance. This means that too few correct messages are triggered.

In contrast, at higher threshold values, more signal attenuation is tolerated. This means that a larger proportion of transmitted BLE beacons are taken into account, but these show a lower precision. This means that more users within the 1.5 metre range will receive a correct message (recall is increased). But it is accompanied by a small increase in false messages to people who are out of range (Precision decreases).

The calibration of the distance measurement is carried out by the technical experts of EPFL and ETH Zurich. For this purpose, comprehensive laboratory tests have been carried out since the beginning of the development of the SwissCovid app, followed by field tests with members of the Swiss Army. Based on these tests, the app was put into operation with the threshold value of 50/55 dB. A conservative calibration was deliberately chosen in order to avoid false alarms, especially in the first phase of app use.

The threshold values of 53/60 dB, which were to be preferred from a technical point of view, were also not yet used because the Exposure Notification Framework of Apple and Google was still under revision at that time. It was intended to wait for the effects of this change to

include them in adaptation considerations. On 6 July 2020, the threshold values were raised to 53/60 dB.

Reasons for the adjustment of the threshold

The adjustment of the thresholds after a further two months is based on experience from practical use, additional laboratory experiments and more precise attenuation tables from Google and Apple.

The SwissCovid app supplements the classic contact tracing and helps to interrupt infection chains of the new coronavirus. The app is particularly intended to inform people about possible infections of which they are unaware, e.g. because the contact is not consciously perceived and therefore cannot be traced via classic contact tracing. This is particularly relevant for people who are very mobile and who are repeatedly in areas with a high volume of people, especially with they do not know personally.

A message via the app informs about a possible infection. The basis for this are the exchanged BLE beacons and the distance evaluation performed above. However, whether an infection has really occurred can only be determined by means of a PCR test for the new corona virus.

Taking these three aspects into consideration, the FOPH has decided, on the recommendation of the EPFL and ETH Zurich, to increase the attenuation thresholds used for distance evaluation to 55/63 dB by September 11, 2020. This is linked to the expectation that the probability of correct reports is significantly increased (recall increases), while the possibility of false alarms increases slightly (precision decreases). From an epidemiological point of view, this is preferred.