COVID-19: The Internet of Things and Cybersecurity

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The COVID-19 pandemic has inspired a range of Internet of Things (IoT) innovations to help stop the spread of the virus. This is the second edition of COVID-19: IoT and Cybersecurity and builds on the rapid advances in the issues surrounding contact tracing applications in the UK.

The level of uptake of contact tracing apps is crucial to their success. The uptake will be improved if people feel confident their data will not be misused, repurposed or shared without their consent.

UK and European governments are looking for solutions to ease lockdown restrictions. A number of advances in the last week involving the tech industry and experts are producing promising privacy-preserving platforms for this to occur.

What value does the Google/Apple Bluetooth partnership provide?

On 10 April, Google and Apple[1] announced their partnership on COVID-19 contact tracing technology. Their approach is twofold:

1. Launch software building blocks (APIs) to make it easier for others to build contact tracing apps.
2. Enable a Bluetooth-based platform functionality into Android and Apple phone platforms

Overview

- A joint initiative by Google and Apple has changed the landscape for contact tracing apps by announcing measures to support decentralised Bluetooth LE approaches.
- However some contact apps being developed are incompatible with the imposed restrictions.
- Some apps, possibly including the proposed NHS app, will need to modify their approach, or continue with a solution that may cause lower uptake.
- A Pan-European approach towards contact tracing has come under scrutiny from experts, with multiple partners pulling their support.
- As it stands, a decentralised approach called DP-3T is widely seen as a privacy-preserving solution, and is similar to the Google and Apple approach.
- The rollout of contact tracing apps needs to have appropriate legal provisions to ensure public trust.

Both companies will release APIs in May. Contact tracing would work using Bluetooth Low Energy[2] (no GPS location data or personal information would be recorded) and will enable interoperability between Android and iOS devices using apps from public health authorities.[3]

Draft Android API[4] (prelim)
Bluetooth specifications[5] (prelim)
Cryptography specifications[6] (prelim)

The interoperability of the apps means that contact tracing would continue to work as people travel and interact with people using a different tool. Ultimately, this scheme could help countries relax lockdowns and border restrictions.[7]

How does the Google/Apple API work?

The software will allow phones to broadcast unique anonymous identifier codes via Bluetooth. Other phones that are nearby will receive the code and store it for 14 days. If a phone user receives a positive COVID-19 diagnosis, they input it into the app. With the infected user's consent, their phone will upload their last 14 days of codes to a temporary store. Other phones would periodically download a list of infected user codes in the region and check for a match, indicating that the two phones had been near each other. If a match is found, the user will be notified with information about what they should do next.[38]

Google will use Google Play Services to update Android systems. However, this service will not be available to Android phones in China or any Huawei phones sold around the world.[39] Analysts also estimate that close to 2 billion phone users will not be benefiting from this initiative globally due to incompatible devices.[40]

This "digital divide" will mostly disadvantage older and poorer people who do not have access to the latest handsets. These people are also the ones most likely to be affected by COVID-19.[41]

The UK Information Commissioner's Opinion on 17 April summarises the current thinking towards this joint initiative, and believes the work to be 'evidence that innovation and data protection are complementary concepts'.[8]

Contact tracing apps need high uptake to be effective

One major challenge that Oxford University epidemiologists agree on, is that contact tracing apps need about 56% of the population (80% of smartphone users based on data from Ofcom) using them to be effective[9], "otherwise, symptomatic people wouldn't know where they contracted the virus and asymptomatic people would continue spreading it unknowingly".[10] However, this is a high target that does not reflect typical uptake of new apps. The researcher involved in the modelling does say that there are benefits even below that 56% uptake target.[11]

The European Data Protection Board, in a letter published to the European Commission, has also stated these applications "may only achieve their maximum efficiency if used by the largest share of the population".[12] This challenge could potentially be solved by Google and Apple building contact tracing into their operating systems.

Moving beyond apps and into built-in functionality in smart phones

Google and Apple "will work to enable a broader Bluetooth-based contact tracing platform by building this functionality into the underlying platforms". This means contact tracing is enabled at the operating system. This is important as it would allow more participants to participate[13] as people are generally more reluctant to download an app.

Challenges still remain. Bluetooth LE has a range of 10 to 30 metres, and the NHS recommends staying 2m away from each other. With a 30m range, as well as the ability for the signal to penetrate through walls, the app could alert you to contact with an infected person that never happened.[14]

Contact tracing by app will not be effective without testing and integration with manual methods

Another concern, that has been pointed out by University of Cambridge's Prof Ross Anderson, is that the technology may not be effective if people are not regularly tested.[15]

That contact tracing apps do not replace the manual contact tracing process is highlighted by the Singporean Ministry of Health who have stated that "it is an important tool in the toolbox of contact tracers. It is not sufficient to rely on technology alone, as we need the expertise in public health and communicable diseases to make sense of the data collected using this technology".[16]

The NHS app may face limitations in light of the privacy standards enforced by the Google/Apple API

Health Secretary Matt Hancock announced the plans to roll out the new smartphone app on 12 April.

However, NHSX may need to rethink their approach now that Google and Apple are partnering to launch APIs, as the currently centralized NHSX app seems to be incompatible with Google and Apple's approach. With NHSX's current model, the app

wouldn't work whilst the phone is locked or if the phone is being used for another purpose. This is because Apple devices will only allow Bluetooth to operate in the background for more privacy-friendly, decentralised contact tracing systems.[17] Google has said these limitations are in place to avoid abuse of surveillance efforts.[18]

Users of these apps would have to have the app open and active all the time for proximity tracking to function. [19]This would negatively affect battery life and use of the phone, as well as leave the phone susceptible if stolen.

There have been some reports of privacy concerns with the app. The Guardian has reported that ministers may have the ability to order de-anonymisation of the data collected.[20] This has however, been denied by NHSX.

NHSX "now faces a choice between carrying on with an app that's less convenient to use, and that fewer people will trust, or starting again with a different model, delaying rollout, and denying them access to data that could be useful for research and for planning".[21]

The rollout of contact tracing apps needs to have appropriate legal provisions to ensure public trust

Proposed protections for digital interventions in relation to immunity certificates have been authored by digital law experts.

The Coronavirus (Safeguards) Bill 2020 (v. 17 April) provides safeguards in relation to the symptom tracking and contact tracing apps that are being rolled out in the UK. Proposed privacy-preserving apps need to be accompanied by laws in order to reassure the public. The draft bill sets out that no-one will be penalised for not having a phone or installing the app unless justified by transparency, legitimacy, necessity and proportionality tests. Data shall not be shared except with freely given consent subject to the above tests. Data must be deleted or anonymised as soon as possible. The bill also creates a Commissioner to review.[22]

The Ada Lovelace Institute has produced a rapid evidence review[23] on the technical and social considerations of using technology to transition from the COVID-19 crisis. The review concludes that rushed deployment of technical solutions without evidence and independent oversight may undermine public trust and impede effectiveness. They state that there is an absence of evidence to support the immediate national deployment of contact tracing apps, symptom tracking apps and immunity certification. They recommend that an independent Group of Advisors on Technology in Emergencies (GATE) be established alongside SAGE.

EU approach for contact tracing apps to support lifting of confinement measures

The European Parliament called for a recommendation to develop a common EU approach for contact tracing with the following conditions:

- not obligatory
- no central storage, but only decentral on the device
- full transparency on the functioning of these apps
- full transparency on commercial interests

The EU Commision have produced a Common EU Toolbox for Member States[24] which sets out essential and practical requirements for efficient tracing apps. Manual tracing will continue to cover vulnerable people less likely to have a smartphone.

Member States are seeking clarification on the solution proposed by the Google/Apple partnership to ensure compatibility with the EU common approach.

Press release

Complicating matters, the *Toolbox* reports that "Member States should consider specifications which allow contact detection to an accuracy of one metre". With Bluetooth LE, this is not yet possible. The few proposed solutions are not yet widely available.

Concern has been raised about the pan-European effort 'PEPP-PT'

PEPP-PT claims to be a pan-European effort at arriving to a proximity tracing standard.

The German federal government and the federal states have stated they support the voluntary use of the "Pan-European Privacy-Preserving Proximity Tracing" because it follows a pan-European approach, provides for compliance

with data protection rules and only anonymises epidemiologically relevant contacts of the last three weeks on the user's mobile phone. Other tracing apps are urged to use the underlying architecture concept so that all apps are compatible.[25] The [Data Protection and Security Architecture for PEPP-PT](#)[26] was released 19 April.

However, there is [concern](#)[27] within the cybersecurity community that to date the PEPP-PT approach has not been open for full scrutiny. [Recent developments communicated by the researchers behind the DP-3T software](#) (below) raise concerns that the PEPP-PT approach has become closed, centralised and [not following the public academic standard maintained by DP-3T](#).[28] [29]

Over 300 academics from over 25 countries have [signed a joint statement](#) warning that centralised approaches to Bluetooth contact tracing, such as PEPP-PT, give reason for concern.[30]

[Several partners of the PEPP-PT initiative have publically pulled their support](#)[31], due to concerns with governance and transparency. Some of these partners have gone on to support the D3-PT initiative, below. The D3-PT have also published their own [security analysis of PEPP-PT](#)[32] stating their concerns.

Governments could build open emerging open source solutions

The Decentralised Privacy-Preserving Proximity Tracing (DP-3T) project claim to be a truly privacy-preserving, decentralised Bluetooth contact tracing app.

[Android app](#) (alpha demo)
[iOS app](#)(alpha demo)

From May, the [apps will be compatible with the Google/Apple protocol and will be able to be used while the phone is locked](#).[33]

The UK's Information Commissioner's Office has provided an [opinion](#)that the underlying principles behind DP-3T are similar to that of the Google and Apple initiative, and that being the case, are supported by the ICO.[34]

Singapore is also offering its code to support other initiatives

Singapore's TraceTogether app has been

downloaded by about [1 in 5 residents in Singapore](#) to support Singapore's contact tracing operations. The app has been recently made its source code freely available online so that others can improve and adapt for deployment elsewhere.[35] They have also published their [BlueTrace protocol](#)[36] to allow other apps to operate across jurisdictions. [Australia is looking at adapting the code base](#)[37] for its own contact tracing app.

Endnotes

1 https://www.apple.com/covid19/contacttracing/
2 https://www.blog.google/documents/57/Overview_of_COVID-19_Contact_Tracing_Using_BLE.pdf
3 https://www.blog.google/inside-google/company-announcements/apple-and-google-partner-covid-19-contact-tracing-technology/
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Key references in bold.