

# Submission to the Special Committee on Covid-19 Response

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1. This submission provides a brief overview of the work of the Expert Panel on Contact Tracing formed by Science Foundation Ireland (SFI) in April 2020 to support the ongoing work in deploying a national contact tracing system, specifically the planned national contact tracing mobile app. The submission also provides details on work in the SFI CONNECT Research Centre to assist in the assessment and evolution of the Irish contact tracing mobile app in terms of its ability to accurately estimate physical proximity through the use of Bluetooth Low Energy technology.
2. CONNECT<sup>1</sup> is one of 16 Research Centres funded through SFI. CONNECT brings together world-class expertise from ten Irish academic institutions to create a national “one-stop-shop” for research, development and innovation in communications networks. The centre has been headquartered in Trinity College Dublin since its creation in 2015. In March 2020 I was appointed as the Director of CONNECT on an interim basis.
3. Following the onset of the Covid-19 crisis in Ireland, SFI with other agencies and the wider research and innovation community has aimed to ensure a coordinated and meaningful contribution to solving some of the challenges facing the country. As part of its process of problem curation, SFI identified Contact Tracing as one of the areas in which the Irish scientific community would be able to provide assistance to the public health authorities.

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<sup>1</sup> <http://connectcentre.ie>

4. SFI formed an expert panel on contact tracing, whose role would be to act as a liaison between the relevant stakeholders in the Department of Health and the HSE, to coordinate any required response from the scientific community. The members of this expert panel are:
  - Prof. Noel O'Connor, Director of the INSIGHT SFI Research Centre for Data Analytics and Professor in the School of Electronic Engineering, Dublin City University;
  - Prof. Vinny Wade, Director of the ADAPT SFI Research Centre for Digital Media Technology and Professor of Computer Science, Trinity College Dublin;
  - Dr Brendan Jennings, Interim Director of the CONNECT SFI Centre for Future Networks and Communications;
  - Dr Jim Buckley, Principal Investigator at the LERO SFI Research Centre and Senior Lecturer in Computer Science and Information Systems, University of Limerick.
5. Upon its formation the SFI expert panel on contact tracing identified issues relating to contact tracing for which the members felt the point expertise from within the Centres and wider community would be able to make a useful contribution. These issues primarily related to the anticipated contact tracing mobile app. They included, amongst others, the following: 1) proximity estimation in contact tracing apps; 2) GDPR, ethical and security/privacy issues relating to gathered data; and 3) potential application of data analytics to gain useful insights from the gathered data.
6. SFI arranged for the expert panel to discuss the identified issues with officials from the Department of Health and the HSE. It was clear that officials had already given considerable consideration to these issues and that steps were being taken to address them. Moreover, it was clear that the officials were engaged in discussions on best practice with peers in public health authorities across Europe who were responsible for the roll out of their national contact tracing apps.
7. Subsequently, Department of Health and HSE officials, requested, via SFI, that the expert panel convene working groups, termed Expert Sub-groups, from the academic community. Currently there are five such sub-groups: the Expert Sub-group on Ethics and Trust; the Expert Sub-group on Human-Computer Interaction; the Expert Sub-group on Data Analytics; the Expert Sub-group on Code Review; and the Expert Sub-group on Scenario-driven Testing. This submission relates to the ongoing work of the Expert Sub-group on Scenario-driven Testing.
8. It is important to note that these Expert Sub-groups are wholly independent of the Department of Health and the HSE. The academic institutions to which the experts are affiliated are not receiving any funding from the Department of Health or the HSE in relation to any work these experts undertake in this context. Instead, their role is to provide independent advice that may, or may not, be taken on board by the Department of Health and the HSE. The experts involved uniformly view the work as their individual contribution in an advisory capacity towards the national effort to combat the Covid-19 pandemic.
9. Given that work on the Irish contact tracing app was well-advanced by the time the Expert Sub-groups were formed, these groups have not had any impact on the design,

implementation or deployment of the initial version of the Irish contact tracing app. The groups' influence will be manifested in subsequent releases of the app.

10. As Director of CONNECT, I agreed to form an Expert Sub-group drawn from the centre's cohort of researchers working on various aspects of communications networks, to provide advice on the use of Bluetooth Low Energy technology to provide estimates of the distance between two mobile devices. This Expert Sub-group was constituted in May 2020 and was named the Expert Sub-group on Scenario-driven Testing. This reflects the focus of the group on assessing the accuracy of the estimation of proximity between mobile handsets in the context of their real-world usage (hence "scenarios.")
11. Prior to the formation of the Expert Sub-group on Scenario-based Testing a number of researchers affiliated with CONNECT had independently started to work on issues relating to the use of mobile apps for contact tracing. These included researchers from the TSSG centre at Waterford Institute of Technology, from the Tyndall National Institute, from the Department of Computer Science at University College Cork, and from the School of Computer Science and Statistics, Trinity College Dublin.
12. Notable amongst these efforts was the work of Prof. Doug Leith and Dr Stephen Farrell, of the School of Computer Science and Statistics in Trinity College Dublin. Prof. Leith is an investigator with the CONNECT centre. Prof. Leith and Dr Farrell published a study<sup>2</sup> (which has not been peer reviewed) on May 6<sup>th</sup> 2020, which highlighted some of the challenges with using Bluetooth Low Energy for estimation of the proximity of mobile handsets.
13. When considering the use of Bluetooth Low Energy in the context of a contact tracing app there are two main aspects to consider. The first is the degree to which it is possible to use the technology to accurately assess whether the proximity between two people having mobile handsets running the contact tracing app on their person is epidemiologically significant. At the time of writing the "close contact definition" for epidemiological significance, as specified by NPHE<sup>3</sup>, is specified<sup>3</sup> as "greater than 15 minutes face-to-face (<2 metres distance)."
14. The second aspect relates to the system architecture put in place to support the contact tracing mobile app. This raises a number of questions, including, but not limited to: what information is collected by the mobile app? Of this information what portion is shared with a central server? What degree of control is the user of the mobile app given over the collection and sharing of information? Once a user of the app tests positive for Covid-19 how is the collected data used to identify close contacts? What information is made available for population-level analysis through the application of data analytics?
15. This submission addresses the first aspect listed above, as this is where the work of the CONNECT Centre is focussed.
16. The goal of a contact tracing app is to *augment* the wider contact tracing effort, by using the app to help identify other people a person using the app may have been in close

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<sup>2</sup> [https://www.scss.tcd.ie/Doug.Leith/pubs/bluetooth\\_rssi\\_study.pdf](https://www.scss.tcd.ie/Doug.Leith/pubs/bluetooth_rssi_study.pdf).

<sup>3</sup> HSE and HPSC, "National Interim Guidelines for Public Health management of contacts of cases of COVID-19," v8.4 (20/5/2020), [Online] Available (15/6/2020): <https://www.hpsc.ie/a-z/respiratory/coronavirus/novelcoronavirus/guidance/contacttracingguidance/National%20Interim%20Guidance%20for%20contact%20tracing.pdf>.

contact (as defined in paragraph 13) in the days preceding the person's diagnosis as Covid-positive. Whilst the person is likely to recall the names of the majority of other people they have been in close contact with, they may: a) fail to recollect some of these interactions, or b) have been in close proximity to another person without having been aware of it, for example whilst sitting on a bus, or in a queue. In the latter case, the other individual is likely to be someone they do not know, so there would be a clear benefit in having an app-based system identify the close contact. Given, this, the proposition is that a contact tracing app ideally will identify close contacts that *might not have otherwise been identified* through "manual" contact tracing.

17. It is possible to track the location of a mobile handset with a good degree of accuracy through use of GPS, data available at mobile base-stations, attachment to WiFi networks, combinations of the three, and the use of other location-tracking technologies. However, it is not clear that location information of this form could be used to accurately determine a close contact (<2m for 15 minutes). Moreover, the sharing of location data raises significant data privacy concerns, which would be likely to inhibit the uptake of the app by the population. For this reason, most European countries (including Ireland) have discounted the use of location data in their contact tracing apps.
18. It is important to note that the *location* at which two people come into close contact is not relevant in the assessment of whether there was potential to pass on the virus. As specified in the close contact definition, it is the *proximity* of the two people that is relevant. It matters that the people spent time close to each other, not in which part of the country where they were when this happened.
19. Notwithstanding that, it should be acknowledge that, at the country level, knowledge of the location at which the virus may have been transferred between people, is potentially of interest from an epidemiological modelling perspective. To my knowledge, the HSE app does not collect information relating to its user's location.
20. Bluetooth Low Energy is a networking technology designed to form a stable connection between a device such as a mobile handset (mobile phone) and a nearby device such as wireless headphones. The manner in which this technology is being repurposed for estimating proximity between two devices is described in the submission to the Covid-19 committee made by Prof. Leith and Dr Farrell; I will not address it here.
21. Key advantages of the use of Bluetooth Low Energy for proximity estimation, as argued by its proponents, are its availability on the majority of modern mobile handsets, and its relatively low impact on battery drain when in use. The first contact tracing app using the approach was developed in Singapore, but one challenge faced was that the app was not approved by Apple for use on iOS (the Apple mobile operating system), which significantly limited the uptake of the app by the population of Singapore.
22. During April 2020, Apple and Google announced the "Google Apple Exposure Notification" (GAEN) system. GAEN is software embedded within the Apple iOS and the Google Android mobile operating systems that would implement proximity estimation functionality using Bluetooth Low Energy. Contact tracing apps could then use GAEN to gather the information required to identify when an individual was in close contact with someone who subsequently tested Covid-positive.

23. Following announcement of the availability of GAEN, the majority of European countries reoriented efforts to implement national contact tracing apps to utilise the system. This has been a contributory factor in delaying the launch of many national contact tracing apps.
24. As well as facilitating the deployment of contact tracing apps on Apple iOS devices, the GAEN system should allow Google and Apple to calibrate the operation of Bluetooth Low Energy proximity estimation across iOS and Android devices, and across different models of iOS and Android devices. Moreover, it will provide a coordinated way of rolling out (through operating system updates) improvements in the system, independently of apps.
25. On the other hand, the implementation of GAEN is closed: Google and Apple are not allowing anyone outside their organisations view or assess the computer code that implements it. This increases the risk of software errors, or indeed subtle implementation choices, leading to unanticipated behaviour of contact tracing apps.
26. It is important to note that GAEN is designed to be flexible so that it can accommodate differences in close contact definitions from different national health authorities and/or changes in these definitions over time. It is thus important that the contact tracing apps that use it are configured in a manner that maximises the accuracy of the close contact determinations that they make. Moreover, improvements of the GAEN system functionality in its future releases may require that contact tracing apps will need to themselves be updated so that their use of the data generated by GAEN can be optimised.
27. As announced by the HSE, extensive testing of the Irish contact tracing app is being undertaken, including a field trial with members of An Garda Síochána.
28. Work ongoing in CONNECT is focussing on the accuracy of the GAEN system. Our researchers are using the GAEN system directly; they do not have access to a pre-release version of the Irish contact tracing app. Given our focus on assessing the accuracy of Bluetooth Low Energy based proximity estimation this is not a limitation. The experimental results we are gathering are relevant to the operation of the app, which uses the GAEN system for this purpose.
29. The focus of the CONNECT experimentation is on assessing the real-world efficacy of GAEN in estimating proximity. In practice, this means that our researchers are trying out the GAEN functionality in a number of scenarios that we believe replicate situations in which the functionality of the contact tracing app is likely to be most useful. This includes, amongst others, individuals sitting apart on a bus, a train carriage, or a Luas carriage, or individuals walking side-by-side or one-in-front-of-the-other.
30. Some results of these experiments are described in the submission to the committee from Prof. Leith and Dr Farrell. They note the impact of signal reflections on the accuracy of proximity estimation, and the impact of the relative orientation of two devices on this accuracy. They conclude that it is very challenging to accurately detect a close contact using the GAEN functionality. These conclusions are in broad agreement with the results similar assessments being made by researchers in other countries.
31. At the time of writing CONNECT is in the process of expanding the number of researchers undertaking scenario-based testing of GAEN. All involved researchers are

strictly adhering to government guidelines regarding social distance and movement. The increase volume of experimental data that this work will generate will serve to strengthen the experimental study and its conclusions.

32. Results of the experiments will be provided to Department of Health and HSE officials. It is our expectation that these results will be of use in terms of optimising the configuration of the contact tracing app (in terms of how it uses the GAEN system) and in terms of a wider assessment of the “added value” that the app brings to the wider national contact tracing system.
33. It is our expectation that the work of the Expert Sub-group on Scenario-driven Testing will continue for the medium term. We expect that the GAEN system will be enhanced and extended by Google and Apple to provide increased accuracy of proximity estimation (possibly through the use of data from other sensors present in most mobile handsets). When such enhancements are rolled out by Google/Apple it will be important to perform an independent assessment of any improvement in performance. Such assessments should then inform changes in the contact tracing app.
34. As Director of CONNECT, I look forward to a continuing positive engagement between the centre researchers and Department of Health and HSE officials in the coming weeks and months.

ENDS.