

## NETWORKS AND APPLICATIONS DURING AND POST PANDEMIC: PART 2 OF TWO PARTS<sup>1</sup>

**T**he article last month talked about the need for much more research in networks and applications before virtual meetings can replace in-person meetings in critical negotiations and serious business, even education. We stressed the need for universal access to make sure the gap between rich and poor will not widen further and rapidly. This month we talk about some of the other aspects of networking related to the pandemic and post pandemic that merit special attention and careful planning.

One new application on the network infrastructure is contact tracing. This mission aims to identify persons in contact with an infected person and with subsequent collection of further information about these contacts. As soon as possible, contacts are tested for infection and upon confirmation, interrupt transmission and reduce spread via isolation and proactive treatment. This is not a new concept, but to be effective, the timescale must be as fast as possible and new technology is available. Thus, virus test results should be available in minutes instead of days. Many of us work with stochastic systems such as branching processes and its special case of birth and death processes. We know longer delays of test results without applying mitigation means more positive branchings can occur in the interim, creating more growth in the infected population. This can easily change the mean next generation population from less than one to greater than one, a big difference between controlling the pandemic and letting it run away rampant.

Tracking of victims and “exposed” contacts can be done via mobile GPS, video, face recognition, vehicular tracking and continuous Internet assessment and updates. There are serious privacy and legal issues implicated that will require policy, regulation and civil liberty discussions. In addition, there is the question of who funds the implementation and operations: national, local or philanthropic.

The future advanced form of contact tracing can be even more “intrusive.” Early detection of outbreaks with high sensitivity/selectivity sensors on the human body is used to find attribution of “parents” including patient “zero.” The response management is necessarily very aggressive and fast paced finding affected individuals so as to control the spread. Harvesting and analysis of real-time “digital footprints” of infected groups and individuals are performed via mobile traffic analysis (tower/sector, GPS, text, email), mobile sensors (accelerometer, wearable health monitors), tweets, Instagram, Google searches, blogs, Facebook posts, etc. Advanced analytics are used for anomaly detection specific to outbreak detection via machine learning from previous events, the resulting social disruptions, simulations and “wake” analysis.

Early detection tremendously helps containment and additional inferred biometrics enhances early detection. Sick people quickly change digital footprints, e.g. from active and mobile to stationary not during nominal times of rest. GPS and accelerometer data have been successfully used to identify mood changes, onset of diseases and visits to pharmacies. Analysis of emotional content of tweets, blogs and texts can be used to assess



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panic and can suggest mitigation measures and evaluate their effectiveness. The path forward should include identification of technology gaps, a robust public/private dialogue and collaboration, government setting of policies and regulations and public funding. Doing all these and still respecting the privacy of citizens will be a very important issue to tackle.

When we rely on the Internet for information and conducting our daily life and business, the authenticity of the information is paramount. Rumors, misinformation and false information on social media proliferating before and after significant events may drive public actions into the wrong state. As an example, during the 2014 Napa Valley earthquake, fake news created traffic jams amid fears of (imaginary) armed insurgents and fabricated reports of primary route congestions. Most artificial intelligence and machine learning tools have vulnerabilities to adversarial attacks that can be

exploited to generate erroneous reports. Current best practices are simply not nearly enough. The good news is there are some technical solutions that have not been implemented by the service providers such as identity verification/authentication, developing the “reputation” of originators, fact checks, determine the correlation of the sources of reports (often several reports are sourced from the same fake report so the providence of reports is important), etc. The service providers do not have to pass judgement on the quality and authenticity of the information (that may draw lawsuits), but they can point out there are inconsistencies with other available information or the report has not been substantiated with evidence and let the readers make their own judgments. More insights should be provided on the providence and the relationships to other information on the net. Attribution of the source of information can be very difficult, what with many possible disguises available such as bots. Time stamping and installation of real time traffic monitoring with GPUs at key domain gateways can help the localization and identification of sources. Unfortunately, all these need extra investment of hardware and processing and may even reduce revenue and are disincentives to profit driven businesses. It will not happen naturally without updated legislation, new policies and regulations, public funding and installation of penalties for irresponsible practices.

In summary, virtual platforms will be an important tool of conducting everyday life during and post pandemic. There are many areas for improvement before high quality interactions can be realized. A differential access to technology will further widen the gulf between rich and poor and will generate big social and economic impacts if the current digital divide is not mitigated. In the worst case scenario, social unrests and instabilities within countries may arise due to large inequities. Moving forward, a thoughtful, balanced and collaborative approach between the public and the private sectors on policies, regulations and funding must be proactively pursued.

<sup>1</sup> Part 1 was published in last month's President's Page.