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Honorable Members of the City Council
City of Los Angeles
Room 395, City Hall
Los Angeles, CA 90012

Attn: Information Technology & General Services Committee

Subject **BLUETOOTH MESH NETWORK TECHNOLOGY FOR EMERGENCY COMMUNICATIONS (Council File 19-1064)**

Pursuant to City Council Motion (Rodriguez/Bonin), Council File No. 19-1064, the Information Technology Agency (ITA) is submitting the following report, with the assistance of the Emergency Management Department, on the potential uses of a Bluetooth mesh network mobile application for communication during an emergency that impacts cell and internet service.

## What is a Bluetooth Mesh Network?

If you own a smartphone, you are familiar with Bluetooth technology. Commonly used to connect with your car or wireless speakers, Bluetooth is a proprietary standard for short-range, wireless communications. There have been five versions of Bluetooth beginning with version 1 in 1999. In 2016 Bluetooth version 5 was introduced along with the "mesh" feature which allows for messages to be relayed between Bluetooth enabled devices (e.g. smartphones and other "smart devices").

In order for a Bluetooth mesh to function properly, messages cannot travel more than 127 hops and exist on a network with fewer than 32,767 nodes (devices). In other words, a message would stop after relaying across 127 devices and stop once it has reached 32,767 devices. This technology was designed to work on networks with nodes that exist in close proximity to one another as the distance between nodes cannot exceed 100 meters. Given the above parameters the primary application of bluetooth mesh has been for "smart buildings" and IoT (Internet of Things) infrastructure. This includes "smart lighting" that communicates between lights and sensors to turn off lights when people are not in the room, fitness trackers that communicate with exercise machines, beacons, etc.

## How a Bluetooth Mesh Network Could Be Used for Emergency Communications

Emergency communications often require fast transmission of a clear message to a broad or targeted group of residents. These communications must be reliable and non-impacted by disaster conditions to reach the intended audience. To accomplish this with a Bluetooth mesh network, residents must have a mobile application installed on their phone that has the proper permissions. Without this, their phone would not be recognized within the Bluetooth network and lack the security permissions to receive or transmit a message. For the purpose of this report,

the consideration is whether the City of Los Angeles should build and deploy a mobile application that takes advantage of Bluetooth mesh networking to communicate evacuation and disaster-related information between Los Angeles residents during an emergency that impacts traditional cellular service.

**Strengths of a Bluetooth Mesh Network**

First of all, a mobile application running on a Bluetooth mesh network can transmit an emergency notification. The character and size limits are more than sufficient to broadcast the typical emergency communication. Secondly, Bluetooth mesh networks are independent of traditional cellular and WiFi infrasructure (can be transmitted if cellular towers are down). This method does not require the Internet or a centralized server/controller in order to function. When used on a smartphone, it can communicate a message a short range to another smartphone without ever traversing the cellular connection and is, therefore, not relying on cell towers to be operational. Through the "mesh network" the message is relayed from one phone to another so long as each phone is within Bluetooth range (20 to 30 meters {80 feet) realistically with up to 100 meters, or 328 feet, in laboratory conditions). While used for a different purpose, the recent Hong Kong protests evidence this technology. Hong Kong protestors have chosen the use of the Bridgefy app to communicate while staying "off the grid.. The Bluetooth Mesh technology via the Bridgefy app has allowed protestors to avoid any potential surveillance that could accompany traditional text messages, cellular communications, and other Internet-based solutions (e.g. chat software).

Third, Bluetooth mesh networks can be geo-fenced (spatially targeted). A transmitter (City of Los Angeles) can be in or out of the targeted area and only those within the geo-fencing will receive the notification. If a specific evacuation message is required for a hillside community, that message can be targeted to residents within that area who have the mobile application.

**Weaknesses of a Bluetooth Mesh Network**

Through our research and discussions with industry experts, there are, unfortunately, several key weaknesses of using Bluetooth mesh networks for the purpose of emergency communications. First of all, a Bluetooth mesh network requires residents with the mobile application to be within 20 to 30 meters of another resident with the mobile app. If not, then they would not receive the communication. Furthermore, without the ability to relay, some messages may die out and entire areas would never receive the communication. Unlike the close proximity of Hong Kong protestors, the City of Los Angeles is spread across 469 square miles and the ability to send one message effectively across this area is highly unlikely. Secondly, Bluetooth mesh networks are limited to 127 hops (127 relaying devices with a 32,767 total device limit). The City of Los Angeles has over 4,000,000 residents. For most uses in the City of Los Angeles, this limits a message to too few recipients. It would become complicated to arrange for more than thirty-three thousand devices to be communicating in this manner. The use of Bluetooth beacons, or repeaters, could potentially be placed throughout the City in order to ensure that a smartphone with the app would always be within range and able to receive a message. However, this would be a large undertaking for a network that would be not often used.

Third, a Bluetooth mesh network would require each resident to download a mobile app to be a part of the communications and their notifications turned on. Applications, such as Bridgefy, require all participants have the app to receive a message and be watching for notifications to be effective. Existing emergency communications platforms, such as Wireless Emergency Alerts (WEA), can be broadcast to a resident's smartphone without previously downloading an app and they automatically provide notifications. Fourth, some residents will have concerns regarding

privacy. By nature, this application would track the locations of those with the app installed. While several safeguards could be included to ensure this capability was only used for legitimate emergency communication purposes, privacy concerns are a growing sentiment among Americans in this digital age. Lastly, a Bluetooth mesh network is susceptible to a shared limitation with other digital emergency communications… electricity. Some disasters would eliminate or limit resident access to electricity for a period of time. Without electricity, most smartphones would last one to two days (depending on age of phone and usage). In other words, without electricity, the Bluetooth mesh network would have one to two days of effective use. So, a Bluetooth mesh network could bypass the loss of cellular connectivity, but not a long-term loss of electricity.

**Conclusion**

Emergency communications are critical for the health and safety of Los Angeles residents. New technologies must always be evaluated whether they would provide residents the best possible tools during a disaster. Unfortunately, the previously mentioned technical limitations of Bluetooth mesh networks make it not likely to be the solution the City of Los Angeles is looking for. In order for a Bluetooth mesh network mobile application to become an effective emergency communications tool, the City of Los Angeles would need to develop the mobile app (or enhance an existing mobile app with this functionality), obtain mass download of the app by City residents, and distribute/maintain 13 million Bluetooth beacons across the City of Los Angeles to ensure the relay of messages to all that are impacted. In addition, an electrical outage caused by the disaster would mean that smartphones using this app would likely have 1 to 2 days of use before they lose power.

In the last two years, the City of Los Angeles has become much more effective in digital communications during an emergency, including multi-channel social media, real-time evacuation maps, and special purpose websites. The Information Technology Agency and Emergency Management Department sees the continued importance of expanding the use of digital communications during an emergency. This would include the following:

1. Continued marketing for residents to register with NotifyLA (https://emergency.lacity.org/notifyla) to receive emergency communications over the cellular network.
2. Establishing a "Telecommunications Emergency Response Committee" comprised of major telecommunication providers, the Emergency Management Department, the Information Technology Agency, and key City departments. This working group would discuss steps taken to make cellular networks resilient, prioritization of service restoration, and emergency communications. The City of Los Angeles in 2015 was the first U.S. city to enact earthquake standards for cellular towers. Each tower is now built to the same standards as public safety facilities, including power generators.
3. Establishing a "Social Media Emergency Response Committee" comprised of major social media companies, the Emergency Management Department, the Information Technology Agency, with optional attendance by Recreation and Parks. This working group would discuss steps that can be taken to social media outlets available for official City communications during an emergency.
4. The Information Technology Agency and Emergency Management Department to research portable power stations for L.A. residents to maintain the charge of their smartphones to receive ongoing communications. These stations could be solar powered or generator charged and be geographically spread across recreation facilities, police stations, libraries, etc. This research would be done in coordination with the Department of Recreation and Parks who has shown great leadership in resident services for

evacuation centers. Once fully researched, our departments will work to obtain necessary funding through the Office of the Mayor and City Council.

Respectfully submitted,

Ted Ross
Chief Information Officer, General Manager

ec: Honorable Mayor Eric Garcetti
Honorable Councilmember and PS Chair, Monica Rodriguez, Council District 7
Honorable Councilmember Mike Bonin, Council District 11
Honorable Councilmember and ITGS Chair, John Lee, Council District 12
Miguel Sangalang, Mayor's Office
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