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The Information Technology Disaster Resource Center, or more affectionately ITDRC, is no stranger to providing critical communications services in times of disaster since 2008. With a nationwide cadre of over 1,700 volunteers, and more than 100 responses in the organization's history, ITDRC launched one of its largest operations to date following Hurricane Maria in September 2017.

For five months following the storm, ITDRC deployed 47 volunteers that established communications for relief efforts, public safety, and direct survivor use at 67 sites across Puerto Rico. Working with our partners, a majority of these sites requiring Internet connectivity were done so utilizing VSAT, or satellite communications, due to the major impact to wired and wireless service provider's infrastructure following the Category 5 storm.

In our opinion, the best way to move forward in strengthening networks and providing stability, is to continue to harden the cellular infrastructure. It seems as if it would be common sense for carriers to be required to have sufficient backup energy systems in place to continue operations in times of disaster, or to provide temporary backhaul at key sites via alternative methods such as VSAT, however, there are no federal regulations stipulating the uptime or standard service level agreements that must be met by carriers to those customers they serve.

This problem is in no way limited to the citizens of Puerto Rico, as can be seen by recent Public Safety Power Shutdowns in California, where cellular networks were impacted due to the loss of power for nearly a week. In this case, millions were affected, not by a natural event, but by the loss of commercial power.

While we should only be so reliant on the carriers to serve our needs uninterrupted, there are recommendations that all agencies, public and private, should take to increase their own resiliency. These include installing generators, whether by combustion engine, or renewable sources, and pre-staging VSAT resources, ready to be deployed to key sites at a moment's notice. Additionally, the use of high powered Land Mobile Radios in simplex mode can enable direct voice communications between sites without relying on terrestrial networks.

In the future, the use of newer Low Earth Orbit and Middle Earth Orbit satellite systems will provide Internet connectivity to larger geographical coverage areas, with lower latency, and faster speeds to reconnect those who have been disconnected; with future capabilities that will allow cellular handsets to "roam" via direct connections to satellites.

The impacts of the recent earthquakes in the southwest have been felt by all Puerto Ricans. When compared to Hurricane Maria, the effects on communications networks were significantly less, in

part due to less physical damage to the infrastructure itself, however, power and wireline connectivity outages did contribute to some downtime.

In summary, there is still a long road ahead to improve the resiliency of communications networks in Puerto Rico, and beyond. Maintaining the availability of networks, by utilizing diverse backhaul and power options, will ensure that services are available in times when they are needed most. Service providers must invest in their networks, and we must hold them accountable to ensure that telephone and data services are available when they are needed in critical times.