Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Public Safety and Homeland Security Bureau	)	PS Docket No. 17-344
Seeks Comment on Response Efforts Undertaken	)	
During 2017 Hurricane Season	)	

COMMENTS OF MOTOROLA SOLUTIONS, INC.

I.   INTRODUCTION

Motorola Solutions, Inc. ("Motorola Solutions" or "MSI") hereby submits these

comments in response to the Public Notice issued by the FCC's Public Safety and Homeland

Security Bureau ("PSHSB") seeking comment on the response efforts undertaken during the

2017 hurricane season.[1] Motorola Solutions commends the Commission for initiating this

proceeding and looks forward to working further with key stakeholders to refine and enhance

best practices to reduce disruptions to communications services during catastrophic events.

Motorola Solutions is the recognized global leader in the development and manufacture

of innovative communication solutions that help public safety and commercial customers build

safer cities and thriving communities. We work with government entities, including Federal

agencies, State and local law enforcement, fire, emergency medical services and all other first

and second level responders to emergency situations. Our mission critical grade

communications networks, devices, applications and services – many of which are custom built

to customer specifications – provide public safety responders with real-time data and information

to elevate situational awareness in ways that help save lives and property. In addition to being

the leading supplier of networks and two-way wireless communications devices to public safety,

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[1]   Public Safety and Homeland Security Bureau Seeks Comment on Response Efforts Undertaken
During 2017 Hurricane Season, *Public Notice*, PS Docket No. 17-344 (rel. Dec. 7, 2017) (*Public Notice*).

Motorola Solutions also supports public safety answering points ("PSAPs") with equipment, software, applications, and network support for the provision of 911 and NG911 services. Motorola Solutions is also working to provide mobile devices, applications, software and services for the FirstNet network as part of its role on the AT&T team selected by the U.S. government to deliver America's first nationwide wireless broadband public safety network.

Motorola Solutions shares the Commission's commitment to ensuring the availability, reliability, and resiliency of advanced public safety and emergency communications systems. Motorola Solutions has contributed to past FCC inquiries into the performance of public safety communications networks during similar disasters, including as a member of the federal advisory committee reviewing the impact of Hurricane Katrina.[2]

With respect to hurricane preparedness, our customer support begins with our technical and support teams working closely with our customers to preplan for pending disasters. We help our customers deploy necessary emergency equipment, identify and acquire key emergency replacement parts, and develop operational steps to mitigate and report outages. From the moment we become aware of a pending event, we initiate and maintain communications with potentially impacted customers throughout the duration to mitigate problems. The capabilities and resiliency of MSI's products and services are best demonstrated during disaster response as our systems and devices are designed, built, and deployed specifically for use during such times.

Many of Motorola Solutions' customers were heavily impacted by the 2017 hurricanes yet very few experienced any impairment to their communications. Motorola Solutions worked with its affected customers in Florida and Texas to ensure support personnel and supplies were

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[2]   *See* Independent Panel Reviewing the Impact of Hurricane Katrina on Communications Networks, Report and Recommendations to the Federal Communications Commission, June 12, 2006, *available at* https://transition.fcc.gov/pshs/docs/advisory/hkip/karrp.pdf.

staged nearby and ready to deploy to the affected areas.[3] A convoy consisting of supply trucks

carrying gas and diesel fuel, communication sites on wheels, generators, antennae, vehicles and

other replacement components and devices were pre-positioned nearby the anticipated disaster

zones to ensure that any necessary network restoration work would be quickly completed.

Motorola Solutions has a long track record of providing equipment and reliable networks

that are architected to be private, dedicated, resilient, and redundant for these very situations.

During the 2017 hurricane season, LMR technology – particularly P25 networks – again

demonstrated superior performance and resiliency compared to other communications options.

In the comments below, Motorola Solutions responds to some of the Bureau's questions based

on our experience assisting customers as they attended to their duties of saving lives and

protecting property following the three major storms of 2017.

II.   DISCUSSION

A. Questions Regarding Impacts to Communications Infrastructure[4]

1.   *What were the major causes of communications outages due to the hurricanes? Were there unique factors that affected outages and/or resilience during any particular hurricane?*

The three major storms of 2017 – Harvey, Irma, and Maria – impacted public safety land

mobile radio ("LMR") networks[5] differently, and therefore tested the resiliency of MSI customer

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[3]   These comments are focused more on the impact of Hurricane Harvey and Hurricane Irma than Hurricane Marie because MSI is involved in more systems operating in Texas and Florida than in Puerto Rico.

[4]   In these comments, the numbering of questions tracks that of the *Public Notice*.

[5]   In general, these comments document the performance and capabilities of different types of public safety LMR systems. However, the best performance was achieved by those public safety networks designed to comply with the "Project 25" suite of standards, which offer more advanced hardening and trunking capabilities than non-P25 networks. In these comments, we will identify those areas where the advanced features of P25 networks were responsible for enhancing public safety communications during the storms in order to distinguish them from the capabilities of non-P25 networks.

solutions in different ways. While the loss of electrical power is a primary reason for network failure during all forms of disasters, hurricanes bring the added factors of flooding and wind damage.

During Hurricanes Harvey and Irma, Motorola Solutions' products and services – particularly P25 networks – performed exceptionally well under extremely difficult conditions. Having applied lessons learned from past disasters, results exceeded expectations as mission critical communications service was maintained at nearly all locations throughout the two storms. In contrast, Hurricane Maria devastated everything, including the underlying infrastructure, so extensively that there were public safety communication outages. Although some LMR sites operated by MSI customers in the San Juan area were operational after just a few days, the tremendous damage to non-communications infrastructure and continued power outages hampered the ability to regain communications capability throughout the insular regions of Puerto Rico.

Hurricane Harvey caused significant wind damage to general infrastructure in some remote areas at the center of the storm but LMR systems were mostly affected by the subsequent storm surge and flooding. Physical damage to equipment, such as back-up power generators, did result in some short-term impact to public safety base station sites located in the most impacted counties hit by the storm. But, because of preplanning, most sites had critical equipment, including generators, located well "above grade" and thus did not have equipment damaged by the water.

Flooding had less of an impact during Hurricane Irma; strong winds were the primary culprit of most of the related civil damage. Nonetheless, public safety LMR networks weathered the storm well, particularly those P25 networks that followed the recommended site hardening standards to protect against Category 4 storms. Those that followed the recommended hardening

standards for mission critical grade networks were able to greatly mitigate or prevent structural damage and associated outages to public safety communication networks. Similarly, although the electrical grid and its associated infrastructure endured significant damage and outages, back-up power generators at the LMR infrastructure sites were able to mitigate the impact and ensure that communications continued while the power outages were addressed.

Hurricane Irma also caused significant physical damage to backhaul communications facilities, but for several reasons, this did not result in system outages to P25 networks. The fact that all LMR systems, including P25 networks, use significantly fewer sites than commercial networks to provide wide area coverage renders them more capable of being consistently hardened with redundant systems. But even if the sites are damaged by the storm, the loss of backhaul in P25 systems does not necessarily mean loss of service, as these systems are designed to operate efficiently even when backhaul is unavailable. In other words, while operations may be impaired at sites where backhaul functionality has been lost, mission critical communications can nevertheless be maintained using site-wide P25 trunking.[6] Also, coverage from P25 base sites is designed to overlap with adjacent sites to provide redundant coverage throughout that that network, as well as any neighboring P25 networks operated by city, county or state agencies in the same locale. This overlapping coverage, combined with preplanned interoperability agreements and the P25 Inter RF Subsystem Interface (ISSI)[7] interoperability features allow

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[6]   In contrast to commercial networks, each P25 message is not automatically routed to a central core but is distributed to other users through the base site's trunking components. For messages intended for users located in the coverage area of other base sites including those that are intended to be routed through a centrally located dispatch center, a temporary link can be established in the field to perform the necessary backhaul functionality.

[7]   The P25 common air interface allows P25 radio users operating in the same frequency band to roam onto other P25 systems. The P25 standard provides an interface between two or more systems, called the ISSI. In a system that does not have an ISSI connection, a user from one system can roam to another P25 system if they have been provisioned as a valid user on the roaming system. However, communication with the home system is lost when the radio roams. When roaming between two systems

mission critical users to roam onto neighboring systems in order to maintain mission critical communications capabilities. Finally, first responders are always able to communicate unit-to-unit (*e.g.,* direct mode) if a P25 site is completely disabled, which in some areas was the only wireless communication service of any type or technology available immediately after the storm.

Hurricane Maria caused catastrophic physical damage to communications systems, especially to older wireless infrastructure owing to the fact that Maria was a devastating Category 5 hurricane. The longer-term communications outages in Puerto Rico were largely due to the civil infrastructure challenges, including difficulty in gaining direct access to sites combined with a series of long-term power disruptions.

In sum, public safety systems that followed best practices and maintenance procedures were generally able to withstand most destructive hurricane winds and avoid the large-scale, long-term communications disruptions associated with flooding and civil power outages. Motorola Solutions believes that the redundancy built into P25 systems, pre-planning, and adherence to best practices are key to promoting network resiliency during natural disasters and to minimize the impact and duration of communication outages.

> ### 2. What were the cascading effects of communications outages? Did communications service outages have impacts on supervisory control and data acquisition systems (SCADAs) of other critical infrastructure?

With respect to Hurricanes Harvey and Irma, LMR sites generally remained operational throughout the events. A small percentage of sites were impacted by power loss or physical damage, but, in the case of P25 networks, alternate paths were identified and made available immediately through redundant sites or roaming agreements with neighboring networks. In the

that have a P25 ISSI connection, the radio user will use an interoperability talk-group set up to include users from System A and System B. One of the benefits of an ISSI link is that the consoles can maintain communications with the home radio users when they roam onto another system

few cases where sites were not functioning, the ability to supplement coverage with service from

neighboring or overlapping P25 networks limited any disruption to communications service.

> **3. To what extent was the communications infrastructure resilient to the hurricanes? What methods were employed prior to hurricane landfall to address infrastructure resiliency?**

As noted above, Motorola Solutions believes that preplanning mitigated or prevented the

public safety network outages that could have resulted from Hurricanes Harvey and Irma. But

the strong performance of these mission critical grade communications networks goes beyond

pre-planning and emergency restoration following disasters. Public safety systems, particularly

those that are P25-compliant, are designed to endure the physical stress of hurricanes, tornadoes,

earthquakes, and all forms of environmental events.[8] And should hardening standards fail to

prevent the loss of a site, P25-compliant systems would have macro cells in place with

overlapping coverage to minimize the resultant loss of coverage. Indeed, these standards and

best practices are designed to preserve emergency communications capabilities when first

responders need them the most.

Based on the information that we have gathered, none of the ten systems monitored by

MSI in eight Florida counties hit by Hurricane Irma ever went down, and users maintained

communication capabilities at all times. The public safety director for Lake County, Florida

reported that "[i]n that time, there were no sites down, no outages and all LMR communications

worked flawlessly. . . Our officers were working in flood-prone areas, and in those areas, LMR

was the only communication working." He also emphasized that there was a 228 percent

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[8]   *See e.g.,* Defining Public Safety Grade Systems and Facilities, A NPSTC Public Safety Communications Report, May 22, 2014, *available at* http://www.npstc.org/download.jsp?tableId=37&column=217&id=3066&file=Public_Safety_Grade_Report_140522.pdf.

increase in push-to-talks by the Lake County Sheriff's Police from the day before to the day of the hurricane, calling it a true "proof point" of the reliability of LMR during disasters.

The resiliency of public safety devices also came into play during the hurricanes. For example, the commander of the Houston Police Department Tactical Operations Division reported that during the Harvey response, a radio was submerged in more than five feet of water for at least four minutes and still worked after being retrieved. Similarly, the Huntsville Fire Department in Walker County, TX, reported that a radio that was partially buried in mud for the better part of a week, and once dried out, worked fine.

> **4. Are there industry best practices that address communications operations in high risk areas (e.g., flood, high-wind areas)? If so, were these practices implemented and did they prevent and/or mitigate outages? To what extent do these best practices involve cross-industry and/or government participation and was such participation effective?**

Motorola Solutions supports industry best practices and the FCC's involvement in developing those best practices. It has been our experience that whenever the Commission provides a forum for discussing the lessons learned following widespread network outages, industry best practices improve. For example, prior to Hurricane Katrina, flooding was not widely thought of as a major consideration for post-event outages. Now, it is well understood that subsequent storm surges may bring as much damage as a hurricane itself, and best practices now call for locating sensitive equipment to higher elevations ahead of time. Before Hurricane Harvey made landfall in Texas, MSI's customers followed these best practices and located equipment on higher ground and minimized the loss of equipment due to flooding. These best practices, coupled with routine and consistent maintenance, can greatly reduce the risk of a communications outage and/or mitigate damage to equipment resulting from a major weather event.

B. **Questions Regarding the FCC's Response**

> *8. Were there interoperability issues among local spectrum users and those that arrived to assist in response? If yes, to what extent and how were they resolved? To what extent was unlicensed spectrum used and were there interoperability issues?*

To facilitate interoperability across multiple public safety networks, cities and counties often have roaming agreements in place, and statewide systems have similar agreements with local communities. In almost all cases during the 2017 hurricane season, the pre-arranged agreements for roaming, ISSI, and system sharing over MSI-maintained networks functioned well and suffered little or no disruption.

Motorola Solutions submits the following example regarding Harris County, Texas, as illustrative of the benefits of these interoperability capabilities:

> Harris County operates two public-safety communications networks: a 40-site LTE network and a 700/800 MHz P25 Phase 2 system with about 60 sites that provides coverage to 20 counties and includes a core-to-core link to the city of Houston's 57-site P25 network, Lin said.
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> This link between the P25 systems proved to be helpful to Harvey recovery operations, particularly as personnel were reassigned from field rescue efforts—using the county's LMR communications—to providing security support at NRG Park, the home field of the Houston Astros that was transformed into a shelter, according to Jim McMillan, senior manager of public-safety communications services.[9]
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> "We were able to send them to the city's interop [interoperability] groups without having to do anything to the radio—we didn't have to reprogram it, and we didn't have to touch it," McMillan said during an interview with IWCE's Urgent Communications. "You just go to the talk group, and the radio re-registers onto the city's layer, and they start communicating.
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> "I really liked the fact that we didn't have to touch people's radios, for the most part. We had an agency that changed roles mid-operation—maybe they were

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[9]   Donny Jackson, "Harris County officials detail communications impacts of unprecedented flooding in aftermath of Hurricane Harvey," Urgent Communications (Sept. 11, 2017), at http://urgentcomm.com/p25/harris-county-officials-detail-communications-impacts-unprecedented-flooding-aftermath-hurricane.

assisting search and rescue, and then they went over to NRG Park to help have security for the facility, which was sort of being handled by the city—they were able to switch over to a city-layer talk group without having to do anything except change the channel on the radio."[10]

D. Questions Regarding Communications Service Provider Experience

1. To what extent were service providers able to pre-position equipment, supplies, and/or resources close to the affected areas in advance of each hurricane? How did this impact the continued availability of communications services or facilitate recovery?

As noted throughout, Motorola Solutions was able to pre-position equipment in disaster areas because of significant advance planning with customers. Because of prior implementation of best practices, there was little need to use many of the pre-positioned resources. Prepositioned service employees were able to quickly address the limited number of sites that required emergency inspection and repair.

6. Were communications services, such as satellite services, mobile ad-hoc networks, Wi-Fi services, mesh-based communications architectures, experimental projects or other services/technologies used and effective in providing connectivity when other services were limited or down? Should the FCC encourage inclusion of these services in future mitigation plans?

To Motorola Solutions' knowledge, public safety LMR systems in Texas and Florida did not suffer outages that required the use of supplemental communications services.

9. Were there challenges with the use of back-up power for network equipment? Are there ways to improve the ability of communications infrastructure to operate when commercial power is lost?

Using back-up power generators successfully during hurricane events requires that they be maintained before they are needed, that they be hardened to withstand hurricane force wind and flooding and that there is an ample supply of fuel on hand to power the generator for at least a

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[10]   *Id.*

week. Because Motorola Solutions and its affected customers adhered to best practices for back-up generators, we are not aware of any significant or systemic challenges to their use.

III.   CONCLUSION

As outlined above, the 2017 hurricane season demonstrated the resiliency of mission critical grade public safety networks and the capability to provide first responders with continued communications capabilities in areas where commercial wireless networks suffered extensive and long-lasting outages. Motorola Solutions looks forward to working further with the Commission on this proceeding to better identify and quantify characteristics of mission critical grade systems that provide such improved performance.

Respectfully submitted,

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