COMMUNICATIONS: PUBLIC SECTOR
In the USVI, public communications networks provide services to the government and first responders, middle-mile fiber services to Internet service providers, and public broadcasting services to the general public. All of these networks sustained significant damage in Hurricanes Irma and Maria, which, in many cases, resulted in systems being out of service for several months.

Damage ranged from minor water and physical damage to equipment and offices to destruction of transmission towers, studios, and buildings, as well as Information Technology (IT) storage resources. Internet access ranged from completely to partly inaccessible, while government voice communications capabilities were either entirely out of service or severely limited. The public safety radio network was only partly functional. Public radio and television were out for several weeks or months.

Repair technicians’ response to these disruptions was hampered by limited access to site locations (communications facilities are often on mountains or hills) as a result of inaccessible roads. Lengthy commercial power outages required constant refueling and servicing of backup generators not designed to run for long periods of time, which, in turn, resulted in loss of power until the generators could be restored to service. Limited staffing resources resulted in long hours for staff and lengthy delays in installing replacement equipment. The scarcity of spare equipment and the burdensome procurement process to acquire essential parts also hindered the recovery efforts.

Future major storm events will damage the networks as currently designed. Of particular concern will be facilities near the coast, which include parts of the fiber infrastructure and some government IT facilities. Other climate risks like rising temperatures or changing precipitation patterns will affect public telecom systems as well, but the impact will be mild to moderate.

To prepare the public communications networks for future climate risks, the responsible agencies will reinforce existing systems, change current system design and operations, and work to improve the sector’s emergency preparedness and response. Measures will include burying aerial parts of system infrastructure, building a completely new public safety radio system, introducing cloud systems for data storage, upgrading the government’s phone systems, and preparing for eventual outages through procuring satellite phones and deploying public WiFi hotspots.

HOW THE PUBLIC COMMUNICATIONS SYSTEMS WORK

The three primary components of the public communications systems in the US Virgin Islands are the services and functions of the Bureau of Information Technology (BIT), the infrastructure and services of Virgin Islands Next Generation Network (viNGN), and public television and radio broadcasting (provided by WTJX).

BIT is a government agency that provides four main services to other parts of the government: it manages the vendors that run the government’s telephone network, runs a microwave radio broadband Internet network that some parts of the government use for their communications, offers help desk support to those Territory agencies that request it, and operates and maintains the public safety radio network that provides radio communications to all public safety agencies in the Territory via a land mobile radio (LMR) repeater network.

viNGN is a semi-autonomous government agency and a wholly owned subsidiary of the Virgin Islands Public Finance Authority (VIPFA). The agency provides a Territory-wide, fee-based broadband “middle-mile” fiber network to private Internet service providers (ISPs), which enables the ISPs to provide broadband Internet connection services to their customers. Through the ISPs and BIT, the viNGN network provides Internet to all of the Territory’s government facilities, including schools and hospitals. The agency also runs several dozen public computer centers throughout the Territory.

WTJX is also a semi-autonomous government agency that both receives content from the public broadcasting service (PBS) and National Public Radio (NPR) and produces its own content for distribution in both television and radio formats to the general public.
**Government telephone network (BIT)**

Several companies provide phone service for USVI government agencies under independent contracts that BIT manages. The companies’ networks are either Plain Old Telephone Systems (POTS) or Voice over Internet Protocol (VoIP) lines that run on a combination of copper (coaxial), hybrid fiber cable (HFC), or fiber optic cables. The government depends on these networks for its daily voice and fax communications and conducts much business that way.

**Government enterprise network and data storage (BIT)**

BIT runs a microwave radio-based network that agencies can use for Internet access and data sharing—although not all agencies do. BIT also offers data storage capabilities on physical storage devices in its St. Croix offices; as with the microwave network, not all agencies use it. Those agencies that do not use BIT’s services are responsible for their own Internet access and data storage.

**Land mobile radio (LMR) public safety radio network (BIT)**

BIT runs the USVI public land mobile radio (LMR) network that government agencies use for communications while in the field. Police agencies, for example, use the network to receive calls for service and to obtain information for field requests like wanted persons information or vehicle records checks. The Virgin Islands Fire Service (VIFS), the Department of Health’s Office of Emergency Medical Services (VIEMS), and volunteer non-government rescue groups on each island also use this network to dispatch emergency workers and to communicate with hospital emergency rooms. The network relies on a series of radio repeaters and microwave links installed on each island, typically atop mountains or hills. Standby power generators back up both the repeaters and the links.

**Middle-mile fiber optic network (viNGN)**

The viNGN fiber network provides bandwidth to local Internet service providers (ISPs) and to BIT. The viNGN backbone infrastructure consists of 220 miles of undersea and terrestrial fiber optic cables throughout the USVI and fiber access points (FAPs) that make it possible to connect to the system. Sixty percent of the terrestrial network is underground. To connect to the US mainland, the agency uses undersea fiber connections; it also owns the interisland undersea connections between St. Croix and St. Thomas. Through local private ISPs and BIT, the agency’s infrastructure supports over 200 of what are known as Community Anchor Institutions (CAIs), including all three of the Territory’s hospitals, all public and private schools, and all of the government bureaus connected to broadband Internet.2

**Public Computer Centers and WiFi hotspots (viNGN)**

The Territory has 33 Public Computer Centers (PCC), which viNGN runs with the help of volunteer managers. PCCs provide computers with broadband Internet access, along with printers and scanners, for public use across the Territory. viNGN also provides a network of free public WiFi hotspots at several locations throughout the three primary islands.

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1 Two dispatching centers, one on St. Thomas and one on St. Croix, dispatch all emergency response calls for Territory agencies and double as the Territory’s 911 Public Safety Answer Points (PSAPs). Each center has the ability to back up the other center if needed. VITEMA oversees and manages these centers (discussed in the Government Response section of this report).

2 As defined in the Broadband Data Improvement Act, 47 USC. § 1305lb(i)(A–B), Community Anchor Institutions include “schools, libraries, medical and health care providers, community colleges and other institutions of higher education, and other community support organizations and entities to facilitate greater use of broadband service by or through these organizations; organizations and agencies that provide outreach, access, equipment, and support services to facilitate greater use of broadband service by low-income, unemployed, aged, and otherwise vulnerable populations.”
Public broadcasting:
WTJX TV and radio

WTJX provides public television (TV) and radio broadcasting through programs that range from children’s programming and craft shows to public affairs programming and, in emergencies, official government instructions to the public. Local staff produces TV and radio shows in the WTJX production studio; the stations also broadcast off-island content received via the Internet or satellite receivers. To distribute programming, WTJX owns two broadcast towers on St. Thomas and leases space on a privately owned tower on St. Croix for its translator. It operates its own transmitters on St. Thomas and a translator on St. Croix; the translator sends the communications signal out to listeners on a different frequency, which allows the programming to be received better on St. Croix, despite using the signal generated on St. Thomas.

Regulation and governance

The Federal Communications Commission (FCC) regulates the individual private communications companies that provide telephony services, as does the USVI Public Service Commission (PSC), which oversees customer service quality and service standards in the Territory (see Communications: Private Sector section for details). The FCC also regulates the microwave radio network, the land mobile public radio (LMR) system, and the public broadcasting service for both radio and television. The viNGN network is not regulated, as viNGN is solely a middle-mile provider.

Funding

The USVI government provides financing for BIT and its various networks, including LMR. viNGN earns revenue from the sale of its broadband service (and was initially funded by grants awarded by the US Department of Commerce to VIPFA in 2010). The public broadcast network is financed by USVI government grants, the Corporation for Public Broadcasting (CPB), and private donations.

IMPACT OF THE HURRICANES

The hurricanes severely damaged public telecom systems: the government telephone system was offline for weeks to several months, some government data stored at BIT was lost, the LMR public safety radio system was only partly operational, viNGN aerial cables were destroyed and service to customers interrupted, and WTJX programming was off the air for months.

Government telephone system (BIT)

The Government of the Virgin Islands (GVI) phone system suffered damage both to the interconnecting lines owned by either viNGN or Viya and to the equipment provider infrastructure (phones and equipment). The interconnecting lines were installed on wooden poles (WAPA infrastructure), which suffered extensive damage in the form of downed poles and lines. As a result, end-user telephone and fax services were offline for periods ranging from weeks to several months. Some of the equipment inside government buildings was also damaged when the structures themselves suffered storm damage.

Government microwave network (BIT)

The microwave network is installed on the same towers that support the public safety radio network. In some cases, the storms damaged or destroyed the antennas for this network so they had to be replaced. The antennas were also blown out of alignment in some locations, so they required realignment. The network went down as a result, and service had not been restored as of May 2018. The government agencies that used the network switched to using regular Internet service when it was available.
Government data storage (BIT)

BIT’s data storage system suffered physical damage causing some data to be either temporarily or permanently inaccessible. It also experienced issues with power outages. The damage was due to pre-storm preparation processes: to prepare the hardware before potential power spikes, the equipment was taken offline, but data files were corrupted when staff performed the functions to restore services. Power issues occurred because many of the emergency standby generators that support the system failed after being run for much longer than their designed run times (over three months instead of hours to a few days); when that happened, agencies could not access the uncompromised data.

With the regular system partly down, BIT used a cloud storage solution to restore some critical applications. The damaged storage drives were shipped for restoration in February 2018, but the vendor was unable to recover any data; BIT has identified a second vendor to attempt additional recovery, but had not resent the drives as of May 2018.

LMR public safety system (BIT)

Eight of the 11 LMR radio towers suffered damage, including two BIT-owned ones; three privately owned towers were destroyed completely. Numerous antennas and microwave dishes were heavily damaged or destroyed, and other interconnecting equipment was also compromised. The radio system was offline at various times during and after the storms, which meant police officers on patrol could not receive radio calls or had to move to different locations to receive signals; Virgin Islands Fire Service (VIFS), Virgin Islands Emergency Medical Service (VIEMS), and rescue personnel were similarly affected. At times, public safety personnel had to use personal cell phones, but cellular service also suffered major service outages. Lack of reliable communications caused delayed response to calls.

As of May 2018, the LMR network was operational and all tower locations were running on commercial power, however, there were still some coverage issues resulting from lost towers that had not been restored to pre-storm conditions. Damage to the system was estimated at above $800,000.
viNGN middle-mile fiber network

The two hurricanes did not affect viNGN’s underground backbone infrastructure, but they did destroy or render unusable 90 percent of the agency’s aerial cable infrastructure. Because the aerial cables deliver 90 percent of viNGN’s connections to end-users, the damage resulted in a significant outage. Elsewhere, two fiber access points (FAPs) that housed the network’s most vital electronic equipment sustained significant structural and water damage, and several of the PCCs suffered equipment damage due to the destruction of the buildings in which they were located. In the weeks after the storms, 18 of viNGN’s 24 generators suffered significant damage from operating well beyond their designed runtime (24/7) and backup battery banks were constantly depleted and recharged, drastically reducing their life span.

viNGN was able to restore service to sites served by underground connections as soon as the users’ buildings had power. Aerial connections had to wait until the Territory’s electric utility, Virgin Islands Water and Power Authority (WAPA), was able to restore its poles; as customers waited for service restoration, viNGN set up 13 free public WiFi hotspots in key locations on St. Croix (seven), St. John (one), and St. Thomas (seven). The disruptions to the viNGN system and to end-user infrastructure resulted in a nearly 70 percent drop in the volume of traffic in the viNGN network; the traffic volumes returned to normal in February 2018 (see chart: Internet traffic volume on the viNGN network). As of May 2018, all viNGN systems were back in operation, although many of the aerial and last mile connections were running on temporary facilities. PCCs fared less well: of the 33 PCCs Territory-wide, only 12 in undamaged buildings have been restored as of May 2018.

Internet traffic volume on the viNGN network
August 2017–February 2018; indexed to August 2017

Public broadcasting: WTJX radio and television

The public broadcasting network sustained varying degrees of damage. On St. Croix, the damage was relatively minimal: a translator suffered water damage and wind damaged two antennas. On St. Thomas, the damage was significant: Irma destroyed the main WTJX office and studio, and both the structure and the production equipment inside the building sustained massive damage. Winds toppled the WTJX-owned, 100-feet auxiliary transmission tower and caused significant damage to the roof of the building that houses the radios at the base of the antennas. Antennas and satellite receiving equipment were damaged and the generator was not able to maintain service, which, in turn, caused the heating, ventilation and air conditioning (HVAC) equipment to fail, increasing the risks for sensitive electronics that require climate-controlled temperatures. The loss of this equipment and the studio meant that programming was very limited for a lengthy period, especially for television: the FM radio station (WTJX-FM) went back on the air on September 27, 2017, and the television station (WTJX-TV) went back on the air the first week of January 2018. Internet at WTJX’s critical transmitter site had been down since Irma and minimal service was not restored until February 2018.

FUTURE CHALLENGES RESULTING FROM CLIMATE CHANGE

In the future, potential increases in the intensity of hurricanes present the biggest climate-related threat to the public communications sector.

Hurricane winds, rainfall, and storm surge

Stronger, although not necessarily more frequent, hurricanes will continue to threaten public telecommunications infrastructure: buildings, towers, and aerial cables may be damaged or destroyed, and storm surge may impact coastal facilities. Of particular concern are BIT’s new St. Thomas location (100 feet from the waterfront), viNGN’s remaining aerial infrastructure, and some of viNGN’s FAPs located near the coast (see map: Storm surge risk for telecommunications assets in Christiansted; Storm surge risk for telecommunications assets in Charlotte Amalie).
Rising sea levels

As sea levels rise, some telecommunication and power manholes will be flooded constantly, which may lead to equipment degradation. Rising seas may also threaten optical fiber, which degrades when exposed to water for extended periods of time unless properly sealed. BIT’s St. Thomas facility may also be at risk of flooding and soil erosion.

Increases in temperature

Communications equipment is cooled by mandatory HVAC equipment. As temperatures rise, this equipment may experience greater stress and occasional outages. Higher temperatures will also increase the potential for heat exhaustion and heat stroke for staff working outdoors.

Changes in precipitation

Possible periods of increased rainfall will adversely affect wireless Internet service. Higher bandwidth frequency will experience worse attenuation: for example, 5G will be more disrupted by rain than 3G.

INITIATIVES FOR INCREASING RESILIENCE IN PUBLIC COMMUNICATIONS

The initiatives to increase the resilience of public communications include reinforcing existing systems, changing current system design and operations, and working to improve the sector’s emergency preparedness and response.

REINFORCE EXISTING SYSTEMS

As with all sectors, the public telecom sector has to strengthen its existing infrastructure to protect it against future storms and storm surge. These measures will include burying viNGN’s aerial cables, burying WAPA cables that provide power to FAPs, protecting fiber infrastructure from rising sea levels and storm surge, and hardening public radio and television infrastructure.

Initiative 1

Bury viNGN’s aerial cables

Although 40 percent of viNGN’s entire network is buried, 60 percent (a total of 115 miles)—representing 90 percent of customer connections—relies on aerial cables. The buried fiber survived the storms, but the aerial cables were mostly destroyed and will be destroyed again if rebuilt as before. Burying the system’s aerial cables will improve viNGN’s ability to service customers, although it will not guarantee all customers will remain online since last mile service depends on private ISPs as well as power at customer locations.
viNGN will bury the existing vulnerable portion of the network fiber optic cable in PVC conduit in order to replace the fiber attached to the WAPA telephone poles. Where cable is not buried, for example, where there is rock just below the surface or where only a very small number of customers would be served, the agency will use stainless steel straps to hold all aerial slack loops in place instead, per the USDA (US Department of Agriculture) Rural Utility Service code.

Initiative 2
Work with WAPA to bury the power cables that feed viNGN fiber access points (FAPs)

viNGN’s FAPs are the facilities that make it possible to connect to the fiber network. They depend on having commercial power, and, although they are equipped with backup generators, those generators are not designed to run for extended periods of time. The power lines that fed the FAPs before the storms were mostly aerial and were largely destroyed. Although many of those lines will be rebuilt on stronger composite poles, burying them where possible would be ideal.

viNGN will work with WAPA to ensure all power coming into the FAPs is run underground.

Initiative 3
Protect public telecom infrastructure against rising seas and storm surge

Coastal infrastructure of both BIT and viNGN faces risks from rising sea levels and storm surge. Specifically, offices, FAPs, and cable enclosures could be affected, which could lead to degradation or loss of service to some customers.

viNGN will floodproof FAPs in flood zones, ensure all splice enclosures are properly sealed with silicon, and will install any new facilities as far inland as possible in the future. BIT will review the flood protection standards in the USVI Building Code and determine whether its facilities need additional freeboard (number of feet above flood level) or more stringent flood protection standards.
**Initiative 4**

**Improve network and facility resilience for WTJX public broadcasting**

The WTJX network plays a vital role in supporting the entire Territory for distribution of video and audio content in emergency and non-emergency times. The loss of the transmission tower and studio took away one critical communications capability the Territory’s government could have used to distribute instructions and information to the public after the storms. This distribution method helps to calm and direct citizen activities, including identifying where vital services such as food and water distribution points are located, explaining how to receive emergency assistance, and even helping locate lost loved ones post-storm.

WTJX will rebuild its St. Thomas studio as a hardened facility. This will allow for continuous broadcasting throughout a storm and will even provide a backup communications source to the St. Thomas VITEMA Emergency Operations Center (EOC) and public safety with its datacasting capabilities. WTJX will also rebuild the transmission facilities to include an additional backup transmission tower and radios.

**CHANGE SYSTEM DESIGN AND OPERATIONS**

In some cases, rebuilding systems and returning to old protocols makes sense; in others, it makes more sense to replace old systems with newer ones while also improving the way the systems are run. Measures in this category include building a completely new public safety radio system, introducing cloud-based systems for data storage, switching the government’s phone systems to VoIP on buried fiber, and consolidating the government’s IT operations.

**Initiative 5**

**Design and build a new public safety radio system**

The hardware of the existing public safety radio network is obsolete. Much of the equipment has reached the end of its useful life and replacement parts are no longer manufactured. Towers at several locations are in need of an upgrade. Before the hurricanes, there were already numerous locations where the signal was too weak to allow effective connectivity between the dispatchers and the mobile units—and storm damage only made this worse. Nor does the network provide for any interoperability with off-island resources or include temporary tower trailers that could replace towers that failed in the storm—both of which became an issue after the hurricanes. System management and processes could also be improved: for instance, there is no system in place to track which radios are in use at any given time, who is using radios, or whether users are authorized to use the equipment.
A radio vendor assessed the existing system, presented its findings in February 2018, and proposed a total replacement of the network. The network replacement plan will add new towers, reposition one tower for better signal, and add the latest technology for a digital radio system that is fully compliant with P-25—the standard for US public safety networks—to allow agencies from multiple jurisdictions to use their own radios to communicate with other systems.

BIT will work with FEMA to hire a consultant to evaluate the existing system more thoroughly, engineer a new network to meet existing industry standards, and create a request for proposals (RFP) to facilitate the competitive selection of a vendor to build the new system. The new system will replace all existing radios and establish a new BIT-owned process for ensuring tracking and validation of authorized, trained users. BIT will coordinate with private tower owners to evaluate all existing towers for structural integrity before new equipment is installed. BIT has also requested FEMA funding for five BIT-owned temporary tower trailers to be deployed throughout the Territory in order to facilitate quicker recovery of failed towers. BIT will work with VITEMA to engage all network stakeholders in discussion of the existing radio procedures and to create an operating standard for all users on the network. This process will contain language to clarify the role and responsibilities both of the dispatcher and dispatch center in managing the use of the network by all users; these trainings will occur even before the new network is put in place.

Initiative 7
Switch the government’s phone systems to VoIP on buried fiber

The government’s current phone systems rely on multiple private providers, many of which use aerial cables that were destroyed in the 2017 storms and will be destroyed again in future ones. Since the government relies on voice communications for conducting much of its daily business, it needs a more resilient phone system.

BIT will create a single telephone network for the government based on Voice over Internet Protocol (VoIP). All services would be built on the viNGN network—and therefore on buried fiber, which is significantly more resilient than aerial cables—using existing government-owned resources (although some commercial contract considerations will be needed to complete the installation and scaling). A VoIP network would have benefits beyond resilience as well, including total cost control, state-of-the-art equipment, a unified help desk function for troubleshooting, and a universal dialing pattern for four or five digit internal network extension to make it easier to communicate.

Initiative 8
Consolidate government IT operations

The GVI does not have a centralized enterprise network: departments run their different systems, which means the risk of service interruptions is high during the best of times and BIT’s ability to respond and provide support is limited. The 2003 Technology Enterprise Act passed by the US Virgin Islands Legislature (Act No. 6634) called for consolidating the IT resources and staff currently dispersed across numerous government agencies under a BIT-led structure, but the act was never fully implemented.

BIT will work with the Governor’s Office to implement the act and to consolidate IT services across the GVI.
BIT will do an agency-by-agency assessment, propose a plan for networking and staffing, and identify any resources best left within an agency based on unique needs. Consolidation will improve service and user support, reduce costs, and make the overall network more resilient.

**IMPROVE EMERGENCY PREPAREDNESS AND RESPONSE**

No amount of hardening and system reconfiguration can protect public telecom systems entirely from all outages. Measures to plan for eventual outages include procuring satellite phones, deploying additional public WiFi hotspots, and preparing for long-term commercial power interruptions.

*Initiative 9*

**Procure satellite phones for all government agencies**

Satellite phones were the only reliable form of communication for a while after the hurricanes. However, no government agencies except for VITEMA had these available. Furthermore, no agencies had any form of Very Small Aperture Terminal (VSAT) satellite equipment. VSAT units create a satellite-driven broadband network for voice and data communications as a substitute for damaged broadband and cellular networks; the units’ small size and ease of setup and use make them ideal for emergency communications.

VITEMA will work to ensure each government organization except BIT has a cache of satellite phones and VSAT terminals as part of their disaster equipment inventories, including a variety of system hardware devices such as portable to vehicle and permanent mount units. VSAT units will be deployed on each island, with enough units to ensure key personnel have access. BIT will have its own satellite phones as well as VSAT terminals to support the government’s IT network. Rhode Island donated five VSATs to BIT for permanent use in March 2018; the agency distributed the units to all three main islands.

*Initiative 10*

**Deploy additional public WiFi hotspots**

viNGN’s public WiFi hotspots provided wireless access at no charge to the general public when all other sources of broadband access were not available. There was no definitive plan for the placement of additional hotspots deployed after the hurricanes’ landfall, but key locations like government facilities (libraries, police/fire stations) and major business locations (grocery stores, banks, etc.) proved to be ideal as long as they were close to a working network element, easily accessible by the public, and powered to allow for the equipment to work.

viNGN is coordinating a plan for activating hotspots in key locations after a disaster, including identifying ideal locations and emergency generator power sources. Hotspots can be pre-deployed long before a disaster and simply activated when needed. viNGN has requested FEMA funding via the 404 and 406 funding mechanism for this effort.

*Initiative 11*

**Ensure power generators can operate for long periods of time**

Most public telecom facilities have backup power generators installed, but the facilities’ current models are not designed to operate for longer than a few days at a time, which meant many failed from overuse in the post-storm outages.

BIT, viNGN, and WTJX will procure continuous duty generators to power their most critical facilities. The generators will be regularly maintained and topped up with fuel before storms.