



# The 2017 Atlantic Hurricane Season:

Mobile industry impact and response in the Caribbean





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# Executive Summary

## Impact of the 2017 hurricanes in the Caribbean

The 2017 Atlantic hurricane season was one of the worst ever recorded, causing widespread destruction, loss of life and long-term economic damage to multiple Caribbean small island states. Governments, industries and communities continue to recover more than six months after Category 5 Hurricanes Irma and Maria hit multiple islands in quick succession. The telecommunications industry felt the force of the hurricanes to varying degrees across their operating countries, with a number of mobile network operators (MNOs) experiencing unprecedented impact.

The focus of this report: sharing GSMA member experiences of the 2017 Caribbean hurricanes to inform and shape disaster preparedness and response strategies across the mobile industry

This report captures some of the key ways GSMA members and their partners responded to Hurricanes Irma and Maria in the Caribbean, from before the storms made landfall to the clean-up and restoration efforts. Using first-hand interviews and secondary resources, we have identified the major challenges MNOs faced in preparing and responding to the 2017 Atlantic hurricane season, and highlighted best practices and innovative approaches. The report also draws on lessons

learned to provide recommendations for other GSMA members operating in climate-vulnerable small island states, where natural disasters are only likely to increase in intensity with climate change.

The following key takeaways provide an opportunity for the wider mobile industry, particularly in other small island states, and interested stakeholders, to learn from the successes and challenges experienced and consider these against their own preparedness and emergency response plans.

## Key takeaways



**1. Fifty per cent of MNOs in the Caribbean were directly impacted and some OpCos experienced over 95 per cent damage to infrastructure across several markets.**

While there were examples of impressive rapid network restoration and innovative temporary connectivity initiatives, more resources (financial and technological) will need to be funnelled into finding innovative ways to ensure mobile infrastructure and networks can withstand Category 5 hurricanes, or similarly extreme natural events, in the future.



**2. In the worst-affected countries, Hurricanes Irma and/or Maria impacted every part of MNO operations.**

Not only was the physical mobile infrastructure severely damaged, but everything needed for that connectivity to function and be restored was also affected, including logistics (emergency equipment, personnel and access), power supply and staff capacity, not to mention significant coordination challenges associated with the response.



**3. Challenging geography, transportation disruptions and extreme weather hampered restoration efforts.**

After Irma and Maria, ensuring access to cell sites and facilities was essential for damage assessments, restoration and re-establishing sites that had been pre-emptively shut down to bring them back online. Having pre-arranged, priority access agreed in advance with the relevant authorities and/or arrangements to share emergency transport facilities can improve the efficiency of the response.



**4. A huge amount of telecommunications equipment suffered irreparable damage, requiring equipment to be imported and experienced emergency personnel to be deployed.**

The Caribbean experience highlighted that vendors should have the scale of stock/inventory needed to meet the demands of MNOs across multiple small island states, and that government authorities should have agreements in place to allow fast-track approaches for importing telecommunications equipment. Further, the deployment of trained emergency personnel (including vendors, group/industry personnel, experts) should be coordinated ahead of time, with immigration requirements in place to ensure ease of entry.



**5. Hundreds of staff in market were directly affected by the hurricanes and hundreds more were deployed from the region and farther afield.**

Senior MNO personnel made the safety and well-being of staff and their families a priority throughout the disaster life-cycle, and were effective in maintaining morale and keeping employees motivated over a prolonged time of crisis. Staff support activities should be documented and planned for in advance, so senior staff do not have to improvise or come up with new processes in high-pressure situations.



**6. The overriding challenge faced was reliance on power grids that were completely destroyed in some areas, resulting in huge expense for MNOs.**

Challenges included insufficient back-up battery systems, inadequate fuel to power back-up generators for the duration of power outages, obtaining and transporting fuel to base stations and the disruption of fuel supplies. A concerted effort must be made to build more resilient and alternative power systems, from sufficient back-up solutions put in place by MNOs, to prioritisation of power supply and distribution pre-arranged by government authorities.

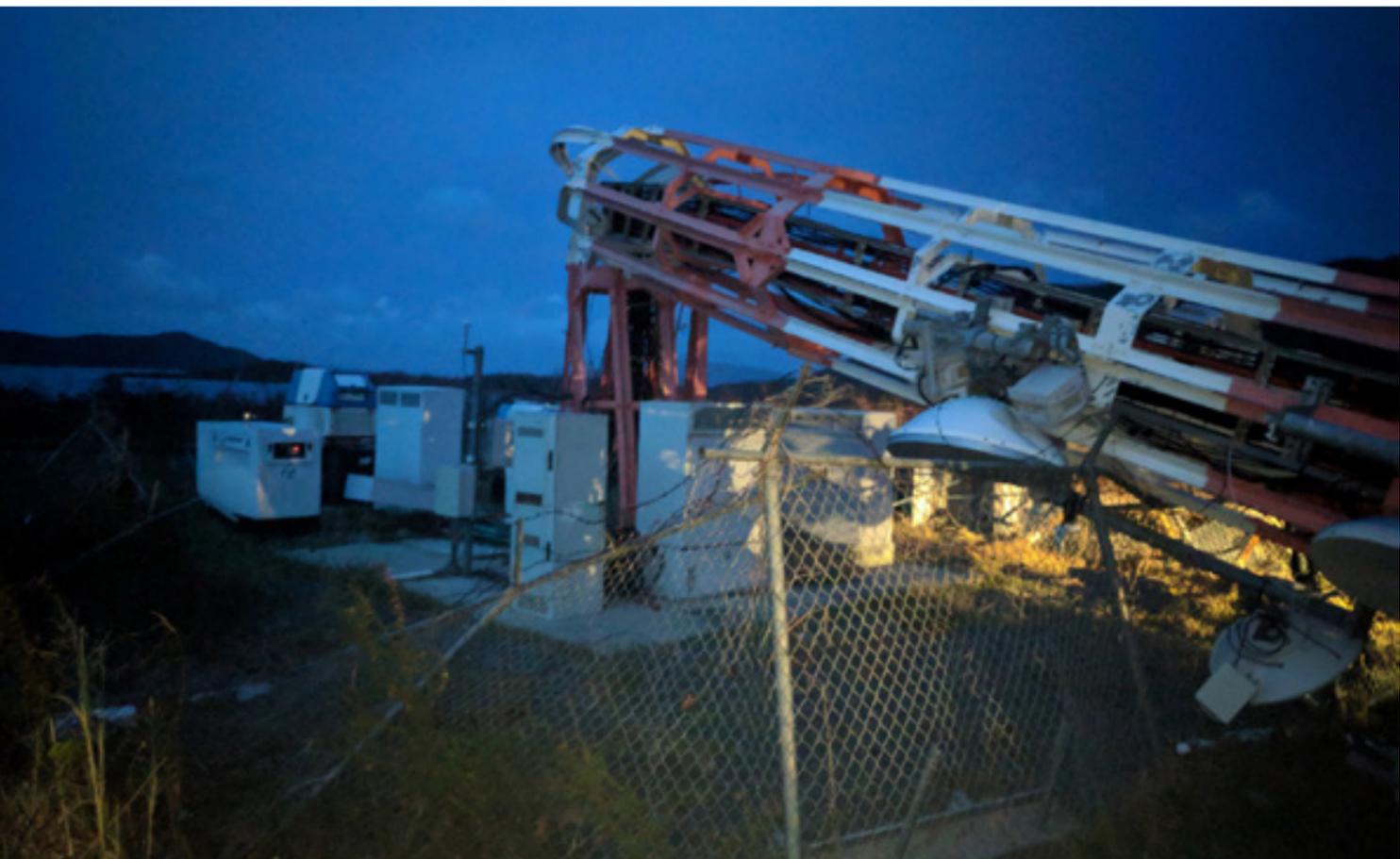


**7. Nearly 60 per cent of people in the Caribbean subscribe to a mobile service, relying on their mobile phones to access essential information and communication services, which proved to be an important lifeline during the hurricane season.** MNOs supported their customers in a multitude of ways by providing early warning messages about approaching hurricanes, updating them regularly on restoration efforts and offering free or reduced SMS, calls and data, as well as free Wi-Fi and charging facilities in certain locations to ensure consistent access to communication. Pre-positioning and setting up support systems and necessary regulator support prior to a disaster is essential for the immediate initiation of community support services.



**8. The destructive force of Hurricanes Irma and Maria exposed gaps in stakeholder coordination and communication, and highlighted multiple interdependencies.** As the region builds back better, the mobile industry and other stakeholders, from government agencies to vendors, commercial power suppliers and other MNOs, must strengthen and enforce coordinating procedures.

These experiences provide an opportunity for MNOs and key stakeholders to consider whether their own infrastructure, networks and processes are resilient and robust enough to withstand the intensity and frequency of natural disasters commensurate with the increasing risks due to climate change. For MNOs in high-risk regions, reassessing investment priorities will not only be vital to protect business assets but also to provide a communication lifeline for vulnerable communities in their operating regions.



# 1. Introduction

The 2017 Atlantic hurricane season was unprecedented in its strength and scale, with 17 named storms, 10 consecutive hurricanes and six major hurricanes. In September, two Category 5 hurricanes (Irma and Maria) and Category 4 Hurricane Jose tore across the northern Caribbean, wreaking devastation in 13 of the region's 28 countries,<sup>1</sup> leaving at least 1.4 million people in need of assistance.

Irma and Maria were the most powerful hurricanes ever recorded in the Atlantic, and the widespread destruction, loss of life and economic damage revealed the unique vulnerabilities of small island states. 5.5 million people lived in areas where wind speeds topped 120 km/h, and 169,000 people and 75,000 buildings were exposed to wind speeds greater than 252 km/h.

For the telecommunications industry, the hurricanes had a direct impact on over 50 per cent of the 71 mobile network operators (MNOs) in the region, with some MNOs experiencing over 95 per cent damage to their infrastructure in several markets. Restoring communications quickly was critical, not only for MNOs to get back to business, but also for affected populations to communicate and for local and international agencies to deliver humanitarian assistance. The series of hurricanes in the Caribbean reinforced, once again, the urgent need for communications in times of crisis, the importance of preparedness, and the need to have comprehensive partnerships and strategies in place to respond faster.

This report captures some of the key ways GSMA members and their partners responded to Hurricanes Irma and Maria in the Caribbean, from before the storms made landfall to the clean-up and restoration efforts. Using first-hand interviews and secondary resources, we have identified the major challenges MNOs faced in preparing and responding to the 2017 Atlantic hurricane season, and highlighted best practices and innovative approaches. The report also draws on lessons learned to provide recommendations for other GSMA members operating in climate-vulnerable small island states, where natural disasters are only likely to increase in intensity with climate change.

<sup>1</sup> The 2017 hurricane season caused mass destruction and loss of life in the US, but for the purposes of this report, we have focused on the Caribbean region—primarily British Virgin Islands, Dominica, Turks and Caicos Islands and Puerto Rico.



## 1.1 Disaster risk in the Caribbean

Hurricanes are a common occurrence in the Caribbean,<sup>2</sup> (Table 1) causing on average \$835 million in losses every year.<sup>3</sup> However, according to the United Nations Development Programme (UNDP), Hurricanes Irma and Maria were a ‘game changer’,<sup>4</sup> with successive Category 5 hurricanes signalling a dangerous change in the intensity and frequency of climate change-related storms and heralding a new normal. Indeed, with sustained winds of up to 185 mph, Hurricane Irma has ignited a debate about whether it is necessary to introduce a Category 6 hurricane classification (see Table 2). Irma generated winds averaging 183 mph for more than 33 hours, longer than any cyclone of comparable power ever recorded in the satellite era.<sup>5</sup>

There is broad consensus that climate change is increasing the intensity of tropical storms in the Atlantic.<sup>6</sup> With sea levels rising as a result of climate change-induced global temperature increases, small island states are increasingly at risk from natural disasters, particularly flash flooding. Effective disaster preparedness strategies, including building climate-resilient infrastructure and communities, will be key to protecting the livelihoods of island residents.

**The mobile industry has an essential role to play in disaster preparedness and response, given its ability to disseminate early warnings to vulnerable populations, to act as a potential lifeline for affected communities, and to provide a communication channel for governments and local and international relief agencies.**

2. Geopolitically, the Caribbean islands are usually considered a sub-region of North America organised into territories including sovereign states, overseas departments and dependencies.  
 3. ODI, November 2018, “The UK should be better prepared for disasters in its Overseas Territories”, <https://www.odi.org/comment/10572-uk-should-be-better-prepared-disasters-its-overseas-territories>  
 4. A. Steiner and I. LaRocque, UNDP, 17 November 2017, “How to build back better after a hurricane... and before the next” <http://www.undp.org/content/undp/en/home/blog/2017/-como-reconstruir-mejor-despues-de-un-huracan-cuando-el-proximo-.html>  
 5. Politiko, 8 September 2017, “Hurricane Irma tops ‘Yolanda’ as strongest super storm of all time”, <http://politiko.com.ph/hurricane-irma-tops-yolanda-strongest-super-storm-time/>  
 6. GFDL, December 2017, “Global Warming and Hurricanes: An Overview of Current Research Results”, <https://www.gfdl.noaa.gov/global-warming-and-hurricanes/>

Table 1

### Recent natural disasters in the Caribbean

- **2016** Hurricane Matthew, **Category 5**
- **2015** Tropical Storm Erika
- **2010** Earthquake, **Haiti**
- **2007** Hurricane Felix, **Category 5**
- **2007** Hurricane Dean, **Category 5**
- **2005** Hurricane Wilma, **Category 5**
- **2005** Hurricane Rita, **Category 5**
- **2005** Hurricane Katrina, **Category 5**
- **2005** Hurricane Ivan, **Category 5**
- **2005** Hurricane Stan
- **1995** The Soufriere Hills volcano eruption, Montserrat
- **1945** Hurricane Donna, **Category 4**

Table 2

### Hurricane crisis definitions

Category	Sustained winds	Types of damage due to hurricane winds
<b>1</b>	74–95 mph 64–82 kt 119–153 km/h	<b>Very dangerous winds will produce some damage:</b> Well-constructed frame homes could have damage to roofs, shingles, vinyl siding and gutters. Large branches of trees will snap and shallow-rooted trees may be toppled. Extensive damage to power lines and poles will likely result in power outages that could last a few to several days.
<b>2</b>	96–110 mph 83–95 kt 154–177 km/h	<b>Extremely dangerous winds will cause extensive damage:</b> Well-constructed frame homes could sustain major roof and siding damage. Many shallow-rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
<b>3</b> MAJOR	111–129 mph 96–112 kt 178–208 km/h	<b>Devastating damage will occur:</b> Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
<b>4</b> MAJOR	130–156 mph 113–136 kt 209–251 km/h	<b>Catastrophic damage will occur:</b> Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
<b>5</b> MAJOR	157 mph or higher 137 kt or higher 252 km/h or higher	<b>Catastrophic damage will occur:</b> A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

# 1.2 The mobile industry in the Caribbean

**28**  
countries

**71**  
MNOs IN  
THE REGION

**C&W (Flow)**  
OPERATES IN 13 MARKETS  
**Digicel**  
OPERATES IN 21 MARKETS

**44.05m**  
Total population of Caribbean:  
(Worldometers, 2018)

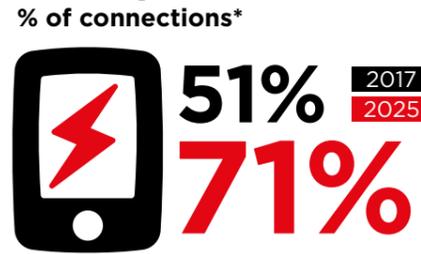
## Unique mobile subscribers



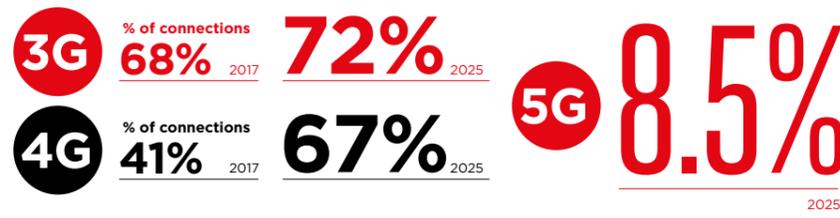
## Mobile internet users



## Smartphones



## Network coverage



## SIM connections

Excluding cellular IoT



## Mobile operator revenue



# 2. Hurricanes Irma and Maria

## 2.1 Snapshot: Impact on the mobile industry in the Caribbean

More than half of MNOs in the Caribbean were directly affected by the 2017 hurricane season. Like most hurricanes, Irma and Maria were detected several days before reaching dangerous levels of intensity and making landfall, giving MNOs advance warning to put their **disaster preparedness and business continuity plans** (BCP) into action (Section 3.1). However, the unparalleled severity and intensity of Irma and Maria meant that no amount of preparation could have prevented at least some impact to MNO assets and staff.

For many smaller MNOs operating in the Caribbean, the **impact of the hurricanes on their businesses was devastating** (Section 3.2). Even for larger MNOs operating in several markets across the region, the impact was unprecedented. For example, the cost of telecommunication damages was estimated at up to USD 1.2 billion, in Puerto Rico. The sheer number of operating markets hit with record-breaking levels of sustained winds stretched the resources and capacity of MNOs—at both the group and operating company (OpCo) level—to the limit.

Despite catastrophic damage to buildings, power supplies and infrastructure, from a mobile communications perspective, sustained interruption in some Caribbean islands could have been worse—a testament to the robust preparedness measures in place and the impressive **restoration abilities** of MNO staff. A priority was to keep **customers informed and updated** throughout the disaster life-cycle, sending early warning messages and regular updates on service interruptions during restoration periods, as well as ensuring they had the means to reliable connectivity services, through the provision of free Wi-Fi services and charging stations.

**Hundreds of staff in market were affected** by the Caribbean hurricanes and hundreds more were

deployed from the region, including from Jamaica and the US. Senior MNO personnel made the safety and well-being of staff and their families a priority, and were effective in maintaining morale and keeping employees motivated over a prolonged time of crisis (Section 3.5).

While there were examples of impressive **rapid network restoration** and **innovative temporary connectivity initiatives**, more resources (financial and technological) will need to be funnelled into finding innovative ways to ensure mobile infrastructure and networks can withstand Category 5 hurricanes (Section 3.2).

The overriding challenge faced by all MNOs was **reliance on power grids** that were completely destroyed in some areas. Although it is very difficult in the wake of devastating hurricanes to maintain power, **stronger coordination** between utility companies, government authorities and the mobile industry may have sped up the restoration of communications (Section 3.4).

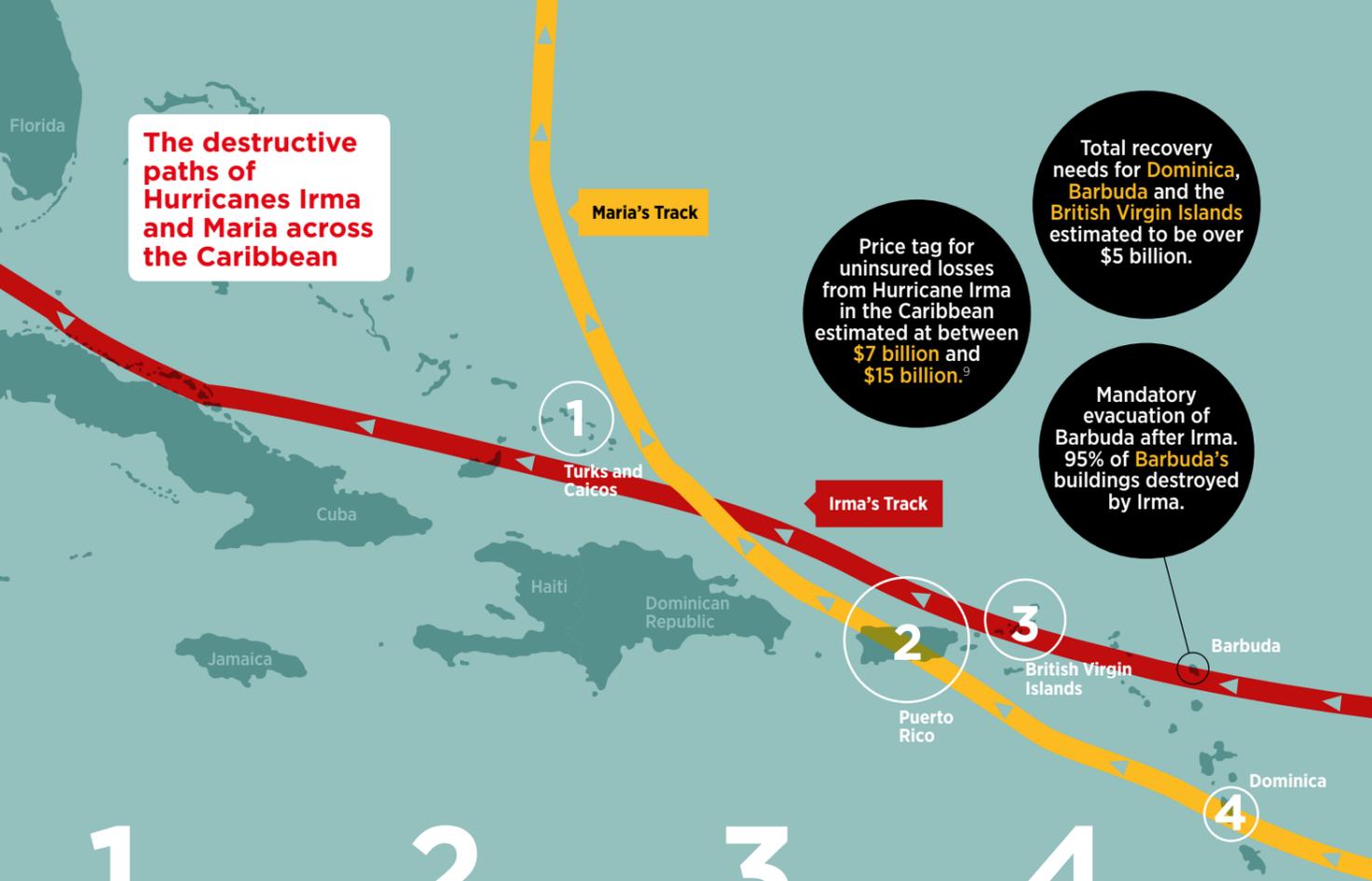
**Logistical bottlenecks** experienced while deploying replacement equipment (access to sites, importing equipment) prevented connectivity from being restored as quickly as possible (Section 3.3). More efficient and established **coordination** processes for network restoration, supported by efficient regulatory frameworks, are needed to ensure an even MNO response and rapid restoration of connectivity for subscribers, first responders and governments (Section 3.7).

The collective experience of these hurricanes has underscored **the need to improve resilience and preparation** for worst-case scenarios, particularly **better coordination with key stakeholders** through the entire disaster life-cycle.

7. Flow is the brand name used by Cable & Wireless Communications (C&W), a subsidiary of Liberty Latin America.

8. GSMA Intelligence, Q4 2017 data

**The destructive paths of Hurricanes Irma and Maria across the Caribbean**



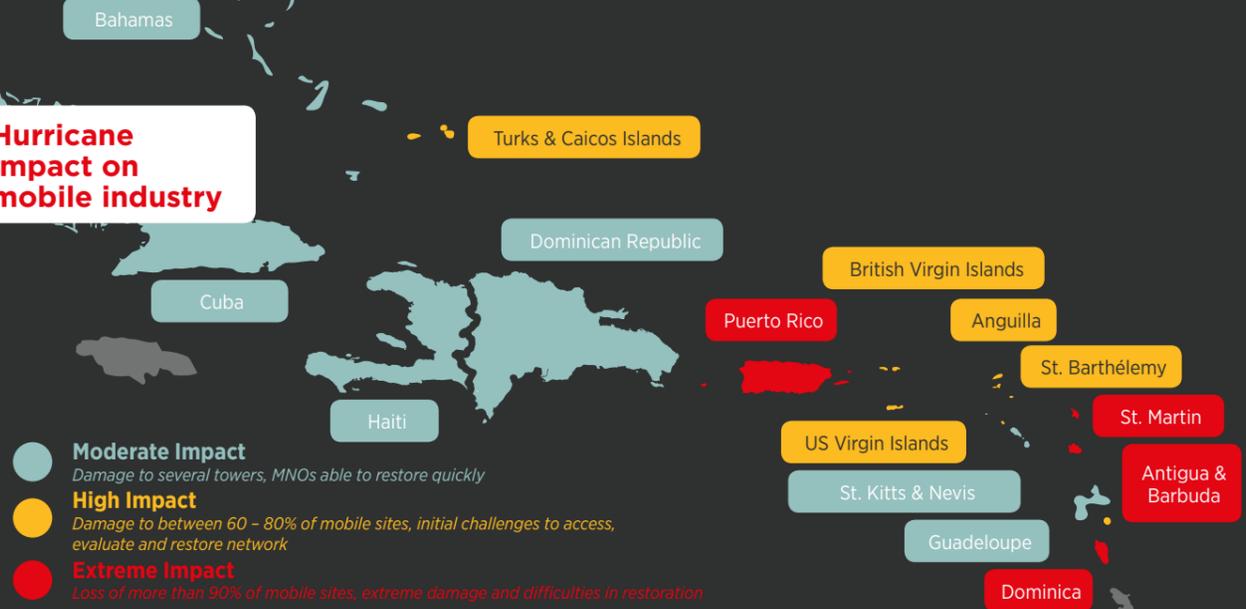
Price tag for uninsured losses from Hurricane Irma in the Caribbean estimated at between **\$7 billion and \$15 billion.**

Total recovery needs for **Dominica, Barbuda and the British Virgin Islands** estimated to be over **\$5 billion.**

Mandatory evacuation of Barbuda after Irma. **95% of Barbuda's buildings destroyed by Irma.**

1	2	3	4
<b>Turks and Caicos</b>	<b>Puerto Rico</b>	<b>British Virgin Islands</b>	<b>Dominica</b>
<p>👤 Total population: <b>34,000</b></p> <p>💰 <b>\$320 m</b> in losses</p> <p>📱 <b>MNOs:</b> Digicel and Flow</p>	<p>👤 Total population: <b>3.3 million</b></p> <p>💰 <b>\$25 - \$43 bn</b> in total damages<sup>10</sup></p> <p>📱 <b>MNOs:</b> AT&amp;T, Sprint, Claro, T-Mobile</p>	<p>👤 Total population: <b>30,000</b></p> <p>💰 <b>\$3.6 bn</b> in total damages</p> <p>📱 <b>MNOs:</b> Digicel, Flow, CCT</p>	<p>👤 Total population: <b>73,000</b></p> <p>💰 <b>\$3.6 bn</b> in total damages</p> <p>📱 <b>MNOs:</b> Digicel and Flow</p>

**Hurricane impact on mobile industry**



9. ODI, November 2018, "The UK should be better prepared for disasters in its Overseas Territories", <https://www.odi.org/comment/10572-uk-should-be-better-prepared-disasters-its-overseas-territories>

10. Business Insurance, December 2017, Maria loss estimate lowered; rates still set to rise <https://www.businessinsurance.com/article/20171207/NEWS06/912317796/Hurricane-Maria-losses-48-billion-dollars-reinsurance-price-hikes-possible>

## Hurricane Irma



**9th** named storm of 2017 Atlantic hurricane season



Strongest storm on record in the open **Atlantic region**



**Category 5** - The first tropical cyclone worldwide to have had sustained wind speeds averaging **183 mph for 33 hours.**



Peak intensity over **British Virgin Islands**



**6 September 2017**  
Landfall on northeastern Caribbean islands



Active for **17 days**



**134 fatalities**



**>\$66.77 billion losses** (2017 USD)

## Hurricane Maria



**13th** named storm of 2017 Atlantic hurricane season



**10th most intense** Atlantic hurricane on record



**Category 5 hurricane** with sustained winds up to 175 mph



The worst natural disaster on record in **Dominica and Puerto Rico**



**18 September 2017**  
Landfall in Dominica



Active for **17 days**



**547 fatalities**



Unofficially, the **third most costly** tropical cyclone on record

## Hurricane Jose



**10th** named storm of 2017 Atlantic hurricane season



**Category 4** wind speed of 155 mph



Bahamas, Bermuda, Nova Scotia, east coast of the United States, Leeward Islands



**5-26 September 2017.** Longest lived Atlantic hurricane since 2012



**1 Fatality**



**\$2.84 million losses** (2017 USD)

11. Business Insurance, December 2017, "Maria loss estimate lowered; rates still set to rise", <https://www.businessinsurance.com/article/20171207/NEWS06/912317796/Hurricane-Maria-losses-48-billion-dollars-reinsurance-price-hikes-possible>

### Impact on Cable and Wireless Communications (C&W) in the Caribbean

**“This event was unprecedented, damaging or devastating six of C&W’s markets in the Caribbean. Everyone was trying to get hold of as many materials as possible. Many suppliers and vendors were not prepared for such high demand and seriously struggled.”** recalled Avik Datta, Vice President Technology, Ventures & Barbados, C&W

Across C&W’s markets, hundreds of staff were impacted by the hurricanes. **“The first few days were about getting personnel and humanitarian aid to Flow staff in offices in all affected markets—primarily BVI, Anguilla, Turks, Dominica.**

**Most islands lost commercial power to the majority of smaller islands, so everything had to run on back-up generators.**

**For the first few weeks, the team were running on adrenaline—long hours, getting power, equipment, engineers, technicians, riggers in country to get sites up as quickly as possible.”**

### Impact on Digicel Group in the Caribbean

Nearly half of Digicel’s markets were impacted by Hurricanes Irma and Maria, with 10 experiencing significant cell tower damage.

**“It was all hands on deck,”** said Denis O’Brien, who founded Digicel in Jamaica in 2001. **“We were kind of an NGO and a commercial business all in one go.”**

Over 140 personnel were deployed to various Caribbean islands following the hurricanes to ensure connectivity could be restored as quickly as possible. Digicel personnel also supported humanitarian efforts to affected populations.

**“There’s no point in building structures that will not be able to withstand Category 4, Category 5 hurricanes, because the frequency is going to be far greater because of climate change,”** O’Brien said.

UN Secretary General António Guterres spoke of seeing a **“level of devastation I had never seen in my life”** in places like Dominica and Barbuda.

### GSMA support to MNOs in the immediate aftermath

The GSMA is committed to offering support and coordination assistance to members at any stage of the disaster cycle. In the aftermath of Hurricanes Irma and Maria, the GSMA Disaster Response programme supported several MNOs in critical need of assistance, and played a crucial coordination role between various stakeholders. Requests came from several MNOs that had been affected in a range of Caribbean markets.

### GSMA’s intervention: a summary

#### Hurricane Irma

- Collaboration with coordination bodies: Worked with the United Nations Emergency Telecommunications Cluster (ETC) to ensure restoration of telecommunications and response efforts were aligned.
- Supported MNOs’ equipment requests to support restoration in BVI.

#### Hurricane Maria

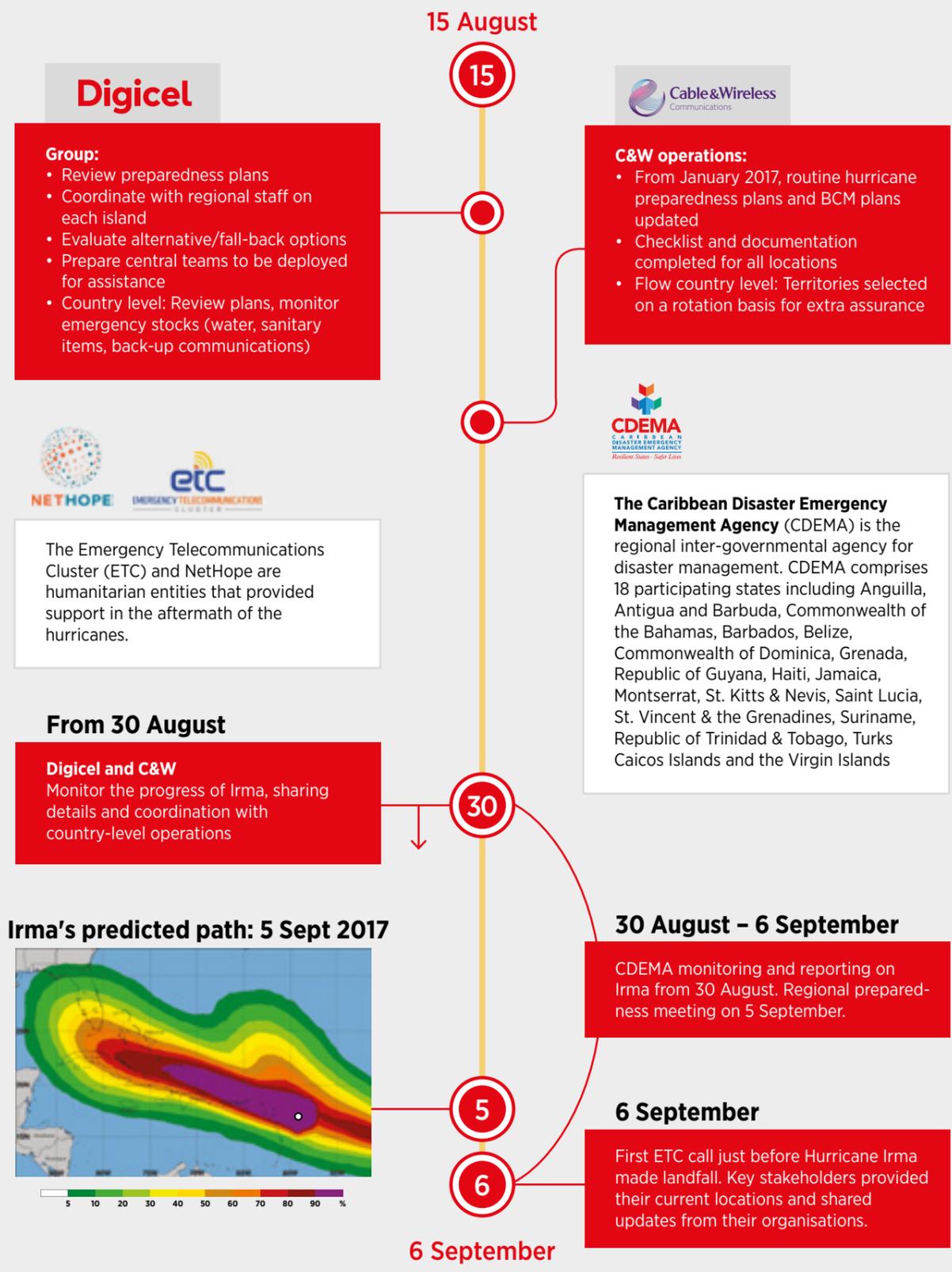
- Personnel deployment logistics: Supported Sprint to send engineers to Puerto Rico
- Facilitate provision of accommodation in Puerto Rico for Sprint engineers
- Temporary connectivity initiatives: Project Loon and NetHope
- Supported Sprint and Google with power and circuits

#### Future support

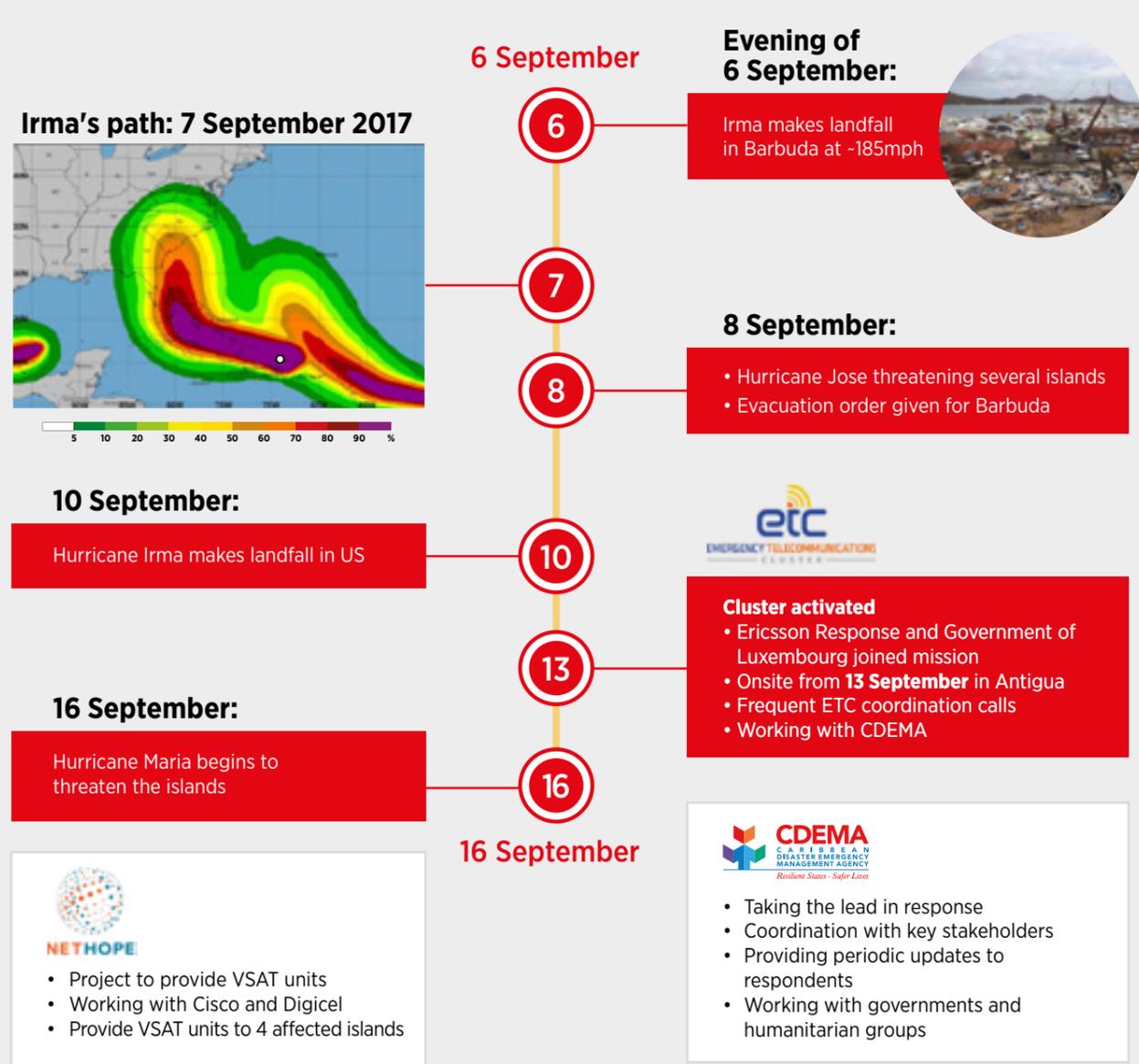
The GSMA advocates that members and stakeholders prioritise preparedness through coordination and resilience building ahead of time. The following resources are offered off-the-shelf to members and other stakeholders to help guide these efforts and provide best practice examples: [GSMA Policy Handbook](#), [Disaster Response Capacity Building programme](#) and the [Business Continuity Management Toolkit](#). For more information please email [M4H@gsma.com](mailto:M4H@gsma.com)

## 2.2 Timeline of the 2017 Atlantic hurricane season

### Before the hurricanes



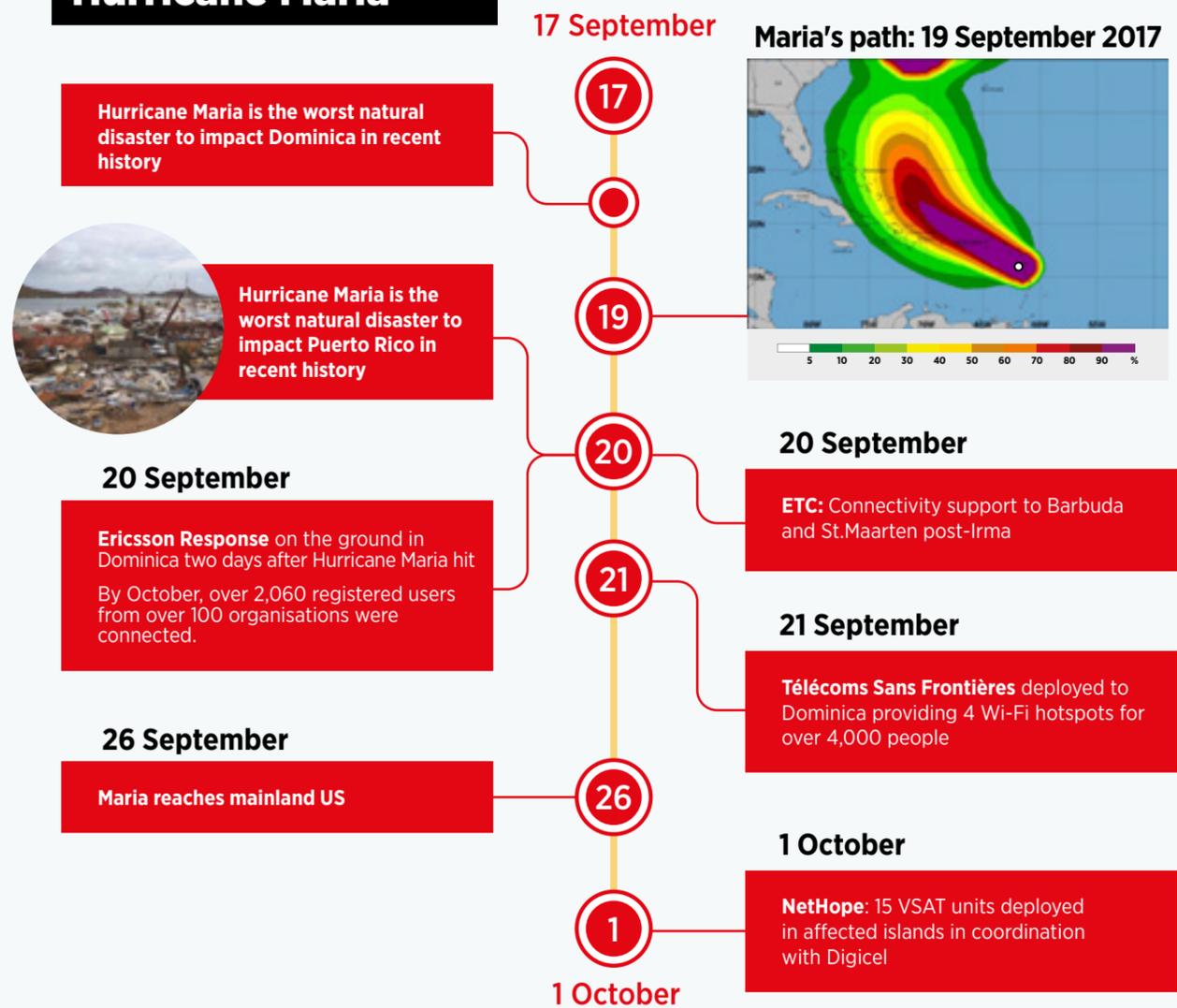
### Hurricane Irma



DATE	COUNTRY
5/6 September	Antigua & Barbuda
6 September	St.Martin & St.Barts, Sint Maarten
6 September	Anguilla
6 September	British Virgin Islands
6 September	USVI
7 September	Puerto Rico
7 September	Turks and Caicos
8 September	Cuba
10 September	Mainland USA



## Hurricane Maria



DATE	COUNTRY
18 September	Dominica
18/19 September	Guadeloupe
19 September	US Virgin Islands
20 September	Puerto Rico
20 September	Dominican Republic
20 September	Haiti
21 September	Turks and Caicos
26 September	Mainland USA



# 3. In Depth: MNO Experiences In The Caribbean

## 3.1 Hurricane preparedness and resilience

Mobile networks are increasingly and routinely relied upon by the general population and essential personnel (emergency services, government, humanitarian agencies) to communicate, coordinate and receive information. For residents of remote islands in the Caribbean, the 2017 hurricanes brought the importance of functioning mobile networks into sharp focus. For MNOs, the need to restore networks and services therefore becomes more than just business—it is also a responsibility to affected populations.

**The three aspects of resilience: people, infrastructure and ecosystems**

While resilience is about ensuring networks can withstand disruption, it is also, critically, about recovering to a point of stability and function sufficient to provide a sustainable service. For MNOs operating in regions at high risk of hurricanes, there are three main aspects to resilience:

1. The effects of the hurricanes on people and processes;
2. The recovery of critical infrastructure; and
3. The building/recovery of ecosystems that support the business.

## Group-level preparations

MNOs conduct their annual preparedness activities from January to May, ahead of hurricane season (typically July to November). These involve a series of procedures and simulations conducted alongside national disaster management offices (NDMOs) and local utilities and emergency services. For example, C&W has a regional crisis management team (RCMT) and local crisis management teams (LCMT) in each OpCo that completes and submits checklists, documents and business continuity plans.

### C&W: Preparations during watch, warning and strike phases

C&W has a 'watch,' 'warning' and 'strike' phase with pre-defined actions for each. The rapidly changing path and severity of hurricanes in 2017, one after the other, heading for multiple markets, made preparations incredibly challenging, particularly when Irma was predicted to hit Miami, C&W's headquarters.

Antigua is C&W's logistics hub for the region, and since the country was not in the path of the hurricanes, the company set up an operating base ('war room') there, flying in personnel from around the region to coordinate the hurricane response. It also set up a virtual team, bringing in specialists from its head office in Miami to form a team of 10 working in a matrix and led by the VP.

Frequent and efficient communication with key personnel in the LCMTs, who were well versed in the activities of each phase, was vital. Once they hit the 'warning' phase for Irma, C&W's RCMT, together with the local teams in each OpCo, had already ensured staff were supported (see section 3.5) by updating emergency contact protocols, organising food and water provisions and protecting assets, for example, refuelling generators and moving vehicles to strategic parts of the island.

### Digicel Group

Digicel Group held daily calls with group network teams, CEOs and senior leadership teams one week before Irma made landfall to ensure all OpCos were supported, sufficiently coordinated and understood the priorities.

Digicel Group has disaster committees in each of its markets, led by its CEOs with coordinators from each division of the business (communications, ICT, engineers, administration, etc.). A clear communications channel and chain of authority were in place to trigger the response at each OpCo.

These are dictated by a business continuity plan (checked by the national disaster management agencies) that is adapted to respond to conditions on the ground in the event of an emergency.

Huge logistical delays are common after a disaster as few flights operate, and those that do prioritise humanitarian relief items. Arranging transport in advance proved critical for Digicel, which had relationships with armed forces, major humanitarian groups and private companies to arrange chartered flights to transport Cells-on-Wheels (COWs) to affected countries immediately.

### Network resilience

A key consideration for MNOs in the Caribbean is building resilience and redundancy into the network so that over time it can withstand the effects of more frequent disasters. This enables a better service for subscribers and disaster responders that should, in turn, lead to better survival rates and less overall impact on regional and national economies.

In recognition of the risks posed by hurricanes, many MNOs positioned temporary back-up equipment in advance, such as COWs. To protect its equipment, Digicel BVI ensured all antennas were tightened, grounding cables were removed, and sites that were unlikely to withstand hurricane-force winds in their current locations were taken down and relocated to other areas.

## Contingency planning: prioritising food, water and generators

Up to four weeks before Irma, the Digicel Disaster Committee in the BVI ramped up stock, bringing in food supplies to the main office in the capital Road Town, and set up a kitchen with a stove and loaded with tin foods. They also ensured they had capacity to accommodate 12 people with beds in the head office, and purchased enough bedding for 45 people (see Section 3.5). Other contingencies included purchasing a 1,000 gallon water tank and two generators (one placed on top of the building and one at the bottom).

Back-up communication was also necessary for internal communication between staff, external communication with key stakeholders (government entities) and smooth communication with group-level colleagues and family and loved ones off the island. Digicel ensured that all OpCos had working satellite phones and even provided them to various government authorities in some countries (ports and airport authorities in BVI, for example).

## External factors should not be underestimated in preparedness planning

An MNO's preparedness efforts can be affected by factors beyond its control, and it is crucial to hold regular coordination meetings with all key stakeholders. In Turks and Caicos Islands, MNOs participated in a meeting called by the DDME prior to the hurricanes, but stakeholders reported they would have benefited from more regular meetings prior to hurricane season.

MNOs confronted other external factors as well, such as the availability of power and equipment from suppliers, regulatory issues and government priorities, which at times created uncertainty and mistrust in already tense circumstances. Implementing coordination processes in preparedness plans and running more country-wide simulations with all key external players would help to prevent these issues and allow MNOs to work in closer cooperation with each other, suppliers, agencies and governments (see Section 3.6).

## 3.2 Network and infrastructure

Hurricanes can affect mobile networks with wind, rain and debris. The level of damage to mobile networks across many Caribbean islands was devastating: 90 per cent of mobile sites were damaged in over nine countries, and four countries lost 100 per cent of their mobile coverage. Network and infrastructure damage is demonstrated in the below four County Case Studies.

### Mobile towers, cabling, network links and transmission paths may be affected as follows:

**Mobile towers** – damage to towers due to structural failure or misalignment of tower equipment from disturbances or vibration.

**Fibre/cable** – underground cabling is generally less prone to disruption, but they would still be at risk in areas where flooding accompanies a hurricane (e.g. from precipitation, storm surge). Above-ground cabling is at more risk of support/pole failures and breaks from debris and falling objects (e.g. trees) and breaks from tension caused by extreme wind speeds.

**Microwave LOS/NLOS links** – disruption to satellite microwave communications due to high levels of attenuation (rain fade).

**VSAT units** – physical damage to equipment from wind or debris, alignment issues from the force of the wind and increased attenuation/rain fade from accompanying precipitation.<sup>12</sup>

12. GSMA Disaster Response, 2016, "Business Continuity Management Report", [https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/05/GSMA\\_Disaster-Response\\_Business\\_Continuity\\_Management\\_Report.pdf](https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/05/GSMA_Disaster-Response_Business_Continuity_Management_Report.pdf)

## Country case studies



Figure 1

### Turks and Caicos Islands

Hurricanes Irma and Maria destroyed the wireless communications connection between Providenciales and Grand Turk, the satellite station on Grand Turk and the majority of mobile infrastructure on both islands.

#### Network and infrastructure damage:

Nearly all of Digicel's and Flow's towers were affected (94 per cent and 92 per cent, respectively). Flow's main damage was to antennas, many of which needed replacing or repositioning (Figure 1).

Flow and Digicel reported that **older equipment purchased in the 1990s was much more resilient** to the hurricanes than newer equipment purchased since the early 2000s. Many of Flow's sites failed due to challenges refuelling generators.

#### MNO response:

In Providenciales, Digicel managed to get sites up and running in two to three days, but on Grand Turk where the government buildings are, it took 10 days.

Flow also experienced delays restoring services in certain areas. In some instances, its network's fibre and cable were damaged and vandalised during residential and commercial restoration and clean-up exercises, and commercial power was not restored to its equipment.<sup>13</sup>

Complications also arose between MNOs that had to rely on their competitor with the monopoly over the fibre link to the country.

13. Turks and Caicos, Weekly News, October 2017, <http://tcweeklynews.com/flow-tci-still-working-to-restore-services-to-all-islands-p8220-127.htm>

### British Virgin Islands

Some of the worst damage to telecommunications in the Caribbean was in BVI, where almost 100 per cent of cellular sites were knocked out. Towers were completely twisted and antennas destroyed.

#### Network and infrastructure damage:

**Monopoles** were less resistant to hurricane-force winds than tripod towers, with most falling because of heavy antenna loads and heavy RAUs on the upper sections of the towers.

However, in many areas with mountainous terrains, monopoles are the only option.

**Rooftop sites** were most resilient with three metre, three-point lattice towers providing 360-degree support (Figure 2).

Infrastructure designs can behave differently in different types of disasters. For example, after the Haiti earthquake in 2010, Digicel's rooftop sites were most affected—either damaged or collapsed.<sup>14</sup>

#### MNO response:

Digicel is looking at **changing the loading** at sites to ensure as much equipment as possible can be placed on the ground or further down the tower.

**A large number of Cells on Wheels (COWs) were procured** following the hurricanes because the level of destruction exceeded all expectations. Digicel BVI deployed 18 COWs in the aftermath of Hurricane Maria. Temporary sites are now being replaced and will be completed by April 2018.

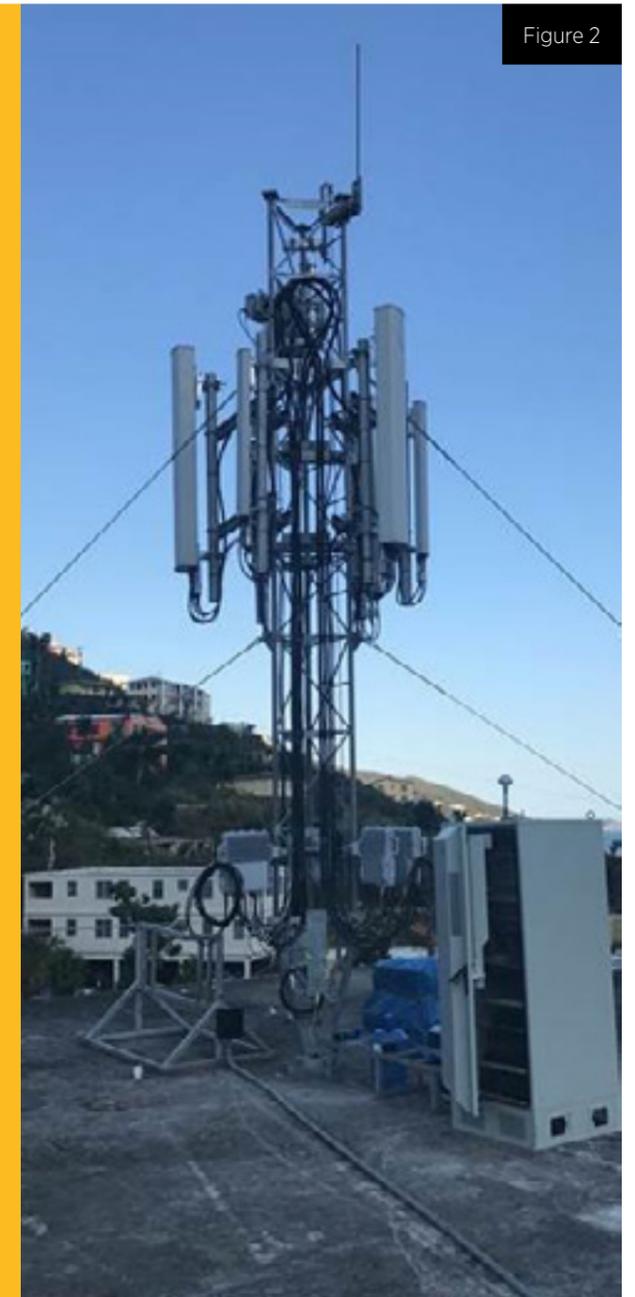


Figure 2

14. GSMA, 2012, "Dealing with Disasters", [https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2012/06/Dealing-with-Disasters\\_Final.pdf](https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2012/06/Dealing-with-Disasters_Final.pdf)

## Puerto Rico

Following Hurricane Maria, 90 per cent of Puerto Rico's telecommunications infrastructure was damaged, costing an estimated \$1.2 billion.<sup>15</sup> Of the 1,600 cellular sites on the island, at least 1,300 (81 per cent) were knocked out of service<sup>16</sup>, with widespread flooding perpetuating the problem.

### Network and infrastructure damage:

Puerto Rico's major problem, and one that is common across much of the Caribbean, is that fibre is laid using power poles with little fibre either buried or having alternative paths. When most of the power poles were destroyed, 100% outage was experienced.

- **1 to 2 months after Hurricane Irma:** 100 per cent power outage, 80 per cent water outage, 80 per cent of fibre
- **3+ months after Irma:** 50 per cent power, 30 per cent water, fibre no longer reported

As of January 2018, cellular connectivity on the island was 96.5 per cent restored, with 2,423 of 2,659 antennas in operation, but finding solutions for rural and isolated communities affected by two hurricanes in a single month remains a challenge.

Secondary challenges were faced during restoration with the continuation of using power poles to restore fibre. Due to the lack of coordination between utilities, outages were extended and repaired equipment/fibre were brought down by utility companies by mistake.

### MNO response:

**AT&T installed portable satellite units** at the base of clusters of cell towers to support more than 10 sites.

To support disaster recovery efforts in Puerto Rico, AT&T deployed its **flying helicopter COWs (Cells on Wings)** to provide data, voice and text services to its customers and recovery teams. The COW carried dozens of gigabytes of data, facilitating thousands of calls and texts. This was the first time an LTE cell site on a drone was successfully deployed to connect residents after a disaster. *"As we tested this new technology, we learned lessons that will help shape how drones could be deployed for future disasters,"* AT&T reported.<sup>17</sup>

**Long-term recovery:** Following an evaluation of the impact of Maria in Puerto Rico, the Telecommunications Regulatory Board of Puerto Rico outlined the need for diverse technologies to create a more resilient and robust telecommunications service, including *"cabling (fiber and copper), wireless, satellite, microwave, temporary technology such as COWs, as well as buried and aerial infrastructure."*<sup>18</sup>



## Lessons learned

**A focus on short-term savings and revenue can detract from investment in technologies that ensure redundancy and excess capacity.** It is widely accepted that every dollar invested in preparedness saves seven dollars in response spending,<sup>21</sup> and although it can be difficult to unlock these funds, it is increasingly apparent that MNOs in high-risk regions cannot afford to underinvest in either business continuity management or disaster response (see Section 4).

**Innovative technologies can strengthen resilience and provide emergency connectivity.** Although there were some examples of innovative technologies reconnecting communities, for example, AT&T's flying Cells on Wings and and Project Loon's partnership in Puerto Rico (see page 24), more needs to be done to build technological resilience in the Caribbean before disaster hits. Even the best-laid plans and most advanced technologies may not stand up to natural forces. A prime example is the triple disasters in Japan in 2011, which provided an opportunity to build even stronger and more innovative solutions,<sup>22</sup> such as the super-resilient green-powered base stations operated by NTT Docomo. Hurricanes Irma and Maria also provide an opportunity for MNOs to consider how technological advances can strengthen the resilience of small island states in the future.

## Dominica

Hurricane Maria destroyed nearly a quarter of all buildings on this 290-square mile island. Of the 26,085 houses, an estimated 23,488 suffered moderate or severe damage, or were destroyed.<sup>19</sup> Six weeks after the hurricane, only central locations in major cities had electricity restored.<sup>20</sup>

### Network and infrastructure damage:

It is estimated that 87 per cent of cellular sites were knocked out in Dominica. Hurricane Maria impacted all 55 of Digicel's cell towers, cutting off connectivity to customers for at least four days after the storm.

### MNO response:

Two months after the hurricane, both Digicel and Flow managed to restore more than 50 per cent of their sites.

15. Caribbean Business, January 2018, <http://caribbeanbusiness.com/puerto-rico-telecom-board-to-present-state-of-communications-after-hurricane-maria-to-fcc/>

16. Wired, October 2017, "In Puerto Rico, No Power Means No Telecommunications", <https://www.wired.com/story/in-puerto-rico-no-power-means-no-telecommunications/>

17. AT&T, "Hurricane Maria: Response & Live Updates", [http://about.att.com/inside\\_connections\\_blog/hurricane\\_maria](http://about.att.com/inside_connections_blog/hurricane_maria)

18. Caribbean Business, January 2018, <http://caribbeanbusiness.com/puerto-rico-telecom-board-to-present-state-of-communications-after-hurricane-maria-to-fcc/>

19. United Nations, "Dominica: Hurricane Maria Situation Report No. 10 (as of 09 November 2017)", <https://reliefweb.int/report/dominica/dominica-hurricane-maria-situation-report-no-10-09-november-2017>

20. Granma, 7 November 2017, "Dominica working to restore power after Maria", <http://en.granma.cu/mundo/2017-11-07/dominica-working-to-restore-power-after-maria>

21. UNDP, "Act now, save later", [http://www.undp.org/content/undp/en/home/ourwork/get\\_involved/ActNow.html](http://www.undp.org/content/undp/en/home/ourwork/get_involved/ActNow.html)

22. GSMA Disaster Response Nepal Workshop, 2015, [https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/12/GSMA\\_Disaster-Response\\_Nepal\\_Workshop.pdf](https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/12/GSMA_Disaster-Response_Nepal_Workshop.pdf)

## Case Study: Project Loon in Puerto Rico



A Loon balloon ready to take flight from the launch site in Nevada to Puerto Rico after Hurricane Maria.



An interview with **Alastair Westgarth**, Head of Project Loon

### What is Project Loon?

Project Loon is a part of X, an innovation lab within Alphabet. Project Loon partners with local MNOs to extend LTE coverage, with the goal of providing a way for people everywhere to connect.

### Can you outline your activities in Puerto Rico following Hurricane Maria? How did the project come about?

Immediately following the landfall of Hurricane Maria, 90 per cent of Puerto Rico's telecommunications infrastructure was damaged.

The Chief Innovation Officer of Puerto Rico reached out to Project Loon to help reconnect people to basic internet service in the moments they needed it most. Puerto Rico served as a balloon launch site for Project Loon for almost two years, so the team hoped to give back to the community by providing some connectivity.

Project Loon integrated with AT&T and T-Mobile's networks, deployed ground infrastructure, and received permission from local and federal governments and aviation authorities to transmit and fly their balloons overhead. On October 6, 2017, the FCC granted Project Loon a temporary spectrum authorisation, the last piece of the technical puzzle, which enabled them to turn on service first with AT&T in Puerto Rico, and with T-Mobile later in October.

The response to Hurricane Maria was the first time Project Loon deployed connectivity from scratch at such a rapid pace, and it still took four weeks. In the future, we want to respond faster, which will require integration with a local MNO partner well before a disaster strikes.

### How does Project Loon work?

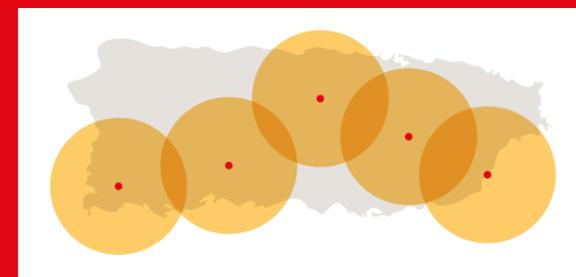
Project Loon is a system of balloons carried by winds in the stratosphere that can send internet access to rural, remote and underserved areas down on Earth below. A backhaul network is transmitted to the nearest balloon from a ground station, relayed across the balloon network, and then back down to people on the ground as LTE service direct to mobile devices. Recent improvements to our software algorithms mean that Project Loon balloons can now cluster over specific areas to maximise the time spent over areas where people need service.

### How many people did you manage to connect through your efforts?

Because 90 per cent of telecommunications infrastructure was damaged by Hurricane Maria, Project Loon tried to maximise the parts of the island and number of people who could have basic connectivity, an essential need during emergency circumstances.

We are proud to have served more than 200,000 users basic connectivity in partnership with AT&T and T-Mobile.

Each Loon balloon has a coverage radius of up to 5,000 km<sup>2</sup>, enabling Project Loon to provide basic internet connectivity to most parts of the island (Puerto Rico is 9,104 km<sup>2</sup>).



Real-world example of a five-balloon cluster over Puerto Rico. Each Loon balloon (red dot) depicted with its coverage area (orange disc).

### In addition to AT&T and T-Mobile, which other stakeholders did you need to coordinate with?

As is the case following a disaster, relief efforts require significant coordination from a diverse set of commercial partners and the government, including network communications, local and federal government, the military and NGOs. Given the significant impact of Hurricane Maria, the industry rallied together to reconnect the people of Puerto Rico, when it mattered most.

### What were the main bottlenecks, challenges and dependencies?

This was a community effort—the FCC expedited a special temporary authorisation for spectrum, infrastructure and backhaul partners accelerated ground deployments, and there was a quick integration and partnership between AT&T, T-Mobile, and Project Loon. Coordinating these efforts in four weeks was a tremendous effort, but ideally, we can respond immediately following these disasters, which requires a shift to preparedness.

### What key lessons did you learn?

Preparedness is key. Project Loon was not designed to be a disaster-response service—this was a special situation. Over time, Project Loon can make mobile networks more resilient to disasters. In countries where Project Loon has been implemented to help reach rural and remote areas, it can also supplement MNOs infrastructure that has been affected by a catastrophe. In order to move from response to preparedness, the Project Loon team is interested in partnering with governments interested in expanding the ability to fly over countries, and engaging with local mobile operators looking to deploy Project Loon on a continuous basis for connecting rural and remote communities.

### What are your short-term plans and longer term objectives for Loon?

Project Loon remains committed to its core mission of providing connectivity to address the growing digital divide, and in support of the Humanitarian Connectivity Charter. We are in discussions with many governments and MNOs around the world about Project Loon.

### 3.3 Logistics

#### Access: Challenging geography, transportation disruptions and extreme weather are barriers

After an emergency, ensuring access to cell sites and facilities is essential for damage assessments, restoration and re-establishing sites that have been pre-emptively shut down to bring them back online. Having pre-arranged, priority access agreed in advance with the relevant authorities and/or arrangements to share emergency transport facilities can improve the efficiency of the response.



**Figure 3:** BVI capital Road Town after Hurricanes Irma, Jose and Maria

After Hurricanes Irma and Maria, several Caribbean countries were completely devastated. Impassable roads and severely damaged fleets (boats and vehicles) made it difficult for engineers and riggers to get to cell towers and other critical sites.

All MNOs in BVI experienced major challenges accessing offices and cell sites, particularly in the immediate aftermath of Irma. This was, in part, due to the geography of the country: mountainous terrain dotted with landslides made roads impassable, and spread-out islands were difficult to reach by helicopter or boat due to high winds, storm surges and damaged vessels.

*“For most sites, access was a major challenge. We had to clear roads ourselves and even build new ones with help from local contractors and suppliers. However, we were committed to restoring sites as quickly as possible and did what was necessary to achieve this.”* CEO, Digicel BVI

Similar access and transport challenges have been experienced in other large-scale disasters. For example, following the 2016 Nepal earthquake and Typhoon Haiyan in the Philippines, MNO staff had to either find their own means of transport to reach damaged sites or sometimes wait for hours for boats and other special transport modes. After the two hurricanes in the Caribbean, the

telecommunications industry was not given priority when it came to clearing debris from roads and accessing critical sites. This resulted in MNOs receiving assistance through personal connections, which created an uneven response with a knock-on effect for subscribers. For example, in BVI, Flow received assistance from the Royal Military commandeering one of their heavy-duty vehicles, while CCT had a number of local contacts with large machinery equipment companies to help them clear roads. Authorities should ensure they create

a level playing field for all MNOs in-country and there should be no differentiation in government assistance to service providers.

In Puerto Rico, extreme fuel shortages (see Section 3.4) created even more challenges for MNOs trying to reach their sites. Although the Puerto Rican authorities recognised the vital role of mobile connectivity and gave MNOs special provision to obtain fuel for their sites, the fuel delivery vehicles were not given special access and had to wait in queues for fuel like everyone else.

#### Importing equipment: a challenge for all MNOs

Although MNOs ensure there is back-up equipment available in warehouses, it may be necessary after extreme disasters to import additional equipment into the country. Regulators and customs and immigration agencies should create an emergency response plan that allows fast-track approvals for these imports.<sup>23</sup>

A huge amount of telecommunications equipment suffered irreparable damage in several Caribbean countries. Group MNOs like Digicel and C&W operations generally depend on neighbouring islands or territories for back-up equipment. However, given that Irma and Maria impacted so many islands, back-up equipment was in short supply. Having two Category 5 hurricanes active in the same region over one month also hampered MNO efforts to import equipment, causing delays and cancellation of flights/vessels.

C&W and Digicel reported supply chain logistics as one of their biggest challenges. Because the damage was so severe and widespread, many suppliers and vendors were not prepared for such high demand. With manufacturers unable to keep up, stocks in central warehousing in Miami were

low and suppliers struggled to meet requests. Shipping companies prioritised goods for the worst-hit territories like Puerto Rico, and it was weeks before equipment arrived where it was needed. Even when it did arrive in port, MNOs experienced major backlogs because customs could not process containers quickly enough.

Despite these many challenges, there were also examples of good practice. The BVI Government established a special process to allow MNOs to import replacement equipment in emergencies without duties or taxes. The processes were reported as excellent with paperwork processed and equipment cleared within a day, according to some MNOs in BVI.

23. GSMA, 2015, “Emergency Mobile Telecommunications: Regulatory Best Practice”, [https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/11/GSMA-Industry-Position\\_Emergency-Telecoms-Regulation.pdf](https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/11/GSMA-Industry-Position_Emergency-Telecoms-Regulation.pdf)

## Emergency personnel: Hundreds of staff flown in to support the response

In the aftermath of a major disaster, it is often necessary to deploy emergency personnel—network engineers, riggers, vendors, group/industry staff and experts—to evaluate and restore damaged sites. This deployment should be coordinated ahead of time, with immigration requirements in place to ensure ease of entry.

The massive damage to infrastructure, particularly in BVI, Turks and Caicos, Dominica and Puerto Rico, required large numbers of extra personnel to restore networks and see to other core components of the business. Within two days of Hurricane Maria, Digicel flew 25 emergency personnel into the BVI, including an operations director to manage the recovery effort, generator technicians, engineers and riggers.

One of the major factors behind the success of the restoration was getting highly skilled staff for each unique job. For example, Digicel reported that riggers from Jamaica, Trinidad and Barbados

were very experienced and competent at working in highly stressful and uncertain environments. It was also essential that staff really understood the systems. To ensure logistics were smooth at the port authorities, Digicel BVI hired staff who understood the authorities and could navigate the systems, fast-tracking telecommunications equipment off the ports within hours.

Digicel's team in Turks and Caicos were impressed with the ease and speed with which the Minister for Immigration granted work permits for their engineers.

## Security: Looting compounded the challenges

MNOs often report security challenges in the aftermath of a disaster. MNOs have a number of assets that need to be protected from lawlessness, which can occur following disasters. This can be particularly problematic for MNOs when resources are scarce and the usual security personnel may have also been impacted by the disaster.

There were numerous reports of looting throughout affected Caribbean islands. Widespread damage to MNO stores left them vulnerable. Lawlessness was perpetuated by infrastructure damage, for example, in BVI, damage to the prison resulted in 142 prisoners escaping. All three MNOs in BVI reported looting of some kind. Stores were looted, and in some cases everything was stolen. Digicel moved all items out of its stores to prevent looting and moved its vehicles to secure locations. Although they had a 24-hour security team for their stores, six generators

were still stolen, causing short-term power outages at those sites.

With a scarcity of fuel, food and water, managing cell tower security was a chronic challenge in Puerto Rico. Incidents of mobile networks going down due to generator theft was reported a few days after Hurricane Maria.<sup>24</sup> With the complete loss of grid power for several weeks, MNOs had to establish back-up power sources at their sites and add security to the towers to protect them.

24. Wireless Estimator, 25 September 2017, "Puerto Rico's horrendous cell site outages complicated by generator/fuel theft concerns", <http://wirelessestimator.com/articles/2017/puerto-ricos-horrendous-cell-site-outages-complicated-by-generatorfuel-theft-concerns/>

## 3.4 Power

### MNOs relied on back-up power for months at huge expense

In every disaster, one of the major problems affecting network reliability is lack of available power. This applies to all aspects of the network, but the situation is most acute at the BTS (Base Transceiver Station). Although the BTS may still be standing, the disruption of power mains can eventually cause the BTS to fail.

Typical challenges include insufficient back-up battery systems, inadequate fuel to power back-up generators for the duration of a power outage, obtaining and transporting fuel to base stations and the disruption of fuel supplies.

MNOs affected by the hurricanes experienced all these power challenges to varying degrees. Lengthy commercial power outages across a number of islands meant that even though most MNOs had the necessary back-up generators in place, obtaining and transporting additional fuel to base stations was a major obstacle. There were also reports of generators being inoperable or not properly maintained on sites where MNOs had to rely on the building owners to fuel them or where they shared towers with other MNOs. This resulted in a lack of oversight and control.

With most of Puerto Rico's transmission lines knocked out, lack of power became the biggest problem for telecommunications. As the Vice-President of the Puerto Rico Telecommunications Alliance explained, "We have to reconstruct the power grid as if we were dropping into the middle of the desert and starting from scratch." Nearly four months after Maria, it was reported that half of Puerto Rico was still without power, with estimates that it could take up to eight months to restore.<sup>25</sup> Sprint reported that "fuel on the island is a major challenge—accessing it, transporting it and keeping it secure."<sup>26</sup>

Power was also identified as the biggest challenge for two out of three MNOs in BVI. Three months after Hurricane Maria, commercial power was still down across 70 per cent of the territory. Flow experienced power outages across the board, with all sites relying on generators. With fuel left off the emergency service list, Flow came within hours of losing all communication across the island because they could not get fuel for a generator at one of their core sites (data centre). Digicel reported that generators had to be refuelled every two days at 42 of their sites (creating exceptionally high operating expenditures) and contracted a full-time staff member from Trinidad to maintain them.

Alignment between utility and telecommunications companies was limited, with MNOs reportedly "left out of the planning process for power restoration. The Telecommunication Regulatory Commission should consult with the power companies to ensure that mobile operators are given priority for key sites."

25. Zoë Schlanger, 2 January 2018, "Half of Puerto Rico still doesn't have power—104 days after Hurricane Maria", Jan 2018, <https://qz.com/1169714/hurricane-maria-half-of-puerto-rico-still-doesnt-have-power/>

26. Ibid.

### 3.5 Staff

#### Keeping staff motivated in a prolonged, chaotic situation

After an emergency, one of the first things an MNO does is account for their staff. The effects on staffing from a hurricane depends on the scale of the disaster and the proximity of staff to the affected area. Hurricanes can affect large areas for extended periods, so the well-being of staff needs to be a key consideration in planning.

Given the advance warnings of the intensity and scale of Hurricanes Irma and Maria, MNOs operating in the Caribbean ensured maximum precautions were taken for their staff before the storms made landfall (see Appendix 4). However, the unprecedented nature of the hurricanes and the severe impact on communication and transport meant that despite having robust methods in place to account for all staff, in some cases it took nearly two weeks for all staff to check in. *"It took a harrowing 13 days to hear from them all through the YesOkay system,"* reported Incident Commander of AT&T's Network Disaster Recovery team in Puerto Rico.<sup>27</sup>

In BVI, TCI, Dominica and Puerto Rico, many MNO employees had severe damage to their homes and were accommodated in their offices. MNOs reported that keeping staff motivated in uncomfortable conditions in a chaotic situation that lasted for several months was a priority.

John Reid, C&W's CEO said, *"I'm hugely proud of our employees who have worked night and day to begin to bring our mobile network back online. While the situation on the ground in Dominica is grave, the passion of our employees to restore our mobile services enabling critical communications, as well as helping the broader relief efforts, has been truly inspiring."*<sup>28</sup>

Many of AT&T's 1,800 staff based in Puerto Rico, together with 230 employees deployed from other parts of the world, were *"living without power or water, more than two months after a monster hurricane decimated their island. Together, they put in long days, often through weekends, as they carry out a Herculean task: rebuilding our network and helping both business and individual customers recover from the disaster."*<sup>29</sup>

To keep staff morale high, senior management did their utmost to make staff feel safe before and in the immediate aftermath of the hurricanes. During the restoration period, Digicel arranged outings for staff and families to help provide a sense of normalcy. *"Morale with staff was reasonably good but something we really had to consistently work at."* Kevin Gordon, CEO, Digicel BVI.

Across the Caribbean, MNOs implemented initiatives to ensure staff well-being was a priority throughout the disaster life-cycle (see Appendix 4).

### 3.6 Customer and community support

As mobile network penetration increases, more customers depend on mobile technology to stay connected. Some of the connectivity challenges customers encounter during a disaster include loss of signal, running out of credit with no way to recharge or pay bills, and lack of power to charge phones. To maximise connectivity in challenging times, MNOs may decide to zero-rate calls, SMS and data and provide alternative charging facilities and WiFi hotspots.

In times of crisis, connectivity can also support the flow of information between governments, communities and humanitarian organisations. Mobile networks have the unique ability to provide decentralised two-way information and relay information where it is needed most. The opportunities for operators to help communicate essential information to disaster-affected populations are significant<sup>30</sup> from fixed short codes to Instant Voice Recognition Systems, to the latest cell broadcast technologies.

The first 72 hours after a disaster are when emergency responders are most able to save lives and when swift assessments of damage are urgently needed. Uninterrupted communication in this period is essential as loss of connectivity not only puts the MNO's reputation at risk, but people's lives.

#### Informing and alerting communities

Several MNOs in the Caribbean worked with National Disaster Management Offices (NDMOs) to disseminate messages to communities before, during and after the hurricanes, alerting them of the precautions they needed to take to prepare appropriately. Between 7 August and 14 November, the Department for Disaster Management (DDM) in BVI created 143 messages for MNOs to disseminate to affected populations.

Some NDMOs have reported considering cell broadcast<sup>31</sup> as a form of early warning system<sup>32</sup> due to its superior functions, including locality accuracy, speed and ability to reach visitors to the island who are roaming. However, the cost for this technology remains high.

27. AT&T, 2017, "The Puerto Rico stories: anatomy of a disaster", 2017, [http://about.att.com/sites/weareatt/puerto\\_rico\\_stories](http://about.att.com/sites/weareatt/puerto_rico_stories)  
28. Market Wired, 22 September 2017, "C&W Announces Partial Restoration of Mobile Network in Dominica", <http://www.marketwired.com/press-release/correction-c-w-announces-partial-restoration-of-mobile-network-in-dominica--nasdaq-lbtya-2234724.htm>  
29. Ibid.

30. AT&T sent 'customer tips' in the wake of Hurricane Irma. For further details: "Hurricane Maria: Response and Live Updates": [http://about.att.com/inside\\_connections\\_blog/hurricane\\_maria](http://about.att.com/inside_connections_blog/hurricane_maria)  
31. GSMA, 2013, "Mobile Network Public Warning Systems and the Rise of Cell-Broadcast", <https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/01/Mobile-Network-Public-Warning-Systems-and-the-Rise-of-Cell-Broadcast.pdf>  
32. GSMA, 2017, Network 2020: Mission Critical Communications <https://www.gsma.com/futurenetworks/wp-content/uploads/2017/02/767-Mission-critical-communications-low-res.pdf>

### Communication with communities in times of crisis: lessons from the Caribbean

- **Warnings must be accurate and timely** – some Caribbean islands rely on other countries for their weather information and warnings before country NDMOs issue the text to MNOs to disseminate to subscribers. When communication went down in Turks and Caicos, there were challenges receiving weather updates from the Bahamas in a timely manner.
- **MoUs must be in place between MNOs and NDMOs** – Digicel BVI had pre-defined agreements for the DDM to use its SMS systems to send emergency messages, while CCT and Flow had agreements allowing the DDM to place radio communications (repeater systems) on its towers and buildings.
- **Messages for MNOs should be prepared in advance** – texts from NDMOs must be complete and of suitable length (160 characters) so that MNOs do not have to spend time shortening messages and risk sending inaccurate information to the public.
- **To ensure widespread dissemination, consideration should be given to ensuring emergency alerts cannot be blocked by users on their device.**
- **Messages should be translated into the most commonly spoken languages** – in TCI, messages were translated into Spanish, Creole and Filipino.

### Customer support

**1. Zero-rated SMS and calls** – several MNOs in the region (and other countries such as the US) zero-rated communications to allow affected populations and their loved ones to connect (see Appendix 3). At the height of Hurricane Irma, Flow provided free local calls and texting on net credit of \$10 to all customers for 48 hours. Customers living in countries in Irma’s path—Antigua and Barbuda, St. Kitts and Nevis, Anguilla, Montserrat, Dominica, BVI and Turks and Caicos Islands—were notified via SMS when the credit became available.<sup>33</sup>

**2. Bills waived** – MNOs waived bills for the months where networks were affected. For example, Digicel waived bills for September and October in their most-affected markets.

**3. Updates about the mobile network** – advisories and updates on network restoration and MNO emergency services kept affected populations informed. Information shared by MNOs on Twitter and Facebook helped to maintain transparency and kept subscribers up to date, particularly at a time when managing customer expectations can be difficult.

“Managing customer expectations continues to be one of our major challenges. Customers expect the same service as prior to the hurricanes, which is hugely challenging with so many temporary sites.”

CEO, Digicel, BVI

### Community support

**4. Provision of charging facilities** – AT&T provided numerous charging stations in Puerto Rico for customers to ensure their devices could function.

**5. Roll out of WiFi hotspots and COWs to provide emergency connectivity in shelters and key locations** – Digicel built benches outside their main office in Providenciales, TCI and set up tents with music where communities could spend time connecting with loved ones and getting online for business. CCT created data lounges for communities to connect to the internet.

33. St. Lucia Times, 7 September 2017, “Flow Initiates Credit Facility For Markets Impacted By Hurricane Irma”, 2017, <https://stluciatimes.com/2017/09/07/flow-initiates-credit-facility-markets-impacted-hurricane-irma/>



Figures 6 & 7: Digicel in Turks and Caicos distributing water and food to staff and local communities.

### The provision of humanitarian aid

MNOs provided humanitarian aid to communities throughout the Caribbean.

**Digicel** donated \$200,000 of building supplies to the BVI government for people who lost homes with no insurance, and donated generators to power 10,000 homes (\$1 million) from General Electric.

**CCT** launched a distribution campaign for baby supplies, tarpaulins, food stuffs and care packages for pregnant women.

**C&W** flew supplies and equipment from St.Vincent, Puerto Rico and Jamaica on 12th and 13th September to BVI and Anguilla, including bottled water, non-perishable food items, baby supplies, tarpaulins, blankets, medical kits, water purification tablets, mosquito repellent, flashlights and batteries.

**C&W** also sent mobile and satellite phones from Antigua to the government of Barbuda to equip the teams coordinating relief efforts.<sup>34</sup>

The **C&W Charitable Foundation** was created with an initial donation of \$500,000 to help with hurricane relief efforts across the region and a regional text-to-donate campaign to raise additional funds.<sup>35</sup>

34. Market Wired, 14 September 2017, “C&W Communications Joins Major Relief Effort for Markets Affected by Hurricane Irma”, <http://www.marketwired.com/press-release/c-w-communications-joins-major-relief-effort-for-markets-affected-by-hurricane-irma-nasdaq-lbtya-2233705.htm>

35. C&W Communications, “Cable & Wireless Charitable Foundation Launched with US\$500K Donation to Support Hurricane Relief”, <http://cwc.com/live/news-and-media/press-releases/cable-wireless-charitable-foundation-launched-with-us%24500k-donation-to-support-hurricane-relief.html>

### 3.7 Stakeholder engagement and collaboration

In both disaster preparation and response, MNOs must typically engage with many different stakeholders. Depending on the nature of the crisis, the main stakeholders may change or include international humanitarian agencies, civil society organisations and NGOs. In the case of the Caribbean response, the main stakeholders included 1. other MNOs, 2. regulators and 3. government agencies, including the NDMO.

In small island states, relationships with stakeholders are especially important. The destructive force of Hurricanes Irma and Maria surpassed the limits of all disaster plans and preparations, exposing gaps in stakeholder coordination and communication, and highlighting the importance of cooperation as the region builds back with a stronger network.

#### 1. Inter-operator coordination

For MNOs operating in small island states, coordination with other MNOs is crucial to building resilience to disasters. Examples of how MNOs can work closely with competitors include:

- Infrastructure sharing post-disaster (with regulatory approval);
- Using each other's connection when their own is down; and
- Working together on restoration.

Although competition between MNOs may be stiff, disasters like the 2017 hurricanes can leave MNOs vulnerable, and having discussions, holding meetings and establishing agreements before disaster strikes can help to restore services faster and provide a more predictable communication platform for both responders and the affected population.

#### MNO cooperation in the Caribbean

- **Communications** – It is important that MNOs establish a regular method of communication before a disaster. Following Hurricane Maria, all MNOs in Puerto Rico joined a daily meeting in which they shared details of their restoration activities. This helped operators prioritise their restoration tasks and ensure at least one MNO had coverage in a given area. The National Business Emergency Operations Centre, under the Federal Emergency Management Agency of the US, also ran a daily call to discuss response efforts. These discussions helped MNOs to make individual decisions and supported national efforts where necessary. In Dominica, MNOs worked directly with the Prime Minister's office and community leaders to help wherever they were needed. A daily meeting was held for MNOs to share their progress, get updates from other respondents and commit to help with specific needs in the country.
- **Sharing towers** – MNOs in BVI are now considering more tower sharing, which would reduce the number of towers in the territory and improve efficiencies.
- **Swapping SIM cards** – MNOs in BVI exchanged data-loaded SIM cards two days before Hurricane Irma to ensure connectivity even if some networks temporarily went down.

#### 2. Coordination with the regulator

Given that the mobile industry is so highly regulated, coordination with the regulator is crucial. National regulatory systems that allow governments to innovate, move quickly and adjust to rapidly changing situations can help facilitate a successful disaster response, while those that do not can delay or even prevent the establishment of emergency communications systems and restoration of commercial systems. The role of the regulator itself is complex, and a mature and comprehensive regulatory body requires both experience and training.

#### Cooperation with regulators in the Caribbean

The Caribbean hurricanes presented huge challenges for regulators in the region at a scale never experienced before. Here, we capture examples of where flexible regulation resulted in a positive response and some areas where capacity building and improvements are needed.

- **A pre-established and agreed framework** outlining how regulators and operators can coordinate to share information with each other and the humanitarian community is necessary. In some affected Caribbean markets, a lack of clear regulations and guidelines around issues such as temporary special authorisations (such as spectrum and roaming) and reporting requirements created confusion and wasted time in a chaotic period. These requirements should be outlined and agreed by stakeholders in advance, including with relevant Ministries and government authorities and all MNOs operating in-country.
- **The ability of governments to adjust to rapidly changing situations** can be enabled by senior government personnel providing direct lines of communication to MNO leadership. This has been seen as an example of best practice, such as after Nepal's 2015 earthquake, when the NTA and its Chairman gave temporary permission over the phone to enable quick action.<sup>36</sup> There were several examples of this practice in small Caribbean markets as well, with Premiers having direct lines of communication with MNOs. However, it is imperative that the same treatment and opportunity is extended to all MNOs to prevent some MNOs from feeling disadvantaged and creating an uneven response capacity, as was reported in the Caribbean.
- **Pre-agreed reporting timelines** are crucial to ensuring all stakeholders have the capacity and willingness to report vital information (e.g. cell site outages) to support the restoration of telecommunications and keep the disaster response community informed. In the Caribbean there were several examples of regulators requesting ad hoc information (sometimes at the request of other Government agencies) that MNOs felt was irrelevant, commercially sensitive or ultimately not beneficial to the restoration of telecommunications services. MNOs also reported having limited capacity to report as regularly and extensively as some regulators requested in the immediate aftermath of Irma and Maria, as resources were prioritised for re-establishing networks or setting up emergency communications systems. *“Although the Commission conducted response efforts impressively overall, they requested a report that asked for too much detail.”*
- Due to the extent of the damage to networks and reliance on temporary emergency communications systems, regulators raised the issue of **minimum service obligations**. While trying to enforce a minimum quality of service that is re-established as fast as possible, regulators recognised that MNOs were experiencing multifaceted challenges. This raised the question of how to best enforce these rules and strike the right balance between being lenient and too rigid.
- Due to the scale of the impact, many telecoms regulators in the region, among other key stakeholders, have reviewed the damage against the preparedness processes in their markets and realised the need for a **large-scale disaster preparation effort**. The Puerto Rico Telecoms Board made a statement<sup>37</sup> highlighting some of the key areas they will seek to improve. The telecommunications regulators of other islands, including BVI and TCI, are also working with external experts to address the challenges they experienced during Irma and Maria.

36. GSMA Disaster Response Nepal Workshop, 2015, [https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/12/GSMA\\_Disaster-Response\\_Nepal\\_Workshop.pdf](https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/12/GSMA_Disaster-Response_Nepal_Workshop.pdf)

37. CyberNews, 11 January 2018, “Puerto Rico telecom board to present state of communications after Hurricane Maria to FCC”, Caribbean Business, <http://caribbeanbusiness.com/puerto-rico-telecom-board-to-present-state-of-communications-after-hurricane-maria-to-fcc/>

**3. Government agencies, including NDMOs**

Following a disaster, the response is typically managed by the National Disaster Management Office or equivalent authority. The NDMO is generally set up within the government structure as the main operational unit interacting with public, private and humanitarian stakeholders to ensure the response is well integrated and coordinated. MNOs play a critical role in this national system and, generally, the more involved they are in the preparation and response stages, the smoother and more efficient the process will be. A coordinated effort between the MNO, regulator, the NDMO and the other government agencies will result in a faster, more efficient response.

**Cooperation with government in the Caribbean**

The Caribbean islands are a complex mix of countries, islands, economies, governments, languages and cultures. Each country has its own NDMO or similar agency that is the key stakeholder for disaster response. These NDMO agencies are at different stages of maturity and responded to the approaching hurricanes in different ways.

- The NDMOs held meetings with key stakeholders to evaluate the plans and processes they had in place for the response prior to the landfall of the hurricanes.
- In BVI, the DDM lost its office to Irma, but managed to ensure they continue operating through the chaos because all processes were in place.
- The DDME in TCI also lost its office during Hurricane Irma. Digicel in TCI hosted the DDME

on its premises, providing office space and communications support for their response efforts.

- The NBEOC of FEMA connected with key stakeholders in Puerto Rico, overseeing the response initiative. MNOs were invited to join the daily call and listen in on the developments and update local teams on the progress.
- The 911 Emergency Response Call Centre in TCI was temporarily housed in the Flow offices during and after the passage of Irma.

In addition to the local NDMO operations, the overall hurricane response was managed by the Caribbean Disaster Emergency Management Agency (CDEMA). MNOs, humanitarian groups and other respondents were guided by CDEMA. Most responding agencies had no previous experience working with CDEMA in the region and they found it to be an 'on the spot learning experience' especially due to the complexities of the region.

**3.8 Humanitarian sector activities**

There are several humanitarian organisations whose remit is connectivity and restoration of communication channels. Mobile connectivity has become increasingly important as humanitarian organisations recognise mobile technology as a vital form of aid for both effective response and the people affected by crises. The key objective of humanitarian organisations with this remit is to provide temporary connectivity to facilitate humanitarian response efforts and, in some cases, restore connectivity for affected populations present in the impacted area.

Following Hurricanes Irma and Maria, Emergency Telecommunications Cluster (ETC) partners, Ericsson Response and the Government of Luxembourg, under the global leadership of the World Food Programme (WFP), deployed to the Caribbean islands, along with NetHope and Télécoms Sans Frontières. In participating states, the ICT response was coordinated with the Caribbean Disaster Emergency Management Agency's (CDEMA) as the lead.

OVERVIEW	RESPONSE
<p><b>1. The Emergency Telecommunications Cluster (ETC)</b></p> <p>The ETC is a global network of organisations<sup>38</sup> that work together to provide shared communications services in humanitarian emergencies. Within 48 hours of a disaster, the ETC provides security communications services and voice and internet connectivity to assist responders with life-saving operations.</p>	<ul style="list-style-type: none"> <li>• Regional IT Officer of WFP deployed to Antigua, working with partners Ericsson Response and Government of Luxembourg to restore vital ICT services.</li> <li>• Provided connectivity support to Barbuda and Sint Maarten after Irma.</li> <li>• Moved operations and focus to Dominica after Maria, and set up internet connectivity by October, providing access to local populations and over 1,600 responders.<sup>39</sup></li> </ul>
<p><b>2. Ericsson Response</b></p> <p>Ericsson Response is a global volunteer initiative established in 2000 (video: <a href="#">Ericsson Response 15 years</a>) that works with humanitarian partners to provide telecommunications support in disasters and other aid and development contexts.</p>	<ul style="list-style-type: none"> <li>• Deployed 18 staff to four Caribbean countries.</li> <li>• In Dominica, connected over 2,060 registered users from over 100 organisations and worked with Flow and Digicel on tower access and coordinating temporary solution deployments.</li> <li>• For the first time, Ericsson and ETC provided connectivity for local populations as well as humanitarian responders.</li> </ul>
<p><b>3. NetHope</b></p> <p>A group of NGOs that work together to solve problems through technological innovation. NetHope's collaborative model uses public and private partnerships to deliver information technology solutions to the developing world.</p>	<ul style="list-style-type: none"> <li>• Emergency Response Team deployed to Puerto Rico, setting up 15 VSAT units on affected islands in coordination with Digicel and Cisco.</li> <li>• Supported the Puerto Rico response,<sup>40</sup> working closely with FEMA and local government, as well as partners such as Ericsson Response and Cisco.</li> </ul>
<p><b>4. Télécoms Sans Frontières (TSF)</b></p> <p>A humanitarian aid NGO specialising in providing emergency telecommunications to victims of natural disasters and conflicts and to other humanitarian aid organisations.</p>	<ul style="list-style-type: none"> <li>• TSF was in Saint Martin throughout the first response phase of the emergency, supporting government-run coordination hubs with emergency connectivity.</li> <li>• In Dominica, set up emergency connectivity for relief workers and national authorities while restoring family ties with Wi-Fi hotspots (7,407 unique users) and ambulant Wi-Fi operations (272 unique users).</li> <li>• Provided 18 days of calling operations, impacting 910 beneficiaries.</li> <li>• Conducted preparedness exercises and VSAT donations at the request of the Dominican government.</li> </ul>

"TSF's operations in the Caribbean marked a first in humanitarian connectivity. We built ambulant Wi-Fi services backhauled to telecoms networks thereby reconnecting isolated populations with data as well as voice in addition to traditional fixed Wi-Fi access. This comes as part of TSF's dedication to providing a more human approach to emergency telecommunications, and adapting our services to the needs of populations in distress."

**Monique Lanne-Petit, Director, Télécoms Sans Frontières**

38. The ETC is one of 11 clusters designated by the Inter-Agency Standing Committee (IASC) and sits within the United Nations World Food Programme (WFP).  
 39. ETC Cluster, "Caribbean: Hurricanes Irma and Maria Updates", <https://www.etccluster.org/updates/2901>  
 40. NetHope, "Emergency Response SitRep #5 Update: Hurricanes Irma and Maria", <https://mailchi.mp/nethope/nethope-sitrep-update-2-hurricane-irma-supporter-call-sept-1162913?e=23577f9465>

# 4. Considerations for the Future

## 1. Invest in the future

Every dollar invested in preparedness saves seven dollars in response spending.<sup>41</sup> Despite the obvious benefits, making the case for investing and planning for disasters can be difficult, especially in an increasingly competitive environment where MNOs' margins are being squeezed and priorities are on short-term revenue generation and investing in new technologies that enhance consumer experiences. MNO departments tasked with developing disaster preparedness and response plans may find it challenging to unlock the funds to support them.

For MNOs in disaster-prone countries, finance departments must consider the longer term return on investment—not only by investing in infrastructure and back-up power systems that are, for example, resilient to Category 5 hurricanes, and sufficiently maintained through onsite checks—but

also investing in more rigorous Business Continuity Plans that are regularly tested.

The 2017 Atlantic hurricane season will undoubtedly prompt MNOs in the region to reconsider their investment decisions and ensure steps are taken to protect future operations, revenue and staff. This is a time for group-level MNOs to be bold and re-evaluate investment priorities in all markets based on risk and vulnerability indexes. One progressive initiative that will increase network resilience in the region is Deep Blue Cable,<sup>42</sup> which is building a fibre-optic cable system in the Caribbean to connect 28 island nations by 2020.<sup>43</sup> Policymakers and regulators should also consider how they can better support the telecommunications industry to make the investments it needs to be more resilient in the future.

41. GSMA, 2016, "GSMA Disaster Response Business Continuity Management Report", 2016, [https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/05/GSMA\\_Disaster-Response\\_Business\\_Continuity\\_Management\\_Report.pdf](https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/05/GSMA_Disaster-Response_Business_Continuity_Management_Report.pdf)

42. Denis O'Brien, CEO of Digicel, is Deep Blue's equity investor, and Digicel will be a significant anchor client.

43. <https://www.deepbluecable.com/>

## 2. Design agile and comprehensive business continuity plans

Having appropriate business continuity plans (BCP) in place before hurricane season helps MNOs ensure their businesses, services and the communities they serve are more resilient, and allows them to be resourceful and respond quickly to rapidly changing circumstances.

**An MNO's BCP should:**

- **Adopt flexible processes** that are adaptable to changing environments. This is crucial for an MNO's long-term business as it protects both their assets and reputation.
- **Allow for practice and testing through simulation.** Business continuity and disaster management plans will only be effective if they can be translated from paper to reality in a sudden onset emergency. Testing several scenarios and bringing partners together in high-pressure situations is crucial for identifying gaps and reinforcing processes.

## 3. Build resilient networks and infrastructure

In the Caribbean, equipment on the edge of the network, such as BTS/Radio Network Controller (RNC) and masts/towers, were highly susceptible to damage. Strategies for building more resilient infrastructure include:

- **Investing in more COWs** – a versatile solution for providing coverage to affected areas and cells.
- **Using collapsible masts/towers** – having sufficient early warning of hurricanes can allow engineers to temporarily shut down the cell and brace it against the effects of the storm. Although this would likely allow service to be restored more quickly, there would be a loss of coverage just before and during the disaster, which may not be acceptable for emergency services that rely on functioning networks. However, used selectively and in combination with an umbrella coverage-type approach may add resilience without losing coverage entirely.
- **Building umbrella/large radio zone base stations** – critical base stations can be built in advantageous geographical locations to cover wider areas and provide coverage in a disaster when adjacent cells are affected (although at a lower capacity).

## 4. Strengthen logistical planning

The dispersed nature of small island states, as well as the rugged terrain of some islands, created logistical bottlenecks. Damaged fleets (boats and vehicles), limited air options (due to strong winds), and a lack of established procedures for working with other stakeholders exacerbated the challenges. For a more efficient response in the future, stakeholders should consider the following recommendations.

### Access

- Ensure priority access is agreed in advance with relevant authorities and/or arrangements are in place to share emergency transport facilities.
- Embed these arrangements in a national emergency communication plan or framework/document so that all stakeholders are aware of them.

### Importing equipment

- Vendors should have the scale of stock/inventory needed to meet the demands of MNOs across multiple markets, all of which may be affected by a disaster.
- To avoid heavy backlogs at ports and airports, regulators and customs and immigration agencies should create an emergency response plan that allows fast-track approvals for importing telecommunications equipment.<sup>44</sup>

### Emergency personnel

- Staff and contractors should be identified in advance and undertake psycho-social training prior to deployment to support their work in high-intensity emergency settings.
- The deployment of emergency personnel (including vendors, group/industry personnel, experts) should be coordinated ahead of time, with immigration requirements in place to ensure ease of entry.
- Guarantee robust security measures to protect assets, including ensuring back-up security personnel are trained and ready, stores are cleared and generators are secured ahead of a disaster.

## 5. Build more resilient and alternative power systems

Mobile networks should be considered a critical component of basic emergency infrastructure, with authorities ensuring adequate power supply and providing support to locate and distribute emergency fuel, including prioritising access to ensure emergency fuel can reach critical sites where it is needed.<sup>45</sup> As witnessed in Puerto Rico, improving the resilience of power systems, particularly for small island states that may have limited power resources, will have the greatest effect on the resilience of the network.

- Plan and implement sufficient power reserve for Base Transceiver Station (BTS), taking into consideration renewable power alternatives (see Appendix 5), and ensure back-up power supplies (batteries, diesel generators and fuel cells) receive regular checks.
- Set up appropriate fuel replenishment supply chain plans in tandem with relevant stakeholders.
- Governments should encourage operators and third parties, such as electricity and power companies, to cooperate to use available resources intelligently and efficiently. Electricity service providers should be included along with MNOs in preparedness discussions.
- MNOs should plan their BCPs and response initiatives in line with the strengths and weaknesses of power suppliers, if possible.

44. GSMA, 2015, "Emergency Mobile Telecommunications: Regulatory Best Practice", [https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/11/GSMA-Industry-Position\\_Emergency-Telecoms-Regulation.pdf](https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/11/GSMA-Industry-Position_Emergency-Telecoms-Regulation.pdf)

45. GSMA, 2012, "Dealing with Disasters: Technical Challenges for Mobile Operators", [https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2012/06/Dealing-with-Disasters\\_Final.pdf](https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2012/06/Dealing-with-Disasters_Final.pdf)

## 6. Prepare and support employees

Given that hurricanes can affect large areas for extended periods, staff well-being in a prolonged, chaotic situation needs to be a key consideration in planning. Staff support activities should be documented and planned for, so human resource and other relevant teams will not have to improvise or come up with new processes in high-pressure situations.

- Conduct regular training and drills. Critical employees should be well-trained and tested in simulation or other exercises to determine their ability to cope in difficult environments.
- Set up early warning feeds for staff for hurricane prediction and tracking.
- Formalise employee support and volunteering procedures, ensuring communication channels (satellite phones, multi SIMs).
- If employees need to report in to work, there should be clarity around provisions made for their families (i.e. if they need to come in to work, can they bring their families) and a store of emergency shelter and provisions should be pre-positioned for field staff and critical staff members.
- Set up a system for employees to check-in/report after a disaster, such as a digitised version of a call tree. Set up employee support policies and processes and ensure they are aware of them.

## 7. Inform and update customers

Disseminating accurate information to customers and ensuring they have the means to communicate throughout the disaster life-cycle can provide a lifeline. The opportunities for operators to help communicate essential information and provide support to disaster-affected populations will only be realised if plans and agreements, including those outlined below, are made in advance of crises.

- Set up systems ahead of time to support customers (toll-free calls, free data, Wi-Fi hotspots and charging stations, etc.).
- Set up Early Warning System options with NDMOs (secure MoUs), including guidelines for different types of disasters.
- Train customer service teams to deal with different types of disasters.
- Educate customers about preparing for a disaster from a connectivity point of view, for example, programming emergency contact numbers into their phone and keeping their mobile charged.

## 8. Considerations for regulators and government agencies

### 1. Regulators

Crafting a regulatory regime that works well in both emergency and non-emergency scenarios is difficult. Emergency situations pose unique challenges that vary greatly depending on geography, pre-disaster telecommunications infrastructure, government institutions and regulatory design. No country has the best system and no one system could account for all the challenges regulators face. But countries, MNOs and manufacturers can learn from each other's experiences and approaches as they work to better serve their citizens and customers.

Although it is necessary for regulation to be context specific and tailored to different types and intensities of disasters, GSMA sets out broad guidelines that regulators and MNOs should work together to establish. We recommend that regulation should:

**(1)** set forth clear rules and lines of communication between governments and responders in emergency situations;

**(2)** provide responders with the flexibility to adjust to unforeseen circumstances rather than insisting that rules designed for non-emergency situations apply no matter the circumstance;

**(3)** improve communication and coordination among various government entities involved in some manner in responding to an emergency; and

**(4)** provide for fast-track government decision making in areas like importation and immigration to respond quickly and effectively to an emergency.

With disaster response-related regulations, several key areas might be considered part of the responsibilities of a telecoms regulator:

#### Before a disaster:

- Proactively engage with MNOs on the topic of preparedness and analyse each operator's BCP and other preparatory aspects in detail; and
- Agree/stipulate key parameters, including the process for reporting outages, minimum recovery time objectives, frequency and other regulations during disasters.

#### Responding to a disaster:

- Implement the agreed disaster-related regulation;
- Take a lead role and manage MNO interactions and responses;
- Support MNOs equally to create a level playing field;
- Play a coordination role within the national disaster regulatory framework;
- Support MNOs in prioritising their requirements within the national framework (importation, taxation, logistics, etc.); and
- Be as flexible as possible to provide MNOs the opportunity to restore network and re-establish connectivity.

#### GSMA Industry Position: Emergency Mobile Telecommunications, Regulatory Best Practice

The GSMA has consolidated its portfolio of regulatory best practices in emergency mobile telecommunications in its Public Policy Handbook.<sup>46</sup> It recognises that no one size fits all and reiterates the importance of unambiguous rules and clearly defined lines of communication between governments and operators in emergency situations.

**In-country roaming** – a potential solution to the loss of network coverage in the event of a disaster. To mitigate against network outages in the event of disasters, in-country roaming could be implemented on a voluntary basis between operators. In specific circumstances it allows end-users to roam to another available network “in country” to e.g. make emergency service calls when their own network provider is unable to provide coverage. We recognise each National Regulatory Authority (NRA) will have differing regulatory approaches depending on their market. As potential solutions differ, these will likely need to be agreed in advance with both regulators and MNOs in the region. The service parameters (e.g. to make and/or emergency calls etc), necessary configuration, testing and trigger points for opening and closing the service also need to be clearly defined and agreed by all parties.

### 2. Government agencies

#### Before a disaster:

- NDMOs should take the lead in developing and regularly reviewing the national emergency telecommunications plan under their overall policy and guidelines.
- NDMOs should engage with the national telecoms regulator to understand the strengths, limitations and processes of the MNOs prior to determining their role within the national framework.
- Prior to a disaster, NDMOs should support the facilitation of crucial links, connections and agreements that MNOs require with other stakeholders (e.g. utilities providers, customs, inland revenue, foreign employment bureaus).

#### Responding to a disaster:

- The NDMO should setup a process for frequent communication between MNOs and the national response.
- The NDMO should ensure that MNOs, along with the other key stakeholders, do not have to spend time developing new relationships or holding extensive meetings during a disaster. The NDMO should set up a concise but sufficiently detailed reporting mechanism that can be easily understood by all parties.

46. GSMA Mobile Policy Handbook, <https://www.gsma.com/publicpolicy/handbook>

# 5. Conclusion

In September 2017, the mobile industry experienced one of the most devastating Atlantic hurricane seasons on record. The unprecedented impact on MNOs in the Caribbean reinforced, in a very real way, the importance of investing in resilient infrastructure and organisational preparedness. The experience also emphasised the interdependencies of the mobile industry and other stakeholders, from government agencies to vendors, commercial power suppliers and other MNOs, all of which were severely impacted themselves and made a coordinated response even more fraught and challenging.

The sheer intensity and scale of Hurricanes Irma and Maria on vulnerable and dispersed small island states across the Caribbean presented profound challenges for MNOs in the region. It was not only the physical mobile infrastructure itself that was severely

damaged, but everything that was needed for that connectivity to function and be restored, including the power supply, human capacity and emergency equipment and access, not to mention the logistics and coordination challenges. Even the best-prepared organisations can be adversely affected by natural disasters, and although MNOs in the region had robust business continuity plans, they were not sufficient for the 2017 hurricanes.

Ahead of the 2018 Atlantic hurricane season, MNOs and interested parties must take stock of what was learned in 2017 and consider how to best invest in enhanced preparedness efforts and “build back better”, not only to protect their own assets, but also to provide a communication lifeline for vulnerable communities in the region.

## Planning for the 2018 Atlantic hurricane season and beyond

### Mobile Network Operators

- How can MNOs design and test their business continuity plans (including regular simulation exercises) to be agile enough to ensure an efficient response to unpredictable events?
- What type and level of investments should MNOs make in both infrastructure and organisational preparedness to ensure better resilience and preparedness in the future?
- What level and type of interaction and collaboration between competitor MNOs in market or within regions would help to increase the speed of restoration?
- How can MNOs encourage and guide customers to be more prepared following a disaster? For example, by running awareness campaigns such as ‘Text, Don’t call.’
- What are the best mechanisms for MNOs and global emergency telecoms response groups (e.g. ETC, TSF) to coordinate ahead of time and during emergencies?

### Broader stakeholders

- How can stakeholders best educate communities/ customers so that they know what to do during a disaster?
- How can regulators and other relevant authorities best collaborate and coordinate with MNOs to ensure and enforce a level playing field for MNOs responding to crisis?
- What kind of disaster management framework should regulators support and how can they ensure flexibility to accommodate different types and intensities of disasters?
- What types of advance agreements for in country roaming should be made between parties and how can these be tested ahead of time?
- How can governments (including NDMOs) better coordinate with the mobile industry and other key stakeholders (utilities) so everyone has a clear understanding of their own roles, as well as key risks, vulnerabilities and dependencies?
- What is the best mechanism to regularly run simulation exercises nationally and within different islands, and how can MNOs be involved from the start?

As the mobile industry, regulators, government authorities, emergency telecoms response groups and other interested parties in the Caribbean work to answer these questions and build robust mechanisms to better deal with future unpredictable events, there is an opportunity for new models of coordination and collaboration to be developed.

There is also an opportunity for the wider mobile industry, particularly in other small island states, and other stakeholders to learn from the successes and challenges experienced during the hurricanes in the Caribbean and consider these against their own preparedness plans. With climate change likely to bring more frequent and higher intensity natural disasters, efficient and effective preparedness and response plans can only be created by sharing lessons and experiences across the mobile industry and coordinating more closely with stakeholders.

# 6. Acronyms

<b>BCM</b>	Business Continuity Management
<b>BCP</b>	Business Continuity Plan
<b>BTS</b>	Base Transceiver Station
<b>BVI</b>	British Virgin Islands
<b>CDEMA</b>	Caribbean Disaster Emergency Management Agency
<b>COW</b>	Cell on Wheels
<b>DDM</b>	Department for Disaster Management
<b>DDME</b>	Department of Disaster Management and Emergencies
<b>ETC</b>	Emergency Telecommunications Cluster
<b>FEMA</b>	Federal Emergency Management Agency
<b>MNO</b>	Mobile Network Operator
<b>MoU</b>	Memorandum of Understanding
<b>NBEOC</b>	National Business Emergency Operations Center
<b>NDMO</b>	National Disaster Management Office
<b>NGO</b>	Non-governmental organisation
<b>OpCo</b>	Operating company
<b>TCI</b>	Turks and Caicos Islands
<b>TSF</b>	Télécoms Sans Frontières
<b>VSAT</b>	Very Small Aperture Terminal

# 7. Appendix

## Appendix 1

Country	Digicel	Flow <sup>47</sup>	Other 1	Other 2	Other 3	Other 4	Other 5	Mobile broadband	Population
Anguilla	Digicel	Flow						21%	14,700
Antigua and Barbuda	Digicel	Flow	APUA					14%	92,300
Aruba	Digicel		MIO	Setar NV				43%	104,100
Bahamas			BTC	ALIV				26%	390,400
Barbados	Digicel	Flow						34%	285,400
British Virgin Islands	Digicel	Flow	CCT					3%	30,400
Caribbean Netherlands	Digicel		CHIPPIE	Kia Mobile				34%	25,600
Cayman Islands	Digicel	Flow						30%	60,400
Cuba			Cubacell						11,400,000
Curaçao	Digicel		CHIPPIE					28%	157,900
Dominica	Digicel	Flow						8%	72,800
Dominican Republic			Claro	Altice	Viva			41%	10,600,000
Grenada	Digicel	Flow	Spice Mobile					5%	107,100
Guadeloupe	Digicel		SFR Caribe	Orange				54%	469,500
Haiti	Digicel		Natcom					16%	10,800,000
Jamaica	Digicel	Flow	Caricel					38%	2,800,000
Martinique								9%	396,400
Montserrat	Digicel	Flow						30%	5,100
Puerto Rico			AT&T	Sprint	Claro	T-Mobile	Open Mobile	47%	3,700,000
Saint Kitts and Nevis	Digicel	Flow	CHIPPIE					12%	55,900
Saint Lucia	Digicel	Flow						7%	185,700
Saint Martin	Digicel		CHIPPIE	Orange	Dauphin Telecom			15%	30,600
Saint Maarten			Orange	Telcell				22%	39,100
Saint Barthelemy	Digicel		CHIPPIE	Orange	Dauphin Telecom			20%	7,400
Saint Vincent and the Grenadines	Digicel	Flow						4%	109,600
Trinidad and Tobago	Digicel		bMobile					11%	1,400,000
Turks and Caicos Islands	Digicel	Flow						14%	34,600
United States Virgin Islands			AT&T	Sprint	Viya	T-Mobile		13%	106,400

47. Flow is the brand name used by Cable & Wireless Communications (C&W), a subsidiary of Liberty Latin America.

## Appendix 2

### Impact of Hurricane Maria on Digicel Group in Dominica

"I can't compare this to anything I've ever been through in life – nothing," Digicel's Dominica CEO, Nikima Royer Jno Baptiste, said.

Although Hurricane Irma spared Dominica, Maria struck with force, impacting all 55 of Digicel's cell towers, cutting off customers' connectivity for at least four days after the storm and destroying nearly a quarter of all buildings on the 290-square mile island.

"It's not the weight of a company, it's the weight of an entire country; on you and your team because connectivity is so important," she said.

In a number of Digicel's markets, there were up to 60 people (local staff and families and external personnel) living in their offices as their temporary homes, sleeping on air mattresses and taking turns cooking.

## Appendix 3

### Digicel's public service announcement in Dominica

#### FREE CALLS FOR DIGICEL CUSTOMERS DOMINICA

Thursday, September 28, 2017 – Roseau, Dominica: Digicel is giving ALL their customers the opportunity to connect to the people and things they love for FREE.

Prepaid customers will be gifted with 30 minutes of FREE calls to local numbers on any network, as well as to the USA, Canada and to landlines in the UK and France.

Postpaid customers can stay in touch with 30 minutes FREE calls on any local network and to USA and Canada numbers, plus to those on UK landlines.

Both offers are valid for two (2) days.

Digicel's technical team is committed to working non-stop to return service to affected customers, in the shortest possible time.

## Appendix 4

### Digicel and Flow staff support

#### Before:

- Checked **contact details** with staff, including primary and secondary contact methods, and next of kin details to update emergency call tree.
- **Reserved hotel rooms.**
- **Satellite phones** provided to key members of staff.
  - In BVI, Digicel provided eight satellite phones to the CEO, CFO, technical managers, finance manager, communications director and the retail manager in Virgin Gorda (the second largest island).
  - In all affected markets, Flow's CEOs and senior management teams were in possession of satphones.
- **Weekly simulation exercises** (evacuations, drills, communications messages) were held with all staff from July.

#### During:

- **Provision of accommodation:**
  - Digicel: BVI – **Housed 50+ people** on four floors of Digicel's office. Staff with families were provided with food and reported feeling 'safe and genuinely touched by the support offered.'
  - Digicel TCI – **accommodation** for 10 families in hotels. Two members of staff lost homes and stayed at the hotel until insurance was sorted.
- **Provision of water, medicine, general food supplies to all staff** before and after the hurricanes.
  - Digicel sent two shipping containers of food supplies from Jamaica to staff in BVI.
  - Flow: "The first few days was about getting personnel and humanitarian aid to Flow staff in offices in all affected markets – BVI, Anguilla, Turks and Caicos and Dominica – we used every transport method, including charter planes, helicopters and boats, to ensure we delivered humanitarian aid to our staff." Avik Datta, Vice President Technology, Ventures & Barbados, Flow Group

#### After:

- In **Dominica, Anguilla and the British Virgin Islands**, Digicel and Flow staff received generators.
- Additional **one month's salary was provided to all Digicel staff** in affected islands.
- **Building materials** were provided to staff whose homes were lost completely.
- **Digicel evacuated staff** and their families out of BVI, for those who wanted to leave and had the necessary visas.
- **Mr. Denis O'Brien**, the founder of Digicel Group, **visited some offices and staff members personally** along with the group/local managers.

## Appendix 5

### Effectiveness of back-up green power

Criteria	Better <span style="float:right">Worse</span>					
	Solar	Wind	Pico-hydro	Biodiesel	Fuel cells	Fossil diesel
<b>Overall ranking</b>	Very Good	Good	Okay	Poor	Very Poor	Very Poor
<b>Capex</b>	Very Poor	Good	Very Good	Very Good	Very Poor	Very Good
<b>Opex</b>	Very Good	Very Good	Good	Very Poor	Very Poor	Very Poor
<b>Reliability</b>	Very Good	Good	Good	Good	Good	Good
<b>Supplier availability</b>	Good	Good	?	Very Poor	Very Poor	Very Good
<b>Theft resistance</b>	Very Poor	Good	Very Good	Very Poor	Good	Very Poor
<b>Public green image</b>	Very Good	Very Good	Very Good	Good	Good	Very Poor
<b>Operational supply chain predictability</b>	Very Good	Very Good	Very Good	Very Poor	Very Poor	Good
<b>Output Predictability</b>	Good	Very Poor	Good	Very Good	Very Good	Very Good
<b>Resource ability</b>	Very Good	Good	Very Poor	Very Poor	Very Poor	Good

Key  Very Good  Good  Okay  Poor  Very Poor



For further information please visit  
the GSMA website at [www.gsma.com](http://www.gsma.com)

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