A SHOW OF RESILIENCE IN PUERTO RICO POST-MARIA

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Abstract: The project team[1]was in the final stages of securing key environmental permissions in Puerto Rico, and making early preparations for installation when Hurricane Maria made landfall on September 20, 2017. Project tasks immediately dropped in priority as the world watched the devastating hurricane unfold in Puerto Rico and the region. The aftermath and damage remain today, much of it still unquantified, as Puerto Rico and region continue to recover.
Nevertheless, amid the tragic conditions were unexpected signs that some systems still functioned in Puerto Rico, a major hub for subsea cable landings stopping between the U.S. and Latin America: the cable station(s) continued operations; portions of the federal and local governments resumed processing permits; and some local businesses found ways to communicate with the mainland and resume business. How was this possible?
This paper highlights the resilience we observed that kept a cable installation on track in Puerto Rico in 2018, and, importantly, why this matter to an island economy struggling to recover. Focusing on what worked, key players influencing the positive outcome of this project were asked about their experience to provide on-the-ground perspectives of how their organizations were able to function during such devastation. This paper highlights how maintenance of critical functions and ingenuity kept a project and commerce alive, and how this resilience can influence the success of future systems.

1. INTRODUCTION

The planning for a new subsea cable system with a landing in Puerto Rico had been underway for months. The project team was in the final stages of securing key environmental permissions in Puerto Rico, and making early preparations for installation when two Category 5 Hurricanes ripped through the U.S Virgin Island within 14 days of each other. On September 6, 2017 came Hurricane Irma, then Hurricane Maria made landfall on September 20, 2017. Project tasks immediately dropped in priority as the world watched the devastating hurricane unfold in Puerto Rico and the region. The aftermath and damage remain today, much of it still unquantified, as Puerto Rico and region continue to recover.

And yet, installation for the new cable landing in Puerto Rico commenced in April 2018.

This paper highlights the resilience we observed in Puerto Rico that, remarkably, kept a cable installation moving forward in early 2018 despite steep challenges. We focus on what we learned from the perspective of people involved with the project.

2. TIMELINE

Figure 1 shows key dates between August 2017, when Hurricane Irma impacted the region ahead of Hurricane Maria, and April 2018 when cable installation of the new system began. [1] [2] [3]

[1] The project team mentioned in this article includes the supplier, installer, and permitting team for a new subsea cable system landing in Puerto Rico. The new system is not identified to retain confidentiality.

3. OVERVIEW OF IMPACTS ON PUERTO RICO

Just 14 days after Hurricane Irma hit St. Thomas and St. John, Hurricane Maria bore down on St. Croix and Puerto Rico. Hurricane Maria rapidly formed from a tropical wave by September 16, and by September 18, Maria was a Category 5 storm. The hurricane made landfall on Puerto Rico late in the morning of September 20, causing catastrophic damage. [4]
One of the most immediate and devastating consequences of the storm was damage to critical infrastructure, and specifically to the power grid causing the loss of electricity, which contributed to disruption in access to water, food, and communications. Reportedly, more that 80 percent of the island's aboveground power lines were damaged [5].

Infrastructure such as roads, bridges, sewage systems, and telecommunication facilities were destroyed or severely damaged, as well as private buildings and residential areas.

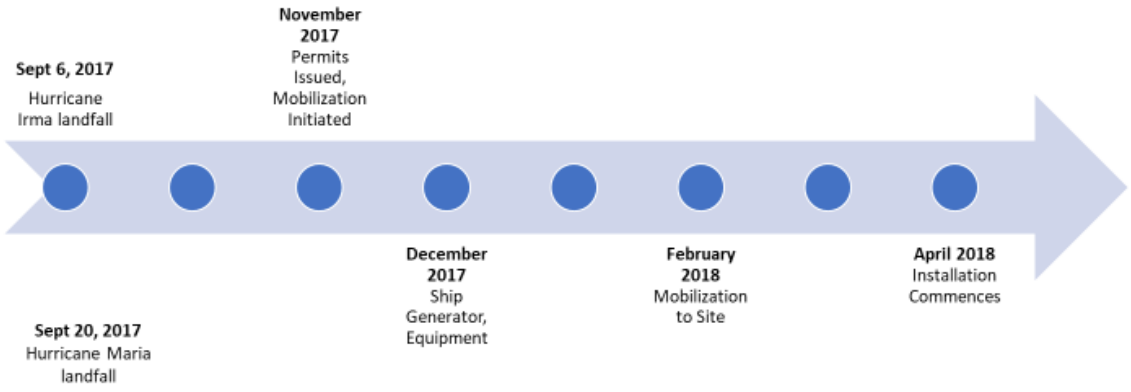

Figure 1 Timeline

Heavy rains and flash floods rendered some areas impassable, and choking streets with debris and sewage-containing water.

Aboveground telecommunication facilities were impacted. The Telecommunications Regulatory Board of Puerto Rico (JRTPR) reported thousands of miles of fiber and other cabling were lost due to the storm, and 95 percent of the cell tower sites in Puerto Rico were out of service after the hurricane. This was likely a combination of damage to the cell sites themselves, as well as to the connecting cables serving the cell sites. [5]

Subsea cables landing in Puerto Rico did not suffer direct damage from Hurricane Maria. However, one cable did experience an outage when the cable landing station flooded; the system was powered down to save the equipment and resulted in interrupted service to some connecting countries in Latin America. [5] [6] [7]

A subsequent damage assessment of installed cables landing in Puerto Rico was conducted. During this proprietary assessment no cable movement or damage was observed; the cable positions were reportedly stable. [7]

4. IMMEDIATE AFTERMATH: MAKING THINGS FUNCTION

The project team, like much of the world, was aware of the severe storm and devastation in its wake, and considered how best to manage inevitable delays to the installation schedule. The last critical federal permit for the new landing was still pending, and given the conditions in Puerto Rico,

seemed unlikely materialize. The permitting team was therefore stunned to hear from the San Juan office of the U.S. Army Corps of Engineers (USACE) in November 2017, and be informed the permit would be processed soon.

How was this possible? We asked some of our contacts on the ground to understand how some of Puerto Rico's systems were able to recover and function. The following highlights what we learned about the resilience of Puerto Rico's systems and communities.

Government facilities and services were critical hubs for emergency support. The airport, U.S. Coast Guard (Department of Homeland Security) facility and other public facilities served as hubs for emergency operations, including incoming emergency supplies (water, food, medical supplies and fuel) and personnel for response and relief efforts. They also were gathering locations for interagency meetings and other coordination with response teams.

These government facilities also provided back-up power and communications for local responders and support teams (including some of the local project team), who were instrumental in reaching a wider relief area. [7] [8]

Communications relied on conventional and unconventional resources. Temporary restoration of telecommunications relied on back-up power generation to compensate for damage to the power grid; temporary cell sites; repaired fiber connections and microwave.

Although Alphabet's Project Loon was not developed as an emergency system, the Project Loon team worked with the Government of Puerto Rico, Federal Communications Commission (FCC), Federal Aviation Administration (FAA), Federal Emergency Management Agency (FEMA), spectrum partners and international aviation authorities to bring balloon-powered internet to the island to supplement internet access. In collaboration with AT&T and T-Mobile, Project Loon supported basic communication and internet access on the island.

Less exotic than internet balloons, but essential to day-to-day communication, was basic outreach with communities, responders, and agencies. Interagency meetings, including meetings at the Convention Center and with municipalities, enabled agency leads to communicate directly with those who may otherwise not have access to timely information. Emergency permitting procedures (see next item) were communicated on the USACE website, at interagency meetings, and via posting a video message (recorded from a mobile phone) on the USACE's Facebook page to get out the message. [8]

Alternative (emergency) environmental regulations and permitting processes helped smooth the way for response and restoration efforts. The USACE Jacksonville District issued emergency permit procedures to expedite review and approval of response and restoration activities. The temporary procedures, which aimed to provide turnaround approvals in 24-48 hours, served to accelerate response activities within the existing environmental regulatory framework. Priority activities included debris removal, bank stabilization, and containment and cleanup of flooded areas. The emergency procedures also included a provision for coordinating with applicable Commonwealth agencies. [10]

In order to implement the emergency permits, USACE mobilized staff to keep pace with the requests for emergency permits. Some staff were able to telecommute and others had the option to get lodging near the office because of the

difficulty in commuting within the damaged roads and streets. [8]

Relief efforts were fundamentally fuelled by personal commitment and ingenuity. Relief efforts required receipt and distribution of water, food, fuel, supplies and equipment – a set of collaborative efforts by federal, state, and local agencies, as well as the community and volunteers. Local people left their homes to report for duty, report to work, and to volunteer in the response. Others redirected routine work to help develop solutions to ease disaster conditions.

Volunteers helped deliver FEMA-provided water, fuel and supplies to communities cut off from normal channels. Regulatory staff used their mobile phones to post video and upload information to a broader audience. [7] [8]

In short, the emergency communication and supply chain relied on a network of federal, Commonwealth, municipal, private and personal resources and actions.

5. INSTALLATION: CHALLENGES AND SOLUTIONS

After obtaining the necessary permissions to install the new cable, the project team turned to planning an installation under non-routine conditions. The installation and permitting team had prior experience at the landing site in Puerto Rico, and was familiar with typical site conditions and commercially available resources. The project teams early in-depth planning meant that equipment, resources and supplies inventories were able to deal with the anticipated post-hurricane local conditions.

The shore end mobilisation commenced in November 2017 by sending containerised equipment to the site, arriving February 2018. One critical action was to procure and deliver a 60 KVA generator to Puerto Rico to ensure power for the operation, as local generators were being used in the relief efforts. [111]

Other preparations requiring additional lead-time included securing travel and lodging for the site-based installation team, some of whom were local but still required lodging near the site.

The following are the project team's observations during the planning and execution of the shore-end installation:

- Lodging shortages and elevated prices caused by the reduced inventory of lodging options, as well as the influx of mainland response and recovery personnel.
- Local traffic and access was exacerbated by the absence of traffic lights caused by localized power outages.
- During installation, water quality was poor, in contrast to prior installations.
- Local weather patterns were atypical, demonstrating some lingering effects of the hurricane. This, combined with poor water quality, resulted in more weather days experienced in past installations.

Despite the constraints and inconveniences noted, the installation was achievable and proceeded. The planning undertaken to de-risk the installation helped mitigate local shortages of equipment and power for the operation.

6. CLOSING

The impacts of back-to-back hurricanes – Irma and Maria – on Puerto Rico and the region in late 2017 were devastating, and restoration is ongoing. But a network of government and private organizations, local citizens, and volunteers mustered available resources to get the island functioning again – slowly in some places, but still moving forward.

The project team installing a new cable in Puerto Rico witnessed some of these efforts firsthand. Some of the key challenges and short-term workaround measures that enabled communication and emergency distributions are noted in this paper.

Critical Infrastructure. Critical infrastructure provides the base for communications, transport, and supply distribution. The power grid proved to be vulnerable, and severely impacted communications and other essential functions.

Aboveground communication infrastructure was damaged, but subsea cables had no reported damage, indicating they remained stable under extreme conditions.

Risk management for remote areas. Puerto Rico is and will continue to be an important telecommunications hub for the region, and between the U.S. and Latin America. Future installations at such hubs and remote areas would benefit from robust risk management during the planning stages to assess essential infrastructure and services, and plan for mitigation measures during non-routine and extreme conditions.

Sound project planning. This project benefited from having prior experience in the project area, and local expertise. During the post-Maria installation planning stage, the project team was able to focus on risk management addressing site-specific emergency conditions, having planned for routine operations during early project stages.

7. REFERENCES

[1] National Weather Service (National Oceanic and Atmospheric Administrations [NOAA]). National Hurricane Center Tropical Cyclone Report, Hurricane Irma. 30 June 2018. Website: https://www.nhc.noaa.gov/data/tcr/AL112017_Irma.pdf.

[2] National Weather Service (NOAA), Major Hurricane Maria - September 20, 2017. Website: https://www.weather.gov/sju/maria2017

[3] Federal Emergency Management Agency (FEMA), Hurricane Maria Federal Response Timeline. Website: https://www.fema.gov/it/media-library/assets/images/150648

[4] U.S. Virgin Islands (USVI) Task Force. Hurricane Recovery and Resilience Task Force Report. 2018 Website: https://first.bloomberglp.com/documents/257521_USVI_Hurricane+Recovery+Taskforce+Report_DIGITAL.pdf

[5] BNAmericas, Telecom Infra Report: Puerto Rico's arduous path to recovery, 2 February 2018: https://www.bnamericas.com/en/features/ict/telecom-infra-report-puerto-ricos-arduous-path-to-recovery

[6] D. Madory, Director of Internet Analysis at Oracle Dyn. Puerto Rico’s Slow Internet Recovery. 7 December, 2017. https://dyn.com/blog/puerto-ricos-slow-internet-recovery/

[7] G. Rivera, Principal, Glauco A. Rivera & Associates. Personal communication with D. Toombs, AECOM. February 2019.

[8] S. Castillo, P.E., Chief, Antilles Regulatory Section, U.S. Army Corps of Engineers. Personal communication with D. Toombs, AECOM. February 2019.

[9] A. Westgarth. Turning on Project Loon in Puerto Rico. Loon blog: https://medium.com/loon-for-all/turning-on-project-loon-in-puerto-rico-f3aa41ad2d7f

[10] USACE, Jacksonville District. Emergency Permit Procedures – Hurricane Maria, 21 September 2017: https://www.saj.usace.army.mil/Missions/Regulatory/Public-Notices/Article/1320389/emergency-permit-procedures-hurricane-maria/

[11] C. Jackson, Kraken Marine. Personal communication with J. Merrett, Manager

Permitting and Environment, ASN.
February 2019.