OPTI STOPS FLOODS BEFORE THEY START:
WITH THE POWER OF PARTICLE

BY NICK JOHNSON

OptiRTC, Inc. is revolutionizing the field of stormwater management with its Particle-powered Continuous Monitoring and Adaptive Control (CMAC) system. Their CMAC system proactively monitors weather forecasts and actuates drainage valves to minimize flooding and environmentally hazardous run-off. And with Particle, they've found a stable, scalable, and robust IoT platform to support their mission of public safety and sustainability.

Particle
Welcome to real IoT.

INTRODUCTION

Particle
Welcome to real IoT.

Ask anyone in the field of stormwater management and they'll all describe the same bleak state of affairs – the vast majority of cities today simply aren't equipped to handle the rainfall they receive. Aging and inadequate infrastructure, combined with rapid city expansion and changing patterns of rainfall, results in a host of stormwater-related problems for communities and the environment.

Of these problems, perhaps the most instantly relatable is what is known as "nuisance flooding" – isolated, low-volume flooding that results in property damage. For anyone who has experienced a flooded basement, this type of stormwater-related damage should be intimately familiar. And while nuisance flooding may not make the national news, the emotional and monetary costs can be steep for those who are affected.

Another way in which stormwater quietly takes its toll is in the form of "non-point water pollution". Non-point pollution refers to when stormwater washes hazardous materials into natural water sources. A common example of non-point pollution is when heavy rains wash toxic pesticides and agricultural wastes from farmlands into local water supplies. Another major source of non-point pollution is roadways, where things like motor oil residue and brake dust are frequently washed away into nearby bodies of water. Like nuisance flooding, this type of stormwater-related damage isn't going to grab many headlines. Nonetheless, its toll on the environment is staggering. In fact, **stormwater runoff is the leading cause of water pollution in the United States, with some 860 billion gallons of sewage and other pollutants flowing into our water supplies each year.**

What does make the national news, however, is "catastrophic" flooding, of which we saw historic levels in 2017. This past year's hurricane season saw unprecedented flooding in a number of regions across the United States, including California, Florida, Arkansas, and Texas. The most precipitous storm, Hurricane Harvey, dumped an estimated **24-to-34 trillion gallons** of rainwater on Houston and the surrounding areas. The rainfall damaged hundreds of thousands of homes, displaced more than 30,000 people, and resulted in nearly **$200 billion in damage**. In the end, Harvey was America's wettest and most costly hurricane on record.

A GROWING THREAT

Particle
Welcome to real IoT.

What's even more alarming is the increasing likelihood that Harvey won't maintain that distinction for very long. As cities grow, so does the presence of water impervious surfaces (e.g. concrete). With fewer places for the water to be passively absorbed, the greater the likelihood of flooding becomes. This phenomenon is then compounded with the fact that the frequency and intensity of severe precipitation events appear to be growing.

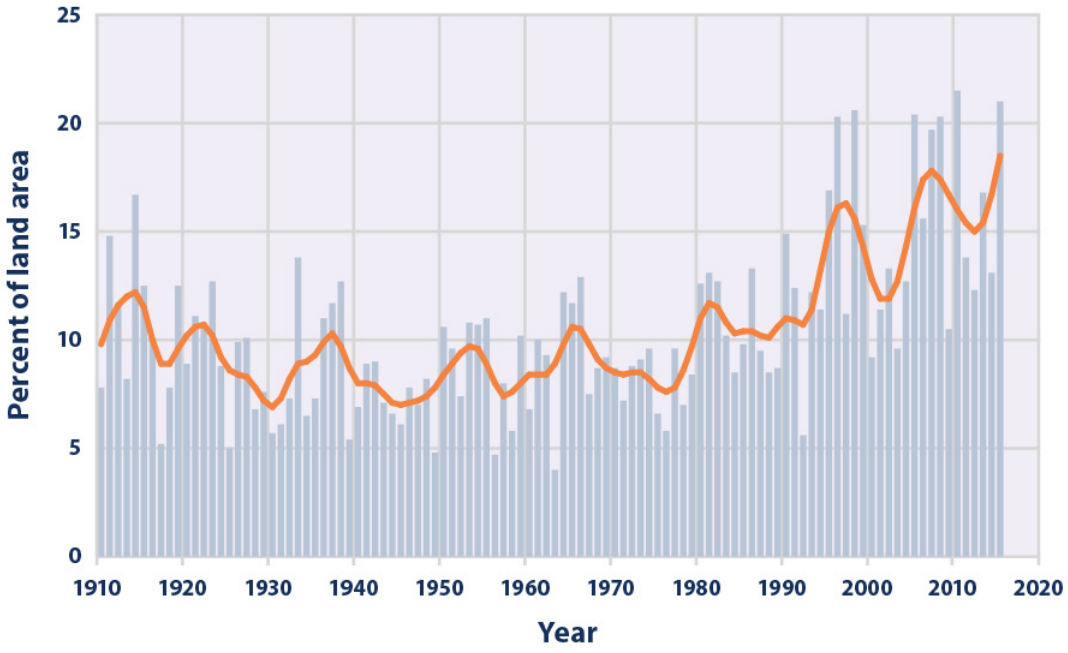


Figure 1. Extreme One-Day Precipitation Events in the Contiguous 48 States, 1910–2015
Environmental Protection Agency

As climate change warms the air and the oceans, the potential for massive precipitation events increases. This is because warmer air can contain more water vapor than cooler air, while warmer ocean surface temperatures can lead to more rapid evaporation and coastal surges. As a result, the U.S. National Climate Assessment has determined that recent climatic changes have increased storms, flooding, and severe precipitation events by up to 30% since 1910 in some regions.

Although the risk of flooding grows, the financial assets available to municipalities to address the problem remain limited. Nonetheless, these bodies are still subject to regulation. The bulk of these regulations are derived from the Clean Water Act of 1972 – which states that "it is the national policy to develop and implement programs to control point and non-point sources of pollution in an expeditious manner."

So, with the increasing threat of severe precipitation, the continuing need for improvement, and the unforgiving fiscal environment, municipalities find themselves grasping for ways to do more with less.

OPTI GETS SMART ABOUT STORMWATER MANAGEMENT

Seeing this disconnect between increasing needs and decreasing means, Opti has developed a way to make stormwater infrastructure perform better. Their Continuous Monitoring and Adaptive Control (CMAC) system uses cloud-connected sensors and remote-controlled actuators to preempt surge and overflow events in stormwater storage systems.

For example – an Opti installation will proactively check weather forecasts for its local watershed and, if it sees a precipitation event in the forecast, it will actuate the appropriate valves to limit overflow, flooding, and erosion to maximize the use of available storage space based on pre-configured site objectives. Typically, this involves predictively draining retention ponds and other water management systems before rainfall occurs.

However, Opti's capabilities aren't limited to flood prevention. The platform offers a wide array of functionality, including rainwater harvesting, environmental monitoring, and hydromodification.

"Our system affects the effective capacity of your storage infrastructure," explained Alex Bedig, Co-Founder and VP of Information and Technology at Opti. "Municipalities are able to get much better results out of their stormwater management system, without undergoing a major civil engineering project."

Opti also utilizes a standard suite of hardware for their platform, which can be configured in a number of different ways. This allows for their platform to interface with a wide variety of different infrastructures, and makes it easy for municipalities and private commercial customers to slowly scale its deployment by reducing the complexity of the watershed-scale solution.

THE OPTI PLATFORM IN ACTION

Particle
Welcome to real IoT.

And these lower-cost, higher-performance technologies are already proving invaluable in the locations where they've been deployed. In Ormond Beach, Florida, for example, Opti's CMAC system greatly mitigated the effects of 2017's Hurricane Irma. After analyzing real-time forecasts and reports from the National Weather Service, the Opti platform and team preemptively discharged 70 acre-feet of water from a large, interconnected lake system in the area.

Subsequent analysis found it highly probable that the lakes would have exceeded their flood stage if it weren't for Opti's swift action. And with numerous homes in the vicinity, such an event would have likely proven devastating for many. What's more, during the storm event itself, Ormond Beach's personnel were freed up to accomplish more in the form of immediate relief.

"During the emergency, they were able to have transparency into what their asset was doing," said Bedig. "They knew both that it was doing what they needed it to do, and that they had visibility into its current state should they need it. As a result, their team could re-direct its focus on dealing with other emergencies."

"Today, most stormwater management practitioners don't have real-time visibility into how many smaller, distributed assets are performing during a storm," explained Bedig. "Opti provides a way to examine and better understand these assets, while enabling storage systems to plan, observe, and respond to flooding and storm events predictively."

Opti is also using their CMAC platform to similar ends in Brooklyn, New York. Like so many large, older cities, New York struggles with stormwater management due to aging infrastructure and rapid expansion. In fact, the city finds itself in violation of Combined Sewer Overflow (CSO) regulations during an estimated 95% of all storm events.

There, at the Brooklyn Botanic Garden, Opti's platform works to mitigate CSOs by preemptively draining a pond ahead of wet weather. However, they must do so without compromising the pond's Koi population and aesthetic qualities for guests. So, as in Ormond Beach, the pond is drained only as much as necessary based on expected rainfall during a given precipitation event. However, the pond cannot be drained below a critical, minimum volume. Even with that caveat in place, however, Opti was able to keep roughly 2.7 million gallons of stormwater out of the city's combined sewers over just a 6-month period.

" When we talk about what makes a stormwater asset 'smart'," said Bedig, " it centers around this ability to have different strategies for different sizes and types of storms, with the same piece of infrastructure."

WHY PARTICLE?

Particle
Welcome to real IoT.

One of the Opti platform's greatest strengths is its flexibility and adaptability. Its ability to be reconfigured, re-implemented, and repurposed for a variety of different needs and infrastructure types has facilitated a rapid and geographically diverse adoption. That's why, today, you can find the Opti platform preventing erosion during Oregon's long, steady rains; and reducing the impact of flash-floods in New York.

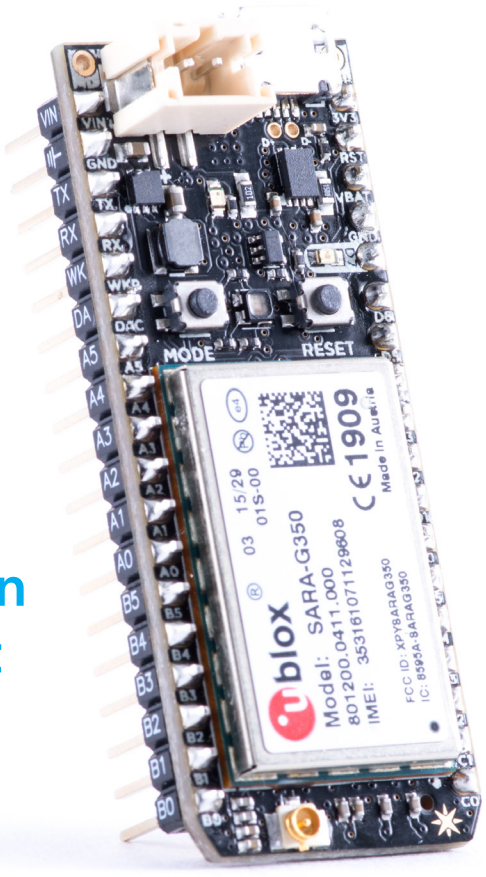
Achieving that supreme degree of adaptability, however, required an equally adaptable IoT platform.

"Prior to Particle, we had around 80 sites on the ground that we needed to move off of a legacy connectivity solution," said Bedig. "So, one of the requirements that imposed – other than some tight scheduling concerns – was a need for the replacement product to support a variety of established functionality."

"Compared to many of the other prototyping and IoT solutions, Particle gave us much more control to program our own behaviors onto the device. That ability to control the actual firmware – and to update it over the air – was something lacking in most other options we evaluated."

After selecting Particle, Opti went about integrating the Electron with their existing CMAC platform and getting their new units deployed in the field. What Bedig and the rest of the Opti team found with Particle was a resounding success. Perhaps most importantly, the Particle-based solution was faster and more responsive than their previous version. However, because they were on a tight time schedule, their time to market was also mission critical.

"The big win here is that we were able to replace all of our legacy devices without much trouble. We went from concept to full production in less than a year. And we wouldn't have gotten there if we didn't have Particle."



WHY PARTICLE? (CONT.)

Particle
Welcome to real IoT.

Bedig explained that a variety of factors contributed to Particle's ease of implementation, not least of which were the wealth of development resources and "out-of-the-box" connectivity.

"Between their commitment to open sourcing key parts of their stack we adopt, the transparency with which their thought leaders were made available, and some of the nitty-gritty details that come along with that – like how usable their APIs are, and how comprehensive their documentation is for those APIs – it really sets them apart."

"Another contributing factor was the single point of service for buying cellular services," explained Bedig. "We've been able to build a relationship that spans not only all the states we operate in, but the countries we'll soon be in as well. Particle provides the cellular data, the SIM cards, and the software services necessary to be the broker of that communication. This has dramatically sped up our ability to get to market and enhanced our operational efficiency."

"The transition to Particle has also reduced the time required for us to handle a support ticket," said Bedig. "In the past, our system was so heterogeneous depending on location and carrier, that we'd have to spend time undue time troubleshooting when a connection went down. Now, billing and basic SIM management is the same across all our sites, all under Particle's MVNO. And as a result, our footprint is much easier to manage."

CONCLUSION

For Opti, Particle represented a faster, more transparent, and more streamlined IoT solution. And with Particle now powering its IoT connectivity, Opti is achieving its objectives of improving water quality, preventing flooding, and mitigating combined sewer overflows across the United States. They count among their customers major cities such as Kansas City, MO, Philadelphia, PA, and Albany, NY. Their innovative and proven model for stormwater management is an exciting development for both environmental preservation and public safety.

This makes Opti part of a burgeoning group of businesses and NPOs that are using IoT to make the world a better place. And as this nascent field continues to develop, these organizations are poised to revolutionize the way we inhabit and co-habitat with the world.