www.pipelinepub.com
Volume 20, Issue 9

A Proactive Approach to Disaster Management

By: Rajesh Suseelan

Reports of wildfires, floods, and other natural disasters are never far from the headlines — a constant reminder of the growing threat of climate change.

Last year was the warmest on record, with millions of people being impacted by extreme weather events. These events are becoming more frequent and more intense as the world's climate changes, and developing countries are being hit the hardest. Emergency responses and long-term recovery are always more challenging in these nations — already struggling with war, political corruption, and fragile infrastructure and agriculture — which struggle to withstand and recover from disasters.

We now have less than six years to meet the target set out in the Paris Agreement of limiting global warming to 1.5°C. Reducing greenhouse gas emissions is critical, but we're also facing the very real prospect of a permanently changed climate. Some parts of the world may eventually become uninhabitable due to crop failures, heat, and adverse weather, leading to profound economic and social challenges.

As the U.S. heads into the Atlantic hurricane season, and countries in the western hemisphere enter the summer months, policymakers are recognizing the enormous challenges that lie ahead. The UN has made it clear that climate change cannot be tackled without technology, which is spurring on the industry to develop solutions aimed at proactively monitoring micro-changes that could indicate imminent disasters. Just as important are reliable communications services. Communities, particularly ones in remote areas, need to receive critical information and advice from the authorities before, during, and after a disaster.

Hydro-meteorological monitoring is a good example of this: it involves the observation, measurement, and analysis of atmospheric and hydrological parameters to understand and predict weather and water-related events. Historical records suggest that the first hydro meteorological observations date all the way back to ca. 3500 BC. But today, the ambiguities that were present in the first hydro-meteorological observations have been greatly reduced due to advances in monitoring, modeling, and forecasting. And now, underpinning it all, is next-generation satellite IoT connectivity, which allows users to collect data from multiple sensors and transform it into actionable insights in near real-time.

Equitable Solutions

With developing countries more vulnerable to the impact of climate change, solutions must be ultra-reliable and low-cost. Whatever the location, satellite IoT overcomes the problems associated with terrestrial solutions, including patchy coverage, speed and cost of deployment, access to remote areas, and reliability.

The number of use-cases for this technology is growing, too. We recently partnered with a national communications company in a developing nation as it set out to combine sensor technology and Big Data management to connect and empower communities around the country, particularly farmers who are often on the front line of climate-related change. With this IoT service, they will be able to combine data from different sources, including rainfall, river levels and soil moisture, in the most at-risk areas.

One area where satellite IoT could be particularly effective is in flood prevention. Developing countries are particularly vulnerable to flooding due to such factors as poorly developed drainage systems or flood defenses, rapid and unplanned urban growth in flood-prone areas, and agricultural vulnerability. Because of this ongoing threat, the country's government has invested in hundreds of weather stations in vulnerable areas; however, transmitting the vast amounts of data generated by these stations over satellite was prohibitively costly, especially as volumes increased. To get around this, the solution was to use standard IP protocols like TCP or UDP to enable satellite connectivity and to integrate these easily with widely available sensors.

Another key consideration is the availability of technical personnel when it comes to deployment. Few countries can depend entirely on specialist teams, which is why they look for intuitive solutions that are easy to implement and maintain. For this country, that meant low-cost, low-power satellite terminals, capable of integrating a satellite modem with a flat-panel antenna. The advantage of these terminals is that they work with both Ku- and Ka-band frequencies — helping to increase bandwidth, improve data processing and signal quality, and reduce latency and costs. In addition to eliminating the need for investment in additional infrastructure, it has also enabled seamless integration with existing sensors and systems.

Choosing the Right Technology and RF Band

Demand for innovative solutions is fueling rapid development of new technologies in the satellite IoT market. The danger, of course, is that we'll end up with a patchwork of different solutions without interoperability. For developing countries in particular, new solutions should continue to deliver value for money over the long term without further investment.

The versatility of satellite IoT is one of its strengths. Users can take advantage of different technologies and frequency bands depending on the application and environment. On the technology side, it's important to consider the satellite's orbital placement (i.e., GEO, MEO, or LEO), the architecture of the satellite network, and the modulation and coding schemes.

Depending on the band you choose, there's likely to be a trade-off between cost, performance, and its suitability for harsh environments, as outlined below. Ka/Ku Bands, for example, enable faster data transmission due to their higher bandwidth and are suitable for broadband services. These bands have traditionally been more susceptible to performance degradation in poor weather conditions, such as rain fade, but recent improvements in satellite technology and ground infrastructure technology have made them more reliable.

L-Band users can expect better penetration and reliability as well as less atmospheric interference, so it's well-suited to critical communications. The main limitation is lower bandwidth. The ISM band, meanwhile, is unlicensed and free, catering to those looking for low-cost IoT applications. The drawback is signal interference because of all the devices operating within its range. Finally, VHF benefits from extensive coverage and low power consumption to aid long-distance communication.

However, its suitability for IoT applications is limited due to low data rates and the potential for congestion.

Public-private Partnerships

Public-private partnerships in both developed and developing nations to date demonstrate the role that industry can play in helping governments tackle major challenges linked to long-standing connectivity issues and the challenges of mitigating the negative effects of climate change. The technology powering satellite IoT is reaching a new level of maturity, with more use cases to reassure stakeholders and, crucially, lower costs to implement. At the same time, innovation continues apace, fueled by demand from governments and international organizations like the European Space Agency (ESA).

As we've seen, high costs that would once have been an insurmountable barrier can now be overcome with low-cost hardware, 5G, and by using existing capacity and infrastructure. This means that developing countries can build resilience in the face of worsening climate change. There is no single solution. It will involve close collaboration between different technology companies, tailoring their solutions to different challenges while ensuring interoperability so that governments, particularly those in developing nations, can get the most from their technology for years to come. This approach will ultimately enable communities and governments to enhance their resilience and protect lives and livelihoods against the growing threat of natural disasters.

•