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THE POTENTIAL ROLE OF SATELLITE IOT IN DISASTER RISK REDUCTION IN INDONESIA

Abstract

Indonesia lies within the Ring of Fire, making the country highly prone to natural disasters such as earthquakes, volcanic eruptions, and tsunamis. The National Board for Disaster Management (BNPB) recorded a dramatically increasing trend in natural disasters, with more than 2,500 events and a total loss of at least 10 billion USD just in the year 2018 alone. Having developed its local satellite development capabilities and recognizing this as an urgent issue, the National Institute of Aeronautics and Space (LAPAN) published a conceptual mission design called the Nusantara Early Warning System. The proposed system shall be a LEO communication satellite constellation flying along the equator, providing 24/7 coverage for both pre-disaster and post-disaster purposes. This constellation aims to be a store-and-forward platform for many of the disaster monitoring sensors deployed all over the country, often in areas where cellular network is compromised. These sensors include seismometers, tsunami buoys, tidal gauges, and weather stations that are operated by national government agencies, mainly the Meteorological, Climatological, and Geophysical Agency (BMKG). Although many of them are already connected over commercial communication satellites, cost has always been an issue hindering the government from deploying sufficient number of sensors to protect the country entirely. Newer Internet-of-Things (IoT) technologies such as the Low Power Wide Area Network (LPWAN) has over the past few years been getting widely adopted and validated due to its long range, low power, and cost-effectiveness. This paper will investigate how satellite IoT utilizing modulation techniques such as in LPWAN can play a role for Indonesia to monitor its geophysical/meteorological activities reliably and affordably; enabling abundant number of sensors to be deployed nation-wide. Concepts from System Architecture framework are applied to design and evaluate a system consisting of terrestrial sensors, communication satellites, and a disaster operations center. The paper will also discuss how developing, operating, and maintaining such a complex system locally can give long-run technological, economic, and social benefits for the country. Results from this study will provide LAPAN, BMKG and similar agencies with insights on adopting satellite IoT for disaster risk reduction toward their journeys on sustainable development.