# A Community Balloon Network in Africa to Study Climate

## Brief Description

**To help fill a large gap in weather data in Western Africa, we are beginning a unique project with the help of local blockchain communities. The country of Nigeria is a leader in the telecommunications field and happens to straddle a region critical to hurricane and climate forecasting. We plan to build weather balloons using open source hardware and weather sensors, and pilot them in West Africa during the upcoming hurricane season. Interested blockchain community members can "mine" digital currency by launching the balloons to over 90,000 feet.**

**We are working with members of Telos4Africa as well as EOS Nairobi on this project. We hope to solidify the relationship with them during this engineering journey. We're hopeful that a shared interest in global currency and environmental sustainability will allow the first African balloon network to soon "take off."**

## Background

The deadliest effects of climate change over the next few decades include heat waves and stronger hurricanes landfalls, particularly in the United States. It is a little known fact that most hurricane activity actually begins over the western African subcontinent. About 85% of the most intense hurricanes that threaten the North America originate as tropical waves of moisture pushed westward by the African Easterly Jet thousands of miles away. It has been shown by IPCC climate models that the intensity of hurricanes will likely increase in a warming climate.

Weather observations on the surface of the earth are clustered most around Europe, Asia, North America, and shipping travel lanes between countries. This means forecasters can predict regional and large-scale weather more accurately in these locations than in areas of less commercial interest. Observations taken from remote locations help to calibrate satellites and are enormously valuable to weather and climate models. In some cases, getting a single observation from a remote location can be more important than getting a hundred observations from a place where other measurements are already present.

Saharan Africa is one of the most sparsely populated and remote areas on earth. The lack of training, resources, and interest in maintaining weather stations means we as a human species cannot observe the Saharan Air Layer that exists between 5,000 and 15,000 feet above western Africa and is one of the most important factors for hurricane formation. Most efforts to collect more data by government agencies have proven unreliable and often unwanted by African communities, as they do not see the merit in participating in these projects.

We're hoping that our mutual interest in global currency and environmental sustainability will provide many successful balloon launches.

## Full Project Description

High altitude ballooning has been an increasingly popular hobby in Europe and there are numerous cases that show that taking observations up to "near-space" conditions at 90,000 feet can be done with open-source hardware and software materials totaling less than fifty dollars[1,2]. The balloons themselves and helium gas are the most expensive parts of the process, and even this can total less than $300.

We take advantage of this low-cost solution by building weather balloons that periodically record temperature, humidity, and pressure during the flight and send the data to earth over a LoRa radio frequency connection. Once the ground-based LoRa gateway has confirmed the balloon has reached an altitude of 100mb (about 50,000 feet), the miner can unlock digital currency reward in Telos or bitcoin to their account.

From there, a miner has many options of converting bitcoin to local Nigerian naira. Also, the Telos4Africa project called Sesacash is currently converting Telos to naira and Ghanian cedis. A reference to their own TLOS proposal can be found here:

/ipfs/QmPix29FVvxB2M5gkCT2vBiwdnkzMX3nBWX9Fsysa58f1B/

Internet blackouts are frequent in Africa over cellular and ground infrastructure networks. Eventually, we hope to have a functioning mesh network of balloons that can send more than just weather data to public blockchains during these outages.

## Cycles 1-3 Technical Requirements

We use the pre-existing TheThingsNetwork (TTN) for LoRa communication, which is a functioning decentralized open source IoT network for amateur radio entrepreneurs. Using TTN means we don't have to reinvent the wheel with a unique gateway with its own packet forwarders. Another bonus is the ability to obtain telemetry data for the balloon using other community gateways within range of the balloon.

More on TheThingsNetwork can be found here:
https://www.thethingsnetwork.org

This balloon project mainly requires assembling hardware modules, but an application is needed to upload the data from the ground-based LoRa gateway and provide digital currency to the miner.

The balloon payload includes:

- Arduino Uno microcontroller (issued by TheThingsNetwork)
- BME280 temperature/humidity/pressure sensor
- Separate SX1278 LoRa-02 module
- 3 AA batteries with voltage conversion

Web application:

- Takes the weather data from TTN server to IPFS using js-ipfs library
- Sends IPFS hash to the Telos blockchain
- Submits eosio actions to the Telos network upon signature using miner's key

Additionally, we will need:

- LoRa gateway 433, 868MHz  (also TheThingsNetwork)
- 600-gallon weather balloon and helium gas
- Tupperware or styrofoam container for the hardware
- Other launch materials for regulatory purposes

This first cycle includes a test launch of the hardware over Kansas City, MO. Success of the launch can be found on the Telos blockchain with an IPFS hash pointing to the data collected during the flight.

## Future Work

Future cycles will fund trips to Nigeria and the equipment needed for repeatable balloon launches.

This project is part of a larger effort to run a functioning eosio blockchain over a LoRaWAN network. There are many benefits of running a blockchain (whose ultimate purpose is resource allocation) over LoRa… particularly for devices desiring a Class B network architecture. We see Africa as the perfect place for LoRa networks to bloom, as the devices require very little power and travel far distances.

If the reader is interested in this related work, they are encouraged to reach out to the author of this proposal.

## My experience before Eosio and Telos

Currently an embedded software engineer at Boeing
Worked at NASA Goddard on weather satellite algorithms (2016-2018)
Worked on a climate model in New Mexico for Master's thesis (2015-2016)
Various weather-related internships with NOAA (pre-2015)

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References:

[1]https://www.researchgate.net/publication/331754934_Study_on_Balloon_Network_Using_LoRa_Mesh_Communication_System
[2] https://www.hackster.io/news/to-space-and-back-with-lorawan-49d434752232