Cellular Network Communication for Ocean based hosts

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Abstract

The paper presents the Oceanic BeeHive (OBH) project, an idea that was conceived during the Nasa SpaceApps challenge 2019. It is an initial sketch of a project which aims to deploy a cellular network infrastructure for make internet connection available for cheap to all the ones who travel and live in the oceans. Unlike many pure space oriented alternatives for bringing internet connection in remote areas OBH is meant to be cheaper, it lays upon existing technologies as cellular networking and satellite communication.

It's clear that the reader must keep in mind that this paper is not meant to give a deep technical approach, instead this could be taken as an attempt to explain what the problem is and which our solution's targets.

As a team we had a lot of fun while developing this solution, it was nice to bounce from an idea to another, trying to understand what technology may be better or not in our specific use case, so that's all.

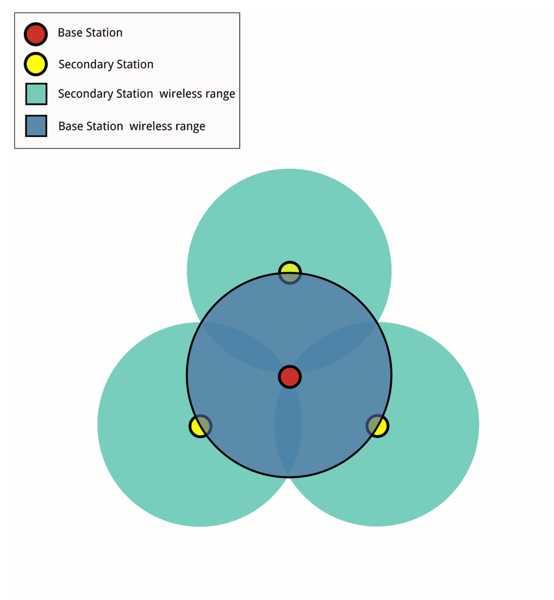
1.0 Introduction

Our proposed cellular network infrastructure is composed of two main components:

1. Base Station
2. Secondary Station

The Base Station behave as a gateway which connects the OBH cellular network to a satellite broadband network by this connecting with the rest of the internet and making the infrastructure part of the Global Area Network. Those stations modulates the satellite signal on the WiMax technology which is a confirmed and already-in-use standard for long distances broadband communications. The Secondary station is basically a WiMax repeater which retransmit the signal captured from the Base Station thus expanding the coverage area. The leafs of this systems are the WiMax modems which serve as an interface for the end users to the OBH.

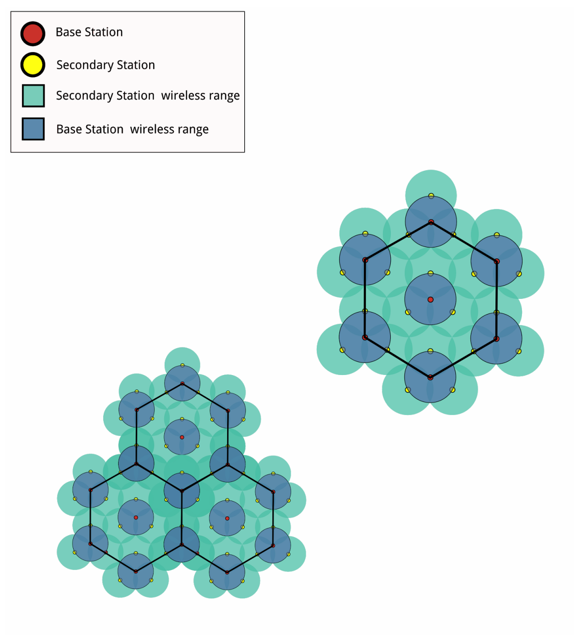
[image 1.0]



As image 1.0 shows a OBH single unit is composed by a Base Station e at least 3 secondary stations. Each of these stations can transmit WiMax signal in a diameter of 100km covering an area of 7850 km^2.

This infrastructure is easily expandable by chaining several single units in order to compose a wider coverage zone as image 2.0 expose.

[image 2.0]



2.0 Faced problems

The natural condition of oceans make it truly hard to implement a cellular network over the water. There are many natural issues that needs to be faced in order to build a stable and contiguous connection. The problems are:

2.1 Power supply into the ocean

As it comes to produce supply electrical power to an ocean floating object one possible solution that we evaluate is to provide a solar panels system.

Estimated needed power per one Base Station:
2.80 KW

Estimated power for square meter of panel surface:
213 W/m^2.

Total number of solar panels per unit: 6.

Considered solar panel model: X21-460-com (SunPower) [2.067m x 1.046m]

2.2 Transmission distances

Reaching long distances in order to decrease the maximum number of stations in the oceans is an important goal in terms of end-user price because as more stations would be needed by the architecture to work as more the end-user price would increase.
With this considerations our system implies a propelling mechanism which relies on gps position to keep the base stable.

2.3 Economical stuff

Panels costs: $2,99/W

Price for each station: €200.000

ITEM	QUANTITY	UNIT PRICE ($K)	AMOUNT($K)
Spectrum	-	-	-
Base Station			
Mast	1	10 - 20	10 – 20
Sectorial Radius	6	3.1 – 4.167	18.6 - 25
Power plant	1	10 - 25	10- 25
CPE			
Materials, poles, digging, UTP cables, cabinet switch	15	2 – 5 (bulk)	2 - 5 (bulk)
Switch Room			
Servers	2	5 - 10	5 - 20
Subtotal			**45.6 - 95**
Workmanship			
Network Setup + System setup + planning	15	.5 – 1.0	**75 - 15**
Subtotal			**53.1 – 110**

In addition to this (110k $) we have considered 90k$ for the surrounding structure, propellers and maintenance.

General components price:

- 387 base stations: €77.000.000
- 1161 secondary station: €232.000.000

Total: €309.000.000
Time to recover the investment: 6 years
Construction costs: €11.000.000
Total investment : €320.000.000

Service prices:
€1/day or €20/month

Profits:
Every day we estimated there are 300.000 people only in the northern Atlantic Ocean. We also estimated 150.000 people every day that will use our network, it makes the economic structure of our project sustainable.
With this project the internet on the oceans will be available to a wider range of people thanks to its lower prices.

3.0 Conclusions

The exposed infrastructure surely needs to be sharpened in all its aspects but it gives an initial blueprint of the available technology that could be used to build a cheap system.