

## DESCRIPTION

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GE03 communicates with coordinator thanks to a 2.4GHz protocol with low range and low power consumption (Zigbee). This document helps to set up GE03 in order to get a proper network.

The protocol is very sensitive to interferences and cannot be properly exploited indoors.

## INTRODUCTION

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The free space transmission budget is given by the Friis equation

$$B=Gr+Gt-20\log(4*\pi/l)-20\log(d)$$

Where

B is the transmission budget ,

Gr is the gain+efficiency of the receiver antenna

Gt is the gain+efficiency of the transmitting antenna

l is the wavelength, here  $l=0.125m$

And d is the distance.

We have with the RF modules a budget of 90dB. Internal antennas have a G of -3dB, which gives a max distance of propagation of 200m. The range between a 15dBi antenna and a Geo3 is over 650m, and the range between 2 15dBi antenna is over 10km.

Then comes the natural impairments of real life propagation. Polarization errors, and masks affects greatly the budget.

It is generally admitted that any obstacle within the first Fresnel zone creation majors propagation losses. The first Fresnel zone is an ellipsoid with great axis is the distance D(in km) between the 2 antennas and the small axis size (in m) equals  $5.6*\sqrt{D}$ .

This gives for a 200m propagation a minimum height of 2.5m , and for a 10 km a height of 17.7m.

Base plate of geocube is metallic making very difficult for radio to go through. This why geocubes can only intercommunicate when they are at the same level. and a collecting antenna (the one of the coordinator or an external antenna of geocube) must be placed above the cubes.

It has been reported problems while using geocubes on roof tops: those are often covered with aluminum sheets for rain isolation purposes, and those can create multipath interferences which completely jam the transmission.

## MEASUREMENTS

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The experiments have been conducted in a field . In a different environment (with concrete or metal for instance) The results may differ greatly.

Between 2 geocubes placed at 20 cm over the ground (grass) the range is approx 30 m.



Between 2 geocubes placed at 1m height the range is approx 150m,

Between 2 geocubes placed at 1.6m height the range is approx 200m;

An experiment between a top of a cliff and a beach has been conducted with a pair of 14 dBi antennas (one omni and one directive) and leads to a 10km range:

