

# Renewable Energy Ad-hoc Communication Hub (REACH)

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## Introduction:

Many people in developing countries cannot enjoy the benefit brought by mobile communication, such as education, e-health, medical treatment and disaster warning etc. Because of the poor power supply network infrastructure, mobile coverage in developing countries cannot keep up with the fast growth of mobile phone users, for example in Africa, the average network coverage is only 15%. It is predicted that mobile coverage there will only expand slowly, as the conventional electricity-hungry mobile base stations need the power grid to operate. This will increase the emissions of carbon dioxide and other toxic pollutant. REARCH is an immediate and clean solution to address this problem. With its green power source and embedded antenna system design, it can be efficiently deployed to form its co-operative ad-hoc mobile networks for expanding the coverage in areas far away from the national power grids. Therefore people living in remote or off-power-grid areas could access mobile network connections for the first time.

## Technology:

### i) Antenna System

The key technology of REARCH is the novel embedded high performance antenna systems that can amplify and relay the mobile phone signal to the users in the remote areas. There are reception blind spots, power/range problems in the existing base station scenario in developing countries; we cannot simply increase the output power to cover the blind spots and extend the range. An alternative smart way to solve the problem is to use a combination of high-gain, may be beamforming, antenna and high-efficiency signal repeater to collect radio waves from the nearby mobile phone base stations. Then the amplified signal can either transmit to other stations for even longer range communication through the ad-hoc network technology, or create a signal shower through the omni-directional antenna serving the people around the stations. REARCH's embedded design enables easy deployment of the station in different geographical environments.

### ii) Renewable Energy Source

The renewable energy source, for example flexible solar panels mounted on the foldable top of the stations, will generate electricity without connecting to any power plants. The generated electricity will power the antenna system and charge up the high-capacity reserve batteries. It also has a recharge socket for mobile phones or other mobile devices. This innovation will significantly reduce the discharge of carbon dioxide and other toxic pollutant. Moreover REARCH will work particularly well initially in African and Middle Eastern countries, because many people there live in small remote and separated villages located around different part of the countries. It is not cost effective to setup a dedicated mobile base station and the required power grid to serve a small community.

### Prototypes:

As shown in Fig. 1, the first version of prototypes was built on golf umbrellas. Four sets of three high-efficiency amorphous silicon based flexible solar panels were arranged in an alternative manner to cope with the holding gesture of the users. The waterproof panel is about  $195 \times 58 \times 0.5 \text{ mm}^3$  and weighs 18g. Maximum output 2 V, 250 mA, 0.5 W. The three panels were connected in series to provide 6V, 250 mA for charging the backup batteries (Fig. 2) or mobile devices such as smartphones. A bright LED was also inserted on the umbrella handle (Fig. 3)



Fig. 1: Outlook of the prototype



Fig. 2: Backup batteries



Fig. 3: A brightness LED on the handle

The weak 3G mobile signal received by the high gain antenna embedded in the top of the stem of the umbrella (Fig. 4) was passed to a low noise amplifier. The gain of the amplifier is 10 dB. The amplified RF signal was re-radiated through a less directional antenna to the users around the umbrella.

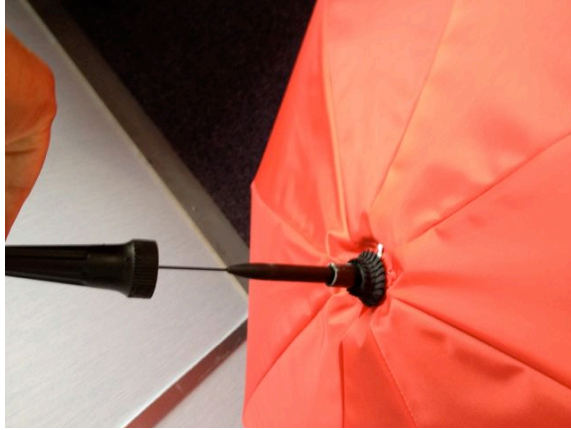


Fig. 4: High gain antenna embedded in the stem

### **Conclusion**

Three functional prototypes, in the form of golf umbrella, have been built, and were field-tested in a large outdoor concert. We are working on the second version of REACH for the small-scale deployment in Africa.