Sustainable Communication Networks
Prof. Dr. Anna Förster

In Cooperation with:
Prof. Dr. Sven Kerzenmacher ( Faculty 4) and Prof. Dr. Christian Wild (Faculty 2)

# Autonomous underwater sensor system for coral reef eutrophication monitoring: IoT System Design

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| **Prerequisites:** | - Basic IoT knowledge (as from the course Internet of Things)<br>- Basic knowledge of various IoT communication technologies<br>- Programming skills (Python, C)<br>- Interest in learning about fuel cells and coral reefs |
| **Level:** | This topic is appropriate for Bachelor Thesis or Master Project |
| **Language:** | German or English |

## Introduction

In Sediment Microbial Fuel Cells (SMFCs) naturally occurring electro-active bacteria generate an electric current between an anode (embedded in the sediment/ocean floor with no oxygen present) and a cathode (submerged in the oxygen-rich ocean water). Such devices can be used to generate electricity from the sub-aquatic environment for e.g. autonomous sensor networks, but can also serve as a sensor for e.g. eutrophication (presence of excessive amounts of nutrients e.g. from waste water) that can negatively affect sensitive marine environments such as coral reefs. In this project, a system architecture is targeted to monitor coral reefs with the above used fuel cell. The fuel cell serves both as the energy source and as the sensor itself.

## Project description

The targeted system architecture must describe all elements of the system, starting from the sensor node with the attached fuel cell, and ending with delivering the data to the central cloud service. The steps to follow include:

1. Familiarise yourself with underwater communication technologies and especially their properties in terms of communication range and bandwidth (references to start with are at the bottom).
2. Perform structured interviews with the cooperation partners (Prof. Wild and Prof. Kerzenmacher) to derive all needed system requirements, such as power output of the fuel cell at different eutrophication levels; the position of the coral reefs to be monitored, their depth and their distance from land; the size and the interface of the fuel cell. During these interviews, you will also have the opportunity to see the fuel cell.
3. Evaluate the available underwater communication technologies in respect to the derived system requirements.
4. Design at least two different system architectures, compare them in terms of their advantages and disadvantages (cost, maintenance ease, market availability of components, energy requirements, etc.) and make a recommendation.

## Contact

If you are interested in this work, please contact us via mail: projects@comnets.uni-bremen.de

## References


[1] C. Gussen et al., A Survey of Underwater Wireless Communication Technologies. Journal of Communication and Information Systems, Vol. 31, Issue 1, pp. 242–255, 2016

[2] M. Jouhari et al., Underwater Wireless Sensor Networks: A Survey on Enabling Technologies, Localization Protocols, and Internet of Underwater Things. IEEE Access, Vol. 7, pp. 96879–96899, 2019