Concerto: A Near Surface Underwater Acoustic Network

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INTRODUCTION

Concerto project is a technology startup whose goal is to generate a technology that allows us to build acoustics based transport mesh networks. The project promotes integration of proven appropiate technologies and research results, with a pragmatic approach to open research problems (Akyildiz, Pompili, and Melodia 2006)

The team will design and protect the intellectual property of the ASIC that implements the logic and protocols allowing large numbers of devices to be built around this chipset, for both client and server devices.

We have chosen precision aquiculture as our initial market to develop a set of products based on the *Concerto* technology.

MARKET FOCUS

Concerto project will focus on the precision aquiculture industry where a large number of divers are hired for jobs that could be best done by a network of sensors able to monitor both, live stock, and water conditions anytime. Also, alarm systems could be built to protect the livestock from most of its natural predators, like seals, which could be fended off by playing recordings of killer whales when seals' noise is detected.

Concerto technology could also help the design of cheap diving computers connected to the boat and between themselves that will allow dive masters, both underwater or on the surface, to follow each of his/her divers position, depth and condition. Given that Chile has the worst record of diving accidents in professional diving due to the challenges of cold water diving, this technology could have a large impact in the country. Because of the directivity of the waves in water, geo-location and geo-referentiation are possible to build into the protocols.

Another possible market for the *Concerto* technology would be the development of electro-acoustic control systems for low cost underwater RPV (Remote Propelled Vehicle), oriented to the sea farming community.

TECHNOLOGY DESCRIPTION

The development of a standard RF (Radio Frequency) based TCP/IP transport technology like IEEE 802.11 allowed a burgeoning of products and solutions to be developed at low cost in the market, which, in turn, enabled new endeavors and solutions to be built. Nevertheless, RF does have the natural physical limits of electromagnetic waves, which include the inability to propagate through water, other liquids, metal, inside Faraday boxes and rocks, especially when loaded with metals like in underground mining operations.

Concerto is a technology that uses sonic waves as the signal's carrier. This allows us to circumvent the limitations imposed by physics to RF and to build IEEE 802.11-like mesh acoustics networks to support a TCP/IP-like protocol suite optimized to operate underwater up to 40 meters deep, targeted both, at VoIP and Data communications.

Sonic waves do have their own physical limitations, such as variable propagation delays, poor power/distance ratio and bandwidth constrains. However, for the markets we have targeted, these physical limits do not impose insurmountable difficulties. Our main research challenges are multipath, fading and high & variable propagation delays.

Currently, the state of the art in this area of the industry is in a state quite similar to the RF industry before the introduction of the IEEE 802.11 standard in terms of status, with a number of proprietary solutions in use, or being developed, but with no standards and high costs.

Concerto project is a technology startup and its goal is to generate and protect relevant Intellectual Property in order to make it a IETF & IEEE standards.

The team will design and protect the ASIC that implements the physics and the protocols allowing large numbers of devices to be built around this chipset, for both client and server devices. The server and client devices for the initial target market will also be developed by the team., but the end game, would be to generate a vibrant ecosystem of companies using our ASIC chipset to design and build large numbers of devices.

SOLUTION ARCHITECTURE

Three different devices will allow us to build complete sensor networks solutions as it is shown in Figure 1:

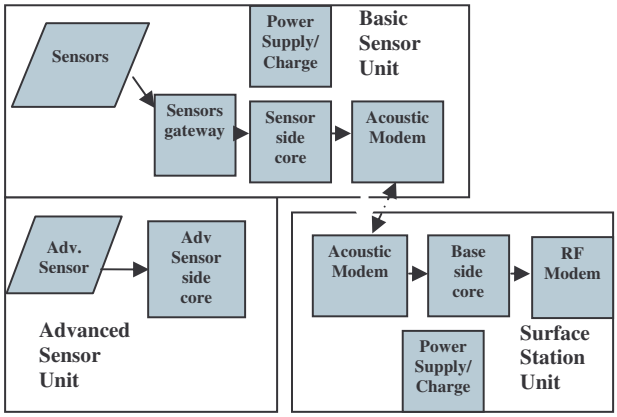

Figure 1: Concerto`s General Architecture

a.- Surface Station Unit:
This is the device that will be floating on the surface communicate with sensors using acoustic transducers. Communication with other surface station units, and with aquiculture farming company intranet will be based on IEEE 802.11 standards. The Surface Station is a communication router powered by a combination of solar cells and batteries.

b.- Basic Sensor Unit:
This is an underwater device that includes the following sensors: temperature, light, UV, Ph, pressure, and oxygen content of the water. The electronics to support data capture and transmition, as well as the acoustic transducer and the power unit is all encased in a waterproof spherical casing.

c.- Advanced Sensor Unit:
This unit is an add-on to the basic sensor unit that includes a video camera, microphone, and enough processing capabilities for data correlation and analysis, like predators recognition, for example.

PLANNING

The development path proposed for the project has 3 phases:

Phase 1: Research and System-level prototype development: In this phase an underwater networks reseach lab should be implemented with infrastructure oriented to design, simulation and basic idea testing.
Phase 2: Testing and validation: In this phase, a small number of units will be developed and placed in industry targets to test operational and performance attributes of the solution.
Phase 3: Technology transfer and business: During this phase manufacturing process will be transfered to a technologically mature commercial foundry for high-volume production.

STATUS

An initial business plan has been submitted to Intel Latinoamerican Challenge being ranked between first 45 Latin american projects and between the first 8 chilean projects presented to the contest. Economical pre-evaluation shows the project is economically feasible.
The project is a joint effort of academics and students of the Faculty of Engineering of Universidad Andrés Bello.

CONCLUSIONS

* This is a technological startup in an initial stage seeking for academic and industry partners.
* Focusing the project on specific markets simplify technological challenges, lowering project costs.

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