SMART Ocean Ireland

"Towards a New Horizon Harnessing Ireland's Potential as a European and Global Centre for Ocean Technology"

March 22/23, 2010

Session 2: Environment: Sensing, Communication and Forecasting

Case Study 3:

Shoal Project – Autonomous Pollution Sensing in the Marine Environment

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Summary of Presentation

- Tyndall National Institute
- Wireless Sensors for Water Quality Monitoring
- Autonomous Wireless Sensors Networks
  "Deploy and Forget"
  "The Sensor Web"
- EU FP7 SHOAL Project

Tyndall National Institute

- Largest ICT research institute in Ireland:
  - Photonics, Microelectronics.
  - Nanotechnology, Microsystems.
- Only 3rd-level silicon fabrication facility.
- Critical mass of researchers/facilities:
  - 400+ staff (120 graduate students).
  - €200m capital investment.
  - €30m annual turnover.
  - October 2009 – New €50m facility.
- Applications – Communications, Energy, Health, Environment.
- Strategic national/international partnerships.

"From Atoms to Systems ……

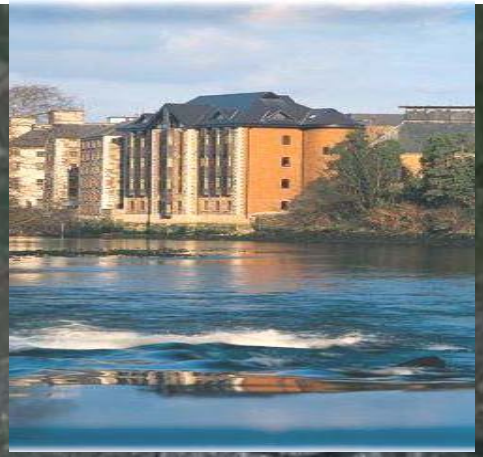
…… Generating Value from Research for Ireland"

SMARTCOAST/DEPLOY (EPA/MI)

November 19/20th, 2009 www.corkfloodwatch.com

Deployment River Lee, Cork City

Inniscarra Reservoir x 2



Lee Road

Tyndall @ Lee Maltings

Tivoli Docks

Marine Institute Foras na Mara

epa

NCSR National Centre for Sensor Research

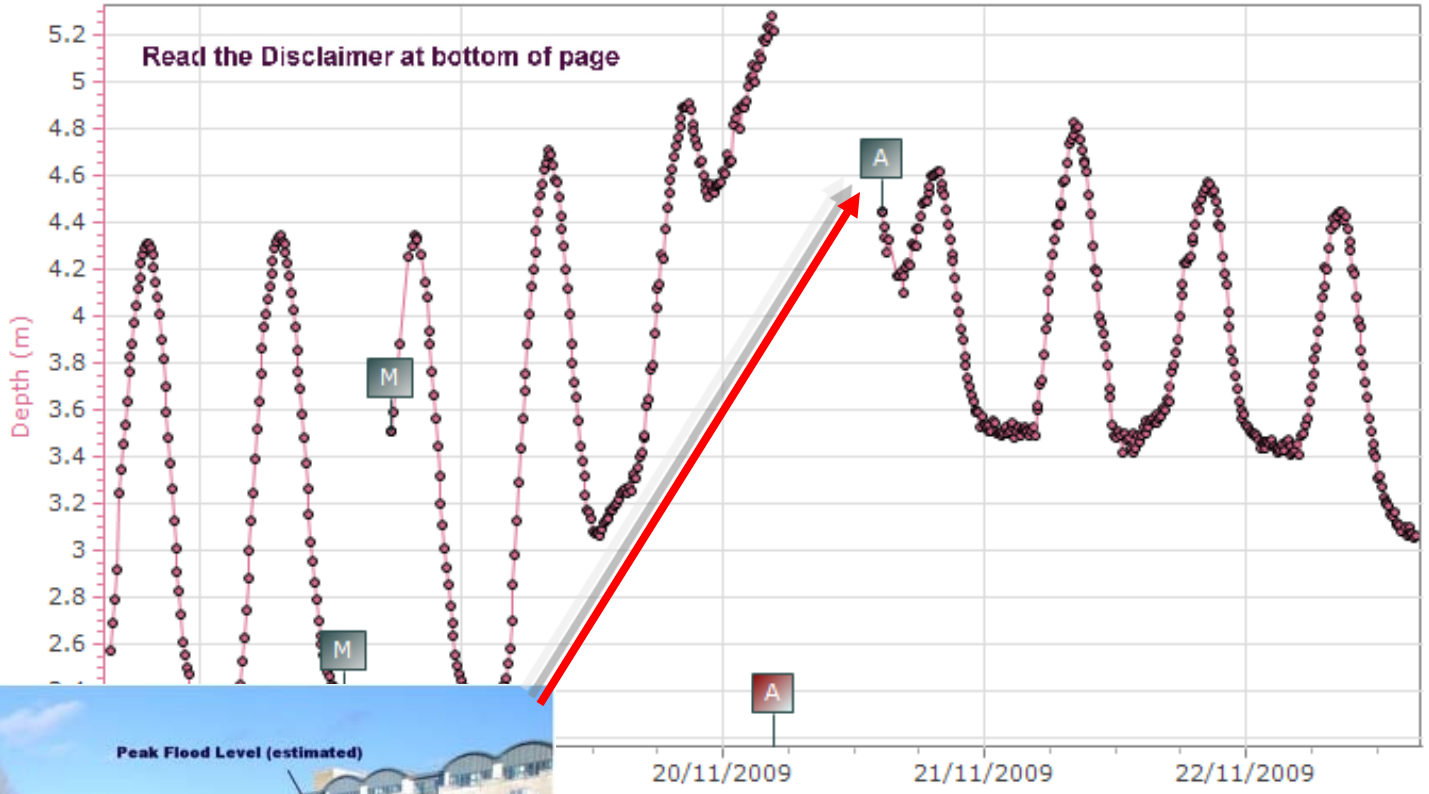
Intelligent Data Systems

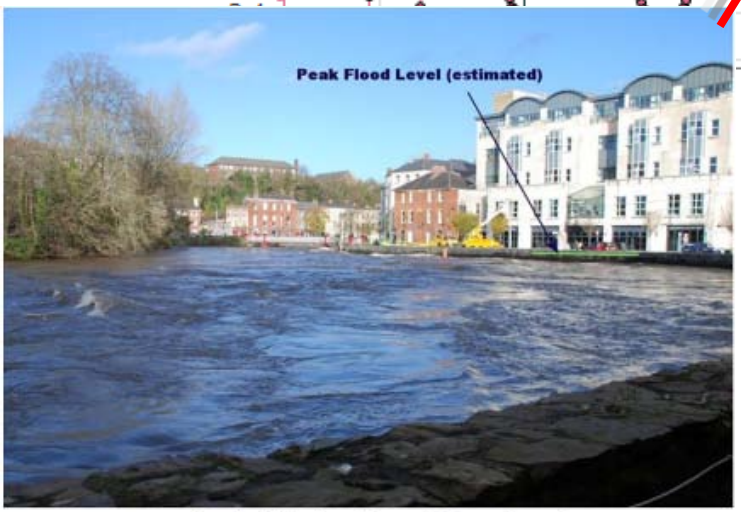
Tyndall National Institute

DEPLOY A Technology Demonstration

Autonomous River Depth Measurements

€250million flood damage





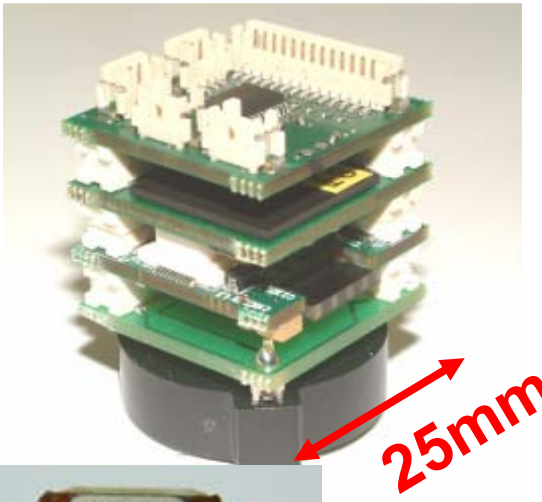
Showing Water Level Approx 10 hours after peak

Live depth data (Deploy Project) & video streaming (Edel O'Connor, Alan Smeatonm, DCU). Providing data in real time for monitoring and analysis.

Microsystems Grand Challenge

"deploy and forget"

- **Autonomous sensors:**
  - Interface to physical world.
  - Embedded intelligence.
  - Miniaturised.
  - Wireless communications, Networked.
  - Self-powered.



- **Key Research Challenges:**
  - Miniaturised, robust packaging.
  - Energy harvesting.
  - Low cost, high volume manufacturable.
  - Massive scaleability.
  - Self cleaning chemo/bio-sensors.

"Cost nothing, Take up no Space, Last forever"

SFI CLARITY CSET

"The Sensor Web"

CLARITY
clarity-centre.org

UCD DUBLIN

DCU

Tyndall National Institute

sfi
science foundation ireland
fondúireacht eolaíochta éireann

IBM

changingworlds

Foster-Miller
A QinetiQ Company

EPISENSOR

Marine Institute
Foras na Mara

epa
Environmental Protection Agency

- bringing information to life.
- focus on the 'Sensor Web'.
- captures the intersection between Adaptive Sensin and Information Discovery.
- Applications:
  - Environment – Water and Air Quality.
  - Health and Fitness - Wearable Electronics.
  - Energy monitoring in the home.
- €16m Budget over 5 years.

FP7 SHOAL

Search and monitoring of **H**armful contaminants, **O**ther pollut**A**nts and **L**eaks in vessels in port using a swarm of robotic fish.

Project Budget: €4.23M

University of Strathclyde Engineering

Tyndall National Institute

Puerto de Gijón

University of Essex

BMT Group

THALES

THALES SAFARE

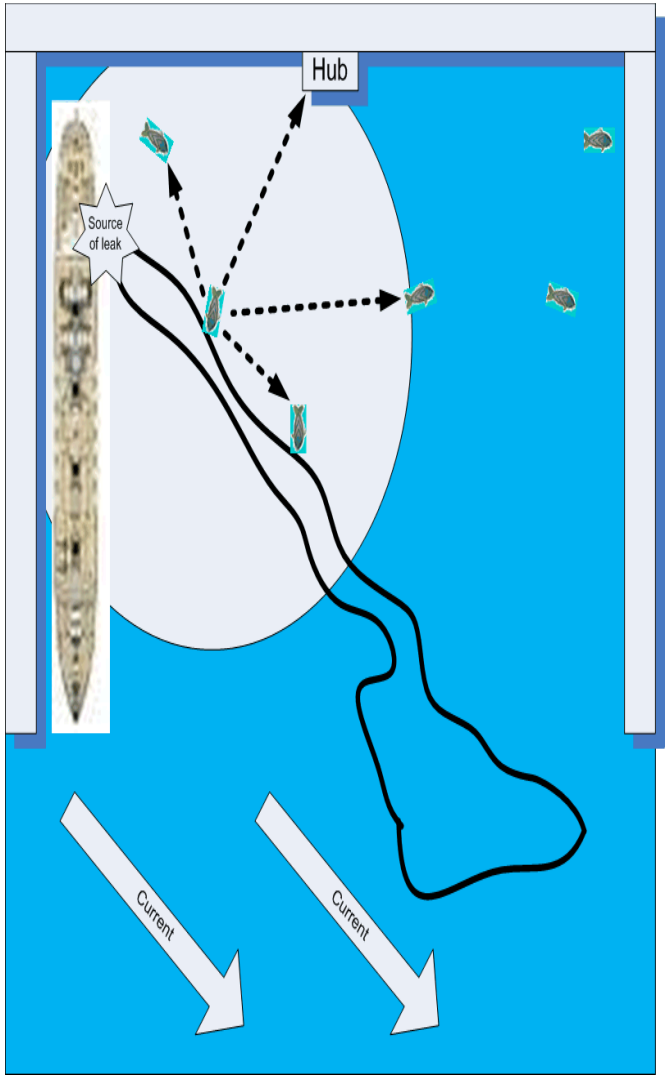
SHOAL @ Tyndall
Instrumentation and software: Dr. Vladimir Ogurtsov.
Chemical Sensors: Dr. Grégoire Herzog.

2009-2012
FP7 ICT-231646

Objective and Strategy

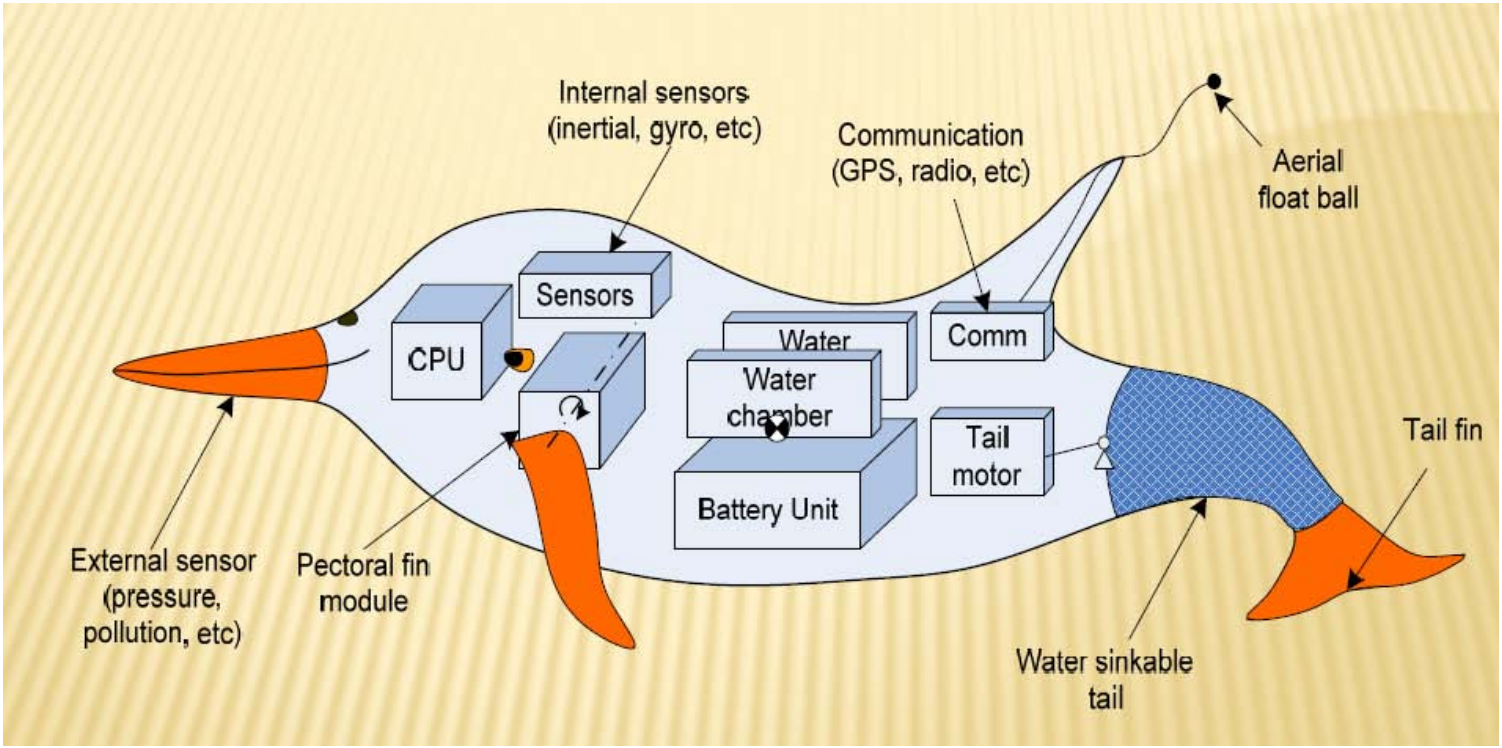
To design and develop three fully functional robotic fish equipped with chemical sensors and a scalable communications infrastructure.

1. Each robotic fish will detect pollution with on-board electrochemical sensors.
2. Underwater communications between fish and to the hub located on-shore.
3. Swarm intelligence will allow the fast and accurate localisation of the pollution source.
4. Results transferred to Port Authority in real time.



Robotic Fish Architecture

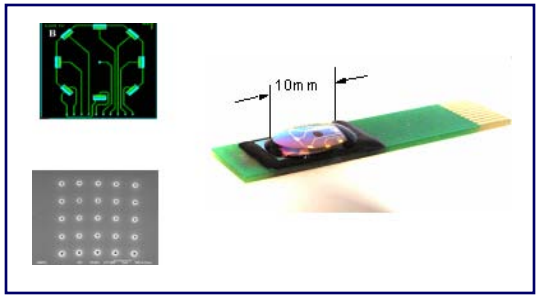
Based on existing prototypes, the consortium will develop a new generation of robotic fish that can operate autonomously in the port to search and monitor harmful contaminants cooperatively.



University of Essex

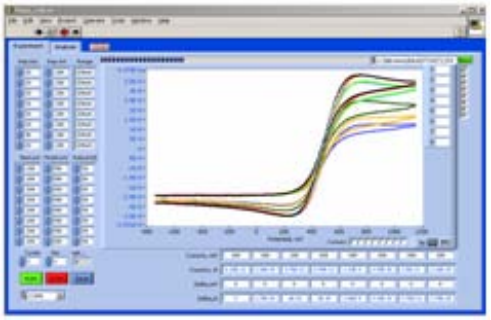
Tyndall's Role

Development of portable and intelligent chemical sensing system capable of autonomous operation on board the robotic fish:



- **Electrochemical sensors for marine pollutants and seawater quality in real-time (heavy metals and phenol derivatives, dissolved oxygen concentration, seawater conductivity and the oxido-reduction potential).**

- **On-board instrumentation.**



- **Intelligent signal processing and data interpretation algorithms capable of operation in autonomous mode.**

Tyndall National Institute

Final field trials

Field trials will take place in 2012 in the Port of Gijón in Spain.

Two locations in the Port have been selected to hold the field trials. They have been selected regarding certain parameters (underwater current, vessel movement, access to the sea…)

Puerto de Gijón

Autoridad Portuaria de Gijón

Conclusions

- Tyndall a strategic partner in next generation wireless sensor technology.
- Autonomous wireless sensor networks require development of “deploy and forget” systems and the integration with the “sensor web”.
- Ireland’s opportunity: clustering across the supply chain/value of research and industry (SMEs and MNCs).