
TSSG
TELECOMMUNICATIONS
SOFTWARE & SYSTEMS GROUP
sfi
HEA
Higher Education Authority
An tÚdarás um Ard-Oideachas
ENTERPRISE
IRELAND
Waterford Institute of Technology
INSTITIÚID TEICNEOLAÍOCHTA PHORT LÁIRGE

“Ireland the Digital Lighthouse”

Programmable Marine Monitoring and Communication Network

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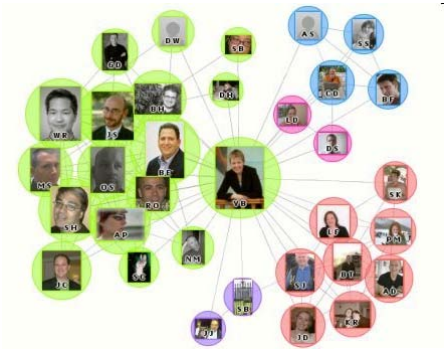
Telecommunications Software and Systems Group (TSSG) Facts

- TSSG provides leadership in research, innovation and commercialisation in ***Communications Network and Service Management***
  - Top 15 companies in European Future Internet (EU Framework programme), SFI SCR FAME, HEA PRTLI Futurecom, EI IST Commercialisation program
  - Leading the Communications Management for networks and services in Europe, providing World class excellence across all areas of the Research and Innovation lifecycle.
  - Creating jobs both in TSSG (140) and in wider Economy (60)
  - 55M Euro research funding 1997-2007
  - Mobile Services cluster of 14 Companies

Emerging Communication Environment



System Solution

Integrated End-to-End

User – Centric

Service Based

Autonomic

Context Aware

Open Multi-platform

Energy Efficient

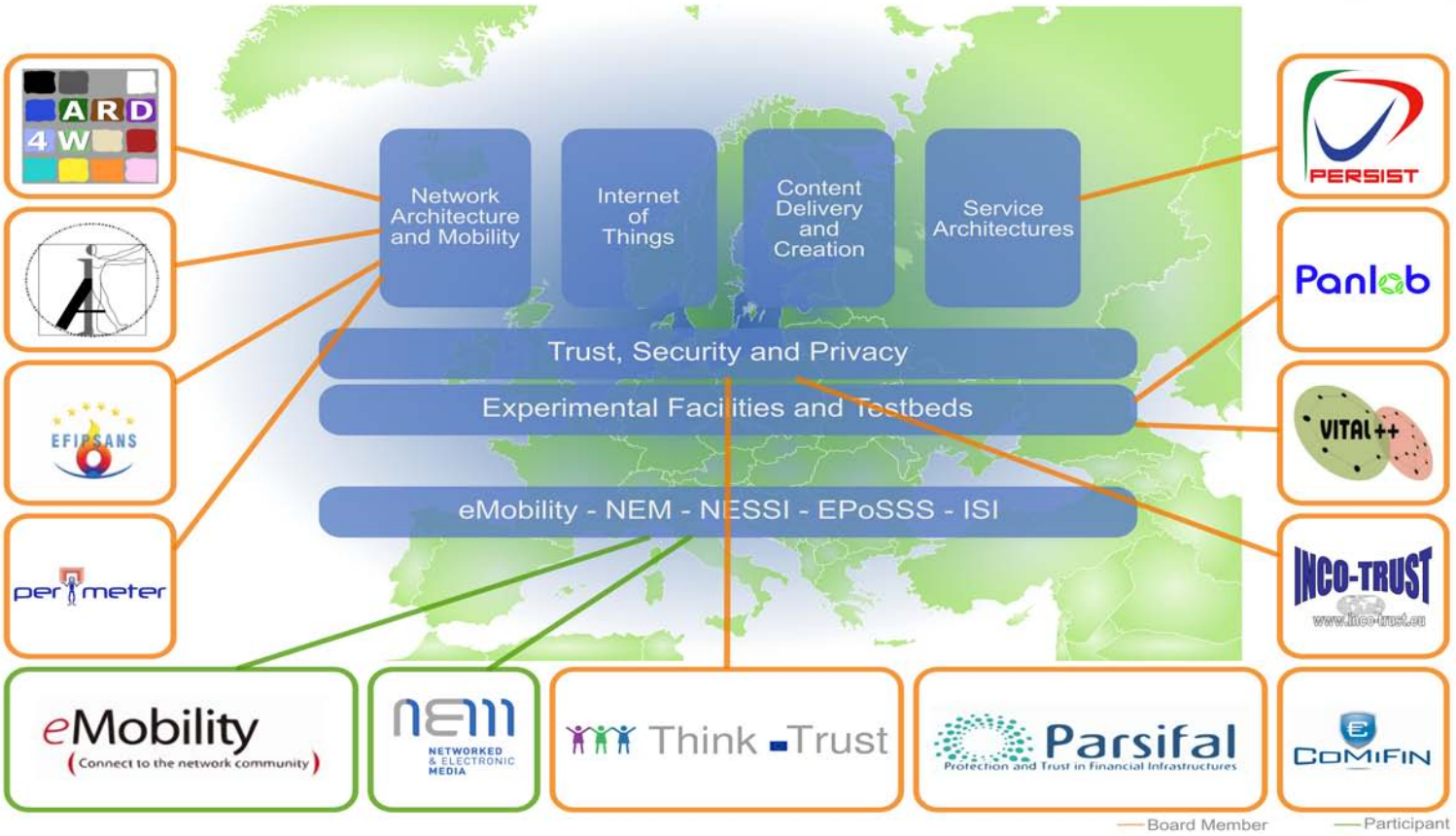
Location based

- GSM/EDGE
- UMTS (3G)
- Cable TV
- WiMax
- IEEE Wi-Fi (802.11x)
- IEEE Ethernet (802.3x)
- IEEE PAN (802.15)

Emerging Communication Environment

Services	*Networks*
Service Creation Environments	Autonomic Network Management
Service composition and integration	Management of Smart Spaces
Service Discovery and Context Awareness	Traffic Management and resource discovery
Policy Management, Service level agreements, Trust and Security Bio-Inspired models	

TSSG Research at the Centre of the Future Internet



First European Commercial Grade Next Generation Network Testbed

Objective

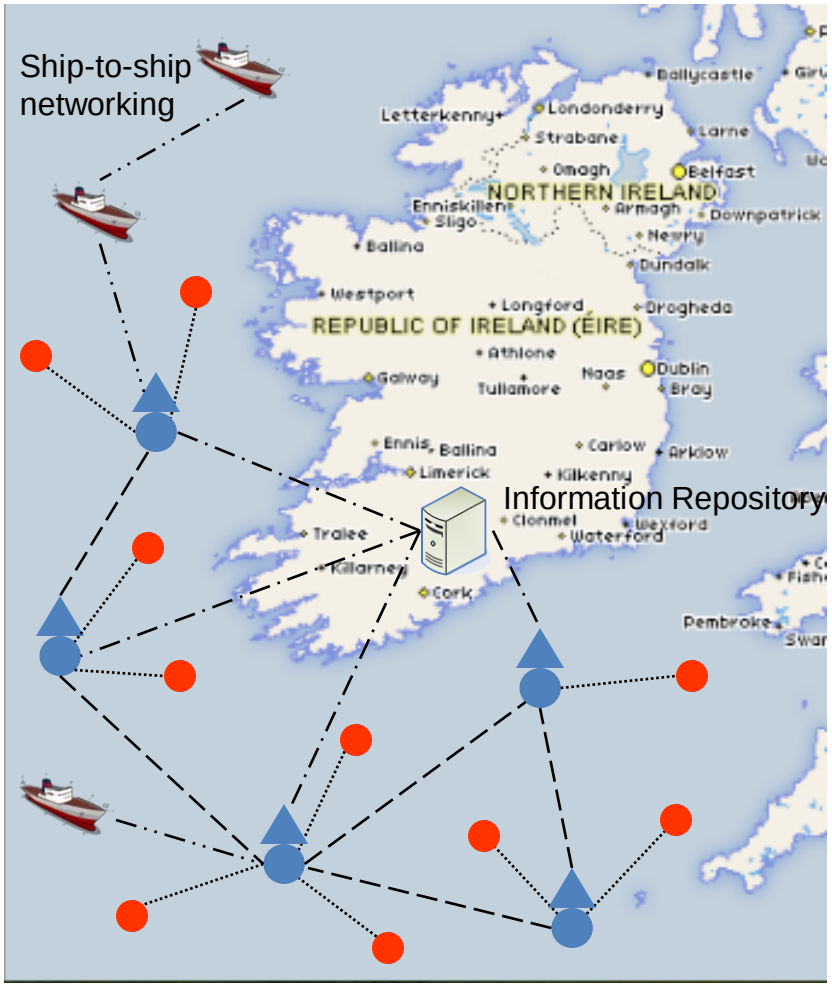
- Create a framework for gathering information from marine based sensors
- Framework allows multiple types of data to be collected from the multi-purpose heterogeneous sensor networks
- Third party users should be able to program the type of data from framework

  E. g. Number of ships passing a particular region

  Environmental researcher may want to know how pollution resulting from ship traffic

  Maritime security may want to maintain statistics of ships passing region
- Information are collected and retrieved from Information repository

Programmable Bay



Buoys

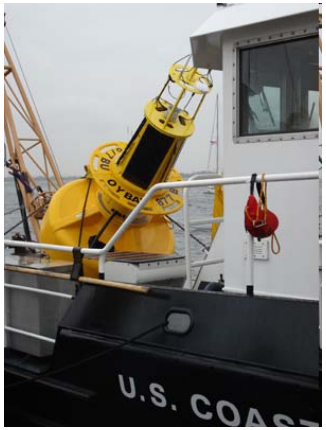
Underwater sensor (communicating via acoustic signals)

Current Systems

- Less temporal and special coverage
- Extremely high cost

Buoys: Real-time, Satellite communications

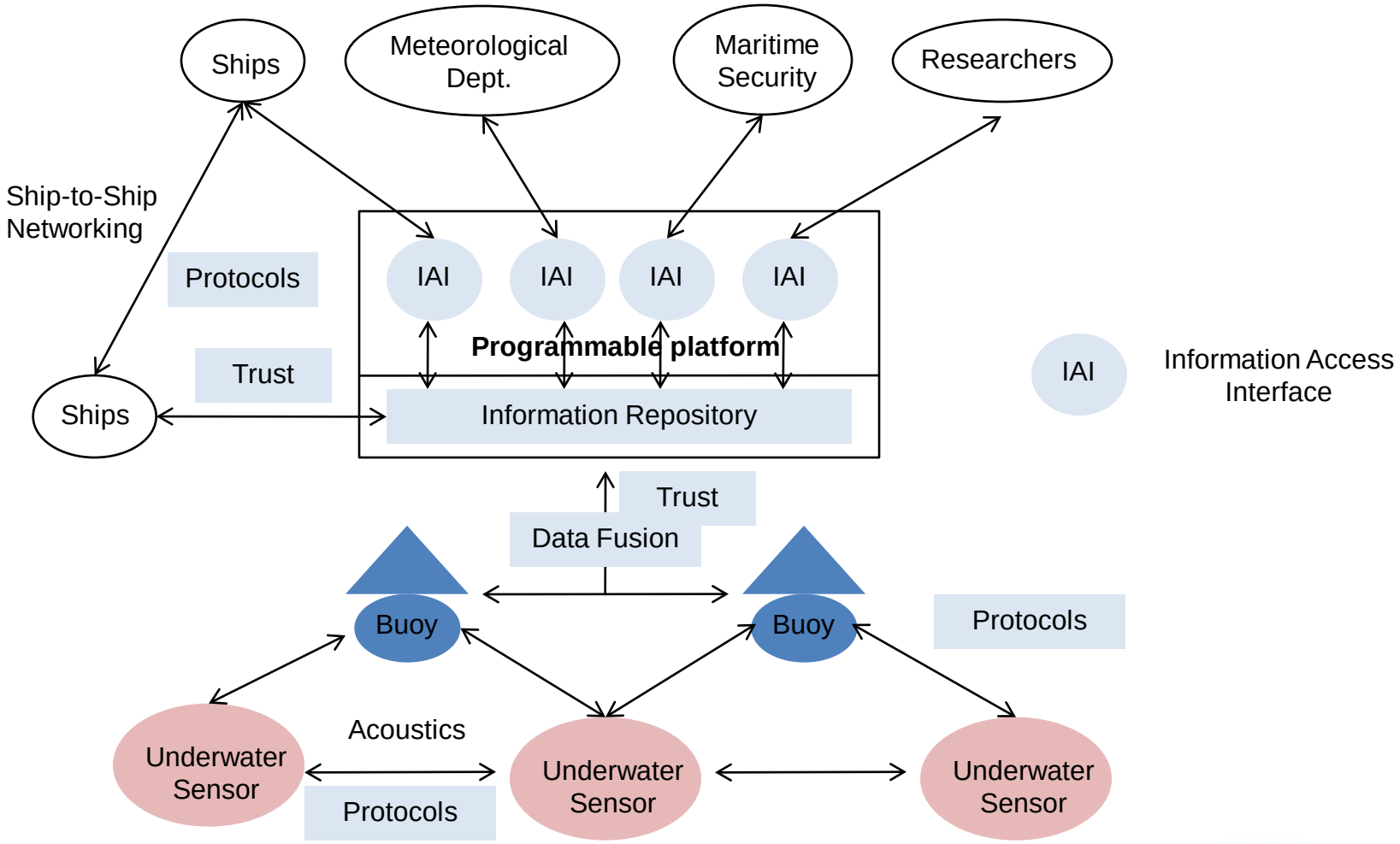
Data collection vessels: Non-real-time, Deploy-monitor-recover



Research Innovations

- Development of protocols for information to be collected from sensors
  - Unlike normal sensors, acoustic based underwater sensors have low data rate and high unreliability –> requires new protocols
- Trust and Reputation based solutions for determining the parties providing information to Information Repository
- Data fusion mechanisms between sensors and buoys, that aggregate information to the repository
- Development of programmable platform to allow access by third party users

Architecture and Protocols



Communication Challenges

- Mote Sensor Networks (IEEE 802.15.4)
  - 2.4 GHz, 250kbps, 30-90m
- Underwater – Acoustic (30-300Hz)
  - High power, Large antennas
- RF in research (Optical – Scattering problem)

Range	<1m	10m	50m	200m	2km	10km
RF in Seawater	Up to 100Mbps	100kbps	5kbps	100bps	10bps	1bps
RF in Freshwater	Up to 100Mbps	1Mbps	100kbps	1kpbs	10bps	1bps

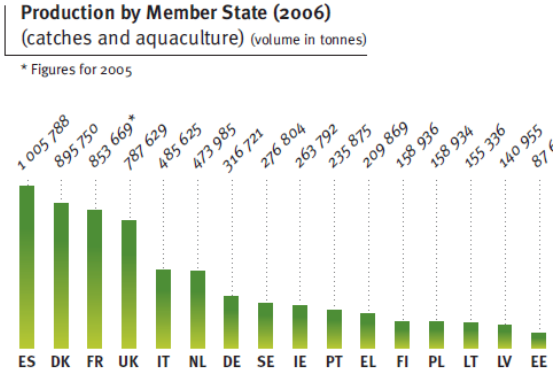
Wireless Fibre Systems Ltd

Applications

- Monitoring of offshore renewable energy infrastructure
  - Wind and Tidal plants
- Pollution control
  - Environmental and sea-life monitoring (Offshore fish farms)
- Traffic monitoring
  - Ships register as they pass nodes in the bay (precise location of ships)
  - Authenticity of goods that are transported into Europe (where Ireland is the gateway)
  - Maritime and boarder security

Services to the Fisheries

- Confirm to EU fish quotas



- Identify movements of fish
  - Reach to the right type and right amount

Fish Robots

Tagged Fish

- Collaboration between ships
  - Void wasting catches

Tracking Cargo

- Tracking containers with sensors
  - Location, Weigh change, Vibration etc.
  - Human hiding (USA Homeland security – Applied NanoTech)
  - Texas-Canada NASCO Corridor (Lockheed Martin project)
  - IBM Returnable Container Management system
- Rapid, reliable and portable Bio-sensors
  - Food contaminations: E. Coli (using Lasers by Purdue Uni)

Future Sensors

- Mote sensors have a life-time
- Passive RFID: Limited range, only identifications
- Energy harvesting wireless sensors (battery-free): solar, vibration, thermal and RF energy
  - RFID Sensor Networks (RSN) by Intel

	CPU	Sensing	Communication	Range	Power	Lifetime	Size (inches)
WSN (Mote)	Yes	Yes	Peer-to-peer	Any	Battery	< 3 yrs	3.0x1.3x.82 (2.16 in^3)
RFID Tag	No	No	Asymmetric	30 ft	Harvested	Indefinite	6.1x0.7x.02 (0.08 in^3)
RSN	Yes	Yes	Asymmetric	10 ft	Harvested	Indefinite	5.5x0.5x.10 (0.60 in^3)

Sensor Networking

- All-IP Networks -> Re-engineer TCP/IP or Revolutionary Designs
  - Easy integration, Interoperability, Public accessibility
  - IPSO Alliance, IETF (6LowPAN, ROLL, CORE working groups)
- Self-organising networks
  - Autonomic networking protocols at TSSG
- Disturbance Tolerance Networks (DTN)
  - Some works at TSSG in disaster communications

Conclusion

- Ireland location at the gateway of Europe provides a unique opportunity for the delivery of internationally traded marine based monitoring and communications services

- Requires greater level of co-ordination between research centres, industry and government agencies

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