

# Control for Coordination of Distributed Systems (C4C)

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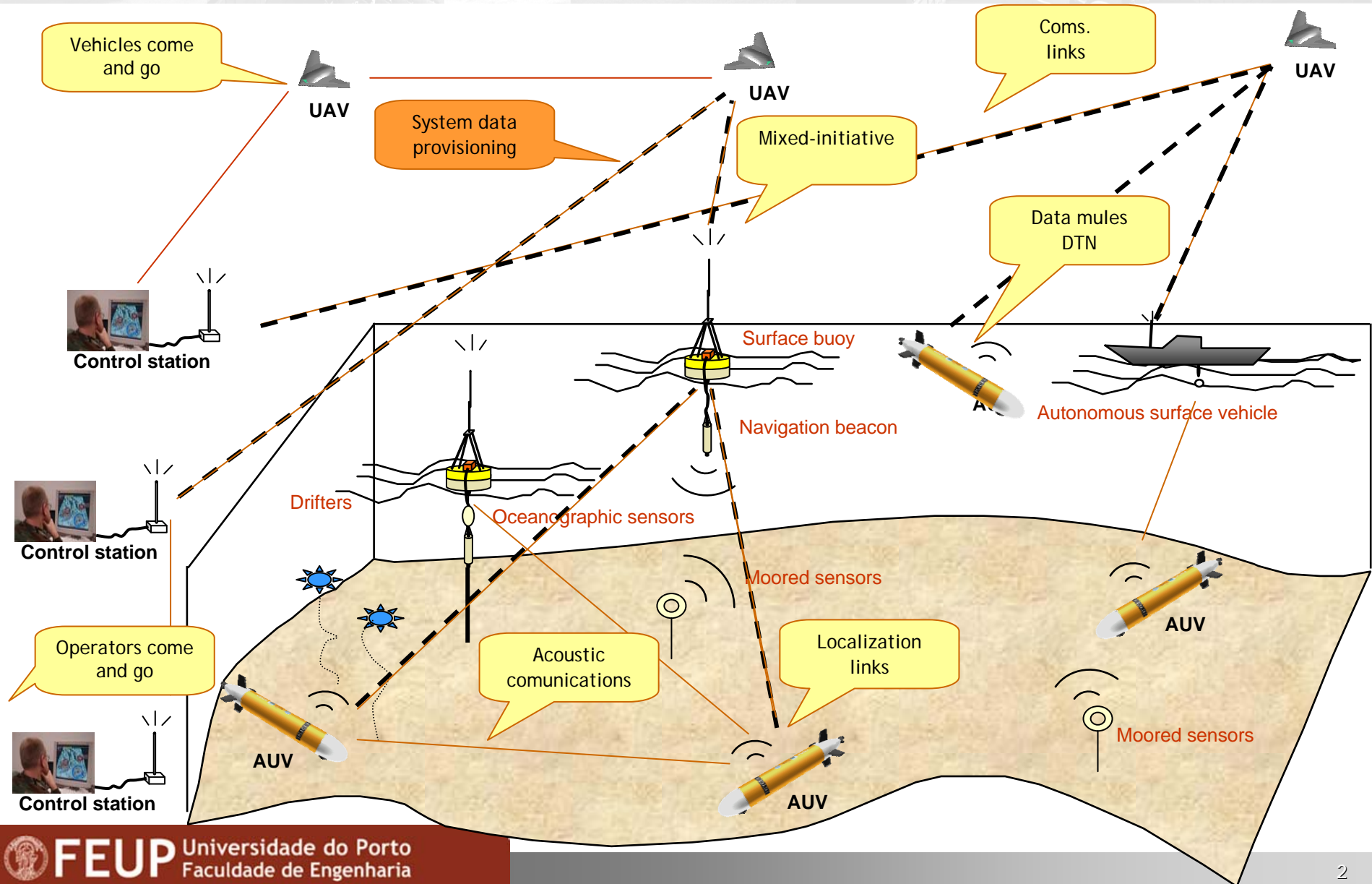
Centrum Wiskunde & Informatica (CWI), Amsterdam, The Netherlands

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Brno, Czech Republic

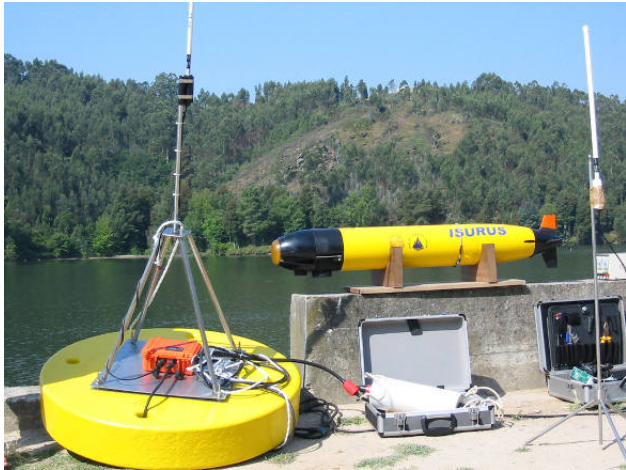
## Project. Control for Coordination of Distributed Systems (C4C)

- Financial Support of the European Commission Program EU.ICT, Objective ICT-2007.3.7 Networked Embedded and Control Systems (Project 223844)
- Life time project: 1 May 2008 - 1 May 2011.
- Partners: 4 industrial firms and 8 academic partners.
- Research focus: Control of distributed systems. Case studies and theory development.

# Challenges



# Vehicles



AUV Isurus



UAVs Lusitânia and Brutus



ROV-IES



ASV Swordfish



Light AUV



ROV-KOS

# Case study. Uninhabited underwater vehicles

## Research objectives

- Mission planning to explore the ocean and the ocean floor for ecological purposes.
- Problems of control and of coordination of vehicles.

## Setting

- University of Porto (FEUP) and company Marine Systems Technology (MST), Porto, Portugal.
- Uninhabited underwater vehicles (UUV) and uninhabited aerial vehicles (UAV).
- Teams: UPO, MST, CWI, UCY, UVR.

# Case study. Control of road networks. DRIP A2.



## Case study. Control of road networks. DRIP A1.



# Case study. Control of road networks

## Research objective

Control Design of a hierarchical model of road networks.

## Setting

- Control and signalling system on the motorway network of The Netherlands.
- Existing network (built since 1975) needs to be upgraded.
- Hierarchical structure necessary.  
Hierarchical levels: Network, stretches of road, and on-ramps.
- Teams: TUD, TRI, CWI, UGE.

# Other case studies - Overview

## Other case studies

- 1 Unmanned aerial vehicles. Coordination control.  
Teams UCY, CWI, UVR.
- 2 Automated guided vehicles at a container terminal.  
Teams HNN, TUE, UGE.
- 3 Complex machines. High-speed printers.  
Teams OCE, TUE, UCY, UPO, UVR, CWI.

# Theory development

## Work packages

- Control for coordination of distributed systems.
- Communication for control of distributed systems.  
Information theory for networks.
- Informatics for control of distributed systems.  
Distributed algorithms. Failure detection.
- Tools for control of distributed systems.  
Modeling and control.

# Control of distributed systems

## Research objectives

- 1 Coordination control of distributed systems.
- 2 Control of hierarchical systems.
- 3 Control with communication.

## Remarks

- Coordination necessary to achieve control objectives.
- Which tasks at the coordinator level and which at the local level?
- Hierarchical systems and their control.
- Teams: CWI, TUD, TUE, UCY, UGE, MST, TRI.

# C4C Consortium

## Companies

- 1 HNN - Hesse-Noord Natie N.V., Antwerp, Belgium (Jan Tijmen Udding).
- 2 MST - Oceanscan - Marine Systems and Technology LDA, Porto, Portugal (Alexandre Sousa).
- 3 OCE - Oce Technologies B.V., Venlo, Netherlands (Lou Somers).
- 4 TRI - Trinité Automatisering B.V., Uithoorn, Netherlands (Frank Ottenhof).

## Academic partners

- CWI - Centrum Wiskunde & Informatica, Amsterdam, The Netherlands (Jan H. van Schuppen; project coordinator).
- CER - Center for Research and Technology - Thessaly, Thessaly, Greece (Leandros Tassioulas).

# C4C Consortium (Continued)

## Academic partners (Continued)

- TUD - Delft University of Technology, Delft, The Netherlands (Jos Vrancken).
- TUE - Eindhoven University of Technology, Eindhoven, The Netherlands (Koos Rooda).
- UCY - University of Cyprus, Nicosia, Cyprus (Charalambos D. Charalambous).
- UGE - Ghent University, Gent, Belgium (René K. Boel).
- UPO - University of Porto (FEUP), Porto, Portugal (Fernando Lobo Pereira).
- UVR - University of Verona, Verona, Italy (Tiziano Villa).

# Advice to prospective project coordinators

## Research proposal

- Original research approach. Impact. Perspectives.
- Research motivated by problems of EU societies.
- Research teams which have a reputation in their area.
- Management structure.

## Project management

- Contacts with the European Commission.
- Project meetings. Format. Frequency.
- Research cooperation.
- Contacts and dissemination.

# Cooperation of CWI team on EU projects with researchers in Czech Republic

- Jan Komenda  
(Institute of Mathematics, Czech Academy of Sciences, Brno, CZ)  
Project EU.ICT.DISC (224498).
- Luboš Brim, Ivana Černá, David Šafránek  
(Department of Computer Science, Masaryk University Brno, Brno, CZ).  
Project EU.ICT.NEST.EC-MOAN (043235).

# Concluding remarks

## Contacts

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<http://www.c4c-project.eu/>

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The End!