DATE 2012, ArtistDesign Special Session
Dresden, March 15th, 2012

Real-Time Networks

Activity leader: *Luis Almeida*
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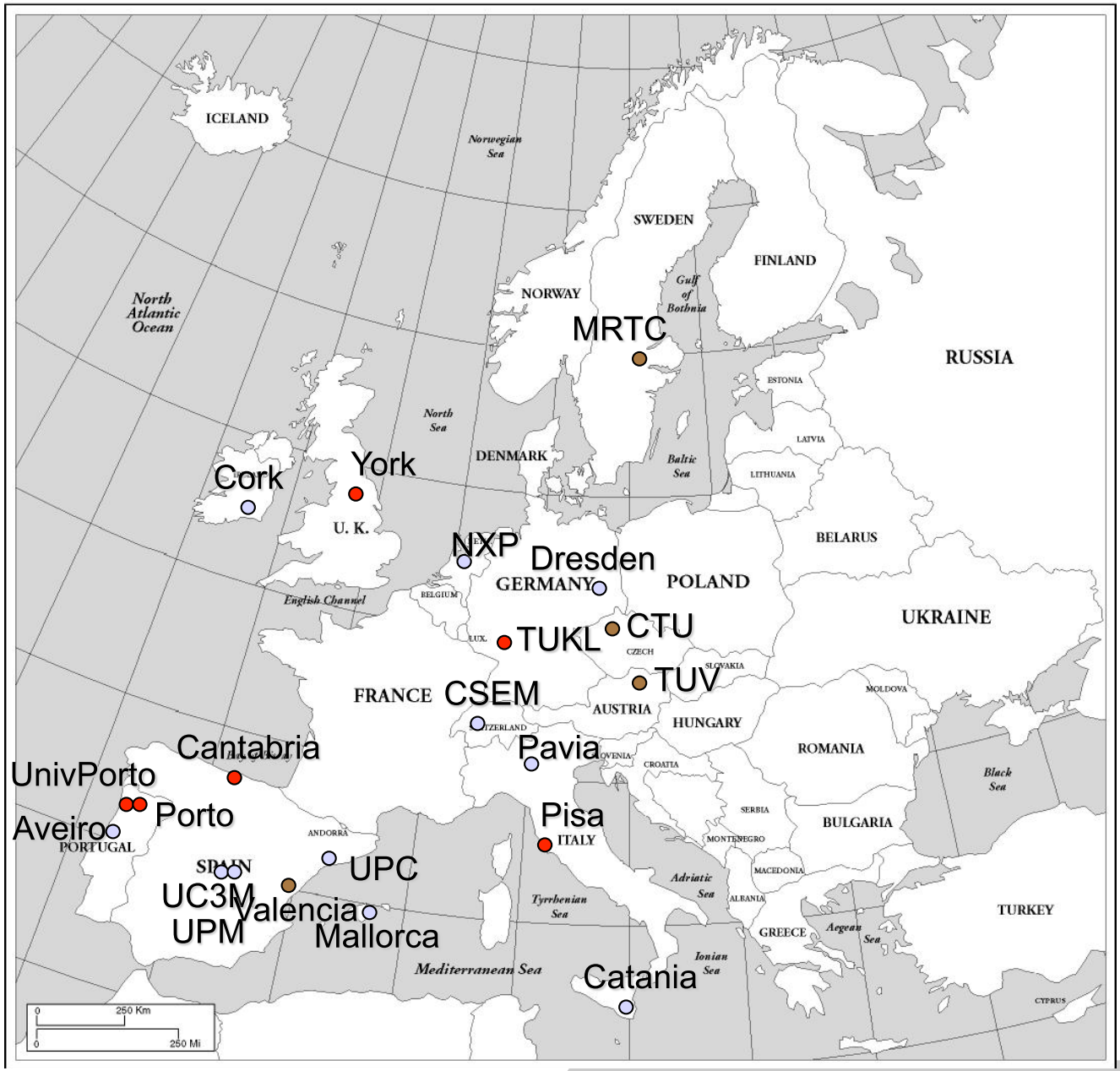
Porto, Portugal



Real-Time Networks Activity

- 6 Core partners
- 9 Affiliated partners
- 4 Other Core partners

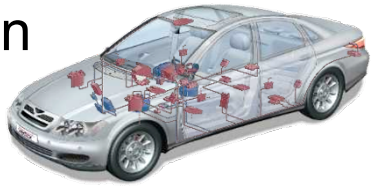
10 Other teams

Strong interactions with:
Resource Management
and
Design for Adaptivity Activities

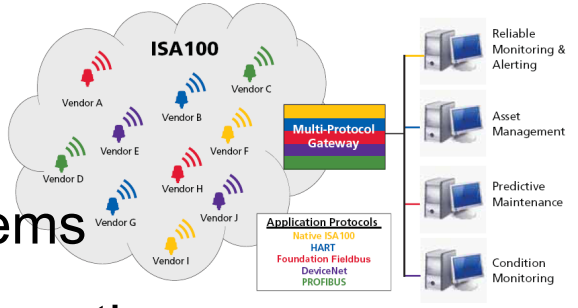
SEVENTH FRAMEWORK PROGRAMME

Objectives

- **Managing complexity in networked embedded systems**
  - QoS adaptation and graceful degradation
  - higher integration with protection



- **Towards *(real-time) wireless everywhere***
  - WSN, MANETs, cooperating embedded systems
  - Reduce communication–related energy consumption



- **Networking technology outreach**
  - courses, seminars, schools, standards, joint R&D projects

Challenges

- **(Real-time) wireless everywhere (WSN)**
  - **Synchronizati**
    - – H
  - **Manag**
    - – Long lifetime, high scalability and data aggregation
- **Managing complexity (NES)**
  - **QoS ad and graceful degradation**
    - – R ations, topology changes, a other reconfigurations
  - **Networking suppo**
    - – Provide real-time and com
      - » Efficient temporal partitioning and dynamic, end-to-end resource reservation

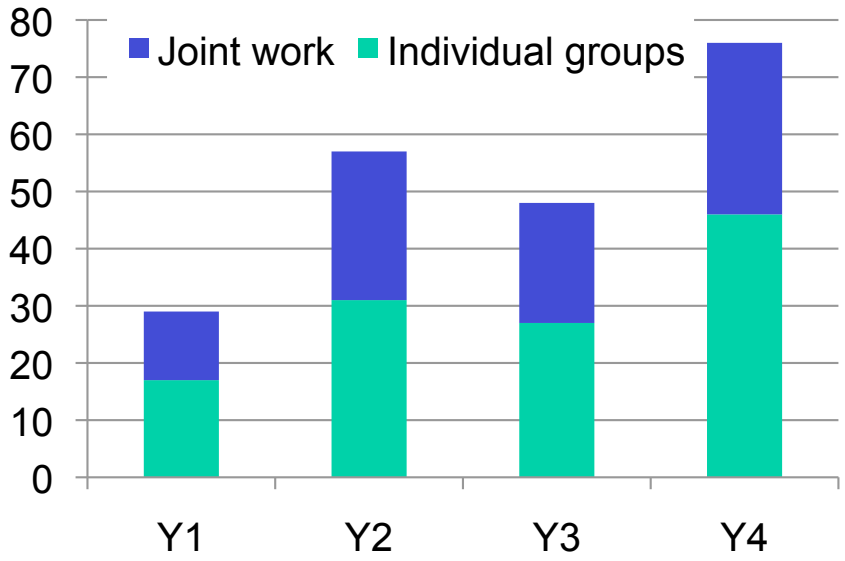
Timeliness and energy in Wireless (Sensor) Networks

Flexibility, robustness and efficiency in NES

Summary of global outcomes

Publications produced

- **121** publications from **individual groups**
- **89** publications from **joint work**



Other activities

- **16 workshops** (RTN, APRES, SOCNE…)
- **12 special sessions/tracks** (ETFA, INDIN…)
- **27 tutorials/seminars** (~all Artist Summer Schools….)
- **10 joint projects** (FP6/7-STREP, ARTEMIS, ITEA2, national)
- Continued participation in the **TinyOS Net2 Working Group** (*OpenZB stack*)
- **16 new collaborations** beyond Core Partners and Affiliated Partners

Global highlights

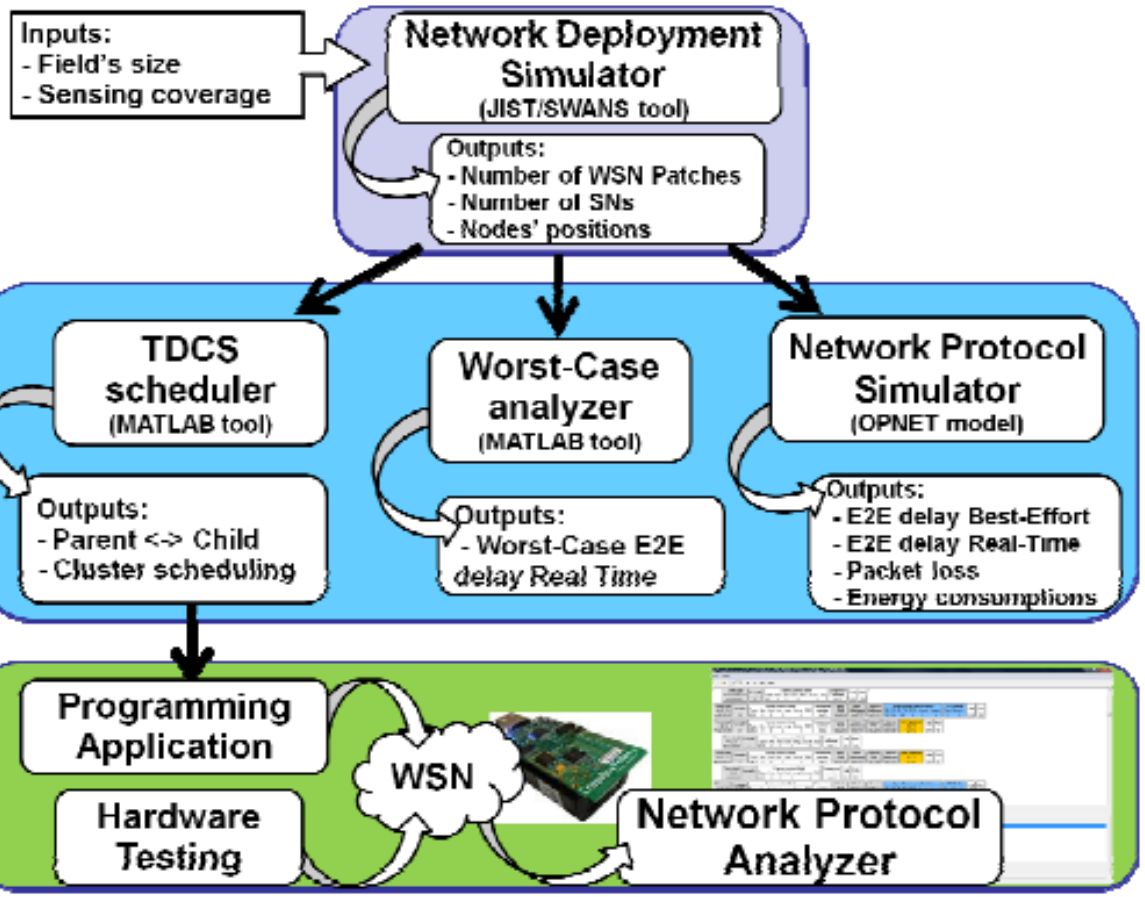
- **Protocols, tools and analysis for wireless networks**
  - ***WSN**: **toolset** to design, analyze, configure and deploy dense networks*
    - **OpenZB** protocol stack, **Z** monitor, **TinyOS** Net2 Working Group
    - **Visual tracking** and **localization** for ITS
  - ***MANETS**: RTDB middleware and protocol for **collaborating robots***
  - ***Industrial systems**: Real-time WiFi, WirelessHART (ISA 100)*
- **Related projects**

WASP** - Wireless Accessible Sensor Populations. **Contact: TUKL
EMMON** - EMbedded MONitoring. **Contact: ISEP-Porto
CONET** - Cooperating Objects Network of Excellence. **Contact: ISEP-Porto
FLEXWARE** - Flexible Wireless Autom. in Real-Time Env. **Contact: Catania
IPERMOB** - Perv. Hetero. Infrast. to Control Urban Mobility in Real-time. **Contact: Pisa,

Evidence

WSN toolset

- **Integrated toolset** for **dense WSNs** comprising:
  - deployment planning
  - worst-case analysis and dimensioning
  - network protocol simulation
  - automatic node programming and testing
  - network sniffing
  - Target: 10k nodes



Widely used open-source tools

OpenZB **Z monitor**

TDCS scheduler

Supporting collaborative robotics

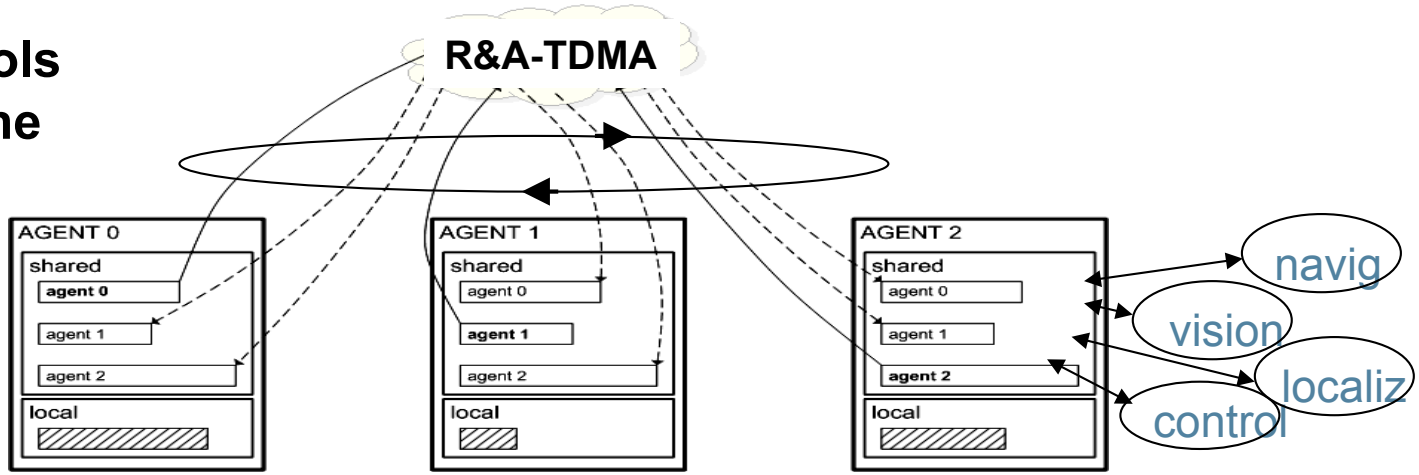
- **Integrated toolset** for teams of **robots** comprising:
  - Real-Time Database (RTDB) middleware

    Distributed shared memory model

    Each member publishes its data relevant to others
    Data available locally to all collaborating members
  - Reconfigurable and Adaptive TDMA protocol

    ***Round divided dynamically** among current members*
    Virtually configuration-free and self-synchronized

Open-source tools with impact in the RoboCup MSL



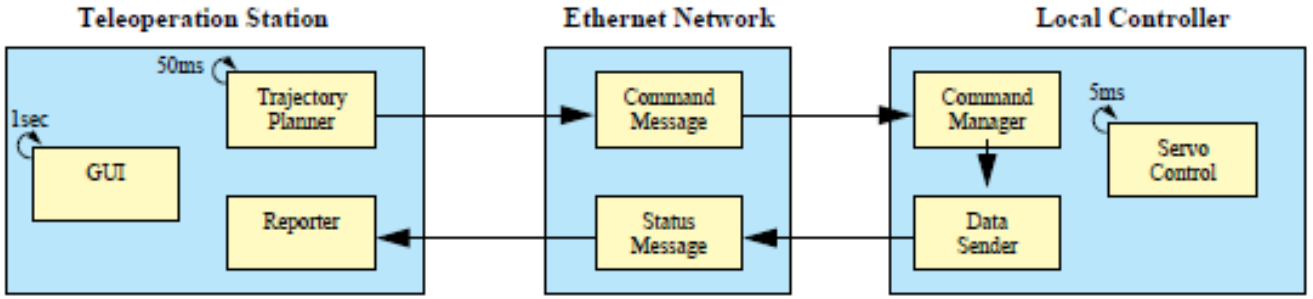
Global highlights

- **Protocols and middleware for robust and flexible real-time communication**
  - *Modeling and analysis suites for distributed embedded systems (**MAST**)*
  - ***Ethernet**: new analysis (**AFDX, AVBs**), new tools (**FTT-SE / HaRTES**)*
  - ***CAN**: new analysis, **(Re)CANcentrate**, topology optimization*
  - ***RT middleware**: analysis(**DDS**), new middleware (**iLAND**, **HI** systems)*
- **Related projects**

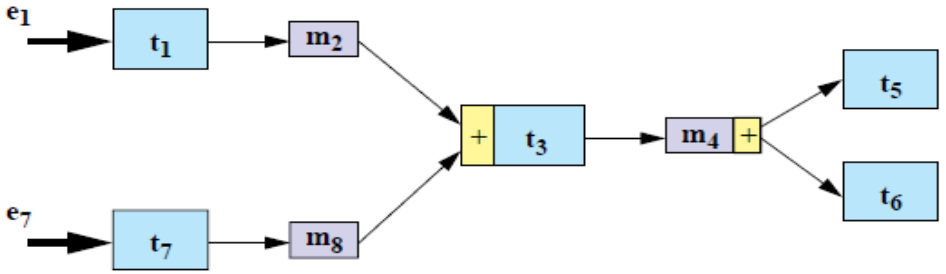
iLAND** - mIddLewAre for deterministic dynamically reconfigurable NetworkeD embedded systems. **Contact: Madrid-UC3M, UnivPorto
HaRTES** - Hard Real-Time Ethernet Sw. **Contact: Aveiro, UnivPorto, Mallorca
CANbids** - CAN infra. for dependable systems. **Contact: Mallorca, UnivPorto
MADES** - UML / MARTE based model-driven approach. **Contact: York
INDEXYS** - INDustrial EXploitation of the genesYS cross-domain architecture. **Contact: TUKL and NXP

MAST suite

- **Modeling and Analysis Suite for Real-Time Applications**
  - **Worst-case response time** schedulability analysis (RTA)
    In single-processor and **distributed systems**
  - Based on the concept of **transaction / end-to-end flow**
  - Includes most **common protocols** for real-time communication



Widely used open-source tools



Flexible Time-Triggered framework

- **TT model + online scheduling for distributed systems**
  - Centralized scheduling per cluster

    Supports any desired scheduling

    Particularly hierarchical virtual channels and prompt reconfiguration

  - Dynamic isochronous and asynchronous channels

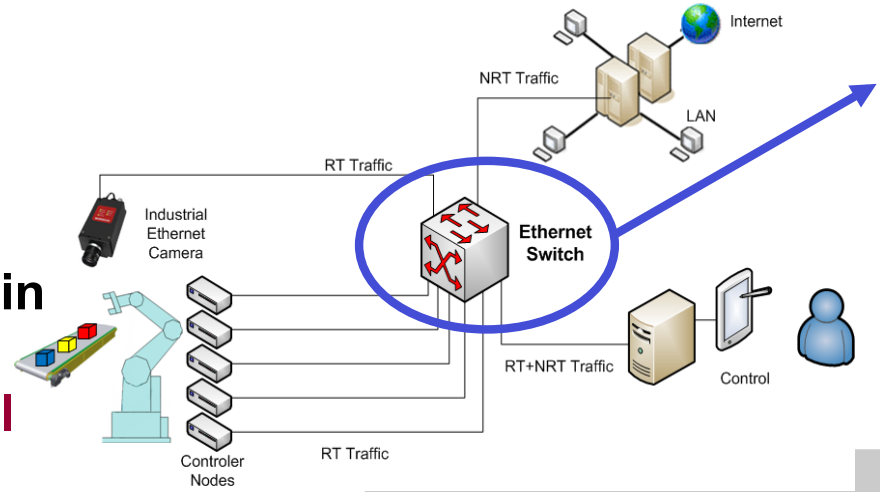
    Analyzable channels with guaranteed latency / mutual isolation

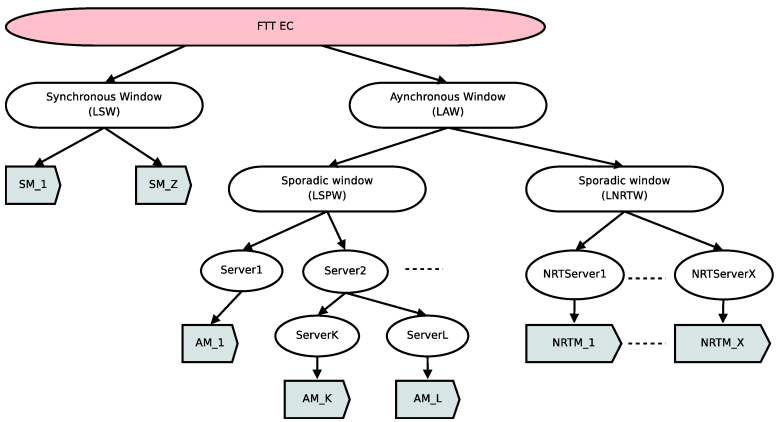
    Supports legacy systems and mixed-criticality applications

HaRTES
Hard Real-Time Ethernet Switching

HLAND

Open source tools with main impact at research level





Virtual channels

SEVENTH FRAMEWORK PROGRAMME

The end ?

- **Steady on-going collaborations**

  *Involving **27 groups** across the world*

- Several **projects starting** or continuing
- Integration in many **complementary communities**
- …

Visit our wiki

http://twiki.fe.up.pt/bin/view/ArtistDesign

Towards a real-time connected world