
LaCoMoCo

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Lars Birkedal [birkedal@itu.dk]

The IT University of Copenhagen



My background

- ◆ Cand. Scient. from University of Copenhagen, 1994
 - Advisors: Neil Jones and Mads Tofte
 - Partial Evaluation of SML
 - The ML Kit with Regions
- ◆ Ph.D. from Carnegie Mellon University, 1999
 - Advisor: Dana Scott
 - Realizability models of type theories and logics
- ◆ Started at ITU March 2000 as Assistant Professor
- ◆ Now Associate Professor and Head of Theory Department, one of four research departments at ITU



Research Departments at ITU, I

- ◆ Theory
 - Logic; semantics; concurrency; mobility; algorithms; data structures; complexity theory.
- ◆ Innovation
 - Image analysis; signal processing for mobile applications; programming language technology; formal verification; 3D graphics; and assistive technologies.



Research Departments at ITU, II

- ◆ Design and Use of IT
 - The interplay between IT and users in an organizational context; Systems development; object-oriented design and programming; and technologies for collaboration and knowledge sharing.
- ◆ Digital Aesthetics and Communication
 - The aesthetic, cultural, social and communicative aspects of IT.



LaCoMoCo

- ◆ Research
 - Context-dependent Mobile Communication: A research theme spanning all departments
- ◆ Teaching
 - Courses (such as this one) and student projects
- ◆ Mobility Lab
 - To facilitate interesting student projects and research
- ◆ Development Working Group
 - development of joint WLAN in Ørestad North
- ◆ <http://lacomoco.itu.dk>



LaCoMoCo

- ◆ Background: development in mobile technologies
- ◆ Context: any information that characterizes a situation related to the interaction between users, applications, and the surrounding environment
- ◆ Key concept in ubiquitous / pervasive computing
- ◆ Weiser 1991: two most crucial issues for realizing potential of ubiquitous computing: location and scale
- ◆ Aim: create a large-scale laboratory in which we can study how to best provide and make use of location and other context information, as a crucial step toward realizing the potential of ubiquitous computing



Partners

- ◆ Crossroads Copenhagen partners
- ◆ DIKU, CBS, RUC in URCC

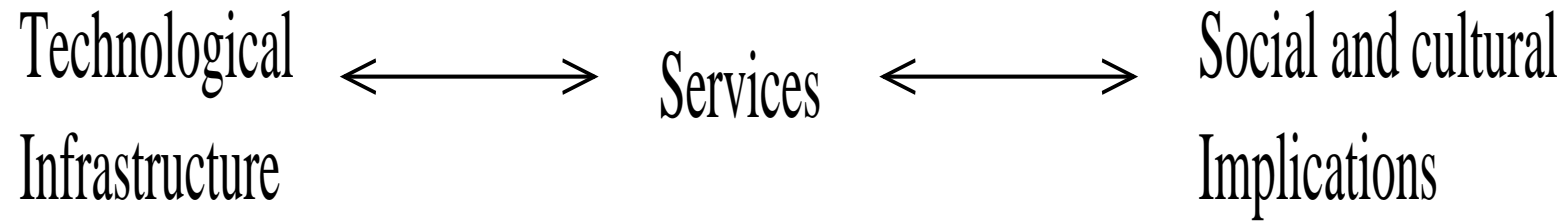


Crossroads Copenhagen (CC)

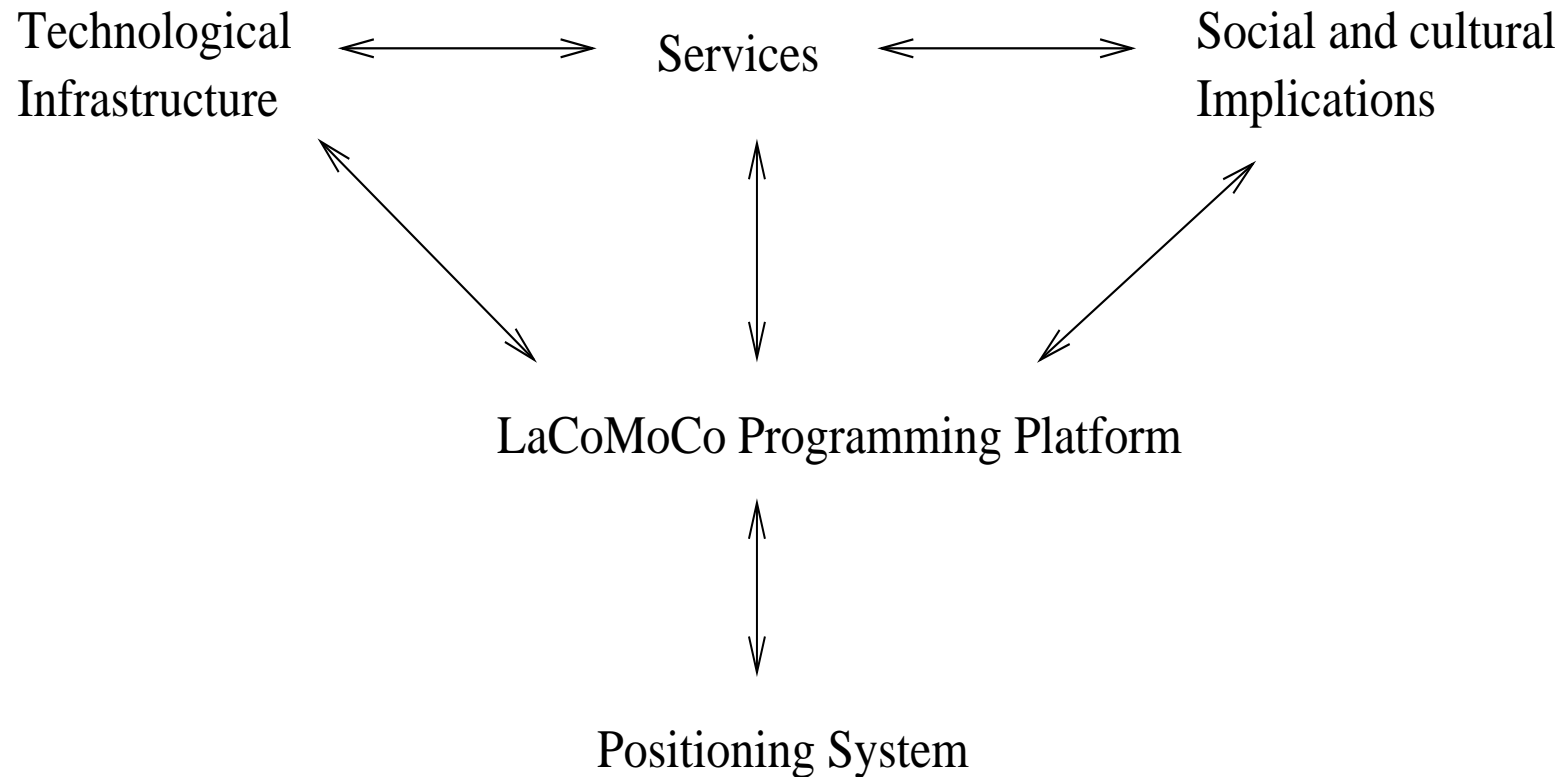
- ◆ Network of public and private institutions and companies for culture, media and communications technology.
- ◆ Partners: Nokia, DR, CSC, ITU, CBS, TDC, KUA, HP, Royal Library, Boersen, Consumer Information, ...
- ◆ Common theme: Context-dependent Mobile Communication.
- ◆ Ørestad North as living laboratory
- ◆ http://www.orestad.dk/or_forside/beliggenhed.
- ◆ <http://www.crossroadscopenhagen.com>



LaCoMoCo Value Chain



LaCoMoCo Project Structure



Positioning System

- ◆ joint WLAN in Ørestad Nord, equipped with positioning system
- ◆ infrastructure should be based on open standards and norms to facilitate collaboration and joint projects
- ◆ 500 m x 500 m area covered (DR, ITU, KUA, . . . , + outdoors)
- ◆ location server for mobile phones
- ◆ roaming
- ◆ partners: DR, ITU, KUA, TDC, Ekahau, . . .



Programming Platform

- ◆ abstract software interface to underlying positioning system
- ◆ provides a uniform platform for applications
- ◆ useful for students, researchers, and company partners
- ◆ research: formulation of open standards and open-source software for interaction with positioning technologies
- ◆ Mobility Lab for conducting experiments
- ◆ Ph.D. school planned
- ◆ 2 faculty members, 2 research assistants



Some Projects in Value Chain

- ◆ Technological Infrastructure
 - Bigraphical Programming Languages*
 - High-precision Positioning and Intrusion Detection*
 - Algorithms for peer-2-peer computing and CAN
- ◆ Services
 - Audio Interfaces for Ambient Intelligent Systems / DELCA*
 - Location-based Services in Industrial Settings*
 - Location-based Gaming*
- ◆ Social and Cultural Implications
 - Use Patterns and Social Networks in CoMoCo
 - IT-surveillance and Management strategies



Pos. and Intrusion Detection, I

- ◆ Positioning today:
 - calibration of positioning server
 - clients send RSS info to positioning server
 - positioning server calculates position and sends it back to the client
- ◆ Accuracy: 1-2 meters, 2.5 dimensions
- ◆ Problems:
 - re-calibration
 - possible interference



Pos. and Intrusion Detection, II

- ◆ design *multimodal* wireless networks, for *joint* communication, positioning, and physical environment change
- ◆ methods for almost self-calibrating positioning based on signal-processing
- ◆ experimentation in the mobility lab
 - simulation tools
 - surveillance prototype for residential house
 - multimodal network implementation
- ◆ patent application filed
- ◆ company partners: Ekahau and Radionet
- ◆ 3 faculty members and 2–5 Ph.D. students



LBS in Industry, I

- ◆ LBS in work domains where actors and artefacts are inherently mobile and where location of actors and artefacts has significance to actors
 - manufacturing, construction, transportation
- ◆ technologies: RFID, WLAN, Bluetooth, ...



LBS in Industry, II

- ◆ challenges:
 - location-based services for individuals — information must be indexed w.r.t. location as well as organizational categories
 - location-based awareness support — location and other sensing data must be coupled with process models and coordinative protocols
 - wireless sensor technologies — possible to dissolve the control room and enable operators to inspect state while monitoring remote processes



LBS in Industry, III

- ◆ theoretical results: model of critical contextual parameters of coordinative practices in cooperative work
- ◆ practical results: prototypes and experimental evaluation of those in real work settings
- ◆ company partners: NKT, NCC
- ◆ 3 faculty members, 1 post. doc, 2 Ph.D. students



Location-based Gaming

- ◆ location-based gaming platform
- ◆ experiments with development of game concepts from idea phase to gameplay implementation and testing
- ◆ research focus: new directions in gameplay, e.g., superposition of virtual space on real space, e.g., Visby, Gotland
- ◆ technologies: WLAN, GSM, UMTS, ...
- ◆ company partners: DR
- ◆ 2 faculty members, 1–2 Ph.D. students, 1 research asst.



DELCA

- ◆ DisEmbodied Locationspecific Conversational Agents
- ◆ Experiments with the development of agents (ghosts) that communicate via speech synthesis and speech recognition.
- ◆ Examples: a ghost that guides you around in a building, a ghost that can help you interact with the printers.
- ◆ 1 faculty member, 2 Ph.D. students, 2 research asst.
- ◆ <http://delca.itu.dk>



Bigraphical Prog. Lang.

- ◆ design programming languages based on the theory of bigraphs for describing mobile distributed systems
- ◆ theory of bigraphs (R. Milner), focuses on two key aspects of mobile distributed systems
 - connectivity
 - mobile locality
- ◆ See the poster outside our offices.
- ◆ 4 faculty members, 3 Ph.D. students



Teaching

- ◆ At ITU we have reflected the research project structure directly in teaching.
- ◆ Ekahau WLAN positioning server installed Fall 2002
- ◆ LaCoMoCo Web API developed by Anders Cervera (employed since November 1, 2002)
- ◆ Platform used by students in projects
- ◆ Now also access to experimental positioning system for mobile GSM phones (based on agreement with TDC), and bluetooth test-kit
- ◆ Courses: Java for mobile devices, Mobile systems software, Location-based Mobile Applications, Peer-2-peer storage systems, Modelbased design of distributed and mobile systems, Mobile business: strategy, technology and marketing



Student Projects, I

- ◆ We have advised around 80 students in related projects.
- ◆ Covering all study lines at ITU, i.e., the whole value chain.
- ◆ Examples:
 - The use of GIS in LBS.
 - Virtual tourist guide on mobile phone.
 - Position-dependent communication system.
 - Dynamic audio in real-life location-based games.
- ◆ See `http://positionserver.it-c.dk:8000` for more examples.



Student Projects, II

- ◆ We very much welcome student projects!
- ◆ Preliminary project description:
<http://positionserver.it-c.dk:8000/projects/p>
- ◆ Meet us at the project-start-day (Wednesday March 24).
- ◆ Jens Chr. Godskesen will organize student projects and there will be many types of projects, including many projects related to the LaCoMoCo research topics.



Links

- ◆ `http://lacomoco.itu.dk`
- ◆ `http://positionserver.itu.dk:8000`
- ◆ `http://www.crossroadscopenhagen.com`

