Distributed Multimedia Systems (DMMS): Courses and Research Areas for Master Students

Thomas Plagemann
DMMS Team

• Faculty

• Part-time Faculty

• Post Doc

• PhD Students
Keywords

- Internet
- Multimedia
- Mobile computing
- Sensors
- Databases
- Data Stream Management
- Event Processing
- Operating Systems
- Pervasive and ubiquitous systems and applications
Mandatory and recommended courses

**Bachelor**

**Recommended:**
- INF3100 – Database systems
- INF3151 – Operating systems
- INF3190 – Data communication

**Master**

**Mandatory†:**
- INF4151 - Operating systems

**Anbefalte emner:**

**For alle:**
- INF5090 – Advanced topics in distributed systems

**Retning datakommunikasjon:**
- INF5040 – Open distributed processing
- INF5050 – Protocols and routing in the Internet

**Retning databaser:**
- INF5100 – Advanced database systems

† INF4151 is mandatory if INF3151 was not taken as part of the Bachelor
Learning by doing

• Guided process to build your OS
  • First design! You propose, we give you feedback!
  • Afterwards implementation
  • In total six projects
    • P1: Bootup
    • P2: Non-preemptive kernel
    • P3: Preemptive kernel
    • P4: Interprocess communication and driver
    • P5: Virtual memory
    • P6: File system

• Grading based on your presentation
  • Design (one week)
  • Code (two weeks)
Some of What You Will Learn

• Operating System Structure
  • structures, processes, threads, and system calls
• Synchronization
  • mutex, semaphores, monitors
• Processor
  • time slices, scheduling
• Virtual memory
  • address spaces, demand paging
• I/O subsystems
  • device drivers, inter process and inter thread communication,
• Networking
• Storage systems
  • disks and file systems
INF 5090: Advanced Topics in Distributed Systems – a distributed, international graduate course –
Basic Approach

• Each lecture will be recorded, stored and online available 24/7
  • Lecturnity: synchronized video, audio, and interaction with powerpoint, ++
  • Lectures are made available on a server
  • Lecturnity player is free of charge
  • We provide a supervised playback

• Hosting lectures from the other Institutions, e.g. 2013:
  • Live: Kave Salamatian (Université de Savoï), Mark Rouncefield (Lancaster University), ++
  • Recorded: Thomas Haenselmann (University of Mannheim), Matti Siekkinen (Aalto University), Sasu Tarkoma (Aalto University)

• Provide access to lectures from the last years (INF5090 since 2005) that are not part of this years "pensum"
What are we teaching?

Future Internet

**Evolutionary:**
- Multicast and CacheCast
- Streaming through firewalls and NATS
- Mobile Ad-Hoc Networks

**Revolutionary:**
- Basic principles
- Delay tolerant networking
- Autonomic Networking in ANA
- Monitoring
- Publish/Subscribe
- DSMS, sensor networks, and event detection
Lab Assignments

• A team of 4 students works on one assignment
  • Normally 2 local students together with 2 remote students

• Six weeks lab assignments

• The deliverables:
  • Paper with design, implementation, and results (max 10 pages IEEE format)
  • Code, traces, etc. documented!

• Important: you have to learn and practise collaboration!
  → tools, cultures, ...
Course Purpose

• The course gives an overview of new developments within data management technology
  • Emphasis on usage and applicability
  • Concepts and design, not so much about concrete systems
Organization of the Course

• Course mode:
  • Lectures: Wednesday, 3 hours, 14:15-17:00, Lille Aud. (old Ifi)
  • 10 weeks lecturing
  • Mandatory exercise

• Examination:
  • Oral1
  • Date to be announced later

1Written exam if number of candidates exceeds a certain threshold
INF5100 (2013) - Overview

• Data Stream Management Systems
• Complex Event Processing
• Distributed Database Systems
• Heterogeneous Database Systems
• Data Warehouses
• Data Mining and XML Databases
• Performance Analysis and Large Scale Databases
Master Thesis at DMMS

• Learn to perform research and development and finish successfully your project
• Research topics with high relevance for the real world
• Integration in our research team → tight collaboration
• High ambitions → many theses have resulted in publications
• Student jobs in the projects available
• International exchanges possible
• Possibility to follow-up with a PhD
Taking a DMMS Master Project

- Many people working on similar/related topics
- We are interested in real systems for the future
  - Wearable computer, sensors, ....
- Our work is mainly of experimental nature and very close to (or part of) ongoing research
- Goal: each master thesis should lead to a publication
- Typical thesis work
  - Read literature, gather information/knowledge about the “problem area”
  - Analyze/test/benchmark existing solutions
  - Design and implement a new/better solution
  - Analyze, test, compare, and evaluate
Some exciting trends....

- Mobile ad-hoc networks
- Delay tolerant networks
- Sensor/actuator systems
- Data stream & event processing
- Pervasive and ubiquitous systems
Expertise

Data Management Systems
File Systems
Data Stream Management Systems

Applications

Operating Systems

Communications

MoD server and Proxy OS
Sensor OS

Emergency and Rescue Media-on-Demand Home care

Middleware Streaming
Overlay networks
Ad-hoc networks
Network monitoring Sensor networks
Research Focus

Content Distribution
- Media Streaming
- Clustering & replication

Emergency & Rescue
- Mobile Data Management
- Monitoring & sensing

Home Care
- Multimodal Event Systems

Future Internet
real world, lab testbed and simulation
Streaming in Sparse MANETs

- DT-Stream (NFR, VERDIKT)
- Streaming in disruptive networks
- Overlay solution

Content Distribution
Emergency & Rescue
Home Care
Mobile Data Management
Multimodal Event Systems
Media Streaming
Clustering & replication
Monitoring & sensing
Pull a Internet real world, lab testbed and simulation

12/08/13
CacheCast: Eliminating Redundancy

**Motivation:**
- IP Multicast does not work
- IPTV, +++ becomes more and more dominant
- Remove redundancy on the link
- Implementation in simulation and real world testbed
  - Close to multicast performance
  - Incremental deployable
  - Server load minimal
- Won Inve2’s innovation prize
- Ongoing patent process
Multimodal Sensing & Event Detection

- SIRIUS & TRIO
- Complex events in Home Care
- Multimodal sensors: impulse radar, RFID, Motes, motion detection, cameras, microphones
- Re-use:
  - Sensor model
  - Physical & logical sensors
  - Environment model
  - Event model
  - Location of interest
  - Capabilities
- Deviation detection
- Learning behavioral patterns
- Using several multi-modal sensors to increase quality of information
Future Directions....
Master Thesis Topics @ DMMS in a Nutshell

- Project driven theses
- Database related topics
- External theses
Research Projects

• TRIO:
  • Using the impulse radar from Novelda AS to monitor health parameters and events of interest in home care applications

• DT-Stream:
  • Enable video streaming for emergency and rescue operations with smart phones via unstable and disrupted networks

• SIRIUS:
  • Using multi-modal sensor systems to identify complex events in emergency and rescue scenarios

• TRAMP:
  • Using Future Internet concepts to realize migration of processes and threads

• CacheCast:
  • Caching packets on links to achieve multicast like performance for single-source multiple destination traffic
## Research Areas in the Projects

<table>
<thead>
<tr>
<th></th>
<th>DT-Stream</th>
<th>TRIO &amp; SIRIUS</th>
<th>TRAMP</th>
<th>CacheCast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking</td>
<td>†</td>
<td>†</td>
<td>†</td>
<td>†</td>
</tr>
<tr>
<td>Mobile</td>
<td>†</td>
<td>†</td>
<td>†</td>
<td>†</td>
</tr>
<tr>
<td>Future Internet</td>
<td>†</td>
<td></td>
<td>†</td>
<td>†</td>
</tr>
<tr>
<td>Operating system</td>
<td>†</td>
<td></td>
<td></td>
<td>†</td>
</tr>
<tr>
<td>Data management</td>
<td>†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensors</td>
<td></td>
<td></td>
<td>†</td>
<td></td>
</tr>
<tr>
<td>Event processing</td>
<td></td>
<td></td>
<td>†</td>
<td></td>
</tr>
<tr>
<td>Ubiquitous</td>
<td>†</td>
<td></td>
<td>†</td>
<td></td>
</tr>
<tr>
<td>Multimedia</td>
<td>†</td>
<td></td>
<td>†</td>
<td></td>
</tr>
<tr>
<td>Middleware</td>
<td>†</td>
<td></td>
<td>†</td>
<td></td>
</tr>
</tbody>
</table>
• Kristoffer Robin Stokke
  • Energy aware mobile computing and sensing
TRAMP

• Francisco Javier Velazquez:
  • Protocols for threat migration

• Hans Vatne Hansen:
  • Migration of multimedia applications
DT-Stream

- Daniel Rodriguez Fernandez:
  - Multi-homing in different network paradigms

- Morten Lindeberg:
  - Cross-layer optimization

- Stein Kristiansen:
  - Realistic simulation of mobile nodes
SIRIUS

• Piotr Kamisinski:
  • Opportunistic complex event processing

• Viet Hoang Nguyen:
  • Quality of sensor data and of complex event detection