The Architecture of the DecentVM

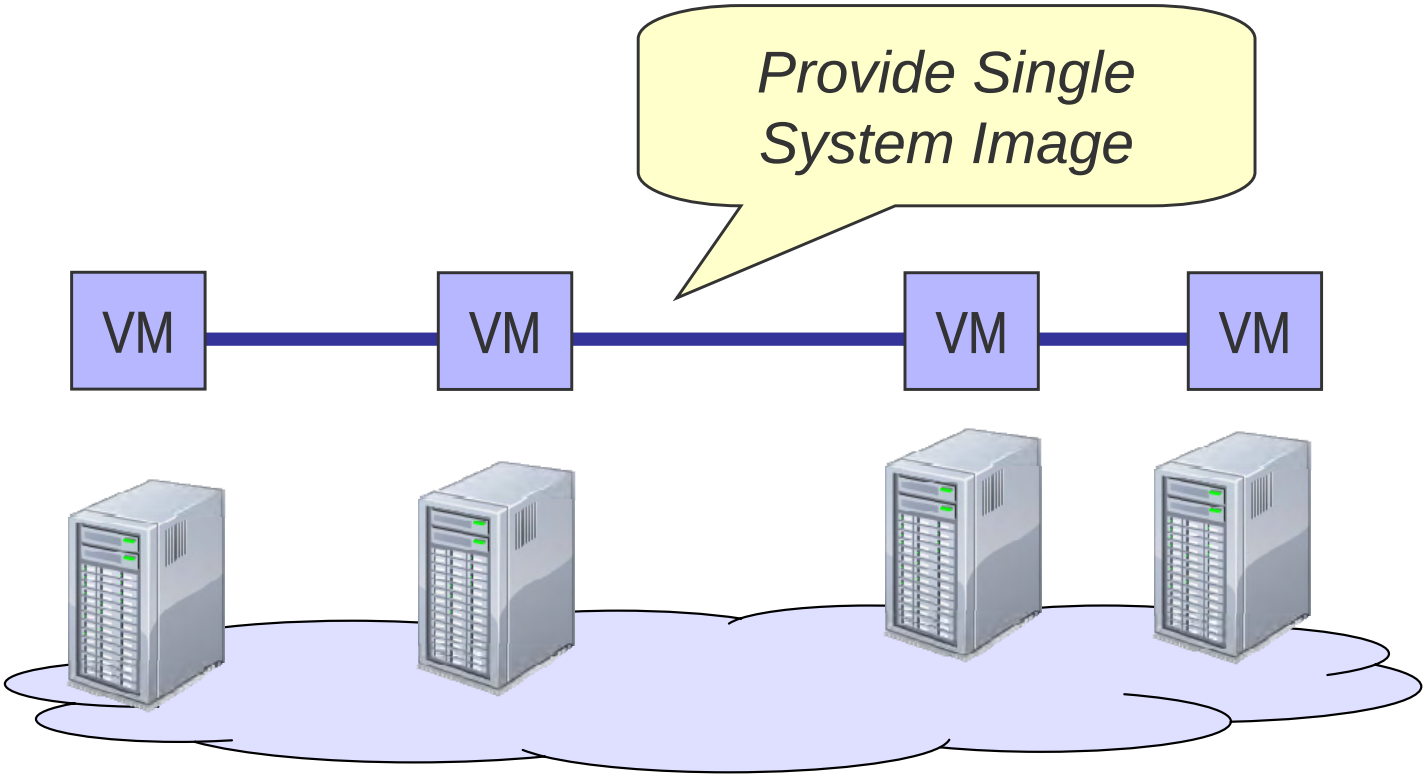
Towards a Decentralized Virtual Machine for Many-Core Computing

17 October 2010

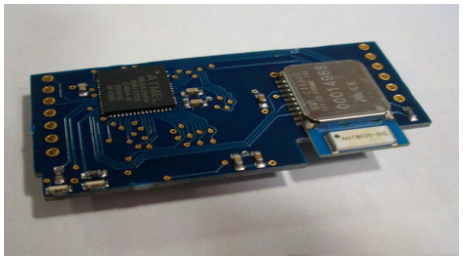
Annette Bieniusa, Johannes Eickhold, and Thomas Fuhrmann

Department of Informatics, Self-Organizing Systems Group
Technische Universität München, Germany

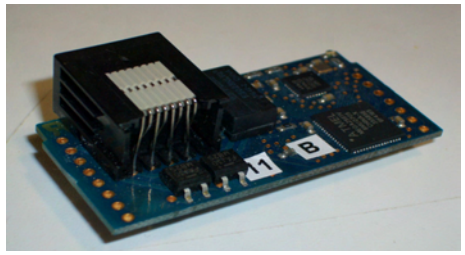
Design Goal of DecentVM



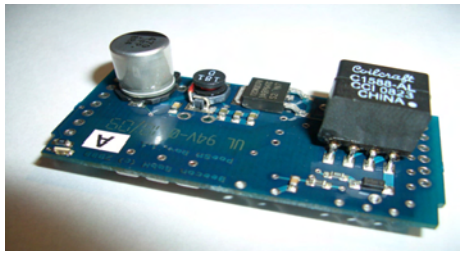
DecentVM's Origin – Modular Embedded Devices



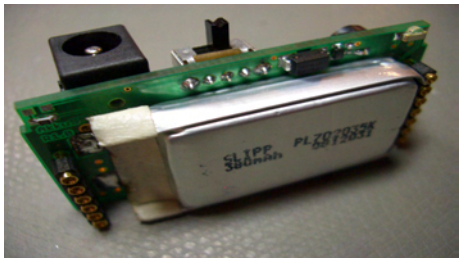
Bluetooth Module



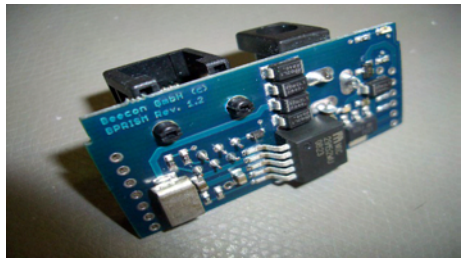
Ethernet Module



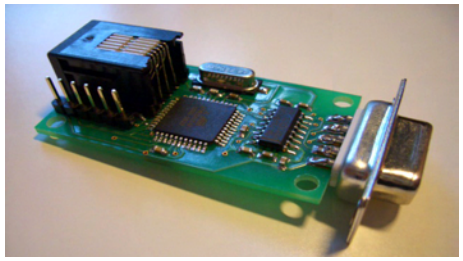
Power-over-Ethernet Module



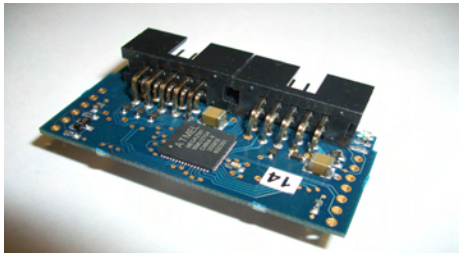
LiPo Battery Module



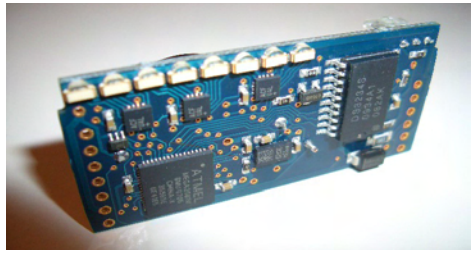
Backplane Module



Access Adapter



I/O Module

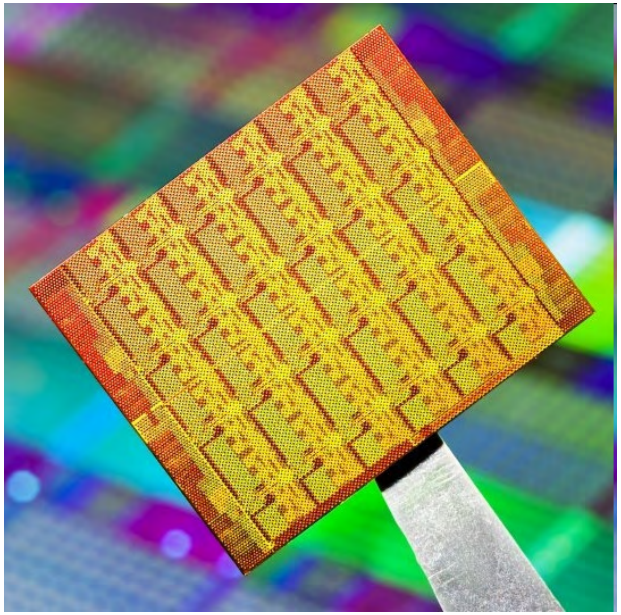


Peripheral Module

Bundesministerium für Bildung und Forschung

Ambicomp Project, 2005-2009

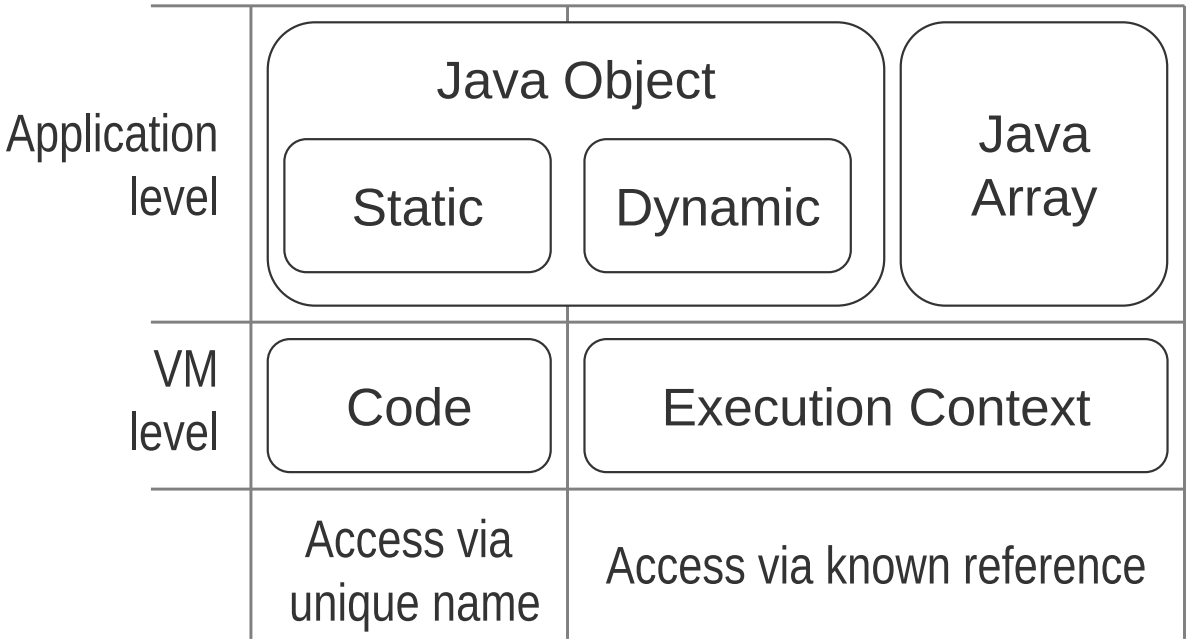
Current Target Architecture and Prototype



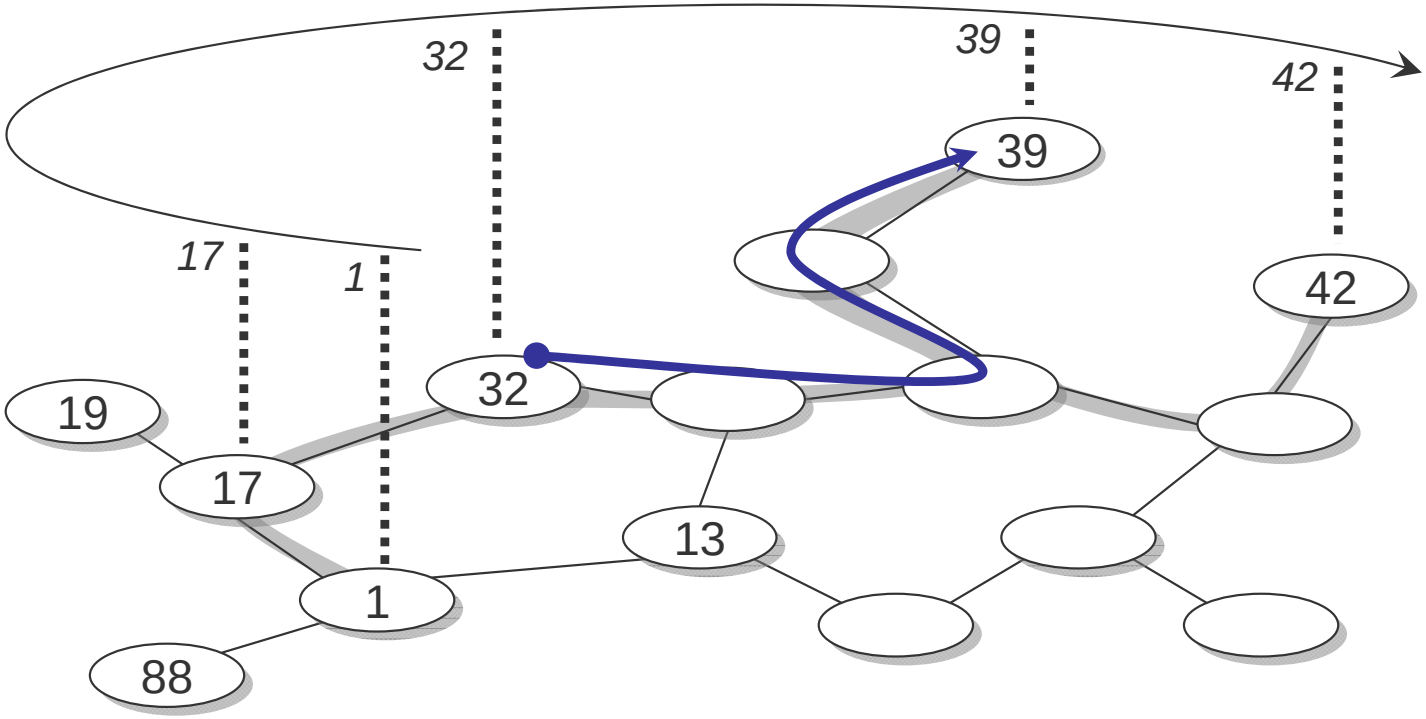
Bundesministerium
für Bildung
und Forschung

J-Cell Project, 2009-2012

Objects in DecentVM

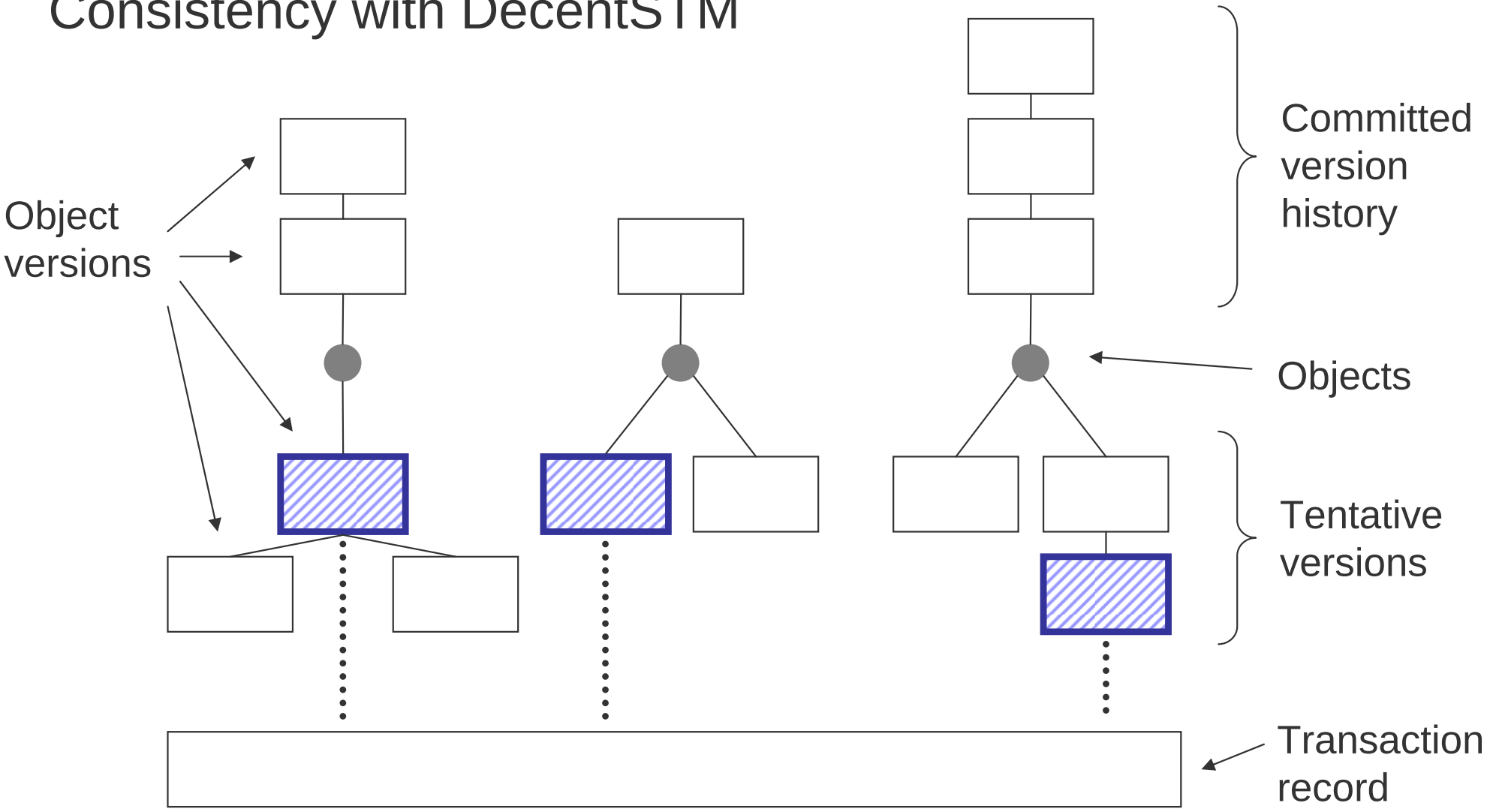


Access via Reference and via Name



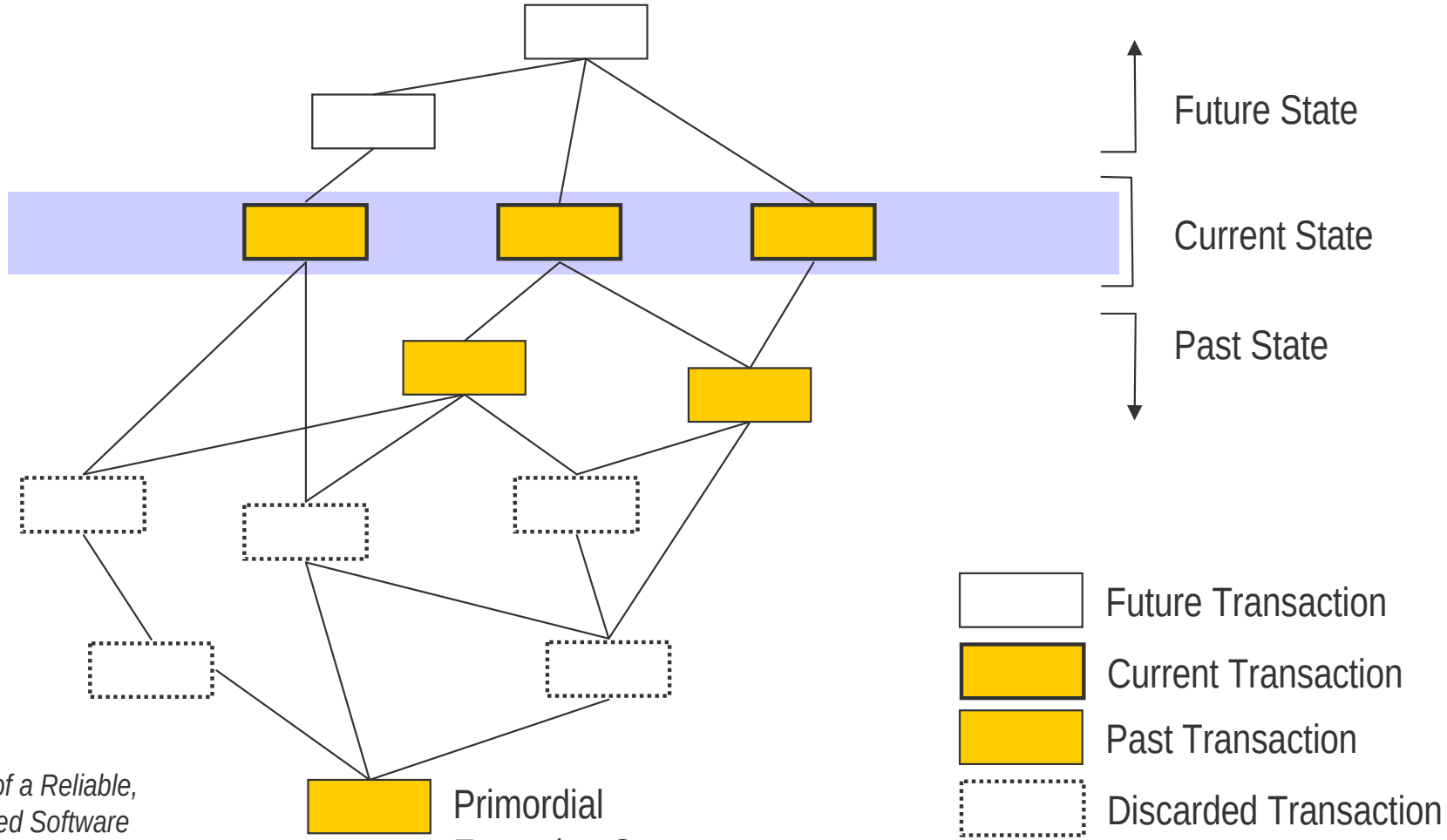
Saballus, Fuhrmann. Maintaining Reference Graphs of Globally Accessible Objects in Fully Decentralized Distributed Systems . HPDC'09

Consistency with DecentSTM



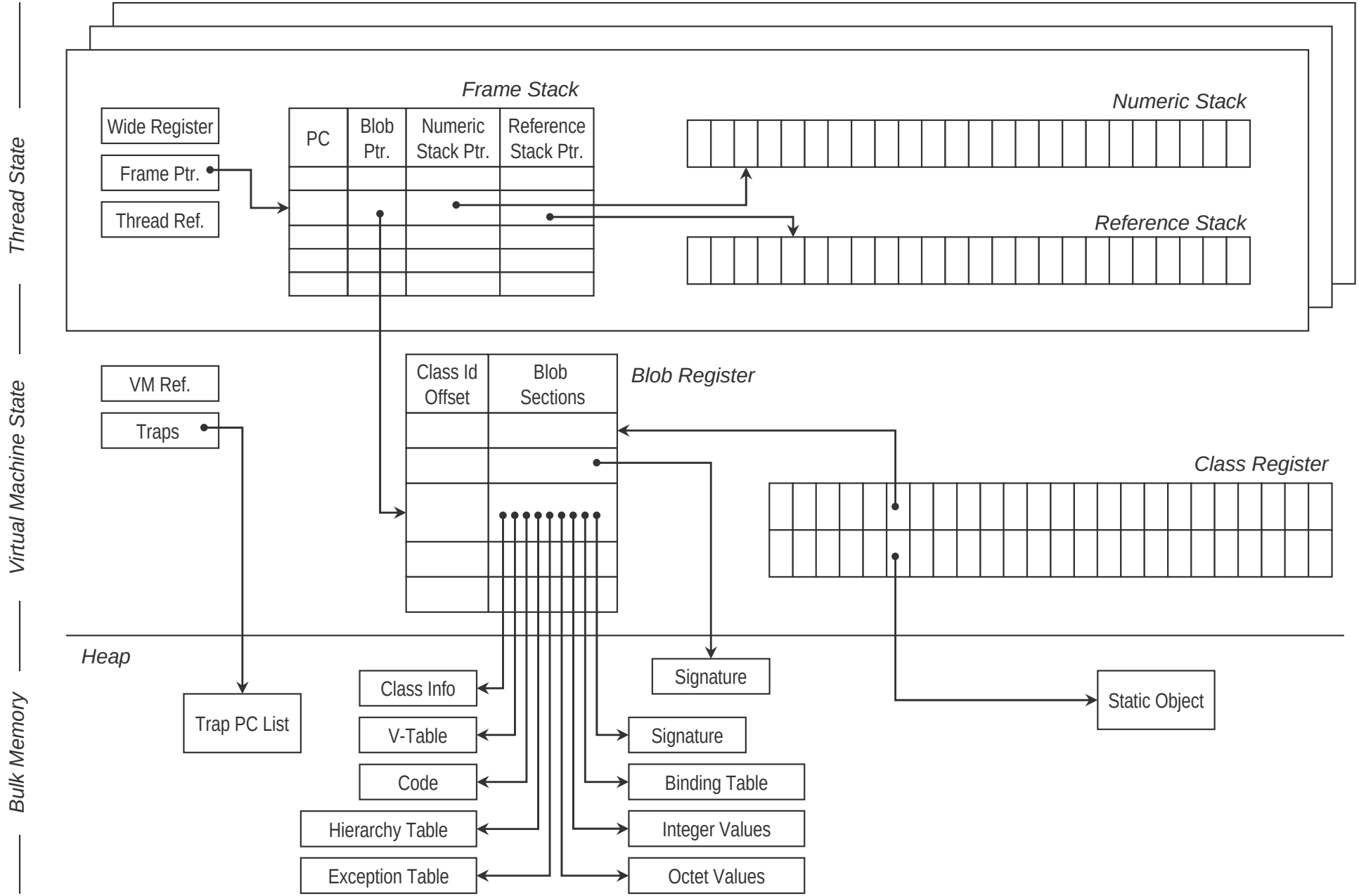
Bieniusa, Fuhrmann. Consistency in Hindsight, A Fully Decentralized STM Algorithm. IPDPS'10

Exploit STM Left-Over State for Redundancy

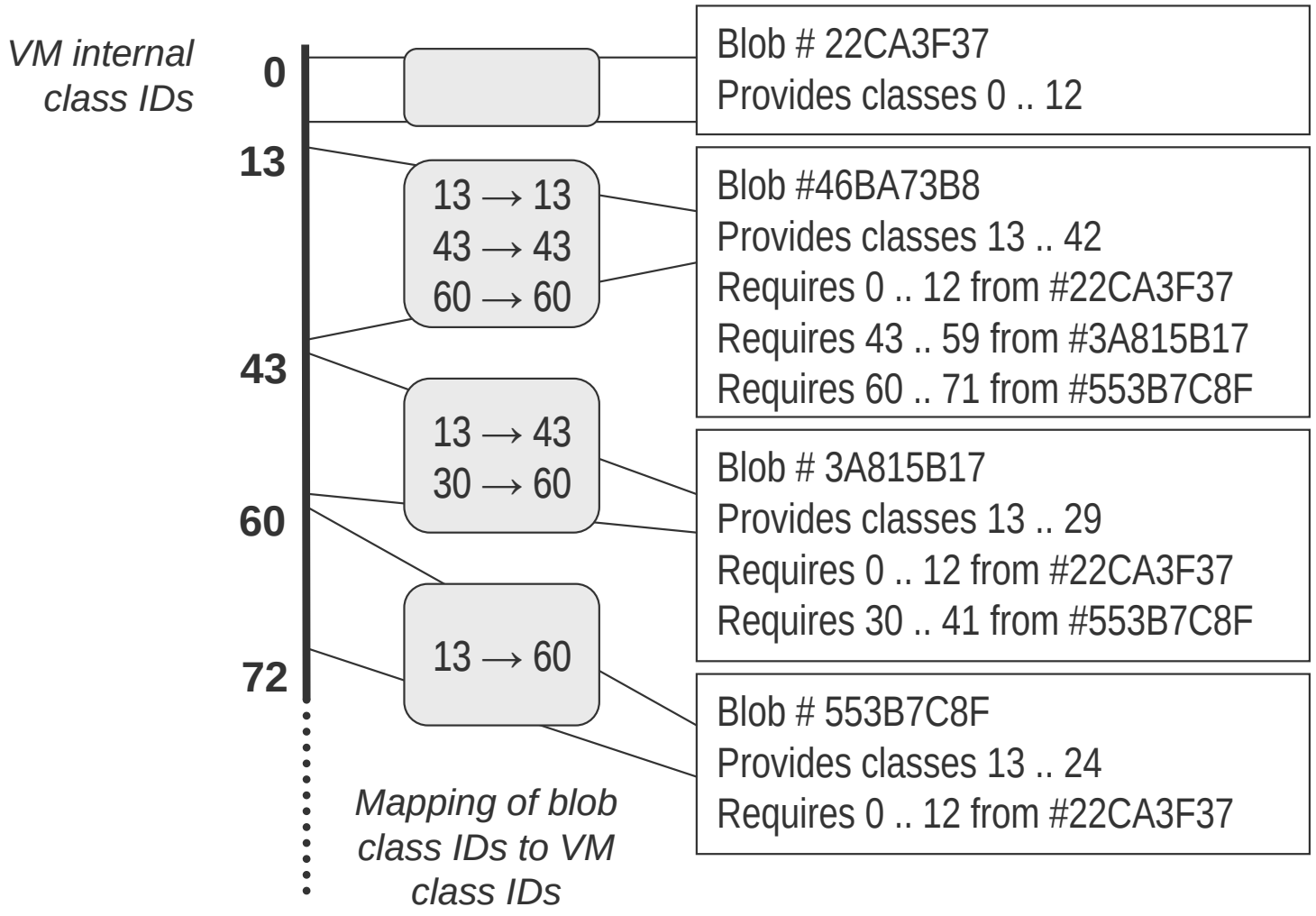


Posselt. Design of a Reliable, Fully Decentralized Software Transactional Memory Protocol. Diploma Thesis, TUM, 2010

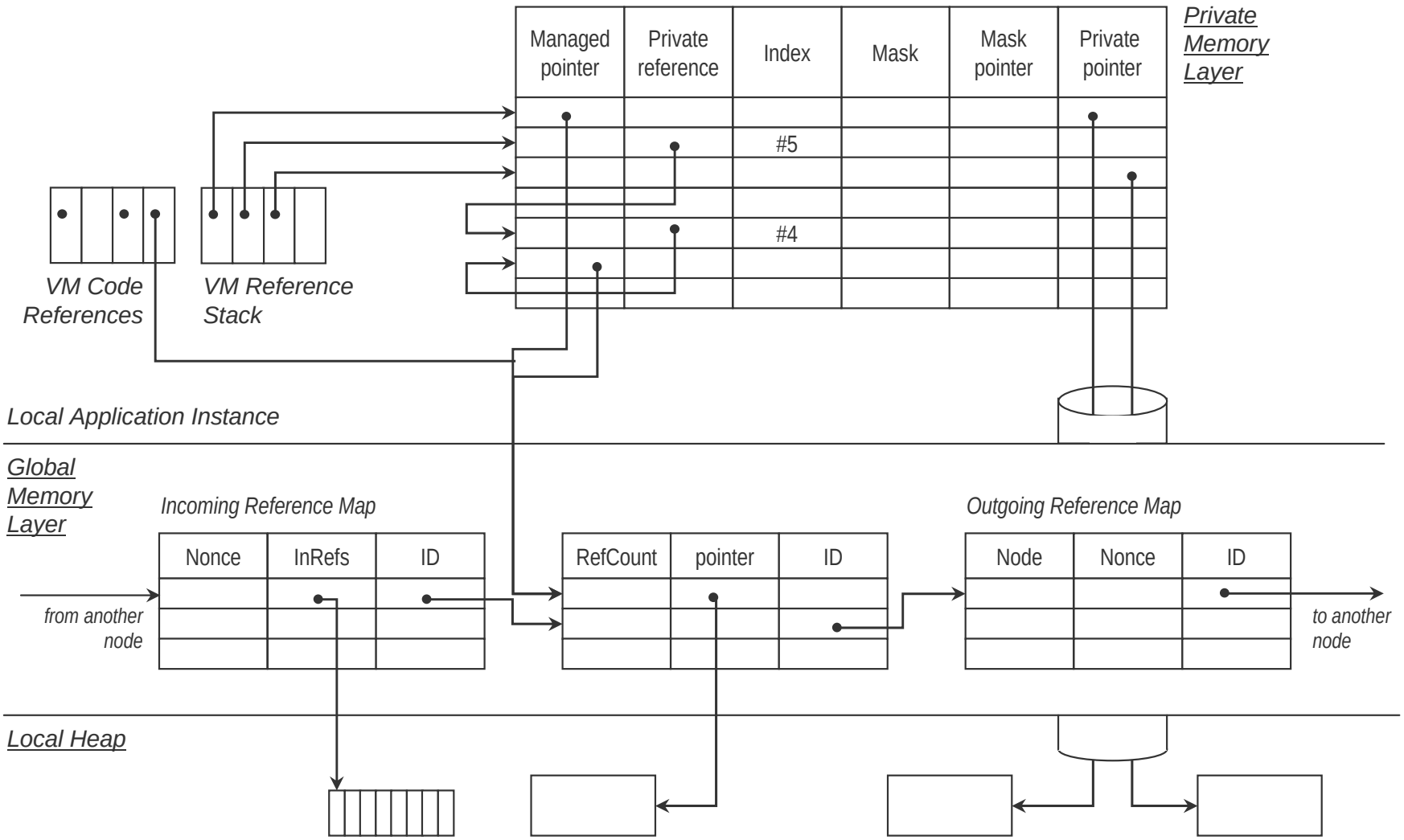
DecentVM – Architecture Overview



Blobs as Suites of Classes



DecentVM‘s Memory Architecture



Summary

- Fully decentralized Virtual Machine
- Memory Access by Name and via References
- Software Transactional Memory for Consistency
- Exploit STM as Extra Redundancy for Reliability

- Research VM (ca. 2000 lines of code ANSI C)
  - Bare metal implementation, i.e. no OS required
  - Offline transcoder transforms Java bytecode into DecentVM code
  - Traps to system library for float arithmetic, etc.
- References, Class IDs, etc. only Locally Valid
  - Need to map class IDs and runtime type info (RTTI)
- Transactions Exploit Private Memory
  - References within a transaction become public only upon commit
  - References need to be resolved only upon numeric GETFIELD

Thank you!

Thomas Fuhrmann

Department of Informatics
Self-Organizing Systems Group
Technische Universität München, Germany

fuhrmann@in.tum.de