Formal Models for Distributed Negotiations

Description

A Web as Wide as the World

- WAN / WEB / Global computing
  - Asynchronous communication
  - Dynamic interconnectivity of autonomous components
  - Dynamic adaptation
  - Interoperability (heterogeneous systems)
  - Mobility
  - Openness
  - Security
  - Quality of services
  - Different levels of abstraction
Our Focus

- In commercial applications, separately designed and implemented components must interact
  - commit (intermediate) results of long-running activities upon (partial) agreements
  - e.g. e-commerce, on-line auction systems
- Formal (meta)models should
  - avoid ad-hoc proprietary solutions
  - offer alternatives to centralized transaction managers
  - hide the coordination layer (separation of concerns)

Distributed Agreements

- Data integration
  - unstructured documents in different formats
- Process cooperation
  - coordination / orchestration / choreography
  - different platforms and policies
- Negotiations / Contracts
  - commit, abort, compensation
  - hierarchical decisions
  - dynamic membership
  - fully distributed control
Commitment

- Different concepts in different areas
  - Classical
    - DataBase transactions
    - Transactional Workflows
    - Committed choice languages (e.g. AKL)
  - Emerging
    - Transition synchronization
    - PDL with commit primitives

Roadmap I

- DataBase Transactions
  - ACID, serializability, commit, abort, roll-back
- One, no-one, one-hundred-thousand transactions
  - Flat
  - Savepoints
  - Chained
  - Nested
  - Distributed
  - Multi-level
  - Sagas
  - Split
  - Flexible
  - Multi-transactions
- Relaxation for mobile computing
Roadmap II

- Commit protocols
  - Transaction managers, failures, timeouts, recovery
  - Generic atomic commitment protocol
  - Two-Phase Commit (2PC) protocol
  - Decentralized 2PC
  - Linear (nested) 2PC
  - Three-Phase Commit protocol

Roadmap III

- Concurrent models
  - Petri Nets (PN)
    - Terminology: places, transitions, tokens, markings
    - Semantics: firings, reachability, processes, unfolding
    - Token philosophies
  - Zero-Safe Nets (ZSN)
    - Transition synchronization
    - Abstract and refined nets
    - Interpreter via unfolding
Roadmap IV

- A Simple Process Algebra (SPA)
  - Signature
  - Operational semantics (LTS, SOS rules)
  - Abstract semantics (behavioural equivalences)
- Encoding SPA in ZSN
  - Compositional encoding
  - True concurrent semantics
  - Correspondence theorem

Roadmap V

- Coordination
  - Linda paradigm
  - PA for Linda primitives
  - Ordered / Unordered semantics
  - Expressiveness
- Linda with transactions (TraLinda)
  - Contextual ZSN
- Serializability in JavaSpaces
  - create/commit primitives
  - informal comparison with TraLinda
Roadmap VI

- From PN to join-calculus
  - Coloured PN
  - Reconfigurable PN
  - Dynamic PN = join-calculus
    - Operational semantics
- Orchestrating transactions in join-calculus
  - Centralized encoding of ZSN
  - Distributed encoding of ZSN
    - Distributed 2PC

Roadmap VII

- Microsoft© BizTalk
  - short / long / timed transactions
  - Extending and executing short transactions via ZSN
- A calculus of compensations for long transactions
  - An algebra of LRT
- Committed join-calculus
  - Membranes, boards and compensations
- 2PC in the pi-calculus
  - Extending the pi-calculus