A Service-Oriented Peer-to-Peer Architecture for Liberalized Markets

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Topics

• Project SESAM – Overview

• SESAM Subproject 4 – Architecture

• Current Work
Project SESAM – Overview
Project context – Internet Economy

• Project framework on Internet Economy funded by the Federal Ministry of Education and Research (BMB+F)
• 7 Projects in different Universities in Germany with industry partners
• Projects spanning working groups (e.g. WG P2P)

• For more information see: http://www.internetoekonomie.net
Project SESAM

• **SESAM** means:
  Self-Organization and Spontaneity in liberalized and harmonized Markets

• Three interwoven topics of Internet Economy
  – Technology – Self-Organizing Networks (P2P)
  – Economy – Spontaneous Activities, Energy Market, Wearable Services
  – Legal factors – Valid Contracts

• Long term project – at least until end of 2007
SESAM – Project Members

- Multidisciplinary project team - members:
  - Institute for Program Structures and Data Organization
    - Prof. Dr. Lockemann
  - Institute of Mathematics
    - Prof. Dr. Zitterbart, Prof. Dr. Juling, Prof. Dr. Hartenstein
  - Institute of Applied Informatics and Formal Description Methods
    - Prof. Dr. Schmeck, Prof. Dr. Studer
  - Institute of Industrial Production
    - Prof. Dr. Rentz
  - Institute of Information Engineering and Management
    - Prof. Dr. Weinhardt, Prof. Dr. Geyer-Schulz
  - Institute of Information Law
    - Prof. Dr. Dreier, Prof. Dr. Sester
SESAM Subprojects

- TP1: Electronic Contracting - Law
- TP2: Spontaneity, Transparency & Incentives – Economy
- TP3: Optimization, Control & Business Models – Economy
- TP4: Architecture – Technology
SESAM – Scenarios

• Core: Self-organizing Infrastructure
• Scenarios with increasing complexity
  – Role change
  – Highly dynamic
Scenario: Multi-Utility-Market

- **Roles**
  - Producer
  - **Reseller**
  - Consumer

- **Utilities**
  - Electricity
  - Water
  - Gas

- **Goals**
  - Bundling of goods
  - Optimization
    - Find bids
    - Create bids
  - Contracting
Scenario: Virtual power plants

Today: “Peer-to-Peer”
“Client-Server”
Distributed Generation

• Role Change
SESAM Subproject 4 – Architecture
Subproject 4 - Architecture

- Goals
  - Security
    - Authentication and Authorization
    - Encryption & Signing
    - Non-repudiation
    - Anonymity, Pseudonyms
    - Privacy issues
  - Robustness
    - Availability, Reliability
    - Stability
    - Self-Organization

System design

Evaluation of sec.&robust. threats
Architectural requirements

- Requirements:
  - Self-Organization
  - Spontaneity
  - Manipulation-free, Discrimination-free

Peer-to-Peer architecture

- Extensible – Integration of new functionality
- Re-Use of components

Service-Oriented architecture
Service Orientation (1)

- All functionality is encapsulated and accessible through a well known interface
- “Everyone” can implement and integrate new services
- Service Description Language: WSDL
- Integration within Applications: Stubs
- Inter-Service message format: SOAP
Service Orientation (2)

- Functional separation of services
  - Core services
    - High degree of Re-use
    - Examples:
      - Document Service
      - Authentication Service
      - Protocol Service
      - ...
  - Application specific services
    - Use Core services
    - Examples:
      - Bid Optimization Service
      - Contracting Service
      - Legal Mediator Service
      - ...

Re-use

App. specific
P2P – Overlay Network

- Integration of multiple overlay networks
  - CAN
  - Chord
  - Pastry
  - Flooding
  - …
  
  *Which one is good for which service?*

- Optimization and Reorganization of the overlay

- Abstraction from P2P-Framework
Combining Services and P2P

- Service specific overlays
  - E.g. document service uses flooding mechanism (1. approach)

- Decentralized service Discovery and Registration

- Offering multiple communication types:
  - Unicast
  - Anycast
  - MultiCast
SO - P2P - Architecture

Service Consumer/Provider
- Doc
- Auth
- Med

Add-on Services
- Stub

System access layer
- SOAP - Processor

Service - Discovery, Registry Management

Transport Layer (JXTA)
- "Address resolution"
  - Random
  - Chord
  - Pastry
Current Work
Current work

- Specification of core services
- Evaluation of overlay networks (service dependent)
- Implementing a prototype using existing frameworks
Core Service Example: DocService

• Function:
  – Distribution of documents
  – Search of documents depending on their content

• Constraints
  – Authentication
  – Integrity, Non-repudiation

• Methods
  – publishDoc(document) -> uuid
  – deleteDoc(uuid)
  – searchDoc(query) -> List of documents

• Open question: How can we support multiple user groups?
Overlay Evaluation – Deploying services

• Evaluating the characteristics of overlay networks w.r.t. service requirements (e.g. Pastry, Chord, CAN, …)
  – Addressing types
  – Latency
  – Privacy
  – …

• “Checklist” with requirements of a service

Method for deploying P2P-services
Prototype Implementation

- Using existing Frameworks

- Web Services → Apache AXIS
  - WSDL2Java for Stub Generation
  - Java2WSDL for WSDL Generation
  - Processing SOAP-Messages
  - Implementation of new Transport Handlers

- Peer-to-Peer → JXTA
  - Core messaging functionality
  - Implementation of Overlays Organizations
General P2P research topics

• Authentication & Trust Models
  – Can we use WS specifications to establish Security and Trust in a P2P network?

• Privacy Model
  – How can we describe Privacy? P3P, EPAL?

• Policy Enforcement (Security, Privacy)
  – Can we enforce Policies without central entities?

• Transactions
  – How can we support transactions in P2P network?

• Uniqueness and Versioning of Services
  – “Everyone” can create new Services => How can we describe their functionality and therefore guarantee their uniqueness?
Questions - Discussion

Any questions?

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