A Peer-to-Peer Registry for Network Management Web Services

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Motivation

Autonomic Communications

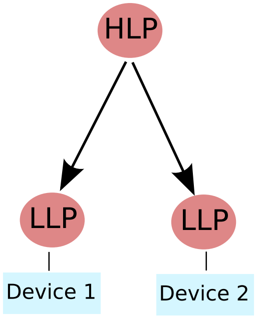
- Complexity of networks grows
- Administrators should be released from repetitive tasks
- Analogy: the autonomic nervous system

Policy-based Network Management

- Govern the behavior of networks with rules
- Policy = Event + Condition + Action
- Research for 15 years

Policy Refinement

- Policies exist on different levels of abstraction
  - High-level policies: business goals
  - Low-level policies: technical details for devices
- Policy Refinement: Breaking down high-level to lower level policies
- Automatic policy refinement: Use Web service composition $\longrightarrow$ Registry required
- Provide a distributed registry as a peer-to-peer overlay



Outline

Introduction

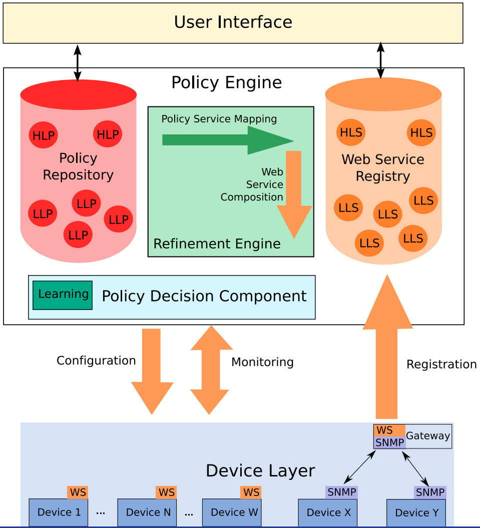
PoMAS: Policy-based Management for Autonomic Self-Organization

Web Service Registry

Evaluation

Conclusion

PoMAS Architecture



Web Service Composition

- Use WS as building blocks
- Synthesis: service selection
- Orchestration: service execution

OWL-S

- OWL Ontology to describe functional properties (IOPEs) semantically
- Static and dynamic synthesis

Management Web Services for Policy Refinement

WS Access to Management Functionality

- Devices offer management services directly (WSDM, WS-Management, NETCONF)
- Devices can register proprietary services
- Gateways can be used (e.g. Nagios, SNMP)

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Refinement Steps

1. Extract policy components from input policies
2. Formulate OWL-S service composition tasks
3. Search for matching service composition
4. Execute composed service when needed

Centralized Approach

UDDI

- Potential service users can browse the categories
  - White Pages: information about organizations
  - Yellow Pages: categorized list
  - Green Pages: technical information (e.g. URI)
- Semantic of services: usually textual descriptions
- No support for OWL-S

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- No support for OWL-S
  - $\rightarrow$ Registries associated with OWL-S Matchmakers

Distributed Approach

The One Ring (Castro et al.)

- Universal ring as overlay
  - Persistent storage
  - Multicast communication
  - Distributed search
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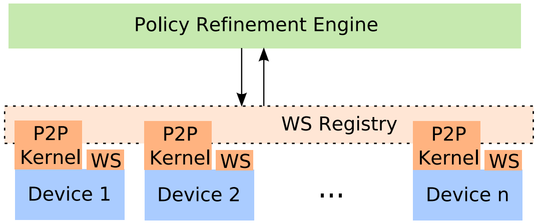
Edutella (Thaden, Siberski, and Nejdl, 2003)

- Peer-to-peer Registry based on Edutella
- Web Service description: DAML-S
- Idea: build an overlay over UDDI (and other) registries

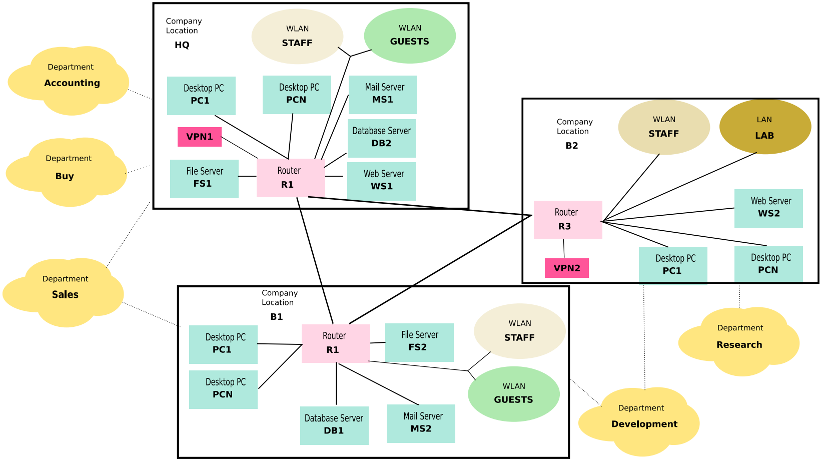
Our Approach: An overlay built by the devices



- All devices take part in the overlay
- No external / central entitity needed
- Different roles based on the resources

Application Scenario: User Management

Network Structure



Application Scenario: User Management

Policies

Requirements

- All devices offer management Web services
- PoMAS is used

Automation

1. New user added
2. PoMAS checks policies for users
    1. Search the registry for relevant Web services
    2. Call the found monitoring Web services
3. Policy violated $\rightarrow$ perform action
    1. Search the registry for relevant Web services
    2. Call the found configuration Web services

Service Description

Semantic description with OWL-S

- Allows searching for IOPEs
- Use inference engines to determine equality
- Exploit inheritance

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Network Ontology

- Ontlogy covering all aspects of networks
- Danger of “world-ontology”
- Use DEN-ng model as starting point

Implementation

- Prototype in Java (using OWL-S API)
- JXTA P2P Framework
  - Rendezvous peers
    - Peers that hold Shared Resource Distributed Index (SRDI)
    - Take part in a distributed hash table (DHT)
  - Edge peers: “normal” peers
  - `JXTAPipes` for internal and external communication
- Plug-in for PoMAS

Evaluation – Settings

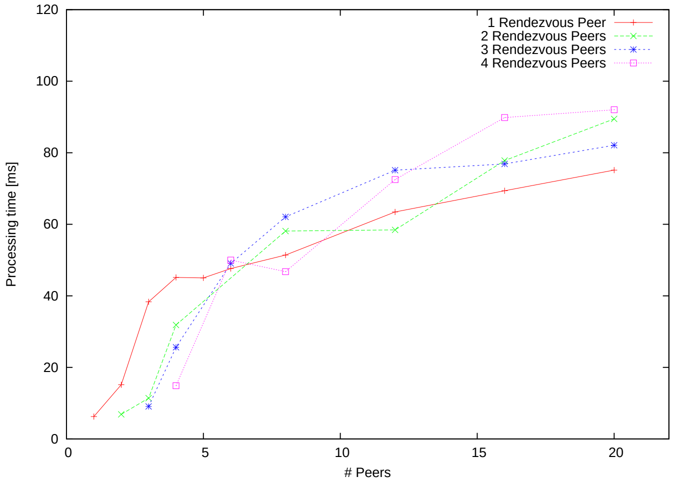
Query Processing

1. Initialize Peers in a Gigabit LAN
2. Dedicated host sends 100 random requests to the network
3. Repeat 50 times
4. Use other rendezvous peers

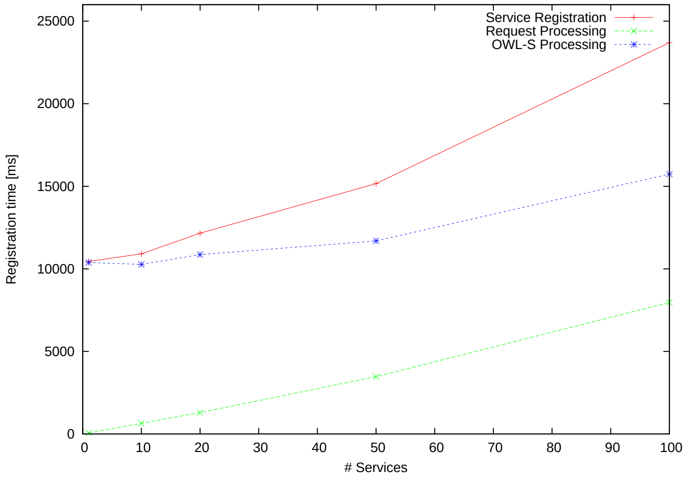
Service Registration

- Most registration on start-up
- Network with 16 peers (4 of them rendezvous peers)

Query Processing



Service Registration



Summary

- Concept of a distributed Peer-to-peer registry for Web services
    - Stores management Web services according to their IOPEs (using OWL-S)
    - Supports PoMAS – Policy-based management system for Autonomic Communications
- Registry as an overlay formed by the devices
- Fits better into the self-management paradigm
- Initial evaluation results: linear scaling

Future Work

- Optimizations, especially for ontology processing
- Investigate and integrate distributed ontology processing techniques
- Find a leaner subsitute for OWL-S libraries
- Provide a prototype suitable for embedded systems

The End

Questions and/or Comments

- Here and now: Speak up!
- Later: `torsten.klie@informatik.uni-erlangen.de`