



# A Unified Framework for the Negotiation and Deployment of Network Services

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**1<sup>st</sup> International Workshop on Autonomic  
Communication (WAC 2004)  
Berlin, Germany, October 18-19, 2004**





# Outline

- Introduction
- Unified Framework for Network Services
  - Phase A: Identify needs and locate providers
  - Phase B: Negotiate agreements
  - Phase C: Deploy and configure services
  - Phase D: Monitor, evaluate, adapt, reconfigure
- Summary of Working Items



# Introduction

- Autonomic Communication Network (ACN)
  - Decentralized collection of autonomic elements – self-organize
  - Learn each other's behaviours, influence upon them
  - Human input: choices, constraints, preferences
  - Problem: how to deal with conflicting human input?
    - Automated conflict detection and resolution
    - Covering full network service lifecycle
      - Definition, announcement, discovery, request, negotiation, agreement, deployment, configuration, execution, reconfiguration
    - Trust boundaries at several scales
      - Software components, nodes, local networks, domains
    - Shared resources: resource management

# Dealing with conflicts in ACNs



- Trust
  - Reputation systems
  - Policy systems
- Resource disputes
  - Decentralized resource control
    - Market-based mechanisms
- Conflict resolution
  - Automated negotiation
    - Numeric: on quantitative issues
    - Symbolic (argumentation): on qualitative issues

# Automated Negotiation



- Model human negotiation process via Intelligent Agents: Theories, Strategies and Protocols [Jennings et al., 2001]
- Goal: automate the process of reaching agreements
- Applications
  - E-commerce
  - Telecommunications
    - VPN service provisioning [Calisti et al., 2000] [Faratin 2000]
    - Provider selection in wireless networks [Faratin 2003]
- Classification
  - Single-issue: e.g. price
  - Multi-issue: price, quality, delivery time,...
  - In practice: Time-constrained (deadline)

# Unified Framework for Network Services



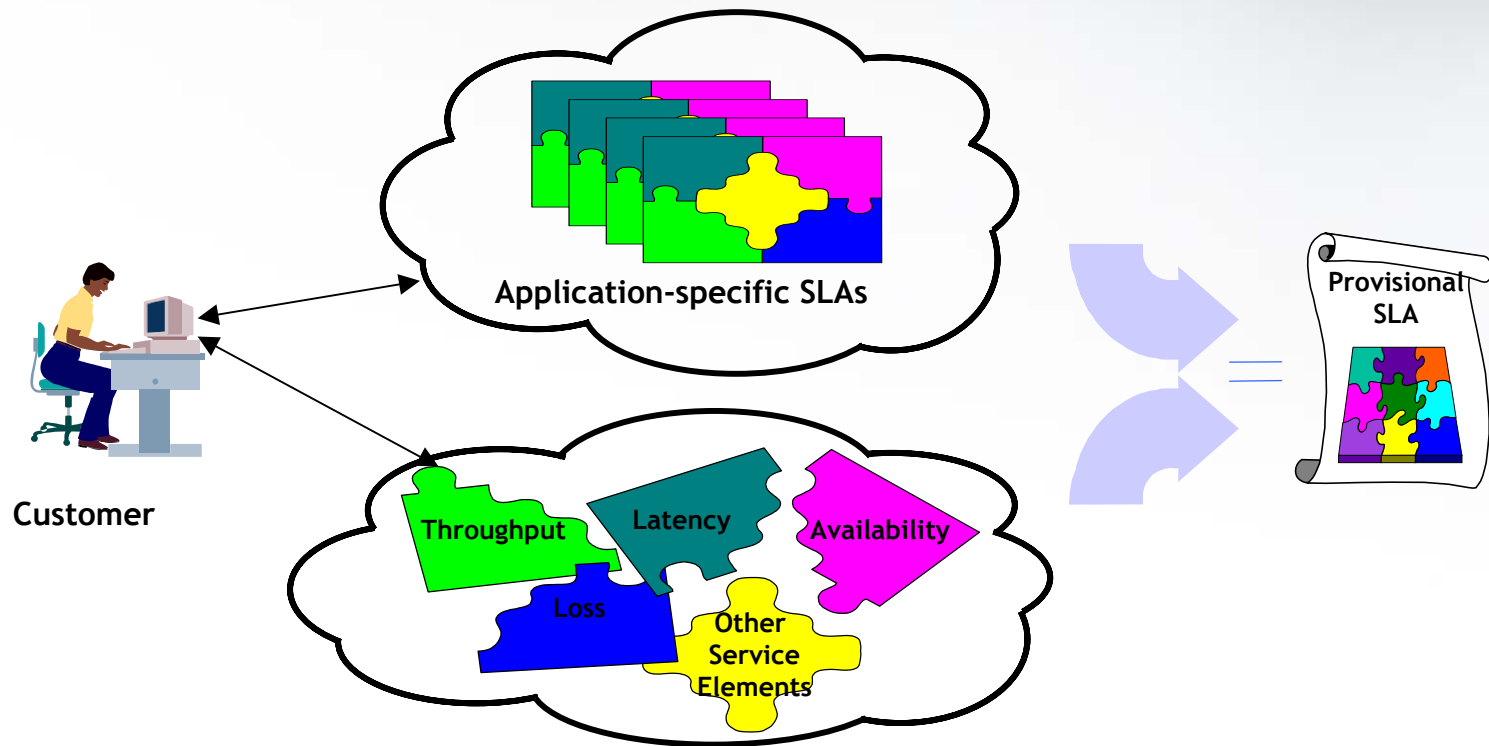
- Service lifecycle
  - Phase A
    - Provider: definition, creation, announcement
    - Customer: requirements, discovery, selection
  - Phase B
    - Request, negotiation, selection, agreement
  - Phase C
    - Deployment, configuration, execution
  - Phase D
    - Monitoring, evaluation, adaptation, reconfiguration

# Unified Framework for Network Services



## Phase A.

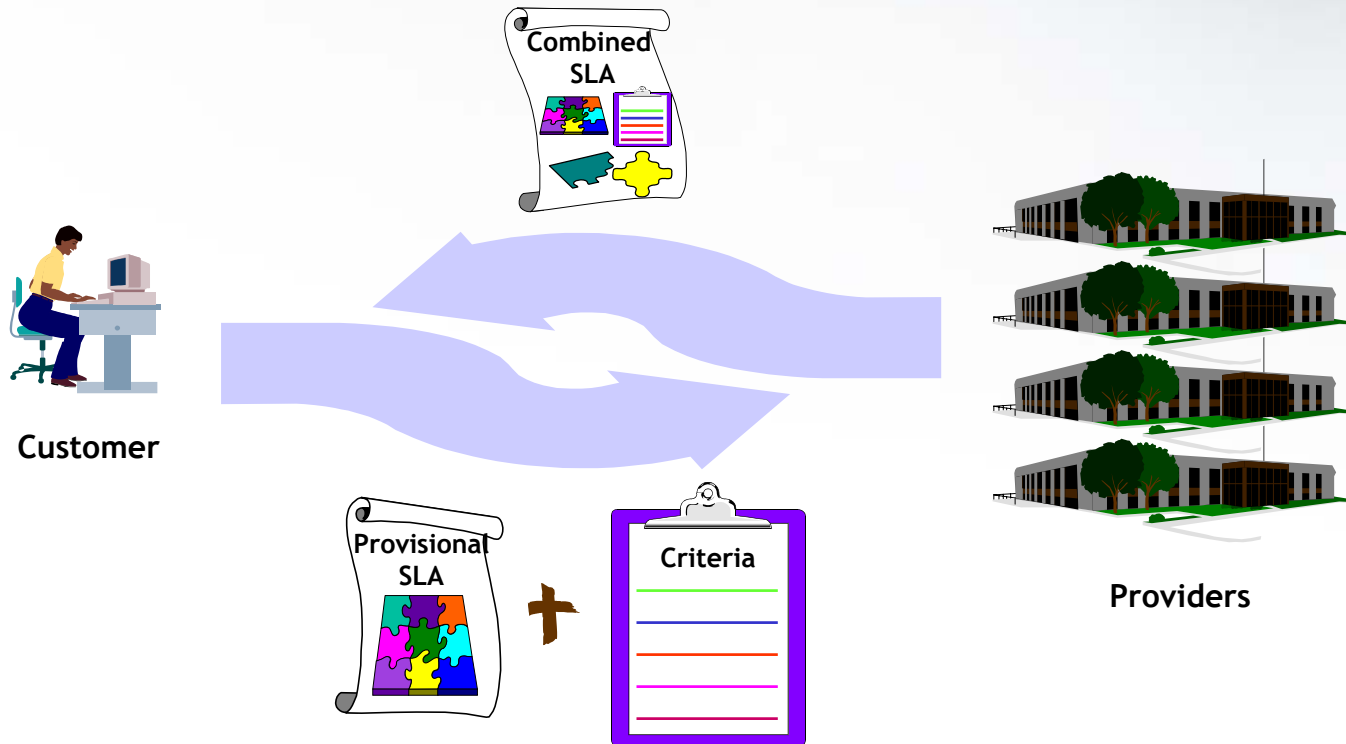
Creating/selecting Applications/Services by means of SLAs



# Unified Framework for Network Services

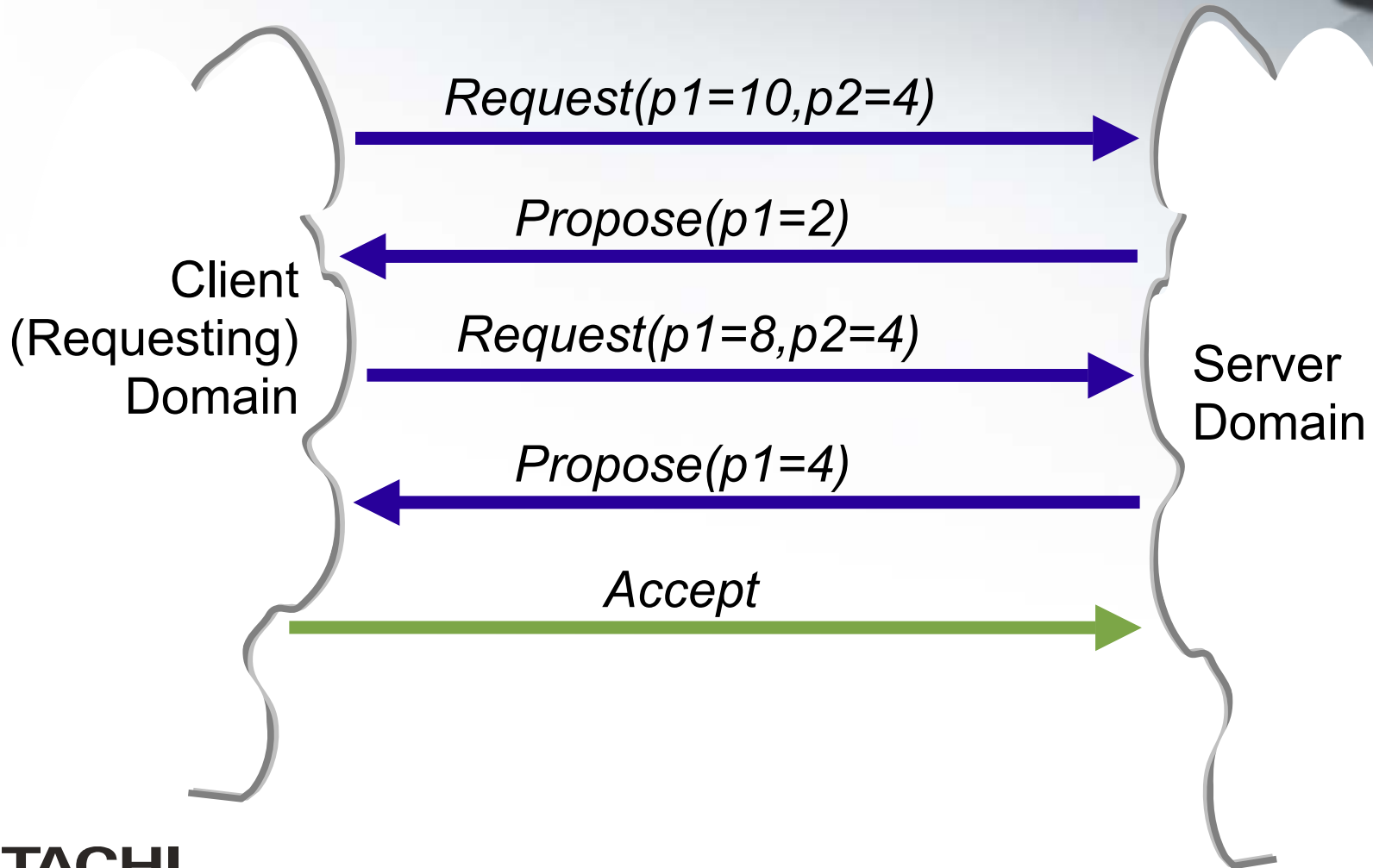


## Phase B. Shopping for Application/Services





# Example of Negotiation Session



# Negotiation Strategy



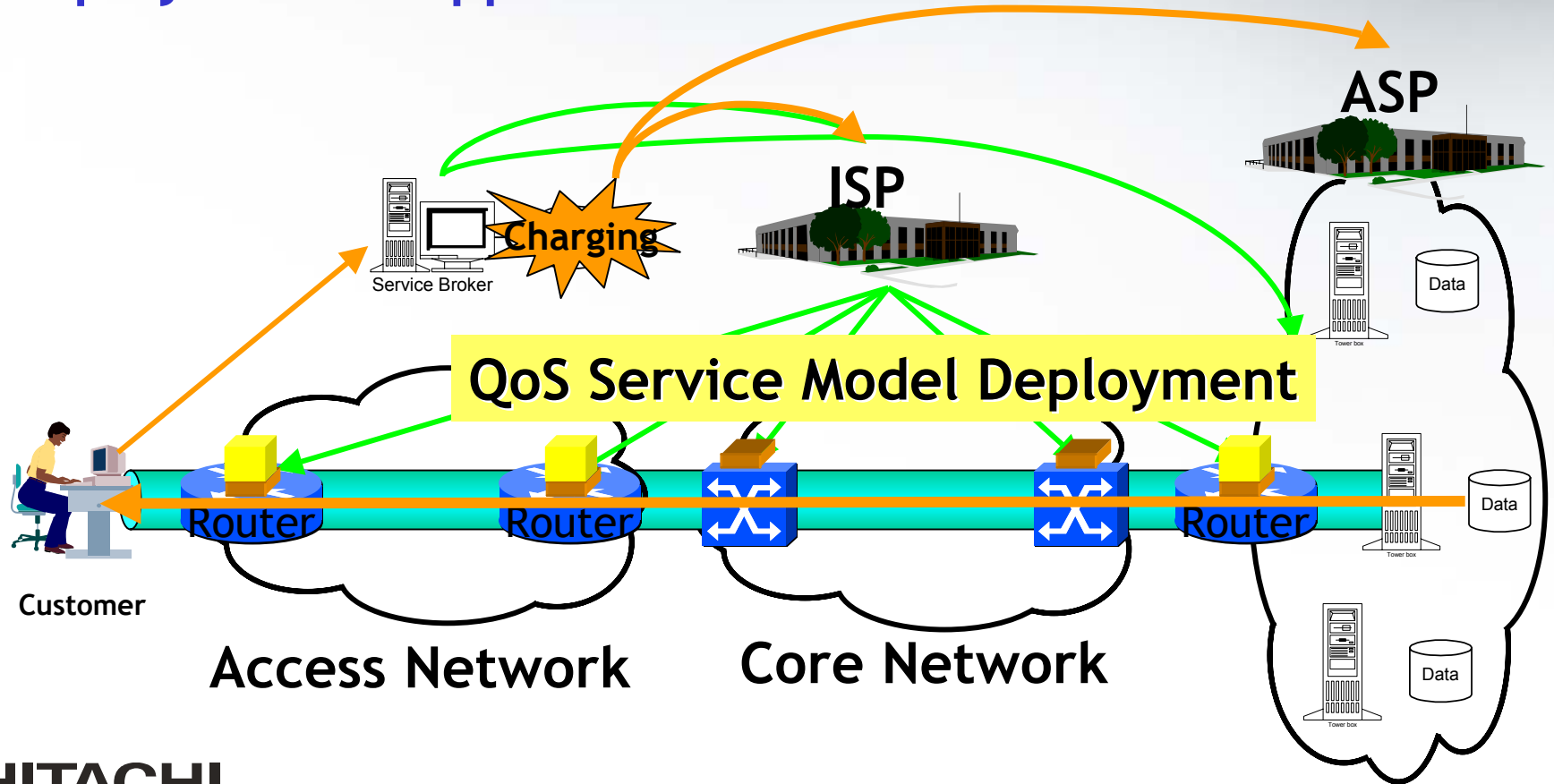
- Strategy: Decision algorithm to determine whether to accept, reject, or calculate/offer proposal/counter-proposal.
  - Time-constrained, Single- or Multi-issue
- Strategy belongs to domain's private information
- Example: Single-issue case in [\[Fatima et al. 2002\]](#)
  - $t$ =current time
  - $T$ =deadline
  - $p(t)$ =my proposal :  $Pmin \leq p(t) \leq Pmax$
  - $q(t)$ =opponent's proposal
  - If  $t > T$  then Reject, else
    - $p(t) = f(Pmin, Pmax, t, T)$
    - If  $U(q(t)) \geq U(p(t))$  then Accept else Propose( $p(t)$ )

# Unified Framework for Network Services



## Phase C.

### Deployment of Applications/Services



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October 18-19, 2004

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# Summary of Working Items



## ■ Phase A

- Provider side:
  - How to describe and announce services in a decentralized way?
  - How to generate services automatically from user input?
- Customer: requirements, discovery
  - How to discover and understand service semantics?  
Possible also without globally standardized ontologies?

# Summary of Working Items



- Phase B
  - Apply negotiation algorithms to real network services
  - Evaluate their performance, their ability to accurately represent their human owner
  - Acceptance?

# Summary of Working Items



- Phase C
  - Network languages to describe elements, technologies, intentions - beyond SLAs
  - From self-deploying (standalone) to self-composing services
  - Location problems: decentralized decisions about placement of service components
  - Security

# Summary of Working Items



- Phase D
  - Fully autonomic, self-adapting system
  - Control system
    - Input: user, network conditions
    - Decision mechanisms to draw conclusions and take actions
    - Output: reconfiguration actions
  - How to make such consistent "global control" impression emerge out of local decisions?
    - Truly self-organizing, with real world constraints