Dynamic Reconfiguration of Evolving Web Services

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DEAS: Design and Evolution of Autonomic Application Software

- Sponsored by IBM Toronto and NSERC: $750K over 3 years
- Principal Investigators
  - Hausi A. Müller, University of Victoria
  - John Mylopoulos, University of Toronto/Trento
  - Marin Litoiu, IBM Canada Ltd.
- Over 15 PhD and MSc students involved
- Investigate methods for designing and evolving high-variability, self-managed systems using goal-driven requirements engineering methods
- Develop an analysis framework for AC application architectures using ABASs
- Investigate methods for evaluating complex tradeoffs
- Self-configuration of web and grid services
- Trust nomenclature for building AC systems incrementally
Goals and Results

- We are looking at:
  - autonomic self-configuration
  - dynamic redeployment
  - evolution management
  ... from a design-time perspective
  ... applied to web services

- Our results thus far:
  - The Chain of Adapters design technique for version management
  - An Eclipse/WTP (Web Tools Platform) plug-in to help apply Chain of Adapters to a WSDL/SOAP web service
  - Support from IBM Autonomic Computing and IBM Web Services VPs
The Challenge

1. Support backwards-compatible web service evolution

2. Minimize cost of supporting older versions

3. Simple for service developers, transparent for client developers

For human administrators as well as self-managing systems
Exhibit A: standalone versions

- Safest: old versions unaffected by new ones
- Maintenance, consistency and scalability headaches
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Exhibit A: standalone versions

- Interface v1
  - My Web Service 1
  - DB

- Interface v2
  - My Web Service 2
  - DB

- Interface v3
  - My Web Service 3
  - DB

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- Maintenance, consistency and scalability headaches
Exhibit B: schema extension

- Single access point forever, single codebase
- Tricky schemas, entangled code versions, constrained changes
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Exhibit C: incremental interfaces

- Common and easy design, single codebase
- Scattered and bloated interfaces, entangled code versions
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Chain of Adapters

- Versions separated, single code base, changes unconstrained
- Changes affect old versions, chain length impacts maintenance and performance

Also known in Haskell as ECT: "Eternal Compatibility in Theory"
**Chain of Adapters**

- Interface v1
- Interface v2
- Adapter
- My Web Service
- DB

- Versions separated, single code base, changes unconstrained
- Changes affect old versions, chain length impacts maintenance and performance

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**Requirements**

1. Backwards compatibility
2. Common code base
3. Common data store
4. Untangled versions
5. Unconstrained evolution
6. Visible mechanism
Chain of Adapters (CofA)
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1. duplicate interface into new namespace
2. create trivial delegating adapter
3. publish frozen interface at new endpoint
4. make compensating changes in adapter
Chain of Adapters (CofA)

1. duplicate interface into new namespace
2. create trivial delegating adapter
3. retarget previous adapter
4. publish frozen interface at new endpoint
5. make compensating changes in adapter
**Chain of Adapters (CofA)**

Pros
- common code/data
- encapsulated versions
- transparent mechanism

Cons
- backwards compatibility not guaranteed
- some constraints on evolution
- performance issues (manageable)
Reconfiguration Scenario

- Applying Chain of Adapters (CofA) within an application allows:
  - splitting the reconfiguration process into smaller chunks
  - shorter service discontinuities
  - easier failure recovery

(Each box in these diagrams encompasses a whole application, including its entire chain of adapters.)
Conclusions

- Present:
  - Design guidance for backwards-compatible web service evolution
  - Eclipse Web Tools Platform (WTP) “freeze & delegate” plug-in

- Next steps:
  - Rewrite Chain of Adapters plug-in for WTP 1.0/1.5
  - Adapt plug-in for IBM WebSphere Application Server (WAS)
  - Integrate plug-in into production WTP or other IBM tools
  - Investigate generalizing chain into tree
    - e.g. for bug fixes, or decoupled client/server development