Dynamic Reconfiguration of Evolving Web Services

Piotr Kaminski and Hausi A. Müller
Department of Computer Science
University of Victoria

Marin Litoiu
CAS Toronto
IBM Canada Ltd.

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

I

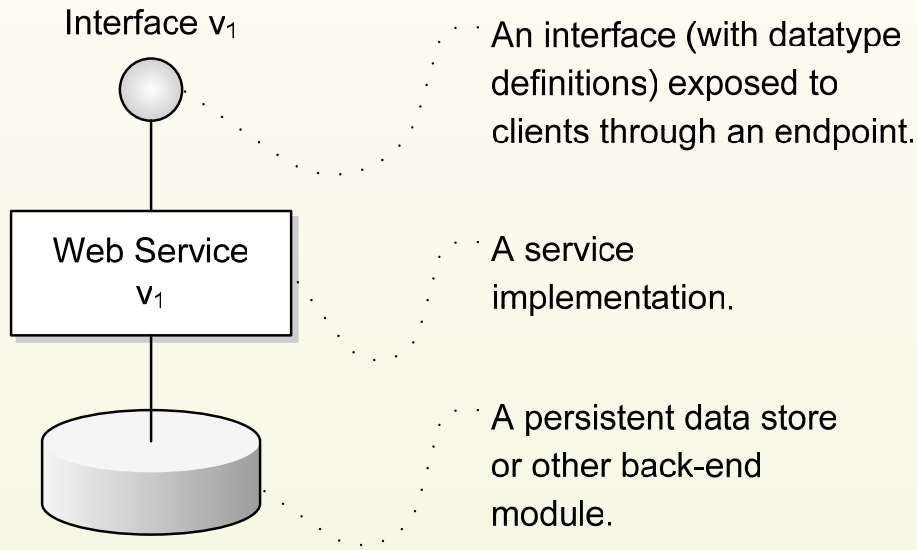
- Investigate methods for designing and evolving high-variability, self-managed systems using goal-driven requirements engineering methods
- Develop an analysis framework for AC application architectures using ABASs
- Investigate methods for evaluating complex tradeoffs
- Self-configuration of web and 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

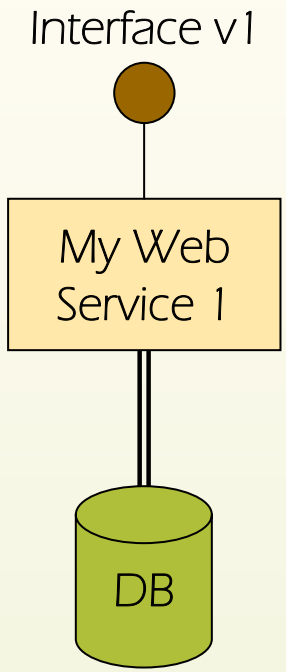
❶ Support backwards-compatible web service evolution

❷ Minimize cost of supporting older versions

❸ 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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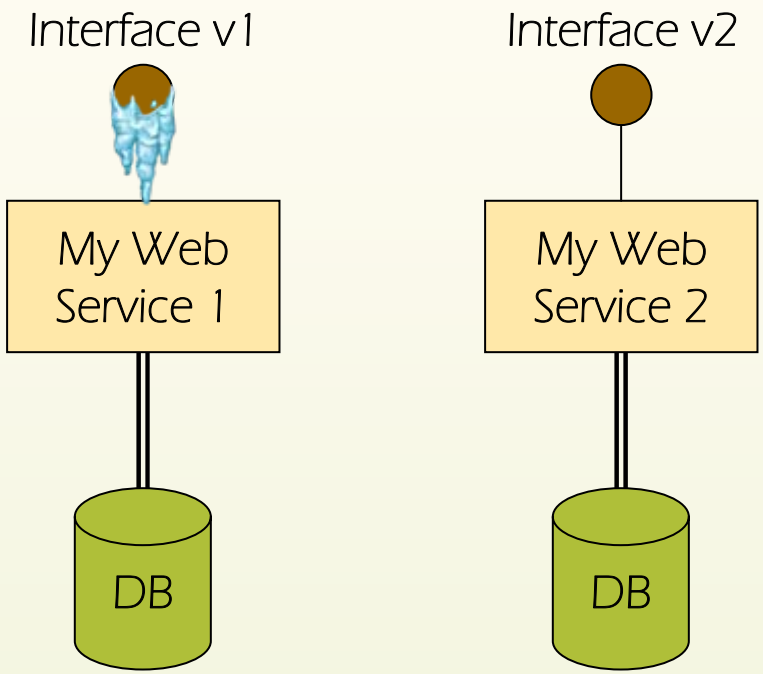

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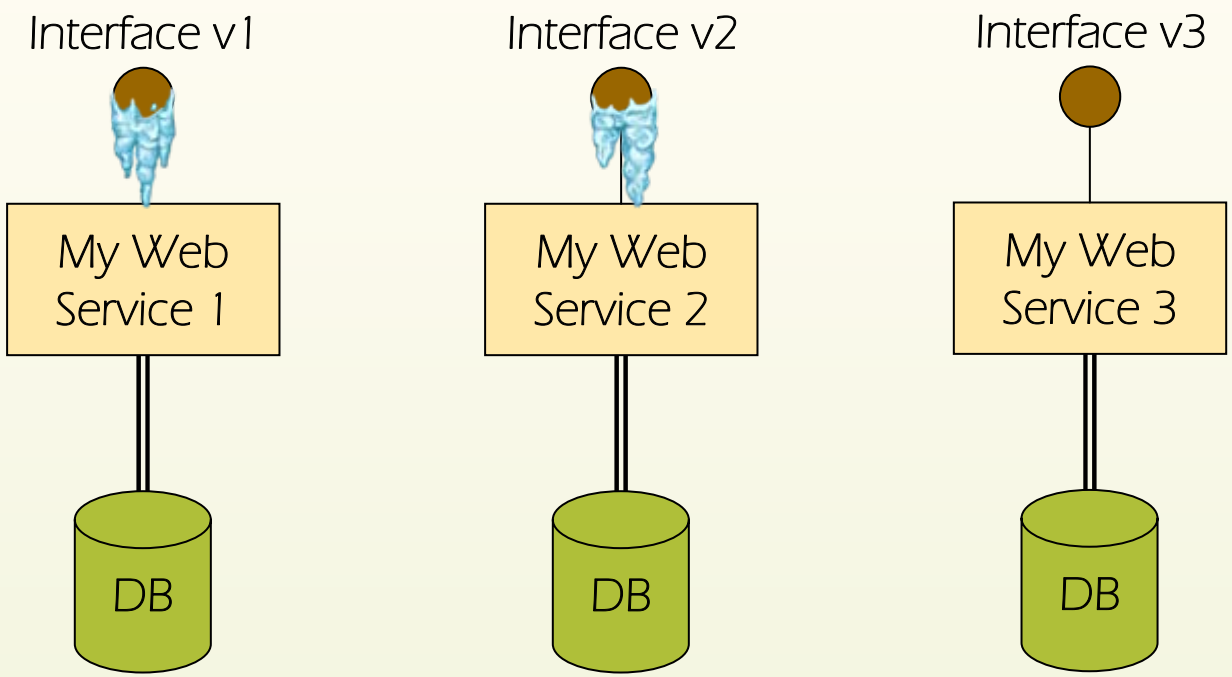

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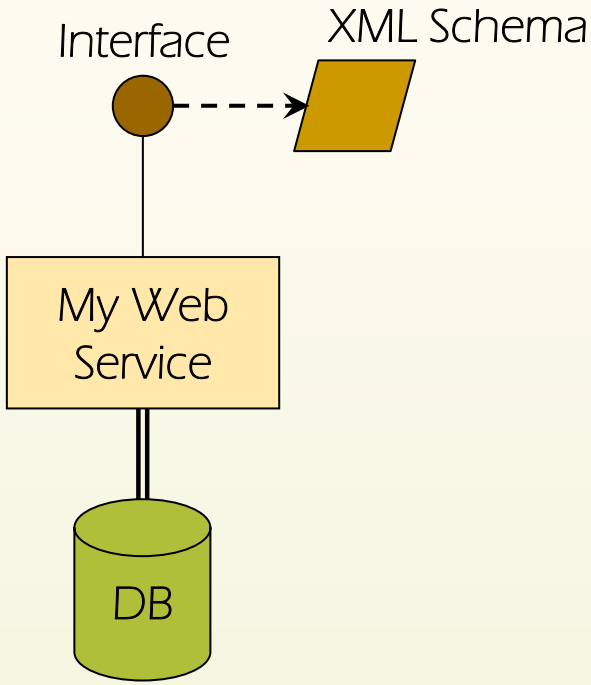
Exhibit B: schema extension



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- ☒ Tricky schemas, entangled code versions, constrained changes

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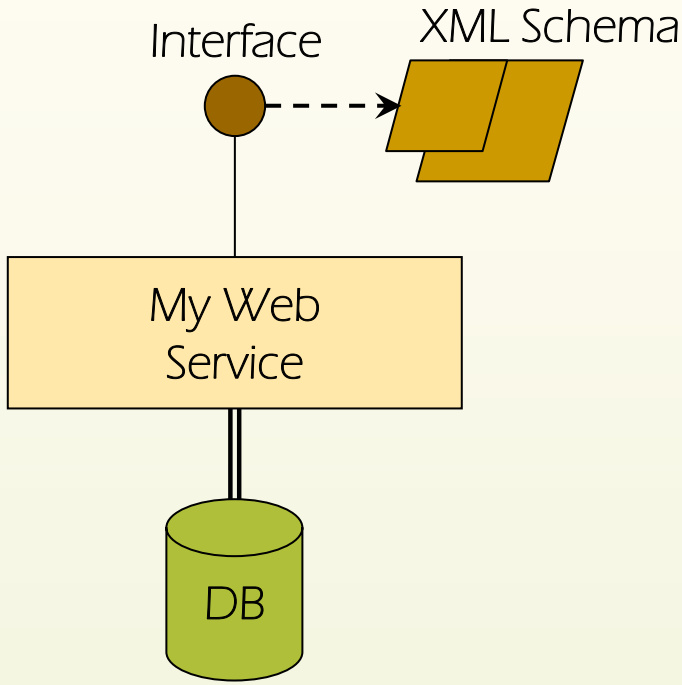

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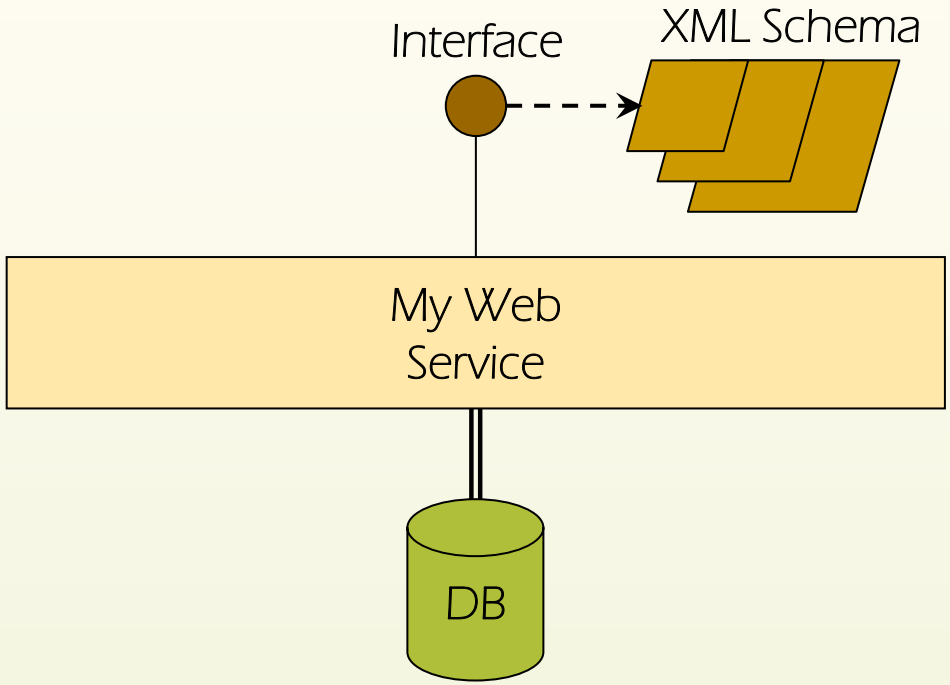

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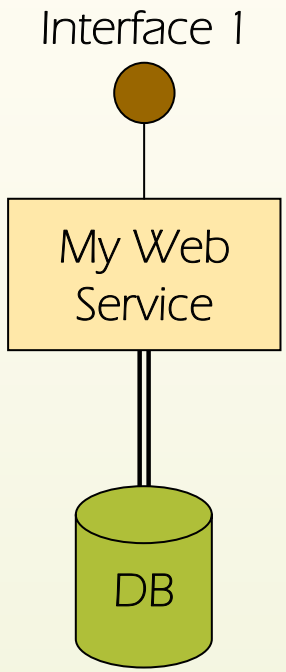
Exhibit C: incremental interfaces



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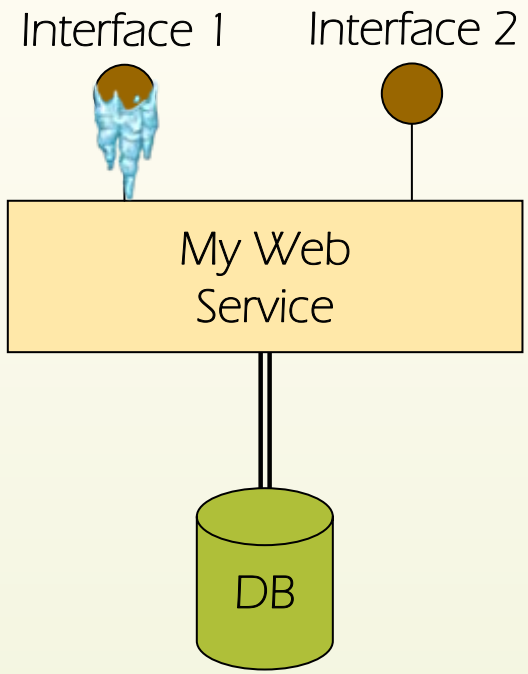

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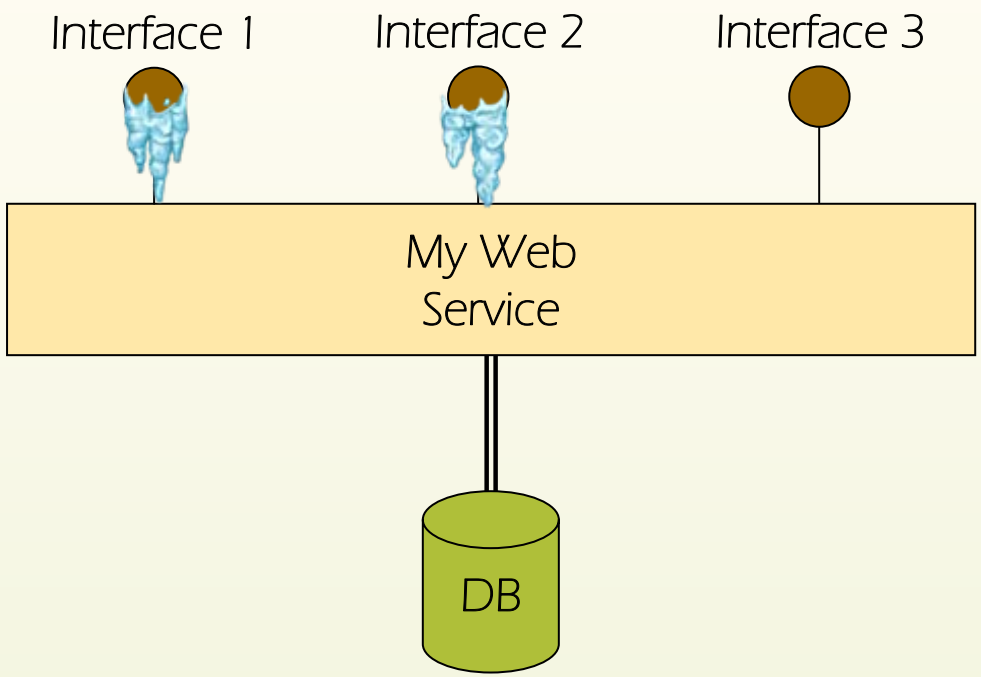

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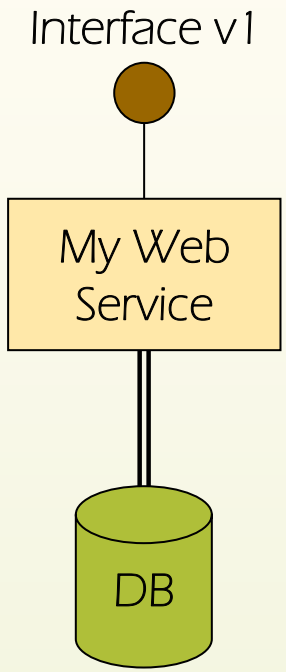
Chain of Adapters

Also known in Haskell as ECT:
"**E**ternal **C**ompatibility in **T**heory"



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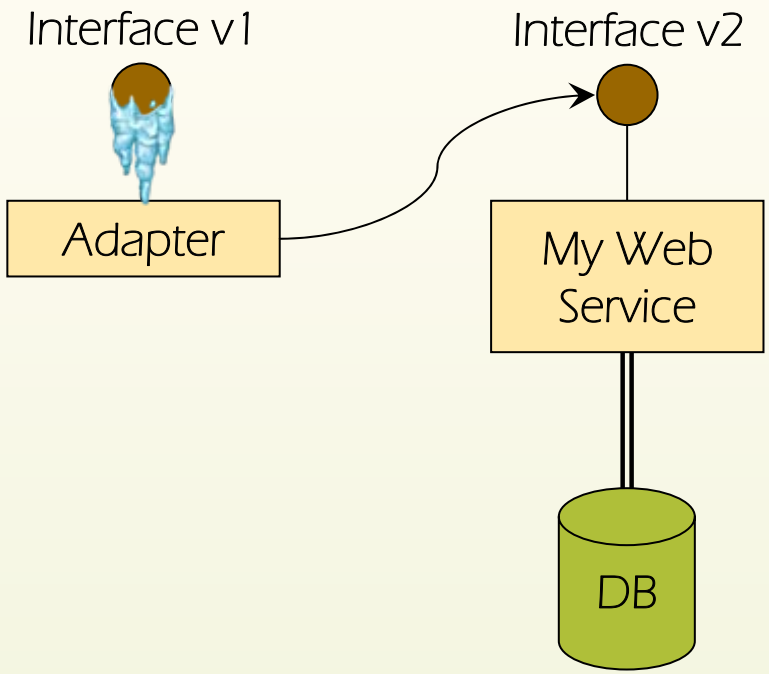

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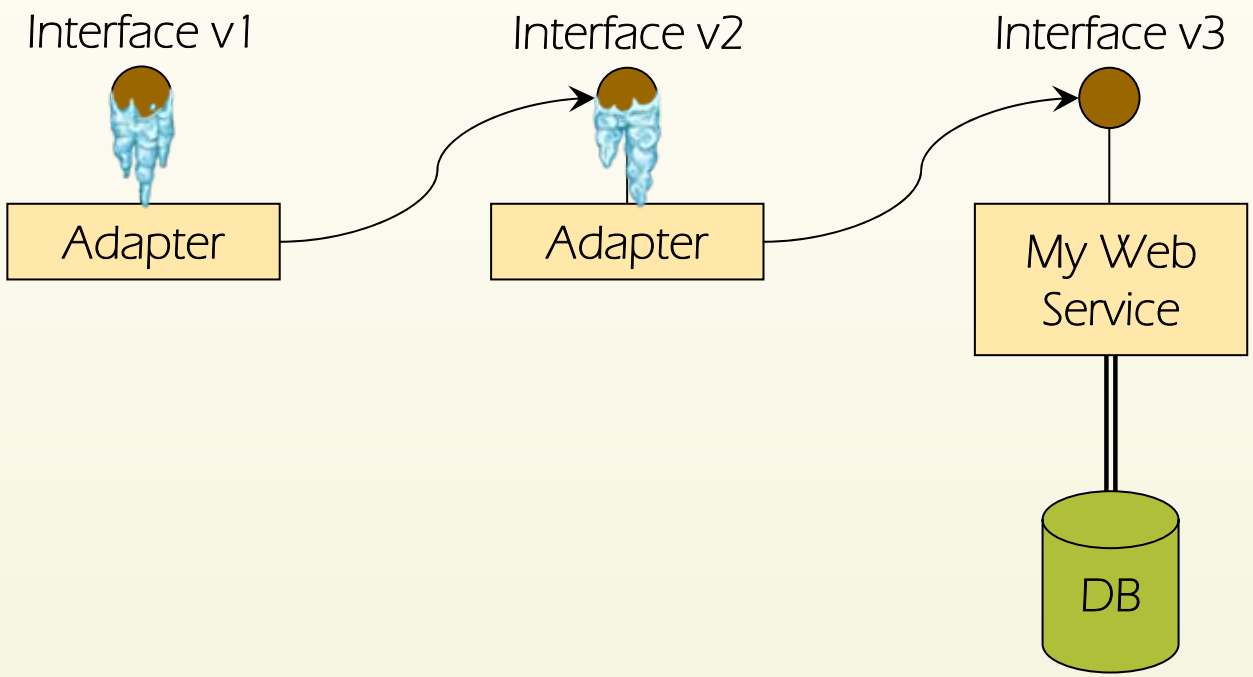

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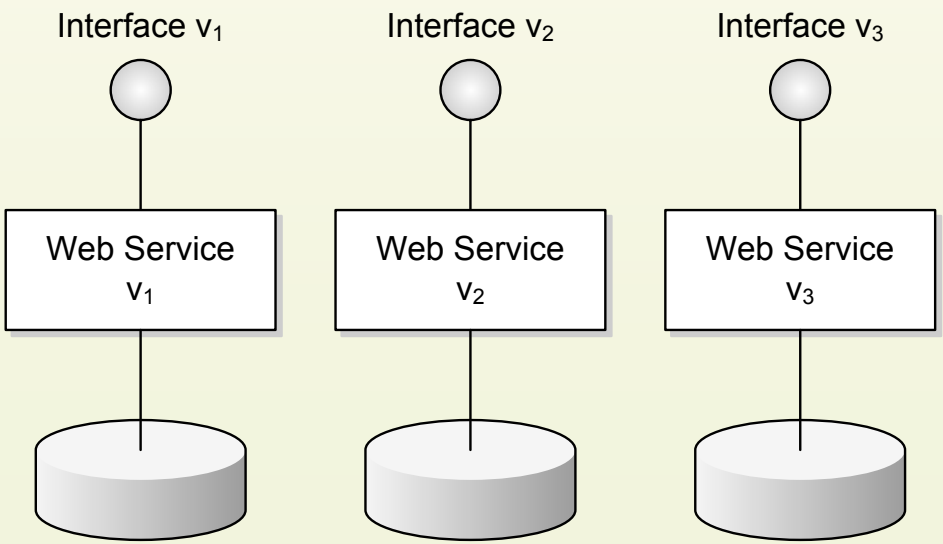
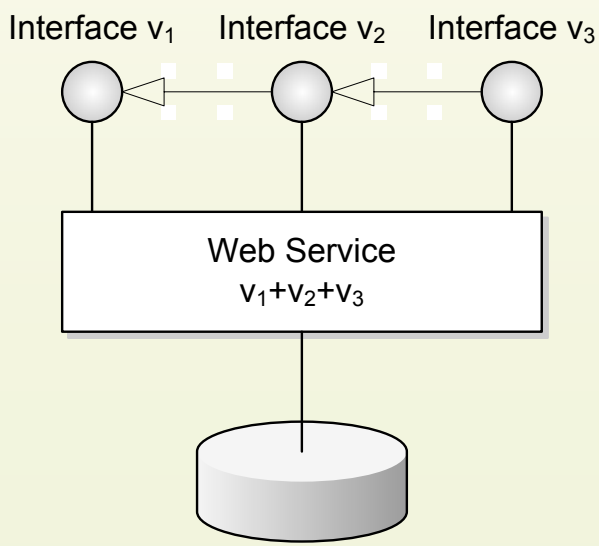
Requirements

1. Backwards compatibility
2. Common code base
3. Common data store
4. Untangled versions
5. Unconstrained evolution
6. Visible mechanism

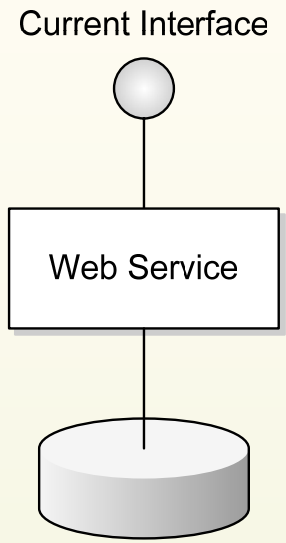
Isolated versions



Tangled versions



Chain of Adapters (CofA)



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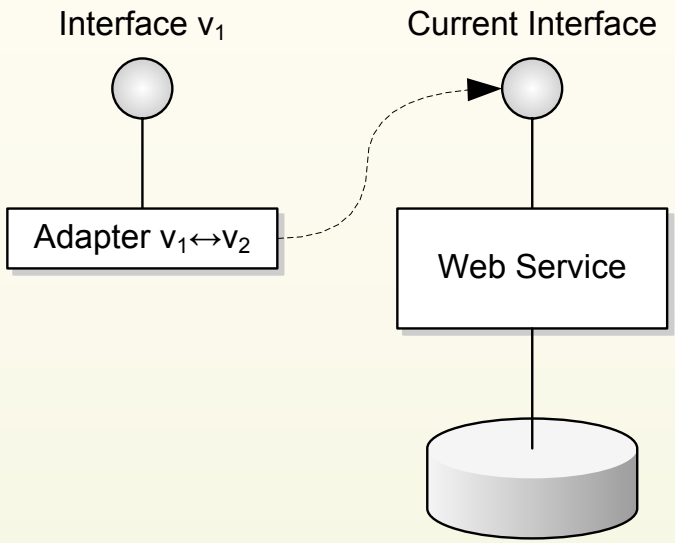

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3. publish frozen interface at new endpoint
4. make compensating changes in adapter

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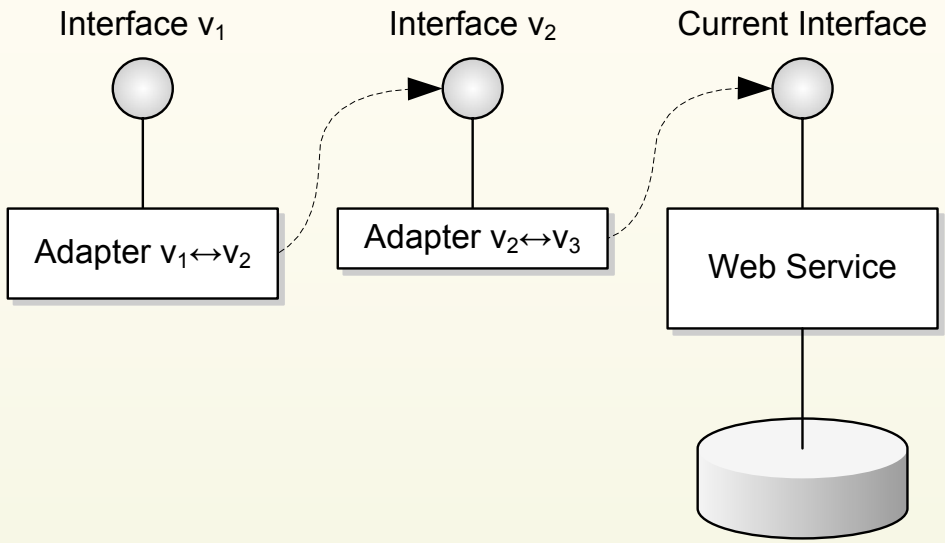

1. duplicate interface into new namespace
2. create trivial delegating adapter
3. retarget previous adapter
4. publish frozen interface at new endpoint
5. make compensating changes in adapter

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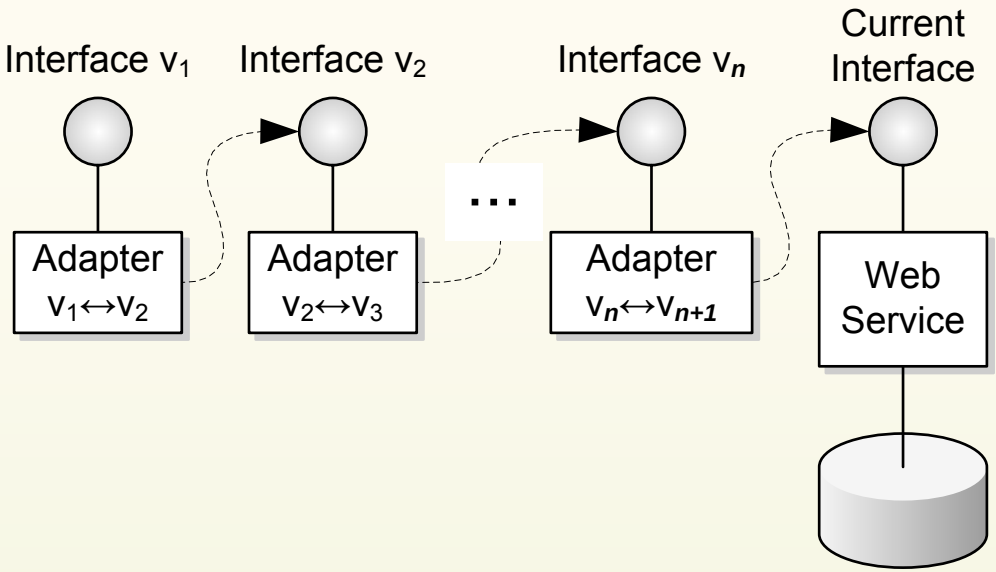


Pros

- common code/data
- encapsulated versions
- transparent mechanism

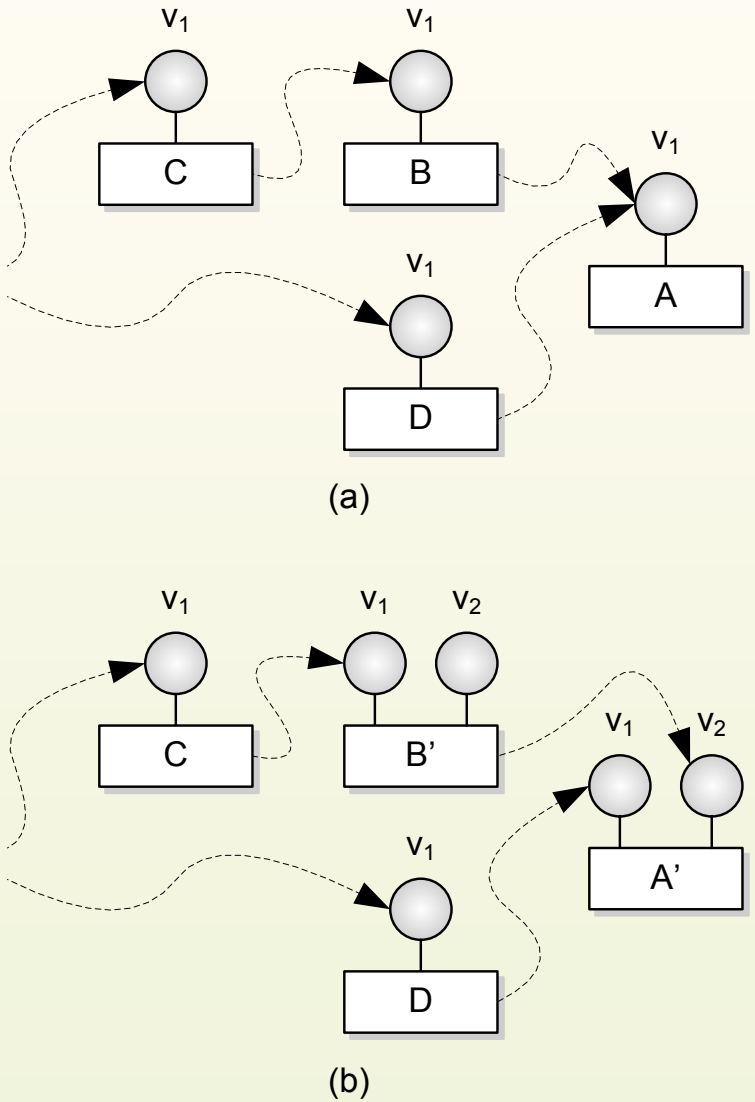
Cons

- 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