



CHEMNITZ UNIVERSITY
OF TECHNOLOGY

HP UDC – Standardizing and Automizing Data Center Operations

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Dr. Sven Graupner, *HP Labs, Palo Alto, CA*



Motivation



- Problems in Data Centers (*Rechenzentren*)
 - Manual operations by system administrators.
 - Limited automation with few standards
 - Overprovisioning
 - Demanding tasks:
 - Adding new hardware or software
 - Migrations
 - Reorganizing network topology



HP Utility Data Center (UDC)



- Set of Resources
 - Diskless servers with Fiberchannel controllers
 - Storage array with SAN
 - Network Appliances
 - (switch, router, load balancer, fw, ...)
- Management & Support
 - Management Rack
 - Operations Center Rack (HP OpenView)
 - Backup Rack



UDC at HP Labs, Palo Alto

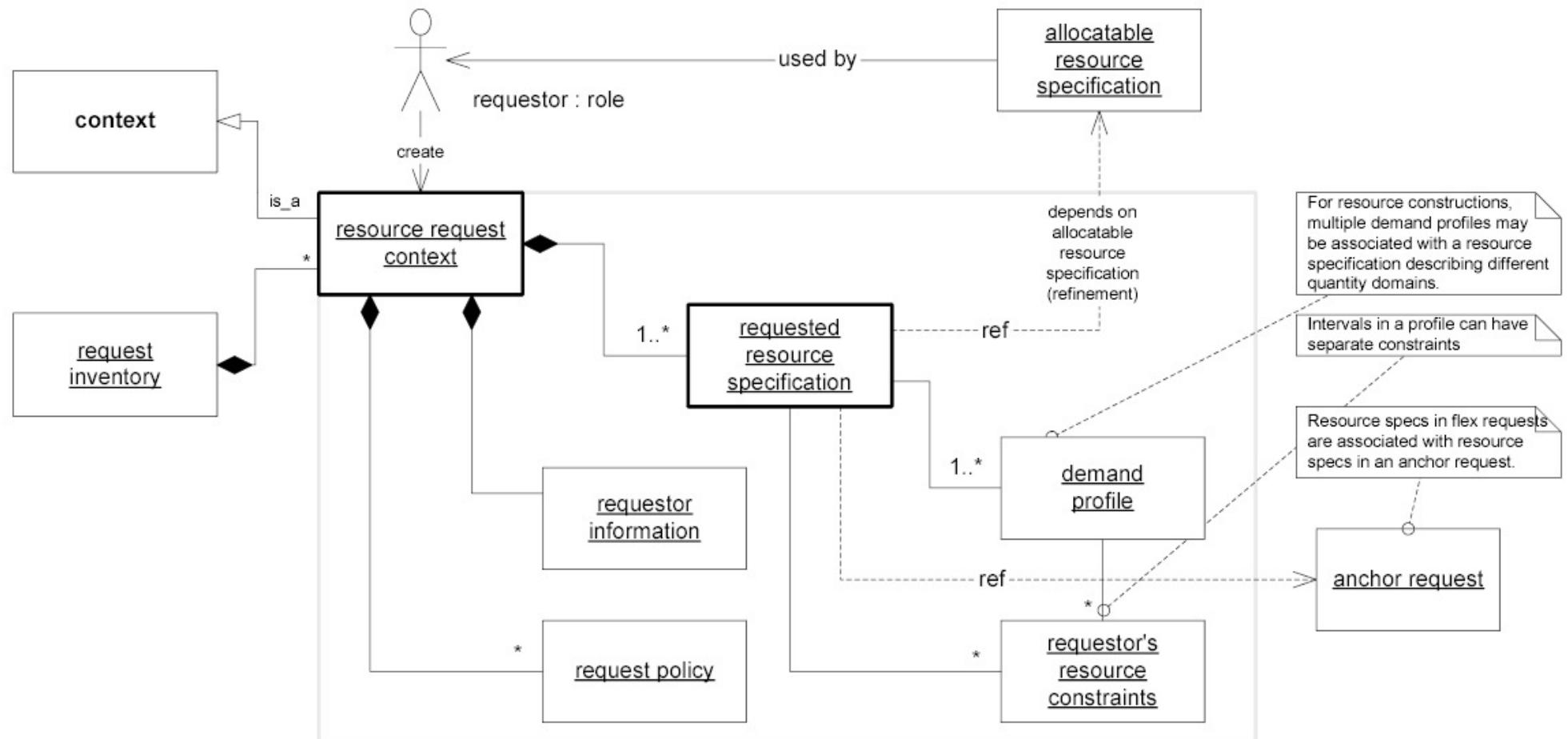
- Flexible creation of „farms“ in a data center
- Decoupling applications from machines
- Virtualization allows standardization and consolidation
- automation and hiding of internal management operations
- Software and configuration management

UDC: Weak points of Controller Software



- Utility Controller user interface is completely graphical
- Limited support for virtual or transitional devices
- None of the evolving “Grid” standards have been incorporated yet
- **Fix set of resource types**
- **No planning capabilities**

Architecture: UML Diagrams



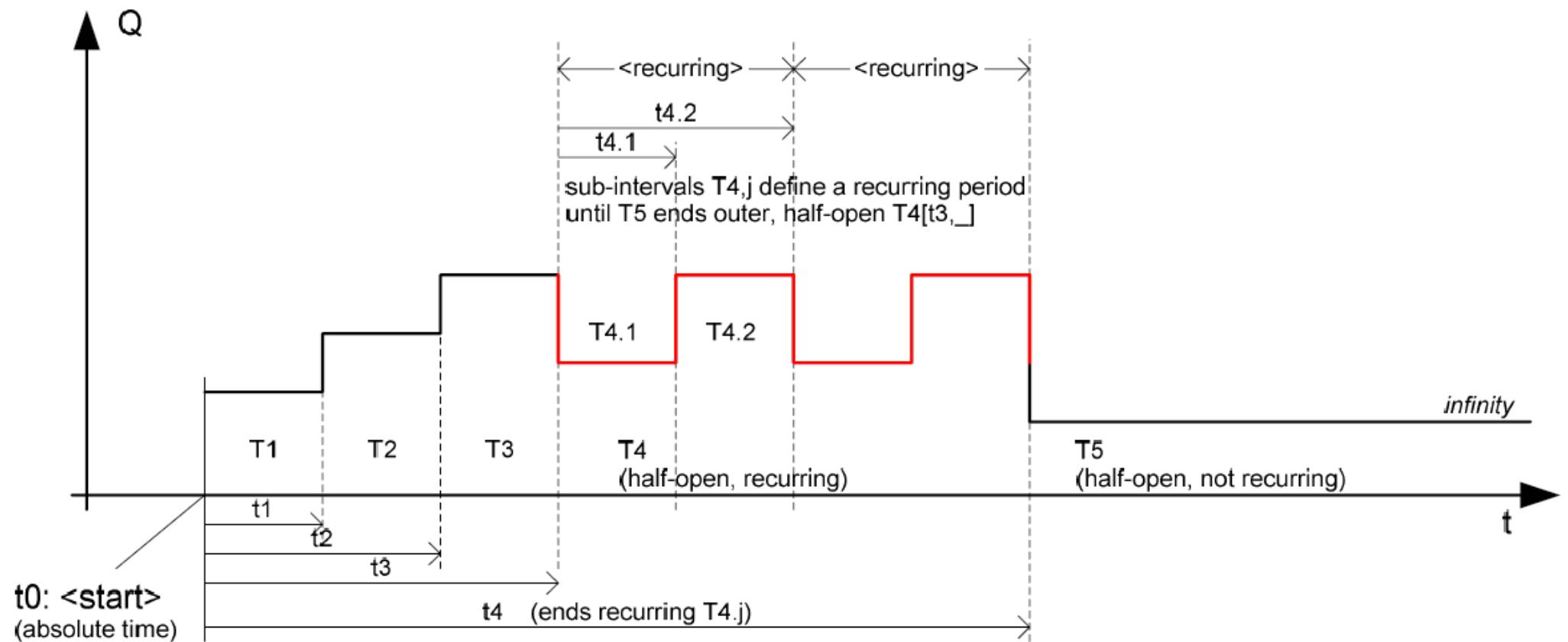
Idea: Reservation System



- Information Model describes
 - **Request** is a container for:
 - MetaData, Resource Descriptions, Profiles
 - **Resource Description** (What do I need?)
 - Properties
 - Construction
 - **Profiles** (How many? When?)
 - Quantity over Time

Request Form	
<hr/>	
10 Linux servers	<hr/>
<hr/>	
next week	<hr/>
	<hr/>
Smith	<hr/>

Information Model: Profile

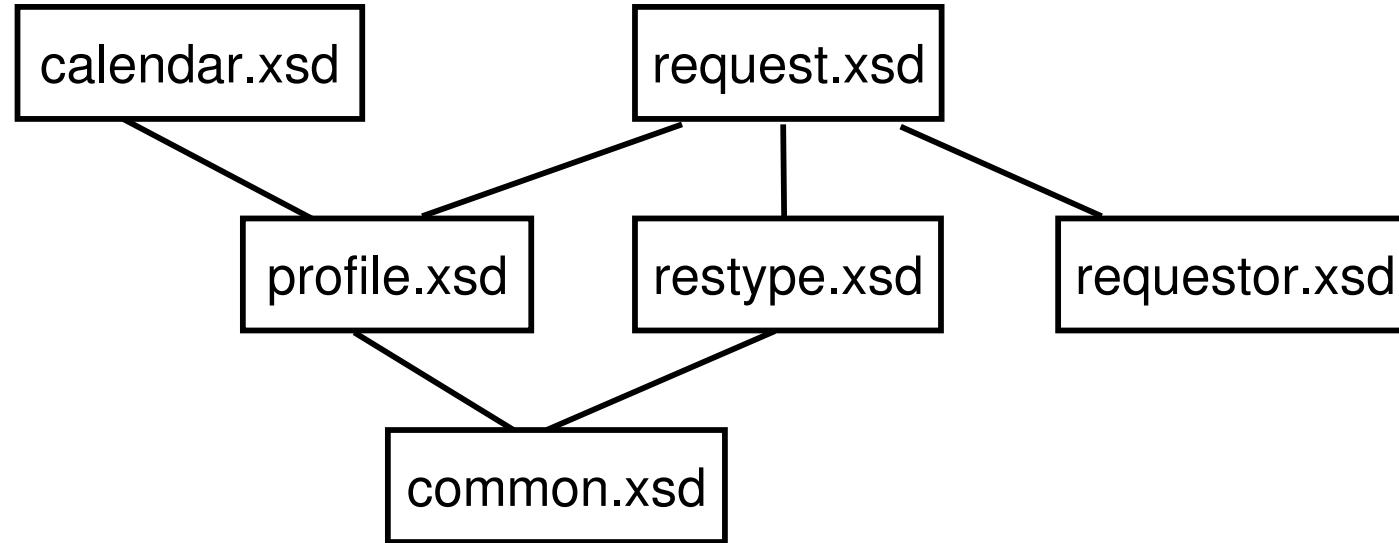


Information Model: Resource Description



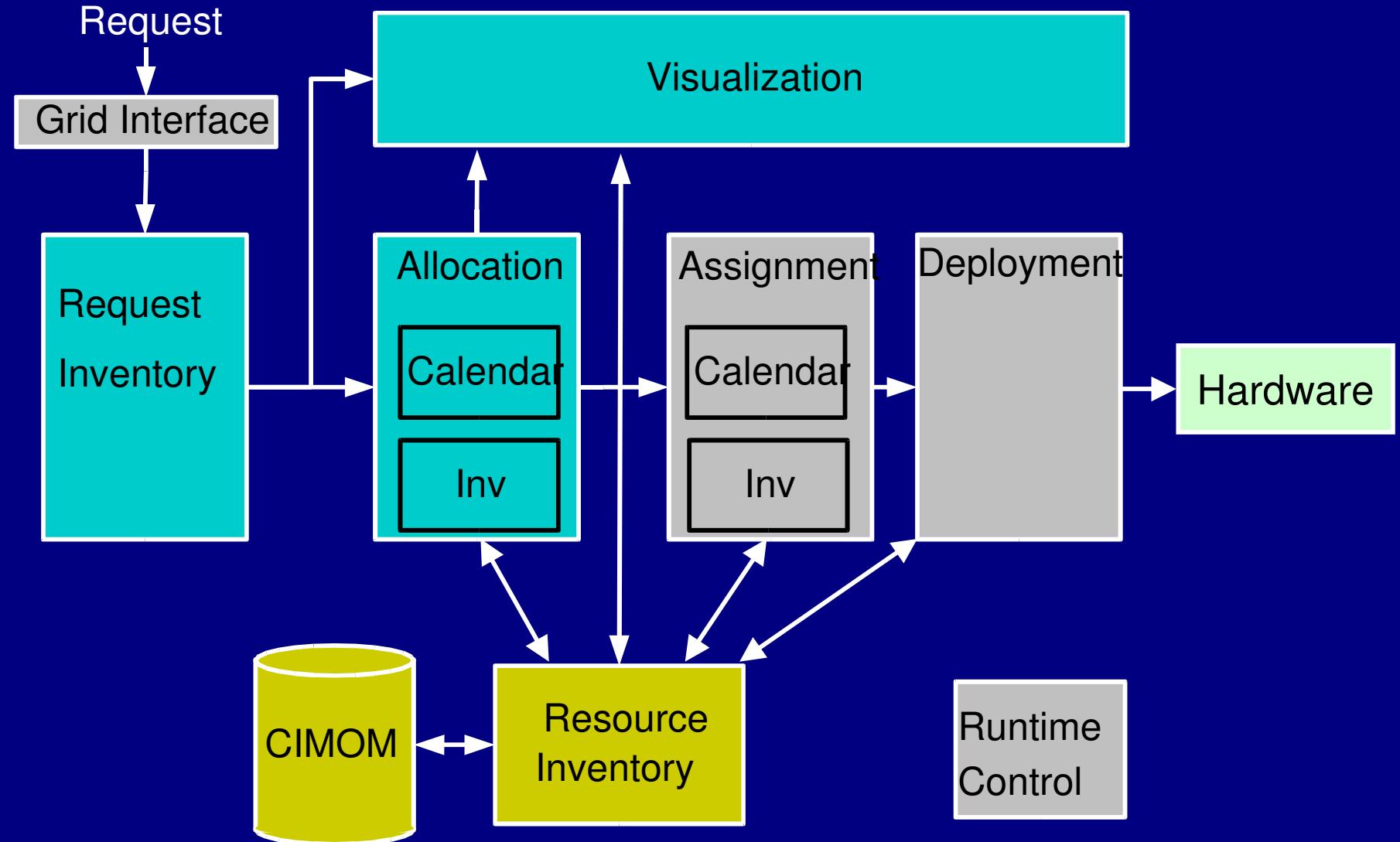
- Metadata
 - ID, name, version, creator, ...
- Associations, such as super class or construction hierarchy
- Properties
 - Attribute-Value pairs
- Constraints
 - Container for rules in policy language format

Implementation: XML Schemas

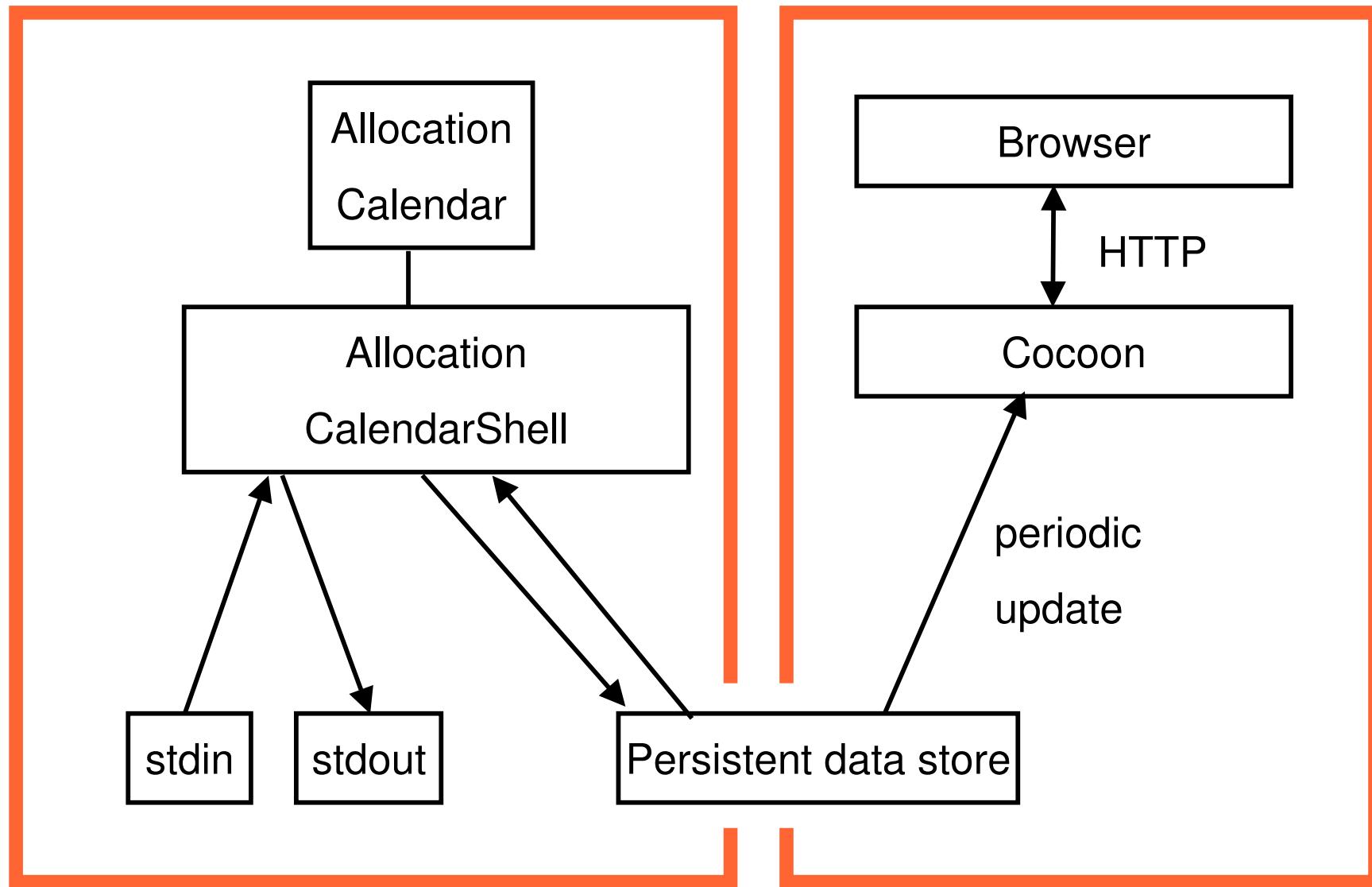


- XML schemas
- Include mechanism
- XML documents are linked

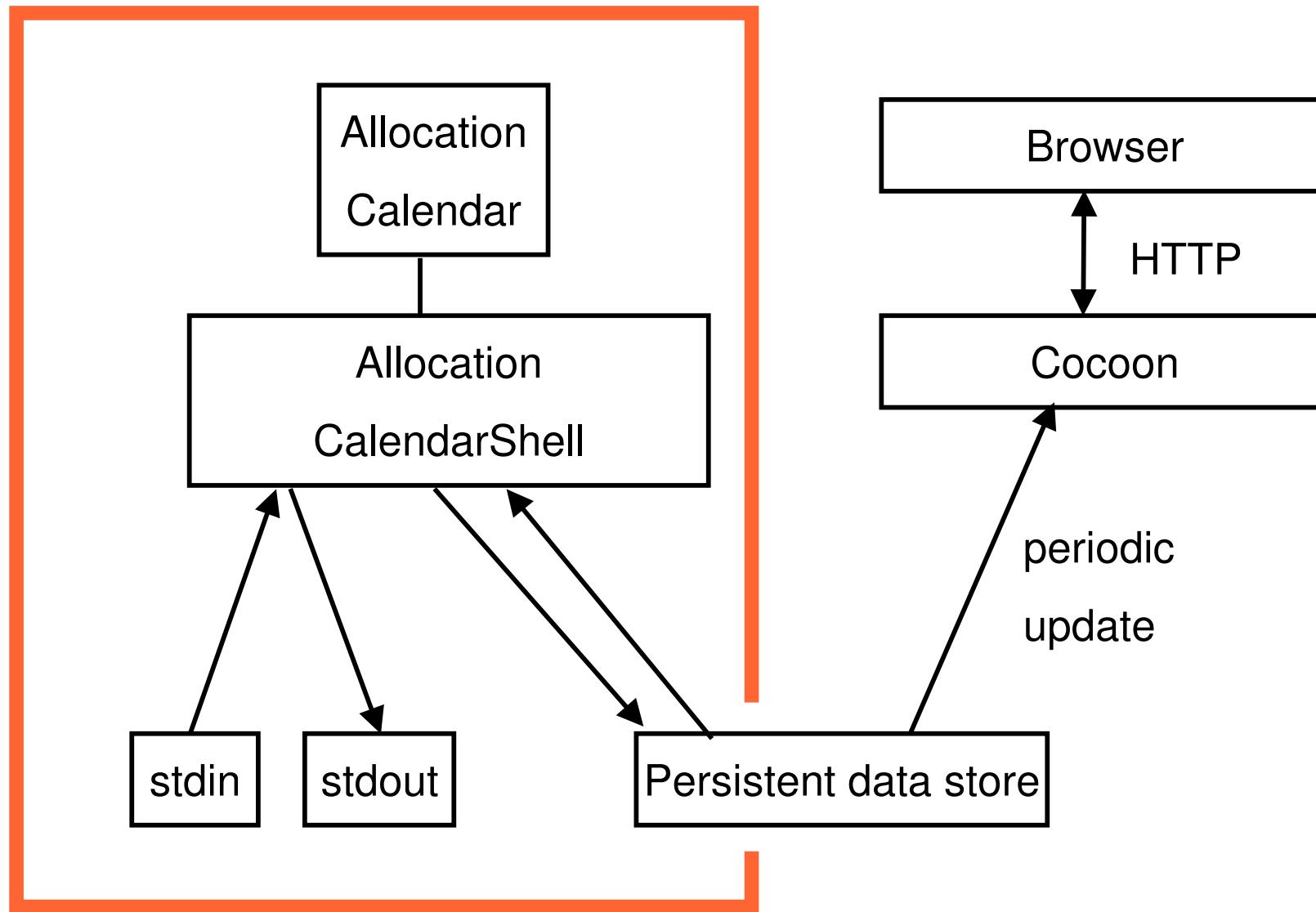
„Quartermaster“ prototype architecture



The two Interfaces: Shell and GUI



Shell Interface



AllocationCalendarShell in Java



- Provides scripting capabilities for the „site calendar“
- Command set:
 - General commands
 - **help**, **exit**, **#**
 - Operations on the site calendar
 - **load**, **save**, **ls**
 - Operations on resource calendars
 - **put**, **ls**, **schedule**, **save**, **rm**
 - Operations on demand profiles
 - **put**, **rm**

Shell Commands by Example



```
cmd ~/uram/src/proto-03

rank@hp1aa ~% /uram/src/proto-03
$ ./qmsh.bat

Quartermaster Allocation Calendar Shell 00.1
'exit' leaves program.
'help' lists commands.

[QM] $ ls
[diskimage, diskless_compute_node, firewall, subnet, loadbalancer, storage]
    completed: 16. msecs

[QM] $ schedule diskimage
2003-06-01T01:00:00-07:00 : [cap 15, request002 2, request003 1]
2003-06-02T01:00:00-07:00 : [cap 15, request002 2, request003 2]
2003-06-03T01:00:00-07:00 : [cap 15, request002 3, request003 3]
2003-06-04T01:00:00-07:00 : [cap 15, request002 3, request003 4]
2003-06-05T01:00:00-07:00 : [cap 15, request002 2, request003 6]
2003-06-06T01:00:00-07:00 : [cap 15, request002 2, request003 1]
2003-06-07T01:00:00-07:00 : [cap 15, request002 4, request003 1]
2003-06-09T01:00:00-07:00 : [cap 9, request002 2, request003 0]
    completed: 31. msecs

[QM] $ ls subnet

Content of .../frugui/data/allococal/prof/capacity/subnet.xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<Profile xmlns="http://hpl.hp.com/rp2" xmlns:xsi="http://www.w3.org/2001/XMLSchema">
    <Interval recurring="false">
        <Interval id="1" start="2003-08-14T01:49:04-07:00">
```

Shell Commands by Example



```
CV ~/uram/src/proto-03

ralk@hplaa ~/uram/src/proto-03
$ ./qmsh.bat

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Shell Commands by Example



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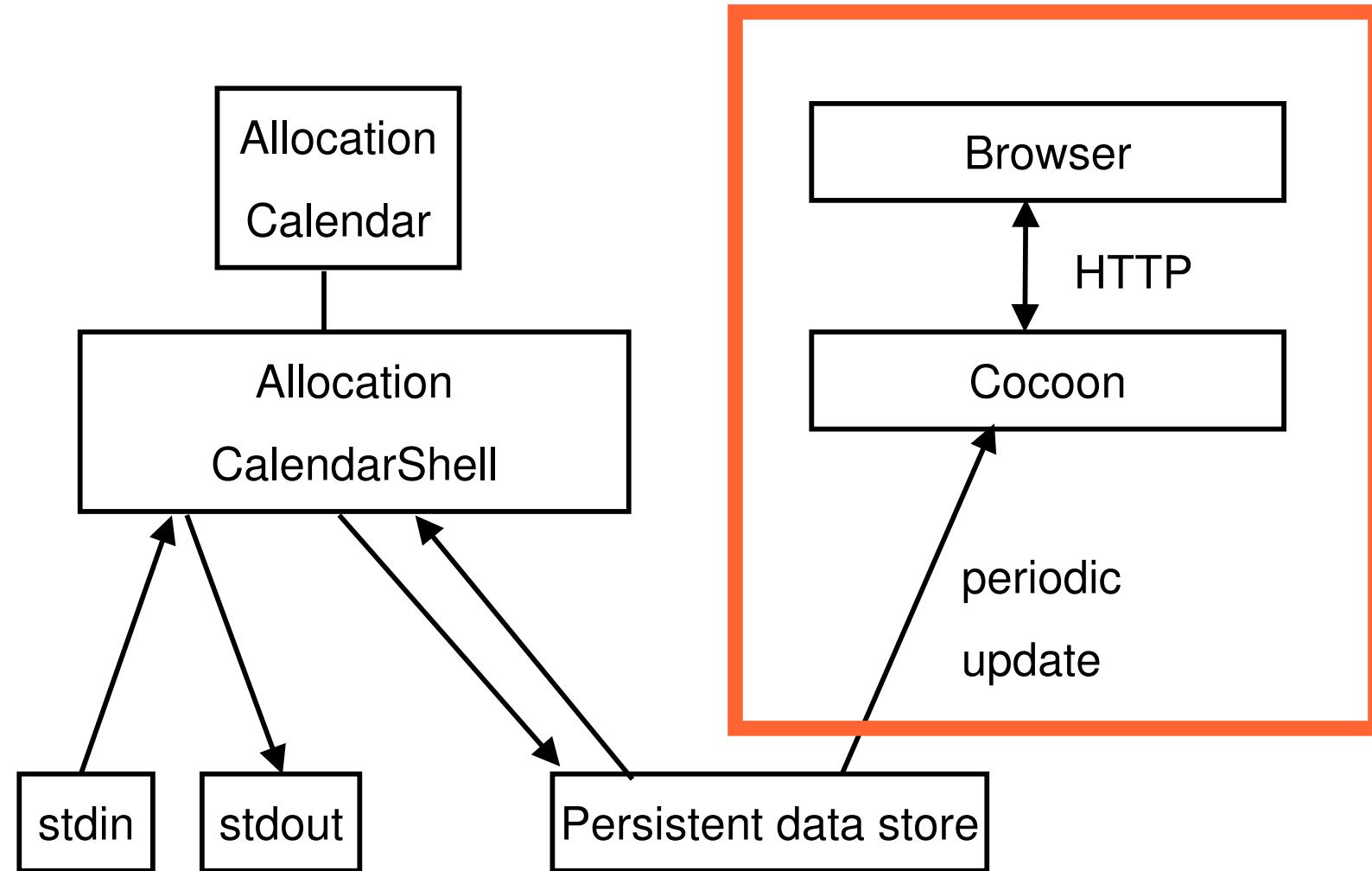
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2003-06-08T01:00:00-07:00 : [cap 9, request002 2, request003 0]
completed: 31. msecs

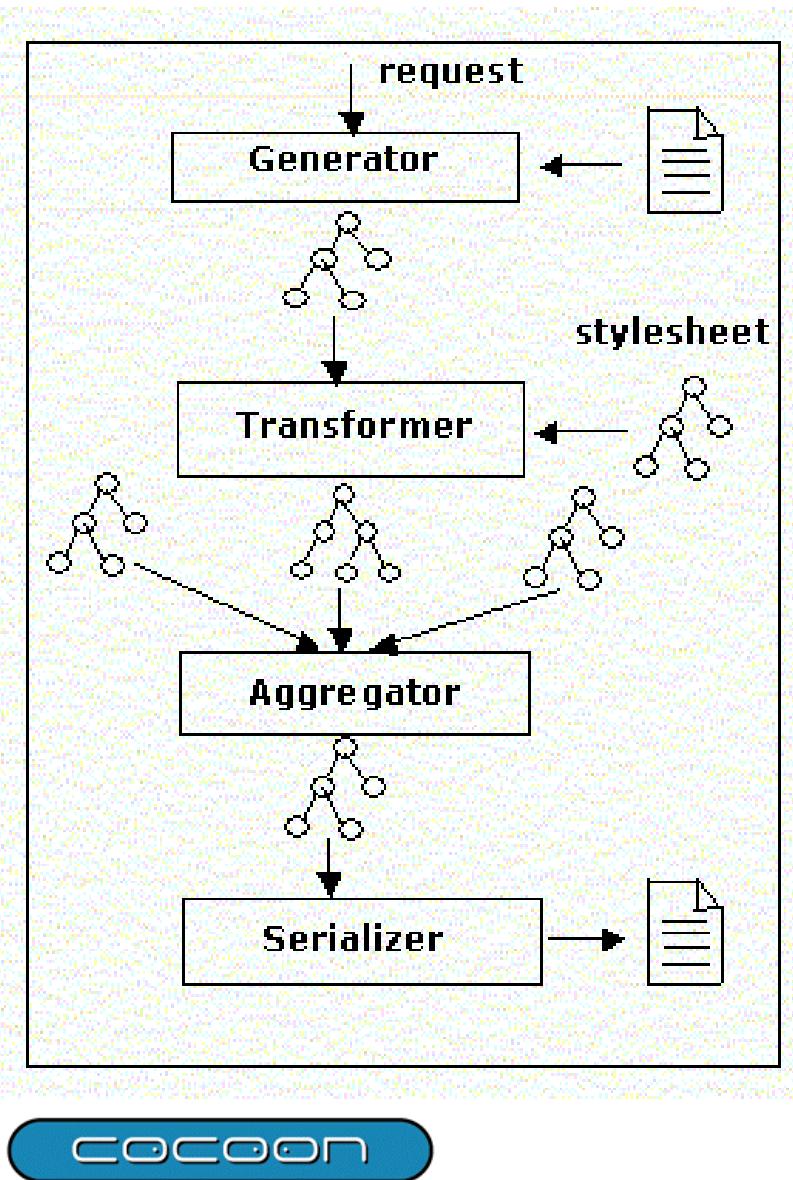
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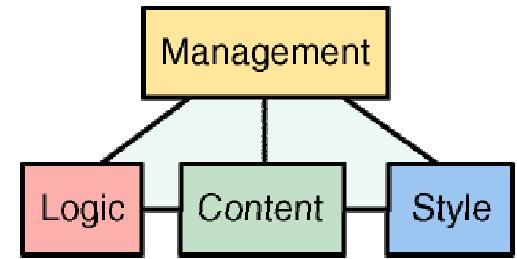
Graphical User Interface



Cocoon: A web development framework



- Generator:
 - Files (XML)
 - Query result from XML or SQL database
 - eXtensible Server Pages (XSP)
 - LDAP
- Transformer
 - XSL stylesheets
- Serializer
 - HTML, SVG, SVGtoBitmap



Cocoon: Request processing

Matchers on the HTTP Request:

URL and its parts (host, domain, path, parameters)

Session ID

Cookies

Browser type

Referer

Sender IP address

Combinations of the above

+ wildcards + regular expressions!

Sitemap.xmap

```
<map:match pattern="view">
  <map:match type="request-parameter-wildcard" pattern="/*/**">
    <map:parameter name="parameter-name" value="data" />

  <map:match type="request-parameter-wildcard" pattern="**">
    <map:parameter name="parameter-name" value="style" />
    <!-- {1} = style -->
    <!-- {..1} = data -->
    <map:generate src="data{..0}.xml" />

  <map:transform src="stylesheets/{1}.xsl">
    <map:parameter name="base-url" value="/cocoon/frugui" />
    <map:parameter name="context" value="{..1}" />
  </map:transform>

  <map:serialize />
</map:match>
</map:match>
</map:match>
```

GUI Screenshot



Federated Resource Utility GUI - Opera

File Edit View Navigation Bookmarks Mail Window Help

Requests Allocation Resource Assignment Deployment

Inventory	Inventory	Inventory	Inventory	Inventory
List Tree				
Calendar	Calendar	Calendar	Calendar	Calendar
List Tree				

Quartermaster Browser

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hp
invent
PDB

RequestInventory

- Sample request 1 (Form View)

Sample request 1

Requestor: John J. Customer, Customer Corporation Inc.

Requested resource specification 1: [ecommercesite](#)

ecommercesite.attribute

Requested resource specification 2: [server](#)

Goals: (satisfy ecommercesite.tiers[1].number == 10 && ecommercesite.tiers[2].number == 5 && ecommercesite.cost < 50);

Decisions and Results



- Separation of Concerns
- Data Organization: Files vs. Database
- Lack of well-established query language for XML
- SQL and XML – mapping data back and forth
- Cocoon runtime performance
- Cocoon documentation

The broader picture



Other people at HP Labs working on:

- policy integration
- agreement protocols in grid environments
- resource type specifications related to Common Information Model (CIM)
- server consolidation, probabilistic capacity planning, Quality of Service management
- workload simulation and placement optimization
- relations to other major HP products: HP Utility Data Center and HP OpenView

End



Thanks for your attention!

