

# Cloudspace: virtual environments in the VO

Matthew J. Graham (Caltech)  
Roy Williams (Caltech)

# Scenario

- For the good of the community, I expose my super data mining algorithm as a service
- It runs on the local cluster in the basement

Performance  
efficiency

Time

# The problem: utility computing

- Dynamic allocation of computing resource to meet demand:
  - more users
  - more data
  - more jobs
- Traditionally throwing more hardware at a problem requires prior software porting:
  - complexity of applications
  - consistency of the environment
- Cannot enforce Quality of Service

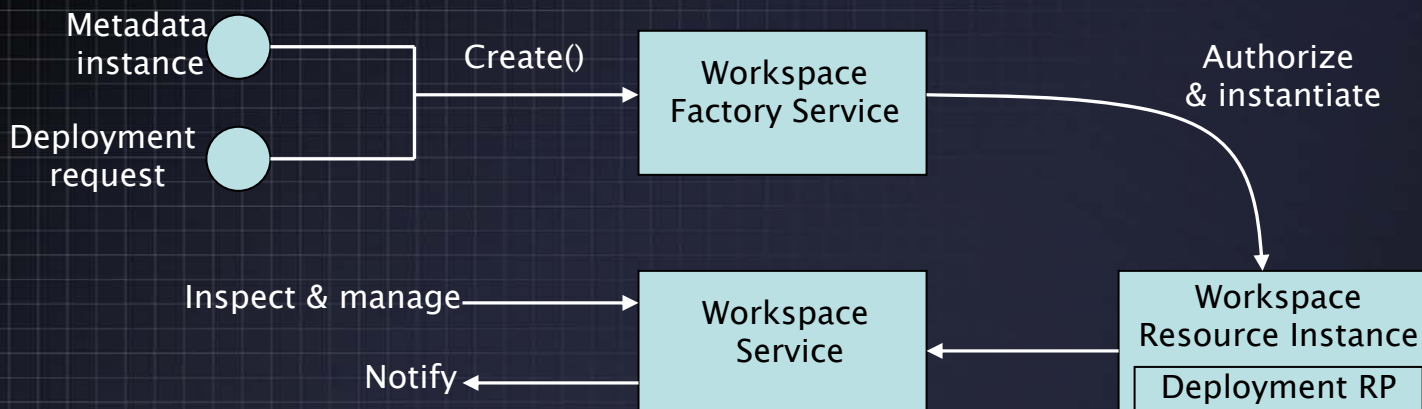
# The solution: virtualization

- Virtual workspaces
  - An abstraction of an execution environment that can be made dynamically available to authorized clients by using well-defined protocols
  - resource quota (e.g. CPU, memory share)
  - software configuration (e.g. O/S, provided services).
- Implement on Virtual Machines (VMs)
  - abstraction of a physical host machine
  - hypervisor intercepts and emulates instructions from VMs and allows management of VMs
  - VMWare, Xen, etc.

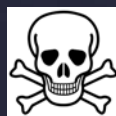
# Existing Technologies

- Amazon EC2 – “computing in the cloud”
  - Use Xen VMs
  - Images, Instances and Security
- FlexiScale from XCalibre/Virtual Iron – “cooler than EC2”
- Google/Microsoft?
- Problem becomes availability of the right type of hypervisor

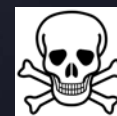
# Globus Workspace



- WSRF
- Back-end implementation on UChicago Teraport cluster and EC2



Contains GLOBUS



# Cloudspace

- Based on VOSpace
  - IVOA standard interface for distributed data storage
  - Lightweight abstraction layer (Façade pattern)
  - Sits on top of proven solutions such as http and SRB
- Resource oriented
- Data and services are both first-class entities
- Universal Worker Service interface to manage resources

# Resource-oriented computing

- A resource is an abstract set of information
- Each resource may be identified by one or more logical identifiers
- A logical identifier may be resolved within an information-context to a physical resource representation
- Computation is the reification of a resource to a physical resource representation
- Resource representations are immutable
- Transreption is the isomorphic lossless transformation of one resource representation to another
- Computational results are resources and are identified within an address space

# Logical identifiers

- URI:
  - [scheme-name]://[scheme-specific-address]
  - Cloudspace scheme is csp – why not ivo://?
  - URI mapping (links)
  - Different URI schemes return different representations (http, ftp)  
cf. HTTP MIME type and headers
- Data objects
  - use VOSpace syntax:  
**vos://nvo.caltech!vospace/myTable1**
- Services
  - use regular IVOA identifiers to address image:  
**ivo://nvo.caltech/service/paramSweeper**
  - csp to address instantiations:  
**csp://nvo.caltech/service/paramSweeper/1234**



# Resource representations

- Data objects use VOSpace <node>
  - Arbitrary metadata (properties, tags)
  - Transreption formats (views)
- Service image uses VOResource mechanism
  - Extension schemata to handle virtualization metadata (Globus equivalent)
- Service instantiation uses UWS representation

# Universal Worker Service

- URIs:
  - /(jobs): Job List
  - /(jobs)/(job-id) : Phase, Termination Time, Quote, Results List
  - /(jobs)/(job-id)/phase: Phase
  - /(jobs)/(job-id)/termination: Termination Time
  - /(job)/(job-id)/quote: Quote
  - /(job)/(job-id)/results: Results List

# Computing in the cloud

- Can use standard endpoint of service
  - `http://some.service.endpoint`
- Define computation in terms of result URI
  - `comp://` scheme refers to computations:  
`comp://nvo.caltech/service/paramSweeper/1234+data@vos://nvo!caltech/vospace/myTable1+params@vos://nvo!caltech/vospace/myParam1`
  - Map to `vos://` data object:  
`vos://nvo!caltech/vospace/myResult1`
- Memoization: data caching a function call

# Not just blue-sky thinking

- Proof-of-concept system
  - NetKernel
  - Ruby script to interface with EC2 as backend
- Other packaged software
  - War files