LISA '09
Federated access control and workflow enforcement in systems configuration

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Outline

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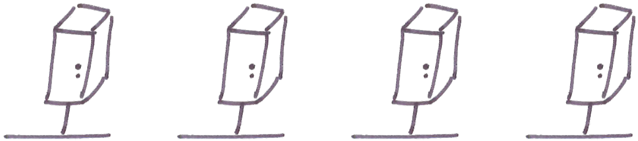
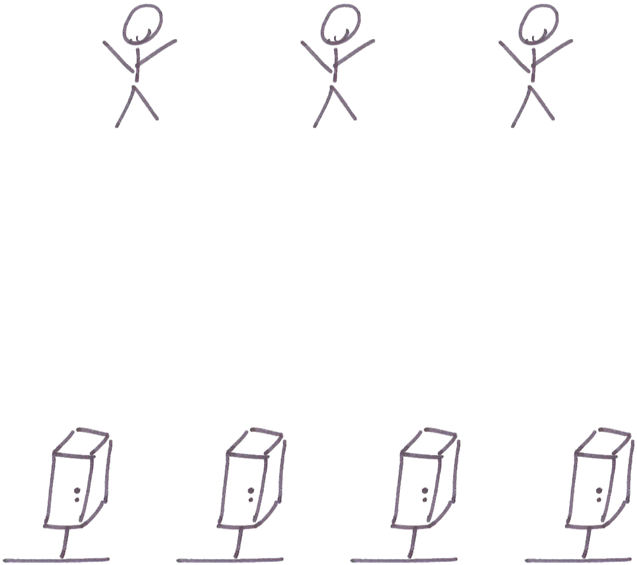
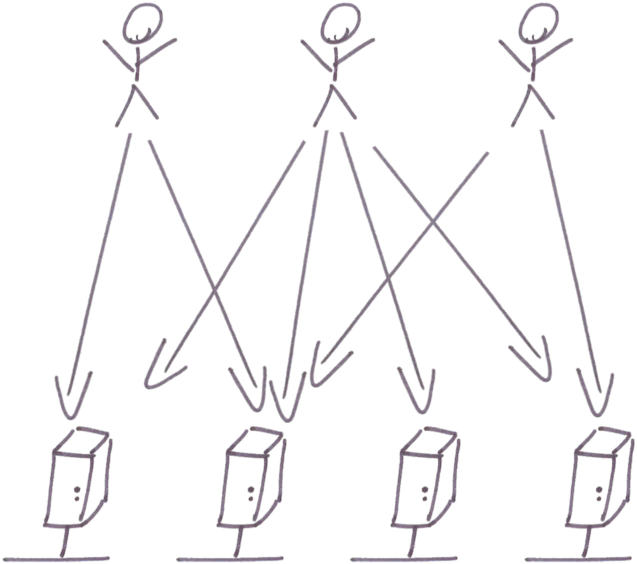
System configuration tools



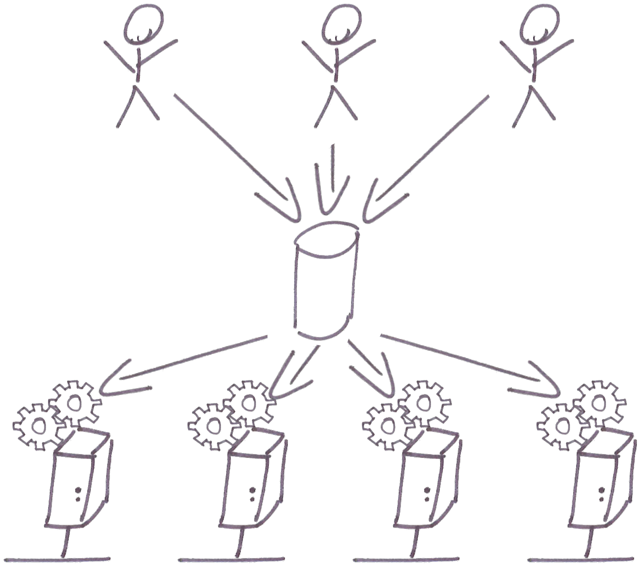
System configuration tools



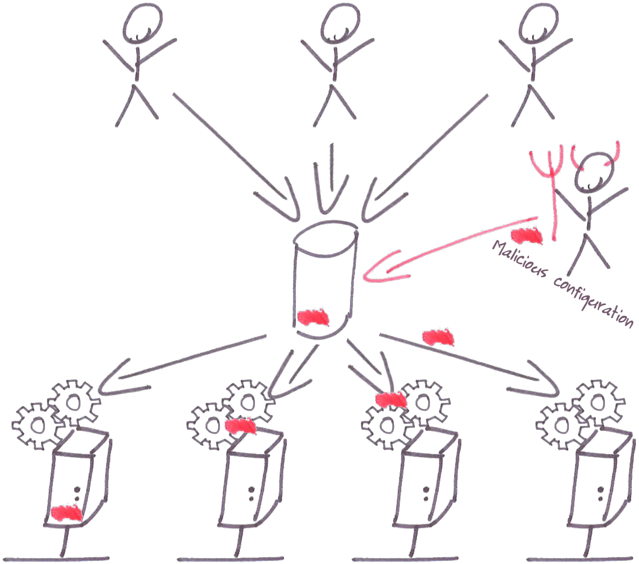
System configuration tools



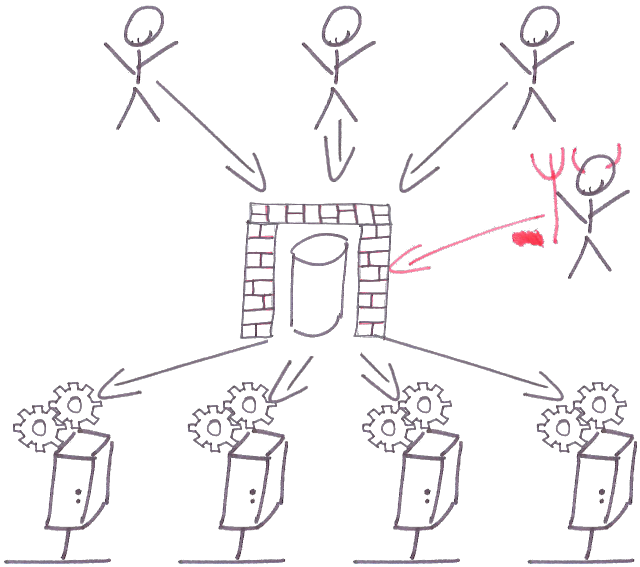
System configuration tools



System configuration tools



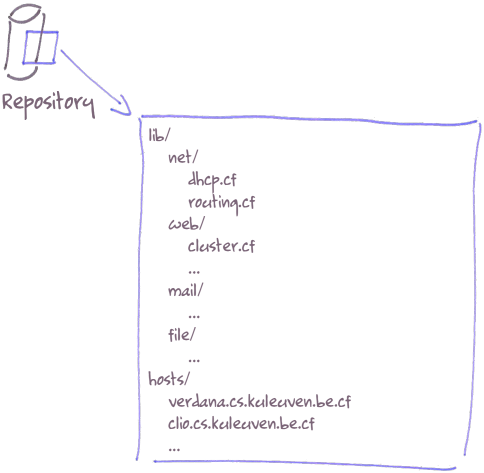
System configuration tools



State of practice in access control

Access control rules

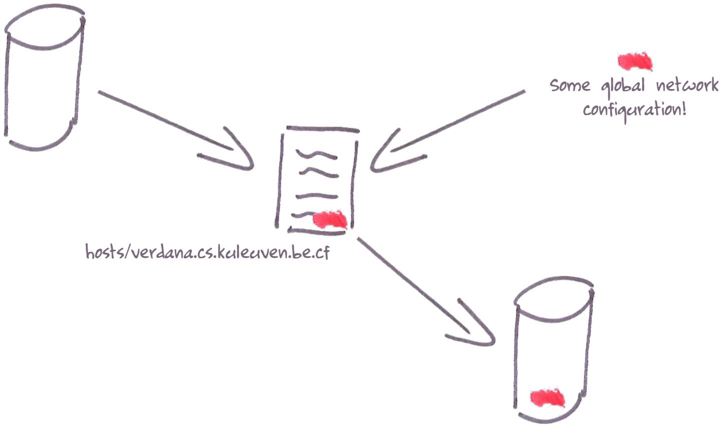
```
[@netadmins]
lib = r
hosts = r
lib/net = rw

[@senior]
 = rw

[@mail]
lib/mail = rw
lib/file = rw

[userA]
hosts/verdana.cs.kuleuven.be.cf = rw
```



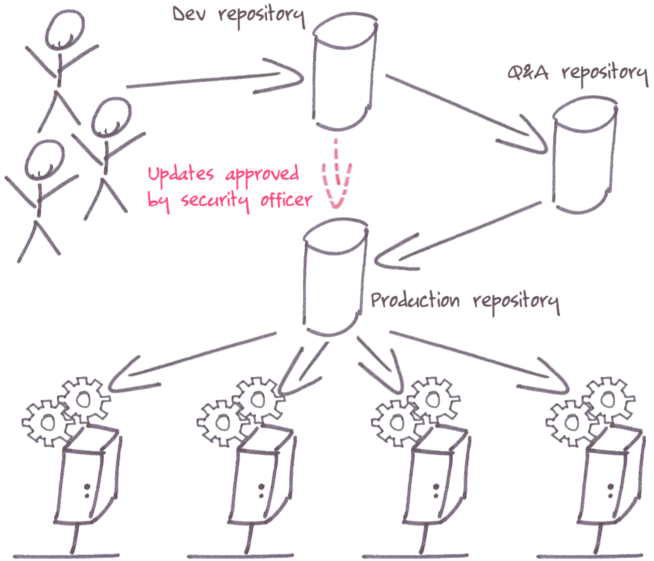
```
lib/
   net/
      dhcp.cf
      routing.cf
   web/
      cluster.cf
      ...
   mail/
      ...
   file/
      ...
hosts/
   verdana.cs.kuleuven.be.cf
   clio.cs.kuleuven.be.cf
   ...
```

State of practice in access control

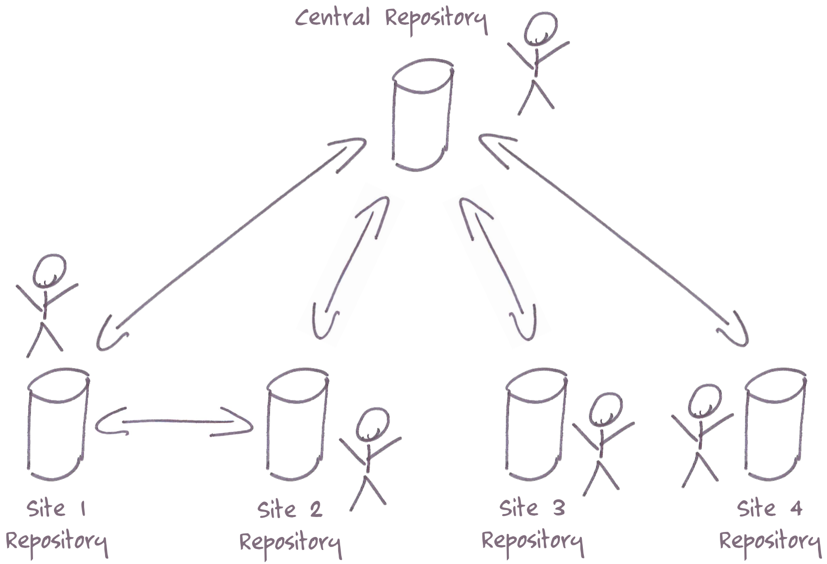
UserA can not be trusted


Some global network configuration!
hosts/verdana.cs.kuleuven.be.cf

Workflow


Dev repository
Q&A repository
Updates approved by security officer
Production repository

Federated infrastructures



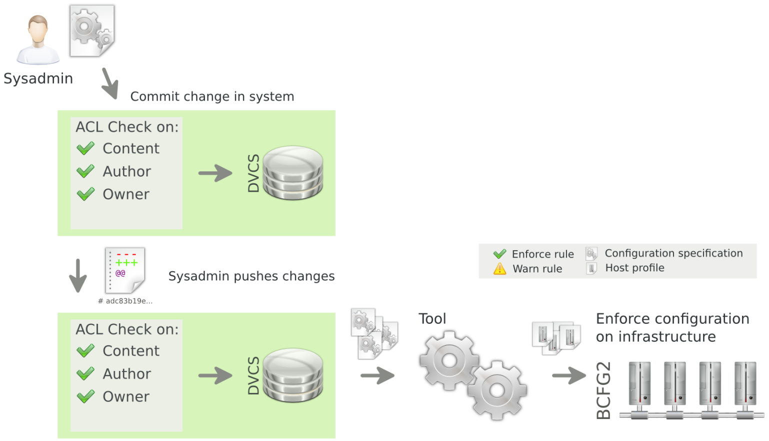
Outline

What is ACHEL?

ACHEL manages access to *repositories* of *configuration specification* by implementing *access control* and enforcing *workflows*

- *fine-grained* acccess control interpreting the *semantics* of *changes*
- *access control* is applied at the *abstraction level* of the configuration specification
- support for workflow in *federated* infrastructures
- a (configuration) *language agnostic* solution

Update 1: an allowed change



Update 1: an allowed change

Current specification for managing the motd file written by Bart:

```
motd_file = File()
motd_file.name = "/etc/motd"
motd_file.content = "Welcome to $hostname"
motd_file.owner = "root"
motd_file.group = "root"
motd_file.perm = "0644"
```

Update 1: an allowed change

Thomas changes the content of the motd file:

```
motd_file = File()
motd_file.name = "/etc/motd"
motd_file.content = template("motd.tmpl")
motd_file.owner = "root"
motd_file.group = "root"
motd_file.perm = "0644"
```

Update 1: an allowed change

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Access control policy

```
# list of admins
define admins as
  bart.vanbrabant@cs.kuleuven.be,
  wouter.joosen@cs.kuleuven.be

# allow admins to create the motd
allow admins to:
  * assign File() to motd_file
  * assign "/etc/motd" to motd_file.name

# allow everyone to manage the motd
allow to:
  * assign * to motd_file.content

# demand approval by an admin to change
# the permissions (all other attributes)
allow to:
  /(add|modify)/ assign * to motd_file.*
  authorised by 1 admins
```

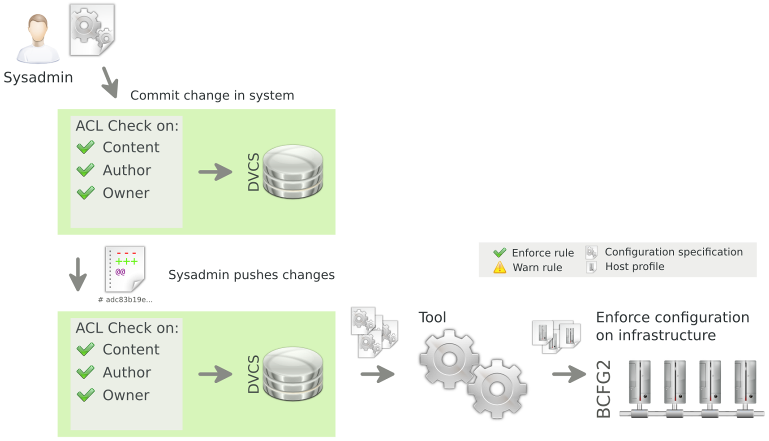
```
update {
  action => modify
  operation => assign
  lhs => motd_file.content
  rhs => template("motd.tmpl")
  old_rhs => "Welcome to $hostname"
  owner => bart.vanbrabant@cs.kuleuven.be
  author => thomas.delaet@cs.kuleuven.be
}
```

Update 1: an allowed change

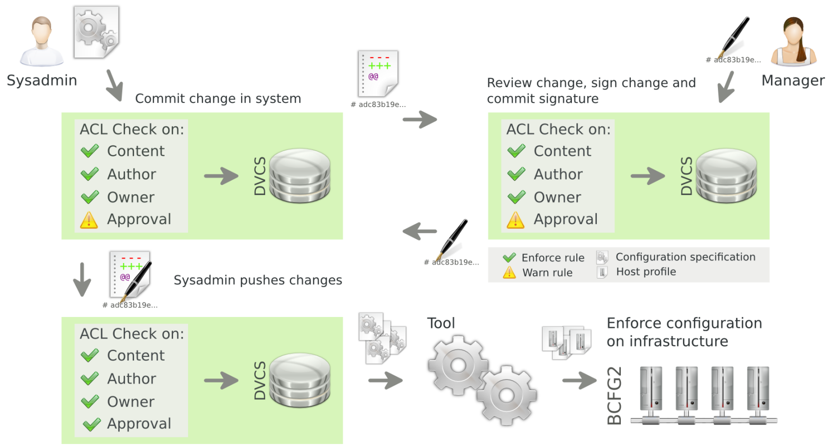
Output from our prototype for the motd example:

```
Rev 1 has 6 changes and 0 signatures
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "/etc/motd" to motd_file.name
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "Welcome at $hostname"
          to motd_file.content
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "root" to motd_file.group
  allowed bart.vanbrabant@cs.kuleuven.be to add assign File() to motd_file
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "root" to motd_file.owner
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "0644" to motd_file.perm
Rev 2 has 1 changes and 0 signatures
  allowed thomas.delaet@cs.kuleuven.be to modify assign template("motd.tmpl")
          to motd_file.content
```

Update 1: an allowed change



Update 2: a change requiring authorisation



Update 2: a change requiring authorisation

Thomas changes the permissions of the motd file:

```
motd_file = File()
motd_file.name = "/etc/motd"
motd_file.content = template("motd.tmpl")
motd_file.owner = "root"
motd_file.group = "wheel"
motd_file.perm = "0644"
```

Update 2: a change requiring authorisation

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Access control policy

```
# list of admins
define admins as
  bart.vanbrabant@cs.kuleuven.be,
  wouter.joosen@cs.kuleuven.be

# allow admins to create the motd
allow admins to:
  * assign File() to motd_file
  * assign "/etc/motd" to motd_file.name

# allow everyone to manage the motd
allow to:
  * assign * to motd_file.content

# demand approval by an admin to change
# the permissions (all other attributes)
allow to:
  /(add|modify)/ assign * to motd_file.*
  authorised by 1 admins
```

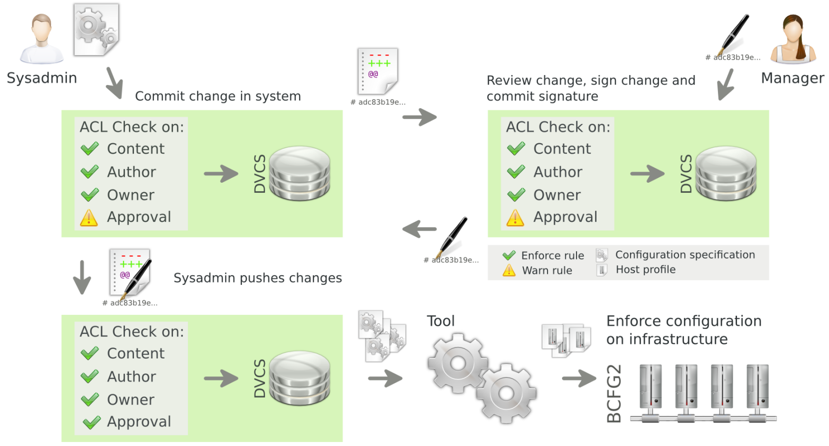
```
update {
  action => modify
  operation => assign
  lhs => motd_file.group
  rhs => "wheel"
  old_rhs => "root"
  owner => bart.vanbrabant@cs.kuleuven.be
  author => thomas.delaet@cs.kuleuven.be
}
```

Update 2: a change requiring authorisation

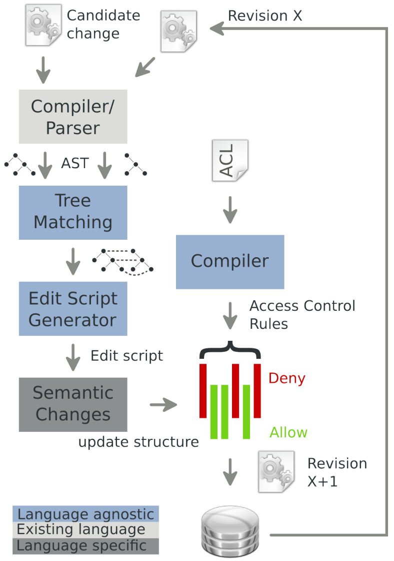
Output from our prototype for the motd example:

```
Rev 1 has 6 changes and 0 signatures
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "/etc/motd" to motd_file.name
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "Welcome at $hostname"
          to motd_file.content
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "root" to motd_file.group
  allowed bart.vanbrabant@cs.kuleuven.be to add assign File() to motd_file
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "root" to motd_file.owner
  allowed bart.vanbrabant@cs.kuleuven.be to add assign "0644" to motd_file.perm
Rev 2 has 1 changes and 0 signatures
  allowed thomas.delaet@cs.kuleuven.be to modify assign template("motd.tmpl")
          to motd_file.content
Rev 3 has 1 changes and 0 signatures
  authorisation (1) required for thomas.delaet@cs.kuleuven.be to modify assign
          "wheel" to motd_file.group owned by bart.vanbrabant@cs.kuleuven.be
```

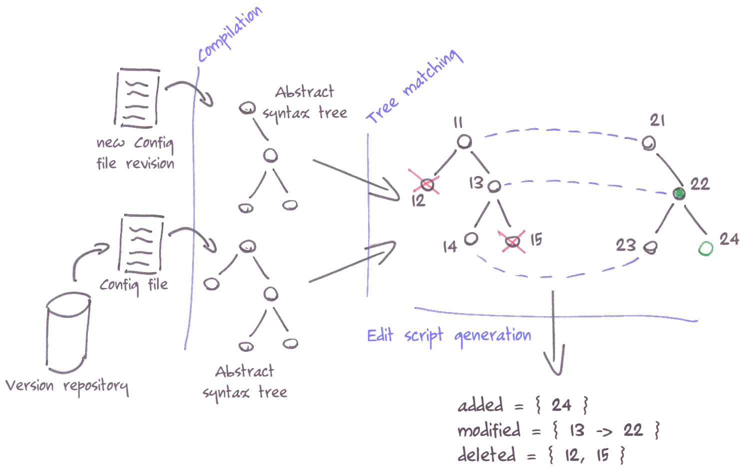
Update 2: a change requiring authorisation



Generating meaningful changes



Generating meaningful changes



Algorithm based on:

- Meaningful change detection in structured data. CHAWATHE AND GARCIA-MOLINE. 1997
- Change Distilling: Tree Differencing for Fine-Grained Source Code Change Extraction. FLURI, WUERSCH, PINZGER AND GALL. 2007

Outline

Prototype

Prototype in Python

- built on Mercurial
- simple configuration language and BCFG2 for deployment
- PGP for signatures and authentication
- access control language using regular expressions for pattern matching

Outline

Case 1: access control and simple workflow

- Small infrastructure
- Team with junior and senior sysadmins
- Enforce responsibilities
- Enforce coding guidelines
- Manage network configuration

Case 1: access rules

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```
# enforce some conventions on everyone
deny to:
  * assign  File()         to  /^[^_]+_(?!file_)[\S]+$/
  * assign  Package()      to  /^[^_]+_(?!pkg_)[\S]+$/
  * assign  Service()      to  /^[^_]+_(?!service_)[\S]+$/
  * assign  Directory()    to  /^[^_]+_(?!dir_)[\S]+$/
  * assign  Symlink()      to  /^[^_]+_(?!ln_)[\S]+$/
  * assign  Permissions()  to  /^[^_]+_(?!perm_)[\S]+$/

# senior admins can do anything else
allow senioradmin to:
  * * *

# allow admins to do everything if a senior admins approves
allow to:
  * * *
  authorised by 1 senioradmin

# network related configuration
deny netadmins to:
  # deny files other then those in /etc/network
  * assign /^(?!\/etc\/network\/)\S+/ to /^net_file_\w+\.name$/
  # deny services other then dhcpd and network
  * assign /^(?!(dhcpd$|network$))\w+$/ to /^net_service_\w+\.name$/

allow netadmins to:
  * import  /^dhcp/
  # allow adding a list of values to the net_dhcp_clients list
  * add     /^\[[^\]]$/ to  /^net_dhcp_clients$/
  # allow only variables prefixed with net (ignore rhs)
  * assign  *           to  /^(?!net_)\S+$/
```

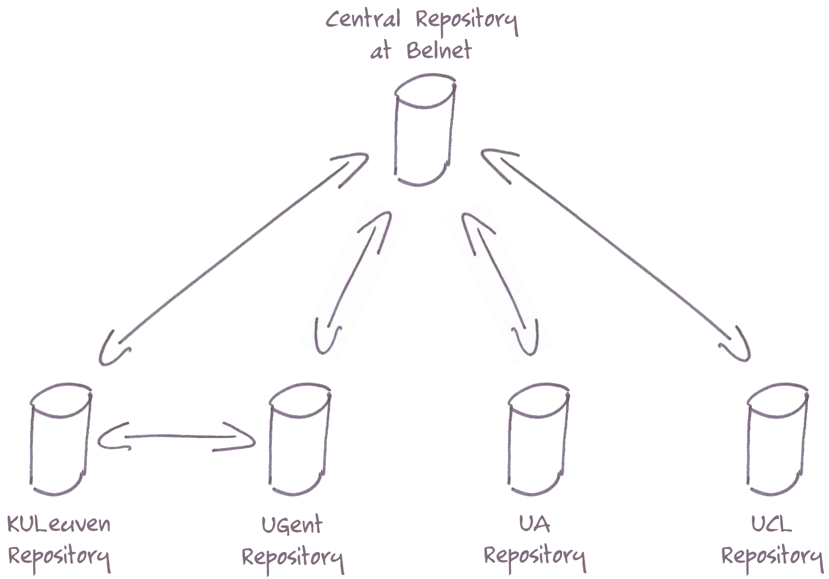
Case 1: configuration

```
# configure network interfaces
net_file_interfaces = File()
net_file_interfaces.name =
    "/etc/network/interfaces"
net_file_interfaces.owner = "root"
net_file_interfaces.group = "root"
net_file_interfaces.perms = "0644"
net_file_interfaces.content = source("net/interfaces.$hostname")

# network service needs to be enabled
net_service_network = Service()
net_service_network.name = "network"
net_service_network.status = "on"

# use template for /etc/hosts
net_file_hosts = File()
net_file_hosts.name = "/etc/hosts"
net_file_hosts.owner = "root"
net_file_hosts.group = "root"
net_file_hosts.perms = "0644"
net_file_hosts.content = template("net/hosts.tmpl")
```

Case 2: complex workflow in federated infra

- Large federated grid infrastructure
- Several administrative domains
- Shared and site specific configuration
- Based on the description of BeGrid in *Devolved Management of Distributed Infrastructures With Quattor, LISA '08*

Case 2: complex workflow in federated infra



Outline

Future work

Validate ACHEL on a complex real-life configuration language.
Key challenges:

- develop an access control language that integrates with the configuration language
- provide integration with the tools used with the configuration language

Conclusion

ACHEL's contributions

- *fine-grained* acccess control interpreting the *semantics* of *changes*
- *access control* is applied at the *abstraction level* of the configuration specification
- support for workflow in *federated* infrastructures
- a language *agnostic* approach

Questions?

Trappist
Achel
BRUIN BIER
BIERE BRUNE
AUTHENTIC TRAPPIST PRODUCT
Trappist
Achel