Current research at LAS-IC-Unicamp

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Agenda

MoBaSeC

Management of security services configuration

Imuno Project

Immune-based computer security

MoBaSeC

- Configuration management of security services
- Dealing with security policies
  - Hierarchical, model-based approach
  - Interactive policy refinement via graphical tool
- Helped by abstract subsystem viewing
- Correctness of config files through object-oriented design
- Being extended to the operating system level

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Typical security administrator design activity

Task

Given a security policy like this:

"Allow Internet surfing"

- Generate config files for all security systems involved.
- Then, repeat that for all policies established by management.

Problems

Large variety of security functionalities and implementations

- Too many paradigms and syntaxes to familiarize

Scalability, understandability, need for integrated management

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An iptables set of rules, inside a much larger file

```
## SSH - external <-> dmz
for host in $BASTION ; do
  iptables -A FORWARD -i $EXT_IF -o $DMZ_IF -p tcp -s $ANY -d $host --dport ssh -m state --state NEW,ESTABLISHED -j ACCEPT
  iptables -A FORWARD -i $DMZ_IF -o $EXT_IF -p tcp -s $host --sport ssh -d $ANY -m state --state ESTABLISHED -j ACCEPT
  iptables -A FORWARD -i $DMZ_IF -o $EXT_IF -p tcp -s $host -d $ANY --dport ssh -m state --state NEW,ESTABLISHED -j ACCEPT
  iptables -A FORWARD -i $EXT_IF -o $DMZ_IF -p tcp -s $ANY --sport ssh -d $host -m state --state ESTABLISHED -j ACCEPT
done
unset host
```

Other filter language examples

Example: permission for an external host to all internal machines
172.16.51.50 $\longleftrightarrow$ 192.168.10.0–255

Cisco's IOS

```
access-list 101 permit ip 172.16.51.50 0.0.0.0 192.168.10.0 0.0.0.255
access-list 101 deny ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
interface serial 0
access group 101 in
access-list 102 permit ip 192.168.10.0 0.0.0.255 172.16.51.50 0.0.0.0
access-list 102 deny ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
interface serial 0
access group 102 out
```

Other filter language examples

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IP Filter

```
# block everything by default
block in from any to any
block out from any to any
# allow something
pass in from 172.16.51.50 to 192.168.10.0/24
pass out from 192.168.10.0/24 to 172.16.51.50
```

Other filter language examples

Example: permission for an external host to all internal machines
172.16.51.50 $\longleftrightarrow$ 192.168.10.0–255

flc

```
#define aquele_host 172.16.51.50
#define minha_rede 192.168.10.0
#if defined(__cisco__)
interface ethernet0;
access-list 101;
#endif
#if defined(__ipfilter__) || defined(__ipfirewall__)
interface le0;
#endif
#if defined(__ipfw__) || defined(__ipfwadm__)
interface 192.168.11.1
#endif
policy block all;
if ( from host aquele_host to minha_rede ) {
log and pass;
}
if ( from minha_rede to host aquele_host ) {
log && pass;
}
block .
end-policy
```

Other examples of security services to be configured

- Other packet filter functions
  NAT/PAT, reverse NAT, transparent proxy
- Proxy servers
- VPNs
- traffic shapers (since they are closely tied to packet filters)
- ad-hoc proxies for common Internet services
- IDSs
- IPSs
- Anti-virus and anti-spam boxes
- tcpwrappers
- DoS detectors and mitigators
- Logging/accounting/auditing structure

OpenVPN, squid . . .

```
remote 143.106.1.75 2222
dev tun
ifconfig 10.0.0.1 10.0.0.2
secret /etc/openvpn/lasitautec-key.txt
cipher AES-128-CBC   # AES
persist-key
persist-tun
port 2222
proto udp
user nobody
group nobody
route 10.2.1.0 255.255.255.0
verb 3
mssfix
```

```
acl all src 0.0.0.0/0.0.0.0
acl interno src 10.1.1.0/255.255.255.0
acl itautec src 10.0.0.0/255.255.255.0
acl localhost src 127.0.0.1/255.255.255.255
acl to_localhost dst 127.0.0.0/8
acl SSL_ports port 443 563 1863 4443 5222
acl Safe_ports port 80          # http
acl Safe_ports port 21          # ftp
acl Safe_ports port 443 563     # https
http_access allow manager localhost
http_access deny !Safe_ports
http_access deny CONNECT !SSL_ports
http_port 10.1.1.1:8080
cache_peer 10.0.0.2 sibling 8080 3130
cache_peer proxy.unicamp.br sibling 3128 3130
...
```

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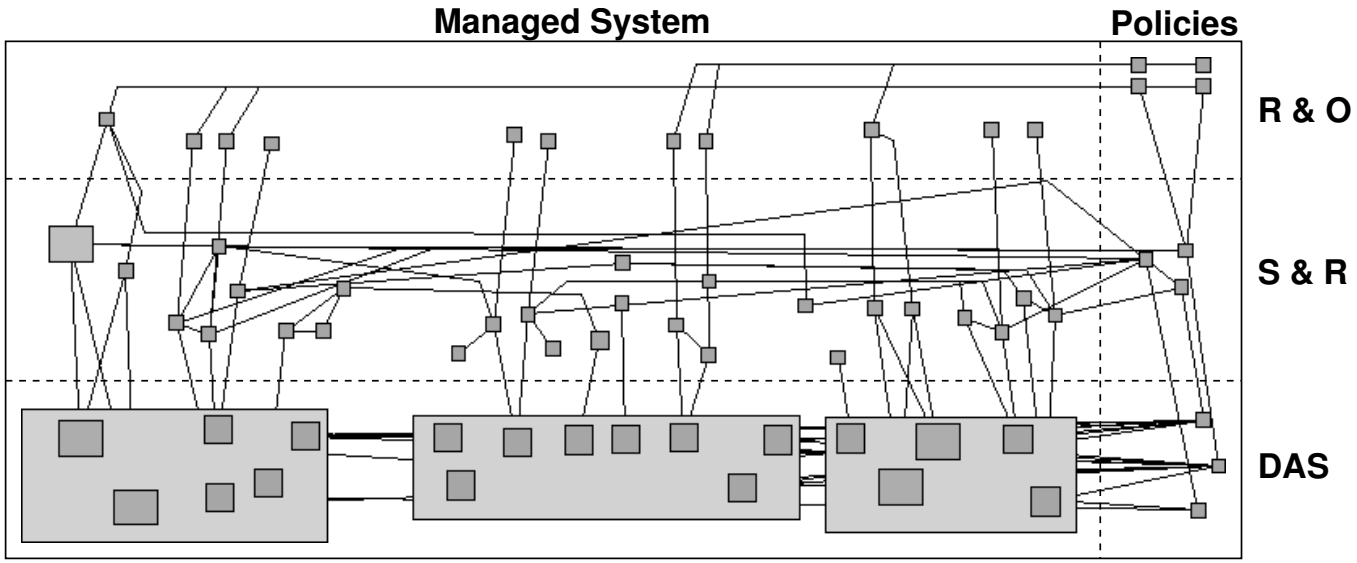
Model-Based Management Approach



- Three-layered model
  - R & O Roles and Objects (RBAC concepts)
  - S & R Subjects and Resources
  - DAS Diagram of Abstract Subsystems (process/hosts)
- Automated building of a policy hierarchy
  - Configuration parameter generation
  - assisted by supporting tool

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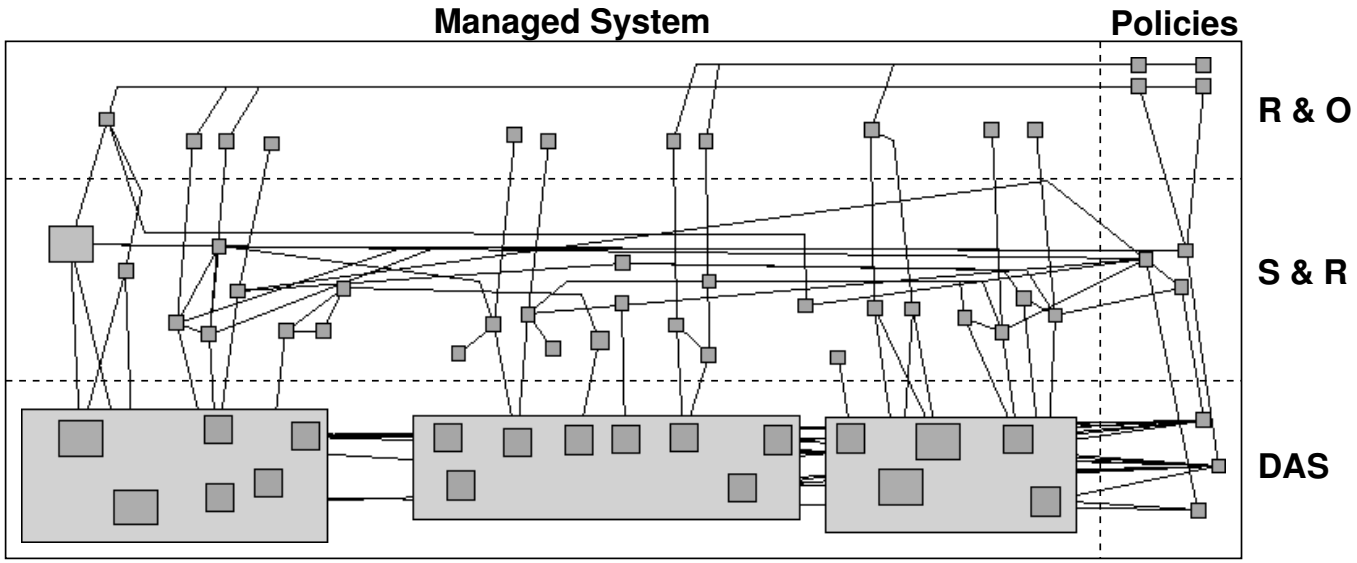

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Diagram of Abstract Subsystems (DAS)

Modular representation of a system's architecture

- Abstract Subsystems (ASs) as *building blocks*

Types of components

Actors	active elements Initiate communication Execute mandatory operations
Mediators	inspect, filter and/or transform data flows According to the policies
Targets	store relevant information
Connectors	communication interfaces between ASs Inert; help with graphing

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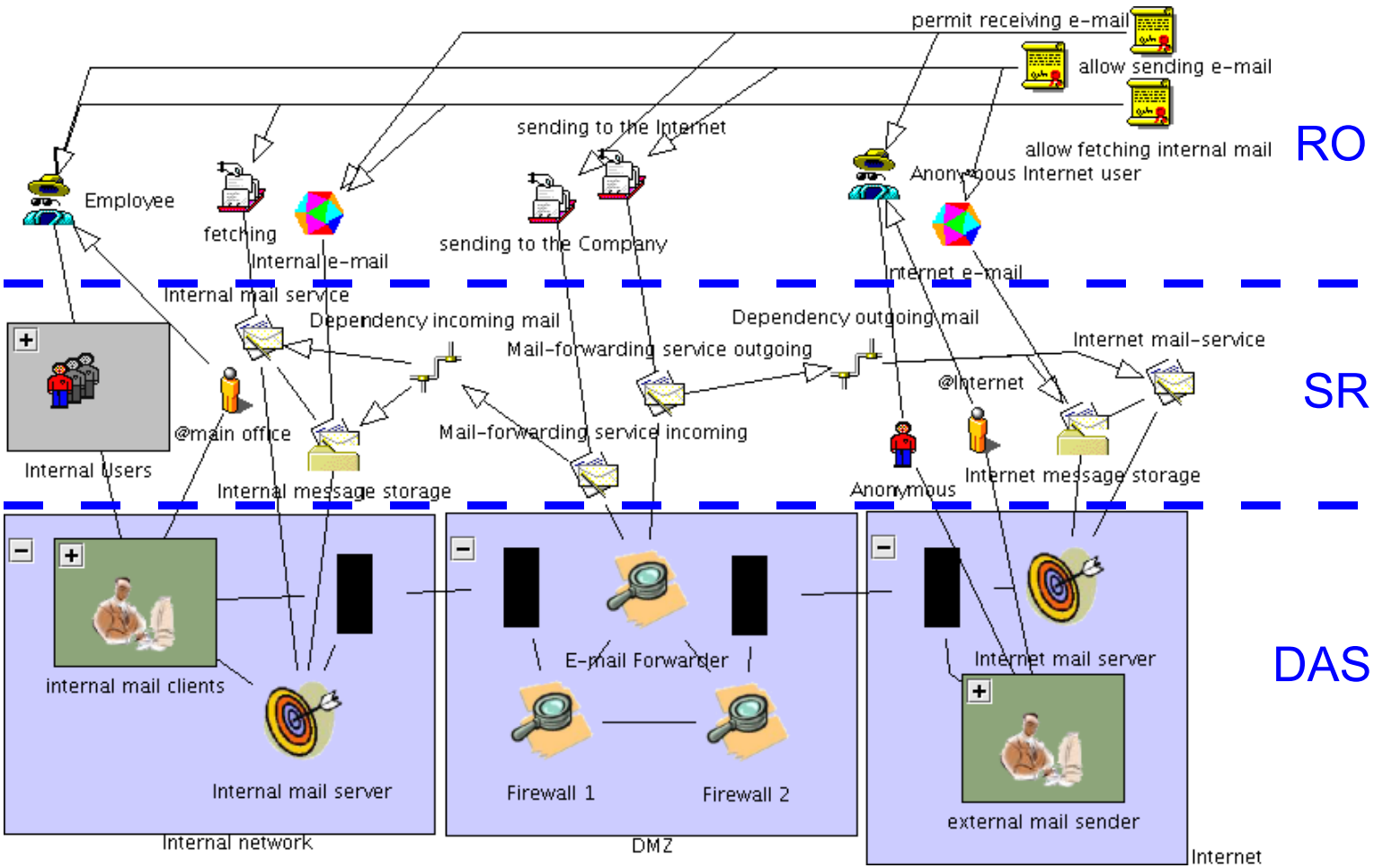
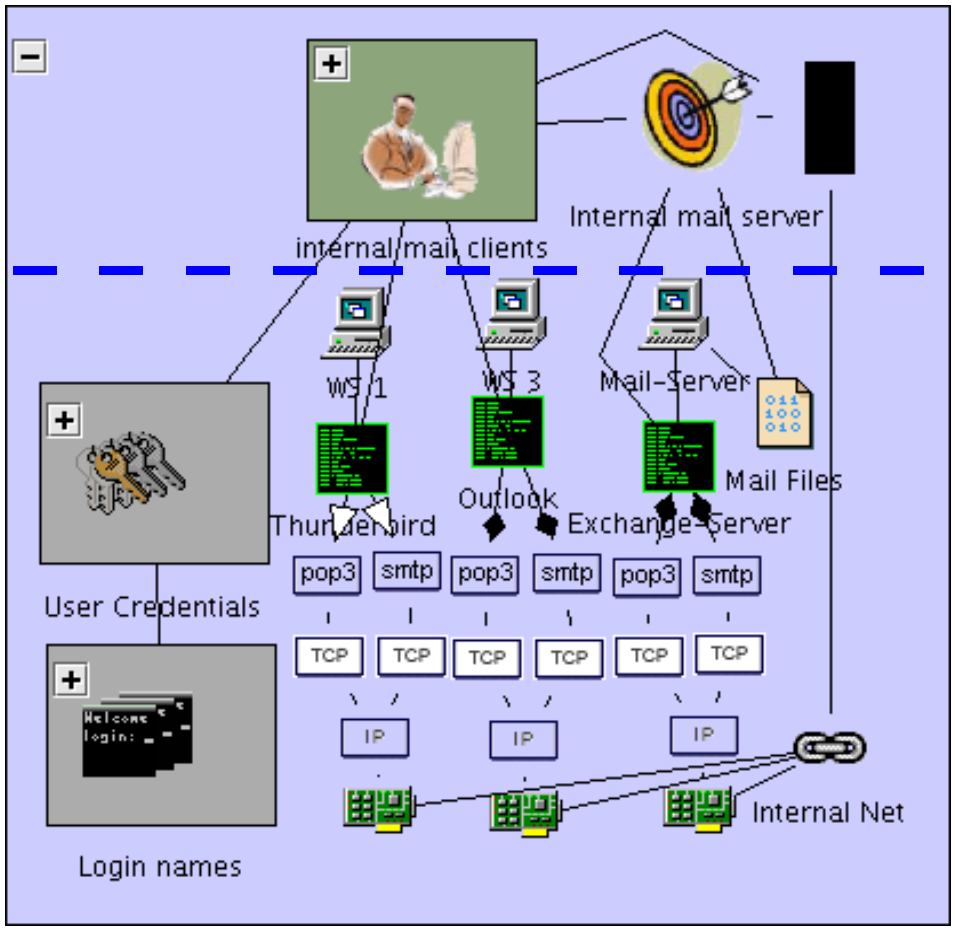
Simple model example



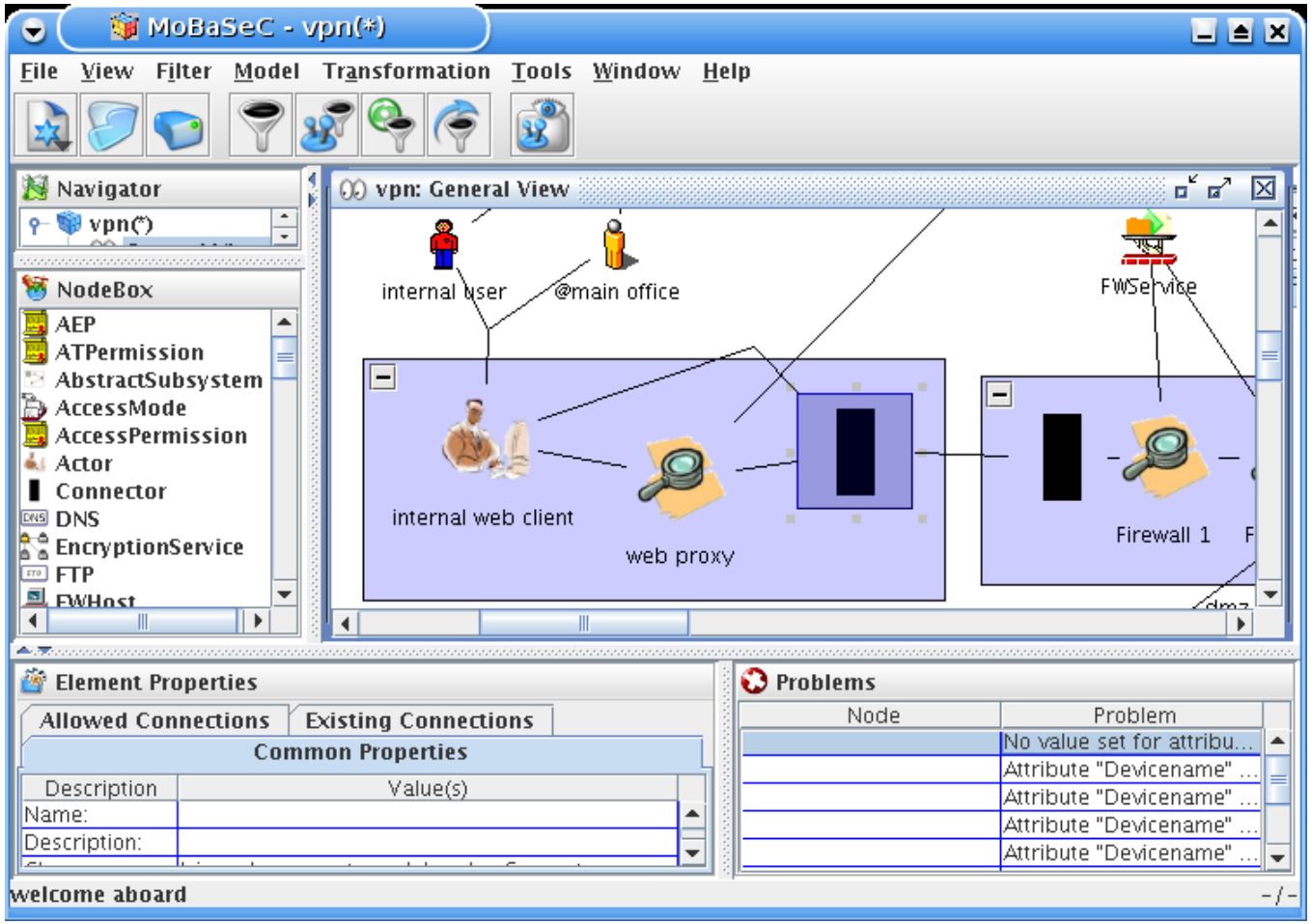
Detailed view of the lowest level



Abstract view

Expanded view (down to the processes and hosts level)

MoBaSeC interface



Supporting tool

- Diagram editor to draw models
- Execution of global and local consistency checks
- Automated generation of service configuration parameters
  - From *AccessPermissions*, highest to lower levels
    $\longrightarrow$ authorization policies automatically derived
  - *Back-end* functions translate PH model
    $\longrightarrow$ specific config files (iptables, Kerberos. . .)
  - Checks and formal validation
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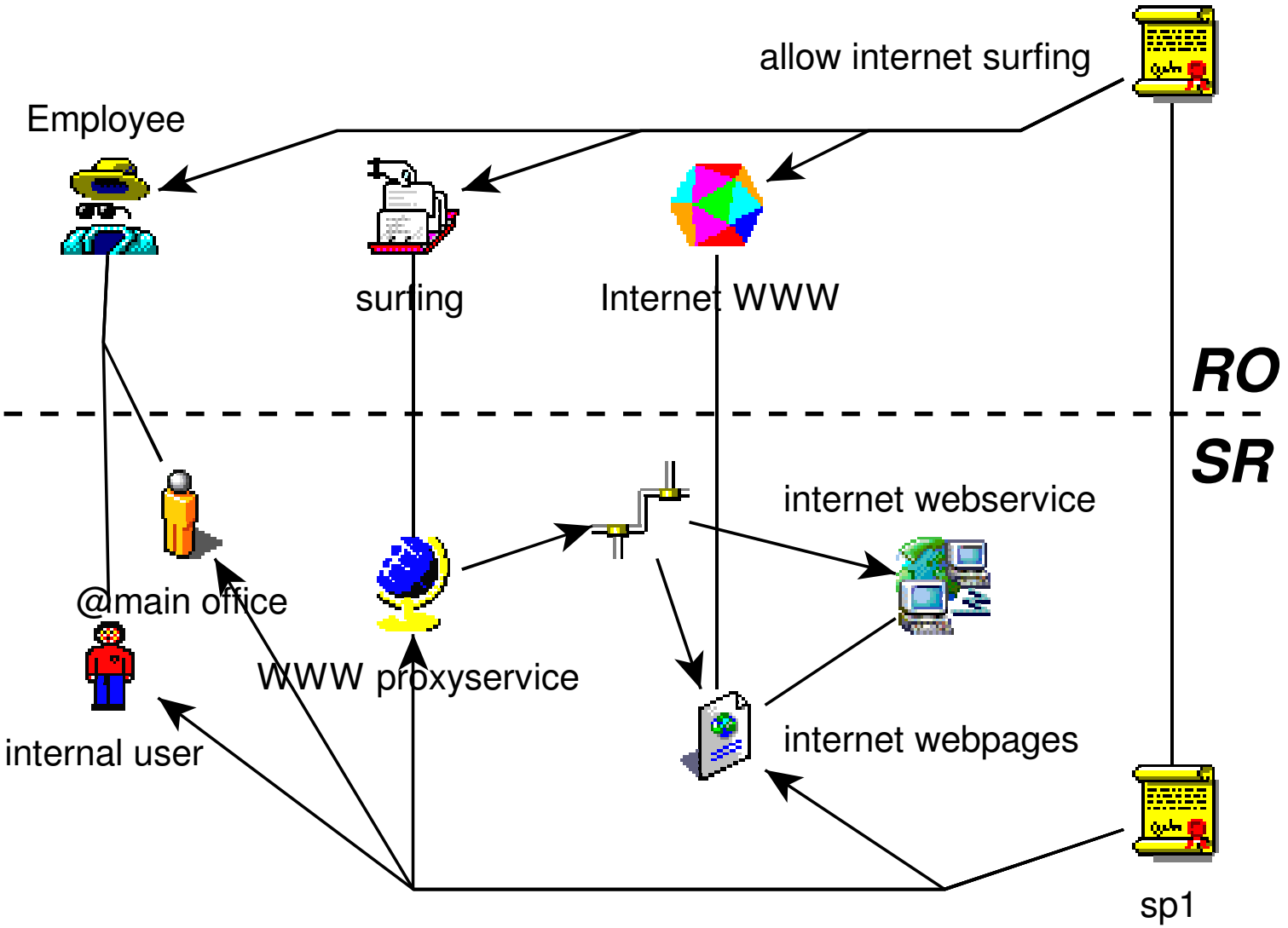
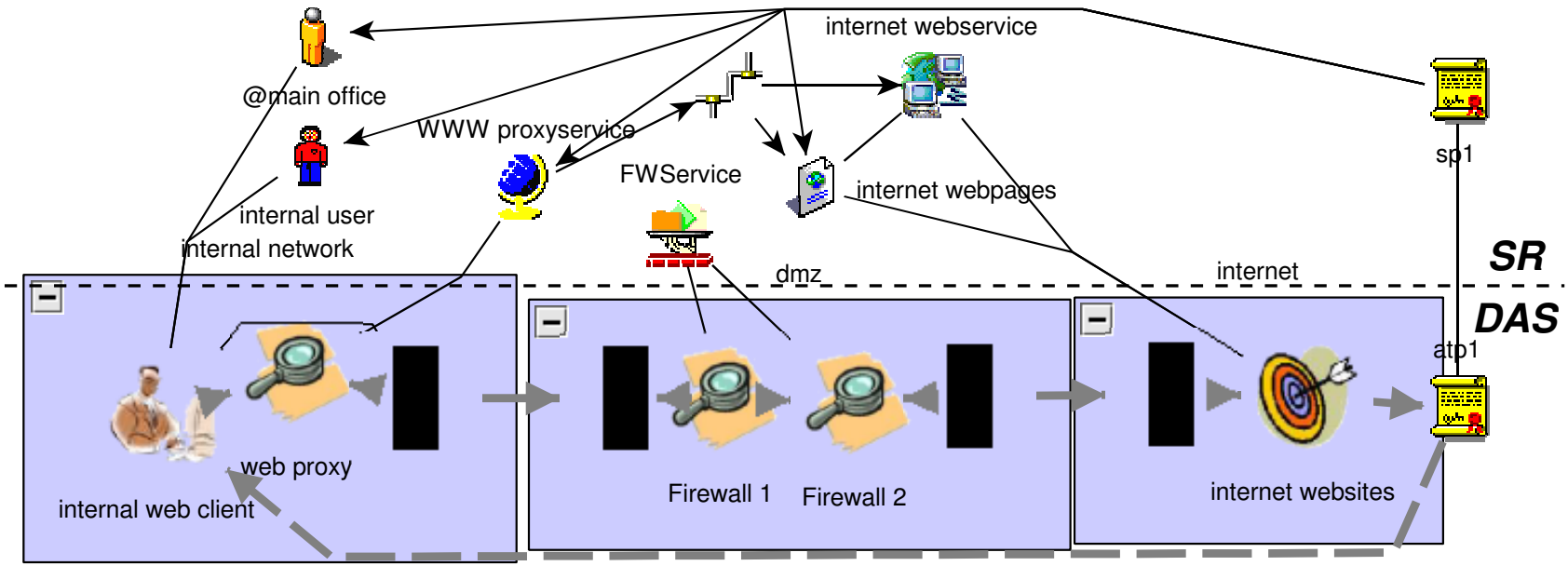
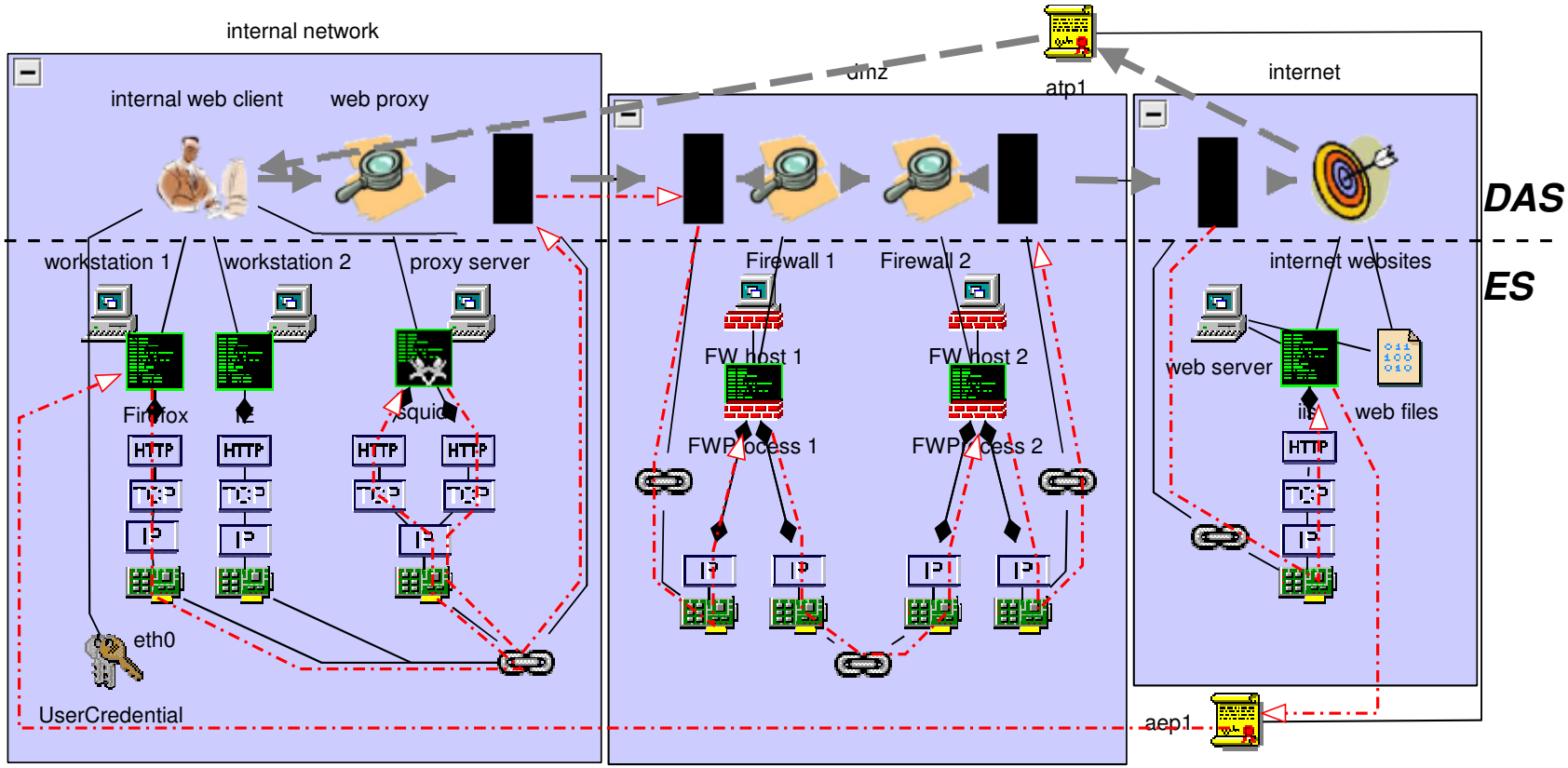
MoBaSeC refinement process - I



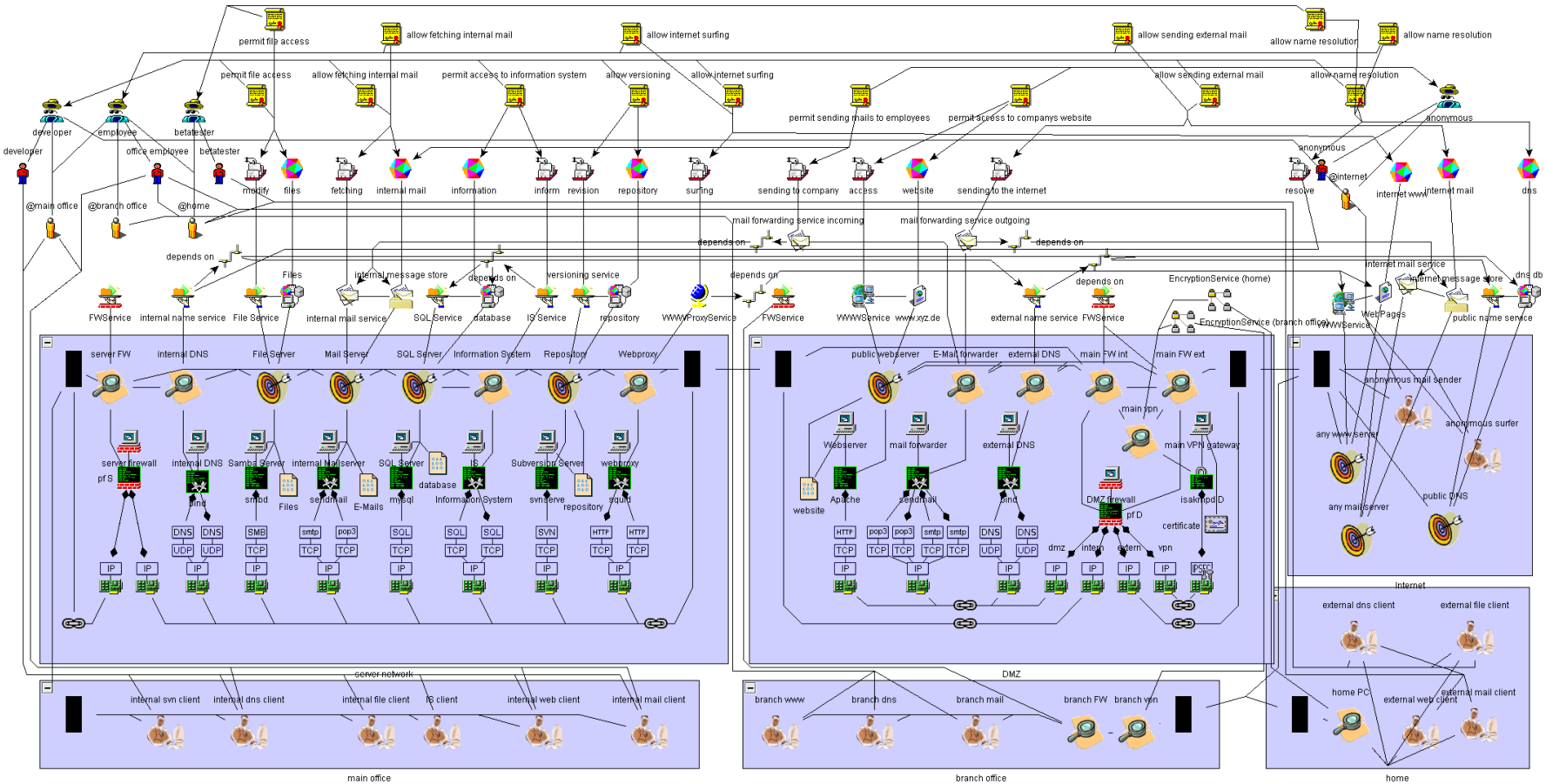
MoBaSeC refinement process - II



MoBaSeC refinement process - III



A larger example



Figures from case studies

scenario	n° of policies at the RO level	n° of network elements (PH/ES)	n° of DAS elements
simple network example	5	95	19
larger network, similar policy	5	540	32
medium-sized network	15	264	49

- Scalability regarding the number of elements
- Policies are the real measure of complexity. . .

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