Semantic Access Control

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Agenda

- ✍ Introduction
- ✍ SAC, *Semantic Access Control Model*
- ✍ Semantic Integration of a PMI
- ✍ Example
- ✍ Implementation
- ✍ Conclusions
- ✍ Future Work

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Traditional Access Control Schemes

DAC, ***Discretionary Access Control***

- Multi-user DBs
  - Reduced number of previously known users.
  - Changes are not frequent.
  - Resources under a unique entity.
- Control based on identity.
  - Rules stating what a user can do or not.

Traditional Access Control Schemes

MAC, *Mandatory Access Control*

- Military environments
  - High number of users
  - Linear and Static Hierarchical classification.
- Control based on Security Levels.
  - Rules established by a central authority.
  - Definition of Security Levels
  - Allocation of levels to resources and users

Traditional Access Control Schemes

RBAC, *Role-based Access Control*

- Business. Corporative Intranets.
  - Hierarchical structures.
  - Access Permissions depending on the user position (role) in the hierarchy.
- Control based on roles played
  - Rules establishing permissions of access to roles.
  - Allocation of roles to users.

Open and Distributed Environments

- Heterogeneity
  - Open Access Control Scheme
- Interoperability
  - Separation of the Responsibilities of Authorization and Access Control
- Flexibility
  - Independence of the Application Domain
- Scalability
  - Completely Distributed Scheme
- Dynamism
  - Adaptation transparently and automatically

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  - *Semantic Policy Language*
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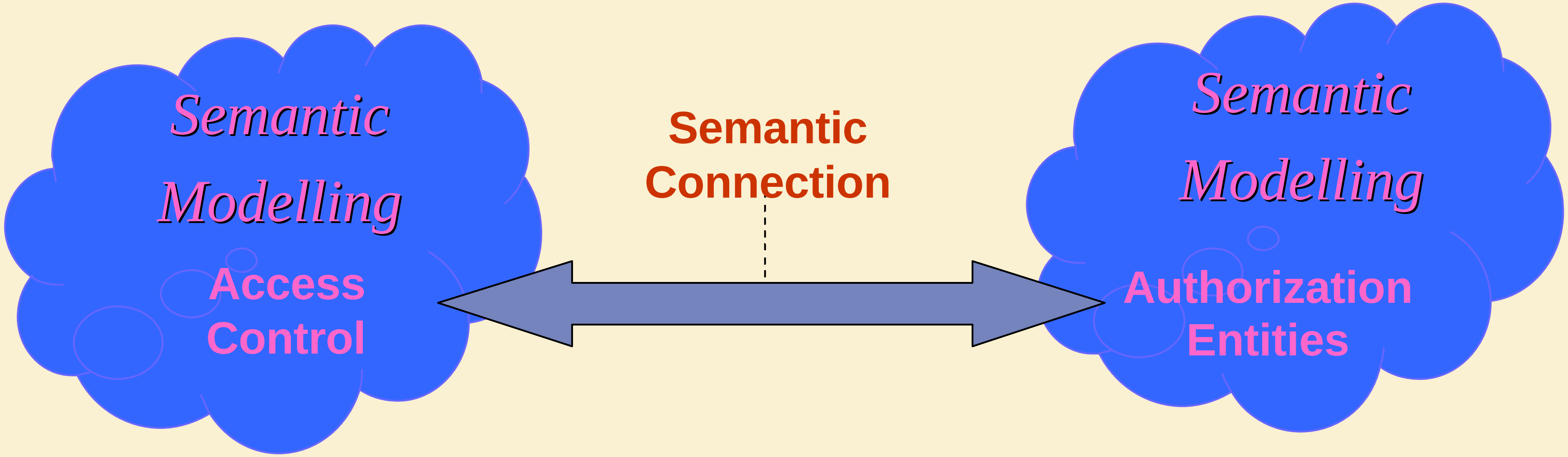
Basis for a New AC Model

Separation of responsibilities of Authorization **and** Access Control **is widely accepted as a Flexible and Interoperable Solution**

Semantic Integration of Authorization and Access Control Applications



SAC, Semantic Access Control

PROVIDES

- Schema based on the concept of attribute
- Access based on semantics
- No ambiguity in policies
- Semantic Correction
- Dynamic Allocation of Policies
- Modularization
- Parameterization
- Reuse

AVOIDS

- Mandatory Previous Subscription
- Mandatory Identification
- Previous Establishment of Elements for the support of access control
  - Users Hierarchy
  - Roles
  - Groups
  - Security Classification
  - ...

Mechanisms in SPL, Semantic Policy Language

- ✍ **To reduce the AC policies definition complexity: *Modularity*, *Parameterisation* and *Abstraction*.**
- ✍ **Modularity in SPL implies:**
  - **The separation of specification in three parts:**
    - **access control criteria**
    - **allocation of policies to resources**
    - **semantic information (properties about resources and context)**
  - **The abstraction of access control components**
  - **The ability to reuse these access control components**

Mechanisms in SPL

- ✍ *Access Control Criteria Specification* (Policy)*:* used to describe necessary conditions to get the access; they can be composed.
- ✍ *Policy Applicability Specification* (PAS): used to relate policies to objects dynamically when a request is received.
- ✍ *Secured Resource Representation* (SRR): used to describe semantic information about resources.
- ✍ *SPL* Policy and PAS can be parameterised:
  - This helps defining flexible and general policies and reducing the number of different policies to manage.
  - Parameters are dynamically instantiated from semantic and contextual information.
- ✍ Policies can be composed importing components of other policies without ambiguity.
  - modular composition of policies based on the XPath standard.

Metadata in SPL

- **Metadata applied at different levels:**
  - **Semantic and contextual validation of access control policies.**
  - **Dynamic policy allocation and instantiation.**
  - **Creation of policies**
    - **For the specification and acquisition of certification rules**
  - **Management of policies**
    - **Any change in the authorization rules or the context is detected and the consequences are revealed.**

SAC, Semantic Access Control

- Attribute Certificate Based Approach.
- Supported by XML related technologies for metadata.
- Modular Language.
- Policy Composition.
- Parameterised Policies.
- Content-aware access control (content introspection).
- Means for the semantic integration of an external PMI.
  - Authorization becomes interoperable.

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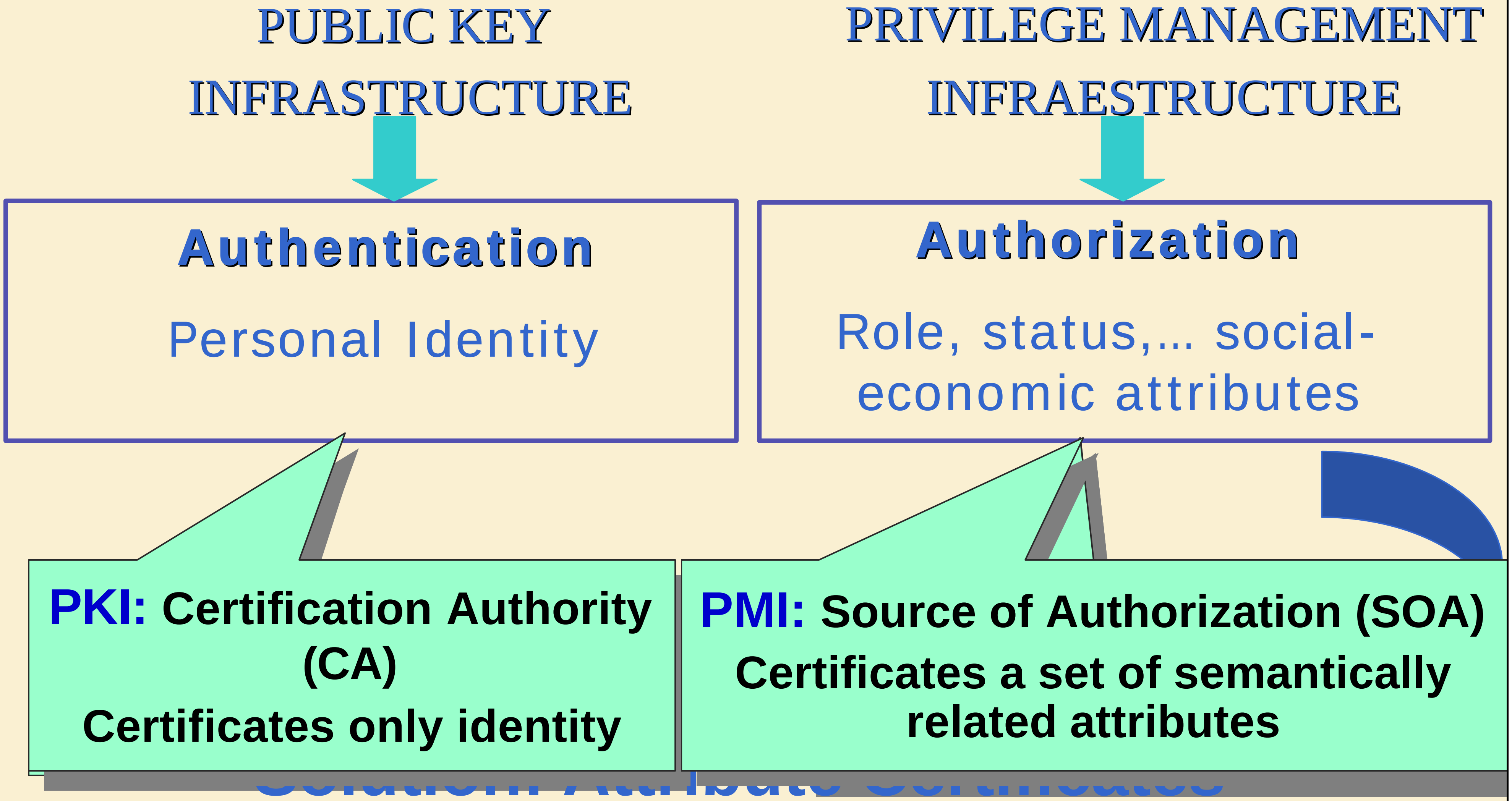
Semantic Integration of a PMI



PUBLIC KEY INFRASTRUCTURE

PRIVILEGE MANAGEMENT INFRAESTRUCTURE

Authentication

Personal Identity

Authorization

Role, status,... social-economic attributes

PKI: **Certification Authority (CA)**

Certificates only identity

PMI: **Source of Authorization (SOA)**

Certificates a set of semantically related attributes

Solution: Attribute Certificates

Semantic Integration of a PMI

SOAD Model (*Source of Authorization Description*)

- **Describes the semantics of the certificates issued by the SOA.**
- **Describes relationships among the certificates**
  - **and between attributes certified by this SOA and others sources of authorization.**
- **Helps to the specification of access criteria.**
- **Enables the semantic validation.**

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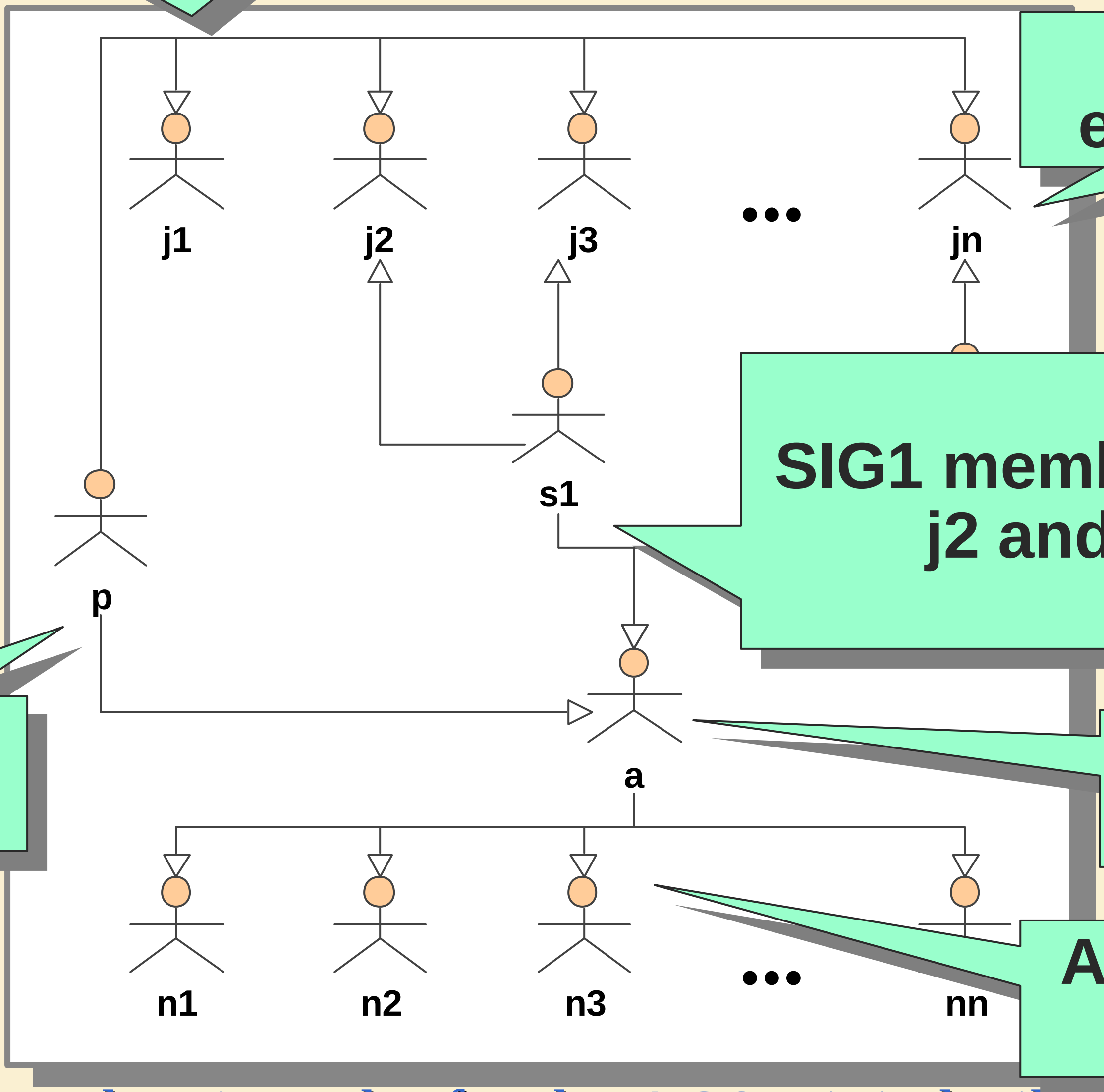
Example: ACS DL

- Various Special Interest Groups (SIGs)
- ACS members can be members of the different SIGs, not mandatory.
- ACS publishes journals and newsletters, directly or through the SIGs.
- Newsletters can be accessed by the ACS members and also by people subscribed to them (ACS members or not).
- Journals can be accessed by users subscribed to them independently they are members of the ACS or not.
- If the journal is published by an Special Interest Group, all the members of that group can access that journal.
- An special subscription type called Portal grants access to every publication in the digital library.

Exa

Role structure must be predefined



A role for each journal

SIG1 members can play j2 and j3 roles

A role for portal

A role for ACS

A role for each newsletter

Role Hierarchy for the ACS Digital Library

Policy for Journals

Instantiated from the journal SRR

```
<?xml version="1.0" encoding="[illegible]"?>
 <Policy … xsi:schemaLocation="http://www.lcc.uma.es/SAC Policy.xsd">
    <Parameter>PublicationName</Parameter>
    <Parameter>PublicationSOA</Parameter>
    <AccessRules>
        <AccessRule >
           <AttributeSet AttributeSetDescription="Suscripción a una
                          publicación" AttributeSetName="Suscripcion">
                 <Attribute Equivalence="Enabled“>
                    <AttributeName>Subscription</AttributeName>
                    <AttributeValue>*PublicationName</AttributeValue>
                    <SOA_ID>*PublicationSOA</SOA_ID>
              </Attribute>
           </AttributeSet>
        </AccessRule>
    </AccessRules>
</Policy>
```

Policy

Allocation of Po

Allocation of policy for journals (Journal.xml) to the ACS journals

```
<?xml version="1.0" encoding="UTF-8"?>
<spl:PAS xmlns:spl="http://www.lcc.uma.es/SAC"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.lcc.uma.es/SAC pas.xsd">
    <spl:Policy>Journal.xml</spl:Policy>
    <spl:Object>
        <spl:ObjectLocation>http://www.acs.org/</spl:ObjectLocation>
        <spl:Conditions>
           <spl:Condition>
              <spl:PropertyName>PublicationType</spl:PropertyName>
           <spl:PropertyValue>Journal</spl:PropertyValue>
           </spl:Condition>
        </spl:Conditions>
    </spl:Object>
</spl:PAS>
```

PAS

Description of TOSEC journals

Properties for the Instantiation

```
<?xml version="1.0" encoding="UTF-8"?>
<SRR …xsi:schemaLocation="http://www.lcc.uma.es/SAC SRR.xsd" >
    <Property>
            <PropertyName>PublicationName</PropertyName>
            <PropertyValue>TOSEC</PropertyValue>
    </Property>
    <Property>
            <PropertyName>PublicationSOA</PropertyName>
            <PropertyValue>SIGSEC</PropertyValue>
    </Property>
    <Property>
            <PropertyName>PublicationType</PropertyName>
            <PropertyValue>Journal</PropertyValue>
    </Property>
    <Resource>http://www.acs.org/Journals/TOSEC/</Resource>
</SRR>
```

SRR

Policy for the TOSEC journal

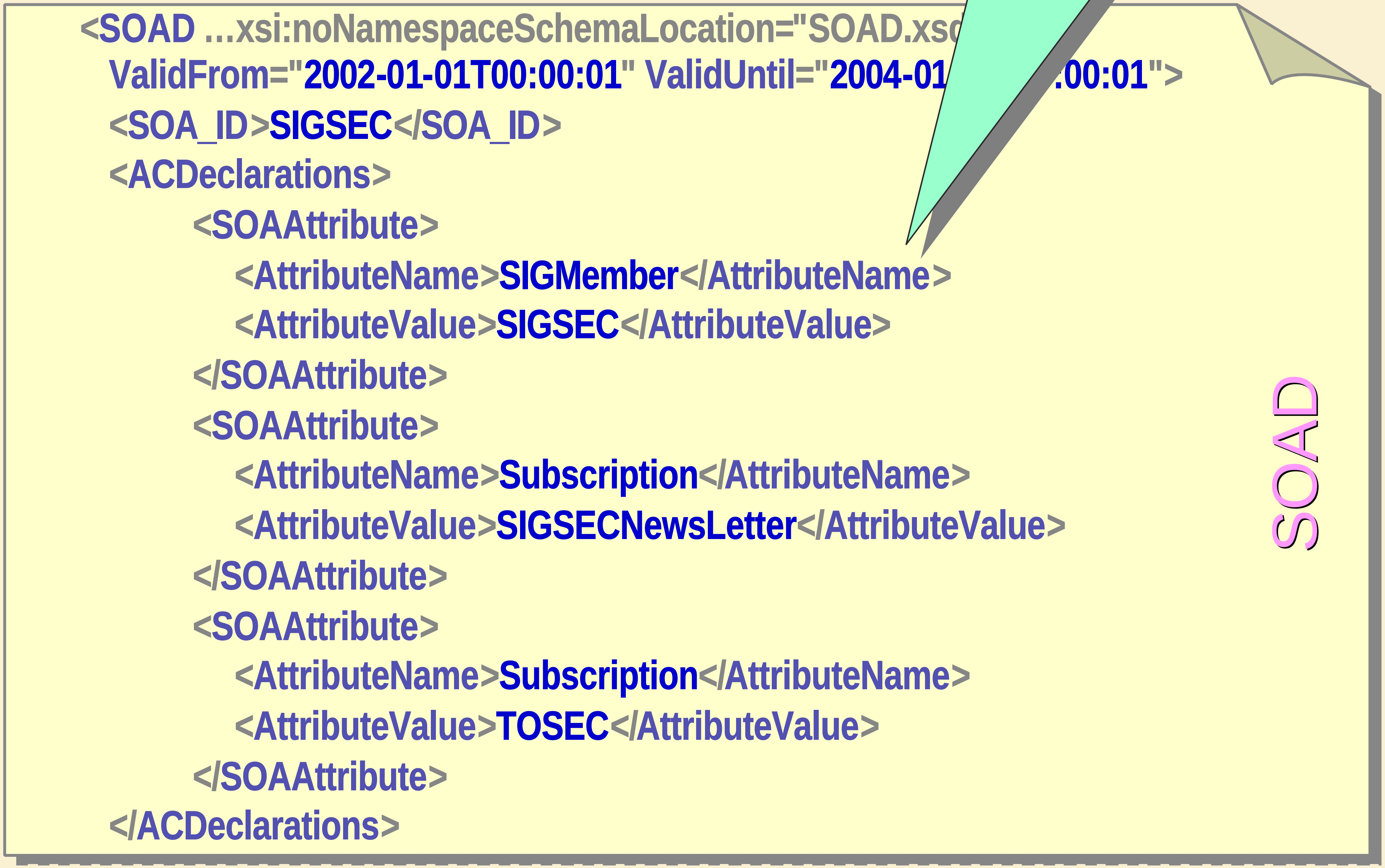
```
<?xml version="1.0" encoding="UTF-8"?>
<Policy …xsi:schemaLocation="http://www.lcc.uma.es/SAC Policy.xsd">
    <AccessRules>
        <AccessRule>
            <AttributeSet AttributeSetDescription="Suscripción a una
                            publicación" AttributeSetName="Suscripcion">
                <Attribute Equivalence="Enabled“>
                    <AttributeName>Subscription</AttributeName>
                    <AttributeValue>TOSEC </AttributeValue>
                    <SOA_ID>SIGSEC</SOA_ID>
                </Attribute>
            </AttributeSet>
        </AccessRule>
    </AccessRules>
</Policy>
```

Policy

Dynamically instantiated policy

Semantics of the Attributes

SOAD of the Interest Group on Security



```
<SOAD …xsi:noNamespaceSchemaLocation="SOAD.xsd
  ValidFrom="2002-01-01T00:00:01" ValidUntil="2004-01         :00:01">
  <SOA_ID>SIGSEC</SOA_ID>
  <ACDeclarations>
        <SOAAttribute>
           <AttributeName>SIGMember</AttributeName>
           <AttributeValue>SIGSEC</AttributeValue>
        </SOAAttribute>
        <SOAAttribute>
           <AttributeName>Subscription</AttributeName>
           <AttributeValue>SIGSECNewsLetter</AttributeValue>
        </SOAAttribute>
        <SOAAttribute>
           <AttributeName>Subscription</AttributeName>
           <AttributeValue>TOSEC</AttributeValue>
        </SOAAttribute>
  </ACDeclarations>
```

Semantics of the Attributes

To be a member of the SIG on Security, SIGSEC, implies the subscription to the SIGSEC newsletters

```
  <ACR
        <SOAAttribute>
          <AttributeName>SIGMember</AttributeName>
          <AttributeValue>SIGSEC</AttributeValue>
        </SOAAttribute>
      </AttributeSet>
      <Relation>Implies</Relation>
      <AttributeSet>
        <SOAAttribute>
          <AttributeName>Subscription</AttributeName>
          <AttributeValue>SIGSECNewsLetter</AttributeValue>
        </SOAAttribute>
        <SOAAttribute>
          <AttributeName>Subscription</AttributeName>
          <AttributeValue>TOSEC</AttributeValue>
        </SOAAttribute>
      </AttributeSet>
    </SOARule>
  </ACRelations>
</SOAD>
```

and to the TOSEC journal

SOAD

Example Conclusions

- ✍ RBAC model presents problems to adapt to changes.
  - Administrative overload.
- ✍ No every problem is easily modelled using RBAC.
- ✍ The SAC model enables to express in a more natural and simple way complex access control situations.
  - Simple, generic, reusable, dynamically instantiated specifications.
- ✍ The semantic integration of external authorization entities provides additional advantages to SAC.

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- *Implementation*
  - *Management Mechanisms in SAC*
  - *Integration Mechanism of the PMI*
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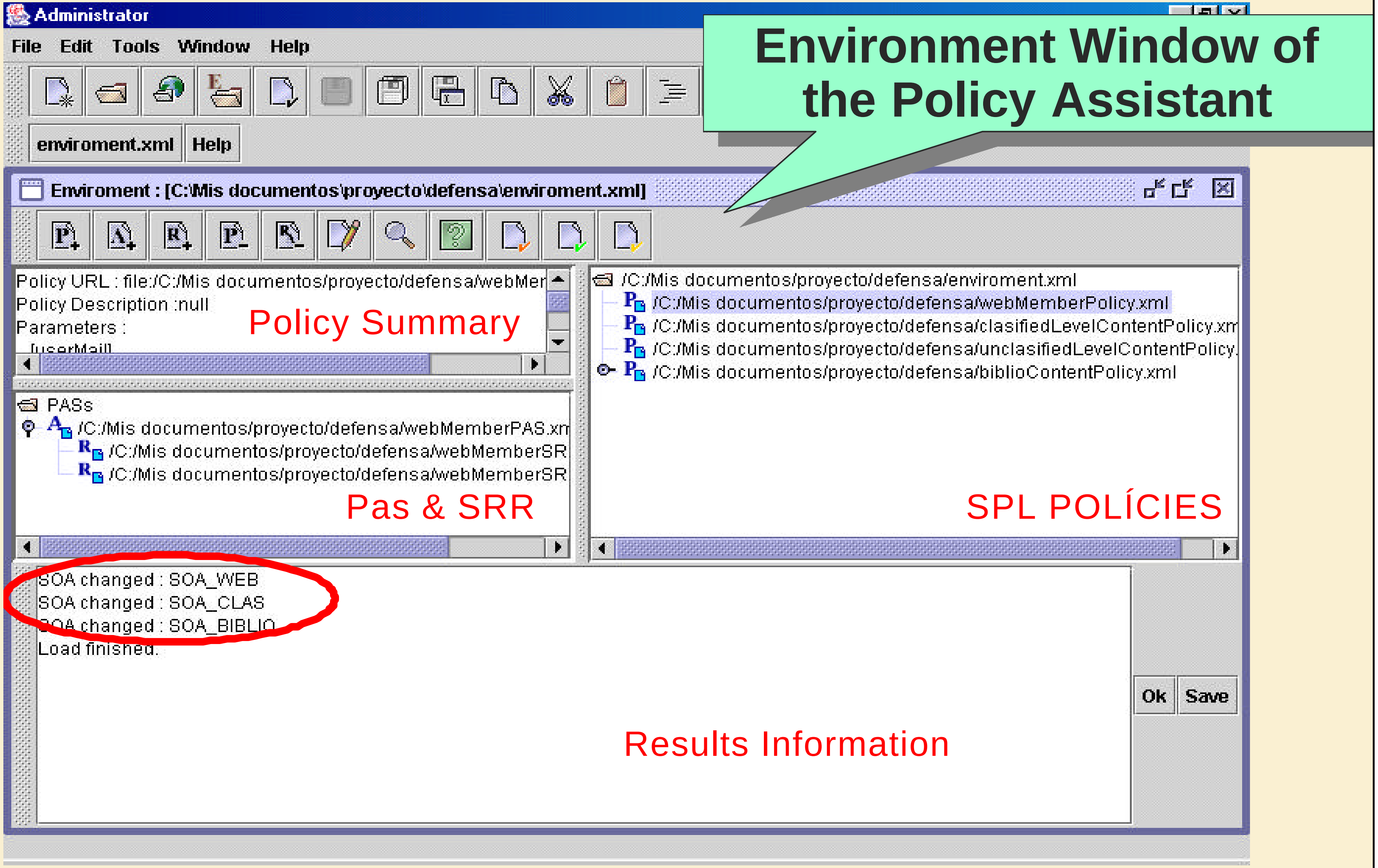
Administration

- ✍ One of the main objectives of the SAC model is the ease of administration.
  - Validation of the semantic and contextual correction.
  - Reuse of components.
  - Ease of implementation.
  - Administrator Supporting tools.
    - Integrated environment with smart and visual edition, syntactic and semantic validation, control of changes, ...
  - Authorization Management.
    - SOADs Client

Administration



Enviroment : [C:\Mis documentos\proyecto\defensa\enviroment.xml]

Policy URL : file:/C:/Mis documentos/proyecto/defensa/webMem
Policy Description :null
Parameters :
[userMail]

PASs
/C:/Mis documentos/proyecto/defensa/webMemberPAS.xm
/C:/Mis documentos/proyecto/defensa/webMemberSR
/C:/Mis documentos/proyecto/defensa/webMemberSR

/C:/Mis documentos/proyecto/defensa/enviroment.xml
/C:/Mis documentos/proyecto/defensa/webMemberPolicy.xml
/C:/Mis documentos/proyecto/defensa/clasifiedLevelContentPolicy.xm
/C:/Mis documentos/proyecto/defensa/unclasifiedLevelContentPolicy.
/C:/Mis documentos/proyecto/defensa/biblioContentPolicy.xml

```
SOA changed : SOA_WEB
SOA changed : SOA_CLAS
SOA changed : SOA_BIBLIO
Load finished.
```

Environment Window of the Policy Assistant

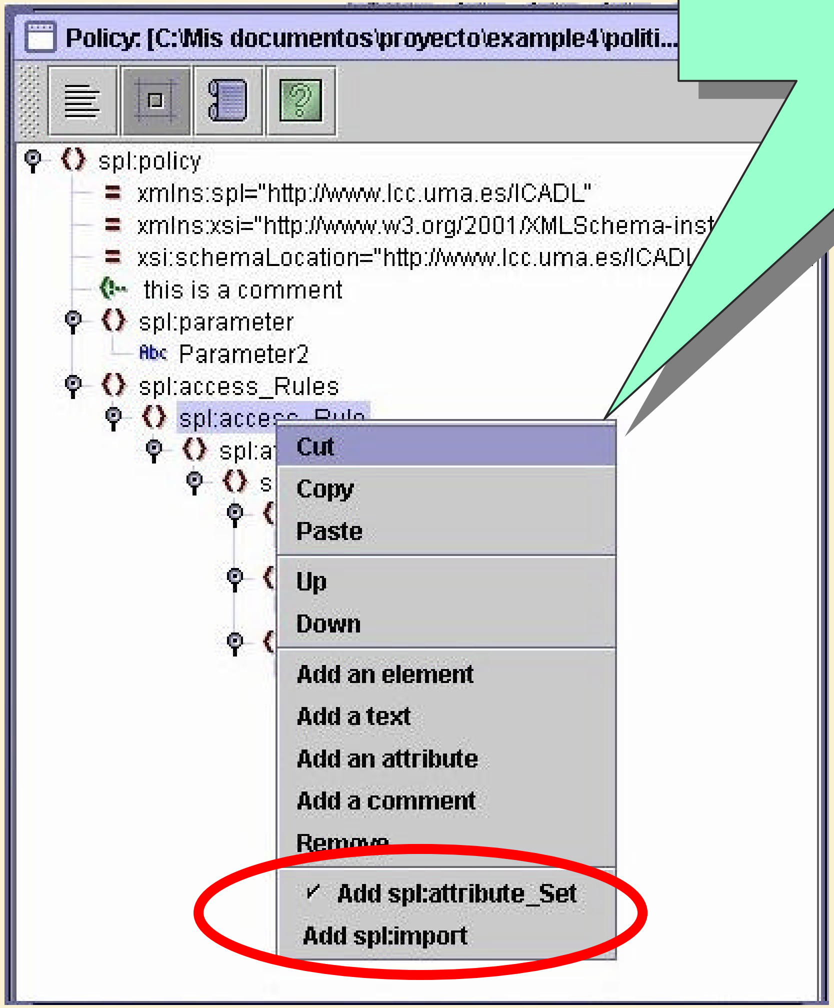
Policy Summary

Pas & SRR

SPL POLÍCIES

Results Information

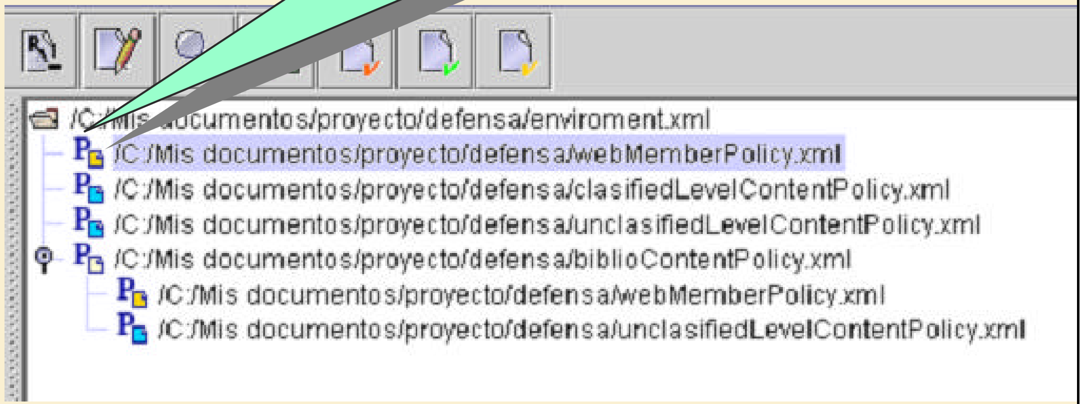
Administration



Policy: [C:\Mis documentos\proyecto\example4\politi...

```
spl:policy
  xmlns:spl="http://www.lcc.uma.es/ICADL"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-inst
  xsi:schemaLocation="http://www.lcc.uma.es/ICADL
  this is a comment
  spl:parameter
    Parameter2
  spl:access_Rules
    spl:access_Rule
      spl:a
        s
```

Context Sensitive Edition



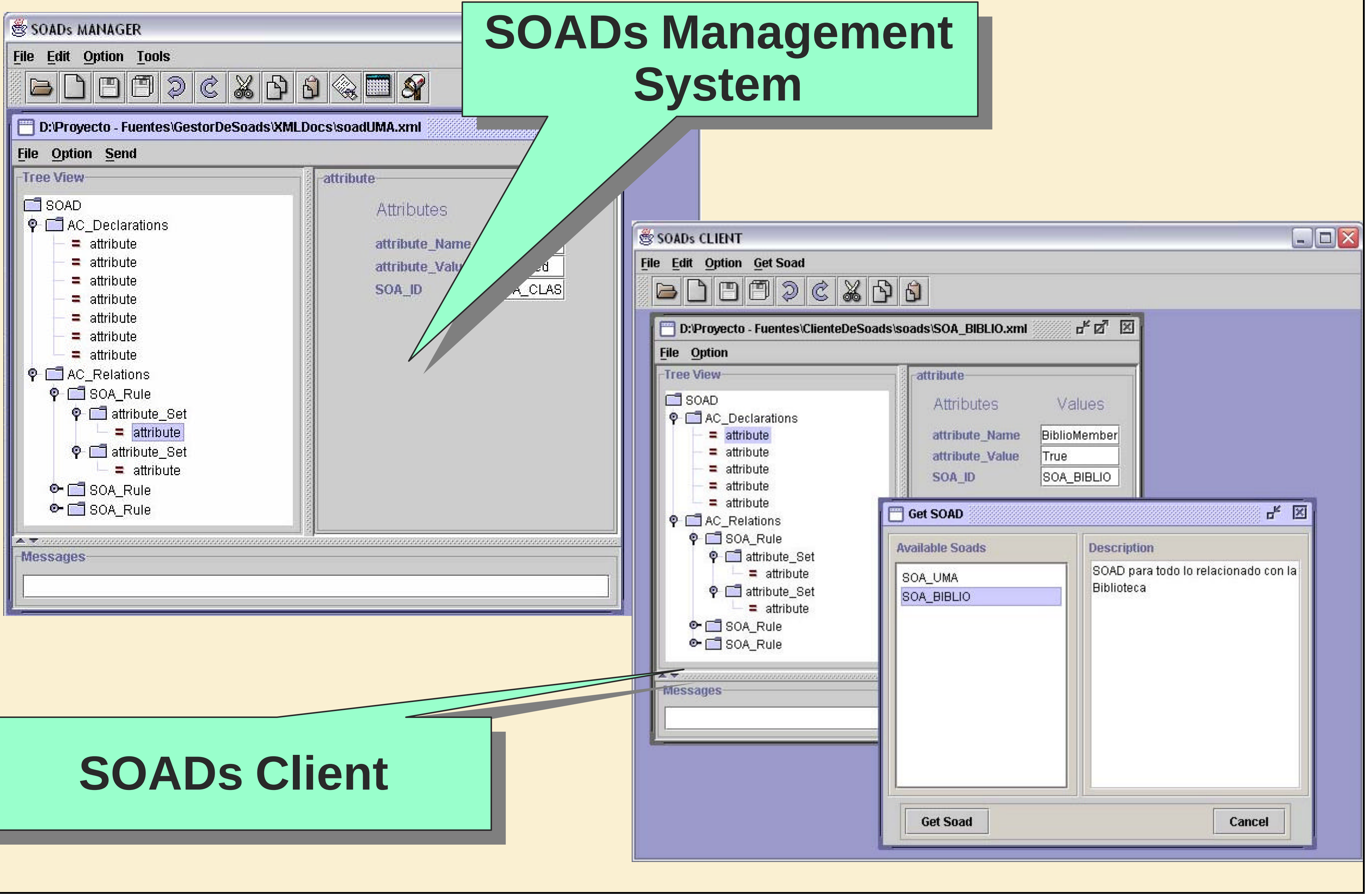
```
/C:/Mis documentos/proyecto/defensa/enviroment.xml
  /C:/Mis documentos/proyecto/defensa/webMemberPolicy.xml
  /C:/Mis documentos/proyecto/defensa/clasifiedLevelContentPolicy.xml
  /C:/Mis documentos/proyecto/defensa/unclasifiedLevelContentPolicy.xml
  /C:/Mis documentos/proyecto/defensa/biblioContentPolicy.xml
    /C:/Mis documentos/proyecto/defensa/webMemberPolicy.xml
    /C:/Mis documentos/proyecto/defensa/unclasifiedLevelContentPolicy.xml
```

Change Control

Semantic Integration of PMI

- ✍SOADs Management at the server and client side
  - Publication / Localization
  - History
  - Caducity
  - Edition on the Server and the Client side.

Semantic Integration of a PMI


SOADs MANAGER
File Edit Option Tools
D:\Proyecto - Fuentes\GestorDeSoads\XMLDocs\soadUMA.xml
File Option Send
Tree View
attribute
Messages

- SOAD
  - AC_Declarations
    - attribute
    - attribute
    - attribute
    - attribute
    - attribute
    - attribute
    - attribute
  - AC_Relations
    - SOA_Rule
      - attribute_Set
        - attribute
      - attribute_Set
        - attribute
    - SOA_Rule
    - SOA_Rule

Attributes	
attribute_Name	
attribute_Valu	ed
SOA_ID	A_CLAS

SOADs Management System

SOADs CLIENT
File Edit Option Get Soad
D:\Proyecto - Fuentes\ClienteDeSoads\soads\SOA_BIBLIO.xml
File Option
Tree View
attribute
Messages

- SOAD
  - AC_Declarations
    - attribute
    - attribute
    - attribute
    - attribute
    - attribute
  - AC_Relations
    - SOA_Rule
      - attribute_Set
        - attribute
      - attribute_Set
        - attribute
    - SOA_Rule
    - SOA_Rule

Attributes	Values
attribute_Name	BiblioMember
attribute_Value	True
SOA_ID	SOA_BIBLIO

Available Soads

- SOA_UMA
- SOA_BIBLIO

Description

SOAD para todo lo relacionado con la Biblioteca

SOADs Client

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Conclusions

- ✍ **Semantic Integration of Applications**
  - **of Authorization and Access Control.**
- ✍ **Access Control Model based on semantics of the contents and the application context.**
- ✍ **High level of Interoperability, Scalability, Flexibility, Adaptability, Applicability.**
- ✍ **Semantic Soundness.**
- ✍ **Ease of Administration.**
- ✍ **Avoids the registration phase.**

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Future Work

- ✍ **Delegation**
  - **To maintain the control over the delegation process.**
    - **Establish semantics of the delegation.**
- ✍ **DRM**
  - **Extension of SPL to express rights over digital contents.**
  - **Inclusion of new DRM functions in the XSCD infrastructure.**
- ✍ **Application of SAC to new environments.**

Thank you for your attention ;-)

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