XACML v3.0 Core and Hierarchical Role Based Access Control (RBAC) Profile
Version 1.0

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Abstract:
This specification defines a profile for the use of XACML in expressing policies that use role based access control (RBAC). It extends the XACML Profile for RBAC Version 1.0 to include a recommended Attribute field for roles, but reduces the scope to address only “core” and “hierarchical” RBAC. This specification has also been updated to apply to XACML v3.0.
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1 Introduction

1.1 Background

{non-normative}
This specification defines a profile for the use of the OASIS eXtensible Access Control Markup Language (XACML) [XACML] to meet the requirements for “core” and “hierarchical” role based access control (RBAC) as specified in [ANSI-RBAC]. Use of this profile requires no changes or extensions to standard XACML Version 3.0. Compared to the Core and hierarchical role based access control (RBAC) profile of XACML v2.0 [RBAC-V2] there are is no new functionality, rather the specification has just been updated for XACML 3.0.

This specification begins with a non-normative explanation of the building blocks from which the RBAC solution is constructed. A full example illustrates these building blocks. The specification then discusses how these building blocks may be used to implement the various elements of the RBAC model presented in [ANSI-RBAC]. Finally, the normative section of the specification describes compliant uses of the building blocks in implementing an RBAC solution.

This specification assumes the reader is somewhat familiar with XACML. An introduction to the RBAC model is available in [RBACIntro].

1.2 Glossary

HasPrivilegesOfRole policy
An optional type of <Policy> that can be included in a Permission <PolicySet> to allow support queries asking if a subject “has the privileges of” a specific role. See Section 2.5: HasPrivilegesOfRole Policies and Requests.

Junior role
In a role hierarchy, Role A is junior to Role B if Role B inherits all the permissions associated with Role A.

Multi-role permissions
A set of permissions for which a user must hold more than one role simultaneously in order to gain access.

Permission
The ability or right to perform some action on some resource, possibly only under certain specified conditions.

PPS
Permission <PolicySet>. See Section 1.9: Policies.

RBAC
Role based access control. A model for controlling access to resources where permitted actions on resources are identified with roles rather than with individual subject identities.

Role Enablement Authority
An entity that assigns role attributes and values to users or enables role attributes and values during a user’s session.

RPS
Role <PolicySet>. See Section 1.9: Policies.

Role
A job function within the context of an organization that has associated semantics regarding the authority and responsibility conferred on the user assigned to the role [ANSI-RBAC].

Senior role

In a role hierarchy, Role A is senior to Role B if Role A inherits all the permissions associated with Role B.

1.3 XML Entity Declarations

In order to improve readability, the examples in this specification assume use of the following XML Internal Entity declarations:

```xml
<!ENTITY xml "http://www.w3.org/2001/XMLSchema#">
<!ENTITY rule-combine "urn:oasis:names:tc:xacml:1.0:rule-combining-algorithm:">
<!ENTITY policy-combine "urn:oasis:names:tc:xacml:1.0:policy-combining-algorithm:">
<!ENTITY function "urn:oasis:names:tc:xacml:1.0:function:">
<!ENTITY subject-category "urn:oasis:names:tc:xacml:1.0:subject-category:">
<!ENTITY subject "urn:oasis:names:tc:xacml:1.0:subject:">
<!ENTITY role "urn:oasis:names:tc:xacml:2.0:subject:role">  
<!ENTITY roles "urn:example:role-values:">  
<!ENTITY resource "urn:oasis:names:tc:xacml:1.0:resource:">
<!ENTITY action "urn:oasis:names:tc:xacml:1.0:action:">
<!ENTITY actions "urn:oasis:names:tc:xacml:2.0:actions:">
<!ENTITY environment "urn:oasis:names:tc:xacml:1.0:environment:">
<!ENTITY category "urn:oasis:names:tc:xacml:3.0:attribute-category:">
```

For example, "&xml;string" is equivalent to "http://www.w3.org/2001/XMLSchema#string".

1.4 Terminology

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

1.5 Normative References


1.6 Non-Normative References


[RBAC-V2] Core and hierarchical role based access control (RBAC) profile of XACML v2.0. 1 February 2005. OASIS Standard. [http://docs.oasis-open.org/xacml/2.0/access_control-xacml-2.0-rbac-profile1-spec-os.pdf](http://docs.oasis-open.org/xacml/2.0/access_control-xacml-2.0-rbac-profile1-spec-os.pdf)

1.7 Scope

Role based access control allows policies to be specified in terms of subject roles rather than strictly in terms of individual subject identities. This is important for scalability and manageability of access control systems.
The policies specified in this profile can answer two types of questions:

1. If a subject has roles R1, R2, ... Rn enabled, can subject X access a given resource using a given action?
2. If a subject has roles R1, R2, ... Rn enabled, does that mean the subject will have permissions associated with a given role R'? That is, is role R' either equal to or junior to any of roles R1, R2, ... Rn?

The policies specified in this profile do not answer the question "What set of roles does subject X have?"

That question must be handled by a Role Enablement Authority, and not directly by an XACML PDP.

Such an entity may make use of XACML policies, but will need additional information. See Section 3: Assigning and Enabling Role Attributes for more information about Role Enablement Authorities.

The policies specified in this profile assume all the roles for a given subject have already been enabled at the time an authorization decision is requested. They do not deal with an environment in which roles must be enabled dynamically based on the resource or actions a subject is attempting to perform. For this reason, the policies specified in this profile also do not deal with static or dynamic "Separation of Duty" (see [ANSI-RBAC]). A future profile may address the requirements of this type of environment.

1.8 Role

In this profile, roles are expressed as XACML Subject Attributes. There is one exception: in a HasPrivilegesOfRole <Policy>, the role appears as a Resource Attribute. See Section 2.5: HasPrivilegesOfRole Policies and Requests for more information.

Role attributes may be expressed in either of two ways, depending on the requirements of the application environment. In some environments there may be a small number of "role" attributes, where the name of each such attribute is some name indicating "role", and where the value of each such attribute indicates the name of the role held. For example, in this first type of environment, there may be one "role" attribute having the AttributeId "&role;" (this profile recommends use of this identifier). The possible roles are values for this one attribute, and might be "&roles;officer", "&roles;manager", and "&roles;employee". This way of expressing roles works best with the XACML way of expressing policies. This method of identifying roles is also most conducive to interoperability.

Alternatively, in other application environments, there may be a number of different attribute identifiers, each indicating a different role. For example, in this second type of environment, there might be three attribute identifiers: "urn:someapp:attributes:officer-role", "urn:someapp:attributes:manager-role", and "urn:someapp:attributes:employee-role". In this case the value of the attribute may be empty or it may contain various parameters associated with the role. XACML policies can handle roles expressed in this way, but not as naturally as in the first way.

XACML supports multiple subjects per access request, indicating various entities that may be involved in making the request. For example, there is usually a human user who initiates the request, at least indirectly. There are usually one or more applications or code bases that generate the actual low-level access request on behalf of the user. There is some computing device on which the application or code base is executing, and this device may have an identity such an IP address. XACML identifies each such Subject with a Category xml attribute in the <Attributes> element that indicates the type of subject being described. For example, the human user has a Category of &subject-category;access-subject; the application that generates the access request has a Category of &subject-category;codebase and so on. In this profile, a role attribute may be associated with any of the categories of subjects involved in making an access request.

1.9 Policies

In this profile, three types of policies are specified.

1. Role <PolicySet> or RPS: a <PolicySet> that associates holders of a given role attribute and value with a Permission <PolicySet> that contains the actual permissions associated with the given role. The <Target> element of a Role <PolicySet> limits the applicability of the <PolicySet> to subjects holding the associated role attribute and value. Each Role
<PolicySet> references a single corresponding Permission <PolicySet> but does not contain or reference any other <Policy> or <PolicySet> elements.

2. Permission <PolicySet> or PPS: a <PolicySet> that contains the actual permissions associated with a given role. It contains <PolicySet> and <Policy> elements and <Rules> that describe the resources and actions that subjects are permitted to access, along with any further conditions on that access, such as time of day. A given Permission <PolicySet> may also contain references to Permission <PolicySet>s associated with other roles that are junior to the given role, thereby allowing the given Permission <PolicySet> to inherit all permissions associated with the role of the referenced Permission <PolicySet>. The <Target> element of a Permission <PolicySet>, if present, must not limit the subjects to which the <PolicySet> is applicable.

3. HasPrivilegesOfRole <Policy>: a <Policy> in a Permission <PolicySet> that supports requests asking whether a subject has the privileges associated with a given role. If this type of request is to be supported, then a HasPrivilegesOfRole <Policy> must be included in each Permission <PolicySet>. Support for this type of <Policy>, and thus for requests asking whether a subject has the privileges associated with a given role, is optional.

Permission <PolicySet> instances must be stored in the policy repository in such a way that they can never be used as the initial policy for an XACML PDP; Permission <PolicySet> instances must be reachable only through the corresponding Role <PolicySet>. This is because, in order to support hierarchical roles, a Permission <PolicySet> must be applicable to every subject. The Permission <PolicySet> depends on its corresponding Role <PolicySet> to ensure that only subjects holding the corresponding role attribute will gain access to the permissions in the given Permission <PolicySet>.

Use of separate Role <PolicySet> and Permission <PolicySet> instances allows support for Hierarchical RBAC, where a more senior role can acquire the permissions of a more junior role. A Permission <PolicySet> that does not reference other Permission <PolicySet> elements could actually be an XACML <Policy> rather than a <PolicySet>. Requiring it to be a <PolicySet>, however, allows its associated role to become part of a role hierarchy at a later time without requiring any change to other policies.

1.10 Multi-Role Permissions

In this profile, it is possible to express policies where a user must hold several roles simultaneously in order to gain access to certain permissions. For example, changing the care instructions for a hospital patient may require that the Subject performing the action have both the physician role and the staff role. These policies may be expressed using a Role <PolicySet> where the <Target> element requires the <Attributes> element with the subject attribute category to have all necessary role attributes. This is done by using a single <AllOf> element containing multiple <Match> elements. The associated Permission <PolicySet> should specify the permissions associated with Subjects who simultaneously have all the specified roles enabled.

The Permission <PolicySet> associated with a multi-role policy may reference the Permission <PolicySet> instances associated with other roles, and thus may inherit permissions from other roles. The permissions associated with a given multi-role <PolicySet> may also be inherited by another role if the other role includes a reference to the Permission <PolicySet> associated with the multi-role policy in its own Permission <PolicySet>.
2 Example

(non-normative)

This section presents a complete example of the types of policies associated with role based access control.

Assume an organization uses two roles, manager and employee. In this example, they are expressed as two separate values for a single XACML Attribute with AttributeId "&role;". The &role; Attribute values corresponding to the two roles are "&roles;employee" and "&roles;manager". An employee has permission to create a purchase order. A manager has permission to sign a purchase order, plus any permissions associated with the employee role. The manager role therefore is senior to the employee role, and the employee role is junior to the manager role.

According to this profile, there will be two Permission <PolicySet> instances: one for the manager role and one for the employee role. The manager Permission <PolicySet> will give any Subject the specific permission to sign a purchase order and will reference the employee Permission <PolicySet> in order to inherit its permissions. The employee Permission <PolicySet> will give any Subject the permission to create a purchase order.

According to this profile, there will also be two Role <PolicySet> instances: one for the manager role and one for the employee role. The manager Role <PolicySet> will contain a <Target> requiring that the Subject hold a &role; Attribute with a value of "&roles;manager". It will reference the manager Permission <PolicySet>. The employee Role <PolicySet> will contain a <Target> requiring that the Subject hold a &role; Attribute with a value of "&roles;employee". It will reference the employee Permission <PolicySet>.

The actual XACML policies implementing this example follow.

2.1 Permission <PolicySet> for the manager role

The following Permission <PolicySet> contains the permissions associated with the manager role. The PDP's policy retrieval must be set up such that access to this <PolicySet> is gained only by reference from the manager Role <PolicySet>.

```xml
<PolicySet xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17 xacml-core-v3-schema-wd-17.xsd"
   PolicySetId="PPS:manager:role"
   Version="1.0"
   PolicyCombinigAlgId="&policy-combine;permit-overrides">
   <Target/>

   <!-- Permissions specifically for the manager role -->
   <Policy PolicyId="Permissions:specifically:for:the:manager:role"
       Version="1.0"
       RuleCombiningAlgId="&rule-combine;permit-overrides">
     <Target/>

     <!-- Permission to sign a purchase order -->
     <Rule RuleId="Permission:to:sign:a:purchase:order" Effect="Permit">
       <Target/>
       <AnyOf>
         <Match MatchId="&function;string-equal">
           <AttributeValue
              DataType="&xml;string">purchase order</AttributeValue>
           <AttributeDesignator
              MustBePresent="false">
```
Listing 1 Permission <PolicySet> for managers

2.2 Permission <PolicySet> for employee role

The following Permission <PolicySet> contains the permissions associated with the employee role. The PDP's policy retrieval must be set up such that access to this <PolicySet> is gained only by reference from the employee Role <PolicySet> or by reference from the more senior manager Role <PolicySet> via the manager Permission <PolicySet>.

```xml
<PolicySet xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17.xsd"
PolicySetId="PPS:employee:role"
Version="1.0"
PolicyCombiningAlgId="&policy-combine;permit-overrides">
  <Target/>
  <!-- Permissions specifically for the employee role -->
  <Policy PolicyId="Permissions:specifically:for:the:employee:role"
    Version="1.0"
    RuleCombiningAlgId="&rule-combine;permit-overrides">
    <Target/>
    <!-- Permission to create a purchase order -->
    <Rule RuleId="Permission:to:create:a:purchase:order" Effect="Permit">
      <Target>
        <AnyOf>
          <Match MatchId="&function;string-equal">
            <AttributeValue
              DataType="&xml;string">purchase order</AttributeValue>
            <AttributeDesignator
              MustBePresent="false"
              Category="&category;resource"
              AttributeId="&resource;resource-id"/>
          </Match>
        </AnyOf>
      </Target>
    </Rule>
  </Policy>
</PolicySet>
```

Listing 2 Permission <PolicySet> for employees

2.3 Role <PolicySet> for the manager role

The following Role <PolicySet> is applicable, according to its <Target>, only to Subjects who hold a 
&amp;role; Attribute with a value of &quot;&amp;roles;manager&quot;. The &lt;PolicySetIdReference&gt; points to the 
Permission &lt;PolicySet&gt; associated with the manager role. That Permission &lt;PolicySet&gt; may be 
viewed in Section 2.1: Permission &lt;PolicySet&gt; for the manager role above.

Listing 3 Role <PolicySet> for managers
2.4 Role <PolicySet> for employee role

The following Role <PolicySet> is applicable, according to its <Target>, only to Subjects who hold a &role; Attribute with a value of "&roles;employee". The <PolicySetIdReference> points to the Permission <PolicySet> associated with the employee role. That Permission <PolicySet> may be viewed in Section 2.2: Permission <PolicySet> for employee role above.

```xml
<PolicySet xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17 xacml-core-v3-schema-wd-17.xsd"
    PolicySetId="RPS:employee:role"
    Version="1.0"
    PolicyCombiningAlgId="&policy-combine;permit-overrides">
    <Target>
        <AnyOf>
            <AllOf>
                <Match MatchId="&function;anyURI-equal">
                    <AttributeValue
                        DataType="&xml;anyURI">&roles;employee</AttributeValue>
                    <AttributeDesignator
                        MustBePresent="false"
                        Category="&subject-category;access-subject"
                        AttributeId="&role;"
                        DataType="&xml;anyURI"/>
                </Match>
            </AllOf>
        </AnyOf>
    </Target>
</PolicySet>
```

Listing 4 Role <PolicySet> for employees

2.5 HasPrivilegesOfRole Policies and Requests

An XACML RBAC system MAY choose to support queries of the form "Does this subject have the privileges of role X?" If so, each Permission <PolicySet> MUST contain a HasPrivilegesOfRole <Policy>.

For the Permission <PolicySet> for managers, the HasPrivilegesOfRole <Policy> would look as follows:

```xml
<-- HasPrivilegesOfRole Policy for manager role -->
<Policy xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17 xacml-core-v3-schema-wd-17.xsd"
    PolicyId="Permission:to:have:manager:role:permissions"
    Version="1.0"
    RuleCombiningAlgId="&rule-combine;permit-overrides">
    <Target/>
    <Rule RuleId="Permission:to:have:manager:permissions" Effect="Permit">
        <Condition>
            <Apply FunctionId="&function;and">
                <Apply FunctionId="&function;anyURI-is-in">
                </Apply>
            </Apply>
        </Condition>
    </Rule>
</Policy>
```

```xml
<PolicySet xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17 xacml-core-v3-schema-wd-17.xsd"
    PolicySetId="PPS:employee:role"
    Version="1.0"
    PolicyCombiningAlgId="&policy-combine;permit-overrides">
    <Target/>
</PolicySet>
```

Listing 4 Role <PolicySet> for employees

2.5 HasPrivilegesOfRole Policies and Requests

An XACML RBAC system MAY choose to support queries of the form "Does this subject have the privileges of role X?" If so, each Permission <PolicySet> MUST contain a HasPrivilegesOfRole <Policy>.

For the Permission <PolicySet> for managers, the HasPrivilegesOfRole <Policy> would look as follows:

```xml
<-- HasPrivilegesOfRole Policy for manager role -->
<Policy xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17 xacml-core-v3-schema-wd-17.xsd"
    PolicyId="Permission:to:have:manager:role:permissions"
    Version="1.0"
    RuleCombiningAlgId="&rule-combine;permit-overrides">
    <Target/>
    <Rule RuleId="Permission:to:have:manager:permissions" Effect="Permit">
        <Condition>
            <Apply FunctionId="&function;and">
                <Apply FunctionId="&function;anyURI-is-in">
                </Apply>
            </Apply>
        </Condition>
    </Rule>
</Policy>
```
<AttributeValue
    DataType="&xml;anyURI">&roles;manager</AttributeValue>
</AttributeDesignator
    MustBePresent="false"
    Category="&category;resource"
    AttributeId="&role;"
    DataType="&xml;anyURI"/>
</Apply>

<Apply FunctionId="&function;anyURI-is-in">
    <AttributeValue
        DataType="&xml;anyURI">&actions;hasPrivilegesofRole</AttributeValue>
    <AttributeDesignator
        MustBePresent="false"
        Category="&category;action"
        AttributeId="&action;action-id"
        DataType="&xml;anyURI"/>
</Apply>

</Apply>
</Condition>
</Rule>
</Policy>

Listing 5 HasPrivilegesOfRole <Policy> for manager role

For the Permission <PolicySet> for employees, the HasPrivilegesOfRole <Policy> would look as follows:

<!-- HasPrivilegesOfRole Policy for employee role -->

<Policy xmlns="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="urn:oasis:names:tc:xacml:3.0:core:schema:wd-17 xacml-core-v3-schema-wd-17.xsd"
    PolicyId="Permission:to:have:employee:role:permissions"
    Version="1.0"
    RuleCombiningAlgId="&rule-combine;permit-overrides">
    <Target/>
</Policy>

<!-- Permission to have employee role permissions -->

<Rule RuleId="Permission:to:have:employee:permissions" Effect="Permit">
    <Condition>
        <Apply FunctionId="&function;and">
            <Apply FunctionId="&function;anyURI-is-in">
                <AttributeValue
                    DataType="&xml;anyURI">&roles;employee</AttributeValue>
                <AttributeDesignator
                    MustBePresent="false"
                    Category="&category;resource"
                    AttributeId="&role;"
                    DataType="&xml;anyURI"/>
            </Apply>
            <Apply FunctionId="&function;anyURI-is-in">
                <AttributeValue
                    DataType="&xml;anyURI">&actions;hasPrivilegesofRole</AttributeValue>
                <AttributeDesignator
                    MustBePresent="false"
                    Category="&category;action"
                    AttributeId="&action;action-id"
                    DataType="&xml;anyURI"/>
            </Apply>
        </Apply>
    </Condition>
</Rule>
</Policy>
Listing 6 HasPrivilegesOfRole <Policy> for employee role

A Request asking whether subject Anne has the privileges associated with &roles;manager would look as follows.

Listing 7 Example of HasPrivilegesOfRole Request

Either the <Request> must contain Anne's direct roles (in this case, &roles;employee), or else the PDP's Context Handler must be able to discover them. HasPrivilegesOfRole policies do not do the job of associating roles with subjects. See Section 3: Assigning and Enabling Role Attributes for more information on how roles are associated with subjects.
3 Assigning and Enabling Role Attributes

{non-normative}

The assignment of various *role* attributes to users and the enabling of those attributes within a session are outside the scope of the XACML PDP. There must be one or more separate entities, referred to a *Role Enablement Authorities*, implemented to perform these functions. This profile assumes that the presence in the XACML Request Context of a *role* attribute for a given user (Subject) is a valid assignment at the time the access decision is requested.

So where do a subject’s *role* attributes come from? What does one of these *Role Enablement Authorities* look like? The answer is implementation dependent and this profile prescribes no specific form for them.

In some cases, *role* attributes might come from an identity management service that maintains information about a user, including the subject’s assigned or allowed *roles*; the identity management service acts as the *Role Enablement Authority*. This service might store static *role* attributes in an LDAP directory, and a PDP’s Context Handler might retrieve them from there. Or this service might respond to requests for a subject’s *role* attributes from a PDP’s Context Handler, where the requests are in the form of SAML Attribute Queries.

*Role Enablement Authorities* could use XACML policies to determine whether a subject is allowed to have a particular *role* attribute and value enabled. However, there are multiple possible ways to do so depending on the specific requirements, so the XACML TC has decided to not standardize any specific form for such policies in this profile.
4 Implementing the RBAC Model

(non-normative)

The following sections describe how to use XACML policies to implement various components of the RBAC model as described in [ANSI-RBAC].

4.1 Core RBAC

(non-normative)

Core RBAC, as defined in [ANSI-RBAC], includes the following five basic data elements:

1. Users
2. Roles
3. Objects
4. Operations
5. Permissions

Users are implemented using XACML Subjects. Any of the XACML attribute Category values which are semantically associated with subjects may be used, as appropriate.

Roles are expressed using one or more XACML Subject Attributes. The set of roles is very application- and policy domain-specific, and it is very important that different uses of roles not be confused. For these reasons, this profile does not attempt to define any standard set of role values, although this profile does recommend use of a common AttributeId value of "urn:oasis:names:tc:xacml:2.0:subject:role".

It is recommended that each application or policy domain agree on and publish a unique set of AttributeId values, DataType values, and <AttributeValue> values that will be used for the various roles relevant to that domain.

Objects are expressed using XACML Resources.

Operations are expressed using XACML Actions.

Permissions are expressed using XACML Role <PolicySet> and Permission <PolicySet> instances as described in previous sections.

Core RBAC requires support for multiple users per role, multiple roles per user, multiple permissions per role, and multiple roles per permission. Each of these requirements can be satisfied by XACML policies based on this profile as follows. Note, however, that the actual assignment of roles to users is outside the scope of the XACML PDP. For more information see Section 3: Assigning and Enabling Role Attributes.

XACML allows multiple Subjects to be associated with a given role attribute. XACML Role <PolicySet>s defined in terms of possession of a particular role <Attribute> and <AttributeValue> will apply to any requesting user for which that role <Attribute> and <AttributeValue> are in the XACML Request Context.

XACML allows multiple role attributes or role attribute values to be associated with a given Subject. If a Subject has multiple roles enabled, then any Role <PolicySet> instance applying to any of those roles may be evaluated, and the permissions in the corresponding Permission <PolicySet> will be permitted. As described in Section 1.10: Multi-Role Permissions, it is even possible to define policies that require a given Subject to have multiple role attributes or values enabled at the same time. In this case, the permissions associated with the multiple-role requirement will apply only to a Subject having all the necessary role attributes and values at the time an XACML Request Context is presented to the PDP for evaluation.

The Permission <PolicySet> associated with a given role may allow access to multiple resources using multiple actions. XACML has a rich set of constructs for composing permissions, so there are multiple ways in which multi-permission roles may be expressed. Any Role A may be associated with a
Permission <PolicySet> B by including a <PolicySetIdReference> to Permission <PolicySet> B in the Permission <PolicySet> associated with the Role A. In this way, the same set of permissions may be associated with more than one role.

In addition to the basic Core RBAC requirements, XACML policies using this profile can also express arbitrary conditions on the application of particular permissions associated with a role. Such conditions might include limiting the permissions to a given time period during the day, or limiting the permissions to role holders who also possess some other attribute, whether it is a role attribute or not.

4.2 Hierarchical RBAC

Hierarchical RBAC, as defined in [ANSI-RBAC], expands Core RBAC with the ability to define inheritance relations between roles. For example, Role A may be defined to inherit all permissions associated with Role B. In this case, Role A is considered to be senior to Role B in the role hierarchy. If Role B in turn inherits permissions associated with Role C, then Role A will also inherit those permissions by virtue of being senior to Role B.

XACML policies using this profile can implement role inheritance by including a <PolicySetIdReference> to the Permission <PolicySet> associated with one role inside the Permission <PolicySet> associated with another role. The role that includes the <PolicySetIdReference> will then inherit the permissions associated with the referenced role.

This profile structures policies in such a way that inheritance properties may be added to a role at any time without requiring changes to <PolicySet> instances associated with any other roles. An organization may not initially use role hierarchies, but may later decide to make use of this functionality without having to rewrite existing policies.
5 Profile

5.1 Roles and Role Attributes

Roles SHALL be expressed using one or more XACML Attributes. Each application domain using this profile for role based access control SHALL define or agree upon one or more AttributeId values to be used for role attributes. Each such AttributeId value SHALL be associated with a set of permitted values and their DataTypes. Each permitted value for such an AttributeId SHALL have well-defined semantics for the use of the corresponding value in policies.

This profile RECOMMENDS use of the "urn:oasis:names:tc:xacml:2.0:subject:role" AttributeId value for all role attributes. Instances of this Attribute SHOULD have a DataType of "http://www.w3.org/2001/XMLSchema#anyURI".

5.2 Role Assignment or Enablement

A Role Enablement Authority is responsible for assigning roles to users and for enabling roles for use within a user's session. This profile prescribes no specific form for a Role Enablement Authority.

5.3 Access Control

Role based access control SHALL be implemented using two types of <PolicySet>s: Role <PolicySet>, Permission <PolicySet>. The specific functions and requirements of these two types of <PolicySet>s are as follows.

For each role, one Role <PolicySet> SHALL be defined. Such a <PolicySet> SHALL contain a <Target> element that makes the <PolicySet> applicable only to Subjects having the XACML Attribute associated with the given role; the <Target> element SHALL NOT restrict the Resource, Action, or Environment. Each Role <PolicySet> SHALL contain a single <PolicySetIdReference> element that references the unique Permission <PolicySet> associated with the role. The Role <PolicySet> SHALL NOT contain any other <Policy>, <PolicySet>, <PolicyIdReference>, or <PolicySetIdReference> elements.

For each role, one Permission <PolicySet> SHALL be defined. Such a <PolicySet> SHALL contain <Policy>, <PolicySet> and <Rule> elements that specify the types of access permitted to Subjects having the given role. The <Target> of the <PolicySet> and its included or referenced <PolicySet>, <Policy>, and <Rule> elements SHALL NOT limit the Subjects to which the Permission <PolicySet> is applicable.

If a given role inherits permissions from one or more junior roles, then the Permission <PolicySet> for the given (senior) role SHALL include a <PolicySetIdReference> element for each junior role. Each such <PolicySetIdReference> shall reference the Permission <PolicySet> associated with the junior role from which the senior role inherits.

A Permission <PolicySet> MAY include a HasPrivilegesOfRole <Policy>. Such a <Policy> SHALL have a <Rule> element with an effect of "Permit". This Rule SHALL permit any Subject to perform an Action with an Attribute having an AttributeId of &action;action-id, a DataType of &xml;anyURI, and an &AttributeValue having a value of &actions;hasPrivilegesOfRole on a Resource having an Attribute that is the role to which the Permission <PolicySet> applies (for example, an AttributeId of &role; role, a DataType of &xml;anyURI, and an &AttributeValue whose value is the URI of the specific role value). Note that the role Attribute, which is a Subject Attribute in a Role <PolicySet> <Target>, is treated as a Resource Attribute in a HasPrivilegesOfRole <Policy>.

The organization of any repository used for policies and the configuration of the PDP SHALL ensure that the PDP can never use a Permission <PolicySet> as the PDP's initial policy.
6 Identifiers

6.1 Profile Identifier

The following identifier SHALL be used as the identifier for this profile when an identifier in the form of a URI is required.

urn:oasis:names:tc:xacml:3.0:profiles:rbac:core-hierarchical

6.2 Role Attribute

The following identifier MAY be used as the AttributeId for role Attributes.

urn:oasis:names:tc:xacml:2.0:subject:role

6.3 Action Attribute Values

The following identifier MAY be used as the <AttributeValue> of the &action;action-id Attribute in a HasPrivilegesOfRole <Policy>.

urn:oasis:names:tc:xacml:2.0:actions:hasPrivilegesOfRole
7 Conformance

An implementation may conform to this profile in one or more of the following ways.

7.1 As a policy processor

An implementation conforms to this specification as a policy processor if it makes use of XACML policies in the manner described in sections 5 and 6.

7.2 As an XACML request generator

An implementation conforms to this specification as an XACML request generator if it produces XACML requests in the manner described in sections 5 and 6.
Appendix A. Acknowledgments

The following individuals have participated in the creation of this specification and are gratefully acknowledged:

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## Appendix B. Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Editor</th>
<th>Changes Made</th>
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<tr>
<td>WD 1</td>
<td>[Rev Date]</td>
<td>Erik Rissanen</td>
<td>Initial update to XACML 3.0.</td>
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<tr>
<td>WD 2</td>
<td>28 Dec 2007</td>
<td>Erik Rissanen</td>
<td>Update to the current OASIS template.</td>
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<tr>
<td>WD 3</td>
<td>4 Nov 2008</td>
<td>Erik Rissanen</td>
<td>Fixed typos in the examples.</td>
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<tr>
<td>WD 4</td>
<td>5 Apr 2009</td>
<td>Erik Rissanen</td>
<td>Editorial cleanups.</td>
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<td>Added conformance section.</td>
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<tr>
<td>WD 5</td>
<td>14 Dec 2009</td>
<td>Erik Rissanen</td>
<td>Also allow &lt;PolicySet&gt; in permission policyset.</td>
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<tr>
<td>WD 06</td>
<td>17 Dec 2009</td>
<td>Erik Rissanen</td>
<td>Fixed formatting issues.</td>
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<td>Updated acknowledgments.</td>
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<td>WD 07</td>
<td>12 Jan 2010</td>
<td>Erik Rissanen</td>
<td>Updated cross references.</td>
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<td>Corrected examples so they are valid against the XACML schema.</td>
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<tr>
<td>WD 08</td>
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<td>Updated cross references.</td>
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<td>Fixed OASIS formatting issues.</td>
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<td>Removed reference to XACML 2.0 intro.</td>
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<tr>
<td>WD 09</td>
<td>24 May 2011</td>
<td>Erik Rissanen</td>
<td>Also allow &lt;PolicySet&gt; in permission policyset in the non-normative text in section 1.8.</td>
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<tr>
<td>WD 10</td>
<td>23 Jan 2014</td>
<td>Erik Rissanen</td>
<td>Migrated to current OASIS document template.</td>
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<tr>
<td>WD 11</td>
<td>15 May 2014</td>
<td>Erik Rissanen</td>
<td>Removed examples of XACML based role enablement authorities.</td>
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