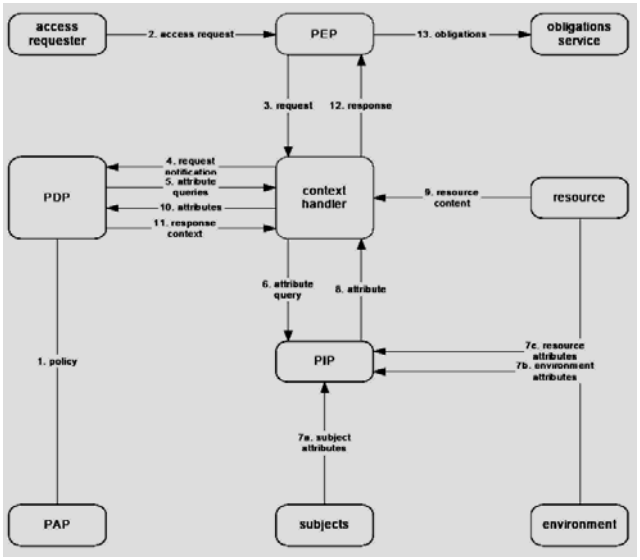
Authorization

- Determining whether to permit or deny a requested action
- Critical questions:
  - What is the model of the authorization system?
  - What languages are used to represent the policy by which decisions are made?

Dataflow Model

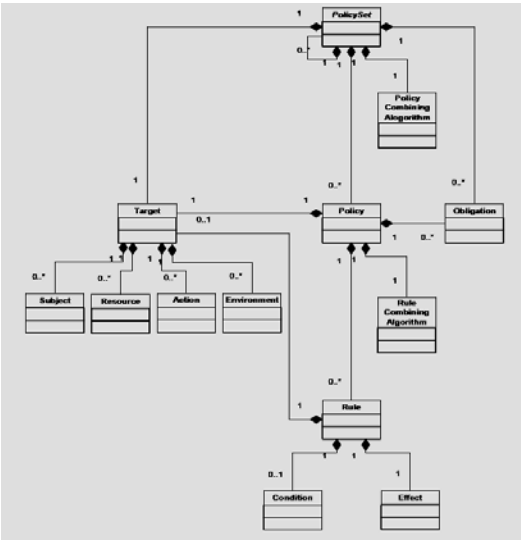


From: OASIS XACML Specification

Request and Response Context

- Request Context
  - Attributes of:
    - Subjects – requester, intermediary, recipient, etc.
    - Resource – name, can be hierarchical
    - Resource Content – specific to resource type, e.g. XML document
    - Action – e.g. Read
    - Environment – other, e.g. time of request
- Response Context
  - Resource ID
  - Decision
  - Status (error values)
  - Obligations

Language Model (UML)

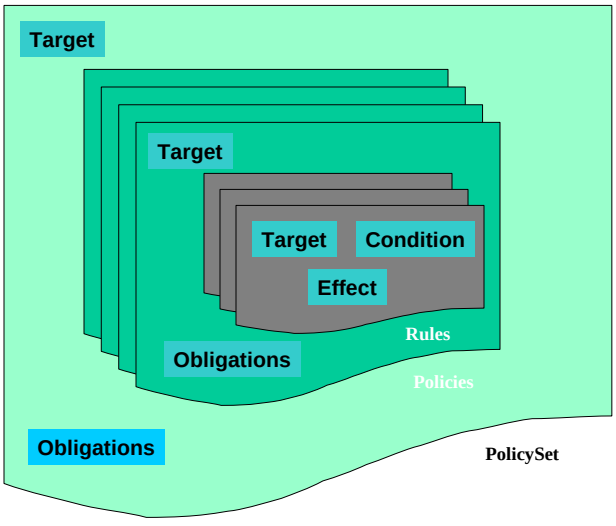


From: OASIS XACML Specification

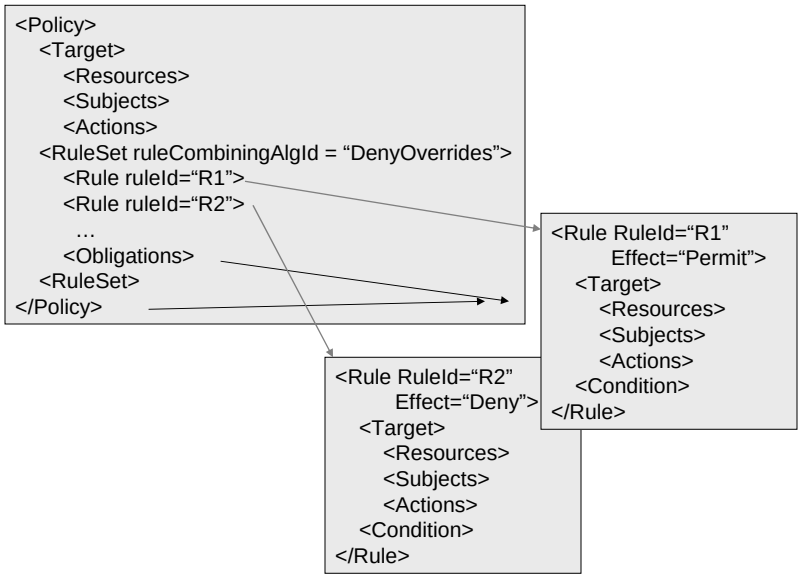
Policies and Policy Sets

- Policy
  - Smallest element PDP can evaluate
  - Contains: Description, Defaults, Target, Rules, Obligations, Rule Combining Algorithm
- Policy Set
  - Allows Policies and Policy Sets to be combined
  - Use not required
  - Contains: Description, Defaults, Target, Policies, Policy Sets, Policy References, Policy Set References, Obligations, Policy Combining Algorithm
- Combining Algorithms: Deny-overrides, Permit-overrides, First-applicable, Only-one-applicable

Language Model (Graphical)



Language Model (XML)



Example Request

```
<Request …>
   <Subject>
      <Attribute AttributeId="urn:oasis:names:tc:xacml:1.0:subject:subject-id"
        DataType="http://www.w3.org/2001/XMLSchema#string">
          <AttributeValue>
              John
          </AttributeValue>
      </Attribute> </Subject>

   <Resource>
      <Attribute AttributeId="urn:oasis:names:tc:xacml:1.0:resource:resource-id"
        DataType="http://www.w3.org/2001/XMLSchema#anyURI">
          <AttributeValue>
              Door
          </AttributeValue>
      </Attribute> </Resource>
   <Action>
      <Attribute AttributeId="urn:oasis:names:tc:xacml:1.0:action:action-id"
        DataType="http://www.w3.org/2001/XMLSchema#string">
          <AttributeValue>
              open
          </AttributeValue>
      </Attribute> </Action>
</Request>
```

Rules

- Smallest unit of administration, cannot be evaluated alone
- Elements
  - Description – documentation
  - Target – select applicable policies
  - Condition – boolean decision function
  - Effect – either “Permit” or “Deny”
- Results
  - If condition is true, return Effect value
  - If not, return NotApplicable
  - If error or missing data return Indeterminate
    - Plus status code

Targets

- Designed to efficiently find the elements (policies, rules) that apply to a request
- Makes it feasible to have very complex Conditions
- Attributes of Subjects, Resources and Actions
- Matches against value, using match function
  - Regular expression
  - RFC822 (email) name
  - X.500 name
  - User defined
- Attributes specified by Id or XPath expression

Example Rule

```
Rule RuleId="Door Control Rule" Effect="Permit">
  <Target>
    <Subjects> <Subject>
      <SubjectMatch MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
        <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">
          John
        </AttributeValue>
        <SubjectAttributeDesignator
          AttributeId="urn:oasis:names:tc:xacml:1.0:subject:subject-id"
          DataType="http://www.w3.org/2001/XMLSchema#string"/>
      </SubjectMatch> </Subject> </Subjects>
    Resources> <Resource>
      <ResourceMatch MatchId="urn:oasis:names:tc:xacml:1.0:function:anyURI-equal">
        <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#anyURI">
          Door
        </AttributeValue>
        <ResourceAttributeDesignator
          AttributeId="urn:oasis:names:tc:xacml:1.0:resource:resource-id"
          DataType="http://www.w3.org/2001/XMLSchema#anyURI"/>
      </ResourceMatch>

    <Actions> <Action>
      <AnyAction/>
    </Action> </Actions>
  </Target>
</Rule>
```


Example Response

```
<Response xmlns="urn:oasis:names:tc:xacml:1.0:context" …. >
  <Result>
    <Decision>
      Permit
    </Decision>
    <Status>
      <StatusCode Value="urn:oasis:names:tc:xacml:1.0:status:ok"/>
    </Status>
  </Result>
</Response>
```

Conditions

- Boolean function to decide if Effect applies
- Inputs come from Request Context
- Values can be primitive, complex or bags
- Can be specified by id or XPath expression
- Fourteen primitive types
- Rich array of typed functions defined
- Functions for dealing with bags
- Order of evaluation unspecified
- Allowed to quit when result is known
- Side effects not permitted

Example Condition

```
<Condition>
   <Apply FunctionId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
      <Apply FunctionId="urn:oasis:names:tc:xacml:1.0:function:string-one-and-only">
         <SubjectAttributeDesignator
            AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:physician-id"
            DataType="http://www.w3.org/2001/XMLSchema#string"/>
      </Apply>
      <Apply FunctionId="urn:oasis:names:tc:xacml:1.0:function:string-one-and-only">
         <AttributeSelector
            RequestContextPath= "//xacml-context:Resource/xacml
            context:ResourceContent/md:record/md:primaryCarePhysician
            /md:registrationID/text()"
            DataType="http://www.w3.org/2001/XMLSchema#string"/>
      </Apply>
   </Apply>
</Condition>
```

Rule applies if physician-id equals primaryCarePhysician

Obligations

- Additional constraints to an authorization decision
- If PEP cannot fulfill an obligation then it disallows access

Example Obligation

```
<Obligation
        ObligationId="urn:oasis:names:tc:xacml:example:obligation:email“ FulfillOn="Permit">
        <AttributeAssignment
            AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:mailto"
            DataType="http://www.w3.org/2001/XMLSchema#string">
            <AttributeSelector RequestContextPath=
                "//md:/record/md:patient/md:patientContact/md:email"
                DataType="http://www.w3.org/2001/XMLSchema#string"/>
        </AttributeAssignment>
        <AttributeAssignment
            AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:text"
            DataType="http://www.w3.org/2001/XMLSchema#string">
                Your medical record has been accessed by:
         </AttributeAssignment>
         <AttributeAssignment
               AttributeId="urn:oasis:names:tc:xacml:2.0:example:attribute:text"
               DataType="http://www.w3.org/2001/XMLSchema#string">
              <SubjectAttributeDesignator
               AttributeId="urn:oasis:names:tc:xacml:1.0:subject:subject-id"
               DataType="http://www.w3.org/2001/XMLSchema#string"/>
        </AttributeAssignment>
</Obligation>
```

Send email to patient’s email address when medical records accessed by subject-id