eXtensible Access Control Markup Language

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Brief description

- Dedicated language for specifying access control rules in XML
- OASIS industry standard
- Several goals: universal, definitive, easy to change, language easy to extend, policies should be composable

Explanation of goals

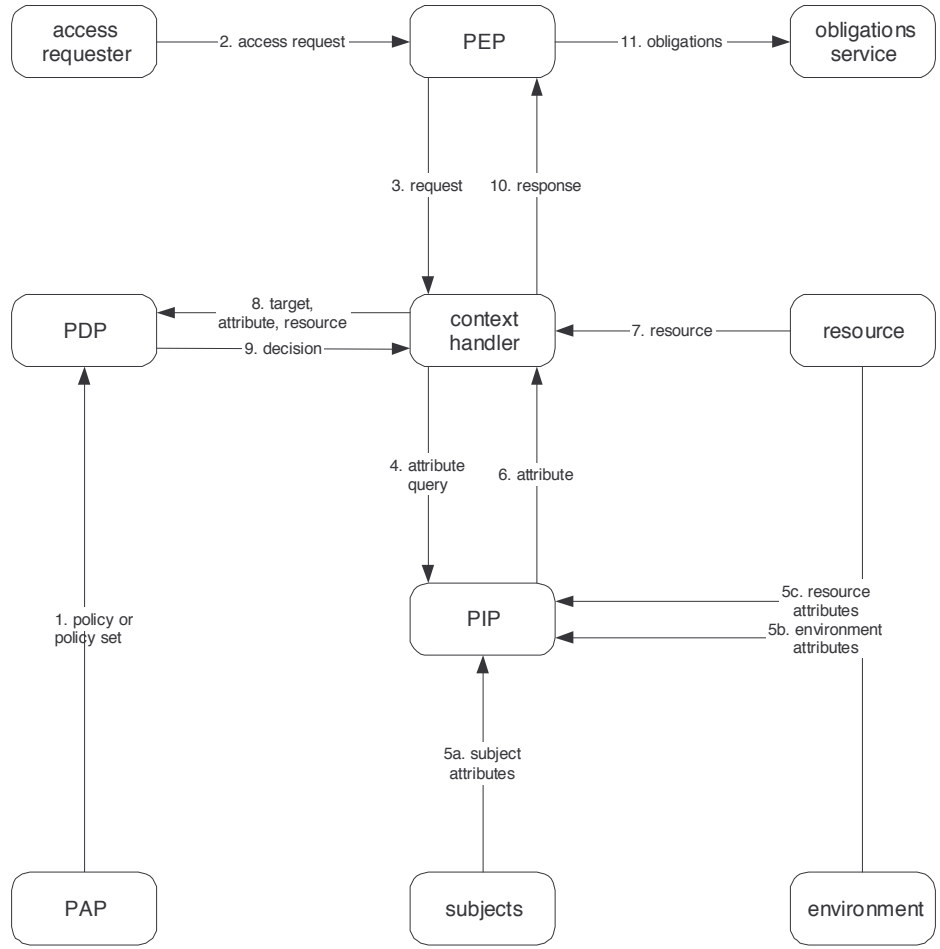
- Unified: the language should be able to express everything relevant for access control
- Definitive: all the rules for access control should be in an XACML policy, not in the server code
- Easy to change: changes to access rules should be relatively easy to make

Explanation, cont.

- Extensible: the language should be easy to extend with new primitives, data types, as needed for specific applications
- Composable policies: should be able to make one policy out of several preexisting smaller ones

XACML Structure

- Spec offers outrageously baroque dataflow model
- Core idea is a request is submitted, it is acted upon by a policy which results in a decision, which is returned to the requestor



Request, response structure

- XML documents with their own rules
- Request is in essence, a bag of attribute-typed value pairs
  - Some secondary structure in Subject, Resource, Action
- Response is in essence one of four values: Permit, Deny, Not Applicable, Indeterminate

Example request

```
<?xml version="1.0" encoding="UTF-8"?>
<Request xmlns="urn:oasis:names:tc:xacml:1.0:context"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Subject SubjectCategory="urn:oasis:names:tc:xacml:1.0:subject-category:access-subject">
    <Attribute AttributeId="urn:oasis:names:tc:xacml:1.0:subject:subject-id"
               DataType="urn:oasis:names:tc:xacml:1.0:data-type:x500name"
               Issuer="www.medico.com" IssueInstant="2001-12-17T09:30:47-05:00">
      <AttributeValue>CN=Julius Hibbert</AttributeValue>
    </Attribute>
    <Attribute AttributeId="urn:oasis:names:tc:xacml:1.0:attribute:role"
               DataType="http://www.w3.org/2001/XMLSchema#string"
               Issuer="www.medico.com" IssueInstant="2001-12-17T09:30:47-05:00">
      <AttributeValue>physician</AttributeValue>
    </Attribute>
    <Attribute AttributeId="urn:oasis:names:tc:xacml:1.0:attribute:physician-id"
               DataType="http://www.w3.org/2001/XMLSchema#string"
               Issuer="www.medico.com" IssueInstant="2001-12-17T09:30:47-05:00">
      <AttributeValue>jh1234</AttributeValue>
    </Attribute>
  </Subject>
  <Resource>
...
  </Resource>
</Request>
```

Example request, decoded

```
{ “Subject ID”: “CN=Julius Hibbert”,
  “Role”: “physician”,
  “Physician ID”: “jh1234” }
```

Example response

```
<?xml version="1.0" encoding="UTF-8"?>
<Response xmlns="urn:oasis:names:tc:xacml:1.0:context"
          xsi:schemaLocation="urn:oasis:names:tc:xacml:1.0:context
    http://www.oasis-open.org/tc/xacml/1.0/cs-xacml-schema-context-01.xsd">
  <Result>
    <Decision>NotApplicable</Decision>
  </Result>
</Response>
```

Policy structure

- Policies take information from requests and give answers
  - Also some "environmental" data external to requests
- Organized hierarchically into PolicySets, Policies and finally Rules, combined using combining algorithms

Writing a policy

- Every level of the tree can have boundary conditions, which are inherited
  - Simple queries on attributes, plus XPath
- Rules may additionally have arbitrary Boolean logic
- Rules have an associated Permit or Deny

Writing a policy, cont.

- Request is a bag of attribute-value pairs, so attribute value requests get bags of values back
- Some minimal string matching, regular expressions, XPath, arithmetic, date comparisons, "set" union/intersection/ subsets, higher order functions

Writing a policy, cont.

```
Lisp:
(> (attribute "urn:example:age" :only-one t) 18)
XACML:
<Condition FunctionId="urn:oasis:names:tc:xacml:1.0:function:integer-less-than">
  <Apply FunctionId="urn:oasis:names:tc:xacml:1.0:function:integer-one-and-only">
    <SubjectAttributeDesignator AttributeId="urn:example:age"
      DataType="http://www.w3.org/2001/XMLSchema#integer"/>
  </Apply>
  <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#integer">
    18
  </AttributeValue>
</Condition>
```

Combining rules

- Policies take several rules and combine the results
- Anything out of its boundary conditions is implicitly Not Applicable
- Combining is done through several algorithms
- Policy combination is essentially the same

Combining rules

- Four combining algorithms in spec
  - Deny overrides (any deny wins)
  - Permit overrides (any permit wins)
  - First applicable (First definitive answer wins)
  - Only one applicable (Indeterminate if more than one rule gives an answer)

A partial example

```
<PolicySet PolicyCombiningAlgId=”...:deny-overrides">
  <Target>
    ...
    <Resources>
      <Resource>
        <ResourceMatch MatchId=”...:string-equal”>
          <AttributeValue DataType=”http://www.w3.org/2001/XMLSchema#string”>
            http://www.medico.com/schemas/record.xsd
          </AttributeValue>
          <ResourceAttributeDesignator AttributeId=”...:target-namespace”
            DataType=”http://www.w3.org/2001/XMLSchema#string” />
        </ResourceMatch>
      </Resource>
    </Resources>
    ...
  </Target>
  <Policy RuleCombiningAlgId=”...:deny-overrides”>
    <Target>...</Target>
    <Rule>...</Rule>
    <Rule>...</Rule>
  </Policy>
  ...
</PolicySet>
```

Other things

- Obligations: things that have to be done in case the rule fires
  - E.g. email
- Policies can refer to other policies by reference
- Environmental attributes can have data not in the original request

Extending XACML

- Several avenues for extension
  - Extension is done by defining new URIs and referring to them
- Functions, data types, combining algorithms