Access Control for the Grid: XACML

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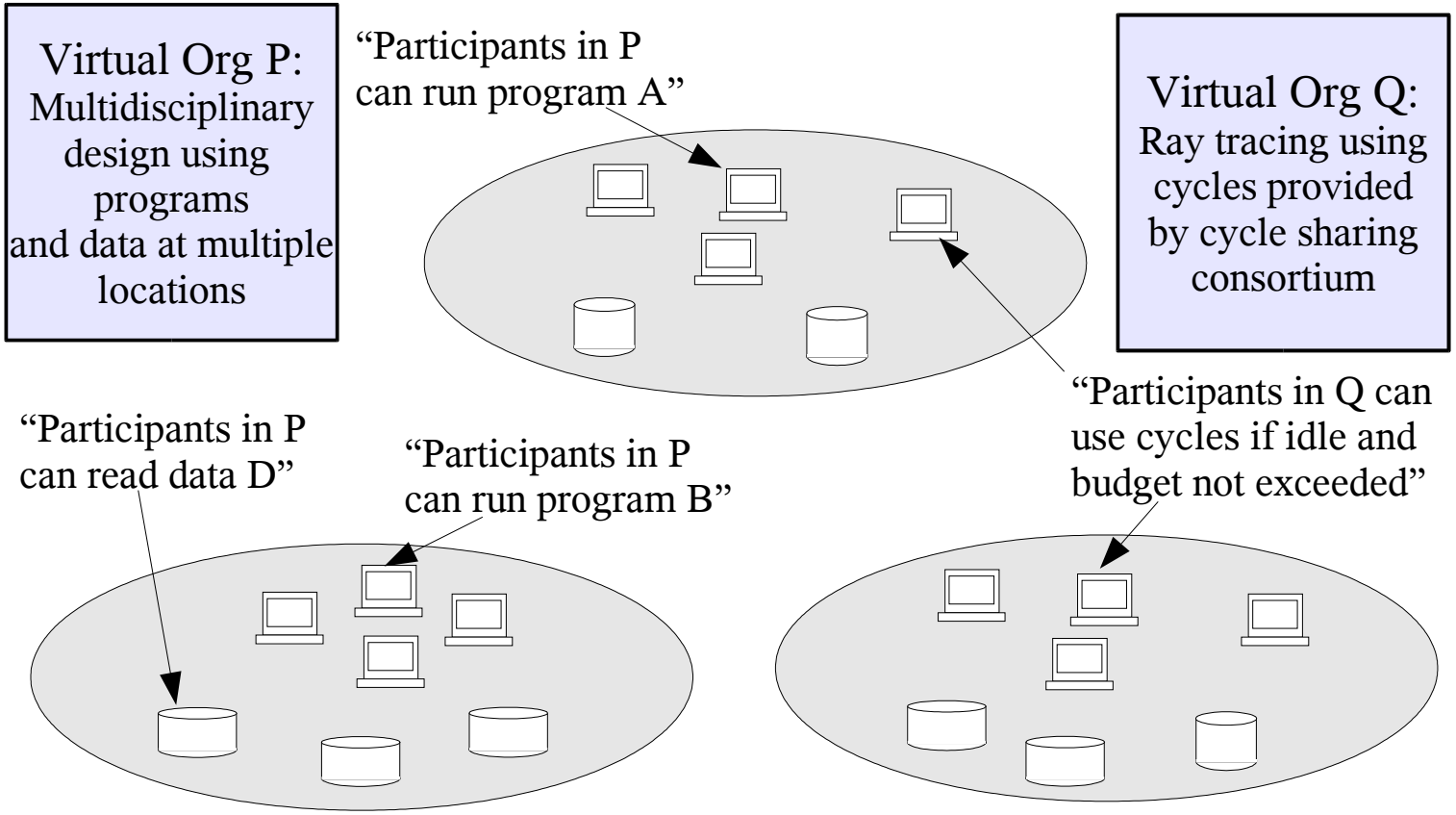
Outline

- Access control in the Grid
- XACML overview
- Use model
- Policy language
- Other features
- Future work
- More information

Access Control in the Grid



*Foster, et al., "The Anatomy of the Grid", IJSA, 2001

XACML Overview

- eXtensible Access Control Markup Language

  General-purpose access control policy and query languages.

- Version 1.0 OASIS Standard, February 2003
- Version 2.0 on standards track now
- Publicly available (C++, C#) and open source (Java) implementations

XACML Overview

- Designed to work in either a centralized or distributed, decentralized environment.
- Ties into legacy systems easily
  - No requirements on what supplies the attribute information
  - No requirements on actual query language
  - No requirements on transport, storage, etc.
- Extensible: new attribute types, new functions

Example

A policy in plain English:

"Only clients

- Who are employed by DOE, AND
- Who are part of the "FusionGrid" Virtual Organization, AND
- Who are authenticated with an X509 public key certificate

are allowed access to Grid resources."

Two-part example

1) Access decision request

2) Policy

Part 1: Access decision request

- A request to the PDP:

  Is this access permitted?

- Describes the access

Access Decision Request

<Request>
<**Subject**>
... Attributes of the subject doing the access ...
</Subject>
<**Resource**>
... Attributes of the resource being accessed ...
</Resource>
<**Action**>
... Attributes of the action to be done on the resource ...
</Action>
<**Environment**>
... Attributes of the access environment ...
</Environment>
</Request>

A Request Attribute

Attribute Identity: “employer”

Type: URI

Value: “urn:us:gov:DOE”

Part 2: Policy

1) Access decision request

2) Policy

what an acceptable access description looks like

Progressive example

1. Referring to an attribute in the request
2. Placing a constraint on an attribute
3. Combining constraints
4. Specifying a rule
5. Specifying a policy
6. Specifying a policy set

Referring to an attribute

```
<SubjectAttributeDesignator
        AttributeId="employer"
        DataType="anyURI" />
```

Alternative:

XPath expression

```
<AttributeSelector
        RequestContextPath="/employer/text()"
        DataType="anyURI" />
```

Constraining an attribute

```
<Apply FunctionId="anyURI-is-in">

    <AttributeValue
        DataType="anyURI">
                urn:us:gov:doe
    </AttributeValue>

    <SubjectAttributeDesignator
        AttributeId="employer"
        DataType="anyURI" />

</Apply>
```

Combining constraints

```
<Condition>

    <Apply FunctionId="and">

        <Apply    “must be a DOE employee”  />
        <Apply    “must be member of FusionGrid”  />
        <Apply    “must authenticate with X509 cert”  />

    </Apply>

</Condition>
```

Rule

```
<Rule
   RuleId="Rule1"
   Effect ="Permit">
```

Optional

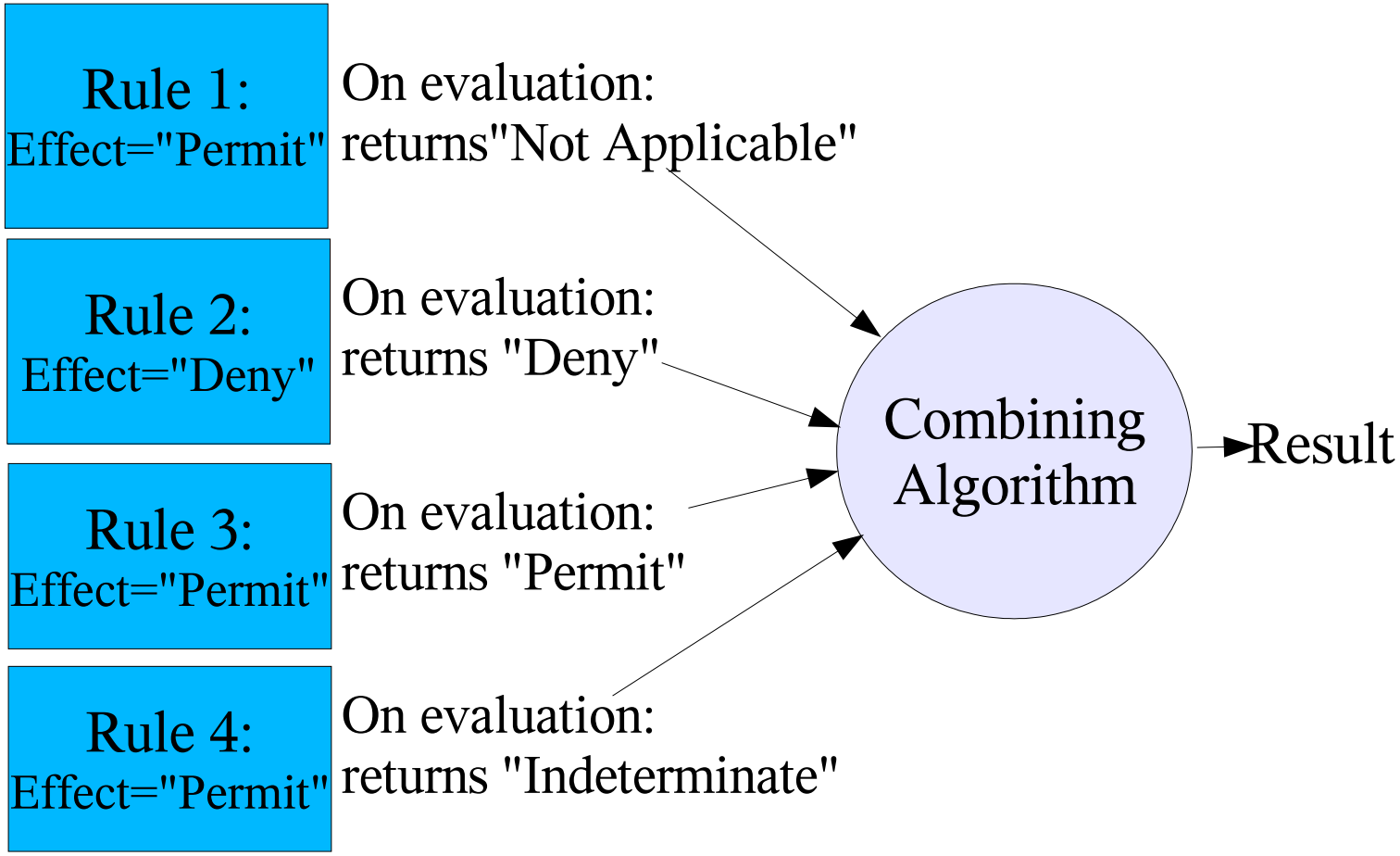
```
   <Target ... />

   <Condition .... />

</Rule>
```

If `<Target>` AND `<Condition>` are TRUE, returns Effect

If `<Target>` OR `<Condition>` is FALSE, returns “Not Applicable”

If error, returns “Indeterminate”

Combining Algorithm



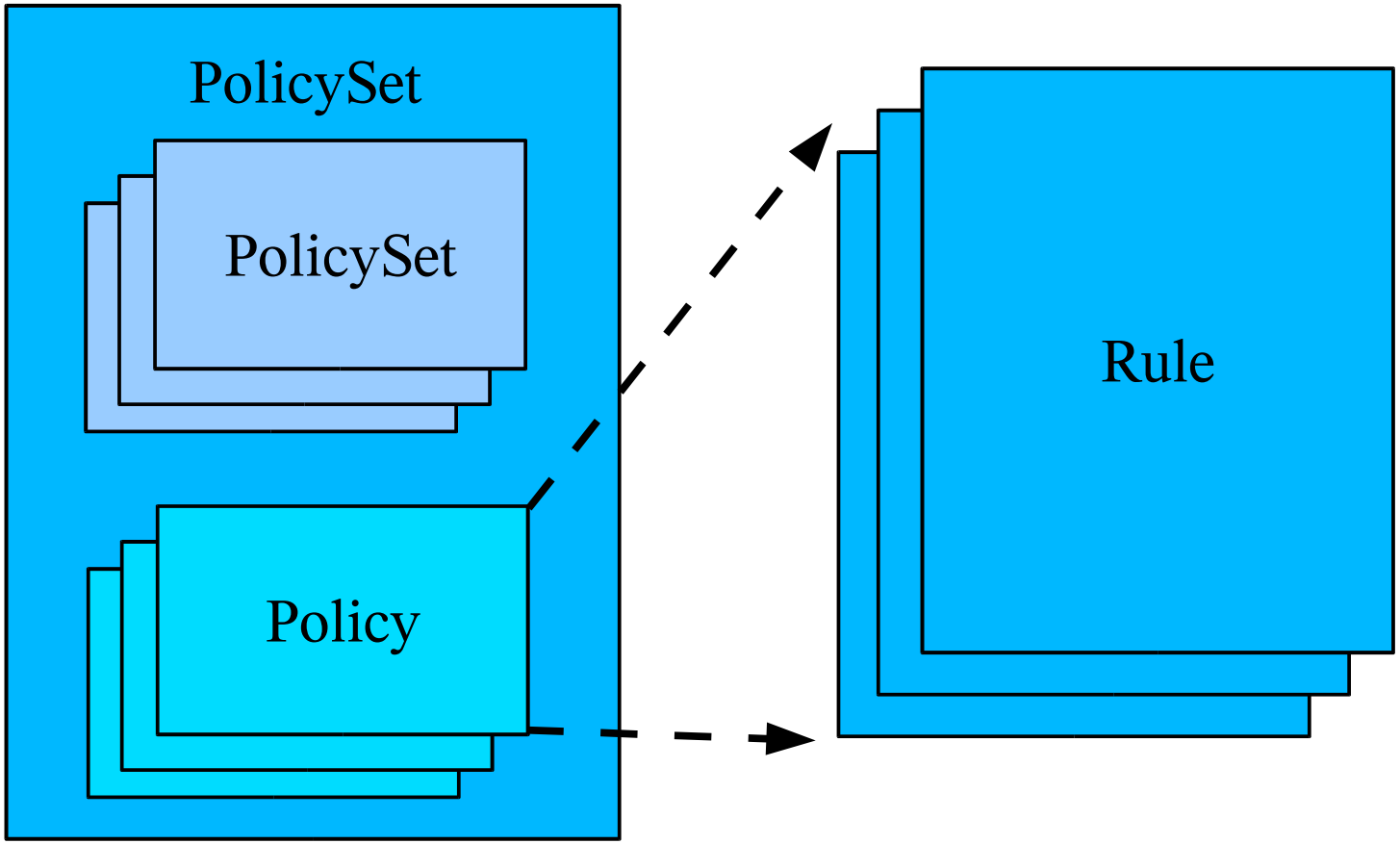
Policy: combination of <Rule>s

```
<Policy
    PolicyId="Policy1"
    RuleCombiningAlgId=
            "deny-overrides" >

  <Target  ....  />

  <Rule1  ...  />
  <Rule2  ...  />
  <Rule3  ...  />

  <Obligations>
    <Obligation ...  />
  </Obligations>
</Policy>
```

Deny-overrides: return "Permit" only if `<Target>` is TRUE AND every `<Rule>` returns "Permit".

Obligations: optional attributes returned to the PEP.

PolicySet: combination of <Policy>s and other <PolicySet>s



Further information

- XACML is in the Globus ToolKit:

  3.9.3 Java WS Core only distribution

- "A Brief Introduction to XACML"

  http://www.oasis-open.org/committees/download.php/2713/Brief_Introduction_to_XACML.html

- OASIS Access Control (XACML) Technical Committee:

  all specifications and other documents

  http://www.oasis-open.org/committees/xacml

- Sun's XACML Open Source Implementation

  http://sunxacml.sourceforge.net

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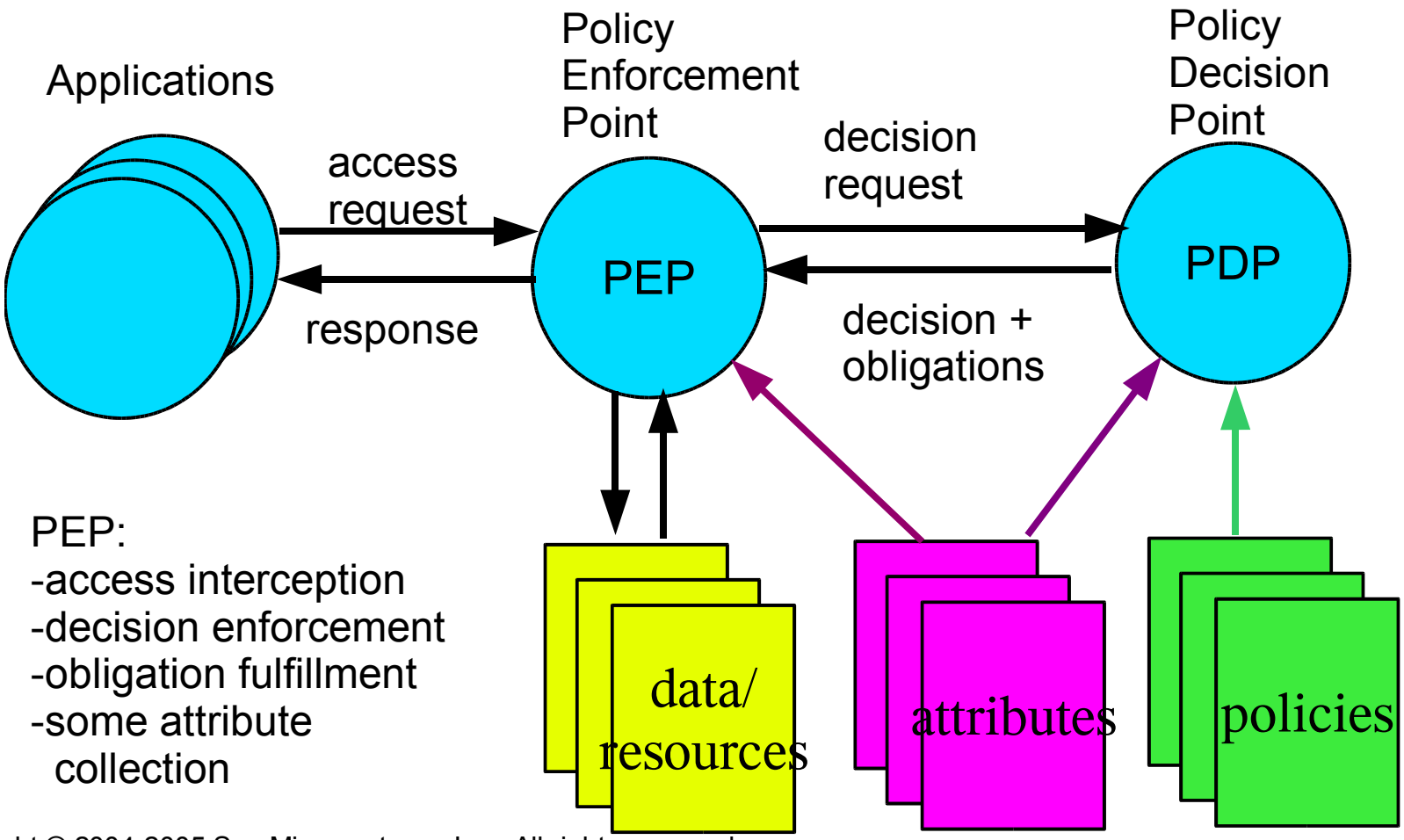
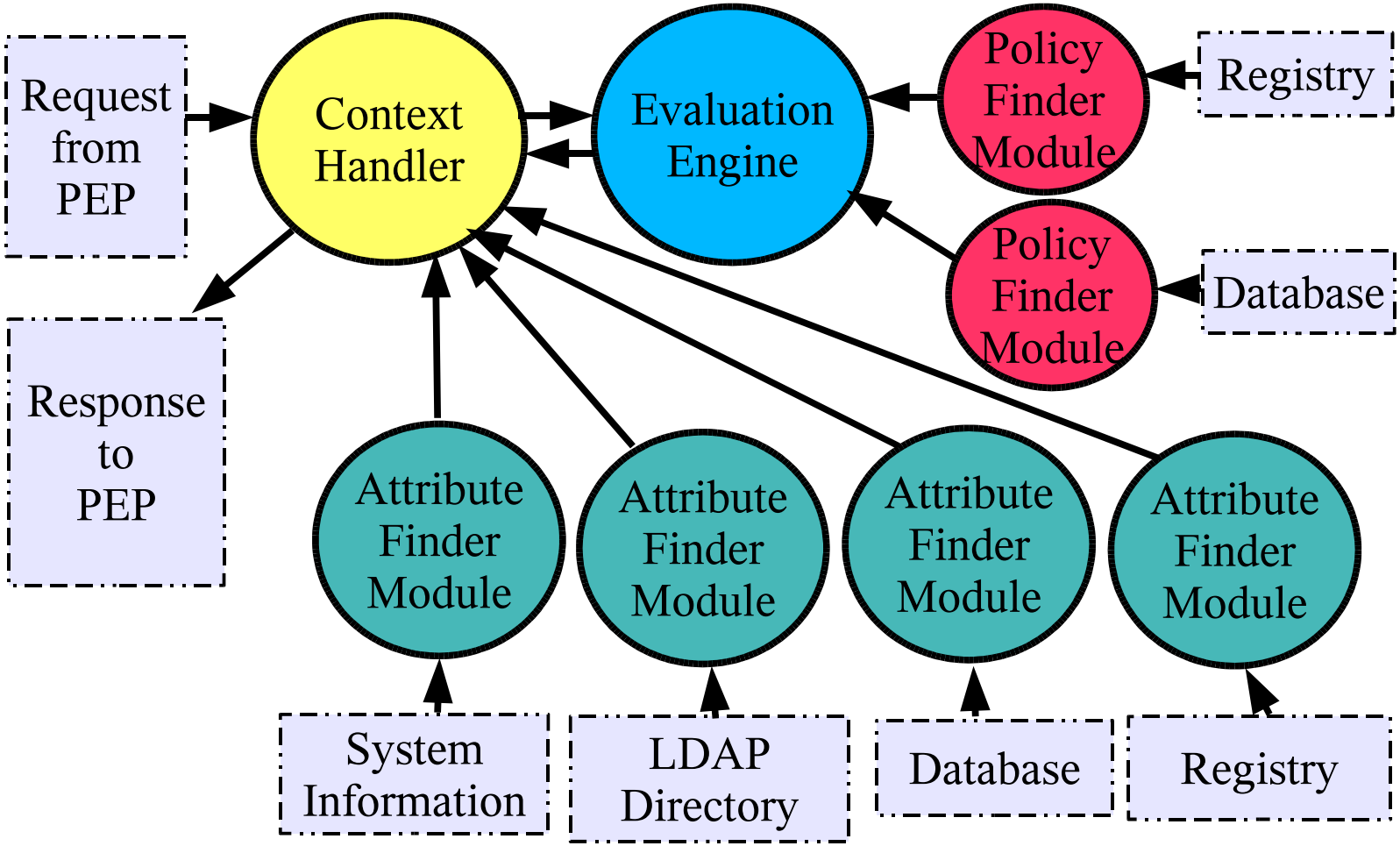
Backup slides

Access Policy Enforcement



PEP:
-access interception
-decision enforcement
-obligation fulfillment
-some attribute collection

XACML Policy Decision Point



Attributes

	Attribute Examples
Subject + Category user, intermediary, recipient, codebase, requesting machine, ...	Subject's identity, role, clearance level, <wss:SecurityToken>, account id, IP address, ...
Resource {+ optional XML ResourceContent}	Resource's identity, classification, location, size, value, ...
Action	Action identity: read, write, execute, modify, open, move, ...; Action purpose, ...
Environment	time of day, date, vocabulary id, contract id, ...

Target

Optional way to pull out key “necessary” predicates (could do everything in `<Condition>`). Useful for indexing policies.

```
<Target>
    <Subjects><Subject><SubjectMatch
            MatchId="anyURI-equal"  DataType="anyURI">
        <AttributeValue  DataType="anyURI">
                    urn:us:gov:doe
        </AttributeValue>
        <SubjectAttributeDesignator
            AttributeId="employer"   DataType="anyURI"/>
    </SubjectMatch></Subject></Subjects>
</Target>
<Condition>... remaining two predicates ... </Condition>
```

PolicySet: combination of <Policy>s and other <PolicySet>s

```
<PolicySet
    PolicySetId="PolicySet1"
    PolicyCombiningAlgId=
        "deny-overrides" >

  <Target  ....  />

  <Policy1  ...  />
  <Policy2  ...  />
  <PolicySet2  ...  />

</PolicySet>
```

Deny-overrides: return "Permit" only if `<Target>` is TRUE AND every `<Policy>` and `<PolicySet>` return "Permit".

Some other features

- Distributed policies: inclusion by reference
- Variable definitions and references (re-use constraints, etc.)
- XPath references to attributes from XML documents

XACML Profiles

- Hierarchical Resources
- Multiple Resources
- Role Based Access Control (RBAC)
- Privacy
- Security Assertion Markup Language (SAML)
- Digital Signature (DSig)

Future work

- Policy tools
  - Composition, editing
  - Analysis
  - Management
- Delegation chains