

# A POLICY-BASED DIALOGUE SYSTEM FOR PHYSICAL ACCESS CONTROL

STIDS 2012  
GEORGE MASON UNIVERSITY  
10/25/2012

MOHAMMAD ABABNEH (George Mason University)  
DUMINDA WIJESEKERA (George Mason University)  
JAMES BRET MICHAEL (Naval Postgraduate School)

# Problem Definition



- Interactive voice (i.e. Dialog) systems are becoming popular, such as
  - ▣ Apple's Siri, Google's Android S-Voice, Microsoft Windows Speech Recognition
- Interactive voice dialogs are hardcoded using technologies like VoiceXML
- Dialogs eventually access or update some information – they are governed by policies
- **Research objective:** To develop a means for using policies to govern interactive voice-based dialogs

# Outline of Presentation



- Requirements
- Potential Applications
- A Sample Dialog
- System Architecture
- Background
  - ▣ VoiceXML
  - ▣ XACML
- Creating Policy Controlled Dialogs
- Architectural Integration of Dialogs and Policies
- Future Work and Framework Improvement
- Summary

# Requirements

- In order to govern dialogs, we need 3 components:
  - ▣ A Dialog System, Policy Framework and Use Cases
- **Dialog System:** VoiceXML
- **Policy Framework:** XACML (eXtensible Access Control Markup Language).
- **Use Cases:** Physical Access Control to Smart Buildings
- **What would we like to do?**
  - ▣ Input: Policy and user's presence information
  - ▣ Runtime: Dialog system automatically produces a series of questions and answers that, if correctly answered, permit the requester to enter the secure facility or smart building.
- **Novelty:** Generate questions appropriate for the requester and the operating environment.

# Potential Applications

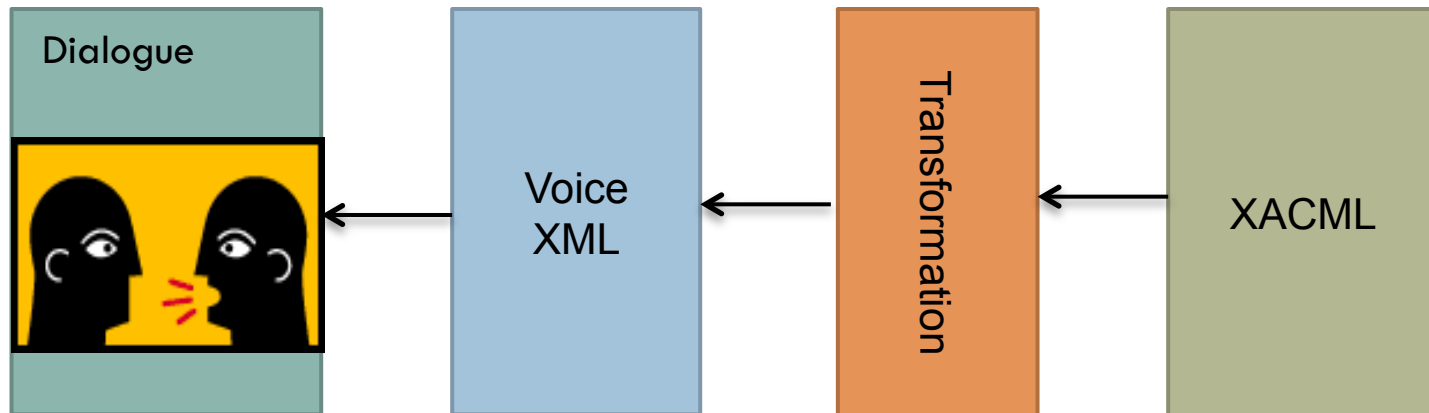
- Mobile computing
- Disaster response
- Weapon systems
- Electronic commerce
- Controlling equipment
- Physical access control



# A Sample Dialogue for Physical Access

1	User/System	Hello
	S	Welcome, Please Say who you are?
2	U	I am User01 (Alice)
	S	Please say your Password or enter it using the key pad
3	U	Pass01
	S	Ok, I got that. Now tell me Why do you need to access the building (Role)
4	U	Professor
	S	What is your office number
5	U	4429
	S	In which floor is the dean's meeting room
6	U	5th
	S	What is the time on the clock to your right
7	U	7:30
	S	Are you sure
8	U	Yes
	S	Is it raining outside?
9	U	Yes
	S	Is it cold or warm?
10	U	Cold
	S	Is the temperature below 40 degrees?
11	U	No
	S	Can you estimate the range that the temperature might be in?
12	U	50 to 60
	S	Ok, granted access

# System Architecture

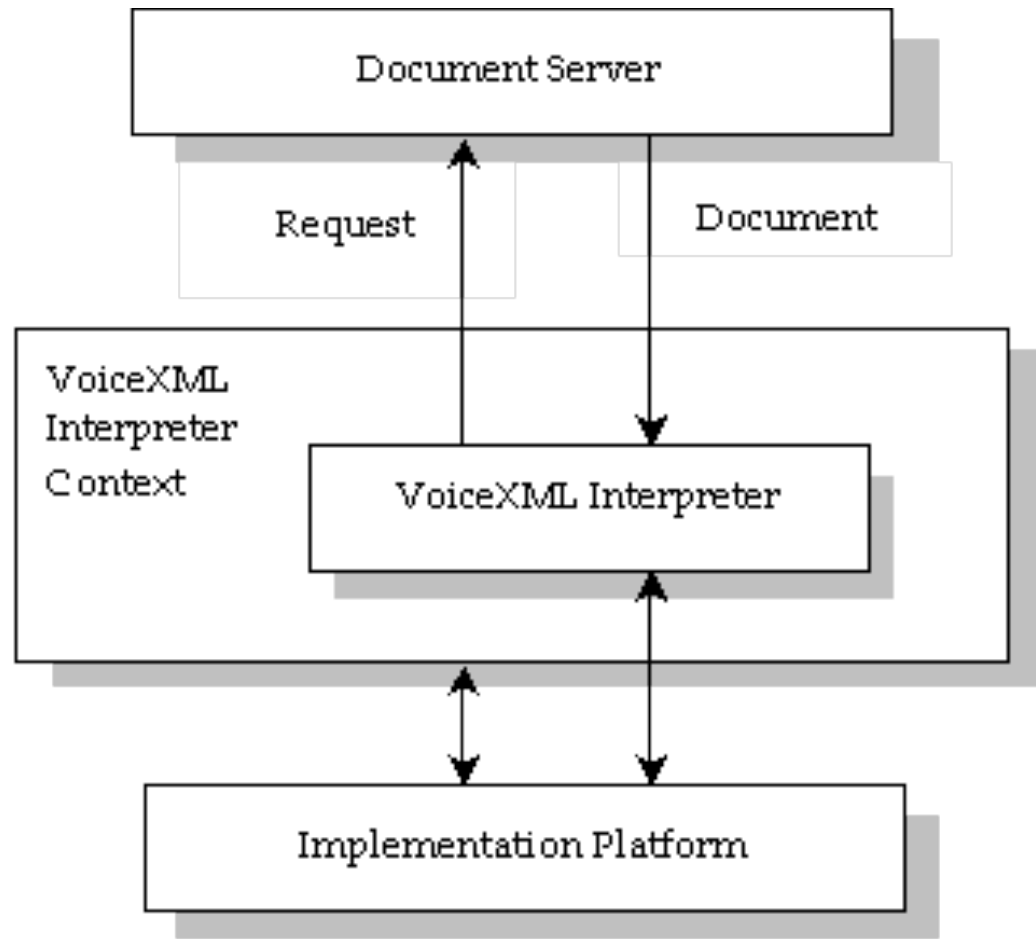


# Background - VoiceXML

- VoiceXML (VXML): W3C's Voice Browser Working Group's Voice Markup Language.
- Intended for audio dialogues with
  - ▣ Synthesized speech, digitized audio, recognition of spoken and
  - ▣ Dual Tone Multi-Frequency (DTMF) key inputs
  - ▣ Recording of spoken input, etc.
- VXML interfaces between user and Web, using a voice interface.
- Purpose: To bring the advantages of web-based development and content delivery to interactive voice response (IVR) applications



# VoiceXML Functionality

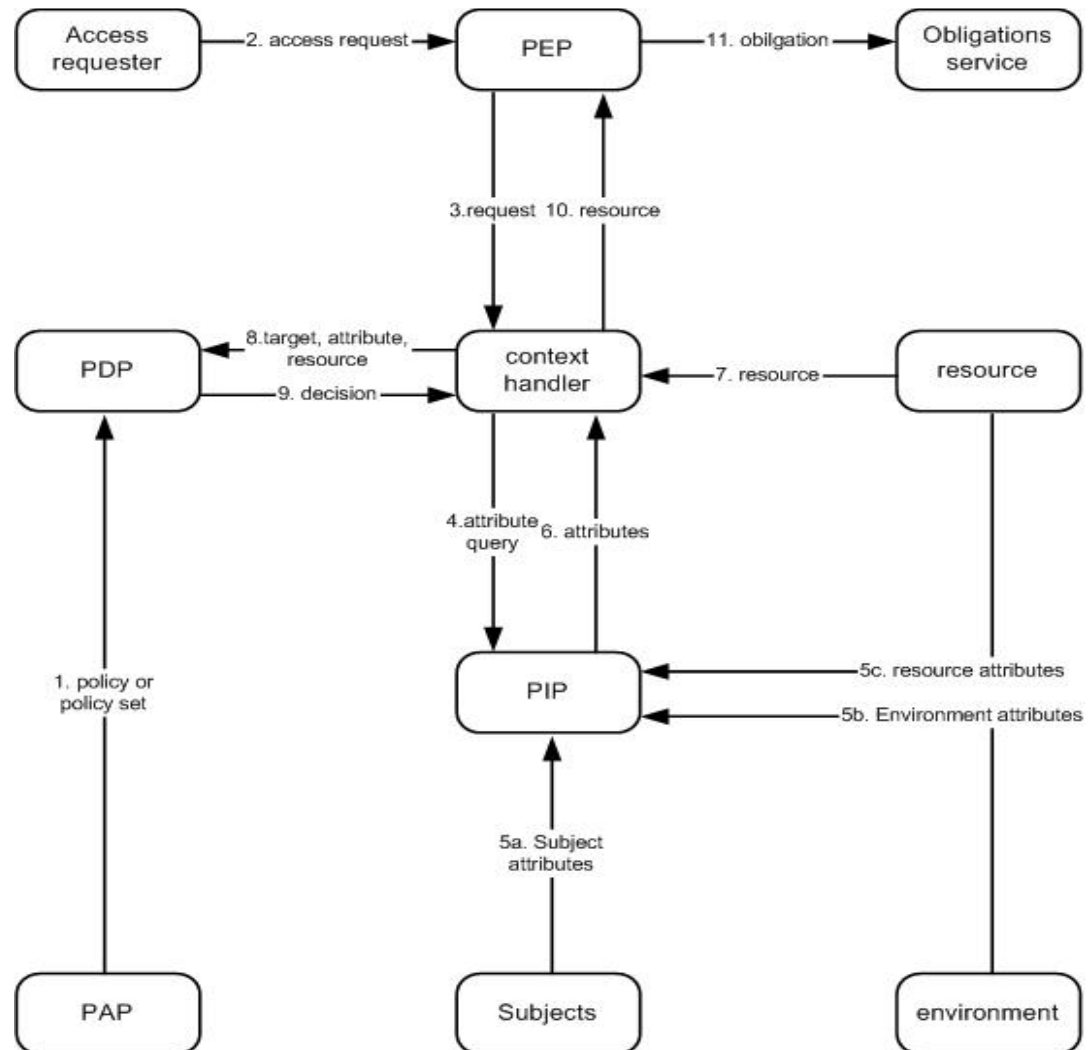


# Sample VoiceXML

```
<?xml version="1.0" encoding="UTF-8"?>
<vxml xmlns="http://www.w3.org/2001/vxml"
  xmlns:xsi="http://www.w3.org/2001/
  XMLSchema-instance"
  xsi:schemaLocation="http://www.w3.org/2001/vxml
  http://www.w3.org/TR/voicexml20/vxml.xsd"
  version="2.0">
  <form>
  <field name="e-mail">
    <prompt>What is your e-mail address?
    </prompt>
    <grammar src="email.grxml"
      type="application/srgs+xml"/>
  </field>
  <block>
  <submit next="http://www.example.com/user.asp"/>
  </block>
  </form>
</vxml>
```

# Background - XACML

- XACML is an OASIS standard XML-based language for specifying access control policies.
- Access decisions to resources are made based on requester's (Subject) and environment attributes.
- Data-Flow Diagram



# Sample XACML

```
<?xml version="1.0" encoding="UTF-8"?>
<Policy RuleCombiningAlgId="identifier:rule-combining-algorithm:deny-
overrides" PolicyId="urn:oasis:names:tc:example:SimplePolicy1"
xsi:schemaLocation="urn:oasis:names:tc:xacml:2.0:policy:schema:cd:04
http://docs.oasis-open.org/xacml/access_control-xacml-2.0-policy-
schema-cd:04.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance" xmlns="urn:oasis:names:tc:xacml:2.0:policy:schema:cd:04">
<Description> Med Example Corp access control policy
</Description>
<Target/>
<Rule Effect="Permit" RuleId="urn:oasis:names:tc:xacml:
2.0:example:SimpleRule1">
<Description> Any subject with an e-mail name in the med.example.com
domain can perform any action on any resource.
</Description>
<Target>
<Subjects>
<Subject>
<SubjectMatch MatchId="urn:oasis:names:tc:xacml:
1.0:function:rfc822Name-match">
<AttributeValue DataType="urn:oasis:names:tc:xacml:1.0:data-
type:rfc822Name"> @med.example.com </AttributeValue>
<SubjectAttributeDesignator DataType="urn:oasis:names:tc:xacml:
1.0:data-type:rfc822Name" AttributeId="urn:oasis:names:tc:xacml:
1.0:subject:subject-id"/>
</SubjectMatch>
</Subject>
</Subjects>
</Target>
</Rule>
</Policy>
```

```
<Request>
<Subject>
<Attribute
AttributeId="urn:oasis:names:tc:xacml:1.0:subject:subject-id"
DataType="urn:oasis:names:tc:xacml:1.0:data-type:rfc822Name">
<AttributeValue>mababneh@@med.example.com </AttributeValue>

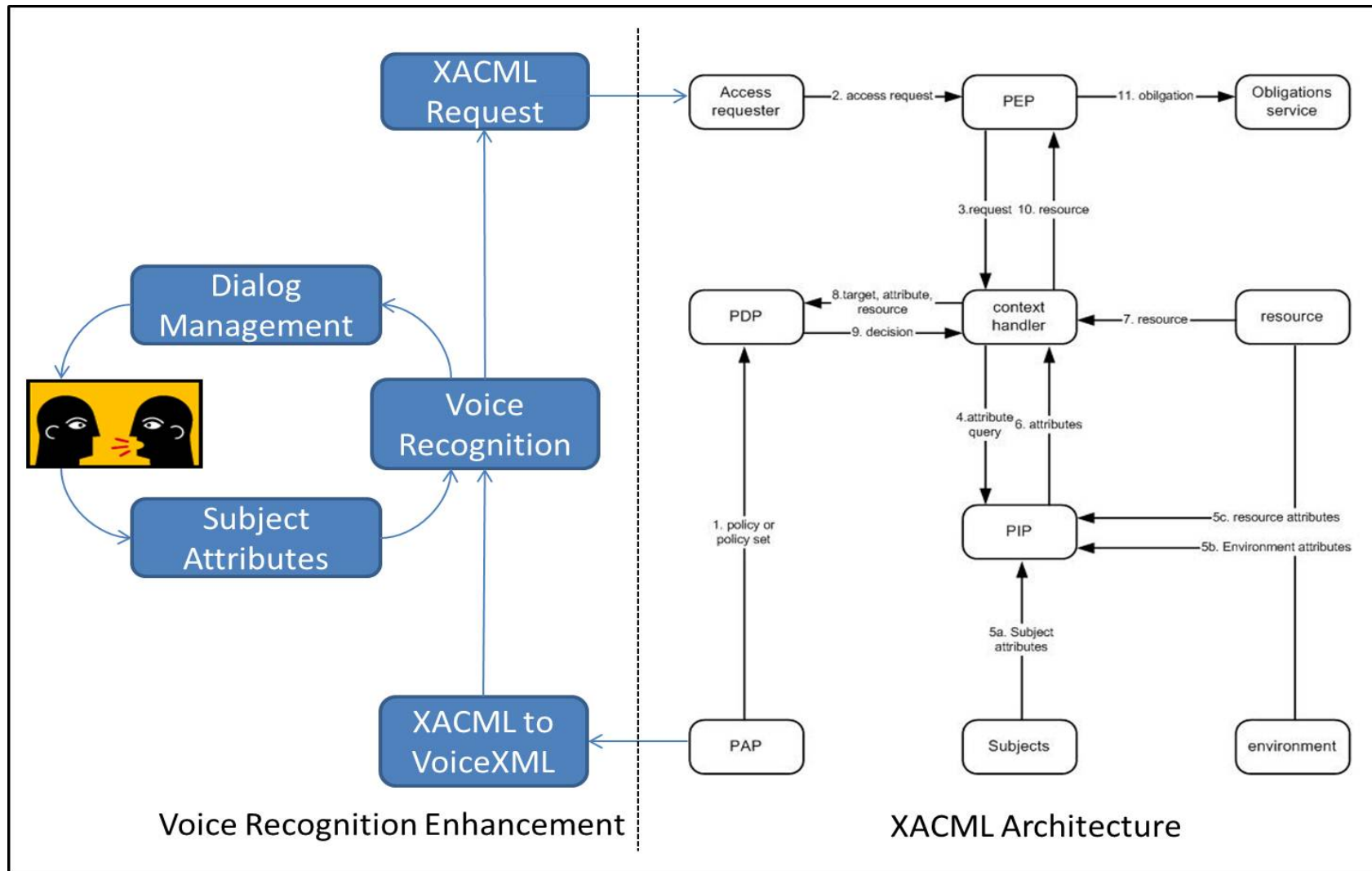
</Attribute>
<Attribute AttributeId="group" DataType=
http://www.w3.org/2001/XMLSchema#string
Issuer="admin@gmu.edu">
<AttributeValue>Developers</AttributeValue>
</Attribute>
</Subject>
<Resource>
<Attribute AttributeId="urn:oasis:names:tc:xacml:1.0:resource:resource-
id" DataType="http://www.w3.org/2001/XMLSchema#anyURI">

<AttributeValue>
http://server.example.com/code/docs/developer-guide.html</
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>read</AttributeValue>
</Attribute>
</Action>
</Request>
```

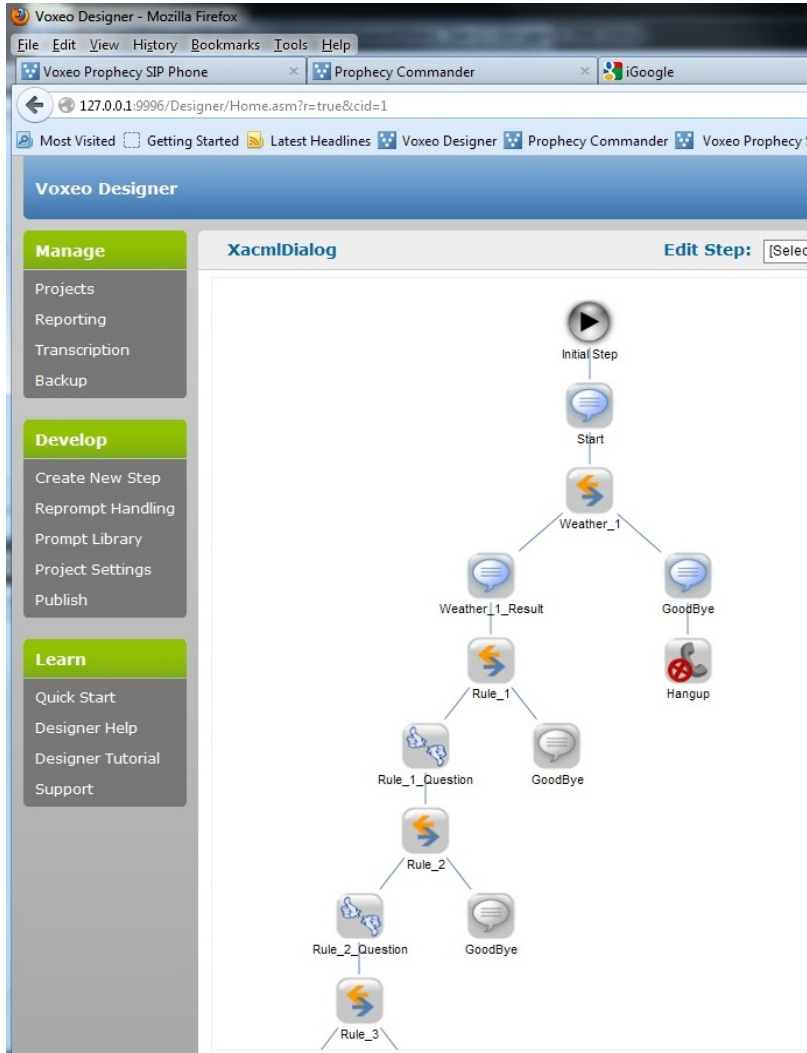
# Creating Policy Controlled Dialogs

- Transform an access control policy into a voice dialog
- Method:
  - ▣ Read and transformed rules of the policy are into VoiceXML blocks and forms.
- Details:
  - ▣ The entire policy is parsed using a DOM parser
  - ▣ Every relevant rule is converted into a question
    - How: translate the rule into a VXML block
    - Voice user interface translating text to speech (TTS), posing the question to the user.
    - Waiting for the user's response through voice recognition.
    - Translate voice back to text
    - Check against the XACML policy for accuracy

# Dialogue-Policy Integration



# Policy Controlled Dialogs using Voxeo VoiceXML Designer



# Dialogue-Policy integration

## XACML-VoiceXML Server Side Script

Policy.jsp

```
<%@page
    import="org.w3c.dom.Node,org.w3c.dom.Element, org.w3c.dom.Document, org.w3c.dom.NodeList,
    javax.xml.parsers.DocumentBuilder, javax.xml.parsers.DocumentBuilderFactory" %>

<%
    DocumentBuilderFactory factory = DocumentBuilderFactory.newInstance();
    DocumentBuilder builder = factory.newDocumentBuilder();
    Document doc = builder.parse("http://127.0.0.1:9990/xacml/Example_1/Policy_1.xml"); %>
<%
    Element root = doc.getDocumentElement(); // policy node
    NodeList ruleNodes = root.getChildNodes(); // rule nodes
    int numberOfChildren;
    numberOfChildren = ruleNodes.getLength();
    String textRule = new String();
    String subjectString = new String();
    String subjectDataTypeString = new String();
    int numberOfSubjectAttributes = doc.getElementsByTagName("SubjectMatch").getLength(); //AttributeValue
    for (int h=0; h<numberOfSubjectAttributes; h++){
        subjectDataTypeString = doc.getElementsByTagName("AttributeValue").item(h).getAttributes().item(0).getNodeValue();
        subjectString = doc.getElementsByTagName("AttributeValue").item(h).getFirstChild().getNodeValue();
        out.println(subjectString);
    } //end for
%>
```



# Dialogue-Policy integration

## Client Side

Integration

Step Name: Rule\_1

Connector Configuration | Next Destinations

**Integration Type**  
Select the type of data integration you would like to perform.

Integration Type: HTTP Request

**HTTP Request**  
Click Configure to set up your HTTP request.

URL: http://127.0.0.1:9990/xacml/Example\_1/Rule\_1.jsp

Method: GET      Response Type: STRING      Configure

Test

Remove      Save      Cancel

# Ongoing Work



- Improving the generation of VoiceXML from XACML
- Integrating the system with a physical access device such as an NFC lock
- Integrating presence information with the dialog access control system

# Future Research Directions



- Making efficient and effective dialogs
- Addressing scalability issues, such as generating dialogs from policies with a large number of hierarchical rules
- Attempting to generate policies from dialogs
- Exploring privacy issues that arise with the use of dialogues

# Summary



- Presented a novel approach to generate dialogues from policies
  - ▣ Example: To control physical access to facilities
- Policy language driven interaction with the user or authorization requester is generated at runtime and implemented using standards-based languages
- Lots of open research questions