Lesson 20 – WS-Policy

Service Oriented Architectures Security

Module 1 - Basic technologies

Unit 1 – Introduction

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Introduction to WS-Policy

Why?

- To integrate software systems with web services
- Need a way to express its characteristics
  - –When/Does it *require …*
    - WS-Security?
    - signed messages?
    - encryption?
  - –What security tokens is it *capable* of processing?
  - –What tokens does it *prefer*?
- Without this standard, developers need docs

Introduction to WS-Policy

What?

- Provides a flexible and extensible *grammar* for expressing the *capabilities*, *requirements*, and *general characteristics* of Web Service *entities*

How?

- Defines a model to express these properties as policies

Introduction to WS-Policy

Goal:

- Provide the mechanisms needed to enable Web Services applications to specify policies

WS-Policy specifies:

1. An XML-based structure called a policy expression containing policy information
2. Grammar elements to indicate how the contained policy assertions apply

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Terminology

Policy: refers to the set of information being expressed as *policy assertions*

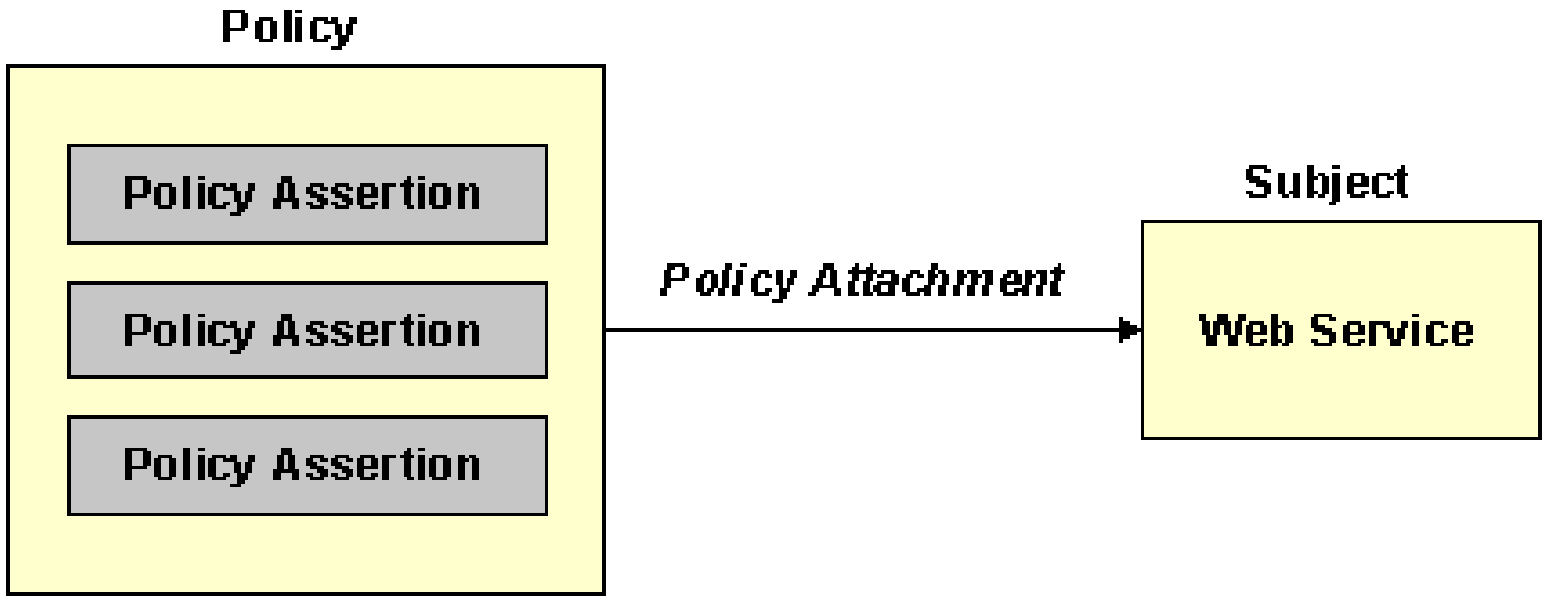
Policy Assertion: represents an individual preference, requirement, capability, etc.

Policy Expression: set of one or more *policy assertions*

Policy Subject: an entity to which a *policy expression* can be bound

Terminology

Policy Attachment: the mechanism for associating policy expressions with one or more subjects



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Policy Expressions

A Policy Expression is the XML representation of a policy

- XML facilitates interoperability between a heterogeneous platforms

We will look at how to name and identify them

Policy Namespaces

WS-Policy schema defines all constructs that can used in a *policy expression*

Prefix	Description	Namespace
wsp	WS-Policy, WS-PolicyAssertions, and WS-PolicyAttachment	http://schemas.xmlsoap.org/ws/2002/12/policy
wsse	WS-SecurityPolicy	http://schemas.xmlsoap.org/ws/2002/12/secext
wsu	WS utilty schema	http://schemas.xmlsoap.org/ws/2002/07/utility
msp	WSE 2.0 policy schema	http://schemas.microsoft.com/wse/2003/06/Policy

Policy Namespaces

wsp:Policy

- Representation of a *policy expression*
- Container for *policy assertions*

```
<wsp:Policy xmlns:wsp="..."
xmlns:wsu="..." wsu:Id="..."
   Name="..." TargetNamespace="...">
   <!-- policy assertions go here -->
</wsp:Policy>
```

- The wsu:Id attribute assigns the *policy expression* an ID value as a URI

Policy Expression Naming

A full ID is formed by:

<base URI>#<wsu:Id value>

Policy Expression:

```
<wsp:Policy xmlns:wsp="..."
    xmlns:wsu="..." wsu:Id="MyPolicies" >
    ...</wsp:Policy>
```

Policy Reference:

```
...
<wsp:PolicyReference xmlns:wsp="..."
  URI="http://virginia.edu/isis/policy.xml#MyPolicies"/>
...
```

Policy Expression Naming

Alternatively, use namespace-qualified name

- Add `Name` and `TargetNamespace`:

```
<wsp:Policy xmlns:wsp="..." Name="MyPolicies"
      TargetNamespace="http://virginia.edu/policies">
...</wsp:Policy>
```

Reference:

```
...
<wsp:PolicyReference xmlns:wsp="..."
      xmlns:p="http://virginia.edu/policies"
      Ref="p:MyPolicies"/>
...
```

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Policy Assertions

A policy assertion:

- represents an individual preference, requirement, capability, or other characteristic
- is the basic building block of a policy expression
- an XML element with a well-known name and meaning

```
<wsp:Policy xmlns:wsp="..." xmlns:wsu="..." wsu:Id="..."
      Name="..." TargetNamespace="..." >
      <Assertion wsp:Usage="..." wsp:Preference="..." />
      <Assertion wsp:Usage="..." wsp:Preference="..." />
... </wsp:Policy>
```

Types of Assertions

Two types:

1. Requirements and capabilities that are explicitly manifested on the wire
2. No wire manifestation, just provide information

The Usage Qualifier

wsp:Usage distinguishes between

- different types of assertions
- how assertions are processed

Value	Meaning
wsp:Required	The assertion must be applied, otherwise an error results
wsp:Rejected	The assertion is not supported and, if present, will cause failure
wsp:Optional	The assertion may be made of the subject, but is not required
wsp:Observed	The assertion will be applied to all subjects and requestors are told
wsp:Ignored	The assertion will be ignored if present and requestors are told

Assertion Example

What does this Assertion state?

```
<wsp:Policy xmlns:wsp="..." xmlns:wsse="...">
  <wsse:SecurityToken wsp:Usage="wsp:Required">
<wsse:TokenType>wsse:Kerberosv5ST</wsse:TokenType>
  </wsse:SecurityToken>
  <wsse:Integrity wsp:Usage="wsp:Required">
    <wsse:Algorithm Type="wsse:AlgSignature"
      URI="http://www.w3.org/2000/09/xmlenc#aes" />
  </wsse:Integrity>
</wsp:Policy>
```

Two policy assertions:

1. Security Token is required
2. Use of AES is required

Assertion Preference

wsp:Preference attribute:

- Used to specify the service's preference as an integer value
- Larger integer => higher preference
- Omitted preference attribute is interpreted as a 0

Assertion Preference Example

What does this Assertion state?

```
<wsp:Policy xmlns:wsp="..." xmlns:wsse="...">
  <wsse:SecurityToken wsp:Usage="wsp:Optional">

<wsse:TokenType>wsse:UsernameToken</wsse:TokenType>
  </wsse:SecurityToken>
  <wsse:SecurityToken wsp:Usage="wsp:Optional"
    wsp:Preference="1">
    <wsse:TokenType>wsse:x509v3</wsse:TokenType>
  </wsse:SecurityToken>
</wsp:Policy>
```

The subject prefers X.509 certificates over UsernameTokens

Standard Policy Assertions

WS-PolicyAssertions defines four general policy assertions for any subject

Policy Assertion	Description
wsp:TextEncoding	Specifies a character encoding
wsp:Language	Specifies a natural language (xml:Lang)
wsp:SpecVersion	Specifies a version of a particular specification
wsp:MessagePredicate	Specifies a predicate that can be tested against the message (XPath expressions by default)

General Assertion Example

What does this Assertion state?

```
<wsp:Policy xmlns:wsse="...">
  <wsp:TextEncoding wsp:Usage="wsp:Required"
Encoding="utf-8"/>
  <wsp:Language wsp:Usage="wsp:Required" Language="en"/>
  <wsp:SpecVersion wsp:Usage="wsp:Required"
    URI="http://www.w3.org/TR/2000/NOTE-SOAP-20000508/" />
  ...
</wsp:Policy>
```

The subject requires

1. The UTF-8 character encoding
2. Any form of the English language
3. SOAP version 1.1

General Assertion Example

What does this Assertion state?

```
<wsp:Policy xmlns:wsp="..." xmlns:wsse="...">
  <wsp:MessagePredicate wsp:Usage="wsp:Required">
    count(wsp:GetHeader(.)/wsse:Security) = 1
  </wsp:MessagePredicate>
  <wsp:MessagePredicate wsp:Usage="wsp:Required">
    count(wsp:GetBody(.)/*) = 1
  </wsp:MessagePredicate>
  ...
</wsp:Policy>
```

Must be:

1. Exactly one wsse:Security header element
2. Exactly one child within the soap:Body element

WS-SecurityPolicy

Defines a set of security-related assertions

Policy Assertion	Description
wsse:SecurityToken	Specifies a type of security token (defined by WS-Security)
wsse:Integrity	Specifies a signature format (defined by WS-Security)
wsse:Confidentiality	Specifies an encryption format (defined by WS-Security)
wsse:Visibility	Specifies portions of a message that MUST be able to be processed by an intermediary or endpoint
wsse:SecurityHeader	Specifies how to use the <Security> header defined in WS-Security
wsse:MessageAge	Specifies the acceptable time period before messages are declared "stale" and discarded

Combining Multiple Assertions

Policy operators are used to combine assertions

- Can nest operators

Policy Operator	Description
wsp:All	Requires that all of its child elements be satisfied
wsp:ExactlyOne	Requires that exactly one child to be satisfied
wsp:OneOrMore	Requires that at least one child be satisfied
wsp:Policy	Same as wsp:All

Assertion Combination Example

What does this Assertion state?

```
<wsp:Policy xmlns:wsp="..." xmlns:wsse="...">
  <wsp:ExactlyOne wsp:Usage="Required">
    <wsse:SecurityToken>
      <wsse:TokenType>wsse:UsernameToken</wsse:TokenType>
    </wsse:SecurityToken>
    <wsse:SecurityToken wsp:Preference="10">
      <wsse:TokenType>wsse:x509v3</wsse:TokenType>
    </wsse:SecurityToken>
    <wsse:SecurityToken wsp:Preference="1">
      <wsse:TokenType>wsse:Kerberosv5ST</wsse:TokenType>
    </wsse:SecurityToken>
  </wsp:ExactlyOne>
</wsp:Policy>
```

Exactly one child must be satisfied

Policy Reference

Mechanism to share policy assertions across policy expressions

Uses the naming conventions discussed above

```
<wsp:Policy xmlns:wsp="...">
  ...
  <wsp:PolicyReference URI="..."
                       Ref="..."
                       Digest="..."
                       DigestAlgorithm="..." />
  ...
</wsp:Policy>
```

Policy Reference Example

```
<wsp:Policy wsu:Id="tokens" xmlns:wsp="..." xmlns:wsse="...">
  <wsp:ExactlyOne wsp:Usage="Required">
    <wsse:SecurityToken>
      <wsse:TokenType>wsse:UsernameToken</wsse:TokenType>
    </wsse:SecurityToken>
    <wsse:SecurityToken wsp:Preference="10">
      <wsse:TokenType>wsse:x509v3</wsse:TokenType>
    </wsse:SecurityToken>
    <wsse:SecurityToken wsp:Preference="1">
      <wsse:TokenType>wsse:Kerberosv5ST</wsse:TokenType>
    </wsse:SecurityToken>
  </wsp:ExactlyOne>
</wsp:Policy>
```

Policy Reference Example

```
<wsp:Policy wsu:Id="tokensWithSignature"
  xmlns:wsp="..." xmlns:wsse="...">
  <wsp:PolicyReference URI="#tokens" />
  <wsse:Integrity wsp:Usage="wsp:Required">
    ...
  </wsse:Integrity>
</wsp:Policy>

<wsp:Policy wsu:Id="tokensWithEncryption"
  xmlns:wsp="..." xmlns:wsse="...">
  <wsp:PolicyReference URI="#tokens" />
  <wsse:Confidentiality wsp:Usage="Required">
  ...
  </wsse:Confidentiality>
</wsp:Policy>
```

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Policy Attachments

WS-PolicyAttachment defines mechanisms to associate expressions with subjects

Specifically defines mechanisms for:

- XML elements
- WSDL definitions
- UDDI entries

Uses attributes

1. wsp:PolicyURIs – list of URIs
2. wsp:PolicyPrefs – list of QNames

Policy Attachments

The attribute wsp:PolicyAttachment binds an endpoint to a policy expression

- Requires no change to the web service

```
<wsp:PolicyAttachment>
  <wsp:AppliesTo>
    <wsa:EndpointReference xmlns:s="...">
      <wsa:Address>http://virginia.edu/someendpoint</wsa:Address>
      <wsa:PortType>s:SomePortType</wsa:PortType>
      <wsa:ServiceName>s:SomeService</wsa:ServiceName>
    </wsa:EndpointReference>
  </wsp:AppliesTo>
  <wsp:PolicyReference URI="http://virginia.edu/policy.xml" />
  <wsse:Security>
    <ds:Signature> ... </ds:Signature>
  </wsse:Security>
</wsp:PolicyAttachment>
```

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Conclusion of WS-Policy

The policy specifications define a standard framework

Developers can:

- express requirements, capabilities, and preferences in an interoperable way
- select web services more meaningfully

Policies provide support for standard assertions

Primary References

http://msdn.microsoft.com/webservices/default.aspx?pull=/library/en-us/dnglobspec/html/ws-policy.asp#ws-policy__toc42483108

- Official document describing WS-Policy

http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnwebsrv/html/understwspol.asp

- "Understanding WS-Policy" – A great reference that I used a lot for this presentation. Provides a great, easy explanation of WS-Policy.

Secondary References

http://schemas.xmlsoap.org/ws/2002/12/Policy/

- This is the policy schema definition

http://msdn.microsoft.com/webservices/default.aspx?pull=/library/en-us/dnglobspec/html/ws-policyassertions.asp

- Provides a very detailed description of WS-PolicyAssertions

http://msdn.microsoft.com/webservices/default.aspx?pull=/library/en-us/dnglobspec/html/ws-policyattachment.asp

- Provides a very detailed description of WS-PolicyAttachment

http://msdn.microsoft.com/webservices/default.aspx?pull=/library/en-us/dnglobspec/html/ws-securitypolicy.asp

- Provides a detailed description of WS-SecurityPolicy

Policy In Action

- **Web Service Enhancements (WSE) 2.0 for .NET 2.0 provides basic support for WS-Policy**
- **Let's go!**