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2 **XACML profile for Web-services**

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13 Abstract:

14 This working draft specifies a profile of XACML for expressing policy associated with
15 Web-service end-points.

16 Status:

17 This version of the specification is a working draft of the committee. As such, it is
18 expected to change prior to adoption as an OASIS standard.

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26	Table of contents	
27	1. Introduction (non-normative)	4
28	1.1 Glossary	4
29	1.2 Notation	4
30	1.3 Schema organization and namespaces	5
31	1.4 Background	5
32	2. Model (Normative)	5
33	3. Example (Non-normative)	9
34	4. Instructions to standards developers	11
35	4.1 Procedure (Normative)	11
36	4.2 Example (Non-normative)	11
37	5. Definitions (Normative)	12
38	6. End-point policy combination (Normative)	12
39	6.1 Combine top-level <PolicySet> elements	13
40	6.2 Combine second-level <PolicySet> elements	13
41	6.3 Combine <Policy> elements	13
42	6.4 Combine <Rule> elements	13
43	6.5 Combine <Apply> elements	13
44	6.6 Eliminate <Policy> elements	15
45	6.7 Substitute <Apply> elements	16
46	6.8 Result	16
47	7. Security considerations (Non-normative)	16
48	8. Bindings	17
49	8.1 WSDL 1.1 (Normative)	17
50	8.1.1. Introduction	17
51	8.1.2. Attachment	17
52	8.1.3. Structure	17
53	8.1.4. Integrity/authenticity protection	18
54	8.1.5. Schema	18
55	8.2 WSDL 1.2 draft (Non-normative)	20
56	8.3 SOAP 1.1 (Normative)	21
57	8.3.1. Introduction	21
58	8.3.2. Structure	21
59	8.3.3. Integrity/authenticity protection	21
60	8.3.4. Schema	21
61	9. References (Non-normative)	22
62	Appendix A. Worked example (Non-normative)	23
63	Consumer policy	23
64	A.1.1. Plain-language policy	23
65	A.1.2. XACML policy	23
66	Combining process	25
	draft-xacml-wspl-03.doc	2

67	A.1.3. Combine <PolicySet> elements	25
68	A.1.4. Combine <Policy> elements	27
69	A.1.5. Combine <Rule> elements	29
70	A.1.6. Combine <Apply> elements	32
71	A.1.7. Substitute <Apply> elements	33
72	Appendix B. Revision history	35
73	Appendix C. Notices	36
74		

76 1. Introduction (non-normative)

77 1.1 Glossary

78 **Aspect** – An independent set of technical features and parameters associated with use of a Web-
 79 service. In most cases, an **aspect** is identified with a single member of the suite of Web-service
 80 specifications for which policy provisions must be described, such as WS-Reliable Messaging or
 81 WS-Security. In the former case, policy provisions may include such items as: maximum time to
 82 live, maximum number of retries and minimum interval between retries.

83 **Authorized attribute** – An attribute whose value must be assigned by an authority, not a policy-
 84 user.

85 **Coincidence** – The property of pairs of **predicates**, **strategies**, **objectives** and **end-point**
 86 **policies** that enables them to be combined.

87 **Combiner** – An entity that combines two or more **end-point policies**.

88 **Constrained attribute** - An attribute whose value cannot be assigned by the policy-user.

89 **End-point policy** – 1. The set of provisions governing all **aspects** of a Web-service end-point.
 90 2. A conjunctive set of **objectives**. 3. An XACML <PolicySet> element.

91 **Objective** – 1. The set of provisions governing a single **aspect** of a Web-service end-point. 2. A
 92 disjunctive list of **strategies**, in order of preference. 3. An XACML <Policy> element.

93 **Solution** – The set of features and parameter values that satisfy an end-point's requirements for
 94 successful invocation.

95 **Strategy** – 1. One **solution** to a single **aspect** of a Web-service end-point. 2. A conjunctive set
 96 of **predicates**. 3. An XACML <Rule> element.

97 **Unconstrained attribute** - An attribute whose value can be assigned by the policy-user within a
 98 certain range

99 1.2 Notation

100 This specification contains schema conforming to W3C XML Schema and normative text to
 101 describe the syntax and semantics of XML-encoded policy statements.

102 The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD",
 103 "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this specification are to be
 104 interpreted as described in IETF RFC 2119 [RFC2119]

105 *"they MUST only be used where it is actually required for interoperation or to limit*
 106 *behavior which has potential for causing harm (e.g., limiting retransmissions)"*

107 These keywords are thus capitalized when used to unambiguously specify requirements over
 108 protocol and application features and behavior that affect the interoperability and security of
 109 implementations. When these words are not capitalized, they are meant in their natural-language
 110 sense.

111 `Listings of schemas appear like this.`

112

113 `Example code listings appear like this.`

114 Conventional XML namespace prefixes are used throughout the listings in this specification to
115 stand for their respective namespaces as follows, whether or not a namespace declaration is
116 present in the example:

- 117 • The prefix `xacml`: stands for the XACML policy namespace.
- 118 • The prefix `xs`: stands for the W3C XML Schema namespace [XS].
- 119 • The prefix `xf`: stands for the XQuery 1.0 and XPath 2.0 Function and Operators
120 specification namespace [XF].

121 This specification uses the following typographical conventions in text: `<XACMLElement>`,
122 `<ns:ForeignElement>`, `Attribute`, **Datatype**, `OtherCode`. Terms in *italic bold-face* are
123 intended to have the meaning defined in the Glossary of this document or [XACML v1.0].

124 1.3 Schema organization and namespaces

125 The XACML policy syntax is defined in a schema associated with the following XML namespace:

126 `urn:oasis:names:tc:xacml:1.0:policy`

127 1.4 Background

128 Access to a standard-conformant Web-service end-point involves a number of *aspects*, such as:
129 reliable messaging, privacy, authorization, trust, authentication and cryptographic security. Each
130 *aspect* addresses a number of optional features and parameters, which must be coordinated
131 between communicating end-points if the service invocation is to be successful. The provider
132 and consumer of the service likely have different preferences amongst the available choices of
133 features and parameters. Therefore, a mechanism is required by which end-points may describe
134 the mandatory features of service invocation, optional features that they support and the order of
135 their preference amongst such features. Additionally, a procedure is required for combining and
136 reducing these feature descriptions into a service invocation instance that respects both end-
137 points' requirements. These requirements are explained in [WSPL Req].

138 This specification defines a profile of XACML that enables it to be used for describing policy
139 associated with Web-service end-points and using them in a successful invocation.

140 2. Model (Normative)

141 In this profile, an XACML `<PolicySet>` element is associated with a concrete Web-service end-
142 point definition. To that end, its `<Target>` element MUST identify the WSDL 1.1 port whose
143 features and parameters it describes. In the case that a policy must be targeted more finely than
144 a port, a second level of `<PolicySet>` whose `<Target>` element identifies the port's operations
145 and messages MUST be inserted. The `<PolicySet>` elements MUST contain `<Policy>`
146 elements that define the *objective* of each *aspect* of policy associated with the port.

147 An XACML `<Policy>` element is associated with a single *aspect* of an *end-point policy*. The
148 `<Target>` element of a `<Policy>` MUST identify the one *objective* of the *end-point policy* to
149 which it applies. Developers of Web-service specifications that make use of XACML MUST
150 define a name and type for its *objective*. In order for an end-point to be successfully invoked, all
151 of its *objectives* MUST be achieved by the service invocation. The `<Policy>` element MUST
152 contain `<Rule>` elements that define acceptable alternative *strategies* for achieving the
153 *objective*.

154 An XACML <Rule> element MUST describe one alternative **strategy** for achieving an **objective**.
155 At least one **strategy** MUST be successful if its **objective** is to be achieved. The lexical order of
156 the **strategies** in the **objective** SHOULD reflect the policy-writer's preferences. For example, the
157 policy writer's preferred **strategy** should appear first. The <Rule> element MUST contain a set
158 of <Apply> elements that define **predicates**.

159 An XACML <Apply> element MUST contain exactly one **predicate**. All **predicates** MUST be
160 satisfied by a service invocation if the associated **strategy** is to be successful.

161 An <Apply> element SHALL NOT contain another <Apply> element. It is RECOMMENDED
162 that <Apply> elements be structured as follows:

```
163 <Apply functionId="...">  
164   <AttributeSelector RequestContextPath="..." DataType="..." />  
165   <AttributeValue DataType="..."> ... </AttributeValue>  
166 </Apply>
```

167 In cases where the policy constrains the *relationship between attribute* values, as opposed to the
168 *literal value of an attribute*, it will be necessary to substitute a second <AttributeSelector>
169 element for the <AttributeValue> element in the above fragment. The order of the
170 <AttributeSelector> element and the <AttributeValue> element in the above fragment
171 MAY be reversed to achieve the required constraint if the applied function has no inverse (e.g.
172 subset). Any of the following elements MAY be used in place of the <AttributeSelector>
173 element in either position: <SubjectAttributeDesignator>, <ResourceAttributeDesignator> or
174 <EnvironmentAttributeDesignator>.

176 The relevant portion of the WSDL 1.1 data model is hierarchical, as shown in Figure 1.

177



178

179

Figure 1 - WSDL 1.1 hierarchical data model

180 This structure is reflected in the **end-point policy** model, as shown in Figure 2.

181 The `name` attribute values of objects in the WSDL 1.1 model SHALL be used in <Target>
182 elements of the **end-point policy** to associate policy statements with those objects. The `names`
183 SHALL be matched using string equality. Nevertheless, a <Target> element used to associate
184 a policy statement with a non-root object in the WSDL 1.1 model is intended to identify the object
185 within the context established by the <Target> elements of its enclosing <PolicySet>
186 element(s). So, target matching SHALL be performed on the set of objects that has been
187 successively refined by the enclosing layers of the **end-point policy**.

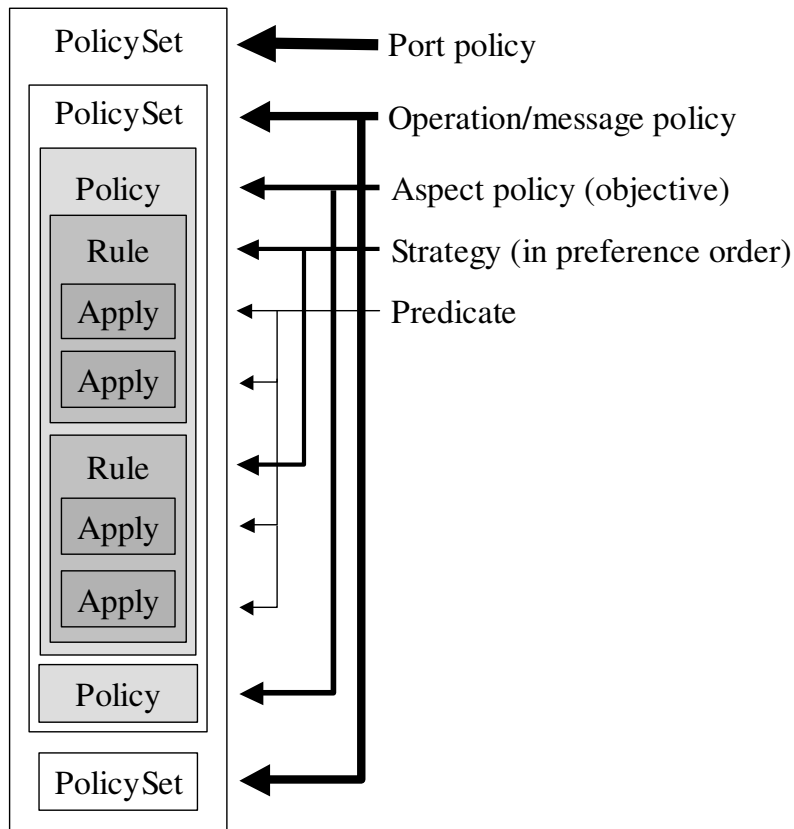


Figure 2 – End-point policy model

188

189

190 This model has been chosen to facilitate combining of *end-point policies*.

191 The following consequences flow from the model:

- 192 1. The policy-combining algorithm for <PolicySet> elements SHALL be
193 "urn:oasis:names:tc:xacml:1.0:policy-combining-algorithm:deny-overrides".
- 194 2. The contents of all <PolicySet/Target/Subjects> elements SHALL be
195 <AnySubject/>.
- 196 3. The contents of the top-level <PolicySet/Target/Resources> element SHALL be
197 the *name* attribute of the end-point's port definition.
- 198 4. The *MatchId* for the <PolicySet/Target/Resources> element SHALL be
199 "urn:oasis:names:tc:xacml:1.0:function:string-equal".
- 200 5. The contents of the top-level <PolicySet/Target/Actions> element SHALL be
201 <AnyAction/>.
- 202 6. If present, the contents of the second-level <PolicySet/Target/Resources>
203 element SHALL either be the *name* attribute of the end-point's message definition or the
204 element <AnyResource/>.
- 205 7. In the case that the <PolicySet/Target/Resources> element is the *name* attribute,
206 the *MatchId* SHALL be "urn:oasis:names:tc:xacml:1.0:function:string-equal".

- 207 8. If present, the contents of the second-level <PolicySet/Target/Actions> element
208 SHALL be the name attribute of the end-point's operation definition or the element
209 <AnyAction/>.
- 210 9. In the case that the <PolicySet/Target/Actions> element is the name attribute, the
211 MatchId SHALL be "urn:oasis:names:tc:xacml:1.0:function:string-equal".
- 212 10. If the contents of the second-level <PolicySet/Target/Resources> element is the
213 element <AnyResource/>, then the contents of the <PolicySet/Target/Actions>
214 element SHALL NOT be the element <AnyAction/>, and vice-versa. Otherwise, its
215 <Policy> elements should be placed immediately subordinate to the top-level
216 <PolicySet> element.
- 217 11. The rule-combining algorithm for a <Policy> element SHALL be
218 "urn:oasis:names:tc:xacml:1.0:rule-combining-algorithm:permit-overrides".
- 219 12. The MatchId for the <Policy/Target/Resources> element SHALL be
220 "urn:oasis:names:tc:xacml:1.0:function:anyURI-equal".
- 221 13. The Effect attribute of all <Rule> elements SHALL be "Permit".
- 222 14. The contents of the <Policy/Target/Subjects> element SHALL be
223 <AnySubject/>.
- 224 15. The contents of the <Policy/Target/Resources> element SHALL be
225 <AnyResource/>.
- 226 16. The contents of the <Policy/Target/Actions> element SHALL identify the
227 **objective** (see Section 4).
- 228 17. The <Rule/Target> element SHALL be omitted.
- 229 18. The FunctionId attribute of a <Condition> element SHALL be
230 "urn:oasis:names:tc:xacml:1.0:function:and".
- 231 19. The FunctionId attribute of an <Apply> element SHALL identify one of the matching
232 functions specified in XACML.

233 In order to be considered conformant with this profile, a <PolicySet> element MUST satisfy all
234 of these conditions.

235 **Predicates** express constraints on **attributes**. **Attributes** fall into three classes:

- 236 • **Unconstrained attributes**,
- 237 • **Constrained attributes** and
- 238 • **Authorized attributes**.

239 An **unconstrained attribute** is one whose value can be assigned by the policy-user. For
240 instance, the minimum time between re-transmissions of an unacknowledged message is an
241 **attribute** that should be under the control of the sender (within certain limits). This is, therefore,
242 in the class of **unconstrained attributes**.

243 A **constrained attribute**, on the other hand, is one whose value is outside the control of the
244 policy-user. This may be because it is an environmental **attribute** or a subject **attribute** whose
245 value is assigned by someone other than the policy-user. The emergency condition code is an
246 example of an environmental **attribute** over which a policy-user has no control; if this **attribute** is
247 used in a **predicate**, then the **predicate** either evaluates "True" or "False", regardless of any
248 action that the policy-user might take. An example of a subject **attribute** over which the policy-
249 user has no control is his or her status in a customer loyalty program. If this **attribute** is used in a
250 **predicate**, then the **predicate** either evaluates "True" or "False", regardless of any action that the

251 policy-user might take. Some **constrained attributes** vary with time either in a predictable or
252 unpredictable manner. In the case of the environmental **attribute** "time", it will never again adopt
253 values in the past, whereas, values in the future will arise in a predictable manner. In this case,
254 the policy-user may choose to wait until the **predicate** involving time evaluates "True".
255 An **authorized attribute** is one whose value has to be asserted by an authority, for instance the
256 policy-user's role. While the other party will not accept the policy-user's own assertion that he or
257 she occupies a particular role, the policy-user may be able to take action to obtain the necessary
258 assertion about the **attribute** from a suitable authority.

259 3. Example (Non-normative)

260 This section contains an example of a service-provider policy on the **aspect** of data-rate
261 allocation.

262 Here is a plain-language description of the policy.

263 Clients paying €150/minute are allocated a guaranteed minimum data-rate of 64kb/s.

264 Clients paying €45/minute are allocated a guaranteed minimum data-rate between 6pm
265 and midnight of 40kb/s.

266 In order to make the example somewhat easier to read, several abbreviations have been
267 introduced. For instance:

268 The <Subjects> element has been omitted from all the <Target> elements.

269 Only <*Match> elements have been retained in <Target> elements.

270 URIs have been abbreviated.

271 "**one-and-only" bag functions have been omitted around <AttributeDesignator>
272 elements in <Condition> elements.

273 `Data` and `Function` prefixes have been omitted. A reader familiar with XACML
274 should be able to reconstruct a syntactically correct policy from the information provided.

```
275 <?xml version="1.0" encoding="UTF-8"?>  
276 <PolicySet PolicySetId="Provider Policy"  
277 PolicyCombiningAlgId="deny-overrides">  
278   <Target>  
279     <Resources>  
280       <ResourceMatch MatchId="equal"  
281         <AttributeValue DataType="anyURI">  
282           serviceX:portX  
283         </AttributeValue>  
284         <ResourceAttributeDesignator AttributeId="portID"  
285           DataType="anyURI"/>  
286       </ResourceMatch>  
287     </Resources>  
288     <Actions>  
289       <AnyAction/>  
290     </Actions>  
291   </Target>  
292   <Policy PolicyId="Provider Data-Rate Allocation Objective"  
293     RuleCombiningAlgId="permit-overrides">  
294     <Target>  
295       <Actions>
```

```

296         <ActionMatch MatchId="equal">
297             <AttributeValue DataType="anyURI">
298                 data-rate-allocation
299             </AttributeValue>
300             <ActionAttributeDesignator AttributeId="objectiveId"
301             DataType="anyURI"/>
302         </ActionMatch>
303     </Actions>
304 </Target>
305 <Rule RuleId="Provider Data-Rate Allocation Objective Strategy
306 1" Effect="Permit">
307     <Condition FunctionId="and">
308         <Apply FunctionId="equal">
309             <SubjectAttributeDesignator DataType="integer"
310             AttributeId="fee"/>
311             <AttributeValue DataType="integer">
312                 150
313             </AttributeValue>
314         </Apply>
315         <Apply FunctionId="greater-than-or-equal">
316             <ResourceAttributeDesignator DataType="integer"
317             AttributeId="data-rate"/>
318             <AttributeValue DataType="integer">
319                 64000
320             </AttributeValue>
321         </Apply>
322     </Condition>
323 </Rule>
324 <Rule RuleId="Provider Data-Rate Allocation Objective Strategy
325 2" Effect="Permit">
326     <Condition FunctionId="and">
327         <Apply FunctionId="equal">
328             <SubjectAttributeDesignator DataType="integer"
329             AttributeId="fee"/>
330             <AttributeValue DataType="integer">
331                 45
332             </AttributeValue>
333         </Apply>
334         <Apply FunctionId="equal">
335             <ResourceAttributeDesignator DataType="integer"
336             AttributeId="data-rate"/>
337             <AttributeValue DataType="integer">
338                 40000
339             </AttributeValue>
340         </Apply>
341         <Apply FunctionId="greater-than-or-equal">
342             <EnvironmentAttributeDesignator DataType="time"
343             AttributeId="timeOfDay"/>
344             <AttributeValue DataType="time">
345                 18:00
346             </AttributeValue>
347         </Apply>
348     </Condition>
349 </Rule>
350 </Policy>
351 </PolicySet>

```

4. Instructions to standards developers

352

353 Developers of Web-services standards that are intended to conform with this profile MUST define
354 standard-specific policy parameters.

4.1 Procedure (Normative)

355

356 Developers of Web-services standards MUST complete the following steps.

357

1. Assign a URI for at least one `objectiveId` attribute. In the event that the specification
358 document-identifier is a URI, it MAY be used as the `objectiveId` URI.

359

2. Define a set of **attribute** names, types and semantics. Classify the **attributes** as
360 unconstrained, constrained or authorized.

361

3. Select one or more matching functions on the **attributes** from the matching functions
362 defined in [XACML]. The functions MUST be type-consistent with the **attributes**. For
363 every individual **attribute**, its associated matching functions MUST be combinable, as
364 defined in Table 1. It is STRONGLY RECOMMENDED to use *type-greater-than-or-equal*
365 or *type-less-than-or-equal* matching functions in preference to *type-greater-than* or *type-*
366 *less-than* matching functions, respectively. If it is, nonetheless, necessary to use *type-*
367 *greater-than* or *type-less-than* matching functions, then ceiling and floor operations
368 (respectively) MUST be defined for the corresponding **attribute**. This merely involves
369 defining a resolution for the **attribute** value. For instance, the **attribute** “minimum time
370 between re-transmissions of an unacknowledged message” may be assigned a
371 resolution of 1 minute. Then, if this **attribute** were to be used as the second operand in a
372 duration-greater-than function, the ceiling operation on this **attribute** would return the
373 shortest value greater than the specified value with a resolution of 1 minute.

374

These attributes and functions MAY be used in **predicates**.

4.2 Example (Non-normative)

375

376 A committee defining the reliable messaging **aspect** of Web-service invocation might assign the
377 URI:

378

urn:oasis:names:tc:wsrm:1.0:objectiveId

380

381 as the `objectiveId`.

382

It might identify the *maximum-time-to-live* **attribute** as a parameter of policy. It might assign the
383 identifier:

384

urn:oasis:names:tc:wsrm:1.0:maximum-time-to-live

386

387 to this **attribute**. Then it might identify the **attribute** type to be

388

<http://www.w3.org/TR/2002/WD-xquery-operators-20020816#DayTimeDuration>.

389

390

391 It might define its meaning to be the maximum value permitted to be assigned by the requestor to
392 the “time-to-live” parameter associated with a service request. Because the **attribute** value can
393 be assigned by the requestor, this is an **unconstrained attribute**.

394 Then it might identify

395

396 urn:oasis:names:tc:xacml:1.0:function:dateTime-less-than-or-equal

397

398 as the matching function associated with the **attribute**. Because this function is neither a *type-*
399 *greater-than* nor a *type-less-than* matching function, there is no need to define a ceiling or floor
400 operation.

401 The committee MUST specify all relevant parameters in a similar way.

402 5. Definitions (Normative)

403 This profile defines one **attribute**.

404 Name: urn:oasis:names:tc:xacml:1.0:attribute:objectiveId.

405 Type: xs:anyURI.

406 Meaning: the value of this **attribute** indicates the **aspect** of policy addressed by a <Policy>
407 element. The

408 Policy/Target/Actions/ActionMatch/ActionAttributeDesignator/@AttributeI
409 d attribute MUST be assigned this value.

410 6. End-point policy combination (Normative)

411 The need to combine two or more policies is described in [WSPL Req].

412 The procedure for combining two top-level <PolicySet> elements is described here. More than
413 two <PolicySet> elements MAY be combined by repeating this procedure. Alternative
414 procedures that achieve the same result under all circumstances SHALL be considered
415 conformant.

416 The combining procedure involves combining **coincident** top-level <PolicySet> elements, then
417 combining **coincident** second-level <PolicySet> elements within the combined top-level
418 <PolicySet> elements, then combining **coincident** <Policy> elements within the combined
419 <PolicySet> elements, then combining **coincident** <Rule> elements within the combined
420 <Policy> elements and finally combining **coincident** <Apply> elements within the combined
421 <Rule> elements. Finally, elimination and substitution steps are applied.

422 The detailed steps are described below.

423 The effect of this procedure is to identify a single <Rule> element for each **objective** that
424 represents the contract between the parties. The contract is compatible with both of the original
425 **end-point policies**, while reflecting the preferences of the **combiner**.

426

6.1 Combine top-level <PolicySet> elements

427 Combine **coincident** top-level <PolicySet> elements. <PolicySet> elements are
428 **coincident** if and only if their <Target> elements are identical.

429 In order to combine two top-level <PolicySet> elements, append the foreign <Policy> and
430 second-level <PolicySet> elements to the **combiner's** <Policy> and second-level
431 <PolicySet> elements and assign a new unique PolicySetId attribute.

432

6.2 Combine second-level <PolicySet> elements

433 If second-level <PolicySet> elements are present, then all **coincident** pairs of these MUST be
434 combined in the same way. If a second-level <PolicySet/Target/Resources> element
435 contains the <AnyResource/> element, then it is **coincident** with another second-level
436 <PolicySet> element if and only if their <Target/Actions> elements are identical. The
437 converse is the case if the <AnyAction> element is present.

438

6.3 Combine <Policy> elements

439 Within the resulting <PolicySet> elements, combine all **coincident** <Policy> elements.
440 <Policy> elements are **coincident** if and only if their <Target> elements are identical.

441 In order to combine two <Policy> elements, append the foreign <Rule> elements to the
442 **combiner's** <Rule> elements and assign a new unique PolicyId attribute.

443

6.4 Combine <Rule> elements

444 Within each resulting <Policy> element, combine <Rule> elements in all possible pairings,
445 taking one from the **combiner's** set and one from the foreign set. The **combiner's** first
446 <Policy> element SHOULD be paired with each of the foreign <Policy> elements, starting
447 with the first, then the **combiner's** second <Policy> element SHOULD be paired with each of
448 the foreign <Policy> elements, etc.. This procedure respects the preferences of each policy
449 writer, while giving priority to those of the **combiner**.

450 In order to combine two <Rule> elements, append the <Apply> elements from the foreign
451 <Rule> element to the **combiner's** <Apply> elements and assign a new unique RuleId
452 attribute.

453

6.5 Combine <Apply> elements

454 Within each resulting <Rule> element, combine all **coincident** <Apply> elements. <Apply>
455 elements are **coincident** if they constrain the same **attribute**. If there exists no **attribute** value
456 for which both <Apply> elements evaluate to "True", then their **strategies** are incompatible and
457 the <Rule> element MUST be discarded. The test for compatible strategies is shown in the third
458 column of Table 1. If no <Rule> elements remain, then the procedure SHALL terminate in
459 failure. Note that in the case where the same **attribute** is constrained by different **aspects**, this
460 procedure will not detect incompatible constraints.

461 **Coincident** <Apply> elements SHALL be combined as shown in the fourth column of Table 1.

462 Table 1 is to be interpreted according to the following key.

463 1. Columns one, two and four contain shorthand versions of an XACML <Apply> element.
464 The portion before the open parenthesis (e.g. "type-equal" in the first row) represents the

- 465 <Apply> element's FunctionId attribute value. The "type-" portion represents any of
 466 the type-specific parts of the standard XACML function identifiers.
- 467 2. Alphabetic symbols (e.g. "a" in the first row) represent XACML
 468 <AttributeDesignator>, <AttributeSelector> or <AttributeValue>
 469 elements.
- 470 3. Where N/A appears in the fourth column there is no single replacement <Apply>
 471 element: the **predicates** are compatible, but not combinable. In these cases, the original
 472 <Apply> elements MUST NOT be modified by this step in the procedure.
- 473 4. \cap means set intersection.
- 474 5. \subseteq means "is a proper subset of".

First <Apply> element	Second <Apply> element	Compatible strategies	Replacement <Apply> element	
type-equal(a,b)	type-equal(a,c)	$b == c$	type-equal(a,b)	
type-equal(a,b)	type-greater-than(a,c)	$b > c$	type-equal(a,b)	
type-equal(a,b)	type-greater-than-or-equal(a,c)	$b \geq c$	type-equal(a,b)	
type-equal(a,b)	type-less-than(a,c)	$b < c$	type-equal(a,b)	
type-equal(a,b)	type-less-than-or-equal(a,c)	$b \leq c$	type-equal(a,b)	
type-greater-than(a,b)	type-greater-than(a,c)		type-greater-than(a,max(b,c))	
type-greater-than(a,b)	type-greater-than-or-equal(a,c)		Where $b \geq c$	type-greater-than(a,b)
			Where $b < c$	type-greater-than-or-equal(a,c)
type-greater-than-or-equal(a,b)	type-greater-than-or-equal(a,c)		type-greater-than-or-equal(a,max(b,c))	
type-less-than(a,b)	type-less-than(a,c)		type-less-than(a,min(b,c))	
type-less-than(a,b)	type-less-than-or-equal(a,c)		Where $b > c$	type-less-than-or-equal(a,c)
			Where $b \leq c$	type-less-than(a,b)
type-less-than-or-equal(a,b)	type-less-than-or-equal(a,c)		type-less-than-or-equal(a,min(b,c))	
type-greater-than(a,b)	type-less-than(a,c)	$b < c$	N/A	
type-greater-than(a,b)	type-less-than-or-	$b < c$	N/A	

	equal(a,c)		
type-greater-than-or-equal(a,b)	type-less-than(a,c)	$b < c$	N/A
type-greater-than-or-equal(a,b)	type--less-than-or-equal(a,c)	$b < c$	N/A
set-equals(a,b)	set-equals(a,c)	$b == c$	set-equals(a,b)
set-equals(a,b)	subset(a,c)	$b \subseteq c$	set-equals(a,b)
subset(a,b)	subset(a,c)	$\cap (b,c) \neq 0$	subset (a, $\cap (b,c)$)

475 **Table 1 - Predicate combination**

476 **6.6 Eliminate <Policy> elements**

477 Following combination, an elimination step MUST be applied. The <Rule> elements represent
478 the available **strategies** in order of preference for each **aspect**. Ideally, the policy-user would
479 adopt the first <Rule> element as its **strategy** for invoking the service. However, some
480 **strategies** may place constraints on **attributes** that are not within the control of the policy-user.
481 Such strategies MUST be eliminated.

482 Elimination proceeds by examining each <Apply> element, as described below.

- 483 1. If the <Apply> element places a literal constraint on a **constrained attribute**, then the
484 policy-user SHALL test whether the constraint is satisfied by the **attribute**. If it is, then it
485 SHALL proceed. If it is not, then the enclosing <Rule> element SHALL be eliminated.
- 486 2. If the <Apply> element places a literal constraint on an **unconstrained attribute**, then the
487 policy-user SHALL assign a value to the **attribute** that satisfies the constraint. If the required
488 value is not in the available range, then the enclosing <Rule> element SHALL be eliminated.
- 489 3. If the <Apply> element constrains the relationship between two **constrained attributes**,
490 then the policy-user SHALL test whether the constraint is satisfied by the **attributes**. If it is,
491 then it SHALL proceed. If it is not, then the enclosing <Rule> element SHALL be eliminated.
- 492 4. If the <Apply> element constrains the relationship between two **unconstrained attributes**,
493 then the policy-user SHALL assign a value to one or both of the **attributes** that satisfies the
494 constraint. If the required value is not in the available range, then the enclosing <Rule>
495 element SHALL be eliminated.
- 496 5. If the <Apply> element constrains the relationship between a **constrained attribute** and an
497 **unconstrained attribute**, then the policy-user SHALL assign a value to the **unconstrained**
498 **attribute** that satisfies the constraint. If the required value is not in the available range, then
499 the enclosing <Rule> element SHALL be eliminated.
- 500 6. If the <Apply> element constrains **authorized attributes**, then the policy-user SHALL obtain
501 the required **attribute** from an acceptable authority. The **strategy** containing the **attribute**
502 constraint should also indicate what constitutes an acceptable authority. If the required
503 **attribute** cannot be obtained, then the enclosing <Rule> element SHALL be eliminated.

504 <Rule> elements MUST be examined in order until one survives the elimination procedure. This
505 represents the highest preference **strategy** with which the policy-user is able to comply.
506 Therefore, this (and only this) one SHALL be retained.

507 If, after completing the elimination step, no <Rule> elements remain, then the procedure SHALL
508 terminate in failure.

509 **6.7 Substitute <Apply> elements**

510 Following elimination, a substitution step MAY be applied to the <Apply> elements of the
511 remaining <Rule> element. Substitution proceeds by the following steps. **Predicates** that only
512 express constraints between **constrained attributes** MAY be eliminated, as it has been
513 determined by the previous step that these evaluate “True”. The substitutions shown in Table 2
514 SHALL be applied.

<Apply> element	Replacement <Apply> element
type-greater-than(a,b)	type-equal(a, \lceil b)
type-greater-than-or-equal(a,b)	type-equal(a,b)
type-less-than(a,b)	type-equal(a, \lfloor b)
type-less-than-or-equal(a,b)	type-equal(a,b)
type-subset(a,b)	set-equals(a,b)

515 **Table 2 – Substitution procedure**

516 Where \lceil represents the ceiling operation defined for the **attribute** and \lfloor represents the floor
517 operation.

518 In the case of a **strategy** that contains compatible, but non-combinable, **predicates** (see note to
519 Table 1) the <Rule> element will contain more than one <Apply> element constraining the
520 same **attribute**. In such cases, all but one of these <Apply> elements MUST be eliminated.
521 The choice of element to retain is left to the implementer. However, it is RECOMMENDED to
522 retain the final one, as this gives priority to the **combiner’s** preference.

523 In the case that one <Apply> element expresses a relational constraint between two **attributes**,
524 and another <Apply> element expresses a literal constraint on one of those **attributes**, then the
525 value of this **attribute**, as dictated by the literal constraint, MAY be substituted for its designator
526 in the other <Apply> element. This procedure MAY be applied recursively until as many of the
527 relational constraints as possible have been replaced by literal constraints.

528 **6.8 Result**

529 The result of this procedure is a set of **strategies**, one for each **aspect** of policy, and each
530 containing value assignments for **attributes** that are under the control of the policy-user. A
531 service invocation using these **attribute** assignments conforms with the applicable policy of both
532 the consumer and the provider.

533 **7. Security considerations (Non-normative)**

534 Policies must be integrity protected. The policy-user must confirm that the author of the policy is
535 an entity that is authoritative for the target end-point. How this is achieved is outside the scope of
536 this specification.

537

8. Bindings

538 <PolicySet> elements MAY be distributed in a [WSDL 1.1] or WSDL 1.2 service description or
539 in a [SOAP 1.1] message. When they are distributed by one of these means, they MUST be
540 distributed as defined in this section.

541

8.1 WSDL 1.1 (Normative)

542 This section defines how <PolicySet> elements SHALL be included in a WSDL 1.1 service
543 description for a Web-service end-point.

544

8.1.1. Introduction

545 As a precursor to invoking a WSDL 1.1 operation of a WSDL 1.1 port, certain consumer
546 configuration steps are likely to be required, and these configuration steps are likely to be
547 associated with the port, rather than with an individual operation. Locating, retrieving, validating
548 and combining policy are appropriate functions to perform as one of these configuration steps.

549 Different *aspects* of policy may be most applicable to different objects within the WSDL 1.1 data
550 model, see Figure 1. For instance, privacy policy may apply to a WSDL 1.1 message definition,
551 regardless of which WSDL 1.1 operation uses the message. Crypto-security policy, on the other
552 hand, may apply to a message definition, differently, according to which operation uses the
553 message. And, trust policy may apply to the port, independent of which operation or message is
554 used.

555

8.1.2. Attachment

556 For the reasons stated in Section 8.1.1, a top-level <PolicySet> element SHALL be targeted
557 only at a WSDL 1.1 port. However, it MUST be possible to associate a policy statement with any
558 object (port, operation or message) either alone or in combination, see Figure 2. For this reason,
559 policy statements MUST be capable of differentiating between the various WSDL 1.1 operation
560 and message definitions of the WSDL 1.1 port at which they are targeted.

561 The WSDL 1.1 schema requires that <wsdl/port>, <wsdl/operation> and
562 <wsdl/message> elements have a *name* attribute of type NCName. This attribute is used to
563 associate policies with a particular port, operation or message or combinations thereof. URLs are
564 a form of NCName.

565

8.1.3. Structure

566 Conformant <PolicySet> elements SHALL be structured as follows:

567 The top-level element SHALL be a <PolicySet> element whose
568 <PolicySet/Target/Resources> element identifies the WSDL 1.1 port to which it is
569 applicable, by means of the *wsdl/port@name* attribute.

570 Policies that apply to the WSDL 1.1 port, regardless of the particular operation or message
571 SHALL be contained in <Policy> elements immediately subordinate to the top-level
572 <PolicySet> element.

573 Policies that apply to some combination of WSDL 1.1 port, operation and message SHALL be
574 contained in <PolicySet> elements subordinate to the top-level <PolicySet> element.

575 These second-level <PolicySet> elements SHALL have <PolicySet/Target/Actions>
576 elements that identify the WSDL 1.1 operation, and <PolicySet/Target/Resources>

draft-xacml-wspl-03.doc

577 elements that identify the WSDL 1.1 message to which they are applicable, by means of the
578 `wSDL/operation@name` and `wSDL/message@name` attributes, respectively. Only WSDL 1.1
579 message definitions of the “input” type SHALL be identified.

580 The `<Policy/Target/Resources>` element SHALL identify the *aspect* of policy to which it
581 applies.

582 **8.1.4. Integrity/authenticity protection**

583 If the `<wSDL/definitions>` element is integrity-protected, then the `<PolicySet>` elements
584 SHOULD be included within the integrity-protection of that element.

585 Where it is not possible to do this, either because the `<wSDL/definitions>` element is not
586 integrity-protected, or for other reasons, `<PolicySet>` elements SHALL be enclosed in a
587 `<saml/Assertion>` element wrapper [SAML]. This allows supporting information, such as the
588 `saml/Assertion@Issuer` attribute to be attached. The `<saml/Assertion>` element SHALL
589 be integrity-protected.

590 The policy-user SHALL ignore the `PolicySet@PolicySetId` attribute.

591 The WSDL 1.1 port to which a policy applies SHALL be identified in the top-level
592 `<PolicySet/Target/Resources>` element, by means of the `wSDL/port@name` attribute.
593 The policy-user SHALL confirm that it has located the correct policy by examining the policy’s top-
594 level `<PolicySet/Target/Resources>` element Furthermore, if they are present, the policy-
595 user SHALL confirm that the policy is current, by examining the
596 `saml/Assertion/Conditions@NotBefore` and
597 `saml/Assertion/Conditions@NotOnOrAfter` attributes.

598 The `wSDL/port@name` attribute SHALL contain a URL. In the case where a policy is wrapped in
599 a `<saml/Assertion>`, the host and domain parts of the `wSDL/port@name` URL SHALL be
600 identical to the `saml/Assertion@Issuer` attribute value. The `saml/Assertion@Issuer`
601 attribute value SHALL be identical to the CN attribute value in the subject field of the certificate
602 [X509] that validates the `<saml/Assertion>` element, whether integrity protection is provided
603 by SSL or XML Digital Signature.

604 **8.1.5. Schema**

605 A `<PolicySet>` element SHALL be included in a `<wSDL/definitions>` element in
606 accordance with the following schema. Additions to the WSDL 1.1 SOAP binding are highlighted.

```
607 <?xml version="1.0" encoding="UTF-8"?>
608 <schema targetNamespace="http://schemas.xmlsoap.org/wSDL/policy-
609 conformant-soap/" xmlns="http://www.w3.org/2001/XMLSchema"
610 xmlns:policy-conformant-
611 soap="http://schemas.xmlsoap.org/wSDL/policy-conformant-soap/"
612 xmlns:xacml="urn:oasis:names:tc:xacml:1.0:policy">
613 <import namespace="urn:oasis:names:tc:xacml:1.0:policy"
614 schemaLocation="http://www.oasis-
615 open.org/committees/download.php/915/cs-xacml-schema-policy-
616 01.xsd"/>
617 <element name="EndPointPolicy" type="xacml:PolicySetType"/>
618 <element name="binding" type="policy-conformant-
619 soap:bindingType"/>
620 <complexType name="bindingType">
621 <attribute name="transport" type="anyURI" use="optional"/>
622
```

```

623     <attribute name="style" type="policy-conformant-
624 soap:styleChoice" use="optional"/>
625   </complexType>
626   <simpleType name="styleChoice">
627     <restriction base="string">
628       <enumeration value="rpc"/>
629       <enumeration value="document"/>
630     </restriction>
631   </simpleType>
632   <element name="operation" type="policy-conformant-
633 soap:operationType"/>
634   <complexType name="operationType">
635     <attribute name="soapAction" type="anyURI" use="optional"/>
636     <attribute name="style" type="policy-conformant-
637 soap:styleChoice" use="optional"/>
638   </complexType>
639   <element name="body" type="policy-conformant-soap:bodyType"/>
640   <complexType name="bodyType">
641     <attribute name="encodingStyle" type="anyURI" use="optional"/>
642     <attribute name="parts" type="NMTOKENS" use="optional"/>
643     <attribute name="use" type="policy-conformant-soap:useChoice"
644 use="optional"/>
645     <attribute name="namespace" type="anyURI" use="optional"/>
646   </complexType>
647   <simpleType name="useChoice">
648     <restriction base="string">
649       <enumeration value="literal"/>
650       <enumeration value="encoded"/>
651     </restriction>
652   </simpleType>
653   <element name="fault" type="policy-conformant-soap:faultType"/>
654   <complexType name="faultType">
655     <complexContent>
656       <restriction base="policy-conformant-soap:bodyType">
657         <attribute name="parts" type="NMTOKENS" use="prohibited"/>
658       </restriction>
659     </complexContent>
660   </complexType>
661   <element name="header" type="policy-conformant-
662 soap:headerType"/>
663   <complexType name="headerType">
664     <all>
665       <element ref="policy-conformant-soap:headerfault"/>
666     </all>
667     <attribute name="message" type="QName" use="required"/>
668     <attribute name="parts" type="NMTOKENS" use="required"/>
669     <attribute name="use" type="policy-conformant-soap:useChoice"
670 use="required"/>
671     <attribute name="encodingStyle" type="anyURI" use="optional"/>
672     <attribute name="namespace" type="anyURI" use="optional"/>
673   </complexType>
674   <element name="headerfault" type="policy-conformant-
675 soap:headerfaultType"/>
676   <complexType name="headerfaultType">
677     <attribute name="message" type="QName" use="required"/>
678     <attribute name="parts" type="NMTOKENS" use="required"/>
679     <attribute name="use" type="policy-conformant-soap:useChoice"
680 use="required"/>

```

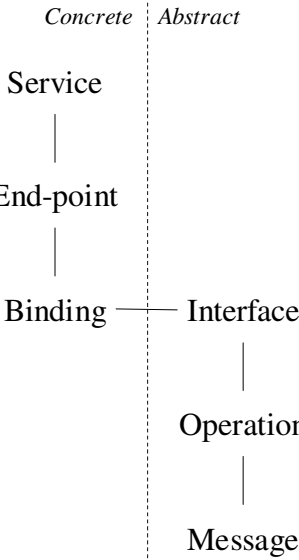
```

681 <attribute name="encodingStyle" type="anyURI" use="optional"/>
682 <attribute name="namespace" type="anyURI" use="optional"/>
683 </complexType>
684 <element name="address" type="policy-conformant-
685 soap:addressType"/>
686 <complexType name="addressType">
687 <attribute name="location" type="anyURI" use="required"/>
688 </complexType>
689 <element name="port" type="wsdl:portType"/>
690 <complexType name="portType">
691 <complexContent>
692 <extension base="wsdl:documented">
693 <sequence>
694 <any namespace="##other" minOccurs="0"/>
695 <element ref="xacml:PolicySetIdReference"/>
696 </sequence>
697 <attribute name="name" type="NCName" use="required"/>
698 <attribute name="binding" type="QName" use="required"/>
699 </extension>
700 </complexContent>
701 </complexType>
702 </schema>

```

703 **8.2 WSDL 1.2 draft (Non-normative)**

704 Version 1.2 of WSDL is currently in draft form. Therefore, this specification does not provide a
705 normative binding for XACML to WSDL 1.2. However, in the current draft of WSDL 1.2, the
706 counterpart of the WSDL 1.1 *port* component is the WSDL 1.2 *binding* component (see Figure 3).
707 Therefore, it is anticipated that, with the exception of swapping the roles of port and binding, the
708 standard method of attaching a <PolicySet> to a WSDL 1.2 definition will be identical to the
709 standard method of attaching a <PolicySet> to a WSDL 1.1 definition (see Section 8.1).



710 **Figure 3 - WSDL 1.2 draft data model**

711

712

8.3 SOAP 1.1 (Normative)

713

8.3.1. Introduction

714 In the case of a WSDL request-response-operation, consumer policies for the response message
715 MAY be conveyed in a SOAP header of the corresponding request message. The names
716 assigned to objects by the consumer are not guaranteed to match those assigned by the provider
717 to the equivalent objects. Therefore, the consumer MUST use the names assigned by the
718 provider to associate consumer policy with WSDL objects. This means that response policies
719 MUST be tailored to the particular provider, and the consumer may require a different policy for
720 each provider of the same service.

721 In the case of the WSDL solicit-response-operation and the notification-operation, the WSDL
722 technique, described above, SHALL be used to disseminate consumer policy.

723

8.3.2. Structure

724 Conformant <PolicySet> elements SHALL be structured as described in Section 8.1.3, above.
725 Only WSDL message definitions of the "output" or "fault" types SHALL be targeted by policies.

726

8.3.3. Integrity/authenticity protection

727 If the <soap/header> element is integrity-protected, then the <PolicySet> elements
728 SHOULD be included within the integrity-protection of that element.

729 Where it is not possible to do this, either because the <soap/header> element is not integrity-
730 protected, or for other reasons, <PolicySet> elements SHALL be enclosed in a
731 <saml/Assertion> element wrapper [SAML]. The <saml/Assertion> element SHALL be
732 integrity protected.

733 The policy-user SHALL ignore the PolicySet@PolicySetId attribute.

734 The policy-user SHALL verify that the <PolicySet/Target> element identifies the
735 wsdl/port@name attribute of the WSDL 1.1 port that originated the request.

736 In the case where a policy is wrapped in a <saml/Assertion>, the host and domain parts of
737 the authenticated name of the originating end-point SHALL be identical to the
738 saml/Assertion@Issuer attribute value. The saml/Assertion@Issuer attribute value
739 SHALL be identical to the CN attribute value in the subject field of the certificate [X509] that
740 validates the <saml/Assertion> element, whether integrity protection is provided by SSL or
741 XML Digital Signature.

742 If they are present, the policy-user SHALL confirm that the policy is current, by examining the
743 saml/Assertion/Conditions@NotBefore and
744 saml/Assertion/Conditions@NotOnOrAfter attributes.

745

8.3.4. Schema

746 An XACML <PolicySet> element SHALL be included in a SOAP header in accordance with the
747 following schema.

748

749

750

751

752

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema
targetNamespace="urn:oasis:names:tc:xacml:wspl:draft:02"
xmlns:EndPointPolicy="urn:oasis:names:tc:xacml:wspl:draft:02"
xmlns:xs=http://www.w3.org/2001/XMLSchema
```

```

753 xmlns:xacml="urn:oasis:names:tc:xacml:1.0:policy"
754 xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
755 elementFormDefault="qualified" attributeFormDefault="unqualified">
756   <xs:import namespace="http://schemas.xmlsoap.org/soap/envelope/"
757   schemaLocation="http://schemas.xmlsoap.org/soap/envelope/" />
758   <xs:import namespace="urn:oasis:names:tc:xacml:1.0:policy"
759   schemaLocation="http://www.oasis-
760   open.org/committees/download.php/915/cs-xacml-schema-policy-
761   01.xsd" />
762   <xs:element name="Policy" type="EndPointPolicy:PolicyType" />
763   <xs:complexType name="PolicyType">
764     <xs:complexContent>
765       <xs:extension base="SOAP-ENV:Header">
766         <xs:sequence>
767           <xs:element ref="xacml:PolicySet" />
768         </xs:sequence>
769       </xs:extension>
770     </xs:complexContent>
771   </xs:complexType>
772 </xs:schema>

```

773 9. References (Non-normative)

- 774 **[RFC2119]** S. Bradner, Key words for use in RFCs to Indicate Requirement Levels, IETF
775 RFC 2119, March 1997. Located at: <http://www.ietf.org/rfc/rfc2119.txt>
- 776 **[SAML]** Assertions and Protocol for the OASIS Security Assertion Markup Language (SAML)
777 OASIS Standard, 5 November 2002. Located at: [http://www.oasis-
open.org/committees/download.php/1371/oasis-sstc-saml-core-1.0.pdf](http://www.oasis-

778 open.org/committees/download.php/1371/oasis-sstc-saml-core-1.0.pdf)
- 779 **[SOAP 1.1]** Simple Object Access Protocol (SOAP) 1.1, W3C Note 08 May 2000. Located
780 at: http://www.w3.org/TR/SOAP/#_Toc478383497
- 781 **[WSDL 1.1]** Web Services Description Language (WSDL) 1.1, W3C Note 15 March 2001.
782 Located at: <http://www.w3.org/TR/wsdl#A4.2>
- 783 **[WSPL Req]** Web-services policy language use-cases and requirements, working draft 01, 7
784 March 2003. Located at: <http://lists.oasis-open.org/archives/xacml/200303/msg00014.html>
- 785 **[X509]** ITU-T Recommendation X.509 version 3 (1997). "Information Technology – Open
786 System Interconnection – The Directory Authentication Framework" ISO/IEC 9594-1:1997
- 787 **[XACML v1.0]** eXtensible Access Control Markup Language (XACML) Version 1.0
788 OASIS Standard, 18 February 2003. Located at: [http://www.oasis-
open.org/committees/xacml/repository/](http://www.oasis-

789 open.org/committees/xacml/repository/)
- 790 **[XF]** XQuery 1.0 and XPath 2.0 Functions and Operators, W3C Working Draft 16 August
791 2002. Available at: <http://www.w3.org/TR/2002/WD-xquery-operators-20020816>
- 792 **[XS]** XML Schema, parts 1 and 2. Available at: <http://www.w3.org/TR/xmlschema-1/> and
793 <http://www.w3.org/TR/xmlschema-2/>

Appendix A. Worked example (Non-normative)

794
795

796 This appendix contains a worked example to illustrate the process of combining and reducing
797 XACML policies that conform with this profile, using two simple policy instances. The example is
798 drawn from the realm of data-rate allocation, and builds on the example given in Section 0.

Consumer policy

799

800 This section describes the service consumer's requirements for the data-rate allocation *aspect* of
801 service invocation.

A.1.1. Plain-language policy

802

803 The plain language description of the policy is as follows.

804 The service-consumer's first choice is to pay a maximum of €100/minute for a minimum
805 guaranteed data-rate of 64kb/s.

806 The second choice is to pay a maximum of €50/minute for a minimum guaranteed data-
807 rate between 9pm and midnight of 32kb/s.

A.1.2. XACML policy

808

```
809 <PolicySet PolicySetId="Consumer Policy"  
810 PolicyCombiningAlgId="deny-overrides">  
811   <Target>  
812     <Resources>  
813       <ResourceMatch MatchId="equal"  
814         <AttributeValue DataType="anyURI">  
815           serviceX:portX  
816         </AttributeValue>  
817         <ResourceAttributeDesignator AttributeId="portID"  
818         DataType="anyURI"/>  
819       </ResourceMatch>  
820     </Resources>  
821     <Actions>  
822       <AnyAction/>  
823     </Actions>  
824   </Target>  
825   <Policy PolicyId="Consumer Data-Rate Allocation Objective"  
826     RuleCombiningAlgId="permit-overrides">  
827     <Target>  
828       <Actions>  
829         <ActionMatch MatchId="equal">  
830           <AttributeValue DataType="anyURI">  
831             data-rate-allocation  
832           </AttributeValue>
```

```

833         <ActionAttributeDesignator AttributeId="objectiveID"
834         DataType="anyURI"/>
835     </ActionMatch>
836 </Actions>
837 </Target>
838 <Rule RuleId="Consumer Data-Rate Allocation Objective Strategy
839 1" Effect="Permit">
840     <Condition FunctionId="and">
841         <Apply FunctionId="less-than-or-equal">
842             <SubjectAttributeDesignator DataType="integer"
843             AttributeId="fee"/>
844             <AttributeValue DataType="integer">
845                 100
846             </AttributeValue>
847         </Apply>
848         <Apply FunctionId="greater-than-or-equal">
849             <ResourceAttributeDesignator DataType="integer"
850             AttributeId="data-rate"/>
851             <AttributeValue DataType="integer">
852                 64000
853             </AttributeValue>
854         </Apply>
855     </Condition>
856 </Rule>
857 <Rule RuleId="Consumer Data-rate Allocation Objective Strategy
858 2" Effect="Permit">
859     <Condition FunctionId="and">
860         <Apply FunctionId="less-than-or-equal">
861             <SubjectAttributeDesignator DataType="integer"
862             AttributeId="fee"/>
863             <AttributeValue DataType="integer">
864                 50
865             </AttributeValue>
866         </Apply>
867         <Apply FunctionId="greater-than-or-equal">
868             <ResourceAttributeDesignator DataType="integer"
869             AttributeId="data-rate"/>
870             <AttributeValue DataType="integer">
871                 32000
872             </AttributeValue>
873         </Apply>
874         <Apply FunctionId="greater-than-or-equal">
875             <EnvironmentAttributeDesignator DataType="time"
876             AttributeId="timeOfDay"/>
877             <AttributeValue DataType="time">
878                 21:00
879             </AttributeValue>
880         </Apply>
881     </Condition>
882 </Rule>
883 </Policy>
884 <</PolicySet>

```


885

Combining process

886

A.1.3. Combine <PolicySet> elements

887

The <Target> elements of the two <PolicySet> elements are identical. Therefore, they may

888

be combined. Append the provider <Policy> elements and assign a new PolicySetId value.

889

```
<PolicySet PolicySetId="Consumer Policy"
890 PolicyCombiningAlgId="deny-overrides">
891   <Target>
892     <Resources>
893       ResourceMatch MatchId="equal"
894       <AttributeValue DataType="anyURI">
895         serviceX:portX
896       </AttributeValue>
897       <ResourceAttributeDesignator AttributeId="portID"
898       DataType="anyURI"/>
899     </ResourceMatch>
900   </Resources>
901   <Actions>
902     <AnyAction/>
903   </Actions>
904 </Target>
905   <Policy PolicyId="Consumer Data-rate Allocation Objective"
906     RuleCombiningAlgId="permit-overrides">
907     <Target>
908       <Actions>
909         <ActionMatch MatchId="equal">
910           <AttributeValue DataType="anyURI">
911             data-rate-allocation
912           </AttributeValue>
913           <ActionAttributeDesignator AttributeId="objectiveID"
914           DataType="anyURI"/>
915         </ActionMatch>
916       </Actions>
917     </Target>
918     <Rule RuleId="Consumer Data-rate Allocation Objective Strategy
919     1" Effect="Permit">
920       <Condition FunctionId="and">
921         <Apply FunctionId="less-than-or-equal">
922           <SubjectAttributeDesignator DataType="integer"
923           AttributeId="fee"/>
924           <AttributeValue DataType="integer">1.00</AttributeValue>
925         </Apply>
926         <Apply FunctionId="greater-than-or-equal">
927           <ResourceAttributeDesignator DataType="integer"
928           AttributeId="data-rate"/>
929           <AttributeValue DataType="integer">
930             64000
931           </AttributeValue>
932         </Apply>
933       </Condition>
934     </Rule>
935     <Rule RuleId="Consumer Data-rate Allocation Objective Strategy
936     2" Effect="Permit">
```

```

937     <Condition FunctionId="and">
938     <Apply FunctionId="less-than-or-equal">
939         <SubjectAttributeDesignator DataType="integer"
940 AttributeId="fee"/>
941         <AttributeValue DataType="integer">0.50</AttributeValue>
942     </Apply>
943     <Apply FunctionId="greater-than-or-equal">
944         <ResourceAttributeDesignator DataType="integer"
945 AttributeId="data-rate"/>
946         <AttributeValue DataType="integer">
947             32000
948         </AttributeValue>
949     </Apply>
950     <Apply FunctionId="greater-than-or-equal">
951         <EnvironmentAttributeDesignator DataType="time"
952 AttributeId="timeOfDay"/>
953         <AttributeValue DataType="time">9:00</AttributeValue>
954     </Apply>
955 </Condition>
956 </Rule>
957 </Policy>
958 <Policy PolicyId="Provider Data-rate Allocation Objective"
959 RuleCombiningAlgId="permit-overrides">
960     <Target>
961     <Actions>
962     <ActionMatch MatchId="equal">
963     <AttributeValue DataType="anyURI">
964     data-rate-allocation
965     </AttributeValue>
966     <ActionAttributeDesignator AttributeId="objectiveID"
967 DataType="anyURI"/>
968     </ActionMatch>
969     </Actions>
970 </Target>
971 <Rule RuleId="Provider Data-rate Allocation Objective Strategy
972 1" Effect="Permit">
973     <Condition FunctionId="and">
974     <Apply FunctionId="equal">
975     <SubjectAttributeDesignator DataType="integer"
976 AttributeId="fee"/>
977     <AttributeValue DataType="integer">1.50</AttributeValue>
978     </Apply>
979     <Apply FunctionId="greater-than-or-equal">
980     <ResourceAttributeDesignator DataType="integer"
981 AttributeId="data-rate"/>
982     <AttributeValue DataType="integer">
983     64000
984     </AttributeValue>
985     </Apply>
986     </Condition>
987 </Rule>
988 <Rule RuleId="Provider Data-rate Allocation Objective Strategy
989 2" Effect="Permit">
990     <Condition FunctionId="and">
991     <Apply FunctionId="equal">
992     <SubjectAttributeDesignator DataType="integer"
993 AttributeId="fee"/>
994     <AttributeValue DataType="integer">0.45</AttributeValue>

```

```

995         </Apply>
996         <Apply FunctionId="equal">
997             <ResourceAttributeDesignator DataType="integer"
998 AttributeId="data-rate"/>
999             <AttributeValue DataType="integer">
1000                 40000
1001             </AttributeValue>
1002         </Apply>
1003         <Apply FunctionId="greater-than-or-equal">
1004             <EnvironmentAttributeDesignator DataType="time"
1005 AttributeId="timeOfDay"/>
1006             <AttributeValue DataType="time">6:00</AttributeValue>
1007         </Apply>
1008     </Condition>
1009 </Rule>
1010 </Policy>
1011 </PolicySet>

```

1012 **A.1.4. Combine <Policy> elements**

1013 The <Target> elements of the two <Policy> elements are identical. Therefore, they may be
1014 combined. Append the provider <Rule> elements and assign a new PolicyId value.

```

1015 <PolicySet PolicySetId="Combined Policies"
1016 PolicyCombiningAlgId="deny-overrides">
1017     <Target>
1018         <Resources>
1019             <ResourceMatch MatchId="equal"
1020                 <AttributeValue DataType="anyURI">
1021                     serviceX:portX
1022                 </AttributeValue>
1023                 <ResourceAttributeDesignator AttributeId="portID"
1024 DataType="anyURI"/>
1025             </ResourceMatch>
1026         </Resources>
1027         <Actions>
1028             <AnyAction/>
1029         </Actions>
1030     </Target>
1031     <Policy PolicyId="Combined Data-rate Allocation Objective"
1032         RuleCombiningAlgId="permit-overrides">
1033         <Target>
1034             <Actions>
1035                 <ActionMatch MatchId="equal">
1036                     <AttributeValue DataType="anyURI">
1037                         data-rate-allocation
1038                     </AttributeValue>
1039                     <ActionAttributeDesignator AttributeId="objectiveID"
1040 DataType="anyURI"/>
1041                 </ActionMatch>
1042             </Actions>
1043         </Target>
1044         <Rule RuleId="Consumer Data-rate Allocation Objective Strategy
1045 1" Effect="Permit">
1046             <Condition FunctionId="and">
1047                 <Apply FunctionId="less-than-or-equal">

```

```

1048         <SubjectAttributeDesignator DataType="integer"
1049 AttributeId="fee"/>
1050         <AttributeValue DataType="integer">1.00</AttributeValue>
1051     </Apply>
1052     <Apply FunctionId="greater-than-or-equal">
1053         <ResourceAttributeDesignator DataType="integer"
1054 AttributeId="data-rate"/>
1055         <AttributeValue DataType="integer">
1056             64000
1057         </AttributeValue>
1058     </Apply>
1059 </Condition>
1060 </Rule>
1061 <Rule RuleId="Consumer Data-rate Allocation Objective Strategy
1062 2" Effect="Permit">
1063     <Condition FunctionId="and">
1064         <Apply FunctionId="less-than-or-equal">
1065             <SubjectAttributeDesignator DataType="integer"
1066 AttributeId="fee"/>
1067             <AttributeValue DataType="integer">0.50</AttributeValue>
1068         </Apply>
1069         <Apply FunctionId="greater-than-or-equal">
1070             <ResourceAttributeDesignator DataType="integer"
1071 AttributeId="data-rate"/>
1072             <AttributeValue
1073 DataType="integer">32000</AttributeValue>
1074         </Apply>
1075         <Apply FunctionId="greater-than-or-equal">
1076             <EnvironmentAttributeDesignator DataType="time"
1077 AttributeId="timeOfDay"/>
1078             <AttributeValue DataType="time">9:00</AttributeValue>
1079         </Apply>
1080     </Condition>
1081 </Rule>
1082 <Rule RuleId="Provider Data-rate Allocation Objective Strategy
1083 1" Effect="Permit">
1084     <Condition FunctionId="and">
1085         <Apply FunctionId="equal">
1086             <SubjectAttributeDesignator DataType="integer"
1087 AttributeId="fee"/>
1088             <AttributeValue DataType="integer">1.50</AttributeValue>
1089         </Apply>
1090         <Apply FunctionId="greater-than-or-equal">
1091             <ResourceAttributeDesignator DataType="integer"
1092 AttributeId="data-rate"/>
1093             <AttributeValue DataType="integer">
1094                 64000
1095             </AttributeValue>
1096         </Apply>
1097     </Condition>
1098 </Rule>
1099 <Rule RuleId="Provider Data-rate Allocation Objective Strategy
1100 2" Effect="Permit">
1101     <Condition FunctionId="and">
1102         <Apply FunctionId="equal">
1103             <SubjectAttributeDesignator DataType="integer"
1104 AttributeId="fee"/>
1105             <AttributeValue DataType="integer">0.45</AttributeValue>

```

```

1106         </Apply>
1107         <Apply FunctionId="equal">
1108             <ResourceAttributeDesignator DataType="integer"
1109 AttributeId="data-rate"/>
1110             <AttributeValue DataType="integer">
1111                 40000
1112             </AttributeValue>
1113         </Apply>
1114         <Apply FunctionId="greater-than-or-equal">
1115             <EnvironmentAttributeDesignator DataType="time"
1116 AttributeId="timeOfDay"/>
1117             <AttributeValue DataType="time">6:00</AttributeValue>
1118         </Apply>
1119     </Condition>
1120 </Rule>
1121 </Policy>
1122 </PolicySet>

```

1123 A.1.5. Combine <Rule> elements

1124 **Coincident** pairs of <Rule> elements are identified and combined. **Coincident** pairs of <Rule>
1125 elements are combined by appending the provider's <Apply> elements. Pairs are combined
1126 only where each member of the pair originally came from different <PolicySet> elements.

```

1127 <PolicySet PolicySetId="Combined Policies"
1128 PolicyCombiningAlgId="deny-overrides">
1129     <Target>
1130         <Resources>
1131             <ResourceMatch MatchId="equal"
1132                 <AttributeValue DataType="anyURI">
1133                     serviceX:portX
1134                 </AttributeValue>
1135                 <ResourceAttributeDesignator AttributeId="portID"
1136 DataType="anyURI"/>
1137             </ResourceMatch>
1138         </Resources>
1139         <Actions>
1140             <AnyAction/>
1141         </Actions>
1142     </Target>
1143     <Policy PolicyId="Combined Data-rate Allocation Objective"
1144 RuleCombiningAlgId="permit-overrides">
1145         <Target>
1146             <Actions>
1147                 <ActionMatch MatchId="equal">
1148                     <AttributeValue DataType="anyURI">
1149                         data-rate-allocation
1150                     </AttributeValue>
1151                     <ActionAttributeDesignator AttributeId="objectiveID"
1152 DataType="anyURI"/>
1153                 </ActionMatch>
1154             </Actions>
1155         </Target>
1156         <Rule RuleId="Consumer Strategy 1/Provider Strategy 1"
1157 Effect="Permit">
1158             <Condition FunctionId="and">

```

```

1159         <Apply FunctionId="less-than-or-equal">
1160             <SubjectAttributeDesignator DataType="integer"
AttributeId="fee"/>
1161         <AttributeValue DataType="integer">1.00</AttributeValue>
1162     </Apply>
1163
1164     <Apply FunctionId="greater-than-or-equal">
1165         <ResourceAttributeDesignator DataType="integer"
AttributeId="data-rate"/>
1166         <AttributeValue DataType="integer">
1167             64000
1168         </AttributeValue>
1169     </Apply>
1170     <Apply FunctionId="equal">
1171         <SubjectAttributeDesignator DataType="integer"
AttributeId="fee"/>
1172         <AttributeValue DataType="integer">1.50</AttributeValue>
1173     </Apply>
1174     <Apply FunctionId="greater-than-or-equal">
1175         <ResourceAttributeDesignator DataType="integer"
AttributeId="data-rate"/>
1176         <AttributeValue DataType="integer">
1177             64000
1178         </AttributeValue>
1179     </Apply>
1180 </Condition>
1181 </Rule>
1182 <Rule RuleId="Consumer Strategy 1/Provider Strategy 2"
Effect="Permit">
1183     <Condition FunctionId="and">
1184         <Apply FunctionId="less-than-or-equal">
1185             <SubjectAttributeDesignator DataType="integer"
AttributeId="fee"/>
1186             <AttributeValue DataType="integer">1.00</AttributeValue>
1187         </Apply>
1188         <Apply FunctionId="greater-than-or-equal">
1189             <ResourceAttributeDesignator DataType="integer"
AttributeId="data-rate"/>
1190             <AttributeValue DataType="integer">64000</AttributeValue>
1191         </Apply>
1192         <Apply FunctionId="equal">
1193             <SubjectAttributeDesignator DataType="integer"
AttributeId="fee"/>
1194             <AttributeValue DataType="integer">0.45</AttributeValue>
1195         </Apply>
1196         <Apply FunctionId="equal">
1197             <ResourceAttributeDesignator DataType="integer"
AttributeId="data-rate"/>
1198             <AttributeValue DataType="integer">40000</AttributeValue>
1199         </Apply>
1200         <Apply FunctionId="greater-than-or-equal">
1201             <EnvironmentAttributeDesignator DataType="time"
AttributeId="timeOfDay"/>
1202             <AttributeValue DataType="time">6:00</AttributeValue>
1203         </Apply>
1204     </Condition>
1205 </Rule>
1206 <Rule RuleId="Consumer Strategy 2/Provider Strategy 1"
Effect="Permit">

```

```

1217     <Condition FunctionId="and">
1218         <Apply FunctionId="less-than-or-equal">
1219             <SubjectAttributeDesignator DataType="integer"
1220 AttributeId="fee"/>
1221             <AttributeValue DataType="integer">0.50</AttributeValue>
1222         </Apply>
1223     </Apply FunctionId="greater-than-or-equal">
1224         <ResourceAttributeDesignator DataType="integer"
1225 AttributeId="data-rate"/>
1226         <AttributeValue DataType="integer">32000</AttributeValue>
1227     </Apply>
1228     <Apply FunctionId="greater-than-or-equal">
1229         <EnvironmentAttributeDesignator DataType="time"
1230 AttributeId="timeOfDay"/>
1231         <AttributeValue DataType="time">9:00</AttributeValue>
1232     </Apply>
1233     <Apply FunctionId="equal">
1234         <SubjectAttributeDesignator DataType="integer"
1235 AttributeId="fee"/>
1236         <AttributeValue DataType="integer">1.50</AttributeValue>
1237     </Apply>
1238     <Apply FunctionId="greater-than-or-equal">
1239         <ResourceAttributeDesignator DataType="integer"
1240 AttributeId="data-rate"/>
1241         <AttributeValue DataType="integer">64000</AttributeValue>
1242     </Apply>
1243 </Condition>
1244 </Rule>
1245 <Rule RuleId="Consumer Strategy 2/Provider Strategy 2"
1246 Effect="Permit">
1247     <Condition FunctionId="and">
1248         <Apply FunctionId="less-than-or-equal">
1249             <SubjectAttributeDesignator DataType="integer"
1250 AttributeId="fee"/>
1251             <AttributeValue DataType="integer">0.50</AttributeValue>
1252         </Apply>
1253         <Apply FunctionId="greater-than-or-equal">
1254             <ResourceAttributeDesignator DataType="integer"
1255 AttributeId="data-rate"/>
1256             <AttributeValue DataType="integer">32000</AttributeValue>
1257         </Apply>
1258         <Apply FunctionId="greater-than-or-equal">
1259             <EnvironmentAttributeDesignator DataType="time"
1260 AttributeId="timeOfDay"/>
1261             <AttributeValue DataType="time">9:00</AttributeValue>
1262         </Apply>
1263         <Apply FunctionId="equal">
1264             <SubjectAttributeDesignator DataType="integer"
1265 AttributeId="fee"/>
1266             <AttributeValue DataType="integer">0.45</AttributeValue>
1267         </Apply>
1268         <Apply FunctionId="equal">
1269             <ResourceAttributeDesignator DataType="integer"
1270 AttributeId="data-rate"/>
1271             <AttributeValue DataType="integer">40000</AttributeValue>
1272         </Apply>
1273     </Apply FunctionId="greater-than-or-equal">

```

```

1274         <EnvironmentAttributeDesignator DataType="time"
1275 AttributeId="timeOfDay"/>
1276         <AttributeValue DataType="time">6:00</AttributeValue>
1277         </Apply>
1278     </Condition>
1279 </Rule>
1280 </Policy>
1281 </PolicySet>

```

1282 A.1.6. Combine <Apply> elements

1283 <Apply> elements are combined if they are combinable according to Table 1.

```

1284 <PolicySet PolicySetId="Combined Policies"
1285 PolicyCombiningAlgId="deny-overrides">
1286   <Target>
1287     <Resources>
1288       <ResourceMatch MatchId="equal"
1289         <AttributeValue DataType="anyURI">
1290           serviceX:portX
1291         </AttributeValue>
1292         <ResourceAttributeDesignator AttributeId="portID"
1293           DataType="anyURI"/>
1294       </ResourceMatch>
1295     </Resources>
1296     <Actions>
1297       <AnyAction/>
1298     </Actions>
1299   </Target>
1300   <Policy PolicyId="Combined Data-rate Allocation Objective"
1301     RuleCombiningAlgId="permit-overrides">
1302     <Target>
1303       <Actions>
1304         <ActionMatch MatchId="equal">
1305           <AttributeValue DataType="anyURI">data-rate-
1306 allocation</AttributeValue>
1307           <ActionAttributeDesignator AttributeId="objectiveID"
1308             DataType="anyURI"/>
1309         </ActionMatch>
1310       </Actions>
1311     </Target>
1312     <!-- Rule RuleId="Consumer Strategy 1/Provider Strategy 2"
1313       Effect="Permit"
1314         Fee predicates are incompatible -->
1315     <!-- Rule RuleId="Consumer Strategy 1/Provider Strategy 2"
1316       Effect="Permit"
1317         Data-rate predicates are incompatible -->
1318     <!-- Rule RuleId="Consumer Strategy 2/Provider Strategy 1"
1319       Effect="Permit"
1320         Fee predicates are incompatible -->
1321     <Rule RuleId="Consumer Strategy 2/Provider Strategy 2"
1322       Effect="Permit">
1323       <Condition FunctionId="and">
1324         <Apply FunctionId="equal">
1325           <SubjectAttributeDesignator DataType="integer"
1326             AttributeId="fee"/>

```



```

1327         <AttributeValue DataType="integer">0.45</AttributeValue>
1328     </Apply>
1329     <Apply FunctionId="equal">
1330         <ResourceAttributeDesignator DataType="integer"
1331 AttributeId="data-rate"/>
1332         <AttributeValue DataType="integer">
1333             40000
1334         </AttributeValue>
1335     </Apply>
1336     <Apply FunctionId="greater-than-or-equal">
1337         <EnvironmentAttributeDesignator DataType="time"
1338 AttributeId="timeOfDay"/>
1339         <AttributeValue DataType="time">9:00</AttributeValue>
1340     </Apply>
1341 </Condition>
1342 </Rule>
1343 </Policy>
1344 </PolicySet>

```

1345 **A.1.7. Substitute <Apply> elements**

1346 Elimination is achieved by deleting all except the first <Rule> element.

```

1347 <PolicySet PolicySetId="Combined Policies"
1348 PolicyCombiningAlgId="deny-overrides">
1349     <Target>
1350         <Resources>
1351             <ResourceMatch MatchId="equal"
1352                 <AttributeValue DataType="anyURI">
1353                     serviceX:portX
1354                 </AttributeValue>
1355                 <ResourceAttributeDesignator AttributeId="portID"
1356 DataType="anyURI"/>
1357             </ResourceMatch>
1358         </Resources>
1359         <Actions>
1360             <AnyAction/>
1361         </Actions>
1362     </Target>
1363     <Policy PolicyId="Combined Data-rate Allocation Objective"
1364         RuleCombiningAlgId="permit-overrides">
1365         <Target>
1366             <Actions>
1367                 <ActionMatch MatchId="equal">
1368                     <AttributeValue DataType="anyURI">
1369                         data-rate-allocation
1370                     </AttributeValue>
1371                     <ActionAttributeDesignator AttributeId="objectiveID"
1372 DataType="anyURI"/>
1373                 </ActionMatch>
1374             </Actions>
1375         </Target>
1376         <Rule RuleId="Consumer Strategy 2/Provider Strategy 2"
1377 Effect="Permit">
1378             <Condition FunctionId="and">
1379                 <Apply FunctionId="equal">

```

```
1380         <SubjectAttributeDesignator DataType="integer"
1381 AttributeId="fee"/>
1382         <AttributeValue DataType="integer">0.45</AttributeValue>
1383     </Apply>
1384     <Apply FunctionId="equal">
1385         <ResourceAttributeDesignator DataType="integer"
1386 AttributeId="data-rate"/>
1387         <AttributeValue DataType="integer">
1388             40000
1389     </AttributeValue>
1390 </Apply>
1391 <Apply FunctionId="equal">
1392     <EnvironmentAttributeDesignator DataType="time"
1393 AttributeId="timeOfDay"/>
1394     <AttributeValue DataType="time">9:00</AttributeValue>
1395 </Apply>
1396 </Condition>
1397 </Rule>
1398 </Policy>
1399 </PolicySet>
```

Appendix B. Revision history

Rev	Date	By whom	What
Draft 02	23 July 2003	Tim Moses	<p>Limited functions and data-types to those defined by XACML.</p> <p>Prohibited the nesting of <Apply> elements.</p> <p>In the WSDL binding, targeted top-level policy statements at <wsdl:port> elements.</p> <p>Introduced two levels of <PolicySet> elements to allow finer targeting of policy statements.</p> <p>Added a "Security Considerations" section.</p> <p>Introduced the elimination step.</p>
Draft 03	5 Sep 2003	Tim Moses	<p>Added text clarifying attribute classification.</p> <p>Modified approach to combining involving greater-than and less-than operations to eliminate floor and ceiling functions.</p> <p>Clarified the procedure when compatible, but non-combinable, predicates are present.</p> <p>Added text in WSDL 1.2 binding section.</p>

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