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5 **FIPA JXTA Discovery Middleware**
6 **Specification**
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59 **1 Scope**

60 This document deals with the application of JXTA [JXTA] as discovery middleware (DM) for the Agent Discovery
61 Service (ADS). This specification forms part of the FIPA Agent Discovery Service Specification [FIPA00095] and
62 contains specifications for:

- 63
- 64 • The necessary extensions to JXTA to be usable as DM within the ADS.
- 65
- 66 • The interface for the interaction of JXTA DMs.
- 67

68 2 JXTA Discovery Middleware

69 JXTA technology [JXTA] is a set of open protocols that allow any connected device on the network to
70 communicate in a peer-to-peer manner.
71

72 2.1 Discovery Middleware Component Name

73 The name assigned to this discovery middleware component is:

74
75 `fipa.ads.dm.jxta.std`
76

77 2.2 New JXTA Components

78 JXTA advertisements are used to describe any kind of resource within the network. A DF-like, template based
79 discovery realized with the means of JXTA needs a mechanism to find arbitrary attribute/value pairs within JXTA
80 advertisements. The new components, which are necessary to realize this, are a new:

- 81
- 82 • JXTA service (see section 2.2.1)
- 83
- 84 • JXTA peer group (see section 2.2.2)
- 85
- 86 • JXTA advertisement type (see section 2.2.3)
- 87

88 2.2.1 Generic Discovery Service

89 This specification does not specify how the Generic Discovery Service (GDS) must look like, but the GDS must
90 provide the DM functionality specified in [FIPA00095].

91
92 A JXTA Module Class ID uniquely identifies a class of JXTA modules, for instance JXTA services, that provide a
93 certain functionality. The JXTA Module Class ID for GDS services offering the DM functionality specified in
94 [FIPA00095] is:

95
96 `urn:jxta:uuid-A4182DD0DC504CD48CC4A441E56627B405`
97

98 A JXTA Module Specification ID uniquely identifies a set of protocol compatible modules. The JXTA Module
99 Specification ID for GDS services offering the DM functionality specified in [FIPA00095] and implementing the
100 Generic Discovery Protocol as specified in 2.3.1 is:

101
102 `urn:jxta:uuid-A4182DD0DC504CD48CC4A441E56627B4F15B15DB91E74BC28945908432FC790406`
103

104 The version of the JXTA Module Specification belonging to the GDS services offering the DM functionality
105 specified in [FIPA00095] and implementing the Generic Discovery Protocol is: 1.0
106

107 2.2.2 Agent Peer Group

108 The Agent Peer Group (APG) is a child of the JXTA Net Peer Group. The APG must be joined during the startup of
109 the DM, because the APG hosts the GDS and is the scope of the GDS. Other services that may also be hosted by
110 the APG are outside the scope of this specification.

111
112 A JXTA Peer Group ID uniquely identifies a JXTA peer group. The JXTA Peer Group ID assigned to the APG is:

113
114 `urn:jxta:uuid-A19999539B18489C8E47860E6C89549E02`
115

116 The JXTA Module Specification ID for the APG uniquely identifies the module providing the implementation of the
 117 peer group module on the JXTA peer. The JXTA Module Specification ID for the APG is:
 118
 119 urn:jxta:uuid-DEADBEEFDEAFBABAFAFEEDBABA00000001994191D8846242F8AF4FBB14AF2CDFAF06
 120

121 2.2.3 Generic Discovery Advertisements

122 A Generic Discovery Advertisement (GDA) is used to handle agent or service descriptions, for example FIPA `df-`
 123 `agent-descriptions` [FIPA00023], at the level of JXTA. A GDA consists of meta information elements and of
 124 elements describing agents or services
 125

126 The `PublishingTime` meta information element contains the time in milliseconds since 1970, when the GDA
 127 was published, that is, made available publicly in the network.
 128

129 The `Id` meta information element is used to specify the content type of the GDA, that is, it defines how the
 130 elements of the GDA, except the meta information elements, must be interpreted. **Table 1** summarizes the
 131 currently available GDA content types.
 132

GDA Content Type	Interpret Content as	Note
<code>Df-agent-description</code>	FIPA <code>df-agent-description</code>	see [FIPA00023] and 2.2.3.1

133
 134 **Table 1:** Possible Content Types of a GDA
 135

136 2.2.3.1 Generic Discovery Advertisements with `df-agent-description` Content

137 In a GDA with `df-agent-description` content, value sets and value sequences of the FIPA `df-agent-`
 138 `description` parameters are broken up to single advertisement elements. For value sequences the order of the
 139 single elements in the advertisement is according to the order of values within a sequence of a FIPA `df-agent-`
 140 `description`.
 141

142 The XML Schema¹ [W3C] of a GDA with `DFAD` content is as follows:
 143

```

144 <xs:element name="GenericDiscoveryAdv" type="fipa:GenericDiscoveryAdv"/>
145 <xs:complexType name="GenericDiscoveryAdv">
146   <xs:sequence>
147     <xs:element name="Id" type="DFAD"/>
148     <xs:element name="PublishingTime" type="xs:unsignedInt"/>
149
150     <xs:complexType name="agentID" minOccurs="0"2>
151       <xs:sequence>
152         <xs:element name="name" type="xs:string"/>
153         <xs:element name="address" type="xs:string"
154           maxOccurs="unbounded" minOccurs="0"/>
155         <xs:element name="resolver" type="agentID"
156           maxOccurs="unbounded" minOccurs="0"/>
157       </xs:sequence>
158     </xs:complexType>
159
160     <xs:complexType name="service" maxOccurs="unbounded" minOccurs="0">
161       <xs:sequence>
162         <xs:element name="name" type="xs:string" minOccurs="0"/>
163         <xs:element name="type" type="xs:string" minOccurs="0"/>
164         <xs:element name="protocol" type="xs:string"
165           maxOccurs="unbounded" minOccurs="0"/>
166         <xs:element name="ontology" type="xs:string"
  
```

¹ As stated in [Sun], service and protocol authors are recommended to specify advertisements and messages by using the XML Schema language.

² The default value for the `minOccurs` and `maxOccurs` attributes is 1.

```

167         maxOccurs="unbounded" minOccurs="0"/>
168     <xs:element name="language" type="xs:string"
169         maxOccurs="unbounded" minOccurs="0"/>
170     <xs:element name="ownership" type="xs:string" minOccurs="0"/>
171     <xs:complexType name="property" maxOccurs="unbounded" minOccurs="0">
172         <xs:sequence>
173             <xs:element name="name" type="xs:string"/>
174             <xs:element name="type" type="xs:string"/>
175         </xs:sequence>
176     </xs:complexType>
177 </xs:sequence>
178 </xs:complexType>
179
180 <xs:element name="protocol" type="xs:string"
181     maxOccurs="unbounded" minOccurs="0"/>
182 <xs:element name="ontology" type="xs:string"
183     maxOccurs="unbounded" minOccurs="0"/>
184 <xs:element name="language" type="xs:string"
185     maxOccurs="unbounded" minOccurs="0"/>
186 <xs:element name="lease-time" type="xs:unsignedInt" minOccurs="0"/>
187 </xs:sequence>
188 </xs:complexType>
189
190 <xs:simpleType name="DFAD">
191     <xs:restriction base="xs:string">
192         <xs:pattern value="df\ -agent\ -description"/>
193     </xs:restriction>
194 </xs:simpleType>
195

```

196 2.3 Interface Definition

197 To enable the interaction of JXTA DMs on different agent platforms (AP), the Generic Discovery Protocol (GDP) is
 198 used to exchange GDAs. The GDP is implemented by the GDS, because it is a part of the GDS. All GDS
 199 implementations, which use the JXTA Module Specification ID defined in 2.2.1, must implement the GDP as
 200 specified in 2.3.1.
 201

202 2.3.1 Generic Discovery Protocol

203 The GDP is a request/response protocol to discover GDAs. The GDP comprises two messages, the
 204 `GenericDiscoveryQuery` message and the `GenericDiscoveryResponse` message.
 205

206 The `GenericDiscoveryQuery` is used for emitting discovery queries. The `Pattern` attribute of the
 207 `GenericDiscoveryQuery` is a required element and must contain a GDA that acts as the search pattern. The
 208 `Threshold` attribute is an optional element defining the maximum number of advertisements that should be sent
 209 by a peer responding to this query.
 210

211 The XML Schema of a `GenericDiscoveryQuery` is as follows:

```

212
213 <xs:element name="GenericDiscoveryQuery" type="fipa:GenericDiscoveryQuery"/>
214 <xs:complexType name="GenericDiscoveryQuery">
215     <xs:sequence>
216         <xs:element name="Pattern" type="fipa:GenericDiscoveryAdv"/>
217         <xs:element name="Threshold" type="xs:unsignedInt" minOccurs="0"/>
218     </xs:sequence>
219 </xs:complexType>
220

```

221 The `GenericDiscoveryResponse` message is used for returning matching GDAs in response to a
 222 `GenericDiscoveryQuery`. The `Count` attribute of the `GenericDiscoveryResponse` message is a required
 223 element and contains the number of returned results, that is, the number of `Response` elements. A

224 GenericDiscoveryResponse message contains one or more Response elements, each one wrapping a GDA
225 that matches the previously received GDA search pattern.

226

227 The XML Schema of a GenericDiscoveryResponse is as follows:

228

```
229 <xs:element name="GenericDiscoveryResponse" type="fipa:GenericDiscoveryResponse"/>
```

```
230 <xs:complexType name="GenericDiscoveryResponse">
```

```
231   <xs:sequence>
```

```
232     <xs:element name="Count" type="xs:unsignedInt"/>
```

```
233     <xs:element name="Response" type="fipa:GenericDiscoveryAdv"
```

```
234       maxOccurs="unbounded" />
```

```
235   </xs:sequence>
```

```
236 </xs:complexType>
```

237

238 **3 References**

239 [FIPA00023] FIPA Agent Management Specification. Foundation for Intelligent Physical Agents, 2002.
240 <http://www.fipa.org/specs/fipa00023/>

241 [FIPA00095] FIPA Agent Discovery Service Specification. Foundation for Intelligent Physical Agents, 2003.
242 <http://www.fipa.org/specs/fipa00095/>

243 [JXTA] Project JXTA.
244 <http://www.jxta.org/>

245 [Sun] JXTA v2.0 Protocols Specification. Sun Microsystems, March 2003.
246 <http://spec.jxta.org/nonav/v1.0/docbook/JXTAProtocols.html>

247 [W3C] XML Schema Part 1: Structures. World Wide Web Consortium (W3C), May 2001.
248 <http://www.w3.org/TR/xmlschema-1/>
249

250 **4 Informative Annex A – Generic Discovery Advertisement Example**

251 As an example the GDA of the `job-agent` is shown below. The GDA is of content type `df-agent-`
252 `description` and describes the agent itself, two of its supported services, one supported ontology and the
253 duration how long the `df-agent-description` is valid.

```
254  
255 <?xml version="1.0"?>  
256 <!DOCTYPE fipa:GenericDiscoveryAdv>  
257  
258 <fipa:GenericDiscoveryAdv xmlns:fipa="http://www.fipa.org">  
259 <Id>df-agent-description</Id>  
260 <PublishingTime>2753606022</PublishingTime>  
261  
262 <agentID>  
263 <name>job-agent@foo.com </name>  
264 <address>iiop://foo.com/acc</address>  
265 </agentID>  
266  
267 <service>  
268 <name>job-application</name>  
269 <protocol>application-proto</protocol>  
270 </service>  
271  
272 <service>  
273 <name>job-offer</name>  
274 <protocol>offer-proto</protocol>  
275 </service>  
276  
277 <ontology>job-onto</ontology>  
278 <lease-time>3600000</lease-time>  
279 </fipa:GenericDiscoveryAdv>  
280
```

281 5 Informative Annex B – Generic Discovery Protocol Example

282 A `GenericDiscoveryQuery`, which can be emitted to discover the job agent, is shown below. This kind of
 283 message is used as part of the GDP in the discovery process of the GDS. The `GenericDiscoveryQuery` wraps
 284 within the `Pattern` element a GDA with content type `df-agent-description`. The GDA is used as `df-`
 285 `agent-description` search template. The `PublishingTime` element of the `df-agent-description`
 286 advertisement is zero because a search template is never published.

287
 288 The `<` characters of the wrapped GDA are encoded by the escape sequence `<`. This is a means of JXTA to
 289 guarantee the appropriate processing of nested advertisements.

```
290 <?xml version="1.0"?>
291 <!DOCTYPE fipa:GenericDisocveryQuery>
292
293 <fipa:GenericDiscoveryQuery xmlns:fipa="http://www.fipa.org">
294
295   <Pattern>
296     &lt;?xml version="1.0"?>
297     &lt;!DOCTYPE fipa:GenericDiscoveryAdv>
298
299     &lt;fipa:GenericDiscoveryAdv xmlns:fipa="http://www.fipa.org">
300       &lt;Id>df-agent-description&lt;/Id>
301       &lt;PublishingTime>0&lt;/PublishingTime>
302
303       &lt;service>
304         &lt;name>job-application&lt;/name>
305         &lt;protocol>application-proto&lt;/protocol>
306       &lt;/service>
307
308       &lt;ontology>job-onto&lt;/ontology>
309     &lt;/fipa:GenericDiscoveryAdv>
310   </Pattern>
311
312   <Threshold>5</Threshold>
313 </fipa:GenericDiscoveryQuery>
```

314
 315
 316 A `GenericDiscoveryResponse` belonging to the previous query is shown below. One matching result is
 317 returned within the `Response` element, namely the `job-agent`.

```
318  

319 <?xml version="1.0"?>
320 <!DOCTYPE fipa:GenericDisocveryResponse>
321
322 <fipa:GenericDiscoveryResponse xmlns:fipa="http://www.fipa.org">
323
324   <Count>1</Count>
325
326   <Response>
327     &lt;?xml version="1.0"?>
328     &lt;!DOCTYPE fipa:GenericDiscoveryAdv>
329
330     &lt;fipa:GenericDiscoveryAdv xmlns:fipa="http://www.fipa.org">
331       &lt;Id>df-agent-description&lt;/Id>
332       &lt;PublishingTime>2753606022&lt;/PublishingTime>
333
334       &lt;agentID>
335         &lt;name>job-agent@foo.com&lt;/name>
336         &lt;address>iiop://foo.com/acc&lt;/address>
337       &lt;/agentID>
338
339       &lt;service>
```

```
341         <name>job-application</name>
342         <protocol>application-proto</protocol>
343     </service>
344
345     <service>
346         <name>job-offer</name>
347         <protocol>offer-proto</protocol>
348     </service>
349
350     <ontology>job-onto</ontology>
351     <lease-time>3600000</lease-time>
352
353     </fipa:GenericDiscoveryAdv>
354 </Response>
355
356 </fipa:GenericDiscoveryResponse>
357
```

358 **6 Informative Annex C – Notes for Developers**

- 359 1. A straight forward way to implement the GDS is to use JXTA's Resolver Service with its Peer Resolver
360 Protocol and to design the GDS similar as JXTA's Discovery Service with its Peer Discovery Protocol. The
361 Peer Resolver Protocol could be used to transport GDP messages. The functionality of JXTA's Discovery
362 Service could be extended to find arbitrary attribute/value pairs within GDAs.
- 364 2. The `Id` meta information element in the GDA can be used efficiently to access a certain type of advertisement
365 within JXTA's local cache. This cache is accessed via the JXTA Discovery Service. Therefore for example all
366 GDAs, which contain `df-agent-description` information and have an `Id` meta information element stating
367 to be a `df-agent-description`, can be retrieved from the JXTA cache via the JXTA Discovery Service.
- 369 3. The GDA's XML Schema definition uses the compositor `sequence`, which is a property of the model group
370 schema component described in [W3C]. Note that despite its use, the order of the elements contained within
371 these compositors is assumed to be arbitrary.

372
373 This modus operandi complies to the one applied in JXTA source code and results from the fact that the
374 current version of the XML Schema language offers no better suited compositor. The `all` compositor would
375 allow for an arbitrary order of contained elements, but limits the occurrence of a certain element to zero or one.
376 This would be an even bigger limitation in the context of a GDA that should contain for example several
377 service descriptions. For details see [W3C] section 3.8.
378

379 **7 Informative Annex D — ChangeLog**

380 **7.1 2002/10/20 – Initial version by TC Ad Hoc**

381 Entire document: Initial version

382

383 **7.2 2002/11/10 - version A by FIPA Architecture Board**

384 Entire document: Changed some typos and formatting

385