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7 **Printer Working Group (PWG)**

8

9 **Overview of the**

10 **PWG Semantic Model**

11

12 May 29, 2002

13 Version 0.4

14 File: ftp://ftp.pwg.org/pub/pwg/Semantic_model/PWG-Semantic-Model-Overview.doc

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78 **1 Model Overview**

79 The Printer Working Group (PWG) has defined a simplified printing model. It represents printing
80 in a client/server print paradigm. The PWG model describes the server as a Printer object. A
81 Printer object may represent one or more physical Printers. The other main object is the Job. A
82 Printer can contain zero or more Jobs and a Job is contained in only one Printer. The PWG model
83 contains methods that act upon these objects.
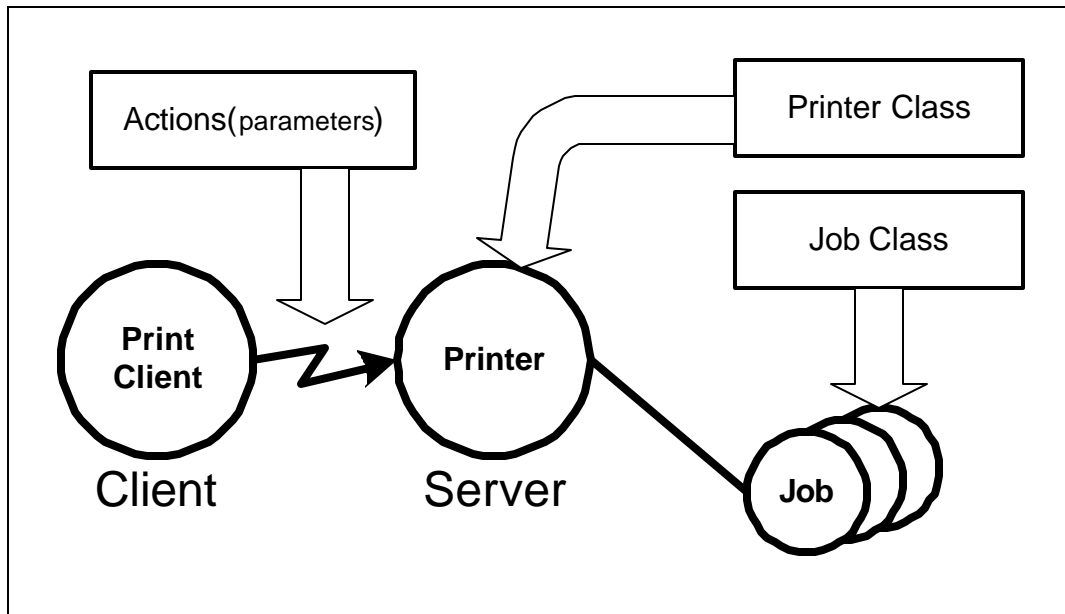
84

85   **Figure 1 Model Overview**

86 The objects are represented in the semantic model as data classes. The methods are represented as a
87 set of actions that act upon those data classes. The actions permit the creation and control of Jobs
88 as well as the submission of a Job's document content or URL reference to the document content.
89 Other actions allow the control of the Job or Printer. There are also actions to query a Printer or
90 Job to access their attributes or to obtain a list of jobs.

91 The model uses a number of terms with specific meaning for a printer.

92   Media: A sheet of paper, or other material, used for printing.

93   Impression: Everything printed on a single side of a media.

94   Page: A logical entity that represents the information contained on a single side of a sheet of
95   media. Note that this the electronic form and that multiple pages can be rendered
96   into a single impression through N-Up printing.

1.1 Conformance terminology

98   The following conformance terminology is used in this document (same as in [RFC2911]):

99   ▪ "must" - verb indicates a requirement for the subject of the sentence.
100   ▪ "should" - verb indicate a recommendation for the subject of the sentence.
101   ▪ "may" - verb indicates an implementation option for the subject of the sentence.
102   ▪ "support" - the Printer performs as defined for the semantics of the operation or attribute.

1.2 Typographic conventions

104   The following typographic conventions are uses in the document:

105   **Bold indicates an action or attribute that must be supported by the Printer.**

106   *Italic indicated an action or attribute that may be supported by the Printer.*

107   Square brackets ([]) indicate an attribute that a client may omit from an action request or a Printer
108   may omit from an action response. A default value is specified for each such attribute that the
109   Printer must use when the client omits such an attribute from an action request.

2   Action Summary

111   Table 1 summarizes the actions defined for the Job and Printer. See section 4 for more details.

Job Creation and Document submission	Job Control	Status and Information access	Printer Control
PrintJob	**CancelJob**	**GetJobs**	*PausePrinter*
PrintUri	*HoldJob*	**GetPrinterAttributes**	*ResumePrinter*
CreateJob	*ReleaseJob*	**GetJobAttributes**	*PurgeJobs*
SendDocument	*RestartJob*		
SendURI			
ValidateJob			

112   **Table 1 - Summary of Actions**

113

3   Data Classes

115   This section describes the data classes in the PWG semantic model. The classes are taken from the
116   model and semantics of IPP [rfc2911]. See Appendix section 6.1 for some systematic changes
117   from the IPP semantics to align with XML practice.

3.1 Printer object class

119   The Printer data class is represented by a collection of attributes divided into two groups as shown
120   in Figure 2:

121   Printer Description Attributes - shown in Figure 3 and described in section 3.1.1

122   "Job Template" Printer Attributes - described in section 0
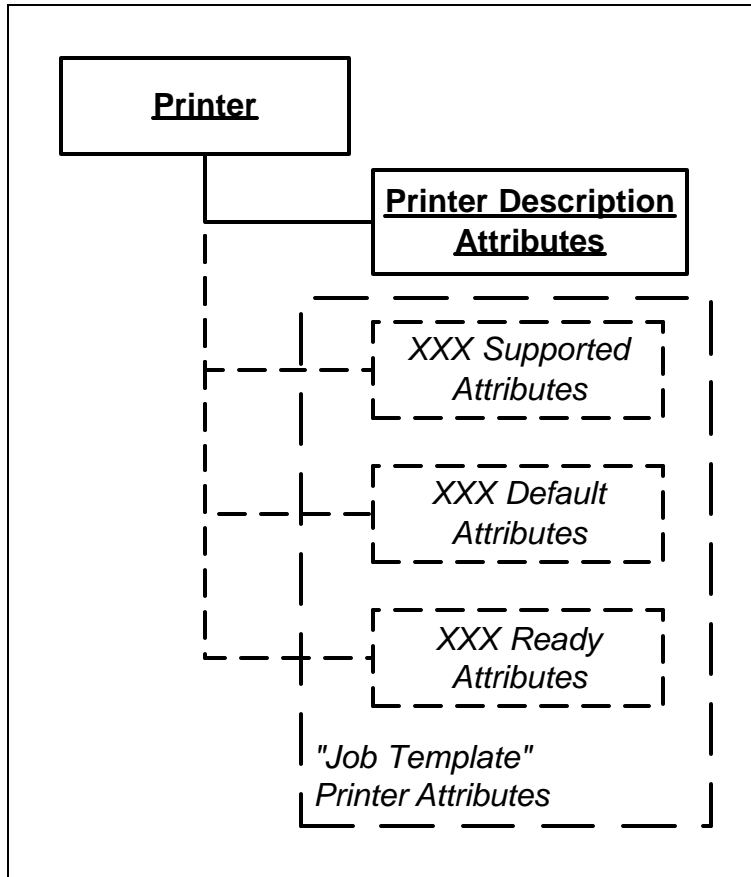
123

124   **Figure 2 Printer data class**

125 **3.1.1 Printer Description Attributes**

126   Figure 3 shows the Printer Description Attributes. These attributes represent the processing state of
127   the printer and information that describes the printer such as its make, where it's located and its
128   speed. It also contains the "xxxSupported" Printer attributes that correspond to Operation Attribute
129   that the client can supply in action requests. The semantics of the attributes are summarized in
130   Table 6 and Table 7 in Appendix section 6.2.
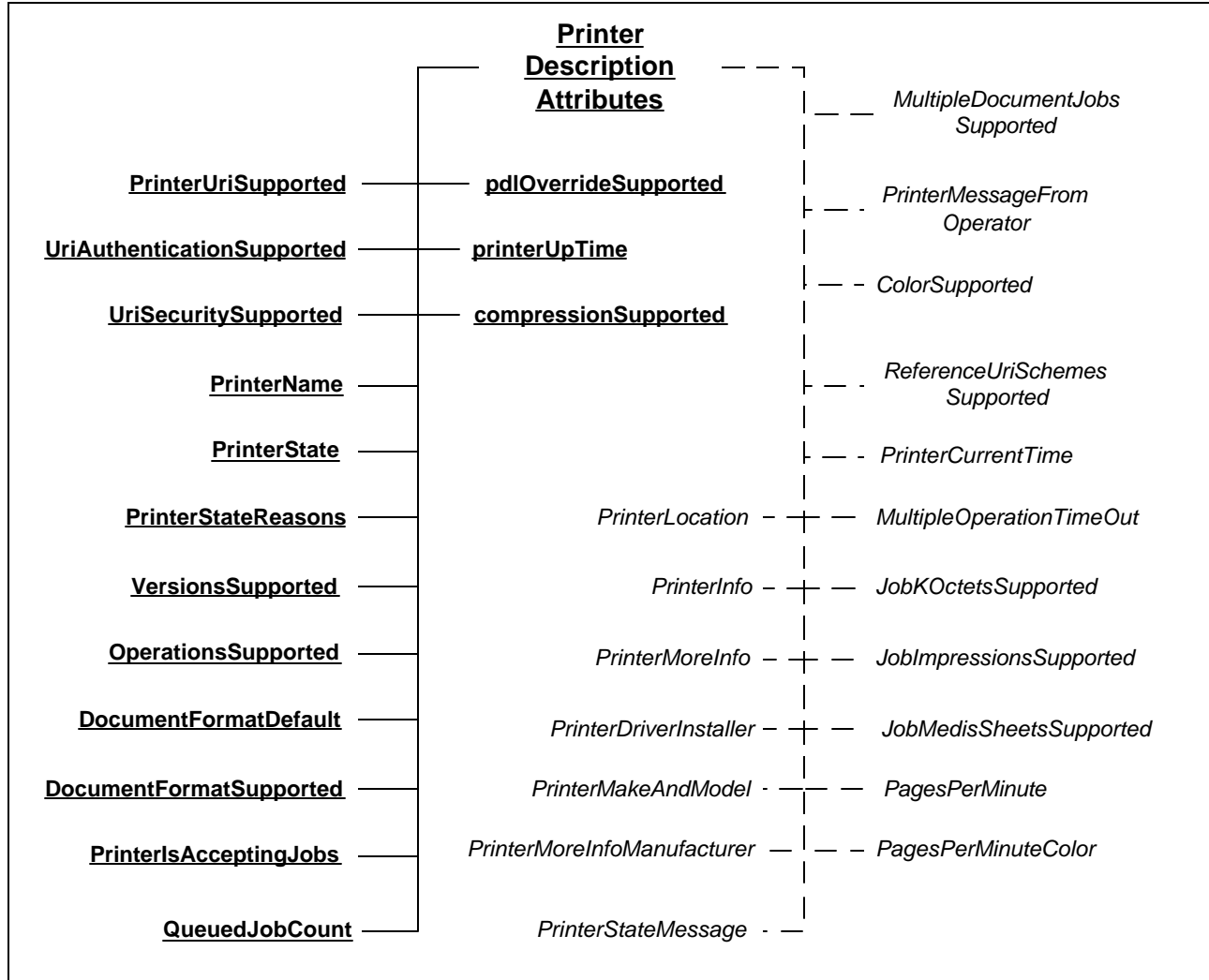
Figure 3 Printer Description Attributes

134 3.1.2 The "PrinterState" attribute and the Printer Life Cycle

135 The "PrinterState" attribute is one of the most important Printer Description attributes. Figure 4
136 shows the values of the "PrinterState" attribute and the Printer life cycle as affected by actions on
137 the Printer and job processing.

* lastDocument = true
** lastDocument = false
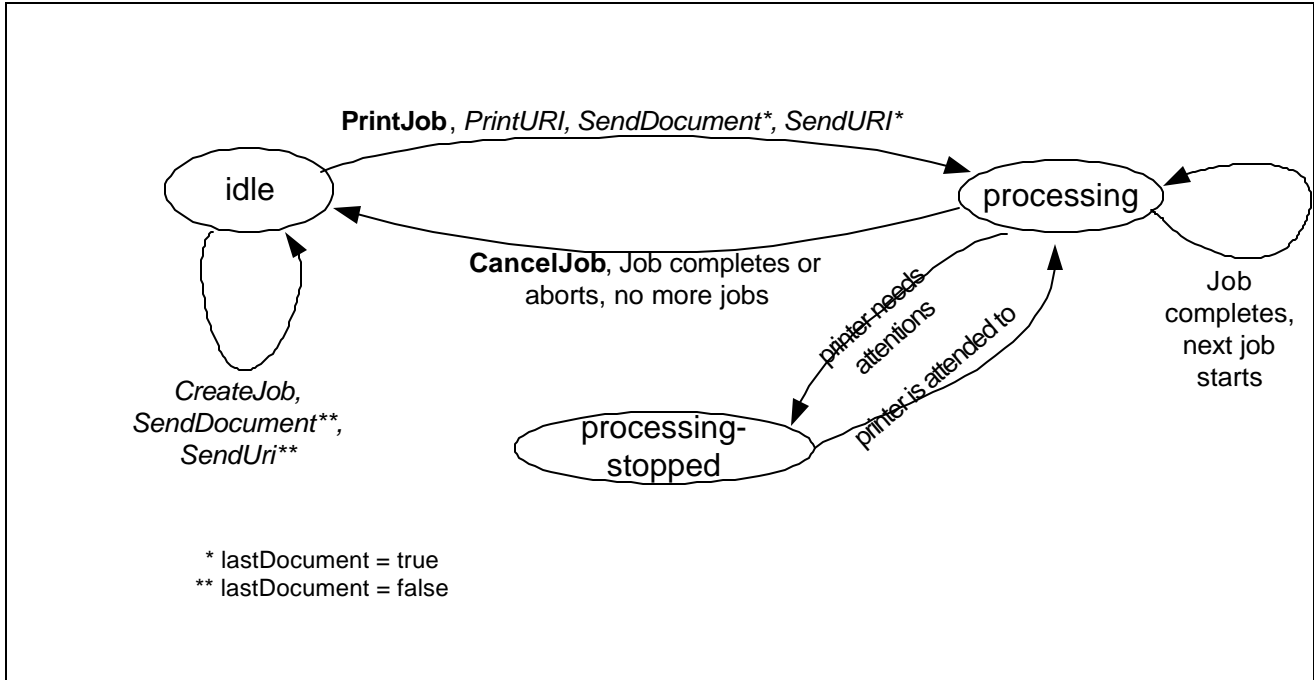
138
139

140 **Figure 4 - The "PrinterState" attribute and the Printer life cycle**

3.1.3 "Job Template" Printer Attributes

142 See section 3.2.1 below for the attributes that may comprise this group. If a Job Template attribute
143 (e.g. Media) is supported, the Printer must have an associated xxxSupported (e.g. MediaSupported)
144 and xxxDefault (e.g. MediaDefault) "Job Template" Printer attribute. There may be an associated
145 xxxReady (e.g. MediaReady) "Job Template" Printer attribute. By retrieving the "Job Template"
146 Printer attributes, a Client can determine all the attributes and their values that may be used in
147 constructing a Job Creation action.

3.1.3.1   xxxSupported Attributes

149 These attributes list all the currently configured valid values for the "xxx" Job Template Attributes.
150 Though the Printer is configured to support the feature, human intervention may be required to
151 process the job (e.g. selected paper may have to be loaded into a tray). The syntax for
152 xxxSupported is multi-valued when an "xxx" attribute is a string. When "xxx" is an integer, the
153 syntax of the corresponding "xxxSupported" attribute is usually RangeOfInteger which indicates
154 the minimum and maximum values supported by the Printer. However, there are some exceptions
155 as indicated in Table 2.

156 **Table 2 - Integer syntaxes whose "xxxSupported" syntax isn't RangeOfInteger**

"xxx" attribute name	"xxx" syntax	"xxxSupported" syntax
JobPriority	Integer	Integer (Max value)
Copies	Integer	Integer (Max value)
PageRanges	RangeOfInteger (multivalued)	Boolean (are PageRanges supported)

157

158 **3.1.3.2   xxxDefault Attributes**

159 These attributes give the default value for the associated production instruction if the Job Template
160 Attribute of the job and the instructions embedded in the PDL are not supplied. The syntax for the
161 "xxxDefault" attribute is the same as the corresponding "xxx" Job Template Attribute. The only
162 exception is that the PageRanges attribute does not have a PageRangesDefault attribute.

163 **3.1.3.3   xxxReady Attributes**

164 These attributes give the features available without human intervention. The syntax for a
165 "xxxReady" attribute is the same as the corresponding "xxx" Job Template Attribute.

3.2 Job object class

167 The Job data class is represented by a collection of attributes divided into two groups as shown in
168 Figure 5:

169   "Job Template" Job Attributes - shown in Figure 6 and described in section 3.2.1

170   Job Description Attributes - shown in Figure 7 and described in section 3.2.2

171
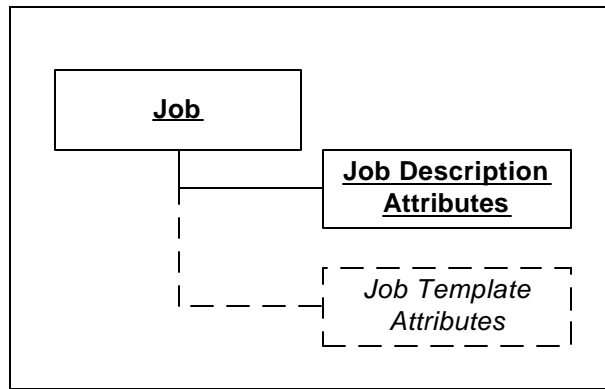
172

173   **Figure 5 Job data Class**

3.2.1 "Job Template" Job Attributes

175 Figure 6 shows the "Job Template" Job Attributes. All Job Template Attributes are optional for a
176 Printer to support. However, a Printer should support each Job Template Attribute that represent a
177 feature of the Printer. The semantics of the attributes are summarized in Table 3 in Appendix
178 section 6.2 for a brief description of each Printer Description attribute.
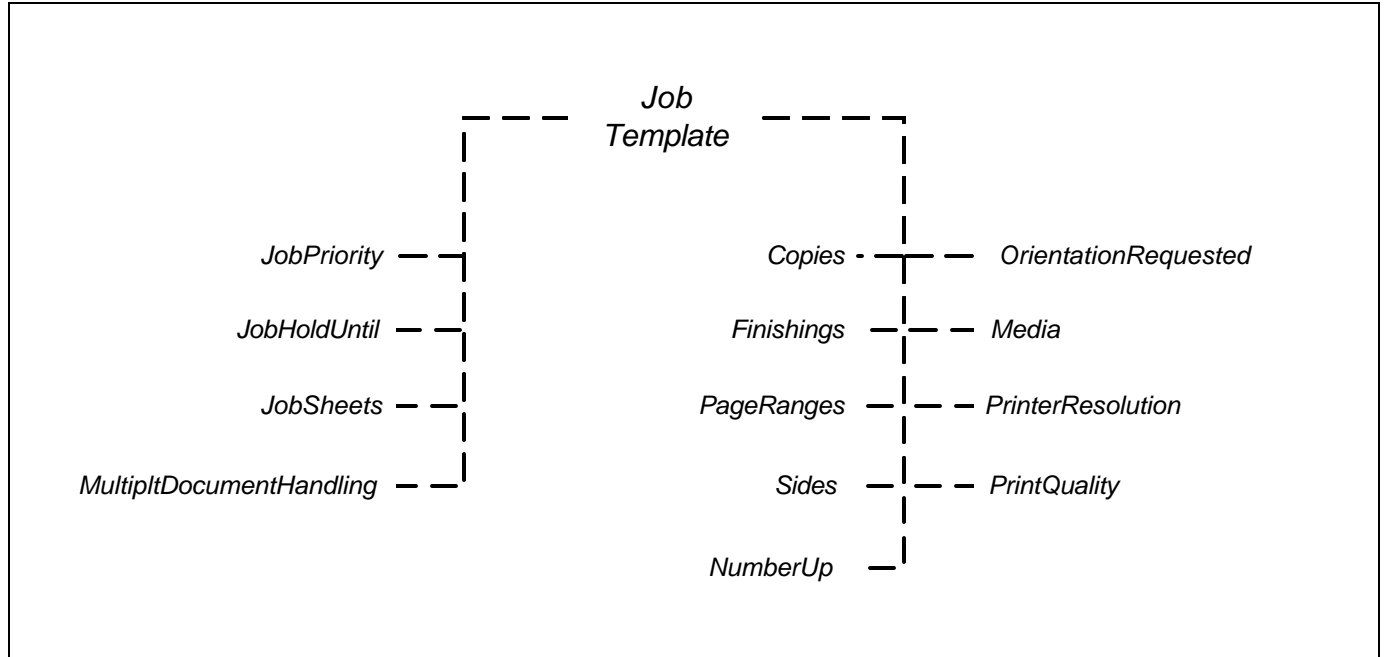
179
180

181 **Figure 6 Job Template Attributes**

182 **3.2.2 Job Description Attributes**

183 Figure 7 shows the Job Description Attributes. The mandatory attributes are shown in a solid box.
184 The optional attributes are shown in a dotted box. The semantics of the attributes are summarized
185 in

186 Table **4** and Table 5 in Appendix section 6.2.
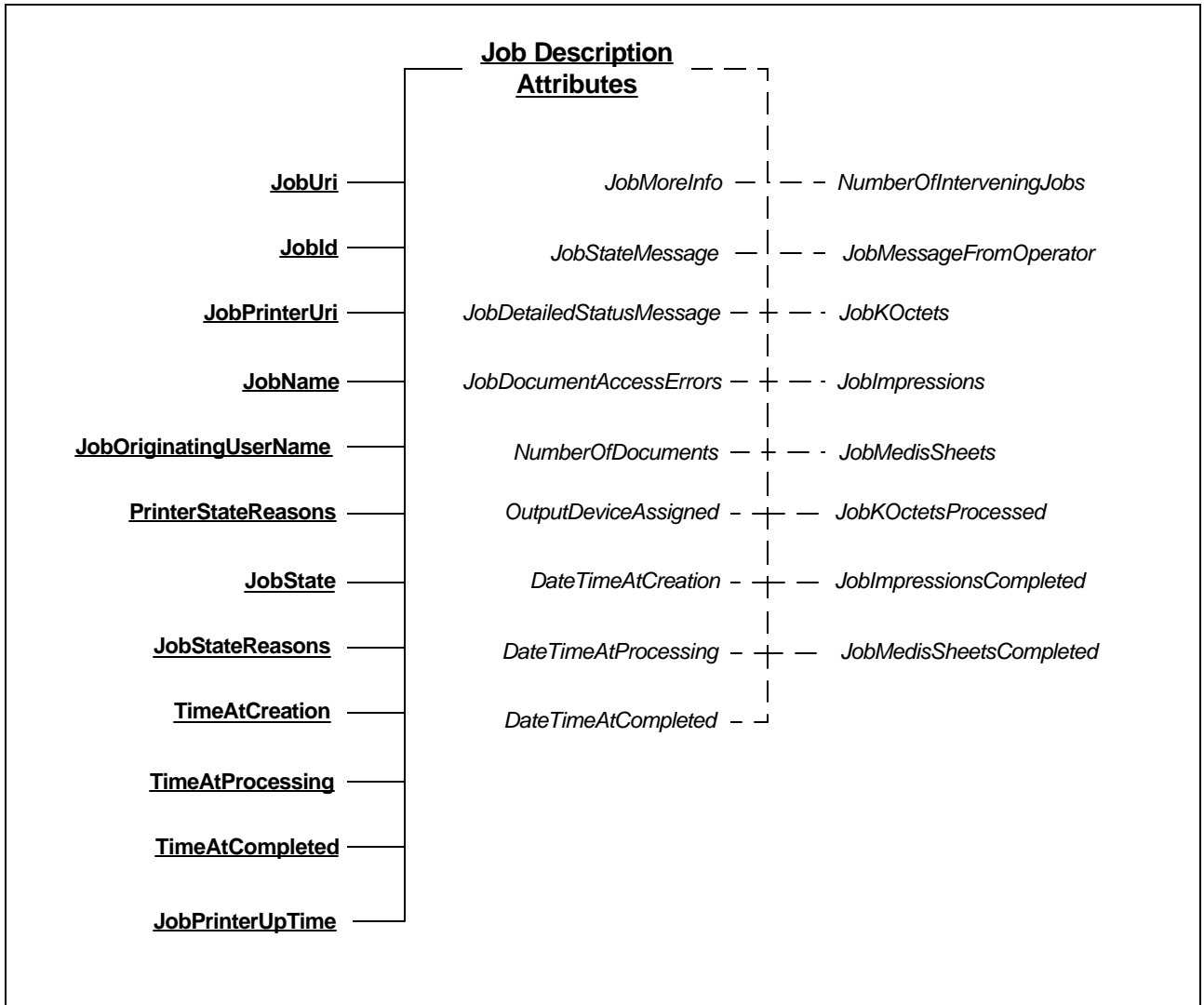
187
188

189 **Figure 7 Job Description Attributes**

190 **3.2.3 The "JobState" attribute and the Job Life Cycle**

191 The "JobState" attribute is one of the most important Job Description attributes. Figure 8 shows
192 the values of the "JobState" attribute and the Job life cycle as affected by actions on the Job,
193 Printer, and job processing.
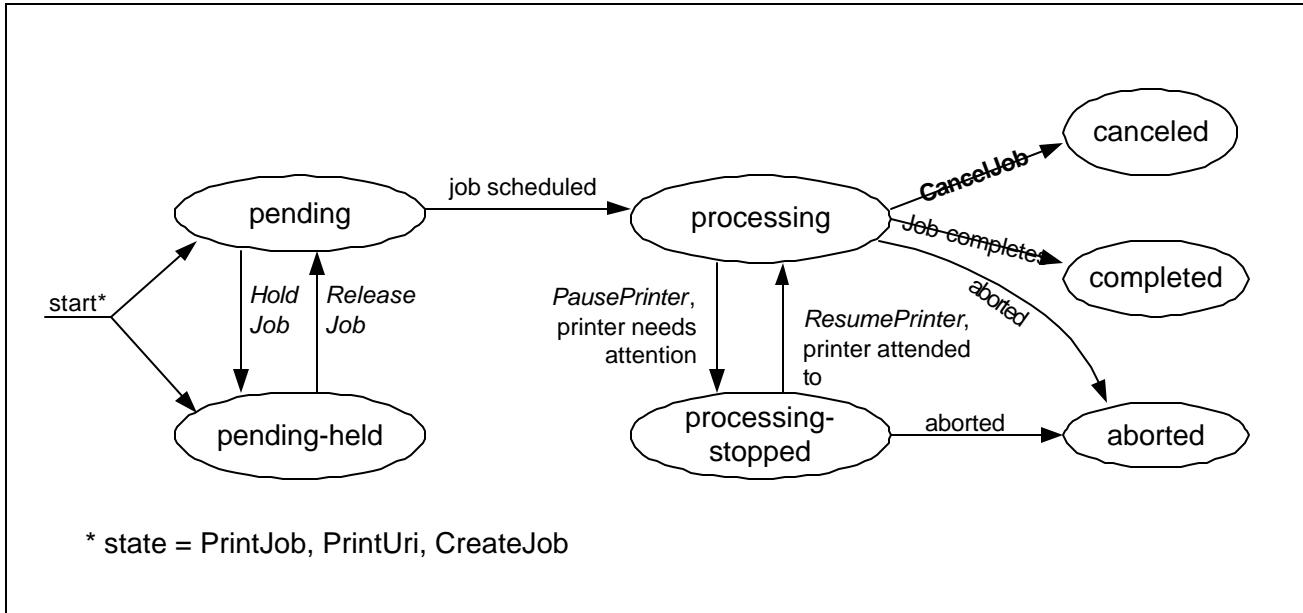
194

195 **Figure 8 - The "JobState" Job Description attribute and the Job object life cycle**

196 **4 Actions**

197 Actions may contain a number of parameters. The first parameter is always the Operation
198 Attributes for the Action. The Operation Attributes contains common information such as the
199 target of the action (Job or Printer), a version number, or a sequence id to tie the request and
200 response together. Other information is Action-specific such as the name of the Job to be created
201 or a filter that controls the information to be returned in a query. The sections below describe the
202 Operation Attributes and any other Action specific parameters.

203 The mandatory parameters and attributes for the Printer to support are in **bold** and the optional ones
204 are in *italics*. The optional ones for the Client to supply are indicated in square brackets ([]).

205 *4.1 Job Creation and document submission Actions*

206 This section describes the Job Creation actions that create a Job and the ones that create Document
207 Content. The Job Creation actions are: PrintJob, PrintUri, and CreateJob. The PrintJob action also
208 submits the Document content. The PrintUri action submits a URI reference to the Document
209 content which the Printer then retrieves when needed at a later time. The CreateJob action only
210 creates the job and the Client must issue subsequent SendDocument and SendUri actions in order
211 to submit document content or a URI reference, respectively, for a job.

212 Production instructions contained in the arguments of the Job Creation action (i.e., Operation and
213 Job Template attributes) is combined with Printer supplied information to create a Job instance.

214 The last action in this section is ValidateJob. This operation allows a Client to send a request with
215 all the information to create a Job, except the document content. The Printer does not create a Job

216 but informs the client whether a CreateJob, PrintJob or PrintUri with the same information would
217 have succeeded. This is useful for allowing a Client to verify the production instructions before
218 sending a large PrintJob request.

219 A concept that is important in the PWG model is a set of production instructions that can be applied
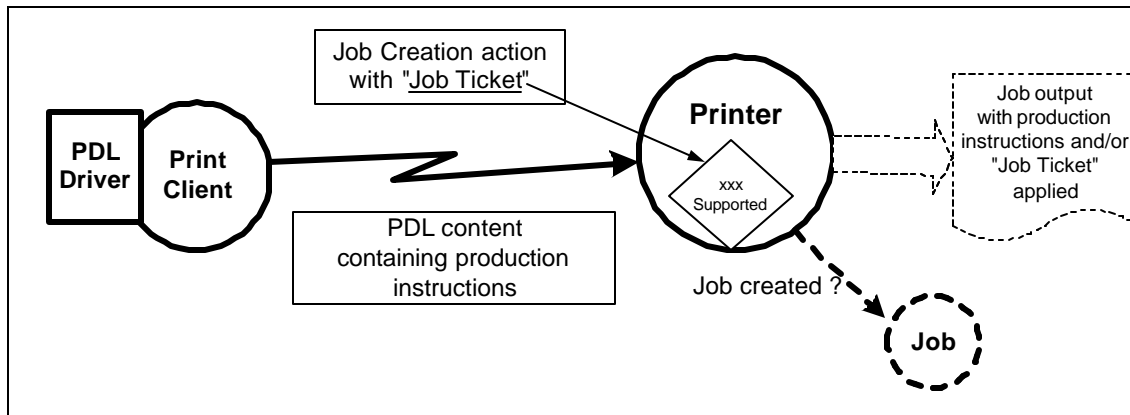220 to a print job. Examples of these instructions include the number of Copies and the media to use.
221 These instructions are often referred to as a Job Ticket. The Job Ticket is made up of the Operation
222 Attributes (see section 3.2.2) and the "Job Template" Job attributes (see section 3.2.1) in a Job
223 Creation operation.

224

225 **Figure 9 Production instruction processing**

226 In the real world, production instructions are also contained in the document content for a job.
227 Page Description Languages (PDL) such as PostScript® and PCL® often contain production
228 instructions.   Some environments use a printer specific driver to generate the PDL stream based on
229 feature selections made through a user interface. Given that productions instructions can occur in
230 both the PDL and in an associated Job, the PWG model allows a Printer to declare its capability to
231 resolve this conflict. The Printer's attribute "PdlOverride" declares if an attempt will be made to
232 override the instructions in the PDL with the instructions in the Job.

233 There is a wide variety of capabilities in Printers. An instance of a Printer is to subject to changes
234 in its configured capabilities. An example would be an administrative change in the media the
235 Printer supports or disabling two-sided printing. Clients need not check the capabilities of a Printer
236 before creating their Job Template Attributes and submitting a job. Since this is a client/server
237 paradigm, it is always possible that the capabilities could change after checking a Printer's
238 capabilities and before a Job is submitted. On the other hand, a client may use the Printer's
239 configured capabilities to create their Job Template Attributes and submit a job.

240 The PWG model allows a client to control the Printer's acceptance of a job submission based on
241 the job request and the Printer's current configured capabilities as follows. When the client
242 supplies a 'true' value for the "AttributeFidelity" Operation attribute, the Printer must reject the job
243 unless the Printer supports *all* of the supplied Job Template attributes and values. When the client
244 supplies a 'false' value or omits the attribute, the Printer must accept the job submission and ignore
245 or substitute attributes and values, respectively, that it does not support. Note that the
246 "AttributeFidelity" Operation attribute covers only the creation of the Job. It is implementation
247 specific how a Printer handles processing a job when the Printer encounters unsupported
248 production instructions in the document content.

4.1.1 PrintJob

250 ([rfc2911] §3.2.1) Submit a print job with only one document and supply the document content
251 data. If the Printer accepts the job, it creates the Job object and returns a unique "JobId" attribute
252 for the Printer and a globally unique "JobUri" attribute. The Printer also sets the corresponding Job
253 Description attributes with these values.

254 **PrintJobRequest(Operation Attributes**, [**Job Template Attributes**], **Document Data**)

255   **Operation Attributes:**

256   **PrinterUri(uri)**: The target printer for the job

257   **[AttributeFidelity(Boolean)]**: Allows a user to control the Printer's acceptance of
258   the job submission based on whether or not the Printer supports *all* the
259   supplied Job Template attributes and values (see section 4.1). Default =
260   'false'.

261   **[documentName(string)]**: Name for the document to be used in an implementation
262   specific manner.

263   **[Compression(string)]**: Compression algorithm used on the Document Data, if
264   any.

265   **[requestingUserName], [JobName], [DocumentFormat],** *[JobKOctets],*
266   *[jobImpressions], [JobMediaSheets]*: see section 3.2.2.

267   **[Job Template Attributes]:**

268   Any Job Template Attribute (see section 3.2.1) or vendor/site specific extension.

269   **Document data:** The document to print.

270

271 **PrintJobResponse(Operation Attributes**, [**Unsupported Attributes**], **Job Attributes**)

272   **Operation Attributes** *:*

273   **statusCode:** Results of the action (see Appendix section 6.3).
274   *[statusMessage]: Localized text description of the status code.*
275   *[detailedStatusMessage]: Text for detailed and technical information about the job.*

276   **[Unsupported Attributes]**: any unsupported or conflicting attributes and or attribute
277   values. May be returned on success or failure.

278   **Job Attributes:**

279   **JobUri, JobId, JobState, JobStateReasons**, *[JobStateMessage],*
280   *[NumberOfInterveningJobs]* See section *3.2.2*.

4.1.2 PrintUri

282 ([rfc2911] §3.2.2) Identical to the PrintJob operation (see section 4.1.1) except that a client
283 supplies a URI reference to the document data. The calling sequence is the same as PrintJob ()
284 except that the Operation Attributes in the request contains the "documentUri" attribute and the
285 Document Data is omitted.

4.1.3 CreateJob

287 ([rfc2911] §3.2.4) Similar to the PrintJob operation (see section 4.1.1), except that in the CreateJob
288 request the Client does not supply Document Data. In addition, the client does not supply any of
289 the "documentName", "DocumentFormat", "Compression", or "documentUri" operation attributes.

290   The client follows this action with one or more SendDocument or SendUri actions to provide the
291   Input Document content. The client supplies a single set of Job Template attributes that the Printer
292   applies to the Output Document(s) of the job. The "MultipleDocumentHandling" Job Template
293   attribute controls whether the Printer produces separate Output Documents or combines the Input
294   Documents into a single Output Document (see section 4.1.3.1).

295   4.1.3.1   The "MultipleDocumentHandling" Job Template attribute

296   When a client submits a job with more than one Input Document, the
297   "MultipleDocumentHandling" Job Template attribute allows the client to specify whether the
298   Printer is to (1) produce corresponding separate Output Documents or (2) combine the Input
299   Documents into a single Output Document. For example, the 'single-document' and 'single-
300   document-new-sheet' values allow the client to staple all of the Input Documents into a single
301   Output Document, with the latter value forcing each Input Document to start on a new sheet (useful
302   when doing two-sided printing). When requesting multiple Copies, the 'separate-document-
303   uncollated-Copies' value results in the Copies of each Input Document being together in an Output
304   set, while the 'separate-document-collated-Copies' value keeps a copy of each Input Document
305   together in an Output set. For example, a job with Input Documents A, B, C and "Copies" = 2 will
306   result in A, A, B, B, C, C or A, B, C, A, B, C, respectively. If the Printer supports multiple
307   documents per job, the Printer must support this Job Template attribute with at least one value.

308   4.1.4 SendDocument

309   ([rfc2911] §3.3.1) Submits the entire Document Content for the next Input Document of a job
310   created by a previous CreateJob action (see section 4.1.3).

311   **SendDocumentRequest(Operation Attributes, Document Data)**

312   **Operation Attributes:**
313   **JobUri(uri)** or (**PrinterUri(uri) and jobId(integer))**: The target job.
314   **[requestingUserName]**: see section 3.2.2.
315   **[documentName(string)]**: Name for the document to be used in an implementation
316   specific manner.
317   **[Compression(string)]**: Compression algorithm used on the Document Data, if
318   any.
319   **[lastDocument(boolean)]**: 'true' if this is the last Input Document for the Job.
320   Default = 'false'.
321   **Document data**: The document to print**.**
322

323   **SendDocumentResponse(Operation Attributes, [Unsupported Attributes], Job Attributes)**

324   **Operation Attributes** *:*
325   **statusCode:** Results of the action (see Appendix section 6.3).
326   *[statusMessage]:* Localized text description of the status code
327   *[detailedStatusMessage]:* Text for detailed and technical information.
328   **[Unsupported Attributes]**: any unsupported or conflicting attributes and or attribute
329   values. May be returned on success or failure.
330   **Job Attributes:**
331   **JobUri, JobId, JobState, JobStateReasons**, *[JobStateMessage],*
332   *[NumberOfInterveningJobs]* See section .

333 4.1.5 SendUri

334 ([rfc2911] §3.3.2) Identical to the SendDocument operation (see section 4.1.4) except that a client
335 supplies a URI reference to the Document Content data, instead of supplying the document content.
336 The calling sequence is the same as SendDocument () except that the Operation Attributes in the
337 request contains the "documentUri" attribute and the Document Data is omitted.

338 4.1.6 ValidateJob

339 ([rfc2911] §3.2.3) This operation is used only to verify capabilities of a Printer object against
340 whatever attributes are supplied by the client in the ValidateJob request. By using the ValidateJob
341 action a client can validate that an identical PrintJob, PrintUri or CreateJob would be accepted.

342 The calling sequence is similar to PrintJob (see section 4.1.1) except the request does not contain
343 the Document Data and the response does not contain the Job Attributes.

344 *4.2 Job Control Actions*

345 This section describes the actions that allow a client to control a Job after it has been submitted:
346 CancelJob, HoldJob, ReleaseJob, and RestartJob.

347 4.2.1 CancelJob

348 ([rfc2911] §3.3.3) Allows a client to cancel a Print Job from the time the Job is created up to the
349 time it is completed, canceled, or aborted.

350 **CancelJobRequest(Operation Attributes)**

351   **Operation Attributes:**
352   **JobUri(uri)** or (**PrinterUri(uri)** and **JobId(integer)**): The target job.
353   **[requestingUserName]**: see section 3.2.2.
354   *[message(string)]: Message from the Client to the Printer Operator. Utilized in an*
355   *implementation specific manner.*
356

357 **CancelJobResponse(Operation Attributes, [Unsupported Attributes])**

358   **Operation Attributes** *:*

359   **statusCode:** Results of the action (see Appendix section 6.3).

360   *[statusMessage]: Localized text description of the status code.*

361   *[detailedstatusMessage]: Text for detailed and technical information about the job*

362   **[Unsupported Attributes]:** any unsupported or conflicting attributes and or attribute

363   values. May be returned on success or failure.

364   **4.2.2 HoldJob**

365 ([rfc2911] §3.3.5) Allows a client to hold a pending Job in the Printer so that it is not eligible for

366 scheduling. The request calling sequence is similar to CancelJob (see section 4.2.1) except that the

367 "jobHoldUntil" attribute may be in the "Operation Attributes". The response sequence is the same

368 as CancelJob.

369   **4.2.3 ReleaseJob**

370 ([rfc2911] §3.3.6) Release a previously held Job so that it is again eligible for scheduling. The

371 calling sequence is the same as CancelJob (see section 4.2.1).

372   **4.2.4 RestartJob**

373 ([rfc2911] §3.3.7) Restart a job that is retained in the Printer after processing has completed. The

374 request calling sequence is similar to CancelJob except that the "jobHoldUntil" attribute may be in

375 the "Operation Attributes". The response sequence is the same as CancelJob (see section 4.2.1).

376   *4.3 Status and information Actions*

377 This section describes the actions that allow a client to obtain status and attributes of Jobs and

378 PrinterS: GetJobs, GetPrinterAttributes, and GetJobAttributes.

379   **4.3.1 GetJobs**

380 ([rfc2911] §3.3.4) Retrieve the list of Jobs belonging to the Printer. The Client may supply a list of

381 Job attribute and/or attribute group names. A group of Job attributes will be returned for each

382 returned Job.

383   **GetJobsRequest(Operation Attributes**)

384   **Operation Attributes:**

385   **PrinterUri(uri)**: The target printer containing the jobs

386   **[requestingUserName]**: see section 3.2.2.

387   **[requestedAttributes (string(multivalued))]**: set of Job Attribute and/or Attribute

388   Group names to be returned for each Job. Default = 'JobUri' and 'JobId'.

389   **[whichJobs(string)]**:Allows user to restrict jobs returned to completed or

390   active/queued states. (keywords: completed, not-completed (Default)).

391   **[myJobs(boolean)]**: Allows user to restrict jobs returned to just the user's jobs or

392   all jobs. Default = 'false'.

393   **[limit(integer)]**: Sets maximum number of jobs to return. Default = no limit.

394   **GetJobsResponse(Operation Attributes**, [**Unsupported Attributes], Job Attributes)**

395   **Operation Attributes** *:*

396   **statusCode:** Results of the action (see Appendix section 6.3).

397   *[statusMessage]: Localized text description of the status code.*

398   *[detailedstatusMessage]: Text for detailed and technical information about the job.*

399   **Unsupported Attributes:** any unsupported or conflicting attributes and or attribute values.

400   May be returned on success or failure.

401   **Job Attributes**(*sequence of requested attributes/values (multivalued)):* A list of jobs each

402   containing the requested attributes

4.3.2 GetPrinterAttributes

404 ([rfc2911] §3.2.5) Returns the values of the requested attributes and/or attribute groups of a

405 Printer.

406 **GetPrinterAttributesRequest(Operation Attributes**)

407   **Operation Attributes:**

408   **PrinterUri(uri)**: The target printer

409   **[requestingUserName]**: see section 3.2.2.

410   **[requestedAttributes (string(multivalued))]**: set of Printer Attribute and/or

411   Attribute Group names to be returned. Default = 'all'.

412   **[DocumentFormat(string)]**: Since some capabilities can be PDL specific, this

413   optional attributes allows the Printer to return capabilities based on PDL if

414   known to the Printer.

415 **GetPrinterAttributesResponse(Operation Attributes**, [**Unsupported Attributes], Printer**

416 **Attributes)**

417   **Operation Attributes** *:*

418   **statusCode:** Results of the action (see Appendix section 6.3).

419   *[statusMessage]: Localized text description of the status code.*

420   *[detailedstatusMessage]: Text for detailed and technical information about the*

421   *Printer.*

422   **[Unsupported Attributes**]: any unsupported or conflicting attributes and or attribute

423   values. May be returned on success or failure.

424   **Printer Attributes(requested attributes/values (multivalued)**): The requested attributes

4.3.3 GetJobAttributes

426 ([rfc2911] §3.3.4) Returns the values of the requested attributes and/or attribute groups of a Job.

427 **GetJobAttributesRequest(Operation Attributes**)

428   **Operation Attributes:**

429   **JobUri(uri)** or **(PrinterUri(uri) and JobId(integer)**): The target job

430   **[requestingUserName]**: see section 3.2.2.

431   **[requested-attributes (string(multivalued))]**: set of Job Attribute and/or Attribute

432   Group names to be returned for each Job. Default = 'all'.

433 **GetJobAttributesResponse(Operation Attributes**, [**Unsupported Attributes], Job Attributes)**

434   **Operation Attributes** *:*
435   **statusCode:** Results of the action (see Appendix section 6.3).
436   *[statusMessage]: Localized text description of the status code.*
437   *[detailedstatusMessage]: Text for detailed and technical information about the job.*
438   **[Unsupported Attributes]:** any unsupported or conflicting attributes and or attribute
439   values. May be returned on success or failure.
440   **Job Attributes(requested attribute/values(multivalued)):** The requested attributes and
441   their values)

4.4 Printer Control Actions

443 This section describes actions which allow a client to control a Printer and may require operator
444 credentials: PausePrinter, ResumePrinter, and PurgeJobs.

4.4.1 PausePrinter

446 ([rfc2911] §3.2.7) Stops the Printer object from scheduling jobs.

447 **PausePrinterRequest(Operation Attributes**)

448   **Operation Attributes:**
449   **PrinterUri(uri)**: The target printer for the job
450   **[requestingUserName]**: see section 3.2.2.
451 **PausePrinterResponse(Operation Attributes**, **[Unsupported Attributes])**

452   **Operational Attributes** *:*
453   **statusCode:** Results of the action (see Appendix section 6.3).
454   *[statusMessage]: Localized text description of the status code.*
455   *[detailedStatusMessage]: Text for detailed and technical information.*
456   **[Unsupported Attributes]**: any unsupported or conflicting attributes and or attribute
457   values. May be returned on success or failure.

4.4.2 ResumePrinter

459 ([rfc2911] §3.2.8) Resume the scheduling of Jobs in the Printer. The calling seque nce is the same
460 as PausePrinter (see section 4.4.1).

4.4.3 PurgeJobs

462 ([rfc2911] §3.2.9) Removes all jobs from the Printer, regardless of their state. . The calling
463 sequence is the same as PausePrinter (see section 4.4.1).

5 References

465 [rfc2911] RFC 2566 "Internet Printing Protocol/1.0 Model and Semantics", March 1999 and RFC
466   2911 "Internet Printing Protocol/1.1 Model and Semantics", September 2000, T. Hastings,
467   R. Herriot, R. Debry, S. Isaacson, P. Powell

468 [PWG5101.1] IEEE-ISTO 5101.1-2001 Media Standardized Names <work in progress>,
469   ftp://ftp.pwg.org/pub/pwg/standards/pwg5101.1.pdf, .doc, .rtf for standardized names

470 [rfc2046] RFC 2046 "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types",
471   November 1996, Freed, N. and N. Borenstein

472 [rfc2048] RFC 2048 "Multipurpose Internet Mail Extension (MIME) Part Four: Registration
473   Procedures", November 1996, Freed, N., Klensin, J. and J. Postel

474 [rfc1123] RFC 1123 " Requirements for Internet Hosts -- Application and Support ", October 1989,
475   Branden, R.

476 # 6 Appendices

477 ## 6.1 Changes to remove some IPP specific aspects

478 This section lists some changes to remove some IPP specific aspects from the PWG Semantic
479 Model. Any attribute name containing "ipp" has had the "ipp" removed. The IPP operation names
480 have the hyphens removed to be the PWG action names and the operations supported are mixed
481 keywords, not integer enum values. All attributes names have had the first letter capitalized and
482 the '-' character removed and the character following the '-' has been capitalized. The keyword
483 attribute values defined remain unchanged and are all lower case, except for the ones that specify
484 other attributes names (which are changed to be the mixed case without hyphens). ISSUE 03:
485 What about the case and hyphens in status code names (and removing the integer values)? The
486 term "object" is sometimes changed to "data class". ISSUE 04: Why? and Why not done
487 consistently? The term "operation" has been changed to "action" to use the term more frequently
488 used with XML.

489 The aspects of the model that deal with globalization (i.e. character set & language) have been
490 removed. Globalization will be addressed in a protocol specific binding of this semantic model.
491 The Printer globalization attributes are charsetConfigured, charsetSupported,
492 naturalLanguageConfigured, naturalLanguageSupported and generatedNaturalLanguageSupported.

493 The types of the attributes have been simplified. All keyword, text, name, DateTime, uri,
494 UriScheme, enum and mimeMediaType are represented by the simple string type. The term
495 "keyword" continues to be used for string values enumerated as part of the PWG Model. The
496 integer enums values are replaced by their associated keyword. The "1setOf X" types are
497 represented as the base type and the "Multivalued" field in the tables below set to "Yes". Integers
498 and Boolean types remain the same. Any applicable constraints placed on the attribute values has
499 been noted in the tables below.

500 ## 6.2 Summary of Job and Printer object attributes

501 This appendix summarizes the attributes for the Job and Printer objects. For each attribute, the
502 tables contain the attribute name, whether the attribute is multi-valued, its syntax, constraints
503 (MAX = 2**31-1, MIN = -2**31, and Maxlength = number of octets for strings), and a reference
504 to the document whether the semantics of the attribute is completely specified:

505   ▪ Table 3 - Optional Job Template Attributes (see section 3.2.1)

506

507   ▪ Table 4 - Mandatory Job Description Attributes (see section 3.2.2)

508   ▪ Table 5 - Optional Job Description Attributes (see section 3.2.2)

509 ▪ Table 6 - Mandatory Printer Description Attributes (see section 3.1.1)

510 ▪ Table 7 - Optional Printer Description Attributes (see section 3.1.1)

511 Currently, this Appendix only lists attributes that are defined in [rfc2911], not any of the twelve
512 additional IPP extension documents (see http://www.pwg.org/ipp/index.html).

513

514 **Table 3 - Optional Job Template Attributes**

Attribute Name	Multivalued	Syntax	constraint	reference
Description (values)				
JobPriority		Integer	1:100	[rfc2911] §4.2.1
Priority for scheduling the Job. A higher value specifies a higher priority.				
JobHoldUntil		String	Type3 keyword	[rfc2911] §4.2.2
Specifies the named time period during which the Job must become a candidate for printing. (keywords: no-hold, indefinite, day-time, evening, night, weekend, second-shift, third-shift)				
JobSheets		String	type3 keyword	[rfc2911] §4.2.3
Specifies which job start/end sheet(s), will be printed with a job.. (example: none, standard)				
MultipleDocumentHandling		String	type2 keyword	[rfc2911] §4.2.4
Controls whether Input Documents in multi-document jobs are combined into a single Output Document or are kept as separate Output Documents (see section 4.1.3.1). Useful for application of Finishings and the placement of one or more print-stream pages into impressions and onto media sheets for multi-document Jobs. (keywords: single-document, separate-documents-uncollated-Copies, separate-documents-collated-Copies, single-document-new-sheet)				
Copies		Integer	1:MAX	[rfc2911] §4.2.5
The number of copies of the Output Document(s) to be printed.				
Finishings	Yes	String	type2 keyword	[rfc2911] §4.2.6
Identifies the finishing that the Printer uses for each copy of each printed Output Document in the Job (example: none, staple, punch, cover, bind, saddle-stitch, edge-stitch, staple-top-left, staple-bottom-left, staple-top-right, staple-bottom-right, edge-stitch-left, edge-stitch-top, edge-stitch-right, edge-stitch-bottom, staple-dual-left, staple-dual-top, staple-dual-right, staple-dual-bottom)				
PageRanges	Yes	rangeOfInteger	Ascending non-overlapping values	[rfc2911] §4.2.7
Identifies the range(s) of pages that are to be printed by the Printer for each copy of each Output Document.				
Sides		String	type2 keyword	[rfc2911] §4.2.8
Indicates how an impression is to be placed upon the side(s) of the media (keyword: one-sided, two-sided-long-edge, two-sided-short-edge, two-sided-long-edge, tumble)				

Attribute Name	Multivalued	Syntax	constraint	reference
Description (values)				
NumberUp		Integer	1:MAX	[rfc2911] §4.2.9
Indicates the number of pages in an impression.				
OrientationRequested		String	type2 keyword	[rfc2911] §4.2.10
The desired orientation for printed pages. (keywords: portrait, landscape, reverse-landscape, reverse-portrait)				
Media		String	type3 keyword	[rfc2911] §4.2.11
The medium that the Printer uses for all impressions of the Job. (example: "na-letter". See [pwg5101.1])				
PrinterResolution		resolution		[rfc2911] §4.2.12
The resolution that Printer uses for the Job in cross-feed and feed direction in units of dpi or dpc.				
PrintQuality		String	type2 keyword	[rfc2911] §4.2.13
The print quality that the Printer uses for the Job. (keyword: draft, normal, high)				

515

516 **Table 4 - Mandatory Job Description Attributes**

Attribute Name	Multivalued	Syntax	constraint	reference
Description (values)				
JobUri		String	uri	[rfc2911] §4.3.1
The Printer sets this to the URI for the job. (example: ipp://www.company.com/printer/jobs/22)				
JobId		Integer	1:MAX	[rfc2911] §4.3.2
The Printer sets this to the ID of the job that is unique for the Printer.				
JobPrinterUri		String	uri	[rfc2911] §4.3.3
The Printer set this to the URI of Printer that created this Job. (example: ipp://www.company.com/printer)				
JobName		String	Maxlength=127	[rfc2911] §4.3.5
The Printer sets this to the client-supplied end-user friendly name for the Job, else the Printer must generate a name from other information. (example: "license agreement memo")				
JobOriginatingUserName		String	Maxlength=1023	[rfc2911] §4.3.6
The Printer sets this attribute to the most authenticated printable name that it can obtain (example: "John Doe", \authDomain\John Doe")				
JobState		String	Type1 keyword	[rfc2911] §4.3.7

Attribute Name	Multivalued	Syntax	constraint	reference
Description (values)				
The current state of the job (see section 3.2.3). See also JobStateReasons attribute below. (keywords: pending, pending-held, processing, processing-stopped, canceled, aborted, completed)				
JobStateReasons	Yes	String	type2 keyword	[rfc2911] §4.3.8
Provides additional information about the job's current state. (keywords: none, job-incoming, job-data-insufficient, document-access-error, submission-interrupted, job-outgoing, job-hold-until-specified, resources-are-not-ready, printer-stopped-partly, printer-stopped, job-interpreting, job-queued, job-transforming, job-queued-for-marker, job-printing, job-canceled-by-user, job-canceled-by-operator, job-canceled-at-device, aborted-by-system, unsupported-compression, compression-error, unsupported-document-format, document-format-error, processing-to-stop-point, service-off-line, job-completed-successfully, job-completed-with-warnings, job-completed-with-errors, job-restartable, queued-in-device))				
TimeAtCreation		Integer	MIN:MAX	[rfc2911] §4.3.14.1
The time at which the Job was created in "PrinterUpTime" seconds.				
TimeAtProcessing		Integer	MIN:MAX	[rfc2911] §4.3.14.2
The time at which the Job first began processing.				
TimeAtCompleted		Integer	MIN:MAX	[rfc2911] §4.3.14.3
The time at which the Job completed.				
JobPrinterUpTime		Integer	1:MAX	[rfc2911] §4.3.14.4
The amount of time (in seconds) that the Printer has been up and running. See Printer attribute "PrinterUpTime"				

517

518   **Table 5 - Optional Job Description Attributes**

Attribute Name	Multivalued	Syntax	constraint	reference
Description (values)				
JobMoreInfo		String	uri	[rfc2911] §4.3.4
URI used to obtain information intended for end user consumption about this specific Job. (example: "http://www.company.com/printer/embededjobpage")				
JobStateMessage		String	Maxlength=127	[rfc2911] §4.3.6
Specifies information about the "JobState" and "jobStateReasons" attributes in human readable text. (example: "Job completed successfully with warnings")				
JobDetailedStatusMessage	Yes	String	Maxlength=1023	[rfc2911] §4.3.10

Attribute Name	Multivalued	Syntax	constraint	reference
Description (values)				
Specifies additional detailed and technical information about the job. Intended for use by the system administrator or other experienced technical persons. (example: "PostScript error: stack overflow")				
JobDocumentAccessErrors	Yes	String	Maxlength=1023	[rfc2911] §4.3.11
Information about each document access error for this job encountered by the Printer. (example: "(404) http://www.company.com/pub/fileToPrint.pdf ")				
NumberOfDocuments		Integer	0:MAX	[rfc2911] §4.3.12
The number of documents in the job.				
OutputDeviceAssigned		String	Maxlength=127	[rfc2911] §4.3.13
Identifies the output device to which the Printer has assigned this job (example: "Pete's Printer")				
DateTimeAtCreation		String	DateTime [rfc1123]	[rfc2911] §4.3.14.5
Indicates the date and time at which the Job was created . (example: Fri, 03 May 2002 08:49:37 GMT)				
DateTimeAtProcessing		String	DateTime [rfc1123]	[rfc2911] §4.3.14.6
Indicates the date and time at which the Job first began processing. (example: Fri, 03 May 2002 08:49:37 GMT)				
DateTimeAtCompleted		String	DateTime [rfc1123]	[rfc2911] §4.3.14.7
Indicates the date and time at which the Job completed. (example: Fri, 03 May 2002 08:49:37 GMT)				
NumberOfInterveningJobs		Integer	0:MAX	[rfc2911] §4.3.15
The number of jobs that are "ahead" of this job assuming the current scheduled order.				
JobMessageFromOperator		String	Maxlength=127	[rfc2911] §4.3.16
Message to the end user indicating the reasons for any management action taken on a job. (example: "Job canceled due to length", "Pick job up in mailbox")				
JobKOctets		Integer	0:MAX	[rfc2911] §4.3.17.1
The total size of the Job's document(s) in integral units of 1024 octets.				
jobImpressions		Integer	0:MAX	[rfc2911] §4.3.17.2
The total size in number of impressions in all the Job's document(s).				
JobMediaSheets		Integer	0:MAX	[rfc2911] §4.3.17.3
The total number of media sheets to be produced for this job.				
JobKOctetsProcessed		Integer	0:MAX	[rfc2911] §4.3.18.1

Attribute Name	Multivalued	Syntax	constraint	reference
	Description (values)			
	the total number of octets processed in integral units of 1024 octets so far.			
jobImpressionsCompleted		Integer	0:MAX	[rfc2911] §4.3.18.2
	The number of impressions completed for the job so far.			
JobMediaSheetsCompleted		Integer	0:MAX	[rfc2911] §4.3.18.3
	The media-sheets completed marking and stacking for the entire job so far.			

519

520   **Table 6 - Mandatory Printer Description Attributes**

Attribute Name	Multivalued	Syntax	constraint	reference
	Description (values)			
PrinterUriSupported	Yes	String	uri	[rfc2911] §4.4.1
	Contains at least one URI for the Printer object. The PrinterUriSupported, UriAuthenticationSupported and the UriSecuritySupported are parallel attributes. Each of these attributes must have the same cardinality. The "i"th value of each of these attributes describes the URI for the printer, the authentication mechanism used and the security method used. (example: ipp://www.company.com/printer)			
UriAuthenticationSupported	Yes	String	type2 keyword	[rfc2911] §4.4.2
	The Client authentication mechanism that the Printer object uses to identify the user. See PrinterUriSupported for additiona information. (keywords: none, requesting-user-name, basic, digest and certificate)			
UriSecuritySupported	Yes	String	type2 keyword	[rfc2911] §4.4.3
	Identifies the security mechanisms used for accessing the Printer object. See PrinterUriSupported for additiona information. (keywords: none, ssl3, tls)			
PrinterName		String	Maxlength=127	[rfc2911] §4.4.4
	The end-user friendly name of the Printer object. (example: "Pete's Printer")			
PrinterState		String	type1 keyword	[rfc2911] §4.4.11
	Identifies the current state of the device (see section 3.1.2). See "PrinterStateReasons" below. (keywords: idle, processing, stopped)			
PrinterStateReasons	Yes	String	type2 keyword	[rfc2911] §4.4.12

Attribute Name	Multivalued	Syntax	constraint	reference
Description (values)				
Augments the "printer-state" attribute to give more detailed information about the Printer state. Each keyword value may have a suffix to indicate its level of severity. The three suffixes (levels) are: "Report" (least severe), "Warning", and "Error" (most severe). Keywords without suffixes are assumed to be "Error" (most severe). See reference sor semantics of defined keywords. (keywords: other, none, media-needed, media-jam, moving-to-paused, paused, shutdown, connecting-to-device, timed-out, stopping, stopped-partly, toner-low, toner-empty, spool-area-full, cover-open, interlock-open, door-open, input-tray-missing, media-low, media-empty, output-tray-missing, output-area-almost-full, output-area-full, marker-supply-low, marker-supply-empty, marker-waste-almost-full, marker-waste-full, fuser-over-temp, fuser-under-temp, opc-near-eol, opc-life-over, developer-low, developer-empty, interpreter-resource-unavailabl)				
VersionsSupported	Yes	String	type2 keyword	[rfc2911] §4.4.14
Identifies the version(s) that this Printer supports, including major and minor versions. This attribute is Protocol specific in an implementation and the current keywords refer to the IPP Protocol and Model. (keywords: 1.0, 1.1)				
OperationsSupported	Yes	String	type2 keyword	[rfc2911] §4.4.15
The set of supported actions for the Printer and Job. (keywords: PrintJob, PrintUri, ValidateJob, CreateJob, SendDocument, SendUri, CancelJob, GetJobAttributes, GetJobs, GetPrinterAttributes, HoldJob, ReleaseJob, RestartJob, PausePrinter, ResumePrinter, PurgeJobs).				
DocumentFormatDefault		String	MimeMediaType [rfc2046], [rfc2048]	[rfc2911] §4.4.21
The document format (i.e. PDL) that the Printer has been configured to assume if the client does not specify a document format in any of the actions that supply document content for a Job. The value "application/octet-stream" has a special meaning. This value is used to indicate that a Printer is capable of auto-sensing the format of the document. (examples: "application/octet-stream", "application/postscript", "application/vnd.hp-PCL", "text/plain; charset=utf-8")				
DocumentFormatSupported	Yes	String	mimeMediaTyp	[rfc2911] §4.4.22
The set of document formats that the Printer. (examples: "application/octet-stream", "application/postscript", "application/vnd.hp-PCL", "text/plain; charset=utf-8")				
PrinterIsAcceptingJobs		Boolean		[rfc2911] §4.4.23
Indicates whether the printer is currently able to accept jobs.				
QueuedJobCount		integer	0:MAX	[rfc2911] §4.4.24
The number of jobs that the Printer has accepted but has not yet completed.				
PdlOverrideSupported		String	type2 keyword	[rfc2911] §4.4.28
Expresses the ability of a Printer to either attempt to override a document's production instructions with Job Template Attributes or not. (keywords: attempted, not-attempted)				
PrinterUpTime		integer	1:MAX	[rfc2911] §4.4.29

Attribute Name	Multivalued	Syntax	constraint	reference
	Description (values)			
	The amount of time (in seconds) that a Printer has been up and running			
CompressionSupported	Yes	String	Type3 keyword	[rfc2911] §4.4.32
	Identifies the set of supported Compression algorithms for document content. (keywords: none, deflate, gzip, compress)			

521

522 **Table 7 - Optional Printer Description Attributes**

Attribute Name	Multivalued	Syntax	constraint	reference
	Description (values)			
PrinterLocation		String	Maxlength=127	[rfc2911] §4.4.5
	Identifies the location of the device. (example: Pete's Office)			
PrinterInfo		String	Maxlength=127	[rfc2911] §4.4.6
	Descriptive information about this Printer object.(example: "Out of courtesy for others, please print only small (1-5 page) jobs at this printer")			
PrinterMoreInfo		String	uri	[rfc2911] §4.4.7
	URI used to obtain information intended for end user consumption about this specific Printer. (example: "http://www.company.com/printer/embeddedwebpage")			
PrinterDriverInstaller		String	Uri	[rfc2911] §4.4.8
	Intended for consumption by automata to locate the driver installer for this Printer object. Note: This attribute has not been used by any known implementation. (example: "http://www.company.com/printer/installerProgram"			
PrinterMakeAndModel		String	Maxlength=127	[rfc2911] §4.4.9
	Identifies the make and model of the device. (example: "Xerox Phaser 7700", "HP LaserJet 1000", "Lexmark Optra Color 45")			
PrinterMoreInfoManufacturer		String	uri	[rfc2911] §4.4.10
	URI used to obtain more information for end user consumption about this type of device. (example: "http://www.xerox.com/go/xrx/template/012.jsp?Xcntry=USA&Xlang=en_US&prodID=7700", "http://www.lexmark.com/US/products/overview/0,1224,MjQ5fDE=,00.html")			
PrinterStateMessage		String	Maxlength=1023	[rfc2911] §4.4.13
	Information about the "printer- state" and "printer-state-reasons" attributes in human readable text. (example: "Printer stopped due to paper jam")			
MultipleDocumentJobsSupported		boolean		[rfc2911] §4.4.16

Attribute Name	Multivalued	Syntax	constraint	reference
Description (values)				
Indicates whether the Printer supports more than one document per job, i.e., more than one SendDocument and/or SendUri request per job. A multi-document per job Printer must implement this attribute and have a value of 'true'. A single document per job Printer may either not support this attribute or support it with a value of 'false'.				
PrinterMessageFromOperator		String	Maxlength=127	[rfc2911] §4.4.25
End user information for the printer. (example: "printer unavailable until 1pm due to preventive mainanance")				
ColorSupported		boolean		[rfc2911] §4.4.26
Indicates if the device is capable of any type of color printing at all, including highlight color.				
ReferenceUriSchemesSupporte d	Yes	String	UriScheme	[rfc2911] §4.4.27
Which URI schemes are supported by the printer to retrieve documents This attribute must be supported if the Printer is capable of print by reference. (example: ftp, http)				
printerCurrentTime		String	DateTime [rfc1123]	[rfc2911] §4.4.30
Indicates the current date and time. (example: Fri, 03 May 2002 08:49:37 GMT)				
MultipleOperationTimeOut		Integer	1:MAX	[rfc2911] §4.4.31
Identifies the minimum time (in seconds) that a multi-document per job Printer must wait between actions on an open job. The actions can add documents to the open Job or close the Job. Timeouts are handled in an implementation specific manner. Multi-document per job PrinterS must implement this attribute. The recommended value is greater than 60 and less than 240.				
JobKOctetsSupported		RangOfInteger	0:MAX	[rfc2911] §4.4.33
Specifies the allowable upper and lower bounds of the total size per job in integral units of 1024 octets.				
JobImpressionsSupporte d		RangOfInteger	0:MAX	[rfc2911] §4.4.34
Specifies the upper and lower bounds for the number of impressions allowed per job.				
JobMediaSheetsSupported		RangOfInteger	0:MAX	[rfc2911] §4.4.35
Specifies the upper and lower bounds for the number of media sheets allowed per job.				
PagesPerMinute		Integer	0:MAX	[rfc2911] §4.4.36
Specifies the nominal number of pages per minute which may be generated by this printer.				
PagesPerMinuteColor		Integer	0:MAX	[rfc2911] §4.4.37
Specifies the nominal number of pages per minute which may be generated by this printer when printing color.				

523

524 *6.3 Action Status Codes*

525 This Appendix lists the status codes that the Printer returns in each action response.

526 The following status codes are returned when the Printer accepts the action request and indicates
527 some degree of success:

528 successful-ok - Action succeeded and no requested attribute were substituted or ignored.
529 successful-ok-ignored-or-substituted-attributes - Action succeeded but some unsupported attributes
530   were ignored or substituted.
531 successful-ok-conflicting-attributes - Action succeeded but some attributes were conflicting and
532   have been substituted or ignored.
533

534 The following status codes are returned when the Printer rejects the action indicating some error on
535 the part of the Client:

536 client-error-bad-request - malformed syntax or constraint exceeded.
537 client-error-forbidden - The Printer understood the request, but is refusing to fulfill it for
538   authentication and/or authorization reasons. The client should not try again even with
539   credentials.
540 client-error-not-authenticated - The request requires user authentication. The client may try again
541   with suitable authentication.
542 client-error-not-authorized - The requester is not authorized to perform the request. The Client
543   should not try again.
544 client-error-not-possible - The action cannot be performed, because of the state of the target object.
545 client-error-timeout - The client did not produce a subsequent request within the time that the
546   Printer was prepared to wait.
547 client-error-not-found - The target object was not found.
548 client-error-gone - The target object is no longer available.
549 client-error-request-entity-too-large - The request and/or the Document Content is too large.
550 client-error-request-value-too-long - A attribute value in the request is longer than the Printer
551   supports.
552 client-error-document-format-not-supported - The document format is not supported.
553 client-error-attributes-or-values-not-supported - An attribute and/or value is not supported and must
554   be in order to carry out the request. The Printer must return the unsupported attributes or
555   values in the Unsupported Attributes group.
556 client-error-uri-scheme-not-supported - The URI scheme is not supported.
557 client-error-charset-not-supported - The charset is not supported.
558 client-error-conflicting-attributes - Some supplied attributes are conflicting. The Printer must
559   return them in the Unsupported Attributes group.
560 client-error-compression-not-supported - The compression of the Document Content is not
561   supported.
562 client-error-compression-error - An error occurred when uncompressing the Document Content.
563 client-error-document-format-error - An error occurred when interpreting the Document Content.
564 client-error-document-access-error - An error occurred when the Printer attempted to access the
565   Document Content through the URI supplied.

566

567 The following status codes are returned when the Printer rejects the action indicating some error on
568 the part of the Printer:

569 server-error-internal-error - An unexpected internal error occurred.
570 server-error-operation-not-supported - The Printer does not support the requested action.
571 server-error-service-unavailable - The Printer is unable to service the request at this time due to
572   overloading or maintenance. The client should try again later as per the "message"
573   Operation attribute.
574 server-error-version-not-supported - The Printer doesn't support the requested major version of the
575   protocol and returns the closest version that it does support.
576 server-error-device-error - The Printer encountered a device error that causes it to be unable to
577   accept a new request. For example, a paper jam for a Printer that doesn't spool and so
578   cannot accept a new job submission until the jam is fixed.
579 server-error-temporary-error - A temporary error such as a buffer full write error, a memory
580   overflow, or a disk full condition.
581 server-error-not-accepting-jobs - The Printer is not currently accepting jobs. Its
582   "PrinterIsAcceptingJobs" Printer Description attribute is 'false'.
583 server-error-busy - A temporary error indicating that the Printer is too busy processing jobs and/or
584   other requests. A Client should try again later.
585 server-error-job-canceled - The job has been canceled by an operator or aborted by the system. For
586   example, while the Client is transmitting the Document Content to the Printer.
587 server-error-multiple-document-jobs-not-supported - The Printer doesn't support multiple
588   document jobs and the client attempted to supply a second SendDocument or SendUri
589   request. The Printer's "MultipleDocumentJobsSupported" Printer Description attribute is
590   'false'.

7 Change Log

592   5/16/02   PJZ   original draft

593   5/23/02   TH   re-organize draft with comments from Melinda Grant

594   5/26/02   TH   detailed review of the draft

595   5/29/02   PJZ   Incorporated comments prior to initial release