



The Printer Working Group

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Working Draft

## **PWG 3D Print Job Ticket and Associated Capabilities v1.0 (PJT3D)**

Status: Stable

Abstract: This document describes the PWG Semantic Model Print3D service schema for embedded Job Tickets. The schema is based on the IPP 3D Printing Extensions v1.0 (3D) and suitable for data exchange and embedding within common 3D file formats such as 3MF and 3D PDF documents so that user intent is preserved regardless of the transport or workflow used.

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This document is available electronically at:

<http://ftp.pwg.org/pub/pwg/ipp/wd/wd-smpjt3d10-20170504.docx>  
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54 Printer manufacturers and vendors of printer related software will benefit from the  
55 interoperability provided by voluntary conformance to these standards.

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57 technically competent, has multiple, independent and interoperable implementations with  
58 substantial operational experience, and enjoys significant public support.

59 For additional information regarding the Printer Working Group visit:

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61 Contact information:

62 The Printer Working Group  
63 c/o The IEEE Industry Standards and Technology Organization  
64 445 Hoes Lane  
65 Piscataway, NJ 08854  
66 USA  
67

**68 About the Internet Printing Protocol Workgroup**

69 The Internet Printing Protocol (IPP) workgroup has developed a modern, full-featured  
70 network printing protocol, which is now the industry standard. IPP allows a print client to  
71 query a printer for its supported capabilities, features, and parameters to allow the  
72 selection of an appropriate printer for each print job. IPP also provides job information prior  
73 to, during, and at the end of job processing.

74 For additional information regarding IPP visit:

75 <http://www.pwg.org/ipp/>

76 Implementers of this document are encouraged to join the IPP mailing list in order to  
77 participate in any discussions of the document. Suggested additions, changes, or  
78 clarification to this document, should be sent to the IPP mailing list for consideration.

79

80

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## 131 **1. Introduction**

132 The IPP 3D Printing Extensions v1.0 [PWG5100.21] defines an extension to the Internet  
133 Printing Protocol (IPP) that supports printing of physical objects by Additive Manufacturing  
134 devices such as three-dimensional (3D) printers. This document defines an XML schema  
135 representing the semantic elements and values of the IPP 3D model, allowing conversion  
136 of IPP Job Tickets and Printer Capabilities into an XML format suitable for data exchange  
137 and embedding within common 3D file formats such as 3MF [3MF] and 3D PDF  
138 [ECMA363] [ISO14739] [ISO32000].

139 The Print3D schema [SCHEMA] is automatically generated from the IANA IPP registry by  
140 the IPP Registry project's [IPPREGISTRY] "regtosm" tool. This schema is based in part on  
141 the PWG Print Job Ticket and Associated Capabilities Version 1.0 (PJT) [PWG5108.07]  
142 which defines an XML schema for the IPP 2D model.

### 143 **1.1 Output Intent Versus Device Process and Control**

144 As with [PWG5108.07], the focus of 3D printing using the Print3DService schema defined  
145 in this document is the specification of output intent and not the processes or device  
146 control needed to produce a given output. Clients can specify general material selections  
147 ("red PLA", "brown wood PLA", "clear ABS", etc.), print preferences and quality, and  
148 whether supports and rafts should be printed. Printers then use implementation specific  
149 device control and (ordered) processes to satisfy the Client-supplied output intent when  
150 processing the Job.

151 Besides enabling simpler, easier to use Client software that is less likely to fail due to  
152 minor implementation differences, this model also prevents the Client from providing  
153 dangerous device control instructions that exceed safe operating parameters or disable  
154 critical safety interlocks.

## 155 **2. Terminology**

### 156 **2.1 Printing Terminology**

157 Normative definitions and semantics of printing terms are imported from IETF Printer MIB  
158 v2 [RFC3805], IETF Finisher MIB [RFC3806], and IETF Internet Printing Protocol/1.1:  
159 Model and Semantics [RFC8011].

160 *Document*: An object created and managed by a Printer that contains the description,  
161 processing, and status information. A Document object may have attached data and is  
162 bound to a single Job.

163 *Intent*: The preferences for the processing and description properties of a Job or  
164 Document.

165 *Job*: An object created and managed by a Printer that contains description, processing,  
166 and status information. The Job also contains zero or more Document objects.

167 *Job Receipt*: A data object that contains information on the actual values of processing  
168 Elements used when a Job was processed.

169 *Job Ticket*: A data object that contains the Job-level Intent (processing and description  
170 Elements).

171 *Printer*: A print Service or hardware device that supports 3D printing.

172 *Service*: A program that accepts and processes requests to create, monitor and manage  
173 Jobs. The Service accepts and processes requests to monitor and control the status of the  
174 Service itself and its associated Resources. A Service may be hosted either locally or  
175 remotely from the Printer.

## 176 **2.2 Other Terminology**

177 *Element*: A term used to convey structure and relationships in XML Document instances.  
178 An Element can contain both content and Elements. Complex Elements are composed, at  
179 least in part, of other Elements.

## 180 **2.3 Acronyms and Organizations**

181 *3D PDF Consortium*: <http://www.3dpdfconsortium.org/>

182 *3MF Consortium*: 3D Manufacturing Format Consortium, <http://www.3mf.io/>

183 *ISO*: International Organization for Standardization, <http://www.iso.org/>

184 *ODL*: Object Definition Language

185 *PWG*: Printer Working Group, <http://www.pwg.org/>

186



## 187 **3. Rationale for the PWG 3D Print Job Ticket and Associated** 188 **Capabilities v1.0 (PJT3D)**

189 Existing specifications define the following:

- 190 1. The IPP 3D Printing Extensions v1.0 (3D) [PWG5100.21] defines an extension  
191 to the Internet Printing Protocol (IPP) that supports printing of physical objects  
192 by Additive Manufacturing devices such as three-dimensional (3D) printers;
- 193 2. The W3C XML Schema Definition Language (XSD) 1.1 Part 1: Structures  
194 [XSD11-1] specifies the XML Schema Definition Language, which offers facilities  
195 for describing the structure and constraining the contents of XML documents,  
196 including those which exploit the XML Namespace facility;
- 197 3. The W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatypes  
198 [XSD11-2] defines facilities for defining datatypes to be used in XML Schemas  
199 as well as other XML specifications;
- 200 4. The 3D Manufacturing Format Core Specification & Reference Guide v1.1 [3MF]  
201 defines an XML schema and file format for describing 3D objects with one or  
202 more materials;
- 203 5. The Universal 3D File Format [ECMA363] defines a binary format for 3D objects  
204 embedded in PDF files;
- 205 6. Document management -- 3D use of Product Representation Compact (PRC)  
206 format -- Part 1: PRC 10001 [ISO14739] defines a binary format for 3D objects  
207 embedded in PDF files; and
- 208 7. Document management — Portable document format — Part 1: PDF 1.7  
209 [ISO32000] defines a binary file format that supports embedded 3D objects with  
210 one or more materials.

211 Therefore, this PWG 3D Print Job Ticket and Associated Capabilities document should  
212 define an XML schema that represents the IPP attributes and values needed to support  
213 embedding of Job Tickets in 3D document files, data exchange of Printer capabilities,  
214 Printer status, Job Receipts, Job Status, and Job Tickets, and workflows utilizing XML data  
215 models.

### 216 **3.1 Use Cases**

#### 217 **3.1.1 Web-Based Submission of 3MF File**

218 Jane has a 3D model she wishes to print using a commercial 3D printing provider. The  
219 provider supports 3MF files but only allows submission using a HTML form on their web  
220 site. Jane uses the software on her Client device to select the materials and required  
221 dimensional accuracy, and then exports the 3D model to a 3MF file with an embedded Job  
222 Ticket. She then submits the file for printing by the provider.

### 223 3.1.2 Job Accounting using Receipts

224 A print provider needs to produce machine-readable records of every Job that is printed  
225 that are provided to customers to report what work has been performed, the billing  
226 department to determine the cost of each Job, and the operations group to track when to  
227 order supplies and perform maintenance. The receipts need to record the amount and type  
228 of materials used, the total processing time, and any issues that were encountered during  
229 printing. The provider generates a standalone file for each Job, providing copies to the  
230 customers, billing department, and operations group.

### 231 3.2 Out of Scope

232 The following are considered out of scope for this document:

- 233 1. Reporting of actual monetary values associated with Jobs.

### 234 3.3 Design Requirements

235 The design requirements for this document are:

- 236 1. Define PWG Semantic Model elements and values that correspond to their IPP  
237 counterparts; and  
238 2. Define a named PWG Semantic Model schema incorporating the elements and  
239 values so that Job Tickets and their associated capabilities can be exchanged.

240

241 **4. The Print3D Schema**

242 The Print3D schema defines a PWG Semantic Model schema for an abstract 3D printing  
 243 Service based on the IPP 3D Printing Extensions v1.0 (3D) [PWG5100.21]. The  
 244 "Print3DServiceType" and "Print3DJobType" types define the abstract data models for the  
 245 Service and its Jobs. The "Print3DJobTicketType" type defines the abstract data model for  
 246 the Job Ticket that is typically embedded in a 3D document file.

247 The schema itself is organized into four schema description ("XSD") files:

248 "Print3DService.xsd": This file defines the Print3D service types and includes all of  
 249 the other files.

250 "PwgCommon.xsd": This file defines the elements mapped from IPP attributes.

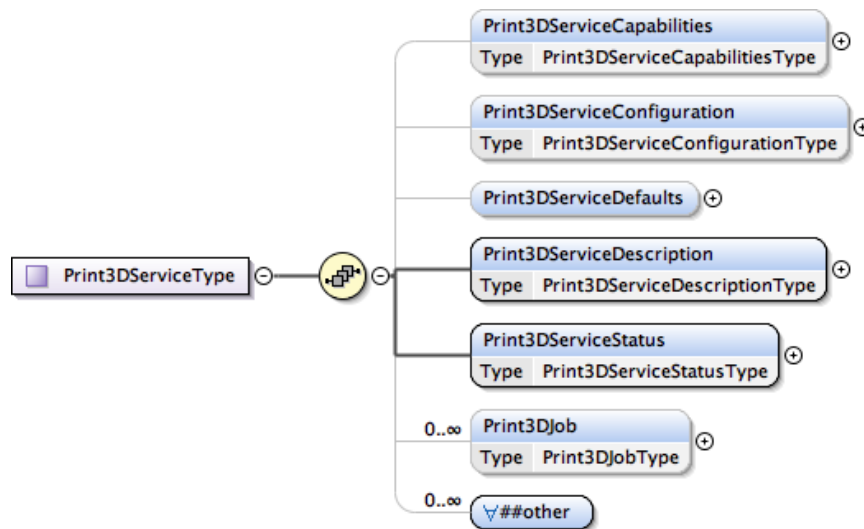
251 "PwgTypes.xsd": This file defines the base IPP types.

252 "PwgWellKnownValues.xsd": This file defines the well-known values of registered  
 253 IPP enum and keyword attributes.

254 The schema namespace URL is "http://www.pwg.org/schemas/smpjt3d10".

255 **4.1 Print3DServiceType**

256 Figure 1 shows the "Print3DServiceType" type which describes an instance of the abstract  
 257 3D printing service and contains the capabilities, configuration, description, status, and  
 258 Jobs list.



259

260

**Figure 1 - Print3DServiceType Schema**

#### 261 4.1.1 Print3DServiceCapabilities

262 This Element contains the supported and "ready" values for each of the Job Ticket  
263 elements. Ready values are those that the Printer can use without operator intervention.

#### 264 4.1.2 Print3DServiceConfiguration

265 This Element contains information about the Printer sub-units.

#### 266 4.1.3 Print3DServiceDefaults

267 This Element contains the default Job Ticket values for the Printer.

#### 268 4.1.4 Print3DServiceDescription

269 This Element contains descriptive values for the Printer, including its name and owner.

#### 270 4.1.5 Print3DServiceStatus

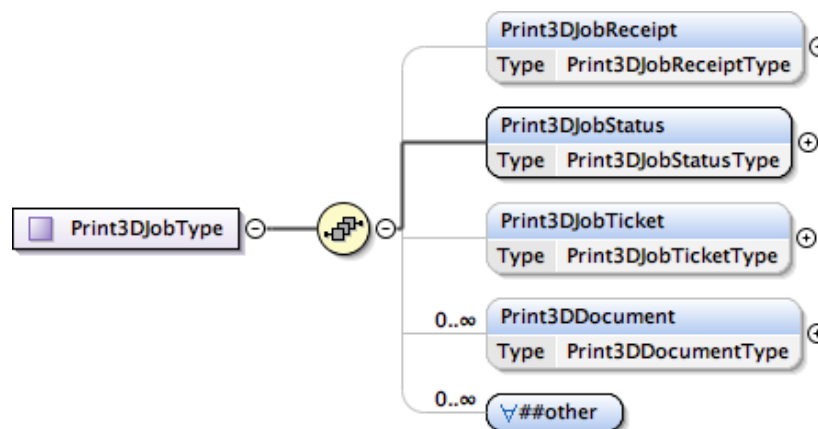
271 This Element contains state values for the Printer.

#### 272 4.1.6 Print3DJob

273 This Element contains the list of active and previously completed 3D print Jobs.

### 274 4.2 Print3DJobType

275 Figure 2 shows the "Print3DJobType" type which describes an instance of the abstract 3D  
276 print Job and contains the Job Receipt, Job Ticket, Job status, and Documents list.



277

278

Figure 2 - Print3DJobType Schema

#### 279 4.2.1 Print3DJobReceipt

280 This Element contains the Job Receipt for a completed Job.

## 281 4.2.2 Print3DJobStatus

282 This Element contains the Job status information.

## 283 4.2.3 Print3DJobTicket

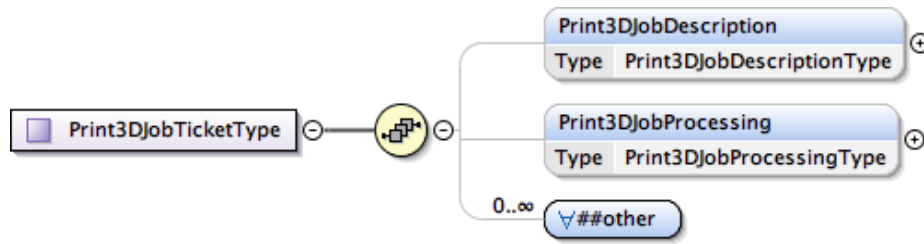
284 This Element contains the Job Ticket for the Job.

## 285 4.2.4 Print3DDocument

286 This Element contains the list of Documents associated with the Job.

## 287 4.3 Print3DJobTicketType

288 Figure 3 shows the "Print3DJobTicketType" type which contains the Job name and  
289 processing intent.



290

291 **Figure 3 - Print3DJobTicketType Schema**

### 292 4.3.1 Print3DJobDescription

293 This Element contains the Job name and any billing information that was supplied.

### 294 4.3.2 Print3DJobProcessing

295 This Element contains the Job processing intent, including the list of materials to use,  
296 required print accuracy, and so forth.

297

## 298 5. Internationalization Considerations

299 For interoperability and basic support for multiple languages, conforming implementations  
300 support:

- 301 1. The Universal Character Set (UCS) Transformation Format -- 8 bit (UTF-8)  
302 [STD63] encoding of Unicode [UNICODE] [ISO10646]; and
- 303 2. The Unicode Format for Network Interchange [RFC5198] which requires  
304 transmission of well-formed UTF-8 strings and recommends transmission of  
305 normalized UTF-8 strings in Normalization Form C (NFC) [UAX15].

306 Unicode NFC is defined as the result of performing Canonical Decomposition (into base  
307 characters and combining marks) followed by Canonical Composition (into canonical  
308 composed characters wherever Unicode has assigned them).

## 309 6. Security Considerations

310 The security considerations for this document are the same as those described in the IPP  
311 3D Printing Extensions v1.0 (3D) [PWG5100.21].

## 312 7. References

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314 v1.1", <http://www.3mf.io/specification>
- 315 [ECMA363] "Universal 3D File Format", ECMA-363
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317 <https://github.com/istopwg/ippregistry>
- 318 [ISO10646] "Information technology -- Universal Coded Character Set (UCS)",  
319 ISO/IEC 10646:2014
- 320 [ISO14739] "Document management -- 3D use of Product Representation  
321 Compact (PRC) format -- Part 1: PRC 10001", ISO 14739-1:2014
- 322 [ISO32000] "Document management — Portable document format — Part 1: PDF  
323 1.7", ISO 32000-1:2008
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330
- 331 [RFC5198] J. Klensin, M. Padlipsky, "Unicode Format for Network Interchange",  
332 RFC 5198, March 2008, <http://tools.ietf.org/html/rfc5198>
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340 <http://www.unicode.org/reports/tr15/tr15-41.html>
- 341 [UNICODE] Unicode Consortium, "Unicode Standard", Version 9.0.0, June 2016,  
342 <http://www.unicode.org/versions/Unicode9.0.0/>
- 343 [XSD11-1] "W3C XML Schema Definition Language (XSD) 1.1 Part 1:  
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345
- 346 [XSD11-2] "W3C XML Schema Definition Language (XSD) 1.1 Part 2:  
347 Datatypes", April 2012, <https://www.w3.org/TR/2012/REC-xmlschema11-2-20120405/>  
348

## 349 8. Author's Address

350 Primary author:

351 Michael Sweet  
352 Apple Inc.  
353 1 Infinite Loop  
354 MS 111-HOMC  
355 Cupertino, CA 95014  
356 msweet@apple.com

357 Additional contributors:

358 Ira McDonald (High North)  
359 Paul Tykodi (TCS)  
360 William Wagner (TIC)  
361 Peter Zehler (Xerox)

## 362 9. Sample Print3DJobTicket

363 The following 3D print job ticket specifies four copies of an object printed with two  
364 materials - blue PLA for the object and a dissolvable PLA for the supports - at normal  
365 quality with supports and rafts:

```
366 <?xml version="1.0" encoding="UTF-8"?>
367 <pwg:Print3DJobTicket xsi:schemaLocation="Print3DService.xsd"
368   xmlns:pwg="http://www.pwg.org/schemas/smpjt3d10"
369   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
370   <pwg:Print3DJobProcessing>
371     <pwg:Copies>4</pwg:Copies>
372     <pwg:MaterialsCol>
373       <pwg:MaterialColor>blue</pwg:MaterialColor>
374       <pwg:MaterialPurpose>InFill</pwg:MaterialPurpose>
375       <pwg:MaterialPurpose>Shell</pwg:MaterialPurpose>
376       <pwg:MaterialType>pla</pwg:MaterialPurpose>
377     </pwg:MaterialsCol>
378     <pwg:MaterialsCol>
379       <pwg:MaterialPurpose>Base</pwg:MaterialPurpose>
380       <pwg:MaterialPurpose>Support</pwg:MaterialPurpose>
381       <pwg:MaterialType>pla-dissolvable</pwg:MaterialPurpose>
382     </pwg:MaterialsCol>
383     <pwg:PlatformTemperature>60</pwg:PlatformTemperature>
384     <pwg:PrintBase>Raft</pwg:PrintBase>
385     <pwg:PrintSupports>Material</pwg:PrintSupports>
386     <pwg:Quality>Normal</pwg:Quality>
387   </pwg:Print3DJobProcessing>
388   <pwg:Print3DJobDescription>
389     <pwg:DocumentMetadata>creator=Jane Doe</pwg:DocumentMetadata>
390     <pwg:DocumentMetadata>date=2017-03-27T12:34:56Z</pwg:DocumentMetadata>
391     <pwg:JobName>Sample 3D Print Job</pwg:JobName>
392   </pwg:Print3DJobDescription>
393 </pwg:Print3DJobTicket>
```

## 394 10. Sample Print3DServiceCapabilities

395 The following 3D print service capabilities describe a printer that supports up to two  
396 materials simultaneously and has blue PLA and dissolvable PLA loaded:

```
397 <?xml version="1.0" encoding="UTF-8"?>
398 <pwg:Print3DServiceCapabilities xsi:schemaLocation="Print3DService.xsd"
399   xmlns:pwg="http://www.pwg.org/schemas/smpjt3d10"
400   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
401
402   <!-- Support millimeters and nanometers for accuracy -->
403   <pwg:AccuracyUnitsSupported>Mm</pwg:AccuracyUnitsSupported>
404   <pwg:AccuracyUnitsSupported>Nm</pwg:AccuracyUnitsSupported>
405
406   <!-- Support 1 to 999 copies -->
407   <pwg:CopiesSupported>
408     <pwg:LowerBound>1</pwg:LowerBound>
409     <pwg:UpperBound>999</pwg:UpperBound>
```



```
410     </pwg:CopiesSupported>
411
412     <!-- Support 3MF and STL -->
413     <pwg:DocumentFormatSupported>model/3mf</pwg:DocumentFormatSupported>
414     <pwg:DocumentFormatSupported>application/sla</pwg:DocumentFormatSupported>
415
416     <!-- Material amounts in grams -->
417     <pwg:MaterialAmountUnitsSupported>G</pwg:MaterialAmountUnitsSupported>
418
419     <!-- 2.85mm filaments -->
420     <pwg:MaterialDiameterSupported>
421         <pwg:LowerBound>2850000</pwg:LowerBound>
422         <pwg:UpperBound>2850000</pwg:UpperBound>
423     </pwg:MaterialDiameterSupported>
424
425     <!-- Supported purposes -->
426     <pwg:MaterialPurposeSupported>All</pwg:MaterialPurposeSupported>
427     <pwg:MaterialPurposeSupported>Base</pwg:MaterialPurposeSupported>
428     <pwg:MaterialPurposeSupported>InFill</pwg:MaterialPurposeSupported>
429     <pwg:MaterialPurposeSupported>Shell</pwg:MaterialPurposeSupported>
430     <pwg:MaterialPurposeSupported>Support</pwg:MaterialPurposeSupported>
431
432     <!-- Supported rates -->
433     <pwg:MaterialRateSupported>
434         <pwg:LowerBound>1</pwg:LowerBound>
435         <pwg:UpperBound>250</pwg:UpperBound>
436     </pwg:MaterialRateSupported>
437     <pwg:MaterialRateUnitsSupported>Ml_second
438     </pwg:MaterialRateUnitsSupported>
439
440     <!-- Shell thickness -->
441     <pwg:MaterialShellThicknessSupported>
442         <pwg:LowerBound>0</pwg:LowerBound>
443         <pwg:UpperBound>4000000</pwg:UpperBound>
444     </pwg:MaterialShellThicknessSupported>
445
446     <!-- Temperatures -->
447     <pwg:MaterialTemperatureSupported>
448         <pwg:LowerBound>180</pwg:LowerBound>
449         <pwg:UpperBound>260</pwg:UpperBound>
450     </pwg:MaterialTemperatureSupported>
451
452     <!-- Supported types -->
453     <pwg:MaterialTypeSupported>nylon</pwg:MaterialTypeSupported>
454     <pwg:MaterialTypeSupported>pet</pwg:MaterialTypeSupported>
455     <pwg:MaterialTypeSupported>pla</pwg:MaterialTypeSupported>
456     <pwg:MaterialTypeSupported>pla-conductive</pwg:MaterialTypeSupported>
457     <pwg:MaterialTypeSupported>pla-dissolvable</pwg:MaterialTypeSupported>
458     <pwg:MaterialTypeSupported>pla-stone</pwg:MaterialTypeSupported>
459     <pwg:MaterialTypeSupported>pla-wood</pwg:MaterialTypeSupported>
460
461     <!-- Support Blue, Orange, Red, and Dissolvable PLA -->
462     <pwg:MaterialsColDatabase>
463         <pwg:MaterialColor>blue</pwg:MaterialColor>
464         <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
465         <pwg:MaterialKey>pla-blue</pwg:MaterialKey>
```

```
466     <pwg:MaterialName>Blue PLA</pwg:MaterialName>
467     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
468     <pwg:MaterialTemperature>
469         <pwg:LowerBound>210</pwg:LowerBound>
470         <pwg:UpperBound>235</pwg:UpperBound>
471     </pwg:MaterialTemperature>
472     <pwg:MaterialType>pla</pwg:MaterialPurpose>
473 </pwg:MaterialsColDatabase>
474 <pwg:MaterialsColDatabase>
475     <pwg:MaterialColor>orange</pwg:MaterialColor>
476     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
477     <pwg:MaterialKey>pla-orange</pwg:MaterialKey>
478     <pwg:MaterialName>Orange PLA</pwg:MaterialName>
479     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
480     <pwg:MaterialTemperature>
481         <pwg:LowerBound>210</pwg:LowerBound>
482         <pwg:UpperBound>235</pwg:UpperBound>
483     </pwg:MaterialTemperature>
484     <pwg:MaterialType>pla</pwg:MaterialPurpose>
485 </pwg:MaterialsColDatabase>
486 <pwg:MaterialsColDatabase>
487     <pwg:MaterialColor>red</pwg:MaterialColor>
488     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
489     <pwg:MaterialKey>pla-red</pwg:MaterialKey>
490     <pwg:MaterialName>Red PLA</pwg:MaterialName>
491     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
492     <pwg:MaterialTemperature>
493         <pwg:LowerBound>210</pwg:LowerBound>
494         <pwg:UpperBound>235</pwg:UpperBound>
495     </pwg:MaterialTemperature>
496     <pwg:MaterialType>pla</pwg:MaterialPurpose>
497 </pwg:MaterialsColDatabase>
498 <pwg:MaterialsColDatabase>
499     <pwg:MaterialColor>clear-white</pwg:MaterialColor>
500     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
501     <pwg:MaterialKey>pla-dissolvable</pwg:MaterialKey>
502     <pwg:MaterialName>Dissolvable PLA</pwg:MaterialName>
503     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
504     <pwg:MaterialType>pla-dissolvable</pwg:MaterialPurpose>
505 </pwg:MaterialsColDatabase>
506
507 <!-- Red and Dissolvable PLA are loaded -->
508 <pwg:MaterialsColReady>
509     <pwg:MaterialColor>red</pwg:MaterialColor>
510     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
511     <pwg:MaterialKey>pla-red</pwg:MaterialKey>
512     <pwg:MaterialName>Red PLA</pwg:MaterialName>
513     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
514     <pwg:MaterialTemperature>
515         <pwg:LowerBound>210</pwg:LowerBound>
516         <pwg:UpperBound>235</pwg:UpperBound>
517     </pwg:MaterialTemperature>
518     <pwg:MaterialType>pla</pwg:MaterialPurpose>
519 </pwg:MaterialsColReady>
520 <pwg:MaterialsColReady>
521     <pwg:MaterialColor>clear-white</pwg:MaterialColor>
```

```
522     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
523     <pwg:MaterialKey>pla-dissolvable</pwg:MaterialKey>
524     <pwg:MaterialName>Dissolvable PLA</pwg:MaterialName>
525     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
526     <pwg:MaterialType>pla-dissolvable</pwg:MaterialPurpose>
527 </pwg:MaterialsColReady>
528
529 <!-- Maximum number of materials per job -->
530 <pwg:MaxMaterialsColSupported>2</pwg:MaxMaterialsColSupported>
531
532 <!-- Supported platform temperatures -->
533 <pwg:PlatformTemperatureSupported>
534     <pwg:LowerBound>40</pwg:LowerBound>
535     <pwg:UpperBound>100</pwg:UpperBound>
536 </pwg:PlatformTemperatureSupported>
537
538 <!-- Brims, Rafts, and Skirts are supported -->
539 <pwg:PrintBaseSupported>Brim</pwg:PrintBaseSupported>
540 <pwg:PrintBaseSupported>None</pwg:PrintBaseSupported>
541 <pwg:PrintBaseSupported>Raft</pwg:PrintBaseSupported>
542 <pwg:PrintBaseSupported>Skirt</pwg:PrintBaseSupported>
543
544 <!-- Supported supports -->
545 <pwg:PrintSupportsSupported>Material</pwg:PrintSupportsSupported>
546 <pwg:PrintSupportsSupported>None</pwg:PrintSupportsSupported>
547 <pwg:PrintSupportsSupported>Standard</pwg:PrintSupportsSupported>
548
549 <!-- Supported qualities -->
550 <pwg:QualitySupported>Draft</pwg:QualitySupported>
551 <pwg:QualitySupported>High</pwg:QualitySupported>
552 <pwg:QualitySupported>Normal</pwg:QualitySupported>
553 </pwg:Print3DServiceCapabilities>
```

## 554 11. IPP Mapping

555 The mapping of the IPP 3D Printing Extensions to the PWG 3D Print Job Ticket and  
556 Associated Capabilities follows the mapping defined in section 21 of the PWG Print Job  
557 Ticket and Associated Capabilities Version 1.0 [PWG5108.07].

558 In addition:

- 559 1. Similar to the handling of "media-color" and "media-type", IPP "material-color"  
560 and "material-type" keyword values are preserved (hyphenated lowercase)  
561 instead of converting them to TitleCase; and
- 562 2. IPP attributes using the 1setOf syntax are mapped to unbounded elements  
563 instead of an element containing an unbounded sequence.  
564

## 565 **12. Change History**

### 566 **12.1 May 4, 2017**

- 567 1. Updated references to 3MF and ISO 10646

### 568 **12.2 April 20, 2017**

- 569 1. Status: Stable  
570 2. Section 1.1: device control commands  
571 3. Section 2.1: remote from the printer  
572 4. Section 9: Fix MaterialColor, MaterialKey, and MaterialType values  
573 5. Section 10: Fix MaterialColor, MaterialKey, and MaterialType values  
574 6. Section 11: Drop operations (item 3)

### 575 **12.3 March 27, 2017**

- 576 1. Section 1: Reference the PJT and talk about output intent  
577 2. Section 2: Define Service  
578 3. Section 4: Added a list of the files in the schema ("roadmap") and the  
579 namespace URL.  
580 4. Section 8: Added acknowledgements  
581 5. Added appendices with sample job ticket, capabilities, and the IPP mapping  
582 strategy.

### 583 **12.4 March 3, 2017**

- 584 1. Updated acronym to "PJT3D", filename to "smpjt3d10"  
585 2. Global: Print3d -> Print3D  
586 3. Global: Element as a defined term.  
587 4. Global: Updated all schema figures to reflect new service name.  
588 5. Abstract: "... suitable for data exchange and embedding within common 3D file  
589 formats such as ..."  
590 6. Section 1: Made it clear the schema is generated from the IANA IPP registry.  
591 7. Section 2.1: Added Intent, Job Receipt, and Job Ticket, Printer  
592 8. Section 2.2: Replaced "Protocol Terminology" with "Other Terminology", define  
593 Element  
594 9. Section 3: Dropped "1.1" from "XML 1.1 schema".  
595 10. Section 3.1.1: Fixed wording.  
596 11. Section 7: Added link to IPP 3D spec.

### 597 **12.5 February 19, 2017**

- 598 Initial revision.

599