



The Printer Working Group

May 4, 2017  
Working Draft

Deleted: April 20

## 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.

This document is a Working Draft. For a definition of a "Working Draft", see: <http://ftp.pwg.org/pub/pwg/general/pwg-process30.pdf>

Field Code Changed

This document is available electronically at:

<http://ftp.pwg.org/pub/pwg/ipp/wd/wd-smpjt3d10-20170504.docx>

<http://ftp.pwg.org/pub/pwg/ipp/wd/wd-smpjt3d10-20170504.pdf>

Deleted: 20170327

Deleted: 20170327

1 Copyright © 2017 The Printer Working Group. All rights reserved.

2 This document may be copied and furnished to others, and derivative works that comment  
3 on, or otherwise explain it or assist in its implementation may be prepared, copied,  
4 published and distributed, in whole or in part, without restriction of any kind, provided that  
5 the above copyright notice, this paragraph and the title of the Document as referenced  
6 below are included on all such copies and derivative works. However, this document itself  
7 may not be modified in any way, such as by removing the copyright notice or references to  
8 the IEEE-ISTO and the Printer Working Group, a program of the IEEE-ISTO.

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

10 The IEEE-ISTO and the Printer Working Group DISCLAIM ANY AND ALL WARRANTIES,  
11 WHETHER EXPRESS OR IMPLIED INCLUDING (WITHOUT LIMITATION) ANY IMPLIED  
12 WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

13 The Printer Working Group, a program of the IEEE-ISTO, reserves the right to make  
14 changes to the document without further notice. The document may be updated, replaced  
15 or made obsolete by other documents at any time.

16 The IEEE-ISTO takes no position regarding the validity or scope of any intellectual  
17 property or other rights that might be claimed to pertain to the implementation or use of the  
18 technology described in this document or the extent to which any license under such rights  
19 might or might not be available; neither does it represent that it has made any effort to  
20 identify any such rights.

21 The IEEE-ISTO invites any interested party to bring to its attention any copyrights, patents,  
22 or patent applications, or other proprietary rights which may cover technology that may be  
23 required to implement the contents of this document. The IEEE-ISTO and its programs  
24 shall not be responsible for identifying patents for which a license may be required by a  
25 document and/or IEEE-ISTO Industry Group Standard or for conducting inquiries into the  
26 legal validity or scope of those patents that are brought to its attention. Inquiries may be  
27 submitted to the IEEE-ISTO by e-mail at: [ieee-isto@ieee.org](mailto:ieee-isto@ieee.org).

28 The Printer Working Group acknowledges that the IEEE-ISTO (acting itself or through its  
29 designees) is, and shall at all times, be the sole entity that may authorize the use of  
30 certification marks, trademarks, or other special designations to indicate compliance with  
31 these materials.

32 Use of this document is wholly voluntary. The existence of this document does not imply  
33 that there are no other ways to produce, test, measure, purchase, market, or provide other  
34 goods and services related to its scope.  
35

### 36 About the IEEE-ISTO

37 The IEEE-ISTO is a not-for-profit corporation offering industry groups an innovative and  
38 flexible operational forum and support services. The IEEE-ISTO provides a forum not only  
39 to develop standards, but also to facilitate activities that support the implementation and  
40 acceptance of standards in the marketplace. The organization is affiliated with the IEEE  
41 (<http://www.ieee.org/>) and the IEEE Standards Association (<http://standards.ieee.org/>).

Field Code Changed

Field Code Changed

42 For additional information regarding the IEEE-ISTO and its industry programs visit:

43 <http://www.ieee-isto.org>

Field Code Changed

### 44 About the IEEE-ISTO PWG

45 The Printer Working Group (or PWG) is a Program of the IEEE Industry Standards and  
46 Technology Organization (ISTO) with member organizations including printer  
47 manufacturers, print server developers, operating system providers, network operating  
48 system providers, network connectivity vendors, and print management application  
49 developers. The group is chartered to make printers and the applications and operating  
50 systems supporting them work together better. All references to the PWG in this  
51 document implicitly mean "The Printer Working Group, a Program of the IEEE ISTO." In  
52 order to meet this objective, the PWG will document the results of their work as open  
53 standards that define print related protocols, interfaces, procedures and conventions.  
54 Printer manufacturers and vendors of printer related software will benefit from the  
55 interoperability provided by voluntary conformance to these standards.

56 In general, a PWG standard is a specification that is stable, well understood, and is  
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:

60 <http://www.pwg.org>

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

Field Code Changed



129 [Figure 2 - Print3DJobType Schema](#) ..... 12

130 [Figure 3 - Print3DJobTicketType Schema](#) ..... 13

131

132

**Deleted:** Figure 1 - Print3DServiceType Schema . 9 ... [2]

## 135 1. Introduction

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

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

### 147 1.1 Output Intent Versus Device Process and Control

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

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

## 159 2. Terminology

### 160 2.1 Printing Terminology

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

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

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

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

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

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

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

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

## 180 2.2 Other Terminology

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

## 184 2.3 Acronyms and Organizations

185 *3D PDF Consortium*: <http://www.3dpdfconsortium.org/>

Field Code Changed

186 *3MF Consortium*: 3D Manufacturing Format Consortium, <http://www.3mf.io/>

Field Code Changed

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

Field Code Changed

188 *ODL*: Object Definition Language

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

Field Code Changed

190



### 191 3. Rationale for the PWG 3D Print Job Ticket and Associated 192 Capabilities v1.0 (PJT3D)

193 Existing specifications define the following:

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

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

#### 220 3.1 Use Cases

##### 221 3.1.1 Web-Based Submission of 3MF File

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

Deleted: 0

**228 3.1.2 Job Accounting using Receipts**

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

**236 3.2 Out of Scope**

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

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

**239 3.3 Design Requirements**

240 The design requirements for this document are:

- 241 1. Define PWG Semantic Model elements and values that correspond to their IPP  
242 counterparts; and  
243 2. Define a named PWG Semantic Model schema incorporating the elements and  
244 values so that Job Tickets and their associated capabilities can be exchanged.  
245

## 246 4. The Print3D Schema

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

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

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

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

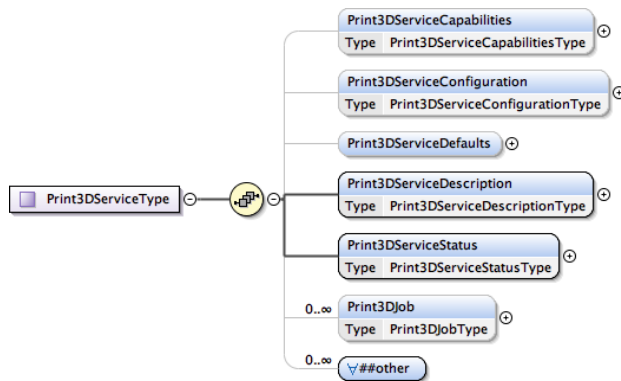
256 "PwgTypes.xsd": This file defines the base IPP types.

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

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

### 260 4.1 Print3DServiceType

261 Figure 1 shows the "Print3DServiceType" type which describes an instance of the abstract  
 262 3D printing service and contains the capabilities, configuration, description, status, and  
 263 Jobs list.



264

265

Figure 1 - Print3DServiceType Schema

#### 266 4.1.1 Print3DServiceCapabilities

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

#### 269 4.1.2 Print3DServiceConfiguration

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

#### 271 4.1.3 Print3DServiceDefaults

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

#### 273 4.1.4 Print3DServiceDescription

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

#### 275 4.1.5 Print3DServiceStatus

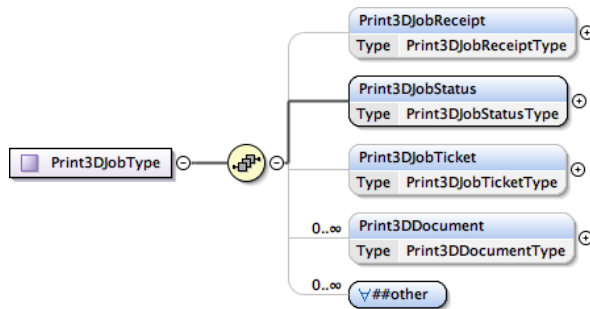
276 This Element contains state values for the Printer.

#### 277 4.1.6 Print3DJob

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

### 279 4.2 Print3DJobType

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



282  
283 **Figure 2 - Print3DJobType Schema**

#### 284 4.2.1 Print3DJobReceipt

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

286 **4.2.2 Print3DJobStatus**

287 This Element contains the Job status information.

288 **4.2.3 Print3DJobTicket**

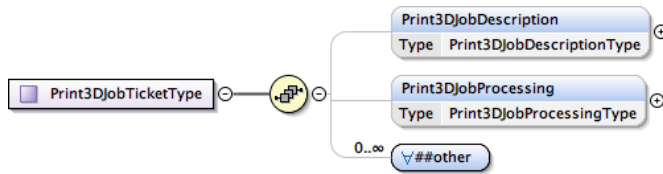
289 This Element contains the Job Ticket for the Job.

290 **4.2.4 Print3DDocument**

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

292 **4.3 Print3DJobTicketType**

293 Figure 3 shows the "Print3DJobTicketType" type which contains the Job name and  
294 processing intent.



295

296 **Figure 3 - Print3DJobTicketType Schema**

296

297 **4.3.1 Print3DJobDescription**

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

299 **4.3.2 Print3DJobProcessing**

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

302

## 303 5. Internationalization Considerations

304 For interoperability and basic support for multiple languages, conforming implementations  
305 support:

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

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

## 314 6. Security Considerations

315 The security considerations for this document are the same as those described in the IPP  
316 3D Printing Extensions v1.0 (3D) [PWG5100.21].

## 317 7. References

- 318 [3MF] "3D Manufacturing Format Core Specification & Reference Guide  
319 v1.1", <http://www.3mf.io/specification>
- 320 [ECMA363] "Universal 3D File Format", ECMA-363
- 321 [IPPREGISTRY] "ISTO-PWG IPP Registry Repository",  
322 <https://github.com/istopwg/ippregistry>
- 323 [ISO10646] "Information technology -- Universal Coded Character Set (UCS)",  
324 ISO/IEC 10646:2014
- 325 [ISO14739] "Document management -- 3D use of Product Representation  
326 Compact (PRC) format -- Part 1: PRC 10001", ISO 14739-1:2014
- 327 [ISO32000] "Document management — Portable document format — Part 1: PDF  
328 1.7", ISO 32000-1:2008
- 329 [PWG5100.21] M. Sweet, "IPP 3D Printing Extensions v1.0 (3D)", PWG 5100.21-  
330 2017, [http://ftp.pwg.org/pub/pwg/candidates/cs-ipp3d10-20170210-  
331 5100.21.pdf](http://ftp.pwg.org/pub/pwg/candidates/cs-ipp3d10-20170210-5100.21.pdf)
- 332 [PWG5108.07] P. Zehler, "PWG Print Job Ticket and Associated Capabilities Version  
333 1.0 (PJT)", PWG 5108.07-2012,

Deleted: 0

Field Code Changed

Deleted: [http://www.3mf.io/wp-content/uploads/2015/04/3MFCoreSpec\\_1.0.1.pdf](http://www.3mf.io/wp-content/uploads/2015/04/3MFCoreSpec_1.0.1.pdf)

Field Code Changed

Deleted: 2011

Field Code Changed

338		<a href="http://ftp.pwg.org/pub/pwg/candidates/cs-sm20-pjt10-20120801-5108.07.pdf">http://ftp.pwg.org/pub/pwg/candidates/cs-sm20-pjt10-20120801-5108.07.pdf</a>	Field Code Changed
339			
340	[RFC5198]	J. Klensin, M. Padlipsky, "Unicode Format for Network Interchange", RFC 5198, March 2008, <a href="http://tools.ietf.org/html/rfc5198">http://tools.ietf.org/html/rfc5198</a>	Field Code Changed
341			
342	[RFC8011]	M. Sweet, I. McDonald, "Internet Printing Protocol/1.1: Model and Semantics", RFC 8011, January 2017, <a href="http://tools.ietf.org/html/rfc8011">http://tools.ietf.org/html/rfc8011</a>	Field Code Changed
343			
344	[SCHEMA]	"PWG Print3D Schema",	
345		<a href="http://ftp.pwg.org/pub/pwg/sm3/schemas/smpjt3d10-20170420.zip">http://ftp.pwg.org/pub/pwg/sm3/schemas/smpjt3d10-20170420.zip</a>	Field Code Changed
346	[STD63]	F. Yergeau, "UTF-8, a transformation format of ISO 10646", RFC 3629/STD 63, November 2003, <a href="http://tools.ietf.org/html/rfc3629">http://tools.ietf.org/html/rfc3629</a>	Field Code Changed
347			
348	[UAX15]	Unicode Consortium, "Normalization Forms", UAX#15, June 2014, <a href="http://www.unicode.org/reports/tr15/tr15-41.html">http://www.unicode.org/reports/tr15/tr15-41.html</a>	Field Code Changed
349			
350	[UNICODE]	Unicode Consortium, "Unicode Standard", Version 9.0.0, June 2016, <a href="http://www.unicode.org/versions/Unicode9.0.0/">http://www.unicode.org/versions/Unicode9.0.0/</a>	Field Code Changed
351			
352	[XSD11-1]	"W3C XML Schema Definition Language (XSD) 1.1 Part 1: Structures", April 2012, <a href="https://www.w3.org/TR/2012/REC-xmlschema11-1-20120405/">https://www.w3.org/TR/2012/REC-xmlschema11-1-20120405/</a>	Field Code Changed
353			
354			
355	[XSD11-2]	"W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatypes", April 2012, <a href="https://www.w3.org/TR/2012/REC-xmlschema11-2-20120405/">https://www.w3.org/TR/2012/REC-xmlschema11-2-20120405/</a>	Field Code Changed
356			
357			

## 358 8. Author's Address

359 Primary author:

360 Michael Sweet  
361 Apple Inc.  
362 1 Infinite Loop  
363 MS 111-HOMC  
364 Cupertino, CA 95014  
365 msweet@apple.com

366 Additional contributors:

367 Ira McDonald (High North)  
368 Paul Tykodi (TCS)  
369 William Wagner (TIC)  
370 Peter Zehler (Xerox)

## 371 9. Sample Print3DJobTicket

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

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

## 403 10. Sample Print3DServiceCapabilities

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

```
406 <?xml version="1.0" encoding="UTF-8"?>
407 <pwg:Print3DServiceCapabilities xsi:schemaLocation="Print3DService.xsd"
408 xmlns:pwg="http://www.pwg.org/schemas/smpjt3d10"
409 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
410
411 <!-- Support millimeters and nanometers for accuracy -->
412 <pwg:AccuracyUnitsSupported>Mm</pwg:AccuracyUnitsSupported>
413 <pwg:AccuracyUnitsSupported>Nm</pwg:AccuracyUnitsSupported>
414
415 <!-- Support 1 to 999 copies -->
416 <pwg:CopiesSupported>
417 <pwg:LowerBound>1</pwg:LowerBound>
418 <pwg:UpperBound>999</pwg:UpperBound>
```



```
419     </pwg:CopiesSupported>
420
421     <!-- Support 3MF and STL -->
422     <pwg:DocumentFormatSupported>model/3mf</pwg:DocumentFormatSupported>
423     <pwg:DocumentFormatSupported>application/sla</pwg:DocumentFormatSupported>
424
425     <!-- Material amounts in grams -->
426     <pwg:MaterialAmountUnitsSupported>G</pwg:MaterialAmountUnitsSupported>
427
428     <!-- 2.85mm filaments -->
429     <pwg:MaterialDiameterSupported>
430       <pwg:LowerBound>2850000</pwg:LowerBound>
431       <pwg:UpperBound>2850000</pwg:UpperBound>
432     </pwg:MaterialDiameterSupported>
433
434     <!-- Supported purposes -->
435     <pwg:MaterialPurposeSupported>All</pwg:MaterialPurposeSupported>
436     <pwg:MaterialPurposeSupported>Base</pwg:MaterialPurposeSupported>
437     <pwg:MaterialPurposeSupported>InFill</pwg:MaterialPurposeSupported>
438     <pwg:MaterialPurposeSupported>Shell</pwg:MaterialPurposeSupported>
439     <pwg:MaterialPurposeSupported>Support</pwg:MaterialPurposeSupported>
440
441     <!-- Supported rates -->
442     <pwg:MaterialRateSupported>
443       <pwg:LowerBound>1</pwg:LowerBound>
444       <pwg:UpperBound>250</pwg:UpperBound>
445     </pwg:MaterialRateSupported>
446     <pwg:MaterialRateUnitsSupported>Ml_second
447     </pwg:MaterialRateUnitsSupported>
448
449     <!-- Shell thickness -->
450     <pwg:MaterialShellThicknessSupported>
451       <pwg:LowerBound>0</pwg:LowerBound>
452       <pwg:UpperBound>4000000</pwg:UpperBound>
453     </pwg:MaterialShellThicknessSupported>
454
455     <!-- Temperatures -->
456     <pwg:MaterialTemperatureSupported>
457       <pwg:LowerBound>180</pwg:LowerBound>
458       <pwg:UpperBound>260</pwg:UpperBound>
459     </pwg:MaterialTemperatureSupported>
460
461     <!-- Supported types -->
462     <pwg:MaterialTypeSupported>nylon</pwg:MaterialTypeSupported>
463     <pwg:MaterialTypeSupported>pet</pwg:MaterialTypeSupported>
464     <pwg:MaterialTypeSupported>pla</pwg:MaterialTypeSupported>
465     <pwg:MaterialTypeSupported>pla-conductive</pwg:MaterialTypeSupported>
466     <pwg:MaterialTypeSupported>pla-dissolvable</pwg:MaterialTypeSupported>
467     <pwg:MaterialTypeSupported>pla-stone</pwg:MaterialTypeSupported>
468     <pwg:MaterialTypeSupported>pla-wood</pwg:MaterialTypeSupported>
469
470     <!-- Support Blue, Orange, Red, and Dissolvable PLA -->
471     <pwg:MaterialsColDatabase>
472       <pwg:MaterialColor>blue</pwg:MaterialColor>
473       <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
474       <pwg:MaterialKey>pla-blue</pwg:MaterialKey>
```

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

```
531     <pwg:MaterialDiameter>2850000</pwg:MaterialDiameter>
532     <pwg:MaterialKey>pla-dissolvable</pwg:MaterialKey>
533     <pwg:MaterialName>Dissolvable PLA</pwg:MaterialName>
534     <pwg:MaterialPurpose>All</pwg:MaterialPurpose>
535     <pwg:MaterialType>pla-dissolvable</pwg:MaterialType>
536 </pwg:MaterialsColReady>
537
538 <!-- Maximum number of materials per job -->
539 <pwg:MaxMaterialsColSupported>2</pwg:MaxMaterialsColSupported>
540
541 <!-- Supported platform temperatures -->
542 <pwg:PlatformTemperatureSupported>
543   <pwg:LowerBound>40</pwg:LowerBound>
544   <pwg:UpperBound>100</pwg:UpperBound>
545 </pwg:PlatformTemperatureSupported>
546
547 <!-- Brims, Rafts, and Skirts are supported -->
548 <pwg:PrintBaseSupported>Brim</pwg:PrintBaseSupported>
549 <pwg:PrintBaseSupported>None</pwg:PrintBaseSupported>
550 <pwg:PrintBaseSupported>Raft</pwg:PrintBaseSupported>
551 <pwg:PrintBaseSupported>Skirt</pwg:PrintBaseSupported>
552
553 <!-- Supported supports -->
554 <pwg:PrintSupportsSupported>Material</pwg:PrintSupportsSupported>
555 <pwg:PrintSupportsSupported>None</pwg:PrintSupportsSupported>
556 <pwg:PrintSupportsSupported>Standard</pwg:PrintSupportsSupported>
557
558 <!-- Supported qualities -->
559 <pwg:QualitySupported>Draft</pwg:QualitySupported>
560 <pwg:QualitySupported>High</pwg:QualitySupported>
561 <pwg:QualitySupported>Normal</pwg:QualitySupported>
562 </pwg:Print3DServiceCapabilities>
```

## 563 11. IPP Mapping

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

567 In addition:

- 568 1. Similar to the handling of "media-color" and "media-type", IPP "material-color"  
569 and "material-type" keyword values are preserved (hyphenated lowercase)  
570 instead of converting them to TitleCase; and
- 571 2. IPP attributes using the 1setOf syntax are mapped to unbounded elements  
572 instead of an element containing an unbounded sequence.  
573

574 **12. Change History**

575 **[12.1 May 4, 2017](#)**

- 576 [1. Updated references to 3MF and ISO 10646](#)

577 **12.2 April 20, 2017**

- 578 1. Status: Stable  
579 2. Section 1.1: device control commands  
580 3. Section 2.1: remote from the printer  
581 4. Section 9: Fix MaterialColor, MaterialKey, and MaterialType values  
582 5. Section 10: Fix MaterialColor, MaterialKey, and MaterialType values  
583 6. Section 11: Drop operations (item 3)

584 **12.3 March 27, 2017**

- 585 1. Section 1: Reference the PJT and talk about output intent  
586 2. Section 2: Define Service  
587 3. Section 4: Added a list of the files in the schema ("roadmap") and the  
588 namespace URL.  
589 4. Section 8: Added acknowledgements  
590 5. Added appendices with sample job ticket, capabilities, and the IPP mapping  
591 strategy.

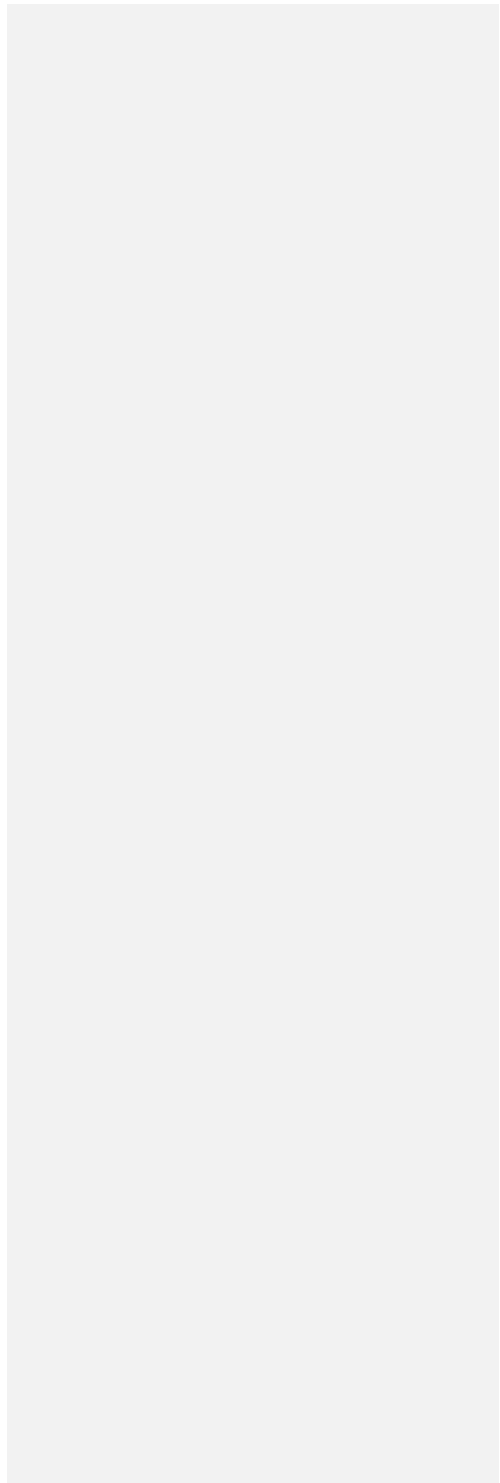
592 **12.4 March 3, 2017**

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

606 **12.5 February 19, 2017**

607 Initial revision.

608



- 1. Introduction..... 6
- 2. Terminology..... 6
  - 2.1 Printing Terminology..... 6
  - 2.2 Protocol Role Terminology..... 6
  - 2.3 Acronyms and Organizations..... 7
- 3. Rationale for the PWG 3D Print Job Ticket and Associated Capabilities v1.0 (Print3D).. 7
  - 3.1 Use Cases..... 8
    - 3.1.1 Web-Based Submission of 3MF File..... 8
    - 3.1.2 Job Accounting using Receipts..... 8
  - 3.2 Out of Scope..... 8
  - 3.3 Design Requirements..... 8
- 4. The Print3D Schema..... 8
  - 4.1 Print3DServiceType..... 9
    - 4.1.1 Print3DServiceCapabilities..... 9
    - 4.1.2 Print3DServiceConfiguration..... 9
    - 4.1.3 Print3DServiceDefaults..... 9
    - 4.1.4 Print3DServiceDescription..... 9
    - 4.1.5 Print3DServiceStatus..... 9
    - 4.1.6 Print3DJob..... 9
  - 4.2 Print3DJobType..... 10
    - 4.2.1 Print3DJobReceipt..... 10
    - 4.2.2 Print3DJobStatus..... 10
    - 4.2.3 Print3DJobTicket..... 10
    - 4.2.4 Print3DDocument..... 10
  - 4.3 Print3DJobTicketType..... 11
    - 4.3.1 Print3DJobDescription..... 11
    - 4.3.2 Print3DJobProcessing..... 11
- 5. Internationalization Considerations..... 11
- 6. Security Considerations..... 11
- 7. References..... 12
- 8. Authors' Addresses..... 13
- 9. Change History..... 14
  - 9.1 February 19, 2017..... 14

- Figure 1 - Print3DServiceType Schema..... 9
- Figure 2 - Print3DJobType Schema..... 10
- Figure 3 - Print3DJobTicketType Schema..... 11