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Working Draft



The Printer Working Group

## Cloud Printing Requirements and Model

Status: Interim

Abstract: This document contains specifications to support Cloud based printing using the PWG semantic model.

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

This document is available electronically at:

<ftp://ftp.pwg.org/pub/pwg/cloud/wd-cloudmodel10-20132012075.docx>

<ftp://ftp.pwg.org/pub/pwg/cloud/wd-cloudmodel10-2013010724205.pdf>

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45 and operating systems supporting them work together better. All references to the PWG in this document  
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51 competent, has multiple, independent and interoperable implementations with substantial operational  
52 experience, and enjoys significant public support.

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56 The Printer Working Group

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61

62 About the Cloud Imaging Work Group

63 Cloud-based applications and solutions are increasingly common, and Cloud-based printing, scanning,  
64 and facsimile (collectively called "Cloud Imaging") are emerging in several different forms. Adopting  
65 standard protocols and schemas now will help interoperability, speed adoption, and address privacy,  
66 security, and legal issues involved in Cloud Imaging.

67 For additional information regarding Cloud Imaging visit:

68 <http://www.pwg.org/Cloud/>

69 Implementers of this specification are encouraged to join the Cloud Imaging mailing list in order to  
70 participate in any discussions of the specification. Suggested additions, changes, or clarification to this  
71 specification, should be sent to the Cloud Mailing list for consideration.

72

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123  
124

## 125 **1. Introduction**

126 This specification introduces a set of requirements and model for Cloud printing from a variety of clients  
127 and operating systems with secure traversal of firewalls to any compliant system or output device.  
128 Legacy solutions are based on the sender and printer residing on the same network or being directly  
129 connected. However, in Cloud computing, clients and printers are frequently on different networks and  
130 legacy solutions are no longer functional.



## 131 2. Terminology

### 132 2.1 Conformance Terminology

133 Capitalized terms, such as MUST, MUST NOT, RECOMMENDED, REQUIRED, SHOULD, SHOULD  
134 NOT, MAY, and OPTIONAL, have special meaning relating to conformance as defined in IETF Key  
135 words for use in RFCs to Indicate Requirement Levels [RFC 2119] The term CONDITIONALLY  
136 REQUIRED is additionally defined for a conformance requirement that applies to a particular capability or  
137 feature.

### 138 2.2 Printing and Cloud Terminology

139 Cloud Printing, as defined in this specification, is consistent with the model implicit in PWG MFD Model  
140 and Common Semantics v1.0 [PWG 5108.01], except that Cloud Printing places a set of Cloud-based  
141 components between the Client and the Print Service Device. Normative definitions and semantics of  
142 printing terms used in this specification are derived from [PWG 5108.01], with most of the terms in the  
143 more general model being implicitly prefaced by “Cloud”. These Cloud Printing specific components and  
144 processes are described in detail in Section 4 of this specification. The definitions of Cloud Printing  
145 specific terms below are summary statements provided for reference convenience and are in no way  
146 supplant the detailed definitions provided in Section 4.

147 **Association:** Association – unspecified method by which the cloud service becomes aware of which  
148 printers the client can send print jobs, request status, and limitations on print jobs to include access to  
149 features or specific capabilities by providing User Credentials.

150 **Client-side** and **Printer-side:** Cloud Printing is distinguished by inserting a set of elements in the Cloud  
151 environment between the Job Originator and the Printer. The path between the Job Originator and the  
152 Cloud is referred to as the “Client-side”. The path between the Cloud and the Printer is referred to as the  
153 “Printer-side”. The distinction is made because, in many cases, details of Client-side interaction can be  
154 considered independently from Printer-side interactions.

155 **Cloud Printing:** an arrangement that uses Cloud-based components to allow a User to locate a Print  
156 Service appropriate to the User’s needs and access rights, to submit a Print Job Request intended for

157 eventual processing by that Print Service, and to query that status of the request and the resulting Print  
158 Job.

159 **Cloud Print Client (Client):** the software component that implements the interface between the User  
160 and the Cloud-based Cloud Printing components. Specifically, the Client implements the interface  
161 between the User and the Cloud service to create an Association and to enumerate available Cloud Print  
162 Services; and the Client implements the interface between the User and the selected Cloud Print Service  
163 to submit a Print Job and to query Job and Printer Status.

164 **Cloud Print Manager:** the software component that implements the interface between the Print Service  
165 Device(Printer) and a cloud-based environment called the Cloud Service, for registration of the Printer;  
166 and that implements the interface between the Printer and one or more cloud-based components called  
167 Cloud Print Service(s) for Job retrieval, Job Management and Job Status notifications.

168 **Cloud Print Service:** a cloud-based software component that implements the Service supporting Client  
169 submission of Job requests and Client Job Status queries. A Cloud Print Service communicates with one  
170 and only one Cloud Print Manager and is created when a Print Service within the Printer managed by the  
171 Cloud Print Manager is registered with the Cloud Service. The Cloud Print Service acts to the Cloud Print  
172 Client as the Cloud Based proxy for the actual Print Service.

173 **Device:** An abstract object representing a hardware component that implements one or more Imaging  
174 Services [PWG 5108.01],.

175 **Job Originator:** The User that submits the initial request to create the Job [PWG 5108.01].

176 **Printer:** A Device implementing Print Services; a Print Service Device

177 **Registration:** unspecified process by which a Cloud Printer Manager makes itself known to the Cloud  
178 Service. This prompts the creation of a Cloud-based Cloud Print Service corresponding to a Print Service  
179 in the Device managed by the Cloud Print Manager.

180 **User:** As defined in the MFD Model and Semantics Standard [PWG 5108.01], Users include the  
181 Administrators, Job Owners, Operators, members of the Job Owner's group and other authenticated  
182 entities.



## 184 **3. Requirements**

### 185 **3.1 Rationale for Cloud Print Model and Requirements**

186 Cloud-based applications and solutions are increasingly common, and Cloud-based printing, scanning,  
187 and facsimile (collectively called "Cloud Imaging") are emerging in several different forms. Adopting  
188 standard protocols and schemas now will help interoperability, speed adoption, and address privacy,  
189 security, and legal issues involved in Cloud Imaging.

190 Cloud printing has many potential implementation methods to comply with the need for security, and that  
191 the components can be located or contained within different locations.

192 The cloud can be a private cloud, a public cloud, or some hybrid federation of the two. The actual print  
193 device may be located at the users location, part of the service provider, at a remote user's location, or  
194 remotely as a pay to print destination.

### 195 **3.2 Consideration of Print Use Cases**

196 Each of the Cloud Printing use cases in this section require establishing a connection to a Cloud-based  
197 entity (typically involving authentication and authorization of the prospective Job Originator), although it is  
198 possible that this connection may not have been made specifically for printing. The printing process  
199 follows the network printing process, and the use cases for network printing apply.

### 200 **3.3 Cloud Print Functional Requirements**

201 For these requirements the following scenario applies. This sets a scenario where a transversal is  
202 required between the user and the cloud service, and between the printer and the cloud service. User is  
203 not part of the cloud service domain and is not directly connected to the printer domain and the Printer is  
204 not part of the cloud service domain. This section describes the functional requirements for any Cloud  
205 Print end-to-end solution.

- 206 1. User to be able to connect to the Cloud Service from a variety of devices, operating systems, and  
207 applications.
- 208 2. User to provide acceptable credentials to the Cloud Service
- 209 3. User to be able to select the print destination.
- 210 4. User to be able to submit a Print Job including a document (direct or by reference) and the print job  
211 attributes.
- 212 5. Cloud Service to return a response that indicates the Print Job submission is acceptable or rejected.
- 213 6. Cloud Service to return a status of printing completed, or the print job failed.
- 214 7. Printer to be registered with the Cloud Service by the Printer owner, including the user rights  
215 associated with the printer. User rights include paid printing, and other printer capabilities that may be  
216 restricted to certain users.
- 217 8. Printer to provide to the Cloud Service it's attributes, including supported document formats, paper  
218 sizes and types, finishing options, and operational status.
- 219 9. Printer to initiate all communications with the Cloud Service.
- 220 10. When the Cloud Service has a job available for printing, the printer to return acceptance or rejection  
221 of the job.
- 222 11. Printer to return operational status when requested
- 223 12. At end of printing, Printer to return a completion status
- 224 13. If unable to complete job, or job is canceled, Printer to return status indicating such activity occurred.
- 225 14. All communications between the Client and the Cloud Service, and between the printer and the  
226 cloud, to be made via a secure connection ensuring data integrity and confidentiality.

227 15. Support and describe a Job ticket and Document Data retention policy, e.g.,  
228 job document data is discarded immediately after processing, discarded after 1 day, saved indefinitely,  
229 etc.

230 16. All interactions between the Printer and the Cloud Service to be logged following the common log  
231 format.

### 232 **3.4 Out of scope**

233 From the Charter of the Cloud Imaging working group [ ] and the recognition that Cloud Printing may use  
234 different paths and elements within the cloud that are not within the province of the Printer Working  
235 Group, the detailed definition of the following elements and aspects of Cloud Printing is out of scope for  
236 this specification, although the general functions performed by these things in Cloud Printing may be  
237 identified in the Model discussion.

- 238 1. Defining Cloud federation interfaces and associated protocols and technologies.
- 239 2. Defining the interface between the physical Printer Device and the component that provides the interface between the Printer and  
240 the Cloud (later called the Cloud Print Manager); this component may be part of the Printer device in which case it is an “internal”  
241 interface; or it may be external, possibly serving multiple physical Printers, in which case it is assumed to use already standardized  
242 Printer interfaces.
- 243 3. Defining new protocols for authentication, authorization, and access control (AAA), enumeration, transport, notification, or device  
244 management.
- 245 4. Defining new document file formats.
- 246 5. Defining new abstract job tickets.
- 247 6. Defining specific interfaces within the Cloud Environment established to support Cloud Printing (later termed the Cloud service).
- 248 7. Defining the interface by which Printers are registered with the Cloud.
- 249 8. Defining the interface by which Users, including potential Job Originators are associated with the Cloud.
- 250 9. Defining the interface between the User and the local component that provides the User’s interface with the cloud (the User Client),  
251 this being part of an application (or operating system) than can be assumed to be proprietary.  
252

### 253 **3.5 Design Requirements**

254 The design requirements can be divided into Client-side interactions between the User and the Cloud  
255 and “Printer-side” interactions between the Printer and the Cloud. Considering the Out-of-Scope items,

256 the design requirements are limited to defining or referencing an existing definition of the User Client to  
257 Cloud interface on the Client-side, and the Cloud Print Service to Cloud Print Manager interface on the  
258 Printer-side. These definitions will, however, assume or impose some characteristics of the otherwise  
259 out-of-scope components.

### 260 **3.5.1 Client-side Design Requirements**

261 The User, operating though a Client, must establish a connection with the Cloud elements supporting the  
262 functions necessary for Cloud Printing. The authentication and authorization of the User, and the  
263 methods by which the printers that he can use are located are out of scope. However, the following are in  
264 scope and must be addressed by this specification:

#### 265 **3.5.1.1 Selecting a Printer**

266 The cloud can determine, on the basis of User Association and Printer Registration, what printers can be  
267 used by the User. The User will select a printer from a group of printers, possibly indirectly on the basis  
268 of his requirements, or possible directly by reviewing the requested printer capabilities.

269 Req 1. The User, operating though the Client, must be able to communicate to the Cloud the  
270 attributes needed of the printer, and the Cloud must be able to provide a list of printers that can be  
271 used by the User that include the required attribute values. From the scenarios, attributes include but  
272 are not limited to the applicable items in the Standard set of printing capabilities (e.g., Table 8 in  
273 IPP/2.0 [PWG5100.12]), and those identified in Section 5.6 of JPS3 [PWG 5100.13].  
274

275 Req 2: The User, operating through the Client, must be able obtain the values of specific  
276 configuration, capabilities and/or status items of an identified printer. The values that may be queried  
277 include but are not limited to the applicable attributes in the Standard set of printing capabilities (e.g.,  
278 Table 8 in IPP/2.0 [PWG5100.12]), and those identified in Section 5.6 of JPS3 [PWG 5100.13]. This  
279 requirement especially includes access to printer status element values

280           **3.5.1.2 Submitting a Job Request**

281           **3.5.1.3 Specifying Handling of the Printed Documents**

282   Specifying to whom, when and where the printed job is to be made available.

283

284           **3.5.1.4 Determining Job Request Status and Job Status**

285   As part of the job request submission process, and possibly as an aspect of Printer selection, a Job  
286   Originator will want to check on the progress of his request.

287           Req 3: User, operating through the Client, must be able to determine the status of a submitted Job  
288           Request, and if that request has been accepted by a printer, the status of the resulting Job.

289   Users with appropriate rights are able to check on their Print Requests and the associated status.

290           Req 4: Users with proper authorization must also be able to determine what Jobs and Print Requests  
291           exist within the printer or service they are authorized to access, and the state of these Print Requests  
292           and jobs.

293

294           **3.5.2 Printer-side Requirements**

295   Although the registration of the printer with the Cloud Service, including communication of printer  
296   capabilities and possibly User access restrictions, is out of scope, the communication of status and  
297   possibly changes in capabilities is not.

298           **3.5.2.1 Communication Printer Status and Configuration Changes**

299



300           **3.5.2.2 Communicating Job Status**

301

302           **3.5.2.3 Handling a Job Request**

303

304           **3.5.2.4 Handling of Printed Document**

305           (Accepting Specification Of How A Job Is To Be Delivered)

306           **3.5.2.5 Access of a Referenced Document**

307           Optional capability for printers capable of print-by-reference.

308           **3.5.3 Transforms**

309           ?

310           **3.5.4 Notification events**

311           TBD

312           **3.5.5 Privacy and security policies**

313           TBD

314           **3.5.6 Logging**

315

## 316 4. Cloud Print Model

### 317 4.1 Cloud Print Model Overview

318 An overall representation of printing in a cloud environment is shown in Figure 1. In a cloud environment,  
319 an individual Client may not be aware of the components and services needed to enable printing to a  
320 device that may be located at an external location, including appropriate tracking, security, and  
321 transforms required to produce and deliver the requested output. ~~The components are each described~~  
322 ~~below.~~ The ~~operations~~ ~~interactions between components~~ are described in the set of sequence diagrams  
323 in Section 4.2.

324 ~~On the Printer-side, the printer is registered with the Cloud service, this process provides the Cloud~~  
325 ~~Service with the details about the Printer. The Cloud Service then creates a Cloud Print Service which~~  
326 ~~will respond to requests initiated from the Cloud Print Manager. On the Client-side, the user connects to~~  
327 ~~the Cloud Service and is provided an enumerated list of available devices. The User can select a Printer~~  
328 ~~represented by the Cloud Print Service by location, or by any desirable attribute(s). The user submits a~~  
329 ~~job to the selected Cloud Print Service. The Cloud Print Service may perform a Transform or other~~  
330 ~~modification to the Print Job prior to placing the Print Job in a list of available Jobs. The Cloud Print~~  
331 ~~Manager initiates the communication with the Cloud Print Service and requests a list of Print Jobs. The~~  
332 ~~Cloud Print Manager retrieves the Print Job and processes the Print Job. During and after completion of~~  
333 ~~the Print Job, The Cloud Print Manager sends the status information to the Cloud Print Service. The~~  
334 ~~User can determine current status of the Print Job from the Cloud Print Service.~~

#### 335 4.1.1 User

336 ~~The User interacts with the Client to provide credentials and request Cloud Printing Operations described~~  
337 ~~in this model.~~

#### 338 4.1.2 Client

339 ~~The Client is the software component that implements the interface between the User and the Cloud~~  
340 ~~service to create an Association; and to enumerate available Cloud Print Services. The Client is also~~

341 ~~implements the interface between the User and the selected Cloud Print Service to submit a Print Job~~  
342 ~~and to query Job and Printer Status.~~

#### 343 ~~4.1.3 Cloud Service~~

344 ~~The Cloud Service is the environment in which the Cloud Print Services reside. The Cloud service~~  
345 ~~supports unspecified methods to register printers and associate Users. The Cloud service provides~~  
346 ~~Management, Access Control, Authentication, Authorization, Accounting and Audit services.~~

#### 347 ~~4.1.4 Cloud Print Manager~~

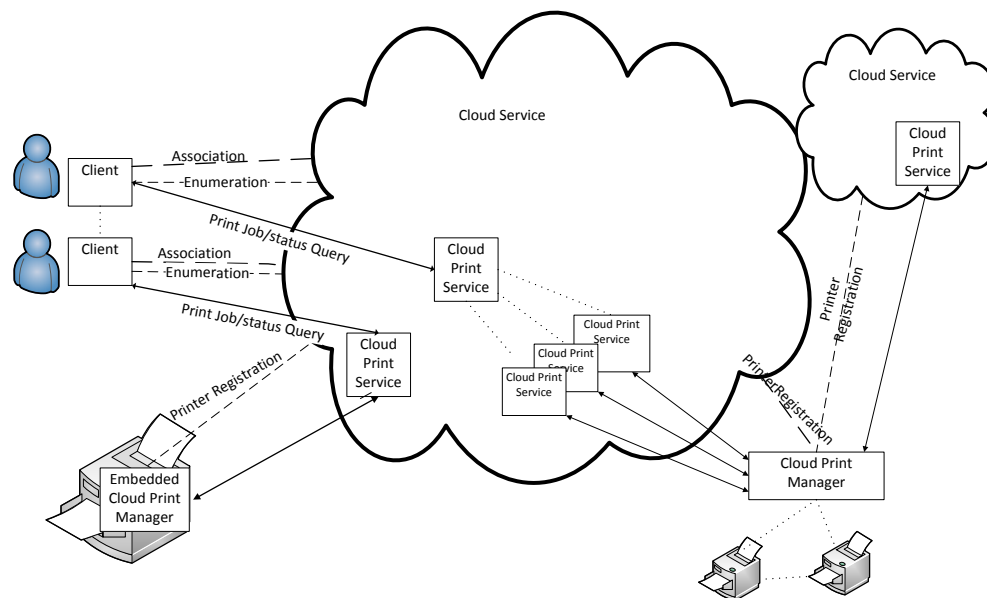
348 ~~The Cloud Print Manager is the software component that implements the interface between the Print~~  
349 ~~Service Device (Printer) and a cloud-based environment called the Cloud service, for registration of the~~  
350 ~~Printer; and that implements the interface between the Printer and one or more cloud-based components~~  
351 ~~called Cloud Print Service(s) for Job retrieval, Job Management and Job Status notifications.~~

#### 352 ~~4.1.5 Cloud Print Service~~

353 ~~The Cloud Print Service is a software component that implements the Service supporting Client~~  
354 ~~submission of Job requests and Client Job Status queries. Whether the Cloud Print Service is a~~  
355 ~~separate entity/service/object is out of scope~~

356 ~~for this document.~~

357



Legend  
 Continuous lines with arrow – defined interfaces in specifications  
 Dashed lines – out of scope for this model

Notes  
 Printer registration – Activity by which the cloud service becomes aware of the printer, including location, capabilities, and features  
 Association – Activity by which the cloud service determines which printers the client can initiate print jobs, request status, and any limitations on print jobs to include access to features or specific capabilities.  
 Enumeration – A Process that delivers to the client a list of printers available to the client.  
 Print Job/status – Process by which client initiates a print job and receives status on the print job.

358

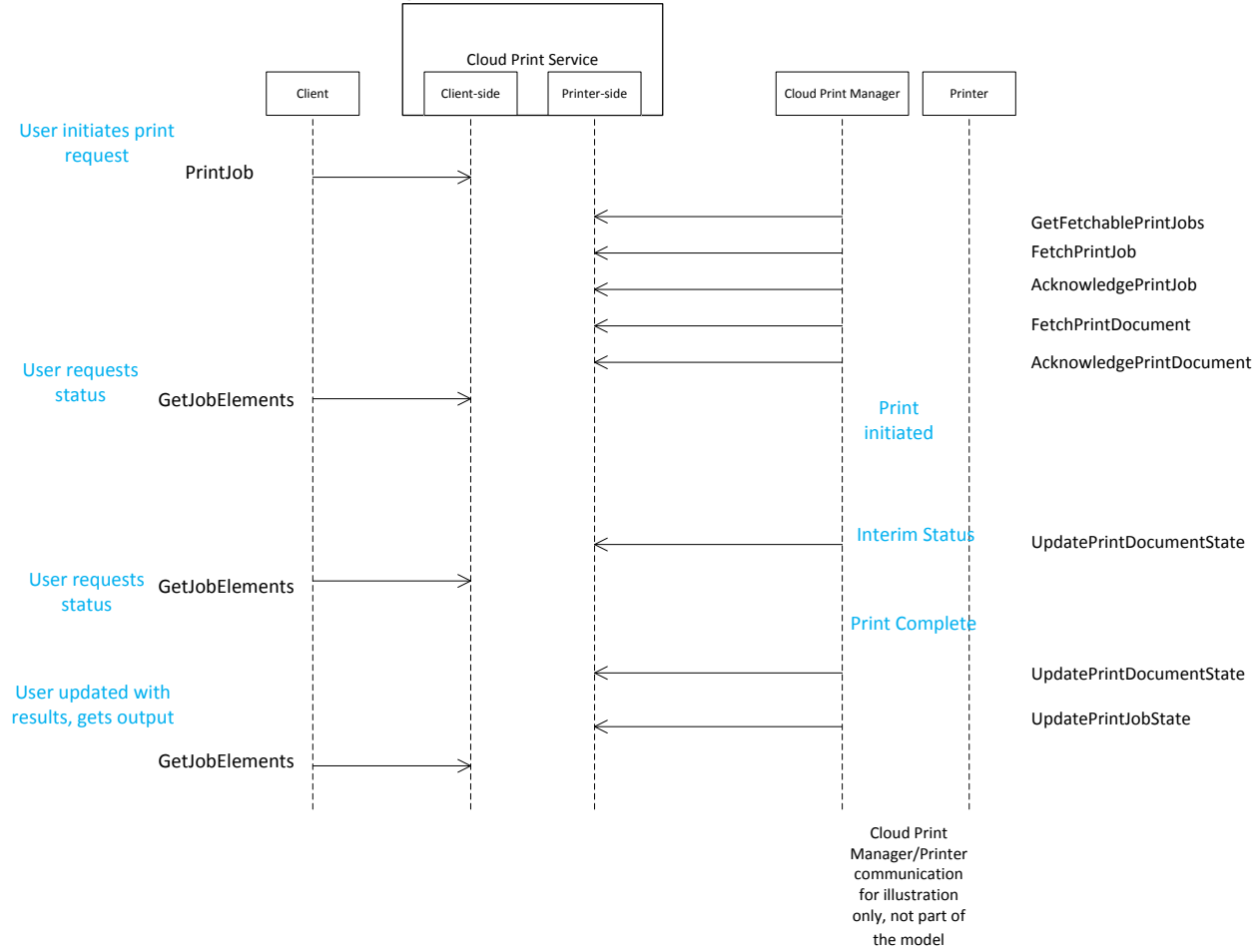
359 **Figure 1 Cloud Printing functional Model**

360 **4.2 Sequence Diagrams**

361

362

**4.2.1 Print Process with printing completed.**



363

364

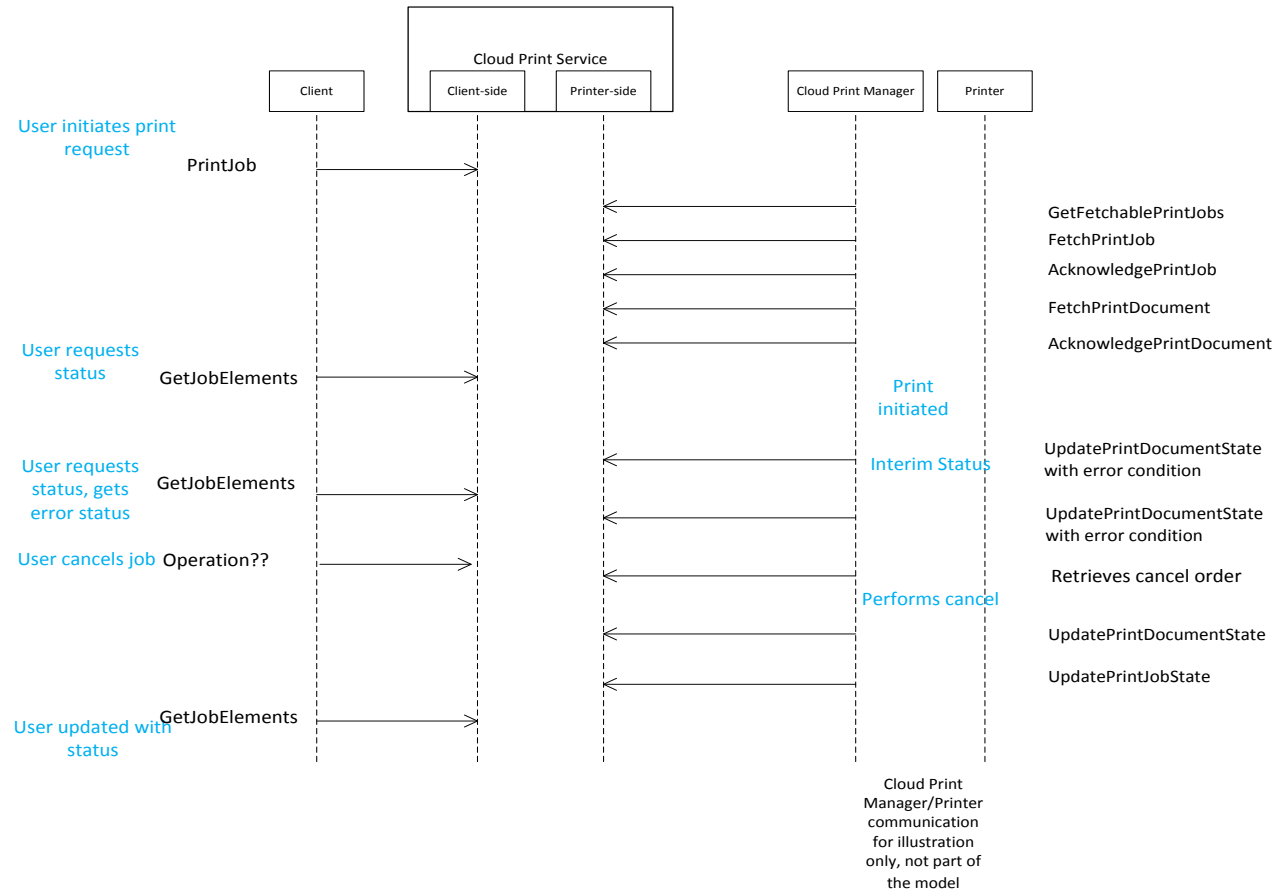
365

**Figure 2 Print process sequence diagram**

366

367

### 4.2.2 Print Processing showing exception handling



368

369

370

Figure 3 Print Processing, Exception Handling

371

372 **4.2.3 Print Processing showing configuration/capability updates**

373

374 **Figure 4 Print Processing, Configuration update**

375

376

377 **4.3 Cloud Print Objects**

378 TBD

379 **4.4 Cloud Print Operations**

380 TBD

381 **4.5 Cloud Registration Objects**

382 TBD

383 **4.6 Cloud Print Service**

384



385 **5. Conformance Requirements**

386 Provide a list of conformance requirements for the document.

387 **6. Internationalization Considerations**

388 For interoperability and basic support for multiple languages, conforming implementations MUST support  
389 the UTF-8 [RFC3629] encoding of Unicode [UNICODE] [ISO10646] and the Unicode Format for 1258  
390 Network Interchange [RFC5198].

391 **7. Security Considerations**

392 | Cloud printing requires printer and print job status, job ticket and print data to transverse a firewall. All  
393 communications with the Cloud Service will be initiated by the Cloud Print Manager.

394 Reference document to follow????

395 **8. IANA Considerations**

396 There are no requirements for IANA registration for this specification.

397 **9. References**

398 **9.1 Normative References**

399 [REFERENCE] F. Last author list or standards body, "Title of referenced document", Document  
400 Number, Month YYYY, URL (if any)

401 **9.2 Informative References**

402 [REFERENCE] F. Last author list or standards body, "Title of referenced document", Document  
403 Number, Month YYYY, URL (if any)

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409 The authors would also like to thank the following individuals for their contributions to this standard:

410

411 **11. Change History**

412 [ PWG Secretary: This section must be removed when Document is approved ]

413 **11.1 Interim Revision**

414 Incorporated Changes from meeting minutes of FtF December 5, 2012, Updated sequence drawing  
415 format.

416 ~~11.1~~**11.2 Interim Revision – November 26/December 5, 2012**

417 Incorporated Changes from meeting minutes of October 29, 2012

418 ~~11.2~~**11.3 Interim revision – October 21, 2012**

419 Incorporated changes from meeting minutes of 10/15 through line 324.

420 ~~11.3~~11.4 **Interim revision – October 2, 2012**

421 Incorporated changes from the virtual f-f meeting, corrected cut and paste error that dropped Out of  
422 scope (3.4) and design requirements (3.5). Revised remainder according to meeting minutes.

423 ~~11.4~~11.5 **Interim revision – October 1, 2012**

424 Major changes – Updated definitions to remove cloud print provider, replacing that item with cloud  
425 service. Revised cloud print functional requirements per multiple meetings. Updated drawings to reflect  
426 changes.

427 ~~11.5~~11.6 **Interim revision: July 23, 2012**

428 Major changes - Implemented changes to scope to remove requirements relating to client association  
429 and printer registration. Revised sequence drawings and cloud model drawing.

430 ~~11.6~~11.7 **Interim revision: June 6, 2012**

431 Implemented changes suggested at April Face-to-Face (but awaiting Section 3 update); template change  
432 request postponed

433 Implemented additions suggested at June Face-to-Face

434 Major made changes reflecting evolving understanding of Cloud printing details

435 Added revised Terminology

436 ~~11.7~~11.8 **Interim revision: April 12, 2012**

437 Updated document title to current date.

438 Updated reference to RFC 2119.

439 Added Figure1

440 Replaced client with Client

441 Updated terminology per meeting minutes

442 ~~11.8~~11.9 **Interim Revision: March 30, 2012**

443 Incorporated corrections from meeting minutes of [ftp://ftp.pwg.org/pub/pwg/cloud/minutes/cloud-f2f-](ftp://ftp.pwg.org/pub/pwg/cloud/minutes/cloud-f2f-minutes-20120319.pdf)  
444 [minutes-20120319.pdf](ftp://ftp.pwg.org/pub/pwg/cloud/minutes/cloud-f2f-minutes-20120319.pdf)

445 ~~11.9~~11.10 **Initial Revision: March 19, 2012**