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Cloud Printing Requirements and Model

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

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This document is available electronically at:

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58 conventions. Printer manufacturers and vendors of printer related software will benefit
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61 technically competent, has multiple, independent and interoperable implementations
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71

72 About the Cloud Imaging Work Group

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

78 For additional information regarding Cloud Imaging visit:

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

80 Implementers of this specification are encouraged to join the Cloud Imaging mailing list
81 in order to participate in any discussions of the specification. Suggested additions,
82 changes, or clarification to this specification, should be sent to the Cloud Mailing list for
83 consideration.
84

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184 1. Introduction

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

191 2. Terminology

192 2.1 Conformance Terminology

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

198 2.2 Printing and Cloud Terminology

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

209 **Cloud Printing:** an arrangement that uses Cloud-based components to allow a User
210 to locate a Print Service appropriate to the User’s needs and access rights, to submit a
211 Print Job Request intended for eventual processing by that Print Service, and to query
212 that status of the request and the resulting Print Job.

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

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

224 **Cloud Print Client (Client):** the software component that implements the interface
225 between the User and the Cloud-based Cloud Printing components. Specifically, the
226 Client implements the interface between the User and the Cloud service to create an
227 Association and to enumerate available Cloud Print Services; and the Client
228 implements the interface between the User and the selected Cloud Print Service to
229 submit a Print Job and to query Job and Printer Status.

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

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

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

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

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

244 **Job Originator:** The User that submits the initial request to create the Job [PWG
245 5108.01].

246 **Client-side and Printer-side:** Cloud Printing is distinguished by inserting a set of
247 elements in the Cloud environment between the Job Originator and the Printer. The
248 path between the Job Originator and the Cloud is referred to as the "Client-side". The
249 path between the Cloud and the Printer is referred to as the "Printer-side". The
250 distinction is made because, in many cases, details of Client-side interaction can be
251 considered independently from Printer-side interactions.

253 **3. Requirements**

254 **3.1 Rationale for Cloud Print Model and Requirements**

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

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

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

266 **3.2 Consideration of Print Use Cases**

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

272 **3.3 Cloud Print Functional Requirements**

273 For these requirements the following scenario applies. This sets a scenario where a
274 transversal is required between the user and the cloud service, and between the
275 printer and the cloud service. User is not part of the cloud service domain and is not
276 directly connected to the printer domain and the Printer is not part of the cloud service
277 domain. This section describes the functional requirements for any Cloud Print end-to-
278 end solution.

- 279 1. User to be able to connect to the Cloud Service from a variety of devices, operating
280 systems, and applications.
- 281 2. User to provide acceptable credentials to the Cloud Service
- 282 3. User to be able to select the print destination.
- 283 4. User to be able to submit a Print Job including a document (direct or by reference)
284 and the print job attributes.

- 285 5. Cloud Service to return a response that indicates the Print Job submission is
286 acceptable or rejected.
- 287 6. Cloud Service to return a status of printing completed, or the print job failed.
- 288 7. Printer to be registered with the Cloud Service by the Printer owner, including the
289 user rights associated with the printer. User rights include paid printing, and other
290 printer capabilities that may be restricted to certain users.
- 291 8. Printer to provide to the Cloud Service it's attributes, including supported document
292 formats, paper sizes and types, finishing options, and operational status.
- 293 9. Printer to initiate all communications with the Cloud Service.
- 294 10. When the Cloud Service has a job available for printing, the printer to return
295 acceptance or rejection of the job.
- 296 11. Printer to return operational status when requested
- 297 12. At end of printing, Printer to return a completion status
- 298 13. If unable to complete job, or job is canceled, Printer to return status indicating such
299 activity occurred.
- 300 14. All communications between the Client and the Cloud Service, and between the
301 printer and the cloud, to be made via a secure connection ensuring data integrity and
302 confidentiality.
- 303 15. Support and describe a Job ticket and Document Data retention policy, e.g.,
304 job document data is discarded immediately after processing, discarded after 1 day,
305 saved indefinitely, etc.
- 306 16. All interactions between the Printer and the Cloud Service to be logged following
307 the common log format.

308 **3.4 Out of scope**

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

- 315 1. Defining Cloud federation interfaces and associated protocols and technologies.
316 2. Defining the interface between the physical Printer Device and the component that provides the interface
317 between the Printer and the Cloud (later called the Cloud Print Manager); this component may be part of

- 318 the Printer device in which case it is an “internal” interface; or it may be external, possibly serving multiple
319 physical Printers, in which case it is assumed to use already standardized Printer interfaces.
- 320 3. Defining new protocols for authentication, authorization, and access control (AAA), enumeration,
321 transport, notification, or device management.
 - 322 4. Defining new document file formats.
 - 323 5. Defining new abstract job tickets.
 - 324 6. Defining specific interfaces within the Cloud Environment established to support Cloud Printing (later
325 termed the Cloud service).
 - 326 7. Defining the interface by which Printers are registered with the Cloud.
 - 327 8. Defining the interface by which Users, including potential Job Originators are associated with the Cloud.
 - 328 9. Defining the interface between the User and the local component that provides the User’s interface with the
329 cloud (the User Client), this being part of an application (or operating system) than can be assumed to be
330 proprietary.
331

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332 3.5 Design Requirements

333 The design requirements can be divided into Client-side interactions between the User
334 and the Cloud and “Printer-side” interactions between the Printer and the Cloud.
335 Considering the Out-of-Scope items, the design requirements are limited to defining or
336 referencing an existing definition of the User Client to Cloud interface on the Client-
337 side, and the Cloud Print Service to Cloud Print Manager interface on the Printer-side.
338 These definitions will, however, assume or impose some characteristics of the
339 otherwise out-of-scope components.

340 3.5.1 Client-side Design Requirements

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

346 3.5.1.1 Selecting a Printer

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

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

357
358 Req 2: The User, operating through the Client, must be able obtain the values of
359 specific configuration, capabilities and/or status items of an identified printer. The

360 values that may be queried include but are not limited to the applicable attributes in
361 the Standard set of printing capabilities (e.g., Table 8 in IPP/2.0 [PWG5100.12]),
362 and those identified in Section 5.6 of JPS3 [PWG 5100.13]. This requirement
363 especially includes access to printer status element values

364 **3.5.1.2 Submitting a Job Request**

365 **3.5.1.3 Specifying Handling of the Printed Documents**

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

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367 **3.5.1.2**

368 **3.5.1.3.5.1.4 Determining Job Request Status and Job Status**

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

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

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

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

379 **3.5.1.4.3.5.1.5 Submitting a Job Request**

380

381 **3.5.1.5 Specifying Handling of the Printed Documents**

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

383 **3.5.2 Printer-side Requirements**

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

387 **3.5.2.1 Communication Printer Status and Configuration Changes**

388

389 **3.5.2.2 Communicating Job Status**

390

391 **3.5.2.3 Handling a Job Request**

392

393 **3.5.2.4 Handling of Printed Document**

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

395 **3.5.2.5 Access of a Referenced Document**

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

397 **3.5.3 Transforms**

398 ?

399 **3.5.4 Notification events**

400 TBD

401 **3.5.5 Privacy and security policies**

402 TBD

403 ~~40~~**3.5.6 Logging**

404

405 **4. Cloud Print Model**

406 **4.1 Cloud Print Model Overview**

407 An overall representation of printing in a cloud environment is shown in Figure 1. In a
408 cloud environment, an individual Client may not be aware of the components and
409 services needed to enable printing to a device that may be located at an external
410 location, including appropriate tracking, security, and transforms required to produce
411 and deliver the requested output. The components are each described below. The
412 interactions between components are described in the set of sequence diagrams in
413 Section 4.2.

414 **4.1.1 User**

415 The User interacts with the Client to provide credentials and request Cloud Printing
416 Operations described in this model.

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417 **4.1.2 Client**

418 The Client is the software component that implements the interface between the User
419 and the Cloud service to create an Association; and to enumerate available Cloud
420 Print Services. The Client is also implements the interface between the User and the
421 selected Cloud Print Service to submit a Print Job and to query Job and Printer Status.

422 **4.1.3 Cloud Service**

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

427 **4.1.4 Cloud Print Manager**

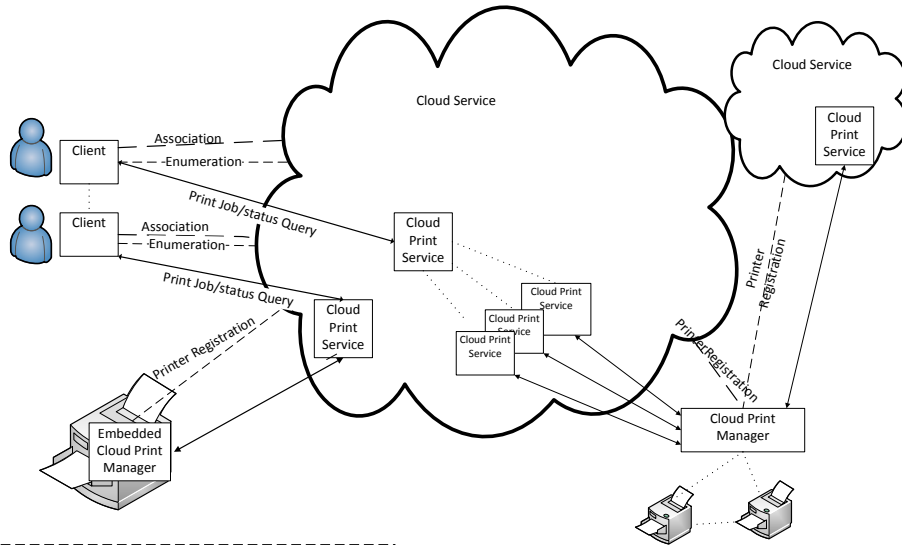
428 The Cloud Print Manager is the software component that implements the interface
429 between the Print Service Device (Printer) and a cloud-based environment called the
430 Cloud service, for registration of the Printer; and that implements the interface between
431 the Printer and one or more cloud-based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

433 **4.1.5 Cloud Print Service**

434 The Cloud Print Service is a software component that implements the Service
435 supporting Client submission of Job requests and Client Job Status queries. Whether
436 the Cloud Print Service is a separate entity/service/object is out-of-scope

437 for this document.

438



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.

439

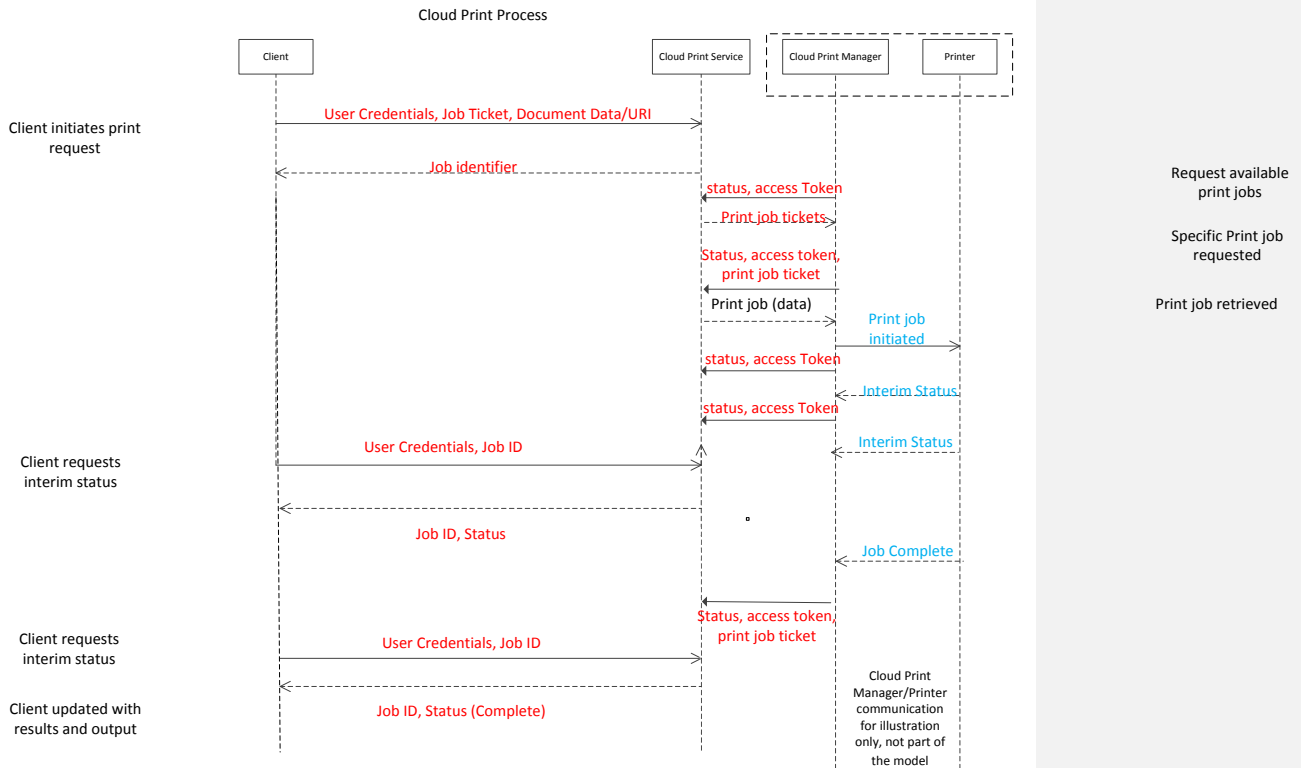
440 **Figure 1 Cloud Printing functional Model**

441 **4.2 Sequence Diagrams**

442

443

4.2.1 Print Process with printing completed.

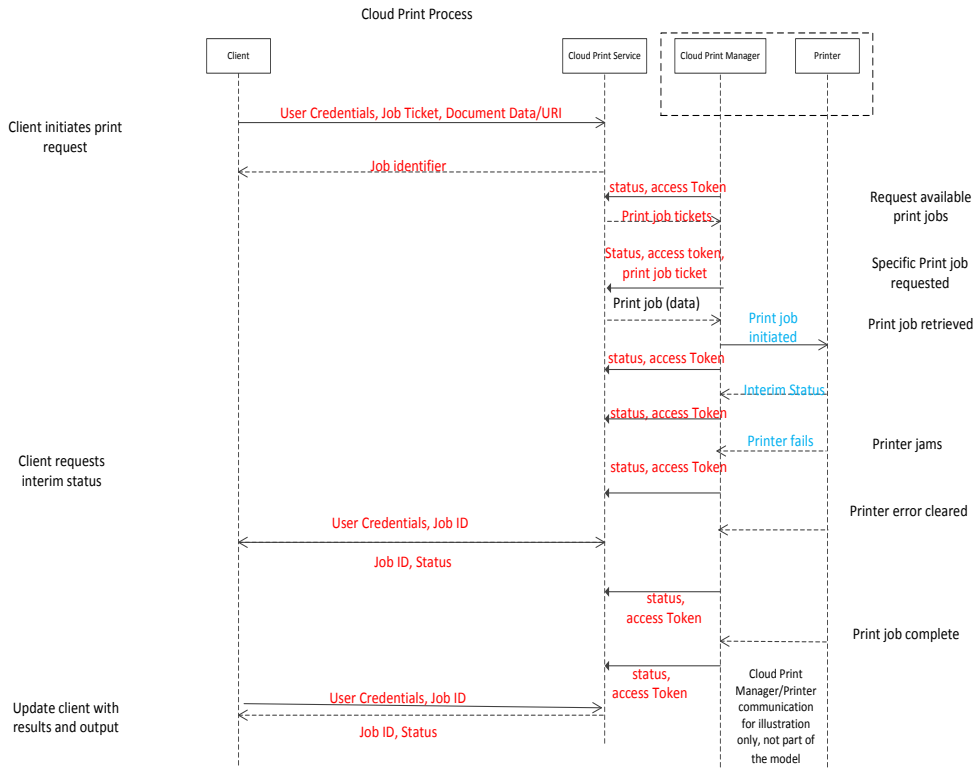


444
445

Figure 2 Print process sequence diagram

446

4.2.2 Print Processing showing exception handling



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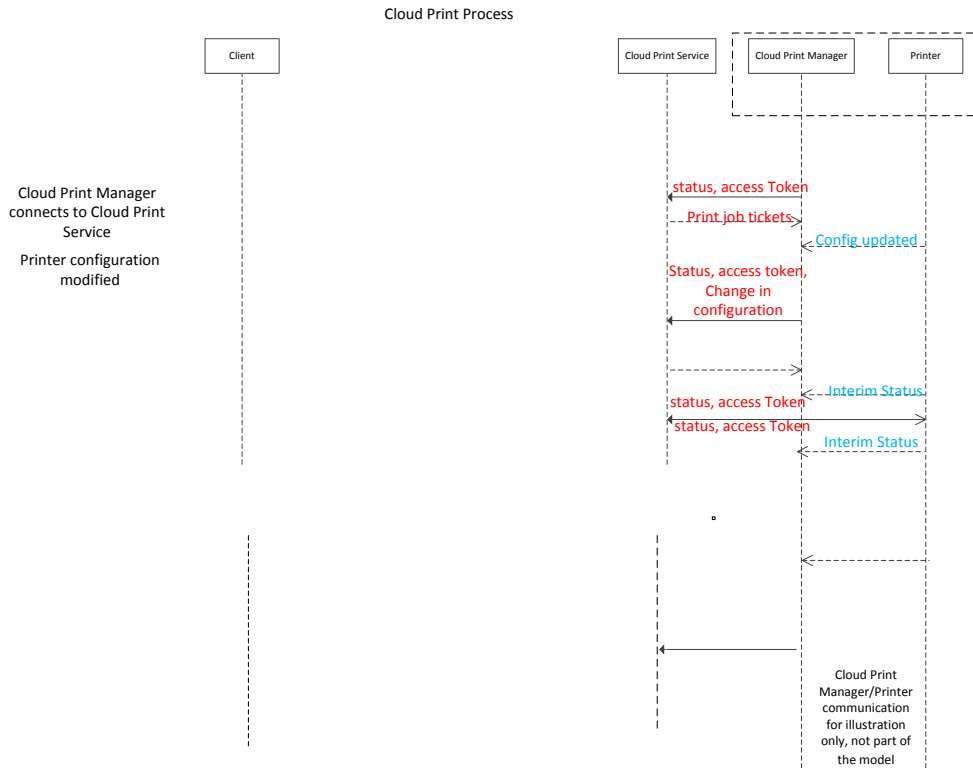
448

Figure 3 Print Processing, Exception Handling

449

4.2.3 Print Processing showing configuration/capability updates

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451

Figure 4 Print Processing, Configuration update

452 **4.3 Cloud Print Objects**

453 TBD

454 **4.4 Cloud Print Operations**

455 TBD

456 **4.5 Cloud Registration Objects**

457 TBD

458 **4.6 Cloud Print Service**

459

460 5. Conformance Requirements

461 Provide a list of conformance requirements for the document.

462 6. Internationalization Considerations

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

467 7. Security Considerations

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

471 Reference document to follow????

472 8. IANA Considerations

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

474 9. References

475 9.1 Normative References

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

478 9.2 Informative References

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

481 10. Authors' Addresses

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

488

489 **11. Change History**

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

491 **11.1 Interim Revision – November 26/December 5, 2012**

492 Incorporated Changes from meeting minutes of October 29, 2012

493 **11.1.1.2 Interim revision – October 21, 2012**

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

495 **11.2.1.3 Interim revision – October 2, 1012**

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

499 **11.3.1.4 Interim revision – October 1, 2012**

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

503 **11.4.1.5 Interim revision: July 23, 2012**

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

507 **11.5.1.6 Interim revision: June 6, 2012**

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

510 Implemented additions suggested at June Face-to-Face

511 Major made changes reflecting evolving understanding of Cloud printing details

Formatted: IEEEStd Level 2 Header

512 Added revised Terminology

513 ~~11.6~~**11.7 Interim revision: April 12, 2012**

514 Updated document title to current date.

515 Updated reference to RFC 2119.

516 Added Figure1

517 Replaced client with Client

518 Updated terminology per meeting minutes

519 ~~11.7~~**11.8 Interim Revision: March 30, 2012**

520 Incorporated corrections from meeting minutes of

521 <ftp://ftp.pwg.org/pub/pwg/cloud/minutes/cloud-f2f-minutes-20120319.pdf>

522 ~~11.8~~**11.9 Initial Revision: March 19, 2012**