January 7~~December 5~~, 201~~2~~
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-cloudmodel10-201320120~~2~~075~~5~~.docx

ftp://ftp.pwg.org/pub/pwg/cloud/wd-cloudmodel10-20133010721~~2~~205~~5~~.pdf

Title: Cloud Printing Requirements and Model

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In general, a PWG standard is a specification that is stable, well understood, and is technically competent, has multiple, independent and interoperable implementations with substantial operational experience, and enjoys significant public support.

For additional information regarding the Printer Working Group visit:

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About the Cloud Imaging Work Group

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

For additional information regarding Cloud Imaging visit:

http://www.pwg.org/Cloud/

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

Table of Contents

1. Introduction

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

2. Terminology

2.1 Conformance Terminology

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

2.2 Printing and Cloud Terminology

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

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

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

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

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

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

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

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

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

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

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

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

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

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3. Requirements

3.1 Rationale for Cloud Print Model and Requirements

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

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

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

3.2 Consideration of Print Use Cases

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

3.3 Cloud Print Functional Requirements

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

1. User to be able to connect to the Cloud Service from a variety of devices, operating systems, and applications.

2. User to provide acceptable credentials to the Cloud Service

3. User to be able to select the print destination.

4. User to be able to submit a Print Job including a document (direct or by reference) and the print job attributes.

5. Cloud Service to return a response that indicates the Print Job submission is acceptable or rejected.

6. Cloud Service to return a status of printing completed, or the print job failed.

7. Printer to be registered with the Cloud Service by the Printer owner, including the user rights associated with the printer. User rights include paid printing, and other printer capabilities that may be restricted to certain users.

8. Printer to provide to the Cloud Service it's attributes, including supported document formats, paper sizes and types, finishing options, and operational status.

9. Printer to initiate all communications with the Cloud Service.

10. When the Cloud Service has a job available for printing, the printer to return acceptance or rejection of the job.

11. Printer to return operational status when requested

12. At end of printing, Printer to return a completion status

13. If unable to complete job, or job is canceled, Printer to return status indicating such activity occurred.

14. All communications between the Client and the Cloud Service, and between the printer and the cloud, to be made via a secure connection ensuring data integrity and confidentiality.

15. Support and describe a Job ticket and Document Data retention policy, e.g.,

job document data is discarded immediately after processing, discarded after 1 day, saved indefinitely, etc.

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

3.4 Out of scope

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

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

3.5 Design Requirements

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

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

3.5.1 Client-side Design Requirements

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

3.5.1.1 Selecting a Printer

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

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

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

3.5.1.2 Submitting a Job Request

3.5.1.3 Specifying Handling of the Printed Documents

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

3.5.1.4 Determining Job Request Status and Job Status

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

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

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

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

3.5.2 Printer-side Requirements

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

3.5.2.1 Communication Printer Status and Configuration Changes

3.5.2.2 Communicating Job Status

3.5.2.3 Handling a Job Request

3.5.2.4 Handling of Printed Document

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

3.5.2.5 Access of a Referenced Document

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

3.5.3 Transforms

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3.5.4 Notification events

TBD

3.5.5 Privacy and security policies

TBD

3.5.6 Logging

4. Cloud Print Model

4.1 Cloud Print Model Overview

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

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

4.1.1 User

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

4.1.2 Client

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

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

4.1.3 Cloud Service

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

4.1.4 Cloud Print Manager

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

4.1.5 Cloud Print Service

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

for this document.

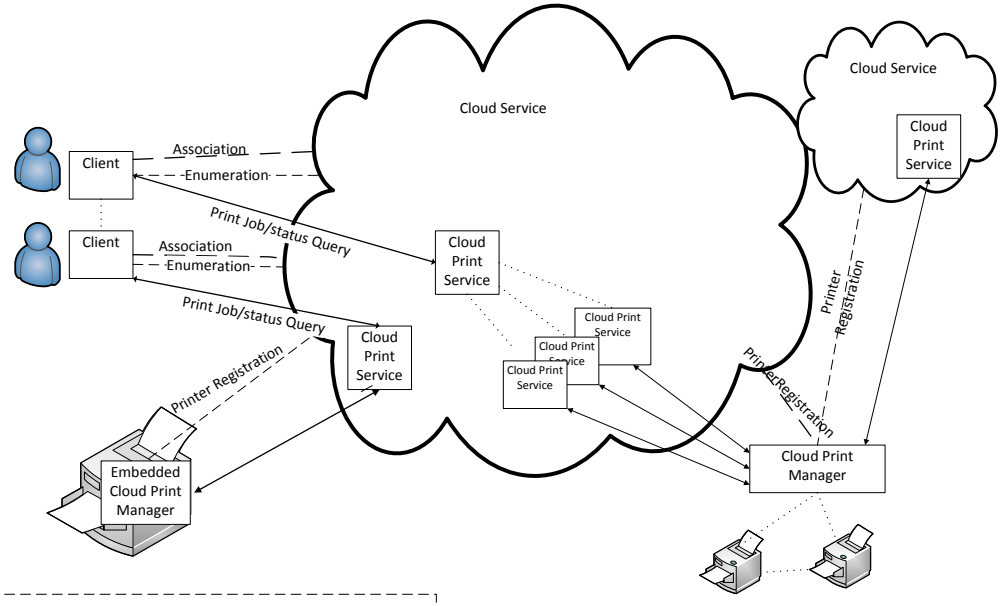

Figure 1 Cloud Printing functional Model

4.2 Sequence Diagrams

4.2.1 Print Process with printing completed.

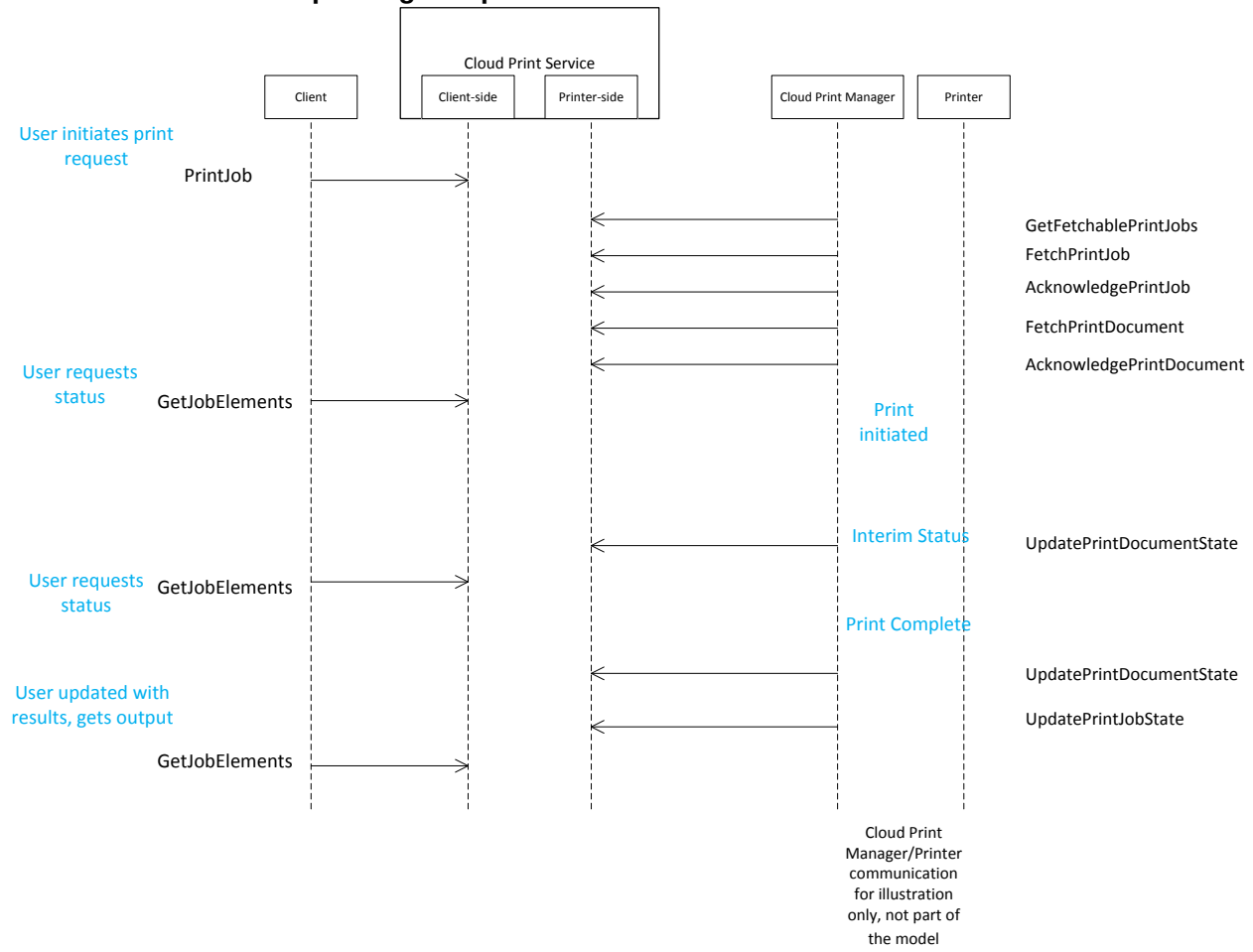

Figure 2 Print process sequence diagram

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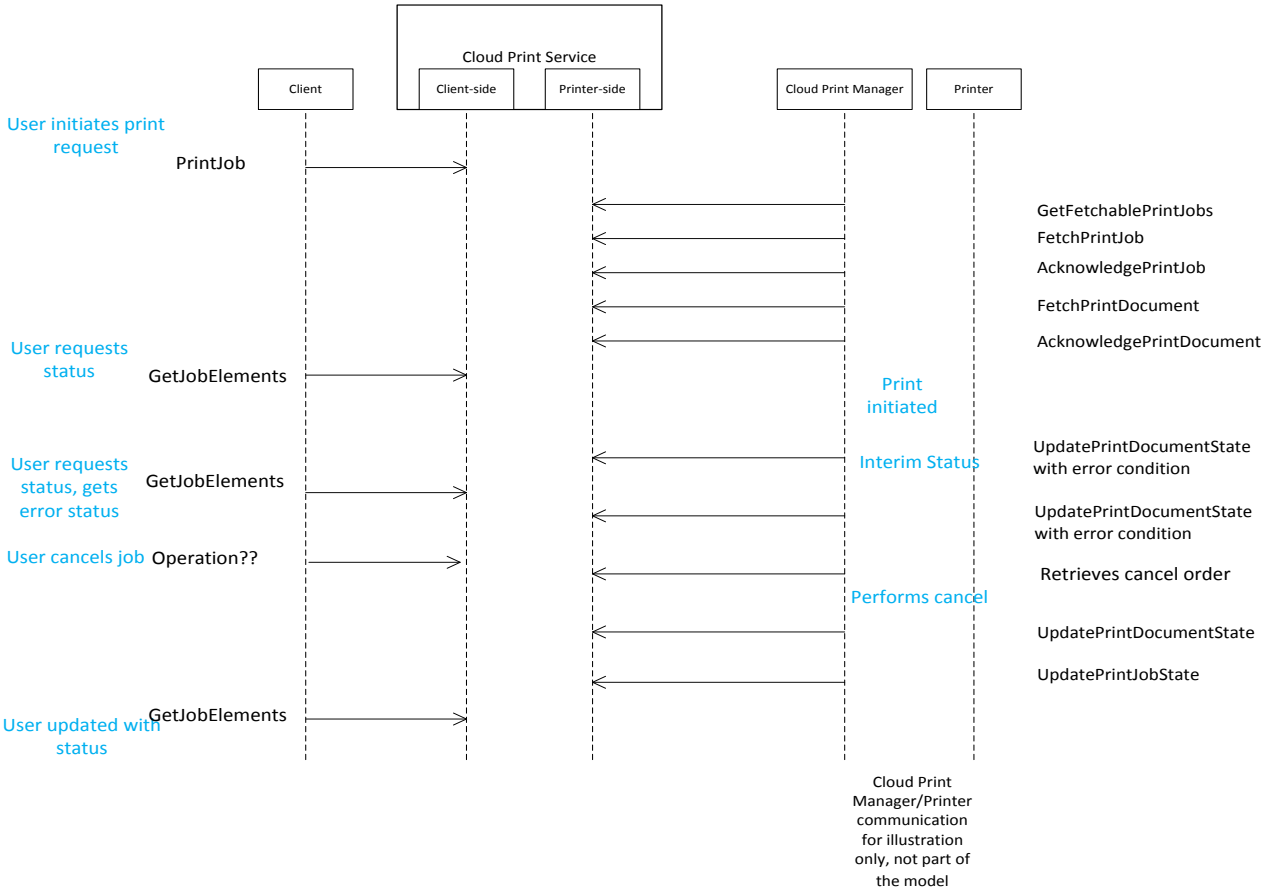
367 **4.2.2 Print Processing showing exception handling**



368
369 Figure 3 Print Processing, Exception Handling
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372 **4.2.3 Print Processing showing configuration/capability updates**

373

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

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4.3 Cloud Print Objects

TBD

4.4 Cloud Print Operations

TBD

4.5 Cloud Registration Objects

TBD

4.6 Cloud Print Service

5. Conformance Requirements

Provide a list of conformance requirements for the document.

6. Internationalization Considerations

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

7. Security Considerations

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

Reference document to follow????

8. IANA Considerations

There are no requirements for IANA registration for this specification.

9. References

9.1 Normative References

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

9.2 Informative References

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

10. Authors' Addresses

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

11. Change History

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

Formatted: IEEEStds Level 2 Header

11.1 Interim Revision

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

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

Incorporated Changes from meeting minutes of October 29, 2012

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

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

~~11.3~~11.4 Interim revision – October 2, 1012

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

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

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

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

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

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

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

Implemented additions suggested at June Face-to-Face

Major made changes reflecting evolving understanding of Cloud printing details

Added revised Terminology

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

Updated document title to current date.

Updated reference to RFC 2119.

Added Figure1

Replaced client with Client

Updated terminology per meeting minutes

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

Incorporated corrections from meeting minutes of ftp://ftp.pwg.org/pub/pwg/cloud/minutes/cloud-f2f-minutes-20120319.pdf

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

