Cloud Imaging Requirements and Model

Status: Initial Draft

Abstract: This document contains specifications to support Cloud based Imaging 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/white-cloudimagingmodel10-20130206.pdf

ftp://ftp.pwg.org/pub/pwg/cloud/white-cloudimagingmodel10-20130206.docx

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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.

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1. Introduction

This specification introduces a set of requirements and model for Cloud Imaging 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 imaging devices are frequently on different networks and legacy solutions are no longer functional.

1. Terminology
	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.

* 1. Imaging and Cloud Terminology

Cloud Imaging, 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 Imaging places a set of Cloud-based components between the Client and the Imaging 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 Imaging specific components and processes are described in detail or by reference in Section 4 of this specification. The definitions of Cloud Imaging specific terms below are summary statements provided for reference convenience and are in no way supplant the detailed definitions provided in Section 4.

**Association**: the process by which a User is paired with a registered Device or Cloud Service.

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

**Cloud Faxing:** from the Job Originators' viewpoint, an arrangement that uses Cloud-based components to allow a User to locate a Fax Service appropriate to the User’s needs and access rights, to submit a Fax Job Request intended for eventual processing by that Fax Service, and to query that status of the request and the resulting Fax Job. However, this PWG Cloud Imaging model is structured to allow a User with the proper credentials and subject to other restrictions of the Cloud environment, to submit any Fax Service request defined in the PWG Semantic Model [REF] to the Cloud Fax Service.

**Cloud Fax Client (Client)**: the software component that implements the interface between the User and the cloud-based Cloud Fax components, including association with the cloud-based environment, for all Semantic Model Fax Service elements and operations.

**Cloud Fax Manager:** the software component that implements the interface between the Fax Service Device (Fax) and a cloud-based environment for registration of the Fax; and that implements the interface between the Fax and one or more cloud-based components, called Cloud Fax Services, for all Semantic Model Fax Service [PWG5108.01] elements and operations and other extensions for Cloud Faxing.

**Cloud Fax Service**: a cloud-based software component that implements the Service supporting Client submission of Semantic Model Print Service requests. A Cloud Fax Service communicates with one and only one Cloud Fax Manager and is created when the Device is registered with the cloud-based environment. The Cloud Fax Service acts as a cloud-based intermediary between the Client and Cloud Fax Manager.

**Cloud Printing:** from the Job Originators' viewpoint, 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. However, this PWG Cloud Printing model is structured to allow a User with the proper credentials and subject to other restrictions of the Cloud environment, to submit any Print Service request defined in the PWG Semantic Model [REF] to the Cloud Print Service.

**Cloud Print Client (Client)**: the software component that implements the interface between the User and the cloud-based Cloud Print components, including association with the cloud-based environment, for all Semantic Model Print Service elements and operations.

**Cloud Print Manager:** the software component that implements the interface between the Print Service Device (Printer) and a cloud-based environment for registration of the Printer; and that implements the interface between the Printer and one or more cloud-based components, called Cloud Print Services, for all Semantic Model Print Service [PWG5108.01] elements and operations and other extensions for Cloud Printing.

**Cloud Print Service**: a cloud-based software component that implements the Service supporting Client submission of Semantic Model Print Service requests. A Cloud Print Service communicates with one and only one Cloud Print Manager and is created when the Device is registered with the cloud-based environment. The Cloud Print Service acts as a cloud-based intermediary between the Client and Cloud Print Manager.

**Cloud Scanning:** from the Job Originators' viewpoint, an arrangement that uses Cloud-based components to allow a User to locate a Scan Service appropriate to the User’s needs and access rights, to submit a Scan Job Request intended for eventual processing by that Scan Service, and to query that status of the request and the resulting Scan Job. However, this PWG Cloud Imaging model is structured to allow a User with the proper credentials and subject to other restrictions of the Cloud environment, to submit any Scan Service request defined in the PWG Semantic Model [REF] to the Cloud Scan Service.

**Cloud Scan Client (Client)**: the software component that implements the interface between the User and the cloud-based Cloud Scan components, including association with the cloud-based environment, for all Semantic Model Scan Service elements and operations.

**Cloud Scan Manager:** the software component that implements the interface between the Scan Service Device (Scanner) and a cloud-based environment for registration of the Scanner; and that implements the interface between the Scanner and one or more cloud-based components, called Cloud Scan Services, for all Semantic Model Scan Service [PWG5108.01] elements and operations and other extensions for Cloud Scanning.

**Cloud Scan Service**: a cloud-based software component that implements the Service supporting Client submission of Semantic Model Scan Service requests. A Cloud Scan Service communicates with one and only one Cloud Scan Manager and is created when the Device is registered with the cloud-based environment. The Cloud Scan Service acts as a cloud-based intermediary between the Client and Cloud Scan Manager.

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

1. Fax: A Device implementing Fax Services; a Fax Service Device.
2. Printer: A Device implementing Print Services; a Print Service Device.
3. Scanner: A Device implementing Scan Services; a Scan Service Device.
4. Single-function Device: A Device implementing a single service.
5. Multifunction Device: A Device implementing two or more services.

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

**Registration**: the process by which a Device becomes known to the cloud-based environment, resulting in the creation of a corresponding Cloud Fax/Print/Scan Service.

**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.

1. Requirements
	1. Rationale for Cloud Imaging 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 Imaging 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 imaging 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 image location.

* 1. Consideration of Imaging Use Cases

Cloud Imaging use cases 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. In PWG Cloud Imaging, the User, operating through the Client, interacts with a Cloud Imaging Service in the same way and using the same operations with which he would interact with any network Imaging Service. That is, once the connection to the appropriate Cloud Service (Fax, Print, Scan) is made (using whatever methods are appropriate to the specific Cloud environment), from the User/Client viewpoint, the imaging process follows the network imaging process, and the use cases for network services (Fax, Print, Scan) apply.

Although the specifics of these use cases depend upon the imaging protocols used, (i.e., the specific binding of the model described in this specification), these use cases generally provide that a User can:

1. Determine the status of a selected Imaging Device
2. Submit a Job Request intended for eventual processing by that Device, and
3. Query that status of the request and the resulting Job

However, Cloud Imaging differs from ordinary network imaging environments in that it involves three distinct sets of communications:

1. from the Client to the Cloud Service (Fax, Print, Scan) and
2. from the Cloud (Fax, Print, Scan) Service to the end Device through a Cloud (Fax, Print, Scan) Manager.
3. From the Device to the Cloud through a Cloud (Fax, Print, Scan) Manager.

Further, because the Cloud (Fax, Print, Scan) Service to Cloud (Fax, Print, Scan) Manager interaction typically involves communicating through a firewall that does not allow the Cloud (Fax, Print, Scan) Service to initiate queries or transfers, this interaction may require operations by which the Cloud (Fax, Print, Scan) Manager asynchronously provides Device and Job information to the Cloud (Fax, Print, Scan) Service and queries the Cloud Service whether there is information waiting for it to request. When incorporating standard imaging use cases from the User viewpoint, the Cloud Imaging model must address the implications of these use cases from the Device and Client viewpoint.

* + 1. Fax Use Cases Ref Cloud Fax document
		2. Print Use Cases Ref Cloud Print document
		3. Scan Use Cases Ref Cloud Scan document
	1. Cloud Imaging Functional Requirements

By the definition of PWG Cloud Imaging, a transversal is required between the User and the Cloud Service and between the Cloud Fax/Print/Scan Manager and the Cloud Service. The User need not be part of the Cloud Service domain and is not directly connected to the Imaging device domain and the Imaging device need not be part of the Cloud Service domain. This section describes the functional requirements for any Cloud Imaging end-to-end solution. These are requirements for the environment in which the Model operates but not necessarily requirements for the Model itself. Requirements for the Model components are identified in section 3.5, Design Requirements.

1. User, operating though a Client, 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 job destination.

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

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

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

7. Imaging device to be registered with the Cloud Service by the Device Owner, including the user rights associated with the device. User rights include paid printing, and other device capabilities that may be restricted to certain users.

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

9. Imaging Device to initiate all communications with the Cloud Service.

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

11. Device to return operational status when requested

12. At end of processing, Device to return a completion status

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

14. All communications between the Client and the Cloud Service, and between the Device 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 Device and the Cloud Service to be logged following the common log format.

* 1. Out of scope

From the Charter of the Cloud Imaging working group [ ] and the recognition that Cloud Imaging 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 Imaging is out of scope for this specification, although the general functions performed by these things in Cloud Imaging may be identified in the Model discussion.

1. Defining Cloud federation interfaces and associated protocols and technologies.
2. Defining the interface between the physical Imaging Device and the component that provides the interface between the Imaging Device and the Cloud (later called the Cloud Fax/Print/Scan Manager); this component may be part of the Imaging device in which case it is an “internal” interface; or it may be external, possibly serving multiple physical Imaging Devices, in which case it is assumed to use already standardized Imaging Device 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 Imaging (later termed the Cloud service).
7. Defining the interface by which Imaging Devices 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.
	1. Design Requirements

Because the PWG Cloud Imaging Model requires two asynchronous sets of interactions to complete any User to Printer action, the design requirements of the PWG Cloud Imaging Model are presented in terms of the requirements on Client-side interactions between the User (operating though the Cloud Print Client) and the Cloud and Device-side interactions between the Imaging Device (seen though the Cloud Print Manager) 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 Fax/Print/Scan Service to Cloud Fax/Print/Scan Manager interface on the Device-side. These definitions will, however, assume or impose some characteristics of the otherwise out-of-scope components.

* + 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 Imaging. As identified in 3.4, the authentication and authorization of the User, and the methods by which the printers that he can use are located are out of scope. Also, as with any network imaging process, the interface between the User and the Cloud Fax/Print/Scan Client is a function of the device operating system and/or the Users application and as identified in 3.4 is out of scope.

With respect to the imaging specific aspects, the User and the Cloud Fax/Print/Scan Client serve the same functions, exercise the same operations, and use one of the same imaging protocols as any imaging process that is compatible with the PWG Semantic Model as specified in the MFD Model and Common Semantics [PWG CS 5108.01]. Therefore, Client-side requirements are:

1. The Cloud Fax/Print/Scan Service follows the state and transition definitions for a service as defined in Sections 7.1 and 7.2 of the MFD Model and Common Semantics [PWG CS 5108.01],
2. The Cloud Fax/Print/Scan Service follows and the Cloud Fax/Print/Scan Client recognizes the Job and Document states and transitions as defined in sections 7.2.2 and 7.2.3 of the MFD Model and Common Semantics [PWG CS 5108.01],
3. The Cloud Fax/Print/Scan Service supports the Basic MFD Interface Requests and Responses as identified in Table 1 and described in section 7.3.1 of MFD Model and Common Semantics [PWG CS 5108.01]; the Cloud Fax/Print/Scan Client uses these requests and accepts the responses to the extent compatible with the capabilities it is to supply to the User.

Cloud Fax/Print/Scan Service support of the administrative operations defined in section 7.3.2 of MFD Model and Common Semantics [PWG CS 5108.01] is optional and is NOT a requirement of the PWG Cloud Printing model as defined in this specification.

* + 1. Device-side Requirements

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

The communication between the Cloud Fax/Print/Scan Manager and the Device could be the same as that between a Client and a Print Service were it not for the probable presence of a firewall preventing the Cloud Fax/Print/Scan Service from initiating requests of and submissions to the Device. Instead, an intermediary actor call the Cloud Fax/Print/Scan Manager exists between the Device and the Cloud Fax/Print/Scan Service to implement a set of operations that allow the communication of device configuration and state information and job and document state information to the Cloud Fax/Print/Scan Service that it cannot request; and the communication of Job Request and Document data to the device that the Cloud Fax/Print/Scan Service cannot submit.

1. The Cloud Print Service and the Cloud Print Manager follow the state and transition definitions for a service as defined in Sections 7.1 and 7.2 of the MFD Model and Common Semantics [PWG CS 5108.01],
2. The Cloud Print Manager follows and the Cloud Print Client recognizes the Job and Document states and transitions as defined in sections 7.2.2 and 7.2.3 of the MFD Model and Common Semantics [PWG CS 5108.01],
3. The Cloud Print Service supports a set of interface requests and responses and the Cloud Print Manager uses these requests and accepts the responses to allow communication of the following types of information:
	1. Printer Capabilities, Configuration and Status.
	2. Job Requests, including Job Tickets, Document Tickets and Document Data
	3. Job and Document Status
4. The interchange between the Cloud Print Manager and the Cloud Print Service provides some method by which the Cloud Print Service can determine whether a disruption in the communication has occured.
5. The Cloud Print Manager provides and the Cloud Print Service supports provisions to allow the synchronization of Job and Document status and the update of Printer status in normal operation, and on recovery after occurrences such as disruption of communication or hard reset of the Cloud Print Manager.
6. Although an optional capability, the Model provides for the Cloud Print Service to notify the Cloud Print Manager that information is available or a request for information is present and the Cloud Print Manager should contact the Cloud Print Service.
	* 1. Transforms

Transforms available in the device should be advertised.

* + 1. Privacy and security policies

The device should not transmit any information that violates best practices for data security.

* + 1. Logging
1. Cloud Imaging Model
	1. Cloud Imaging Model Overview

An overall representation of imaging 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 imaging with a device that may be located at an external location, including appropriate tracking, security, and transforms required to produce and deliver the requested document. The operations are described in the specific document for each of the services.

On the Device-side, the device is registered with the Cloud service, this process provides the Cloud Service with the details about the Device. The Cloud Service then creates a Cloud Fax/Print/Scan Service which will respond to requests initiated from the Cloud Fax/Print/Scan 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 Fax/Print/Scan Manager initiates the communication with the Cloud Fax/Print/Scan Service and processes requests from a list Jobs. During and after completion of the Fax/Print/Scan Job, The Cloud Fax/Print/Scan Manager sends the status information to the Cloud Fax/Print/Scan Service. The User can determine current status of the Fax/Print/Scan Job from the Cloud Fax/Print/Scan Service.



Figure Cloud Imaging functional Model

* 1. Sequence Diagrams

Sequence drawings are available for each of the specific services in the reference document.

* + 1. Cloud Faxing Requirements and model
		2. Cloud Printing Requirements and model
		3. Cloud Scanning Requirements and model
		4. Cloud Device Management Requirements and model (future)
	1. Cloud Imaging Objects

These objects are specific to the cloud

* 1. Cloud Imaging Operations

These operations are specific to the cloud

* 1. Cloud Fax/Print/Scan Services
1. Conformance Requirements

Provide a list of conformance requirements for the document.

1. 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].

1. Security Considerations

Cloud Imaging requires device and job status, job ticket and imaging data to transverse a firewall. All communications with the Cloud Service will be initiated by the Cloud Fax/Print/Scan Manager.

Reference document to follow????

1. IANA Considerations

There are no requirements for IANA registration for this specification.

1. References
	1. Normative References

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

* 1. Informative References

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

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

1. Change History

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

* 1. Initial Revision: February 6, 2013