Cloud Imaging Requirements and Model

Status: Interim Draft

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

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This document is available electronically at:

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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:

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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 identifies the requirements and presents the model for PWG Cloud Imaging, which is considered to be the use of any of the Imaging Services (Print, Scan, Copy, FaxIn, FaxOut, EmailIn, EmailOut, Transform and Resource) where at least some portion of the imaging Service is performed by an entity within the Cloud. The User and the physical hardcopy imaging device (if used) are typically outside of the Cloud and therefore separate from the Imaging Server.

The PWG Semantic Model supports Imaging Hardcopy Devices that operate separately from an interfacing Imaging Service. The MFD Model and Common Semantics [PWG5108.01] defines the outward-facing semantics of this interface to ensure conformance to the model. Although the Semantic Model does not specifically define the interface between a Service and the Hardcopy Device, when the Imaging Device is network-accessible to the Service, the existing Semantic Model interface can be used with the external interfacing Service acting as a Client to the Imaging Device's Service. However, when the Imaging Device is not network accessible to the Service, a new interface is required that allows the Imaging Device to retrieve and update Jobs and Documents, as well as to provide its current status and configuration to the Service.

Therefore, as part of the Cloud Imaging Model, this specification defines a new printing interface between a PWG Semantic Model Imaging Device and an external interfacing Service to support situations where the Imaging Device is not network accessible to the Service. While the focus of this specification is on Cloud-based Services, the same interface can be used in any situation where the Imaging Device is not network accessible to the Service, as is common in many secure and multi-homed network environments. For example, a gateway Service might use the printing interface defined by this specification to provide guest printing from an open Wi-Fi network to a secure corporate LAN.

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 Imaging:** from the Job Originators' viewpoint, an arrangement that uses Cloud-based components to allow a User to locate an Imaging Service appropriate to the User’s needs and access rights, to submit an Imaging Job Request intended for eventual processing by that Imaging Service, and to query that status of the request and the resulting Imaging Job.

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

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

**Cloud Imaging Service**: a cloud-based software component that implements one or more Imaging Services supporting Client submission of Semantic Model Imaging Service requests. A Cloud Imaging Service may communicate with one or more 'downstream' Cloud Imaging Services and/or with one or more Cloud Imaging Device Managers. It is created when one Imaging Device with which it is associated is registered with the cloud-based environment.

**Cloud Service**: a general term representing the Cloud environment, including the various ways in which the Cloud may be accessed and the various specific Services available on the Cloud. The Cloud Imaging Service is a component of the Cloud Service.

**Imaging Device**: An abstract object representing a hardware component that implements one or more Imaging Services [PWG 5108.01] (Print, Scan, Copy, FaxIn, FaxOut, EmailIn and EmailOut. Transform and Resource Services are considered Imaging support Services).

**Document**: an object created and managed by an Imaging Service that contains the description, processing, and status information of a data object submitted by a User. A Document object is bound to a single Job [PWG 5108.01].

**Document Data:** the digitized data submitted by a Job Originator as the Document or portion of a Document to be processed by an MFD Service, or as the resulting data from the scanning of Hardcopy Document(s) in an MFD. The images from the scanned Hardcopy Document(s) are encoded in a specified format and stored at a Destination [PWG 5108.01].

Imaging Service: One of the Services performed by a Multifunction Device (MFD) as defined in the MFD Model and Commong Semantics specification [PWG 5108.01]. These consist of Print, Scan, Copy, FaxIn, FaxOut, EmailIn, EmailOut, Transform and Resource Services. The external interfaces to these Services are represented in Figure 1, which is based on Figure 6 of [PWG 5108.01].

**Job**: a data object, created and managed by a Service, that contains the description, processing, and status information of a Job submitted by a User. The Job can contain zero or more Document objects .

**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.



Figure 1 - Basic Imaging Services and their Interfaces

1. Requirements
	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 to address that fact 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 user's location, at a Print Service provider, at a remote user’s location, or at a pay to print destination.

* 1. Consideration of Cloud Printing Use Cases

Cloud Imaging requires establishing a connection to a Cloud-based entity (typically involving authentication and authorization of the prospective Job Originator), although this connection may not have been made specifically for use of an Imaging Service. In Cloud Imaging, interaction is required between the User and a Cloud Service and between the Imaging Device and a Cloud Service. The User need not be part of the Cloud Service domain and may not be directly connected to the domain in which the Imaging Device exists; and the Imaging Device need not be part of the Cloud Service domain.

In the PWG Model, the part of the Cloud Service dealing with Print Job specific functions is called the Cloud Imaging Service. The agent allowing the Printer to communicate with the Cloud Service is called the Cloud Imaging Device Manager. The use cases recognize that there need be other interfaces between the components described in this specification and the Cloud Service. However, this specification is specifically concerned with the interaction between Client and Cloud Imaging Service, and between the Cloud Imaging Device Manager and Cloud Imaging Service.

* + 1. General Cloud Imaging Sequence

The following Use Case outlines a full Cloud Imaging sequence, including setup of the Cloud Imaging capability. Details dealing with specific Imaging Services and with circumstances involving errors, aborts, cancels or other exceptions to a successful Job completion are covered in subsequent Use Cases.

* + - 1. General
1. All communications between the Client and the Cloud Service, and between the Imaging Device or Device Manager and the Cloud, are made via secure connections ensuring data integrity and confidentiality.
2. All interactions between the Imaging Device or Device Manager and the Cloud Service are logged following the common log format. [ref]
	* + 1. Imaging Device Registration

An Imaging Device, potentially supporting multiple Imaging Services, communicates with the Cloud Print Server via a Cloud Imaging Device Manager The Cloud Imaging Device Manager may be anything from interfacing software in the Device to a separate entity providing interface for multiple Devices. When handling multiple devices, the Cloud Imaging Device Manager may represent them individually, or it may represent them as a single (or multiple) composite device. It is assumed that the Owner of a Device also has control over the interfacing Cloud Imaging Device Manager, and it is up to the Owner whether he registers a composite Device or each Device individually. In the latter instance, each Device registration is separate.

An Imaging Device may be registered with more than one Cloud Imaging Service, but each registration is a separate action.

1. The Imaging Device Owner must create or assign an existing Cloud Imaging Device Manager to the Device. The Cloud Imaging Device Manager is configured to handle the Imaging Services operations and messages appropriate to the Device Imaging Services to be made accessible to the Cloud. The Cloud Imaging Device Manager may be anything from interface software within the Device to a stand-alone server handling many Devices. The Imaging Device itself may range from a single unit such as a printer to a composite logical Device created by the Cloud Imaging Device Manager and reflecting multiple physical devices with which it interfaces.
2. The Imaging Device is registered with the Cloud Service by the Owner. The registration must identify the specific Device Imaging Services to be made accessible, the Cloud Imaging Device Manager providing the interface and any User rights restrictions associated with Device access via the Cloud. User rights include paid Service arraignments and Service capabilities that may be restricted to certain Users.
3. Registration identifies Device capabilities and operational status, including supported Imaging Services and Service attributes such as document formats, paper sizes and types, finishing options, and operational status.
4. In conjunction with Device registration, a Cloud Imaging Service is created; or the Device may be assigned to an existing Cloud Imaging Service. The Cloud Imaging Service must perform the Imaging Services supported by the Device and which the Device Owner wishes to make accessible. The Cloud Imaging Service is configured with the Device capabilities and operational status.
5. A data retention policy for the Cloud Imaging Service in the handling of Job Tickets and Document Data for the subject Device is defined. ( e.g., Job document data is discarded immediately after processing, discarded after 1 day, saved indefinitely, etc.)
6. On completion of Device Registration, the Cloud Imaging Device Manager for the Device establishes connections to the Cloud Imaging Service, updating information on Device's capabilities, configuration and status, querying the status of any Imaging Jobs the Cloud Imaging Service has for the Device, and providing status information on any Imaging Jobs that were initiated by a request obtained from that Cloud Imaging Service. For security purposes, it is desirable that the Cloud Imaging Service authenticate that any Cloud Imaging Device Manager access is from the one identified during registration.
	* + 1. Job Request Submission
7. User, operating though a Client, connects to the Cloud Service from a variety of devices, operating systems, and applications.
8. User provides acceptable credentials to the Cloud Service
9. User may know the Cloud Imaging Service and Imaging Device he wishes to use; or he may query the Cloud Service about the desired Imaging Services available to him and selects a Service on the basis of characteristics such as location of the Imaging Device, capability and configuration.
10. Client establishes communication with the desired Cloud Print Server. The Client can obtain and provide to the User current information on the capabilities and status of the selected Server and, where applicable, the end Imaging Device.
11. User, operating through the Client, submits an Imaging Job Request to the Cloud Imaging Service. The Job Request has Job Ticket information. When requesting "Digital Data Input" Services (Print, FaxOut, EmailOut, and Transform) the Job Ticket includes or references the location of the desired input Document Data, which may in fact be a scan device. When requesting "Digital Data Output" Services (Scan, FaxIn, EmailIn,Transform and perhaps Print), the Job Ticket references the location the produced Digital Document is to be sent, which may in fact be a Print Device. A Copy Job can be considered a Scan Job with printer destination or a Print Job with a scanner input.
12. Cloud Imaging Service returns a response indicating the status of the Job Request including whether it has been accepted or rejected.
	* + 1. Job Processing
13. If it accepts the Job Request, the Cloud Imaging Service creates a Job in the appropriate Service and, in accord with Service's state, will eventually start processing the Job. This processing may include transform operations and/or Document Data retrieval. If processing proceeds successfully and a hardcopy Imaging Device (e.g., Print or Scan Device) is necessary for Job execution, the Cloud Imaging Service will eventually put a Create Job Request for the Job in a queue for the desired Imaging Device. The state of the Job in the Cloud Imaging Service will always be accessible to the Client.
14. Cloud Imaging Device Manager, in its monitoring of the Cloud Imaging Service, recognizes that there is a Job Create Request waiting. It will pass this on to the Imaging Device which, depending on its state and the Job Ticket information, will reject the request or accept the request and cause a Job to be created within the Device. The state of this new Job within the Device will be reported back to the Cloud Imaging Service through the Cloud Imaging Device Manager.
15. Cloud Imaging Service will continue adjust the state of the Job corresponding to the User's request including, where an Imaging Device is necessary, the Imaging Device's Job State and 'reasons' as reported by the Cloud Imaging Device Manager. The Client will query the Cloud Imaging Service for Job State/status and associated 'reasons' information.
16. Client will make the state of the User's Imaging Request available to him. Where possible, additional reasons information will be provided for Jobs which are in a state other than Completed.
	* 1. Print Attached Document Data to Remote Device (Success)

The simplest Cloud Imaging use case is a User printing a document that is available on the User's device. The User, operating though his client, locates an appropriate Cloud Imaging Service, determines that his document format can be accepted, that it can be printed as he wishes and that the printed document will be available where he wants it. The User may check the status of the Cloud Imaging Service and of the Print Device. He then submits a Create Print Job request with his document attached. Later he may check the status of his request and ultimately of the print Job created in response to that request.

The User Client sends operation requests to the Cloud Imaging Service. However, although the Cloud Imaging Service may have some method of alerting the Cloud Imaging Device Manager (which provides the Cloud interface for the Print Device) that it should contact the Cloud Imaging Service, it is still up to the Cloud Imaging Device Manager to provide information on Device and Job status, to query if Job Requests for the Devices it interfaces are present, and to pull the Job and the attached document from the Cloud Imaging Service.

Once the Job is accepted by the Print Device, the Job state is communicated back to the Cloud Imaging Service through the Cloud Imaging Device Manager and, either in response to a query from the Client or by some notification method, communicated to the User. In this way, the User may determine when the Job is completed.

* + 1. FaxOut or EmailOut From Hardcopy Input (Success)

The use case for FaxOut or EmailOut would be similar to that for Print if the Device sending the Fax or EMail were isolated from the Cloud Imaging Service as by a firewall. If the document being sent is available in Digital form, the only difference from Print would be that the Document is sent to a Fax Modem or EMail client in the Device rather than a marking engine. However, facsimile transmission inputs are often from hardcopy, with the User being at the Device (or at least the Scan Device).

As in Standard FaxOut and EmailOut, Scanner input is accommodated by using the AddHardcopyDocument operation. This operation would be sent by the Cloud User Client to the Cloud Imaging Service. The Cloud Imaging Service would accept this request only if the FaxOut (or EmailOut) Services of the Device selected by the User had both Fax Modem (or EMail client) and Scanner capabilities. However, the Cloud Imaging Service (either on its own or in relaying capabilities from the Cloud Imaging Device Manager) could offer an alternative of using a User-selected Scan Device and a Fax Modem or EMail client in dome other Device, or even in in the Cloud. The User would need to be informed of and accept (or reject) this option.

A transmission report (and a Transmission Log) is generated and is available from the Cloud Imaging Service and, if there is a local Marking Engine available, may be provided as hardcopy to the User..

* + 1. Print, FaxOut or EmailOut Referenced Document (Success)

In this use case, the Document Data that the User wishes to Print, FaxOut or EmailOut is not on the User’s device. Rather the User has a URL reference to where the Document Data can be accessed. The User, operating though his Client, must locate an appropriate Cloud Imaging Service that reports support of obtaining a source document by reference. However, until the Job request has been submitted, the User may not be able to determine whether the Cloud Imaging Service or following components can access the specific Document Data desired or properly process it.

If access to the desired Document Data requires passwords or some other security token, the Job Request must somehow provide the appropriate passwords or security tokens.

When the Job is completed satisfactorily, this status is communicated back to the Cloud Imaging Service by the Cloud Imaging Device Manager and, either in response to a query from the Client or by some notification method, is communicated to the User. As with EmailOut or FaxOut from scanned hardcopy, a transmission report (and a Transmission Log) is available from the Cloud Imaging Service and, if there is a local Marking Engine available, may be provided as hardcopy.

* + 1. Use of Cloud Imaging Service for Local Devices

It may be necessary for all Imaging Services to go through a Cloud Server (or a server somehow isolated from end Imaging Devices), even when the Imaging Device and the User are co-located. This may be because the Users are using Cloud based applications from which they wish to use Imaging Services, or to allow use monitoring for accounting or other reasons.

The Imaging Devices in any Cloud Imaging setup could range from full function MFDs to simple input/output elements (e.g., Scanning and Marking Engines), relying upon the Cloud Imaging Service for broader functionality. At either extreme, the Devices would need to contain or interface with a Cloud Imaging Device Manager that communicates with the Cloud Imaging Service. Note that the configuration using simple input/output elements requires the use of the Cloud Imaging Service for any Imaging Job. The following Use Cases illustrate such use for Scan, FaxIn/EmailIn, and Copy Services.

* + - 1. Use of Cloud Imaging Service for Scan Service

In a Scan Service use case, the selected Scanning Engine is physically accessible to the User so that he can load hardcopy. However, the User does not interface with the Scanner; rather, he contacts the Cloud Imaging Service supporting this Service and submits his request. Aside from possibly getting signals from the Scanner on when to load hardcopy and actually inserting the hardcopy, the Users sole interaction is with the Cloud Imaging Service.

The output of a Scan Service is Digital Document Data, usually in the form of a file. The Scan Engine, via the Cloud Imaging Device Manager, will deliver the scanned image to the Cloud Imaging Service, which will reformat the data as directed and deliver it to the selected destination. This may be a location in the cloud, or back to the Client.

* + - 1. Use of Cloud Imaging Service for FaxIn/EmailIn

The output of an FaxIn or EmailIn Service is either Document Digital Data stored at a defined destination, or hardcopy produced by a Marking Engine. In the former case, a FaxIn or EmailIn Service could be completely implemented in the Cloud or could use the FaxIn Modem or Email Client in a local Imaging Device. If a hardcopy output is required and Cloud Imaging Service indicates hardcopy capability at an appropriate location, the Digital Document Data could be directed to a marking engine within the FaxIn or EmailIn Device, or to a Print Service or Marking Engine physically accessible to the User (perhaps selected by the User or configured when the FaxIn or EmailIn Device was registered.)

Although there are instances when the location of the FaxIn Modem or Email Client is important (e.g., for access to internal company phone lines or servers), location of the Marking Engine will be particularly important of hardcopy output is desired. This is to be considered in choosing the Device performing this aspect of the FaxIn or EmailIn Service or may be part of how the virtual Service Device is configured during registration.

* + - 1. Use of Cloud Imaging Service for Local Print

The Print Service Use Cases discussed in paragraphs 3.2.2,3.2.3, and 3.2.4 could use a local Print Device as well as a remote one. Again, all normal User interface other than pulling the hardcopy from the machine would be with the Cloud Imaging Service rather than the Print Device. Machine faults could be reported via the Cloud Imaging service, but might best be handled directly with the machine.

* + - 1. Use of Cloud Imaging Service for Copy

The Copy Service inherently uses local Scanning and Marking Engines, but could use a Cloud Imaging Service for formatting, image processing and accounting. A composite Copy Device could be registered employing local input and output devices that may in the same MFD or may be separate simple devices. All normal User interface other inserting the hardcopy to be scanned and pulling the hardcopy from the machine would be with the Cloud Imaging Service rather than the local devices. Machine faults could be reported via the Cloud Imaging service, but might best be handled directly with the appropriate machine.

* + 1. Use Cloud Imaging Service Transform Capability

Cloud Imaging can also be used to access capabilities that may not be supported by a desired Imaging Device, even when that Device may be directly accessible to the User. In an example of this use case, the User has access to a document formatted in Apple Pages™ that he wishes to print on a local Print Device, but neither his computer nor the Print Device accept this format. However, the Print Device can also be accessed though a Cloud Imaging Service that indicates that it supports a Transform Service that does accept Pages format and converts it into a format suitable for the selected Print Device. The Transform Service may be within the Cloud Imaging Service or accessible to the Cloud Imaging Service either elsewhere in the Cloud or in some out-of-cloud Device registered with the Cloud Imaging Service.

The User therefore submits the Create Print Job Request to the Cloud Imaging Service. The Cloud Imaging Service will attempt to access the referenced Document Data, convert its format to one accepted by the destination Print Device, and pass the document to the Cloud Imaging Device Manager. The Cloud Imaging Service may use the Transform and Print Services sequentially or it may 'stream' the handling making the reformatted document "fetchable" by the Cloud Imaging Device Manager before format conversion is complete. In either case, the Cloud Imaging Service is 'orchestrating' a workflow between two (or more) Services, although since these are all compatible Imaging Services, no special workflow operations are needed.

The Cloud Imaging Service reports on the status of the Job to the User Client. This status reflects both what the Cloud Imaging Service is doing and the Job states reported by each of the participating Services. Therefore, it might be quite possible for the Job State reported to Client to bounce around among Pending, Processing and ProcessingStopped

* + 1. Paper Out Exception Occurs After a Job Request is Submitted

If, in use cases such as outlined above, some fault condition occurs at the Print Device that affects the execution of the Job Request, the Cloud Imaging Device Manager communicates this information to the Cloud Imaging Service. Depending upon the nature of the fault and the characteristics of the Cloud Imaging Service, the Service itself may abort the Job (and report this to the Client) or it may communicate the status to the Client and allow the User to wait for the fault condition to be resolved. In the particular case of an Out-of-Paper fault, it would be reasonable to give the User the option of cancelling the Job or allowing it to remain in the Processing or ProcessingStopped state until the fault is resolved or some other action is taken.

The use cases of the User cancelling a Job and of an Operator cancelling a Job are discussed below. However, regardless of where a Job is cancelled or aborted, the Cloud Imaging Device Manager must communicate with the Cloud Imaging Service and the Cloud Imaging Service must communicate with the Client to allow resolution of effective Job state.

This use case has parallels in Imaging Services using other Imaging Devices, if the Imaging Device has some sort of fault condition requiring operator intervention.

* + 1. Document Data Access Failure

In execution a request requiring access of Document Data by-Reference, several failures can occur in accessing the referenced Document Data. Unless the component doing the access considers the failure to be a temporary communications failure that can be quickly and automatically remedied, failures result in the Job being aborted and the Job state and, if possible, the detailed reason reported to the Client

Initial access can be blocked by failure to access the network, problems accessing the account, or read access privileges to the referenced file. These may be a result of communications problems, faulty passwords/security tokens, or login procedure handling. Once initial read access is achieved, there may be communication failures or delays, possible resulting in timeout failures.

If possible, it is desirable to report the nature and level of the failure to the Client, which can present this information to the User to allow him to correct the problem if the failure was a result of the User supplying incorrect or incomplete information.

* + 1. Cancel Job From Client

The User, operating through the Client, has issued a Create Job Request. He may or may not have received confirmation that his request has been accepted. For some reason, perhaps because he has received a error response or a status response indicating that the Job will take too long, or for some personal reason, the User decides to cancel the Job.

When the User cancels the Job, the Client communicates this command to the Cloud Imaging Service, which cancels the Job. The Cloud Imaging Device Manager queries the Cloud Imaging Service to determine Job state, and if the Job has been canceled, it acts to appropriately adjust Job state at the Imaging Device.

* + 1. Cancel Job at Cloud Imaging Device Manager or Imaging Device (MFD)

For some reason, such as a need for maintenance, it is possible that an Operator with access to the Imaging Device or the Cloud Imaging Device Manager (or an administrator of the Cloud Imaging Service) intentionally cancels a Job. The communication of this changed Job State is communicated between the Cloud Imaging Device Manager and the Cloud Print Server, and between the Cloud Print Server and the Client.

* + 1. Remedial Action in response to Abort or Downstream Job Cancel.

A User's Create Job request might be aborted or cancelled for no reason or intent of the User. Depending upon the configuration and capabilities of the components in the Cloud Imaging path, it may be possible for some components to take remedial action. For example, if a Device aborts a Job and the Cloud Imaging Device Manager Services multiple devices that have the required capability, it may redirect the Job to another Device. Or, if the Cloud Imaging Service interfaces with multiple downstream Imaging Servers, or multiple Cloud Imaging Device Managers, the Cloud Imaging Service could cause the Job request to be redirected, possibly doing some preprocessing to compensate for reduced capability of the alternate device.

In any such instance, the User's intent as expressed in the Job Ticket information would be adhered to and the User, though his Client, would have access to the Job Request state and status information.

* + 1. Connection Lost between Cloud Imaging Service and Cloud Imaging Device Manager

If there is a communication failure between the Cloud Imaging Device Manager and the Cloud Imaging Service, the Cloud Imaging Service may not immediately be aware of it. The perceived state of Jobs in the Imaging Devices and in the Cloud Imaging Service may diverge. If the failure were just in the communications link, Job Requests previously submitted by the Cloud Imaging Service may be fully satisfied; alternatively, if there were Device problems, the Cloud Imaging Device Manager and/or the Imaging Device may have lost all memory of recently submitted Job Requests.

When communication is restored, the Cloud Imaging Device Manager must cause the Job statuses in the Cloud Imaging Service and the Cloud Imaging Manager/Device to be realigned. This must also be done whenever the Cloud Imaging Device Manager is initialized or started.

The Client (and therefore the User) will see Job status as reported by the Cloud Imaging Service. Once the Cloud Imaging Device Manager has started on the Job, it will be reporting status back to the Cloud Imaging Service. The Job statuses in the Cloud Imaging Service and the Cloud Imaging Device Manager can be very different after communication between the Cloud Imaging Device Manager and the Cloud Imaging Service is lost and then restored. For example, the Cloud Imaging Service may have aborted the Job or the Client cancelled the Job while the Printer has continued and perhaps completed it.

* + 1. Use of Resource Services

The Resource Service allows professionally prepared job processing resources to be stored and then reused later for repetitive job processing, sharing by users, and management in centralized or distributed manner. The Resource Service is accessed by the User Client and uses a different interface set than the Hardcopy Imaging Services.

Resources available to a User from a Resource Service include:

* Templates containing the pre-set descriptive and processing parameters of a job or document suitable for submission to a targeted Imaging S ervice. A Template contains instructions representing the user’s preconfigured intent that can be used as-is or modified by the user, if authorized. Once the user is satisfied with the Template, the network Template Client application passes the Template to an intended MFD Service Client for creating job tickets or document tickets. These tickets are then used for job creation by the Service .
* an input or output ICC Profile enabling correct color space conversion
* a Form for document production for insertion at the front page of a document
* an image (e.g. Watermark, Logo, background) for Overlays
* a Font for text printing

In a Cloud environment, the Resource Service may be in the Cloud and be identified in conjunction with a Cloud Imaging Service. Alternatively, it may be associated with a Device at a User's base location, in which case it is most reasonably located from a remote site by a standard means for accessing servers at a base location, such as by VPN.

* 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.
10. Defining Cloud based access to the Resource Service.
	1. Design Requirements

Because the PWG Cloud Imaging Model requires two asynchronous sets of interactions to complete any User to Device 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 User Client) and the Cloud Imaging Service and Device-side interactions between the Imaging Device (seen though the Cloud Imaging Device Manager) and the Cloud Imaging Service. Considering the Out-of-Scope items, the design requirements are limited to defining or referencing an existing definition of the User Client to Cloud Imaging Service. interface on the Client-side, and the Cloud Imaging Device Manager to Cloud Imaging Service 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. The authentication and authorization of the User, and the methods by which the Imaging Devices 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 Client is a function of the device operating system and/or the Users application and is out of scope.

With respect to the imaging specific aspects, the User and the 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 Imaging 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 Imaging Service follows and the Cloud 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 Imaging 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 Client uses these requests and accepts the responses to the extent compatible with the capabilities it is to supply to the User.

Cloud Imaging 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 Imaging Device 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 to the Cloud Imaging Service with which that Imaging Device is identified during registration is not.

The communication between the Cloud Imaging Service and the Device could be the same as that between Client software in an upstream Imaging Service and an Imaging Service in a Device were it not for the probable presence of a firewall preventing the Cloud Imaging Service from initiating requests of and submissions to the Device. Instead, an intermediary actor call the Cloud Imaging Device Manager exists between the Device and the Cloud Imaging 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 Imaging Service; and the communication of Job Ticket and Document data to the device.

1. The Cloud Imaging Service and the Cloud Imaging Device 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 Imaging Device Manager follows and the Cloud User 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 Imaging Service supports a set of interface requests and responses and the Cloud Imaging Device Manager uses these requests and accepts the responses to allow communication of the following types of information:
	1. Imaging Device Capabilities, Configuration and Status.
	2. Job Request Information, including Job Tickets, Document Tickets and Document Data
	3. Job and Document Status
4. The interchange between the Cloud Imaging Device Manager and the Cloud Imaging Service provides some method by which the Cloud Imaging Service can determine whether a disruption in the communication has occurred.
5. The Cloud Imaging Device Manager provides and the Cloud Imaging Service supports provisions to allow the synchronization of Job and Document status and the update of Imaging Device status in normal operation, and on recovery after occurrences such as disruption of communication or hard reset of the Cloud Imaging Device Manager.
6. Although an optional capability, the Model provides for the Cloud Imaging Service to notify the Cloud Imaging Device Manager that information is available or a request for information is present and the Cloud Imaging Device Manager should contact the Cloud Imaging Service.
	* 1. Transform Services

In addition to the User/Client to Cloud Imaging Service communication and the Cloud Imaging Device Manager to Cloud Imaging Service communication necessary for submitting and executing Job requests, there are communications from Cloud and potentially from Device-resident Imaging Services to Cloud and Device-resident Transform Services.

Transform Services are registered and associated with a Cloud Imaging Service as are hardcopy Imaging Services, and the additional capabilities provided by the Transform Service should be advertised by the Cloud Imaging Service in addition to the capabilities provided by the Cloud Imaging Service itself and those provided by the Imaging Devices which communicate with it.

* + 1. Privacy and security policies

The use of Cloud connections for handling imaging jobs requires attention to security concerns even for relatively low sensitivity information. Requirements run the gamut from authentication and authorization for access of Clients and Device Managers to Services, to integrity and privacy of all imaging data, to secure logging and access to use data for billing purposes.

In many cases the specifics of security provisions are out of the scope of this specification either because they relate to registration or association issues or because they are a function of the binding used to implement the model. However, basic security aspects of the Model require that:

1. Any User Client connection to a Cloud Imaging Service have the Users identity be authenticated according to the access provisions of the Cloud Imaging Service and of the Devices with which it communicates.
2. Any Device Manager connection to a Cloud Imaging Service have the Device Manager identity be authenticated according to the Service-Manager configuration defined at Device Registration.
3. All document data transmitted be encrypted and protected from alteration at a level commensurate with the sensitivity of the information.
4. All document data within a Cloud Imaging Service not be accessible to any one or any agent other than the authenticated Job Originator (through his client) and the Device selected by the Job Originator (through its Device Manager).
5. The operations and messages in the model must not require the transmission any information that violates standard best practices for data security.
	* 1. Logging

The Cloud Imaging Service must maintain a log of all Job transactions, including Job Identification, Job Originating User, selected devices(s), date/time of transaction, resources used. The log is necessary for accounting as well as resource monitoring and maintenance purposes The log must follow the format defined in PWG Common Log Format [CS-5110.3]. The log entries must be retained long enough to ensure that log information is recovered, according to policy established when the Cloud Imaging Service is created.

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 Imaging Device represented by the Cloud Imaging Service by location, or by any desirable attribute(s). The user submits a Job to the selected Cloud Imaging Service. The Cloud Imaging 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. Update 8 May 2013

Sections 1 through 3 modified to satisfy comments from Cloud Conference Call, ftp://ftp.pwg.org/pub/pwg/cloud/minutes/cloud-concall-minutes-20130429.pdf

* 1. Update April 25, 2013

Sections 1 through 3.2.11 modified to reflect requested changes in previous Cloud Printing Model document, and Cloud Imaging Service approach.

* 1. Initial Revision: February 6, 2013