The Printer Working Group

IPP Enterprise Printing Extensions v2.0
(EPX)

Status: Approved

Abstract: This specification defines the conceptual Job Release, Job Storage, Job Print Policy, Job Proof and Suspend, and Job Proof Print features for IPP, to support printing workflows important to institutional IT environments such as corporate businesses, governments, and universities.

This specification was previously titled "IPP Job and Printer Extensions - Set 2".

This document is a PWG Working Draft. For a definition of a "PWG Working Draft", see:

https://ftp.pwg.org/pub/pwg/general/process/pwg-process-4.pdf

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https://ftp.pwg.org/pub/pwg/candidates/cs-ippepx20-20240315-5100.11.docx
https://ftp.pwg.org/pub/pwg/candidates/cs-ippepx20-20240315-5100.11.pdf

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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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1. Introduction

This specification defines the conceptual IPP Job Release, Job Storage, Job Print Policy, Job Proof and Suspend, and Job Proof Print features, to support printing workflows important to institutional IT environments such as corporate businesses, governments, and universities.

This specification updates "IPP Job and Printer Extensions - Set 2" [PWG5100.11-2010]. Section 14.1 lists the changes to the earlier revision of this specification.

2. Terminology

This section defines the following terms used throughout this document.

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 Key words for use in RFCs to Indicate Requirement Levels [BCP14].

The term CONDITIONALLY REQUIRED indicates a MUST conformance requirement that applies only when a specified condition is true.

The term DEPRECATED indicates a SHOULD NOT conformance requirement for previously defined and approved protocol elements that are planned to be removed from use.

The term OBSOLETE indicates a MUST NOT conformance requirement for previously defined and approved protocol elements that have been removed from use.

2.2 Printing Terminology

This specification uses normative definitions and semantics of printing terms leveraged from the Internet Printing Protocol/1.1: Model and Semantics [STD92], and the IETF Printer MIB v2 [RFC3805], and these are labeled with references to indicate their source. Additional printing terms defined in this specification have no reference annotation.

Administrator: An End User authorized to manage all aspects of an Output Device or Printer, including creating the printer instances and controlling the authorization of other End Users and Operators. [STD92]

Authenticated User: The same as "authenticated user" defined in [STD92] RFC 8011 section 9.3.

Console: The physical control interface used to display the state of the Printer and change its settings. This can also refer to a network management service or protocol e.g. SNMPv3, HTTPS/HTML, SSH, etc. [RFC3805]

Document: An object created and managed by a Printer containing the description, processing, and status information. A Document object can have attached data and is bound to a single Job. [STD92]

Document Creation Operation: An IPP operation that creates a Document object i.e. Print-Job, Print-URI, Send-Document and Send-URI. [STD92]

End User: A person or software process authorized to perform basic printing functions, including finding/locating a Printer, creating a local instance of a Printer, viewing Printer status, viewing Printer capabilities, submitting a Print Job, viewing Print Job status, and altering the attributes of a Print Job. [STD92]

Final Copies: The copies a Printer produces if a Proof and Suspend Job is approved. If the Proof and Suspend Job is rejected, the Final Copies are not produced.

Input Page: A page according to the definition of "pages" in the language used to express the Document data. [STD92]

Job: An object created and managed by a Printer that contains description, processing, and status information. The Job also contains zero or more Document objects. [STD92]

Job Creation Operation: An IPP operation that creates a Job object i.e. Create-Job, Print-Job, and Print-URI. The Restart-Job operation is not considered a Job Creation Operation, since the Printer re-uses the existing Job object. The Validate-Job operation is not considered a Job Creation Operation because no Job object is created. [STD92]

Job Owner: The End User who created the Job. [STD92]

Job Submission Operation: An IPP operation that creates Jobs and/or Documents i.e. Create-Job, Print-Job, Print-URI, Send-Document, and Send-URI. [STD92]

Logical Device: A print server, software service, or gateway that processes Jobs and either forwards or stores the processed Job or uses one or more Physical Devices to render output. [STD92]

Operator: An End User that also has special rights on the Output Device or Printer. The Operator typically monitors the status of the Printer and manages and controls the Jobs at the Output Device. The Operator can query and control the Printer, Jobs, and Documents based on site policy. [STD92]

Output Device: A single Logical or Physical Device. [STD92]

Password Release Job: A Job that has a permanently attached password to authorize processing the Job. If the Job is copied, the new copy preserves the original password to preserve the authorization requirement.

Physical Device: A hardware implementation of an endpoint device, e.g., a marking engine, a fax modem, etc. [STD92]

PIN Printing: A Password Release Job that uses a numerical password ("PIN").

Proof Copies: The copies a Printer produces when initially processing a Proof and Suspend Job.

Proof and Suspend Job: A Job that produces Proof Copies when first in the 'processing' state, then is moved by the Printer to the 'processing-stopped' state for approval or rejection. If approved, the Printer moves the Job back into the 'processing' state to produce the Final Copies. If rejected, the Printer moves the Job immediately into the 'canceled' state.

Proof Job: A Job retained by the Printer after the initial "proof" set of copies has been produced, to enable the remaining copies to be printed at some later time, rather than aging the Job out after an implementation-defined period.

Release Action: An action performed at the Physical Device to allow a Release Job in its initial 'pending-held' state to proceed to the 'processing' state.

Release Job: A Job submitted to a print service with annotations indicating that the receiving Printer is to withhold the Job from processing until the Printer receives some release action, such as a button press on its Console, a Job password, or user authentication credentials, to authorize the Printer to release the Job into the 'processing' state.

Release Printing: A workflow where Release Jobs are submitted to a print service and held until the End User provides necessary information to release the Job into the 'processing' state. The nature of the necessary information can depend on the solution but might include information such as a username and password, swiping an identification card or credit card in a card reader on the Printer, or simply pushing a button. The print service can be hosted on a Physical Device or a Logical Device such as a centralized print service or print service provider.

Retained Job: A Job that the Printer retains in the Job Retention Phase [STD92] once the Job has reached its terminal state ('completed', 'aborted', or 'canceled'), for an implementation-defined period.

Stored Job: A Retained Job that has reached the 'completed' state and that has identifying attributes marking it as a Stored Job instead of simply as a previously processed Job. The Documents in a Stored Job are maintained in their originally submitted state and format. The Printer retains a Stored Job for an implementation-defined period, unless otherwise configured, so that it can be listed and selected for reprinting at some time in the future.

2.3 Protocol Role Terminology

This document also defines the following protocol roles in order to specify unambiguous conformance requirements:

Client: Initiator of outgoing connections and sender of outgoing operation requests (Hypertext Transfer Protocol -- HTTP/1.1 [STD99] User Agent).

Printer: Listener for incoming connections and receiver of incoming operation requests (Hypertext Transfer Protocol -- HTTP/1.1 [STD99] Server) that represents one or more Physical Devices or a Logical Device.

2.4 Other Terminology

AAA Framework: A common method for performing authentication, authorization, and accounting between multiple entities. [RFC2903] [RFC2904]

i^{th}: Referring to a specific 1setOf value - the first value, the second value, and so forth.

Secure Transport: Encryption of the IPP connection at the HTTP layer using Transport Layer Security [RFC8446] as per [RFC7472].

2.5 Acronyms and Organizations

IANA: Internet Assigned Numbers Authority, https://www.iana.org/

IETF: Internet Engineering Task Force, https://www.ietf.org/

ISO: International Organization for Standardization, https://www.iso.org/

PIN: Personal Identification Number

PWG: Printer Working Group, https://www.pwg.org/

3. Requirements

3.1 Rationale for IPP Enterprise Printing Extensions v2.0

IETF and PWG IPP printing standards define an abstract model of a Print Service (i.e., Logical Device) and a Print Device (i.e., a Physical Device) in section 3.1 of Internet Printing Protocol/1.1 [STD92]. Some IPP Printers already support proofing, saving, and reprinting large Print Jobs via vendor proprietary operations and attributes.

Therefore, this IPP Enterprise Printing Extensions v2.0 specification should extend IPP so that it supports:

1. Creating a Proof Job using IPP Job Creation Operations;

2. Creating a Stored Job using IPP Job Creation Operations;

3. Creating a new Job using IPP from a Stored Job or Proof Job, with the new Job having possibly different processing instructions;

4. Creating a Release Job using IPP Job Creation Operations;

5. Releasing a Release Job using IPP Job operations;

These extensions to IPP are to be designed in such a way that Proof Jobs, Stored Jobs and Release Jobs can interoperate, so that a single Job could be a Release Job, a Stored Job and a Proof Job.

Also, given the availability of the hrStorage elements in the Host Resources MIB [RFC2790] and S.M.A.R.T. log data [INCITS-452], and given the need to query this information via IPP, this IPP Enterprise Printing Extensions v2.0 specification should:

6. Define IPP Printer Status attributes that supply the status, capabilities, and name of each storage device installed in a Printer; and

7. Define "printer-state-reasons" keywords corresponding to states that storage devices may have.

3.2 Use Cases

3.2.1 Releasing a Job with a Button Press

Lisa is a high school student. She just finished writing a paper for her Ancient History class and wants to use the printer in the library to print a copy to turn into her teacher. She wants to have the printer hold the job until she releases it so that it isn't sitting in the output tray. She selects the "Button Press" option in the print options dialog window and clicks "Print". Her laptop submits the job to the printer, and the printer holds the job. Later, when Lisa goes to the printer, she sees the held job listed on the control panel screen. She pushes the "OK" button and the printer prints the job.

3.2.2 Releasing a Job with a Job Password

Frank works in a sales office that is large enough for him to have privacy concerns, but not so large that the printers are integrated into the IT infrastructure in a sophisticated manner. He is editing a sensitive business report that contains financial data. He wants to make sure that, if he prints it to the office's shared printer, he can be confident only people with the original password can pick it up or re-print it. Frank sees that the printer supports a "Job Password" method for job release, so he selects that option in the print options dialog window, overrides the automatically generated unique password with one of his choosing, and clicks "Print" to submit the job. The printer delays printing the job until someone first provides the matching password. Frank goes to the printer, observes that his job is listed on the control panel screen, selects it, and enters the matching password at the prompt. The printer prints the job, and Frank relaxes knowing the job printed from a shared printer without being seen by others.

3.2.3 Releasing a Job with User Authorization

James works in a large law office. He is editing a set of documents for a client. He wants to be sure that he will be the only one able to collect the printed copy or reprint it if he submits it to the office's shared printer. The printers are connected to the firm's AAA Framework.

James selects the "Authorized Release" option in the print options dialog window and clicks "Print" to submit the job. The printer challenges James' laptop for authentication credentials, and the laptop provides this since it is also part of the same AAA Framework. The printer accepts the Job and holds it.

James goes to the printer, logs into it with his identity badge and selects the held job to release it. The printer prints the job and James takes it back to his desk.

3.2.4 Storing a Job for Later Reprinting

Vincent is an administrative assistant for a school. The school provides its teachers with paper forms for documenting their class assignments and attendance. Vincent makes these forms available on the school's web site and on the school's printer as a Stored Job accessible by any accounts in the Faculty user group. He sends an email to the school faculty letting them know that the Stored Job is available for reprinting.

3.2.5 Reprinting a Stored Job

Lily is a teacher. She has run out of her supply of assignment tracking forms. She goes to the school's office, logs in using her faculty account, and selects Stored Jobs on its control panel. Among the Stored Jobs listed, she finds the assignment tracking form that had been stored by Vincent. She selects that Stored Job for reprinting, choosing to have 30 copies made, and taps Print. The copies are printed, and she returns to her classroom with the newly printed copies.

3.2.6 Proof Printing

Abby, Brian, and Cyrus work in the system engineering department of a large software vendor. They collaborate to find, describe, and evaluate software feature requirements for financial management tools in their requirements database.

Abby is an artist and chooses their standard fonts and writes style sheets and layout guides for their software requirements specifications. Brian is a quiet, steady worker and an excellent proofreader. Cyrus is a good talker who does the interviewing of the marketers and engineers.

Once a month, Cyrus extracts from their database all the detailed software requirements for each project into a spreadsheet. He also extracts all the high-level software requirements into a word processing document. Cyrus then submits a single job with the two documents (the spreadsheet and the word processing document) for a proof print of 3 copies (single-sided and portrait).

Abby searches for layout and visual content errors, while Brian looks for typos and missing words. Cyrus commits their fixes to the database, regenerates the source documents, and does another cycle of proof print.

Finally, Cyrus wants to produce 60 copies (2-up, two-sided, and landscape) of the retained proof job. He reprints the job from the printer's job history but specifies overrides for some processing instructions.

3.2.7 Print Policy for Some End Users Limits Print Capabilities

Sue wants to print her report on her department's printer. She wants to print it in color to make the color graphs look best. However, she has abused her printing privileges, so her department head has instructed the network administrator to restrict her user account's ability to print in color.

Sue opens the document on her laptop, chooses to print, and selects the department's printer. The Printer authenticates the laptop using Sue's credentials, and then provides the laptop with the print choices available for Sue's account, which does not include color printing. Sue decides whether to print it in black-and-white anyway or to print from one of the campus printing centers, where she can pay to print in color.

Bob is an associate professor in the same department as Sue. His account has no limitations for color printing. He opens a document on his tablet, taps to print, and selects the department's printer. His tablet presents print options including the option of printing in color. Bob chooses to print in color, and prints his document, which prints in color as he expects.

3.2.8 User Not Listed in Print Policy Denied Ability to Print in Color

Ed is visiting Duncan's office and needs to print a 3-page document. Ed is not listed as a user in the print policy. Ed opens the document on his laptop, clicks to print, and selects the Printer Duncan pointed out to him. The laptop does not support print policies or does but has no valid credentials. The Printer provides Ed's laptop with the default print capabilities. When the Job is submitted to the Printer, the Printer rejects the Job or identifies the setting that were adjusted, since unknown users don't have the right to print in color on this printer.

3.2.9 Monitor Printer Storage

Jane is responsible for maintaining all the enterprise MFPs, each containing hard drives for stored jobs and spooling. She uses her printer management application to query the status of each MFP's installed hard drive to schedule maintenance and monitor usage throughout her network.

3.3 Exceptions

3.3.1 Incorrect Job Password Prevents Release

Velma is one of Frank's co-workers. She is very competitive and has questionable business ethics. She goes to the department's printer to see if she can re-print any of Frank's jobs. Many of Frank's jobs are submitted as requiring user account authorization to release or reprint and are not visible to her, but she finds one Job Frank submitted using password release. She suspects this job is the latest draft of a key report and tries to re-print it. The Job she selected is a Job Password protected Release Job , so the printer presents a password challenge UI to authorize re-printing. Velma doesn't know it, so she guesses a few times, gives up, and goes to the break room to brood.

3.3.2 Incorrect Credentials Prevents Job Release

Wilbur is a corporate spy who has infiltrated the offices of James' law firm. He is hoping that he can acquire documents pertaining to a case, but he cannot access the documents on the law firm's computers. He hopes he will be able to reprint documents on the printers since they are not as carefully protected. He goes to the control panel and looks for the printer's Job History. The printer does allow listing the Job history to unauthenticated users, so he looks through the past jobs, selects one and taps "Print". He is challenged to log into the printer using matching account credentials, but he doesn't have credentials that are authorized access to any of the jobs in the history. Wilbur gives up and goes looking for a recycle bin to plunder.

3.3.3 Storage Failure

A MFP's internal hard drive has failed, preventing job storage and spooling. Jane uses her printer management application to query the failure reason.

3.4 Out of Scope

The following are out of scope for this specification:

1. Specifying the methods used by the Printer to manage its storage for Stored Jobs or pending Jobs;

2. Defining specific methods for multi-factor authentication for PIN and Release Printing, e.g., smart cards;

3. Specifying the methods used by the Printer to implement authentication and authorization; and

4. Specifying the methods used by the Printer to present features on its Console.

3.5 Design Requirements

The design requirements for this specification are:

1. Follow the naming conventions defined in Internet Printing Protocol/1.1 [STD92], including keyword value (lowercase) and hyphenation requirements;

2. Maintain compatibility with existing IPP operations when defining new operations and attributes;

3. Define an IPP operation to allow a Client to obtain supported Printer capabilities for a specific End User;

4. Define new attributes and values to support the conceptual Job Release feature;

5. Define new attributes and values to support the conceptual Job Storage feature;

6. Define new operations, attributes and values to support the conceptual Job Print Policy feature;

7. Define new attributes to support the conceptual Job Proof and Suspend feature;

8. Define new attributes to support the conceptual Job Proof Print feature;

9. Define attributes and values to describe the corresponding hrStorage elements from the Host Resources MIB [RFC2790];

10. Define "printer-state-reasons" keywords corresponding to the hrStorageStatus values from the Host Resources MIB;

11. Define additional attributes to support other minor enhancements to IPP that relate to the significant features defined in this specification;

12. Define security requirements necessary to support the features specified; and

13. Define sections to register all attributes, values, and operations with IANA.

4. IPP Model for Enterprise Printing

This specification extends the Internet Printing Protocol/1.1 [STD92] model to add support for the conceptual Job Release, Job Storage, Job Print Policy, Job Proof and Suspend, and Job Proof Print features. This specification also defines a few other IPP attributes and attribute values to better satisfy the use cases in section 3.2.

4.1 Job Print Policy

An Administrator can configure a "print policy" where each Authenticated User has access to only a subset of a Printer's features and options. The Client can obtain the filtered set of features and capabilities for its Authenticated User using the Get-User-Printer-Attributes operation (section 5.1), which is semantically analogous to the Get-Printer-Attributes operation [STD92], but is defined to allow the Printer to challenge for authentication. By convention, a Printer cannot challenge the Client for authentication in response to a Get-Printer-Attributes operation request.

A Printer declares its support for the Job Print Policy feature by including the enum value defined for the 'Get-User-Printer-Attributes' operation in its "operations-supported" Printer Description attribute [STD92].

The sequence diagrams in Figure 1 and Figure 2 illustrate the actors' user experiences, and the underlying IPP interactions supporting that user experience, from the Use Case in section 3.2.7. The sequence diagram in Figure 3 illustrates the actor's user experience, and the underlying IPP interactions supporting that user experience, from the Use Case in section 3.2.8.

Figure 1 - Sequence Diagram for Use Case 3.2.7 - Bob's Experience
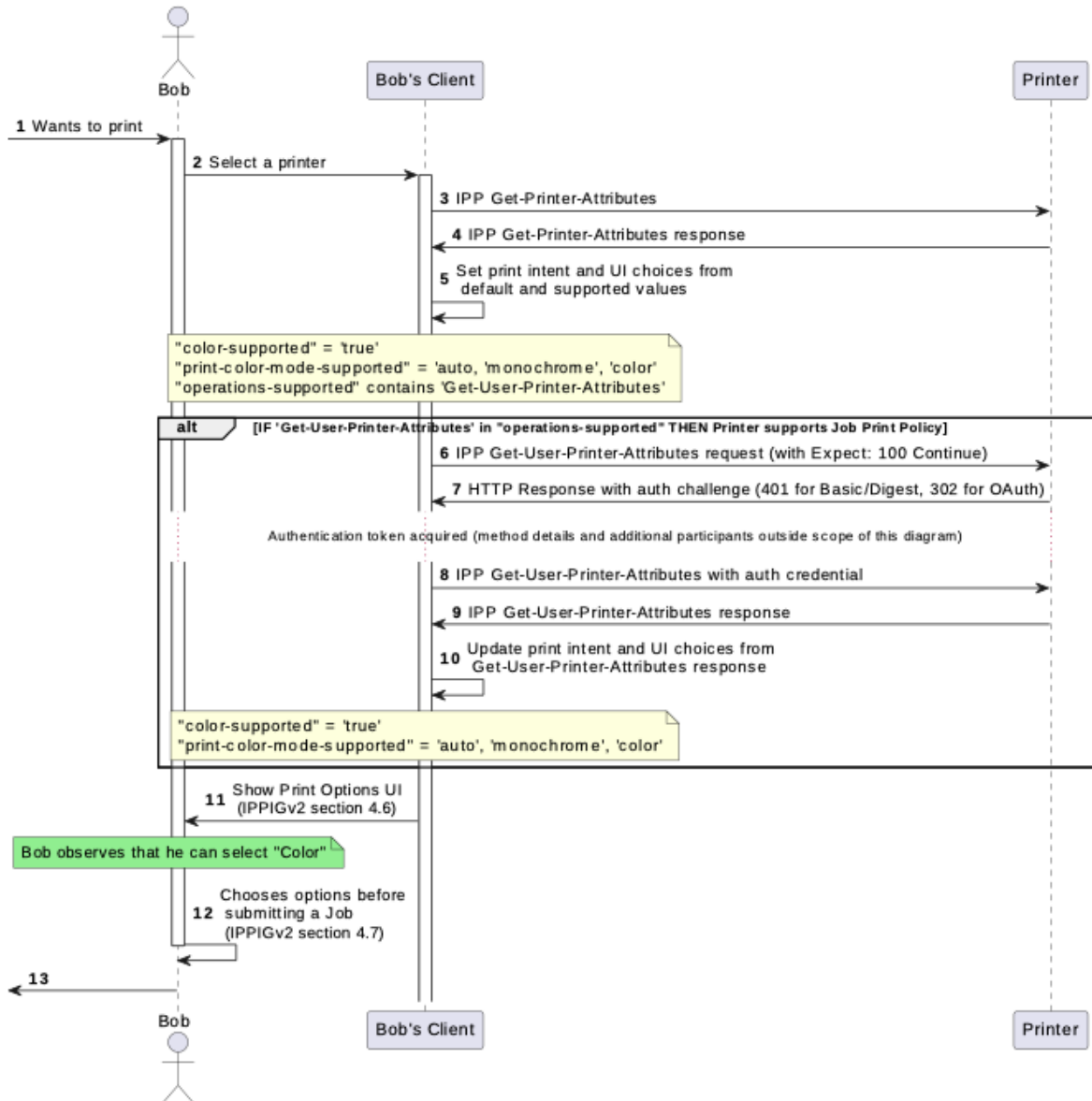
Figure 2 - Sequence Diagram for Use Case 3.2.7 - Sue's Experience
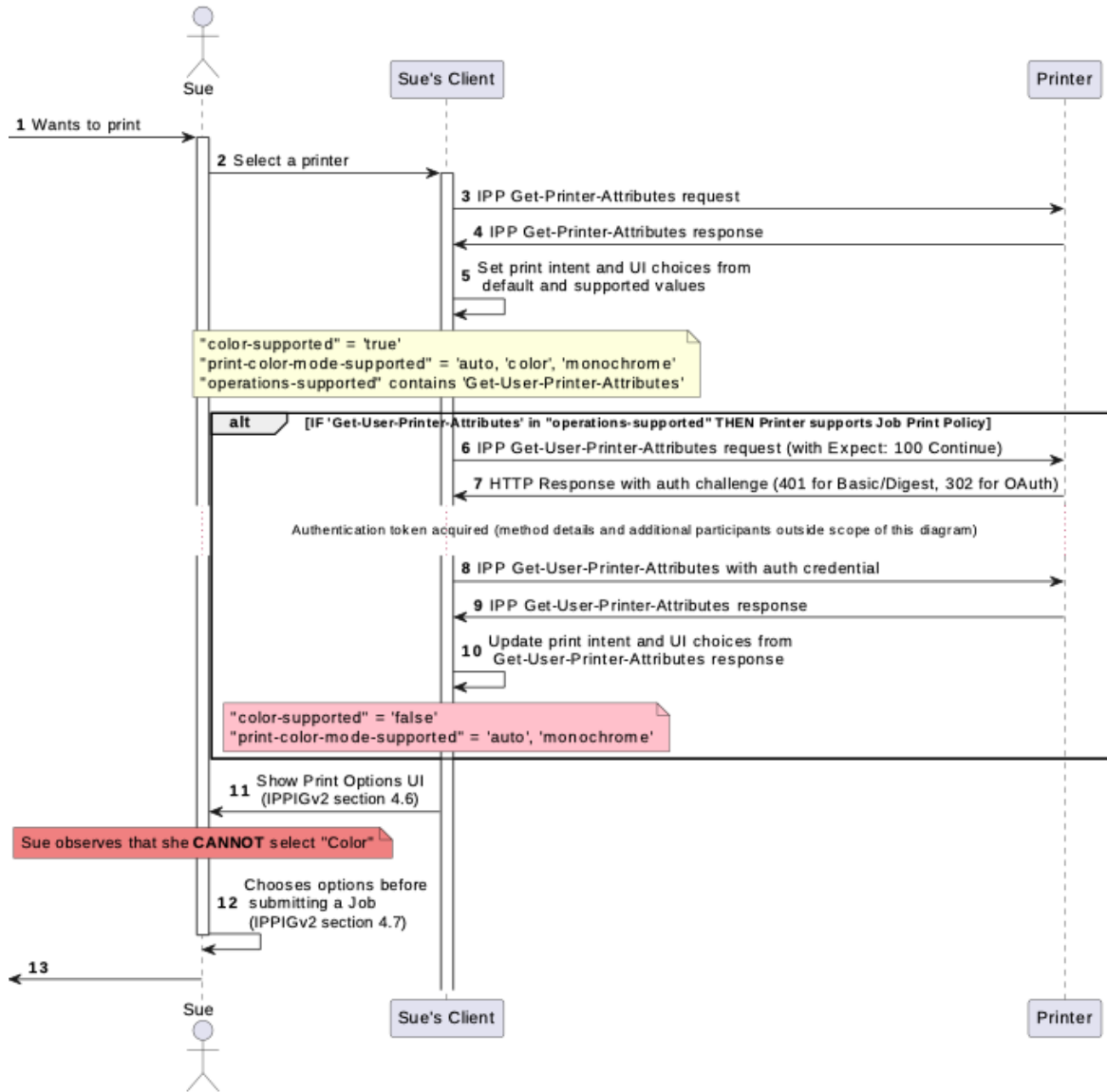
Figure 3 - Sequence Diagram for Use Case 3.2.8 - Ed's Experience
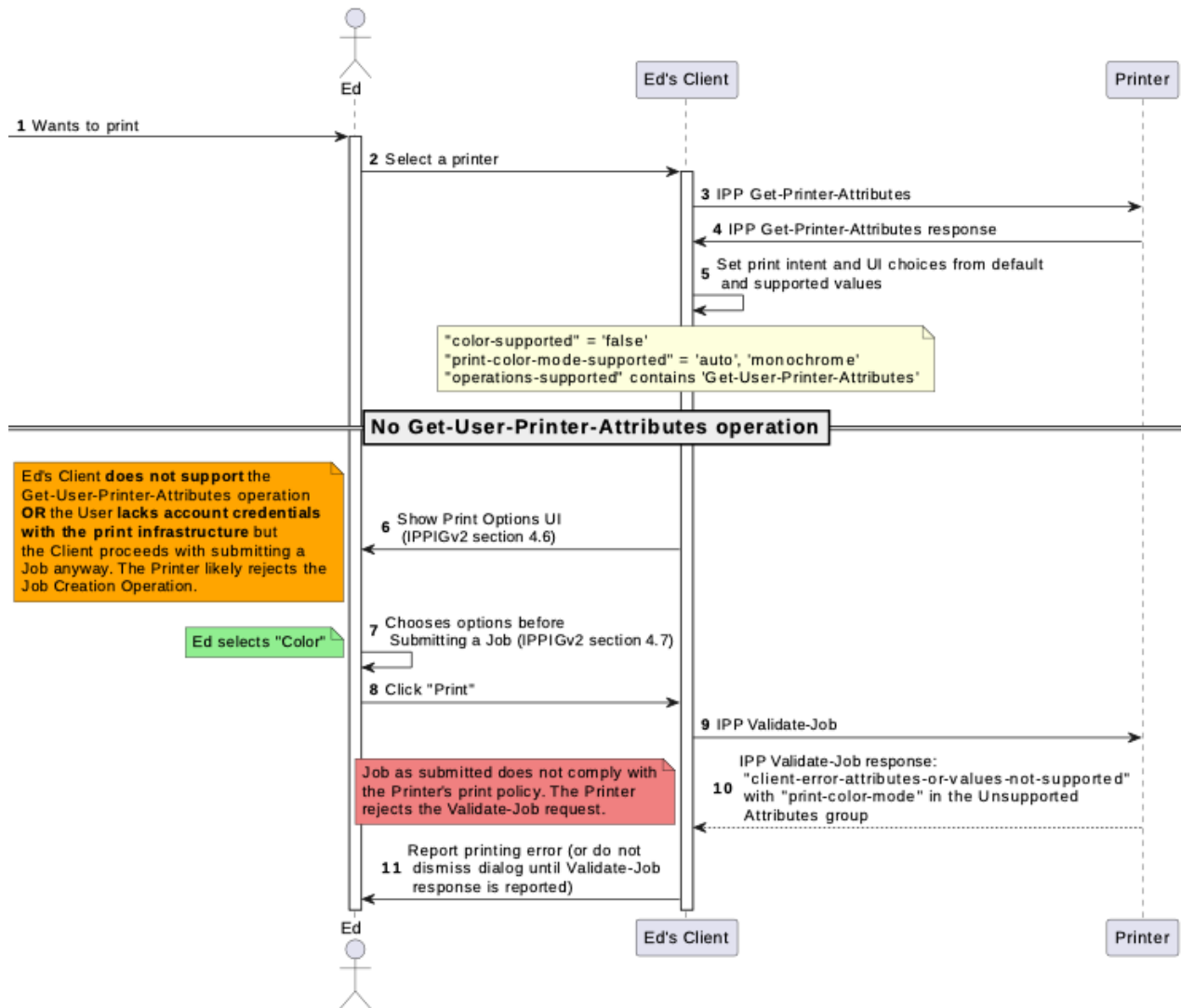
4.2 Job Proof

4.2.1 Job Proof and Suspend

An IPP Client uses the Job Proof and Suspend feature to request the Printer create a Job as a Proof and Suspend Job, which is a single Job used to produce both the Proof Copies and Final Copies (if approved). A Printer supporting Job Proof and Suspend will print the number of Proof Copies specified by the "proof-copies" Job Template attribute (section 6.2.2) when the Job is initially in the 'processing' state. Once the Printer produces the Proof Copies, it moves the Job to the 'processing-stopped' state and adds the 'job-suspended-for-approval' keyword to the "job-state-reasons" Job Status attribute [STD92] to indicate that it is awaiting approval (or rejection).

A Client can get the list of Proof and Suspend Jobs awaiting approval using a Get-Jobs operation by specifying the 'proof-and-suspend' keyword for the "which-jobs" operation attribute (section 8.4). A Client can use the Resume-Job operation [RFC3998] to approve the Proof and Suspend Job to complete and produce the Final Copies. The Printer responds by moving the Job into the 'processing' state and produces the Final Copies. A Client rejects a Proof and Suspend Job using a Cancel-Job operation. The Printer responds by moving the Job to the 'canceled' terminal state. The Printer might also provide a function on its Console to approve or reject a Proof and Suspend Job.

Note: A print service might force (via policy) that multiple copy Jobs automatically produce a proof copy followed by N-1 copies once approved/released.

Figure 4 illustrates the Job states of a successful Proof and Suspend Job to produce both the Proof Copies and the Final Copies.
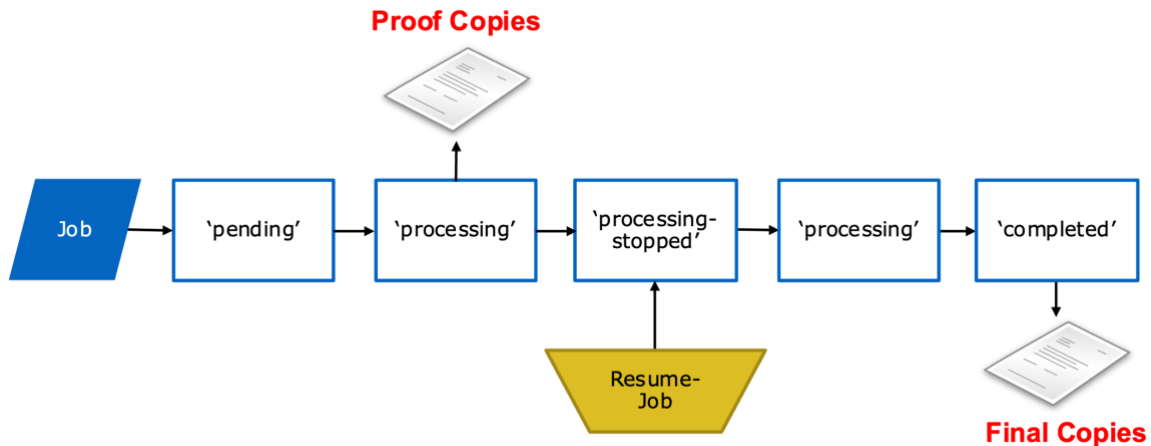
Figure 4 - Job Proof and Suspend

4.2.2 Job Proof Print (DEPRECATED)

Job Proof Print [PWG5100.11-2010] enables a Client to submit a Job as a Proof Job. Job Proof Print is DEPRECATED because its use of resubmission complicates job accounting and compatibility with other features in this specification. A Job Proof Print implementation has never been deployed.

When processed, a Proof Job produces the specified number of proof copies and proof settings. Once the Proof Job reaches the 'completed' state, the Printer retains the Proof Job so that it is available for resubmission once the proof copies have been reviewed. If the Job is satisfactory, a Client can request the Printer to produce the "normal" copies using the Resubmit-Job operation [PWG5100.7]. The Printer might also provide a method to do this via its Console. The Printer will clean up abandoned Proof Jobs after an implementation-defined time if it has not been concluded by moving the retained Proof Job to the Job History phase [STD92].

4.3 Job Release

An IPP Client uses the Job Release feature to request a Printer hold a Job in the 'pending-held' state until that Printer receives the specified Release Action to release the Job to processing. A Client can request Job Release by including the "job-release-action" operation attribute (section 6.1.3) in a Job Creation Operation. This Job Release feature defines "push release" where the Document data resides on the Printer. Figure 5 illustrates the Job states of a successful Release Job and the effect of the Release Action.
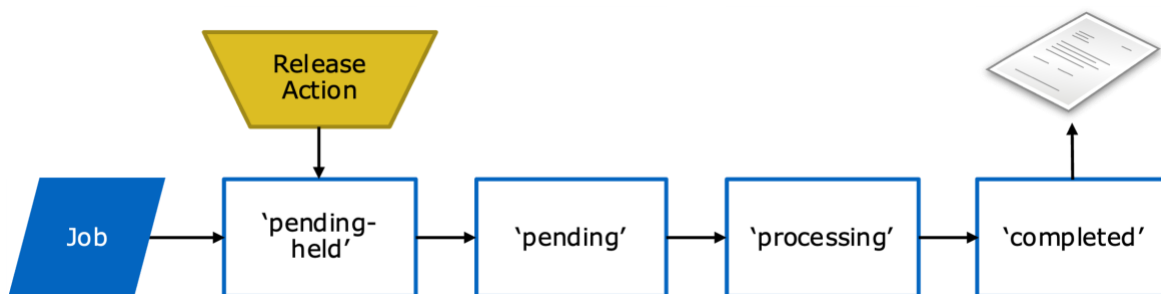
Figure 5 - Release Job

This specification defines three Release Actions: Button Press, Job Password, and User Authorization. The Printer's supported Release Actions are listed in its "job-release-action-supported" Printer Description attribute (section 6.4.9). The Printer can be configured with a default Release Action, indicated by the "job-release-action-default" Printer Description attribute (section 6.4.8). The default Release Action cannot be 'job-password'.

Table 1 lists the defined Release Actions and their corresponding "job-state-reasons" keyword indicators (section 8.2).

Table 1 - Release Actions for Job Release

Release Action	"job-release-action"	"job-state-reasons" indicators
(none)	'none'	n/a
Button Press	'button-press'	'job-held-for-button-press' 'job-held-for-release'
Job Password	'job-password'	'job-password-wait' 'job-held-for-release'
User Authorization	'owner-auth'	'job-held-for-authorization' 'job-held-for-release'

4.4 Job Storage

An IPP Client uses the Job Storage feature to request that the Printer "store" a Job and its Documents as part of processing to make the Job available for later reprinting. A Client can request Job Storage by supplying the "job-storage" Job Template attribute (section 6.1.4) in the Job Creation Operation, which includes how the Printer should process the Job and who has access to the Stored Job. The Printer's "job-storage-supported", "job-storage-access-supported", "job-storage-disposition-supported", and "job-storage-group-supported" Printer Description attributes list the Printer's supported Job Storage options. The Client specifies whether the Job is accessible by all users, only the Job Owner, or End Users that are members of one of the supported groups listed by the Printer. The Client can also specify whether the Printer prints the Job before storage (illustrated in Figure 6) or simply stores it without printing (illustrated in Figure 7).
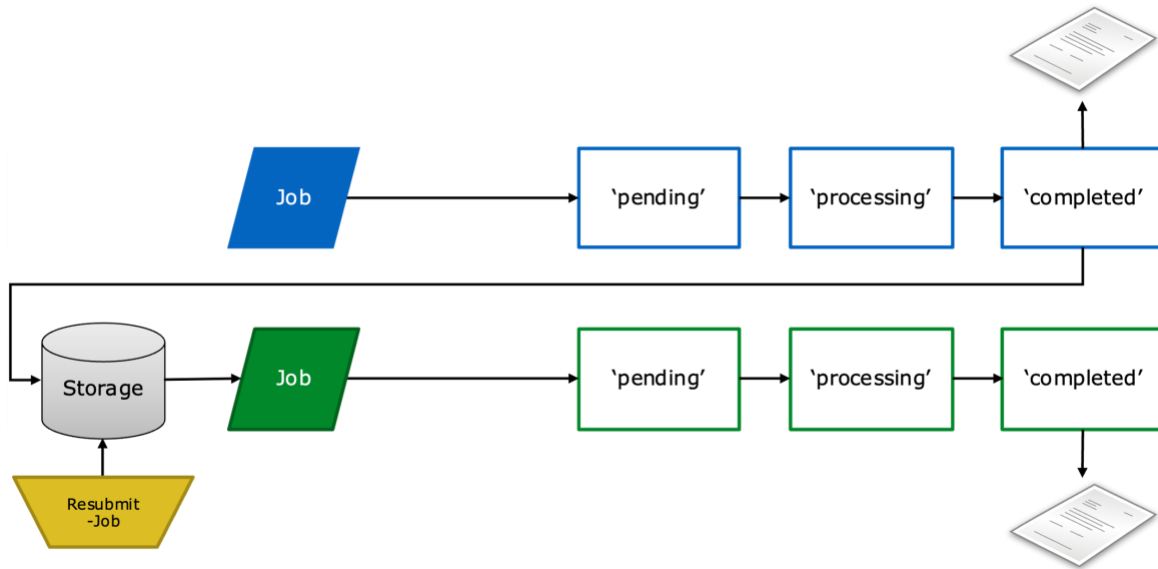
Figure 6 - Job Storage - 'print-and-store'
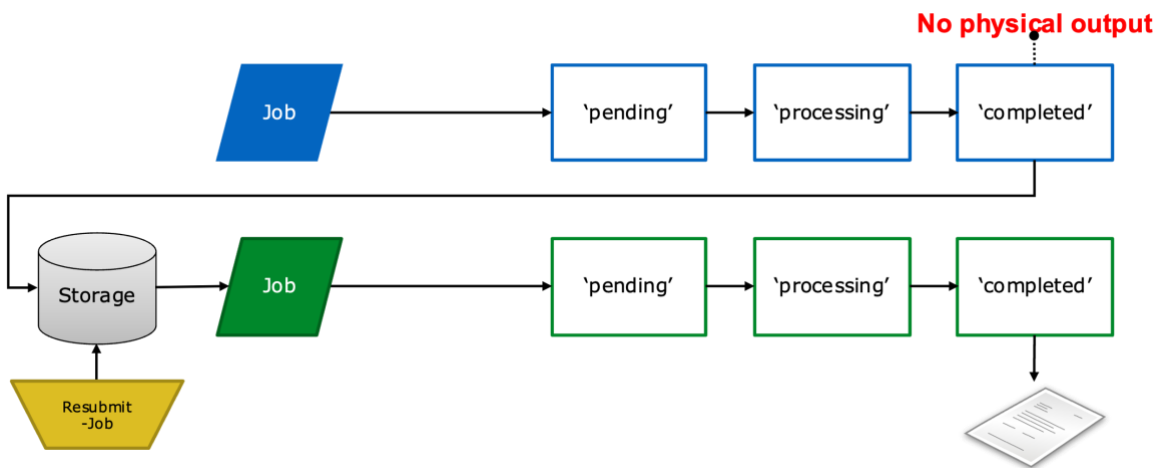
Figure 7 - Job Storage - 'store-only'

4.4.1 Stored Jobs

The Job becomes a Stored Job when it has reached the 'completed' state [STD92], is in the Job Retention phase [STD92], and the Printer has restored the Job's original Documents submitted by the Client before processing. The Job's storage status is indicated by the "job-state-reasons" Job Status attribute [STD92] keywords 'job-stored-successfully', 'job-stored-with-errors', 'job-stored-with-warnings', or 'job-storing' (section 8.2). The Printer retains the Stored Job for an implementation-defined period in the Job Retention Phase (see [STD92] section 5.3.7.2 "Partitioning of Job States"), which is longer than the implementation-defined period used for conventional Jobs. As with other Jobs, the Client can explicitly specify the retention period using the "job-retain-until", "job-retain-until-interval", and "job-retain-until-time" attributes [PWG5100.7].

4.4.2 Find and Evaluate a Stored Job

A Client gets a list of Stored Jobs from the Printer using the Get-Jobs operation [STD92] supplying the "which-jobs" operation attribute with either the 'stored-public', 'stored-group' or 'stored-owner' keyword. A Client can search the Job's "job-state-reasons" Job Status attribute for the 'job-stored-successfully', 'job-stored-with-errors', 'job-stored-with-warnings', or 'job-storing' keywords (section 8.2) to identify a Stored Job and evaluate its disposition.

4.4.3 Print a Copy of a Stored Job

There are two methods defined to print a copy of the Stored Job: using the Resubmit-Job operation [PWG5100.7]; and by direct interaction with the Console.

The Resubmit-Job operation [PWG5100.7] re-processes a copy of any Retained Job with the ability to supply additional operation and Job Template attributes that will affect the processing of that copy of the Job by either overriding the values of existing attributes or providing additional attributes. The Client MUST be prepared for an authentication challenge.

An End User can request the Printer to print a Stored Job using its Console. The details of the user experience and presentation on the Console are beyond the scope of this document.

4.5 Feature Interoperability

Job Release can be used with Job Proof and Suspend, as illustrated in Figure 8.
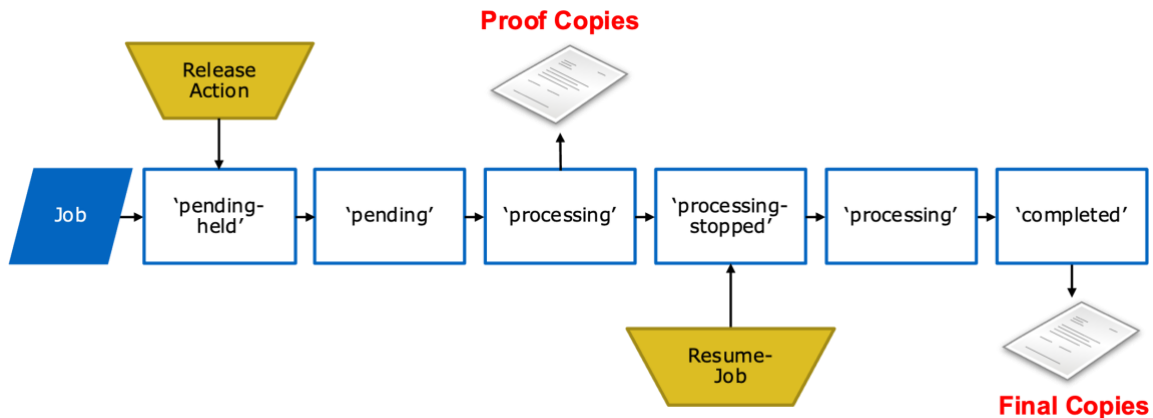
Figure 8 - Job Release with Job Proof and Suspend

Job Release can be used with Job Storage, as illustrated in Figure 9 and Figure 10.
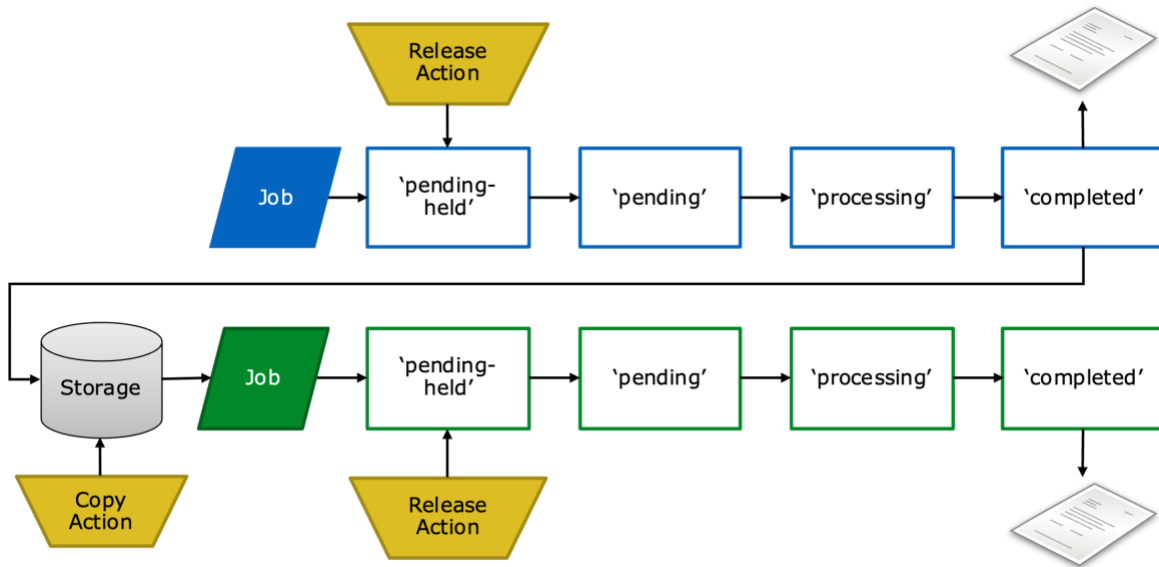
Figure 9 - Job Release with Job Storage - 'print-and-store'
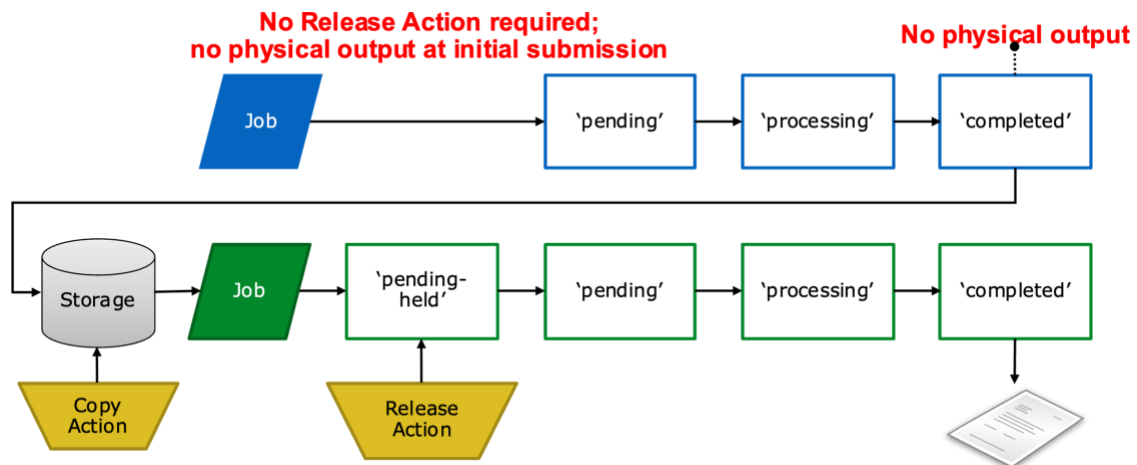
Figure 10 - Job Release with Job Storage - 'store-only'

Job Proof and Suspend can be used with Job Storage, as illustrated in Figure 11.
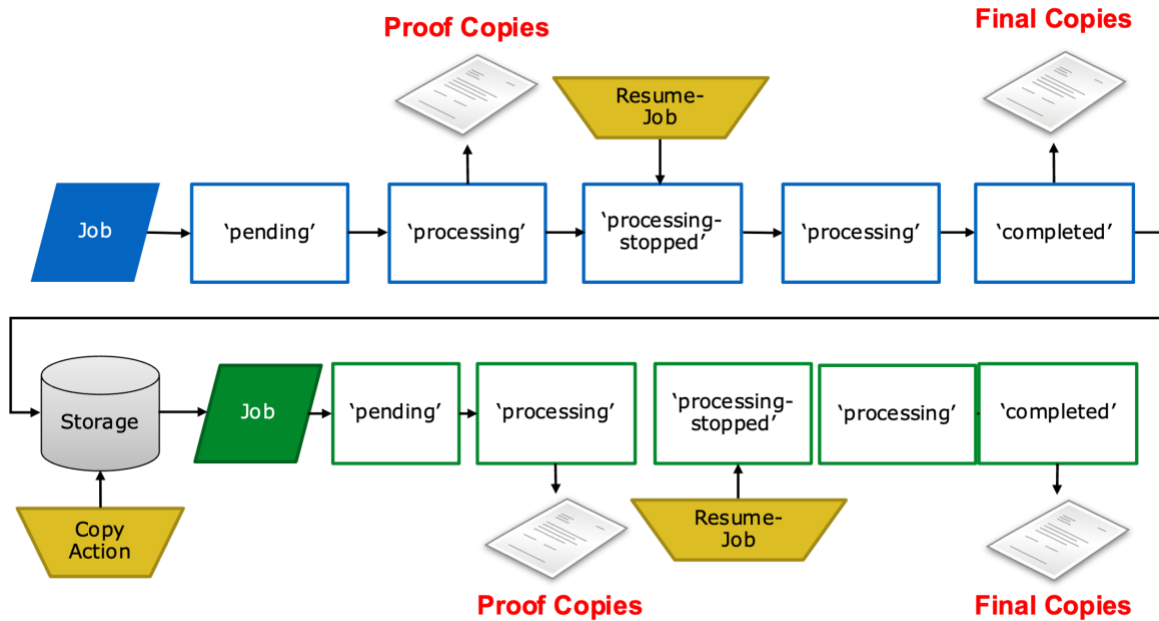
Figure 11 - Job Proof and Suspend with Job Storage - 'print-and-store'

Job Proof and Suspend, Job Release and Job Storage can all be used together, as illustrated in Figure 12.
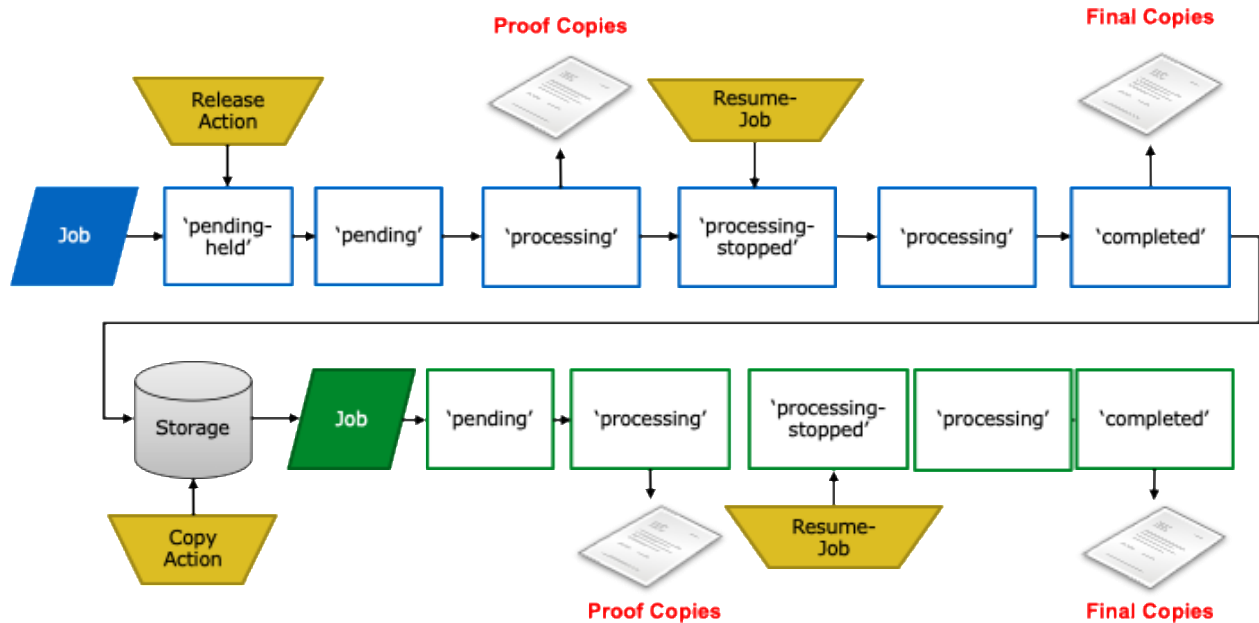
Figure 12 - Job Proof and Suspend, Job Release and Job Storage - 'print-and-store'

4.6 Storage Attributes

The new storage related attributes and values defined in this specification follow the design of the "printer-finisher" and "printer-finisher-description" attributes [PWG5100.1] and the "printer-state-reasons" extensions from the MFD Alerts v1.1 [PWG5107.3]. Two parallel Printer Status attributes - "printer-storage" and "printer-storage-description" - supply the content of the hrStorage elements from the Host Resources MIB [RFC2790] and the lifetime run hours from the S.M.A.R.T. self-test log [INCITS-452], while additional keywords for the "printer-state-reasons" attribute [STD92] provide roll-up status for all storage sub-units.

5. New Operations

5.1 Get-User-Printer-Attributes

This CONDITIONALLY REQUIRED operation is semantically analogous to the Get-Printer-Attributes operation [STD92] but the Printer filters the set of attributes and attribute values in the response based on the Authenticated User. A Printer that supports the Job Print Policy feature (section 4.1) MUST support this attribute.

The Authenticated User performing this operation MUST be either an End User permitted to create Print Jobs or an Operator or Administrator for the Printer. Otherwise, the Printer MUST reject the operation and return the 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' status code, as appropriate. A Client can deduce the authenticated user's role and capabilities by inspecting the value of the "operations-supported" Printer Description attribute, which is filtered according to the user's identity and role.

The Client MUST be prepared to receive and respond to an authentication challenge (e.g., HTTP, TLS) in response to a Get-User-Printer-Attributes request. If the Client initiates the Get-User-Printer-Attributes operation over an HTTP connection without TLS, the Client MUST be prepared to receive an HTTP 426 response to upgrade the connection to TLS [RFC2817][RFC8446]. A Printer MUST send a Get-User-Printer-Attributes response over Secure Transport for authentication methods that require a secure channel, as defined in [STD92]. IPP Authentication Methods v1.0 [PWG5199.10] provides guidance for making and responding to the various types of authentication challenges used with IPP.

A Printer MUST support all the same operation attributes for a Get-User-Printer-Attributes operation that it supports with a Get-Printer-Attributes operation, including those a Client can use to request a filtered response: "document-format" [STD92]; "first-index" [PWG5100.13]; "limit" [PWG5100.13]; "requested-attributes" [STD92]; and any of the attributes named by "printer-get-attributes-supported" [PWG5100.13].

5.1.1 Get-User-Printer-Attributes Request

The following groups of attributes are supplied as part of the Get-User-Printer-Attributes request:

Group 1: Operation Attributes

>"attributes-charset" (charset) and "attributes-natural-language" (naturalLanguage):

>>The Client MUST supply and the Printer MUST support both of these attributes, as described in [STD92] Section 4.1.4.1.

>"printer-uri" (uri):

>>The Client MUST supply and the Printer MUST support this attribute, which specifies the target for this operation, as described in [STD92] Section 4.1.5.

>"requesting-user-name" (name(MAX)):

>>The Client MUST supply and the Printer MUST support this attribute, as described in [STD92] Section 9.3.

>"requesting-user-uri" (uri):

>>The Client SHOULD supply and the Printer MUST support this attribute, as described in [PWG5100.13] section 5.1.6.

>"requesting-user-vcard" (1setOf text(MAX)):

>>The Client SHOULD supply and the Printer MUST support this attribute, as described in [PWG5100.22] section 7.1.6.

>"requested-attributes" (1setOf keyword):

>>The Client SHOULD supply and the Printer MUST support this attribute, as described in [STD92] Section 4.2.5.1.

>"document-format" (mimeMediaType):

>>The Client MAY supply and the Printer MUST support this attribute, as described in [STD92] Section 4.2.5.1.

5.1.2 Get-User-Printer-Attributes Response

The Printer returns the following sets of attributes as part of the Get-User-Printer-Attributes response:

Group 1: Operation Attributes

"attributes-charset" (charset) and "attributes-natural-language" (naturalLanguage):

> The Client MUST support and the Printer MUST supply both of these attributes, as described in [STD92] Section 4.1.4.1.

Status Message:

> In addition to the REQUIRED status-code returned, the response MAY include the "status-message" (text(255)) and/or the "detailed-status-message" (text(MAX)) operation attribute as described in [STD92] Appendix B and Section 4.1.6.

Group 2: Unsupported Attributes

> See [STD92] Section 4.1.7 for details on returning unsupported attributes.

Group 3: Printer Attributes

> This group contains the set of requested attributes and their values for the authenticated user. See [STD92] Section 4.2.5.2 for details.

6. New Attributes

6.1 Operation Attributes

Table 2 lists the operation attributes defined in this specification, each with its corresponding conformance requirements.

Table 2 - New Operation Attributes

Attribute	Printer Conformance
job-password	CONDITIONALLY REQUIRED
job-password-encryption	CONDITIONALLY REQUIRED
job-release-action	CONDITIONALLY REQUIRED
job-storage	CONDITIONALLY REQUIRED

6.1.1 job-password (octetString(255))

This CONDITIONALLY REQUIRED operation attribute specifies a password used to protect the Job. A Printer that supports the Job Password Release Action for the Job Release feature MUST support this attribute. The Printer will only process a Job created with a "job-password" after the Printer has received the matching password value on its Console or via a Release-Job operation (section 7.3).

The Client selects one of the hashing methods listed in the Printer's "job-password-encryption-supported" Printer Description attribute (section 6.4.3) to obfuscate ("encrypt") the User-provided cleartext password value before transmission. When the User enters a password on the Printer's Console, the Printer hashes this password using the method specified by the Job's "job-password-encryption" operation attribute (section 6.1.2) and compares the hashed password value to the "job-password" stored in the Job. If the values match, the Printer releases the Job to processing.

If the Printer's "job-password-repertoire-configured" Printer Description attribute (section 6.4.5) specifies one of the UTF-8 repertoires, the Client and the Printer MUST convert the encoding of the received cleartext password value to Network Unicode UTF-8 encoding [RFC5198] [UAX15] to ensure that matching cleartext password strings entered on Client and Printer will produce matching values when encrypted.

A Client can include this operation attribute in a Job Creation Operation (Print-Job, Print-URI, and Create-Job) request, as per section 7.1, or in a Validate-Job request, as per section 7.7. Security requirements for using this attribute are in section 12.1.

The Printer MUST set the Job's initial state according to the methodology specified in section 4.3. The Printer MUST add the 'job-password-wait' keyword to the Job's "job-state-reasons" attribute at the time the Job is created. When the Printer has received the matching password and the Job is released to processing, the Printer removes the 'job-password-wait' keyword from the Job's "job-state-reasons" attribute to indicate that that condition is no longer preventing processing.

6.1.2 job-password-encryption (type2 keyword)

This CONDITIONALLY REQUIRED operation attribute specifies the hash method the Client used to obfuscate ("encrypt") the value of the "job-password" operation attribute (section 6.1.1) supplied in the same request. A Printer that supports the Job Password Release Action for the Job Release feature MUST support this attribute. A Client supplies this operation attribute whenever it supplies the "job-password" operation attribute.

A Client can include this operation attribute in a Job Creation Operation (Print-Job, Print-URI, and Create-Job) request, as per section 7.1, or in a Validate-Job request, as per section 7.7. Security requirements for using this attribute are in section 12.1.

Note: The original definition of this attribute also included the "name(MAX)" syntax, which is now OBSOLETE.

Table 3 lists the keywords defined by this specification.

Table 3 - "job-password-encryption-supported" Keywords

Keyword	Description
'none'	The "job-password" attribute value is passed in the clear. No cryptographic hashing has been applied.

Keyword	Description
'sha2-224'	The Secure Hash Algorithm 2 [FIPS180-4] [ISO10118-3], with an output size of 224 bits.
'sha2-256'	The Secure Hash Algorithm 2 [FIPS180-4] [ISO10118-3], with an output size of 256 bits.
'sha2-384'	The Secure Hash Algorithm 2 [FIPS180-4] [ISO10118-3], with an output size of 384 bits.
'sha2-512'	The Secure Hash Algorithm 2 [FIPS180-4] [ISO10118-3], with an output size of 512 bits.
'sha2-512_224'	The Secure Hash Algorithm 2 [FIPS180-4] [ISO10118-3], with an output size of 512 bits, truncated to 224 bits.
'sha2-512_256'	The Secure Hash Algorithm 2 [FIPS180-4] [ISO10118-3], with an output size of 512 bits, truncated to 256 bits.
'sha3-224'	The Secure Hash Algorithm 3 [FIPS202] [ISO10118-3], with an output size of 224 bits.
'sha3-256'	The Secure Hash Algorithm 3 [FIPS202] [ISO10118-3], with an output size of 256 bits.
'sha3-384'	The Secure Hash Algorithm 3 [FIPS202] [ISO10118-3], with an output size of 384 bits.
'sha3-512'	The Secure Hash Algorithm 3 [FIPS202] [ISO10118-3], with an output size of 512 bits.
'sha3-512_224'	The Secure Hash Algorithm 3 [FIPS202] [ISO10118-3], with an output size of 512 bits, truncated to 224 bits.
'sha3-512_256'	The Secure Hash Algorithm 3 [FIPS202] [ISO10118-3], with an output size of 512 bits, truncated to 256 bits.
'shake-128'	The SHAKE128 method [FIPS202] [ISO10118-3], with an output size of 128 bits.
'shake-256'	The SHAKE256 method [FIPS202] [ISO10118-3], with an output size of 256 bits.

6.1.3 job-release-action (type2 keyword)

This CONDITIONALLY REQUIRED operation attribute specifies the action that causes the Printer to move the Job to the 'pending' state. Table 4 lists the keywords defined in this specification.

Table 4 - "job-release-action" Keywords

Keyword	Meaning
'none'	The Printer moves the Job at once to the 'pending' state unless other dependencies are unsatisfied.
'button-press'	Pressing a button on the Console releases the Job to the 'pending' state.

'job-password'	Providing a password matching the Job's "job-password" at the Console or via a Release-Job operation releases the Job to the 'pending' state.
'owner-authorized'	Authenticating the Job Owner at the Console or via a Release-Job operation authorizes the Printer to release the Job to the 'pending' state. A Client supplying this keyword is expected to properly handle an authentication challenge.

When the User releases a Release Job, the Printer MUST remove the Job Release indicator keywords from the Job's "job-state-reasons" attribute and MUST move the Job to the 'pending' state if there are no other reasons preventing the Job from being a candidate for processing.

A Printer supporting Job Release MUST support the "job-spooling-supported" Printer Description attribute [PWG5100.7] and MUST support the 'spool' keyword.

Additional semantics and requirements when using the "job-release-action" attribute in a Job Creation request are provided in section 7.8.

6.1.4 job-storage (collection)

This CONDITIONALLY REQUIRED operation attribute is a collection with members specifying how a Printer processes a Job to become a Stored Job and which End Users have access to the Stored Job. A Printer that supports the Job Storage feature (section 4.4) MUST support this attribute.

The Printer copies the "job-storage" attribute received in a Job Creation Operation into the corresponding Job as a Job Status attribute (section 6.3.1). Table 5 lists the "job-storage" member attributes.

Table 5 - "job-storage" Member Attributes

Member Attribute	Printer Conformance
job-storage-access	REQUIRED
job-storage-disposition	REQUIRED
job-storage-group	CONDITIONALLY REQUIRED

A Client can use this attribute with the "job-release-action" attribute (section 6.1.3) to create a Release Job that is also a Stored Job. A Client determines whether a Printer supports Stored Jobs that are also Release Jobs by first finding the 'job-storage' keyword in the Printer's "printer-get-attributes-supported" Printer Description attribute, then sending an empty "job-storage" collection as an operation attribute in a new Get-Printer-Attributes request, and finally detecting that the response contains both the "job-storage-supported" Printer Description attribute (section 6.4.13) and the "job-release-action-supported" Printer Description attribute (section 6.4.9).

Additional semantics and requirements when using the "job-storage" attribute in a Job Creation request are provided in section 7.9.

6.1.4.1 job-storage-access (type2 keyword)

This REQUIRED member attribute specifies the access restrictions on the Stored Job. Table 6 lists the keywords defined in this specification.

Table 6 - "job-storage-access" Keywords

Keyword	Meaning	Conformance Requirements
'group'	Accessible only by members of the group named by the "job-storage-group" member attribute (section 6.1.4.3)	MAY
'owner'	Accessible only by the Job Owner	MUST
'public'	Accessible by all users	MUST

6.1.4.2 job-storage-disposition (type2 keyword)

This REQUIRED member attribute specifies how the Printer processes the Job. Table 7 lists the keywords defined in this specification.

Table 7 - "job-storage-disposition" Keywords

Keyword	Meaning	Conformance Requirements
'print-and-store"	The Printer prints the Job. If the Job reaches the 'completed' state, the Printer retains the Job in the Job Retention phase.	MUST
'store-only'	The Printer does not print the Job. The Printer immediately retains the Job in the Job Retention phase.	MUST

If the Client specifies 'store-only' for this member attribute and specifies operation attributes or Job Template attributes requesting that this Job be a Release Job, a newly created Job MUST be processed immediately to allow it to become a Stored Job, since processing will not produce any physical output.

A Printer MUST reject a Job Creation Operation where the Client supplies both the "proof-print" operation attribute and the "job-storage-disposition" member attribute specifying 'store-only'.

The "job-storage-disposition" member attribute MUST NOT be preserved by the Job as a member of the "job-storage" Job Status attribute (section 6.3.1).

6.1.4.3 job-storage-group (name(MAX))

This CONDITIONALLY REQUIRED member attribute specifies the group that has access to this Stored Job. If the Client supplies the 'group' value for the "job-storage-access" attribute, then the Client MUST also supply this member attribute to specify the group name. The value of this member attribute MUST be one of the values listed by the Printer's "job-storage-group-supported" Printer Description attribute (section 6.4.12).

6.2 Job Template Attributes

Table 8 lists the Job and Document Template attributes defined in this specification, each with its corresponding conformance requirements.

Table 8 - New Job and Document Template Attributes

Attribute	Printer Conformance
job-cancel-after	OPTIONAL
proof-copies	CONDITIONALLY REQUIRED
proof-print	DEPRECATED

6.2.1 job-cancel-after (integer(1:MAX))

This OPTIONAL Job Template attribute specifies the maximum number of seconds the Printer allows for processing the Job. The Printer starts timing the processing when it puts the Job in the 'processing' state. If the Printer moves the Job into the 'processing-stopped' state, it stops the timer. The Printer resumes timing when it moves the Job back into the 'processing' state. If the Printer cancels the Job because of this timer, the Printer MUST add the 'job-canceled-after-timeout' keyword to the "job-state-reasons" Job Status attribute (section 8.2).

6.2.2 proof-copies (integer(1:MAX))

This CONDITIONALLY REQUIRED Job Template attribute specifies the requested number of Proof Copies the Printer produces before suspending the Job's processing. A Printer that supports the conceptual Job Proof and Suspend feature MUST support this attribute. Once the Printer produces the Proof Copies, it suspends the Job by moving it into the 'processing-stopped' state, awaiting approval. If approved, the Printer moves the Job back into the 'processing' state and produces the Final Copies. The value MUST be within the range indicated by the Printer's "proof-copies-supported" Printer Description attribute (section 6.4.17).

If a Client supplies this attribute in a Job Creation Operation, it MUST also supply the "copies" Job Template attribute [STD92]. The Client MUST specify a value for the "proof-copies" attribute that is less than the value for the "copies" attribute. The value of the "copies" attribute is the total number of copies the Printer will produce for the Job, including both Proof Copies and Final Copies. As an example, if "copies" = 14 and "proof-copies" = 2, then initial processing will produce 2 Proof Copies and approval will produce 12 Final Copies.

Note: There is no "proof-copies-default" Printer Description attribute.

6.2.3 proof-print (collection)

This DEPRECATED Job Template attribute specifies the number of "proof" copies to produce and any of the attributes the Printer names in its "proof-print-supported" Printer Description attribute (section 6.4.20). A Printer that supports the Job Proof Print feature MUST support this attribute.

When printing the proof copies, the Printer prioritizes the Job member attributes in the "proof-print" collection over the other Job Template attributes, to allow for special processing for the proof copies. After the proof prints have been produced, the Printer MUST retain the completed Job as a Proof Job to allow the proof prints to be reviewed. This retention period SHOULD be longer than the period for ordinary completed Jobs [STD92]. The implementation-defined period can be overridden using the "job-retain-until", "job-retain-until-interval", or "job-retain-until-time" attribute [PWG5100.7].

When a Proof Job is concluded, using any of the operations that reprint a Retained Job (e.g., Reprocess-Job or Resubmit-Job), the Printer MUST remove the "proof-print" attribute from the copy of the Proof Job so that the Job is not proofed again. Only if the Resubmit-Job operation supplies its own "proof-print" attribute, will the copied Job be re-proofed.

Table 9 lists the member attributes of the "proof-print" collection attribute.

Table 9 - "proof-print" Member Attributes

Member Attribute Name	Client Request	Printer Conformance
proof-print-copies	MUST	MUST
media	MUST include one or the other, but MUST NOT include both	MUST
media-col		MAY
{Any attributes listed in "proof-print-supported" (6.4.20)}	MAY	MAY

6.2.3.1 proof-print-copies (integer (0:MAX))

This REQUIRED member attribute specifies the number of proof copies the Printer produces when the Job is processed. The range of allowed values is reported by the Printer's "proof-print-copies-supported" Printer Description attributes (section 6.4.16). This number is separate from the "copies" Job Template attribute. A Proof Job where "proof-print-copies" is 4 and "copies" is 10 will ultimately produce 14 copies.

If the "proof-print-copies" value is 0 (zero), then no proof prints are produced. There are legacy environments that provide a simple short-lived "job storage" feature using Proof Print using this [PWG5100.11-2010], but the preferred method for doing "job-storage" is using the Job Storage feature described in section 4.4.

6.2.3.2 media (type2 keyword | name(MAX)) or media-col (collection)

These CONDITIONALLY REQUIRED member attributes specifies the media the Printer MUST use for the specified "proof-print-copies" of the Proof Job. These member attributes are identical to the "media" [STD92] or the "media-col" [PWG5100.7] Job Template attributes. The Client MUST supply either the "media" or the "media-col" member attribute but MUST NOT supply both. If a Printer receives a Job Creation request that includes neither or both in a "proof-print" Job Template attribute, the Printer MUST either reject the request and return the 'client-error-bad-request' status code [STD92], or accept the request and use the "media" or "media-col" member attribute, independent of the value of the "ipp-attribute-fidelity" attribute [STD92] supplied by the Client, depending on implementation.

6.3 Job Status Attributes

Table 8 lists the Job Status attributes defined in this specification, each with its corresponding conformance requirements.

Table 10 - New Job Status Attributes

Attribute	Printer Conformance
job-release-action	CONDITIONALLY REQUIRED
job-storage	CONDITIONALLY REQUIRED
parent-job-id	CONDITIONALLY REQUIRED
parent-job-uuid	CONDITIONALLY REQUIRED

6.3.1 job-release-action (type2 keyword)

This CONDITIONALLY REQUIRED Job Status attribute contains the Job's Release Action as configured by the Client using the "job-release-action" operation attribute (section 6.1.3). The Printer releases the Job to the 'processing' state only after the Printer has received the specified action.

This Job Status attribute MUST be preserved with the Job until the Job's Document Content is removed (e.g. not before the Job has entered the Job History phase [STD92]). If the Release Job is copied, as in the case of reprinting a Stored Job or completing a Proof Job, this Job Status attribute and value MUST be included in the new copy to preserve Job protection.

6.3.2 job-storage (collection)

This CONDITIONALLY REQUIRED Job Status attribute contains a complete copy of the "job-storage" operation attribute (section 6.1.3) provided in the Job Creation operation, including all its members. If the Printer supports the "job-storage" operation attribute, then it MUST support this attribute.

When a Printer copies a Stored Job, it MUST NOT include this attribute in the new copy.

6.3.3 parent-job-id (integer(1:MAX))

This CONDITIONALLY REQUIRED Job Status attribute contains the "job-id" [STD92] of the Job that was copied to create this Job. A Printer that supports the Resubmit-Job operation [PWG5100.7] MUST support this attribute.

6.3.4 parent-job-uuid (uri(45))

This CONDITIONALLY REQUIRED Job Status attribute contains the "job-uuid" [PWG5100.13] of the Job that was copied to create this Job. A Printer that supports the Resubmit-Job operation [PWG5100.7] MUST support this attribute.

6.4 Printer Description Attributes

Table 11 lists the Printer Description attributes defined in this specification, each with its corresponding conformance requirement.

Table 11 - New Printer Description Attributes

Attribute	Printer Conformance
job-cancel-after-default	CONDITIONALLY REQUIRED
job-cancel-after-supported	CONDITIONALLY REQUIRED
job-password-encryption-supported	CONDITIONALLY REQUIRED
job-password-length-supported	CONDITIONALLY REQUIRED
job-password-repertoire-configured	CONDITIONALLY REQUIRED
job-password-repertoire-supported	CONDITIONALLY REQUIRED
job-password-supported	CONDITIONALLY REQUIRED
job-release-action-default	CONDITIONALLY REQUIRED
job-release-action-supported	CONDITIONALLY REQUIRED
job-storage-access-supported	CONDITIONALLY REQUIRED
job-storage-disposition-supported	CONDITIONALLY REQUIRED
job-storage-group-supported	CONDITIONALLY REQUIRED

Attribute	Printer Conformance
job-storage-supported	CONDITIONALLY REQUIRED
printer-asset-tag	RECOMMENDED
printer-detailed-status-messages	OPTIONAL
printer-service-contact-col	REQUIRED
proof-copies-supported	CONDITIONALLY REQUIRED
proof-print-copies-supported	DEPRECATED
proof-print-default	DEPRECATED
proof-print-supported	DEPRECATED

6.4.1 job-cancel-after-default (integer(1:MAX) | no-value)

This CONDITIONALLY REQUIRED Printer Description attribute provides the default value for the "job-cancel-after" Job Template attribute (section 6.2.1). A Printer that supports the "job-cancel-after" attribute MUST support this attribute.

6.4.2 job-cancel-after-supported (rangeOfInteger(1:MAX))

This CONDITIONALLY REQUIRED Printer Description attribute lists the range of values the Printer supports for the "job-cancel-after" Job Template attribute (section 6.2.1). A Printer that supports the "job-cancel-after" attribute MUST support this attribute.

6.4.3 job-password-encryption-supported (1setOf type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute lists the cryptographic hashes the Printer supports for the "job-password-encryption" operation attribute (section 6.1.2). A Printer that supports the "job-password-encryption" attribute MUST support this attribute. A Printer that supports the Job Password Release Action for the Job Release feature MUST support this attribute.

Note: The original definition of this attribute also included the "name(MAX)" syntax option in its syntax definition, but as site-local or vendor-unique hashing algorithms were never used and are of little value, that syntax is now OBSOLETE.

6.4.4 job-password-length-supported (rangeOfInteger (4:1020))

This CONDITIONALLY REQUIRED Printer Description attribute lists the minimum and maximum number of characters the Printer supports for the unencrypted job password string. A Printer that supports the "job-password" operation attribute (section 6.1.1) MUST support this attribute. A Printer that supports the Job Password Release Action for the Job Release feature MUST support this attribute.

The length of a character in octets varies with the character set used in the currently configured password repertoire (section 6.4.5). For some character sets (e.g. UTF-8) with variable length encodings, the maximum length should be considered. This attribute complements the "job-password-supported" Printer Description attribute (section 6.4.7), which specifies the maximum password length supported before encryption, measured in octets.

6.4.5 job-password-repertoire-configured (type2 keyword | unknown)

This CONDITIONALLY REQUIRED Printer Description attribute contains the Printer's currently configured password repertoire. A Printer that supports the "job-password" operation attribute (section 6.1.1) MUST support this attribute. A Printer that supports the Job Password Release Action for the Job Release feature MUST support this attribute. The value of this attribute MUST be one of the values specified in the Printer's "job-password-repertoire-supported" attribute (section 6.4.5).

6.4.6 job-password-repertoire-supported (1setOf type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute lists the password repertoires (allowable characters, character sets and encodings) the Printer is configured to use by its Operator. A Printer that supports the "job-password" operation attribute (section 6.1.1) MUST support this attribute. A Printer that supports the Job Password Release Action for the Job Release feature MUST support this attribute.

A printing Client uses the "job-password-repertoire-configured" attribute (section 6.4.5) to get the Printer's currently configured Job password repertoire. A management Client uses the Set-Printer-Attributes operation [RFC3380] to configure the site-allowed list as well as the currently configured Job password repertoire.

The keywords follow a 'REGISTRY_ENCODING_RANGE' naming structure. Vendors MAY implement their own repertoire keywords, prefixed with "vendor_". Vendors SHOULD register their vendor repertoire keywords with the PWG to achieve interoperability. For example, a vendor could choose to register the 'vendor_us-ascii_lowercase' keyword to specify a repertoire limited to using only lowercase characters from the US ASCII encoding.

Table 12 lists the keywords defined in this specification. The "utf-8" encoding element in this context means Network Unicode [RFC5198].

Table 12 – "job-password-repertoire-supported" Keywords

Keyword	Description
'iana_us-ascii_digits'	US ASCII digits (0x30-0x39)
'iana_us-ascii_letters'	US ASCII letters (0x41-0x5A, 0x61-0x7A)
'iana_us-ascii_complex'	US ASCII letters and numbers, with at least one uppercase letter, one lowercase letter, and one digit (0x30-0x39, 0x41-0x5A, 0x61-0x7A)

'iana_us-ascii_any'	US ASCII printable characters (0x20-0x7e)
'iana_utf-8_digits'	UTF-8 numerical digits
'iana_utf-8_letters'	UTF-8 letters
'iana_utf-8_any'	UTF-8 printable characters

6.4.7 job-password-supported (integer(0:255))

This CONDITIONALLY REQUIRED Printer Description attribute contains the maximum unencrypted password length the Printer supports for the "job-password" operation attribute (section 6.1.1), measured in octets. A Printer that supports the "job-password" attribute MUST support this attribute. A Printer that supports the Job Password Release Action for the Job Release feature MUST support this attribute.

A Printer provides '0' (zero) for this attribute if "job-password" is supported but administratively disabled. The value is equal to or greater than the upper range value provided by the "job-password-length-supported" attribute (section 6.4.4). This attribute is provided for backward compatibility.

A conforming Printer MUST be able to accept 255 octets without truncation. However, a Printer MAY serve as a Logical Device for another print system that can only accept shorter passwords.

6.4.8 job-release-action-default (type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute contains the default value for the "job-release-action" operation attribute (section 6.1.3). A Printer that supports the "job-release-action" attribute MUST support this attribute. A Printer MUST NOT supply the 'job-password' keyword for this attribute.

6.4.9 job-release-action-supported (1setOf type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute lists the keywords the Printer will accept for the 'job-release-action' operation attribute (section 6.1.3).

6.4.10 job-storage-access-supported (1setOf type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute lists the keywords the Printer will accept for the "job-storage-access" member of the "job-storage" operation attribute (section 6.1.4.1). A Printer that supports Job Storage MUST support this attribute. Table 6 lists the keywords defined by this specification.

6.4.11 job-storage-disposition-supported (1setOf type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute lists the keywords the Printer will accept for the "job-storage-disposition" member of the "job-storage" operation attribute (section 6.1.4.2). A Printer that supports Job Storage MUST support this attribute. Table 7 lists the keywords defined by this specification.

6.4.12 job-storage-group-supported (1setOf name(MAX))

This CONDITIONALLY REQUIRED Printer Description attribute lists the group names the Printer will accept for the "job-storage-group" member of the "job-storage" operation attribute (section 6.1.4.3). A Printer that supports Job Storage and that includes the 'group' keyword in its "job-storage-access-supported" Printer Description attribute (section 6.4.8) MUST support this attribute. The values provided by this attribute MAY vary based on the identity of the most authenticated user (see [STD92] RFC 8011 section 9.3).

6.4.13 job-storage-supported (1setOf keyword)

This CONDITIONALLY REQUIRED Printer Description attribute lists the Printer's supported member attributes for the "job-storage" operation attribute (section 6.1.4). A Printer that supports Job Storage MUST support this attribute.

6.4.14 printer-asset-tag (octetString(MAX))

This RECOMMENDED Printer Description attribute contains the site-specific asset tag or identifier value.

6.4.15 printer-detailed-status-messages (1setOf text(MAX))

This OPTIONAL Printer Description attribute lists human-readable status messages providing detailed technical information about the Printer such as fault and warning messages, in the same way "job-detailed-status-messages" [STD92] provides additional information about a Job. The Printer SHOULD localize the messages listed by this attribute, unless such localization would obscure the technical meaning of the message.

6.4.16 printer-service-contact-col (collection | unknown)

This REQUIRED Printer Description attribute contains contact information for the service agent responsible for maintaining the Printer, or the 'unknown' out-of-band value if no service agent contact information has been configured. Table 13 lists the member attributes defined in this specification. A Printer MUST support the "contact-name" and "contact-uri" member attributes.

A Printer receiving this attribute in a Set-Printer-Attributes operation [RFC3380] replaces the entire existing value with the one received if the Printer accepted the operation. A Printer receiving this attribute in a Set-Printer-Attributes operation where the collection lacks all the REQUIRED members MUST reject the request and return the 'client-error-bad-request' status code.

Table 13 – "printer-service-contact-col" Member Attributes

Member Attribute	Printer Conformance
contact-name (name(MAX))	REQUIRED
contact-uri (uri)	REQUIRED

Member Attribute	Printer Conformance
contact-vcard (1setOf text(MAX))	RECOMMENDED

6.4.16.1 contact-name (name(MAX))

This REQUIRED member attribute contains the contact's name, e.g., 'Alex Doe'.

6.4.16.2 contact-uri (uri)

This REQUIRED member attribute contains a URI that can be used for contacting the Printer service agent, e.g., 'mailto:adoe@example.com' or 'tel:+1-000-555-1212'.

6.4.16.3 contact-vcard (1setOf text(MAX))

This RECOMMENDED member attribute contains the contact vCard [RFC6350]. The content of all text(MAX) listed by this attribute is concatenated together to get the complete vCard. Figure 13 illustrates using PAPI encoding [PAPI] a "contact-vcard" member attribute with each line conveyed in its own text(MAX) (PHOTO value truncated for brevity).

Figure 13 - Example "contact-vcard" member attribute

```
contact-vcard =
  "BEGIN:VCARD\r\n",
  "VERSION:4.0\r\n",
  "UID:urn:uuid:85a872f4-6635-4b56-9a38-26d76566e9c6\r\n",
  "KIND:individual\r\n",
  "FN;PID=1.1:Alex Doe\r\n",
  "N:Doe;Alex;;;\r\n",
  "ORG:Example Corp\r\n",
  "TITLE:IT Support Specialist\r\n",
  "EMAIL;PID=1.1:adoe@example.com\r\n",
  "TEL;VALUE=uri;TYPE=work:tel:+1-000-555-1212\r\n",
  "PHOTO:data:image/jpeg;base64,...\r\n",
  "END:VCARD\r\n"
```

6.4.17 proof-copies-supported (rangeOfInteger(1:MAX))

This CONDITIONALLY REQUIRED Printer Description attribute indicates the range of values the Printer will accept for the "proof-copies" Job Template attribute (section 6.2.2). A Printer that supports Job Proof and Suspend MUST support this attribute. If a Printer supports this attribute, it MUST also support the "job-spooling-supported" Printer Description attribute [PWG5100.7] and that attribute MUST list the 'spooling' keyword.

6.4.18 proof-print-copies-supported (rangeOfInteger(0:MAX))

This DEPRECATED Printer Description attribute indicates the range of values the Printer supports for the "proof-print-copies" member attribute (section 6.2.3.1).

6.4.19 proof-print-default (collection)

This DEPRECATED Printer Description attribute provides the default value the Printer will use for the "proof-print" Job Template attribute (section 6.2.3). A Printer SHOULD NOT implement this attribute.

6.4.20 proof-print-supported (1setOf keyword)

This DEPRECATED Printer Description attribute lists the Job Template attributes the Printer supports as members of a "proof-print" Job Template attribute (section 6.2.2).

6.5 Printer Status Attributes

Table 8 lists the Job Status attributes defined in this specification, each with its corresponding conformance requirements.

Table 14 - New Job Status Attributes

Attribute	Printer Conformance
printer-serial-number	REQUIRED
printer-storage	REQUIRED
printer-storage-description	REQUIRED

6.5.1 printer-serial-number (text(255))

This REQUIRED Printer Status attribute contains the Printer's unique serial number value, which could be an alphanumeric value.

6.5.2 printer-storage (1setOf octetString(MAX))

This REQUIRED attribute lists the storage sub-units associated with the Printer. Each value consists of a series of unordered key/value pairs that are structured according to the ABNF [STD68] [EPX-ABNF] defined in Figure 14. Table 15 lists the keywords defined in this specification.

A Printer MUST encode the values of "printer-storage" using printable characters from the Net-ASCII subset of the US-ASCII character set [RFC5198].

This attribute MUST have the same cardinality (supply the same number of values) as the "printer-storage-description" (section 6.5.3) attribute. The ith value in the "printer-storage" attribute corresponds to the ith value in the "printer-storage-description" attribute.

Table 15 - Keywords for "printer-storage"

Host Resources MIB Element	IPP Data Type	IPP Keyword	Conformance
hrStorageTable			
hrStorageType	String	type	REQUIRED

hrStorageAllocationUnits	Integer	units	REQUIRED
hrStorageSize	Integer	size	REQUIRED
hrStorageUsed	Integer	used	REQUIRED
hrStorageAllocationFailures	Integer	failures	RECOMMENDED
N/A (note 1)	Integer	hours	RECOMMENDED

14. Note 1: The Host Resources MIB [RFC2790] does not provide a value for the number of power-on hours for a storage device. This value can be obtained from the S.M.A.R.T. self-test log [INCITS-452] provided by many storage devices.

Figure 14 - ABNF for "printer-storage" Values

```
printer-storage  = 1*storage-required *storage-optional *storage-ext
storage-required = storage-type / storage-units / storage-size /
                   storage-used
storage-optional = storage-failures / storage-hours
storage-ext      = storage-extname "=" storage-extvalue ";"
storage-extname  = 1*[ALPHA / DIGIT / "-"]
storage-extvalue = 1*[ALPHA / DIGIT / "-" / "." / ","]
storage-failures = "failures=" 1*DIGIT ";"
storage-hours    = "hours=" 1*DIGIT ";"
storage-size     = "size=" 1*DIGIT ";"
storage-type     = "type=" 1*[ALPHA / DIGIT / "-"] ";"
storage-units    = "units=" 1*DIGIT ";"
storage-used     = "used=" 1*DIGIT ";"
```

6.5.3 printer-storage-description (1setOf text(MAX))

This REQUIRED attribute provides a description of each storage sub-unit associated with the Printer.

When the descriptions are mapped from the hrStorageDescription element [RFC2790], they MUST be mapped using the following process:

15. The value of hrStorageDescription is converted from the character set specified by prtGeneralCurrentLocalization and prtLocalizationCharacterSet [RFC3805] to the character set specified by the "charset-configured" Printer Description attribute [STD92]; and

16. The new "printer-storage-description" value is tagged with the natural language specified by prtGeneralCurrentLocalization, prtLocalizationLanguage, and prtLocalizationCountry [RFC3805] unless the natural language matches the language to be used in the response as indicated by the "attributes-natural-language" operation attribute [STD92].

This attribute MUST have the same cardinality (supply the same number of values) as the "printer-storage" attribute (section 6.5.2). The ith value in the "printer-storage-description" attribute corresponds to the ith value in the "printer-storage " attribute.

7. Additional Semantics for Existing Operations

7.1 Create-Job, Print-Job, and Print-URI Operations: "job-password" and "job-password-encryption"

This specification extends the Job Creation operations (Create-Job, Print-Job, and Print-URI) [STD92] to allow a Client to include the "job-password" (section 6.1.1) and "job-password-encryption" operation attributes (section 6.1.2). These operation attributes are used to protect the Job by preventing the Printer from processing it until a matching password has been entered in the Printer's Console or submitted via a Release-Job operation (section 7.3).

A Client always use Secure Transport when supplying the "job-password" attribute in a Job Creation request when the "job-password-encryption" attribute specifies the value 'none'. If a Printer receives a Job Creation request over a connection that is not Secure Transport that includes the "job-password-encryption" operation attribute specifying 'none', then the Printer MUST reject the request and return the 'client-error-bad-request' status code.

If a Printer supports the "job-password" and "job-password-encryption" operation attributes, then the Printer MUST implement the security considerations in section 12.1.

If a Printer supports the "job-password" and "job-password-encryption" operation attributes in a Job Creation request, then the Printer MUST validate the values supplied. If the Printer does not support the values or the values are invalid, then the Printer MUST reject the request by returning the 'client-error-bad-request' status code.

If the "job-password" attribute is not supported, its syntax is invalid, or its value is not supported, then the Printer MUST return the "job-password" attribute in the Unsupported Attributes group specifying the 'unsupported' out-of-band value [STD92].

If the "job-password-encryption" attribute is invalid or its value is not supported, then the Printer MUST return the "job-password-encryption" attribute in the Unsupported Attributes group, specifying either the value supplied in the request or the 'unsupported' out-of-band value.

7.2 Get-Jobs Operation: "job-storage-group"

This specification extends the Get-Jobs operation to allow a Client to request a list of Jobs in a specific storage group. When a Client supplies the 'stored-group' keyword (section 8.4) for the "which-jobs" attribute in a Get-Jobs request, the Client also supplies a "job-storage-group" attribute, specifying one of the groups listed by the Printer's "job-storage-group-supported" Printer Description attribute (section 6.4.12).

If a Printer receives a Get-Jobs operation request, and the request supplies the "which-jobs" operation attribute with a value 'stored-group', but does not supply a "job-storage-group" attribute, then the Printer MUST reject the request and return the 'client-error-bad-request' status code [STD92].

If a Printer receives a Get-Jobs operation request, and the request supplies the "which-jobs" operation attribute with a value 'stored-group' and supplies a "job-storage-group" attribute but its value is not one of the groups listed by the Printer's "job-storage-group-supported" Printer Description attribute, then the Printer MUST reject the request and return the 'client-error-unsupported-attributes-or-values' status code with the "job-storage-group" attribute and value in the response's Unsupported Attributes group [STD92].

7.3 Release-Job: "job-password" and "job-password-encryption"

This specification extends the Release-Job operation [STD92] to allow a Client to include the "job-password" operation attribute (section 6.1.1) and the "job-password-encryption" operation attribute (section 6.1.2) to release the Job to processing if the supplied password matches the one supplied in the Job Creation operation (section 7.1).

A Client always use Secure Transport when supplying the "job-password" attribute in a Release-Job request when the "job-password-encryption" attribute specifies the value 'none'. If a Printer receives a Release-Job request that includes the "job-password-encryption" operation attribute specifying 'none' over a connection that is not Secure Transport, then the Printer MUST reject the request and return the 'client-error-bad-request' status code.

If a Printer supports the "job-password" and "job-password-encryption" operation attributes, then the Printer MUST implement the security considerations in section 12.1.

If a Printer supports the "job-password" and "job-password-encryption" operation attributes in a Job Creation request, then the Printer MUST validate the values supplied. If the Printer does not support the values or the values are invalid, then the Printer MUST reject the request by returning the 'client-error-bad-request' status code.

If the "job-password" attribute is not supported, its syntax is invalid, or its value is not supported, then the Printer MUST return the "job-password" attribute in the Unsupported Attributes group specifying the 'unsupported' out-of-band value [STD92].

If the "job-password-encryption" attribute is invalid or its value is not supported, then the Printer MUST return the "job-password-encryption" attribute in the Unsupported Attributes group, specifying either the value supplied in the request or the 'unsupported' out-of-band value.

7.4 Resubmit-Job and Reprocess-Job Operations: Stored Jobs

If the Printer supports both the Job Storage feature (section 4.4) and the Resubmit-Job operation [PWG5100.7] or the Reprocess-Job operation [RFC3998], then the Printer MUST support the supported operation or operations with a Stored Job and MUST remove the "job-storage" Job Template attribute from the copied Job.

7.5 Resubmit-Job Operation: "job-storage"

If the Printer supports both the Job Storage feature (section 4.4) and the Resubmit-Job operation [PWG5100.7], then the Printer MUST reject any Resubmit-Job operation that includes a "job-storage" Job Template attribute and return a "client-error-attributes-or-values-not-supported" operation status code.

7.6 Resubmit-Job and Reprocess-Job Operations: "parent-job-id" and "parent-job-uuid"

If a Printer copies a Job in response to a Resubmit-Job [PWG5100.7] or a Reprocess-Job operation [RFC3998], then the Printer MUST add the "parent-job-id" (section 6.3.3) and "parent-job-uuid" (section 6.3.4) Job Status attributes to the new Job.

7.7 Validate-Job Operation: "job-password" and "job-password-encryption"

This specification extends the Validate-Job operation [STD92] to allow a Client to include the "job-password" (section 6.1.1) and "job-password-encryption" (section 6.1.2) operation attributes. These operation attributes are used with a Validate-Job operation to request the Printer to confirm that the values supplied are supported before submitting them in a Job Creation request.

If a Printer supports the "job-password" and "job-password-encryption" operation attributes in a Job Creation request, then the Printer MUST support these attributes in a Validate-Job request, and MUST validate the values supplied. If the Printer does not support the values or the values are invalid, then the Printer MUST reject the request by returning the 'client-error-bad-request' status code.

A Client always use Secure Transport when supplying the "job-password" attribute in a Validate-Job request when the "job-password-encryption" attribute specifies the value 'none'. If a Printer receives a Validate-Job request over a connection that is not Secure Transport that includes the "job-password-encryption" operation attribute specifying 'none', then the Printer MUST reject the request and return the 'client-error-bad-request' status code.

If the "job-password-encryption" attribute specifies a value of 'none', then the Printer validates the length and repertoire of the "job-password" value. Otherwise, the Printer validates the length of the string is correct for the hashing method specified by the "job-password-encryption" attribute. A Printer MUST discard these attributes and values along with the rest of the values as per the semantics of the Validate-Job operation. A Printer MUST NOT return the "job-password" attribute in a Validate-Job response

If a Printer supports the "job-password" and "job-password-encryption" operation attributes, then the Printer MUST implement the security considerations in section 12.1.

If the Printer rejects a request because the "job-password" attribute is invalid or its value is not supported, then the Printer MUST return the "job-password" attribute in the Unsupported Attributes group specifying the 'unsupported' out-of-band value [STD92].

If the Printer rejects a request because the "job-password-encryption" attribute is invalid or its value is not supported, then the Printer MAY return the "job-password-encryption" attribute in the Unsupported Attributes group specifying either the value supplied in the request or the 'unsupported' out-of-band value.

Note: Printers conforming to [PWG5100.11-2010] can reject a Validate-Job request and return the 'client-error-bad-request' status code when the Validate-Job request includes the "job-password" and/or "job-password-encryption" operation attributes, as this was previously disallowed.

7.8 Validate-Job, Create-Job, Print-Job, and Print-URI Operations: "job-release-action"

This specification extends the Validate-Job operation and Job Creation operations (Create-Job, Print-Job, Print-URI) to allow a Client to request that the Job to be created is a Release Job by supplying the "job-release-action" operation attribute (section 6.1.3).

If a Client supplies the "job-release-action" attribute specifying the 'job-password' keyword, then the Client also supplies the "job-password" (section 6.1.1) and "job-password-encryption" (section 6.1.2) operation attributes. If a Printer receives an operation that includes the "job-release-action" attribute supplying the 'job-password' keyword but lacks "job-password" and/or "job-password-encryption", then the Printer MUST reject the request.

If a Client supplies the "job-release-action" attribute specifying either the 'button-press' or 'owner-authorized' keywords, then the Client does not supply the "job-password" or "job-password-encryption" operation attributes. If a Printer receives a request supplying "job-release-action" attribute specifying 'button-press' or 'owner-authorized', and also supplying "job-password" and/or "job-password-encryption", then the Printer MUST reject the request.

If a Printer accepts a Job Creation operation request including a "job-release-action" operation attribute and creates a new Release Job, then the Printer MUST set the new Job's "job-state" [STD92] to 'pending-held' to await release. The Printer MUST add keywords to the Job's "job-state-reasons" (section 8.2) corresponding to the release action. However, if the Release Job is also a Stored Job with "job-storage-disposition" specifying 'store-only' (section 6.1.4.2), then the Printer can set the Job's "job-state" to 'pending' if no other reasons prevent it from being a candidate for processing.

Note: A Printer can move the Job immediately from the 'pending' state to the 'processing' state [STD92].

7.9 Validate-Job, Create-Job, Print-Job, and Print-URI Operations: "job-storage"

This specification extends the Validate-Job, Create-Job, Print-Job, and Print-URI operations to allow a Client to request that the Job to be created is a Stored Job by supplying the "job-storage" operation attribute (section 6.1.3). If a Printer receives a "job-storage" operation attribute and any members or values are invalid or not supported, then the Printer MUST reject the request, return the 'client-error-attributes-or-values-not-supported' status code and include the "job-storage" attribute in the Unsupported Attributes group [STD92].

8. Additional Values and Semantics for Existing IPP Attributes

This section defines new values for existing attributes defined in other specifications.

8.1 ipp-features-supported (1setOf type2 keyword)

This specification defines new keyword values for the "ipp-features-supported" Printer Description attribute [PWG5100.13] to enable the Printer to indicate its support for one or more of the conceptual features defined in section 4. Table 16 lists the new keywords defined in this specification.

Table 16 – New "ipp-features-supported" Keywords

Keyword	Conformance Requirement
'job-release'	CONDITIONALLY REQUIRED for Printers that support the conceptual Job Release feature
'job-storage'	CONDITIONALLY REQUIRED for Printers that support the conceptual Job Storage feature
'print-policy'	CONDITIONALLY REQUIRED for Printers that support the conceptual Job Print Policy feature

| 'proof-and-suspend' | CONDITIONALLY REQUIRED for Printers that support the conceptual Job Proof and Suspend feature |
| 'proof-print' | CONDITIONALLY REQUIRED for Printers that support the conceptual Job Proof Print feature |

8.2 job-state-reasons (1setOf type2 keyword) Job Description attribute

This specification defines new keywords for the "job-state-reasons" attribute [STD92] to support the Job Release feature (section 4.3), the Job Storage feature (section 4.4), and the Job Proof Print feature (section 4.2), as well as other keywords to report additional conditions. Table 17 lists the new keywords defined in this specification.

Table 17 – New "job-state-reasons" Keywords

Keyword	Description and Conformance Requirements
'conflicting-attributes'	The Job contains Job Template or Document Template attributes with conflicting values. Although certain conflicts detected at submission time prevent Job Creation, those reported in cases of fan-out [STD92] might not cause a Job to be aborted. REQUIRED
'job-canceled-after-timeout'	The Printer canceled the Job because the time span specified by the "job-cancel-after" Job Template attribute elapsed before the Job could be processed. CONDITIONALLY REQUIRED [1]
'job-held-for-authorization'	The Printer is holding the Job in the 'pending-held' state until the Printer receives authenticated authorization to release it to processing. CONDITIONALLY REQUIRED [4]
'job-held-for-button-press'	The Printer is holding the Job in the 'pending-held' state until the Printer receives a button press or similar physical input to release it to processing. CONDITIONALLY REQUIRED [3]
'job-held-for-release'	The Printer is holding the Job awaiting a Release Action to release it to processing. CONDITIONALLY REQUIRED [2] or [3] or [4]

Keyword	Description and Conformance Requirements
'job-password-wait'	The Printer is holding the Job in the 'pending-held' state until the Printer receives a password value that matches the Job's "job-password" value to release it to processing. CONDITIONALLY REQUIRED [2]
'job-printed-successfully'	The Job was successfully printed but was not successfully stored as indicated by 'job-stored-with-warnings' or 'job-stored-with-errors'. If the Job was not requested to be stored, the Printer uses the 'job-completed-successfully' keyword [STD92]. CONDITIONALLY REQUIRED [5]
'job-printed-with-errors'	The Job was printed with errors but was successfully stored as indicated by 'job-stored-successfully' or was not successfully stored as indicated by 'job-stored-with-warnings' or 'job-stored-with-errors'. If the Job was not requested to be stored, the Printer uses the 'job-completed-with-errors' keyword [STD92]. CONDITIONALLY REQUIRED [5]
'job-printed-with-warnings'	The Job was printed with warnings but was successfully stored as indicated by 'job-stored-successfully' or was not successfully stored as indicated by 'job-stored-with-warnings' or 'job-stored-with-errors'. If the Job was not requested to be stored, the Printer uses the 'job-completed-with-warnings' keyword [STD92]. CONDITIONALLY REQUIRED [5]
'job-resuming'	The Printer is moving the Job from the 'processing-stopped' state to the 'processing' state. CONDITIONALLY REQUIRED [9]
'job-stored'	The Printer successfully created this Job as a Stored Job and storage was successful. The Printer MUST also supply 'job-completed-successfully', except when "job-storage-disposition" = 'save-only'. CONDITIONALLY REQUIRED [5]
'job-stored-with-errors'	The Printer successfully created this Job as a Stored Job but there were errors storing the Job.

Keyword	Description and Conformance Requirements
	CONDITIONALLY REQUIRED [5]
'job-stored-with-warnings'	The Printer successfully created this Job as a Stored Job but there were warnings storing the Job.
	CONDITIONALLY REQUIRED [5]
'job-storing'	The Printer is in the process of storing the Job to its storage location.
	CONDITIONALLY REQUIRED [5]
'job-suspended-by-operator'	The Job has been indefinitely suspended by the Operator.
	CONDITIONALLY REQUIRED [8]
'job-suspended-by-system'	The Job has been indefinitely suspended by the Printer's system software during normal processing of the Job.
	CONDITIONALLY REQUIRED [8]
'job-suspended-by-user'	The Job has been indefinitely suspended by the originating user.
	CONDITIONALLY REQUIRED [8]
'job-suspended-for-approval'	The Proof and Suspend Job is in the 'processing-stopped' state awaiting approval to produce the Final Copies or rejection and cancelation.
	CONDITIONALLY REQUIRED [6]
'job-suspending'	The Printer is in the process of moving the Job from the 'processing' state to the 'processing-stopped' state.
	CONDITIONALLY REQUIRED [8]
'unsupported-attributes-or-values'	The Job Template or Document Template attributes contain unsupported attributes or values. Although certain conflicts detected at submission time prevent Job Creation, those reported in cases of fan-out [STD92] might not cause a Job to be aborted.
	REQUIRED

Notes:

[1] REQUIRED for Printers that support the "job-cancel-after" Job Template attribute
[2] REQUIRED for Printers that support the Password Job Release
[3] REQUIRED for Printers that support the Button Press Job Release
[4] REQUIRED for Printers that support the User Authorization Job Release
[5] REQUIRED for Printers that support Job Storage
[6] REQUIRED for Printers that support Job Proof and Suspend
[7] REQUIRED for Printers that support "job-spooling-supported"
[8] REQUIRED for Printers that support the Suspend-Current-Job operation [RFC3998]
[9] REQUIRED for Printers that support the Resume-Job operation [RFC3998]

The semantics of the 'job-completed-successfully', 'job-completed-with-warnings', and 'job-completed-with-errors' keywords [STD92] are also clarified in the list above for implementations that support the "job-storage-disposition" member attribute (section 6.1.4.2), in such a way that these values remain compatible with Printers and Clients that do not support Job Storage.

Table 18 enumerates the possible combinations of print and store success, warning, and error conditions. Note that two values occur only when there are print warnings/errors and a store error.

Table 18 - Values of "job-state-reasons" attribute for various Job conditions

	Not storing	Store successful
Not printing	<not possible>	'job-completed-successfully'
Print successful	'job-completed-successfully'	'job-completed-successfully'
Print warnings	'job-completed-with-warnings'	'job-completed-with-warnings'
Print errors	'job-completed-with-errors'	'job-completed-with-errors'
Print warnings and errors	'job-completed-with-errors'	'job-completed-with-errors'

8.3 printer-state-reasons (1setOf type2 keyword)

This specification defines new CONDITIONALLY REQUIRED keywords for the "printer-state-reasons" Printer Status attribute [STD92]. Table 19 lists the new keywords defined in this specification. A Printer that supports the "printer-storage" Printer Status attribute (section 6.1.4) MUST support all applicable keywords listed in Table 19.

Table 19 – New "printer-state-reasons" Keywords

Keyword	Description and Conformance Requirements
'storage-added'	One or more storage sub-units were added.
'storage-almost-full'	One or more storage sub-units are almost full.

Keyword	Description and Conformance Requirements
'storage-cover-closed'	The door/cover for one or more storage sub-units is closed.
'storage-cover-open'	The door/cover for one or more storage sub-units is open.
'storage-configuration-change'	One or more storage sub-units were reconfigured.
'storage-full'	One or more storage sub-units are full.
'storage-interlock-closed'	An interlock for one or more storage sub-units is closed.
'storage-interlock-open'	An interlock for one or more storage sub-units is open.
'storage-life-almost-over'	One or more storage sub-units have almost reached their end-of-life.
'storage-life-over'	One or more storage sub-units have reached their end-of-life.
'storage-missing'	One or more storage sub-units have been unexpectedly removed.
'storage-offline'	One or more storage sub-units are offline.
'storage-over-temperature'	The temperature of one or more storage sub-units is above its operating temperature range.
'storage-power-saver'	One or more storage sub-units are in low power mode.
'storage-recoverable-failure'	One or more storage sub-units have experienced recoverable errors.
'storage-removed'	One or more storage sub-units have been permanently removed.
'storage-thermistor-failure'	The temperature sensor in one or more storage sub-units has failed.
'storage-turned-off'	One or more storage sub-units have been powered off.

Keyword	Description and Conformance Requirements
'storage-turned-on'	One or more storage sub-units have been powered on.
'storage-under-temperature'	The temperature of one or more storage sub-units is below its operating temperature range.
'storage-unrecoverable-failure'	One or more storage sub-units have experienced unrecoverable (fatal) errors.
'storage-warming-up'	One or more storage sub-units are powering on.

8.4 which-jobs (type2 keyword)

This specification defines additional keyword values for the IPP "which-jobs" operation attribute for the Get-Jobs operation [STD92] to support filtering for Proof Jobs and types of Stored Jobs. Table 20 lists the new keywords defined in this specification.

Table 20 – New "which-jobs" Keywords

Keyword	Description and Conformance Requirements
'proof-print' [1]	Used to request the set of Proof Jobs (section 6.2.3) that are in the 'completed', 'canceled', or 'aborted' terminal state.
'proof-and-suspend' [2] [5]	Used to request the set of Proof and Suspend Jobs (section 4.2.1) which are in the 'processing-stopped' state.
'stored-group' [4] [5]	Used to request the set of Stored Jobs associated with the specified group have reached the 'completed' state. A Printer that lists the 'group' keyword in its "job-storage-access-supported" Printer Description attribute MUST support this keyword.
'stored-owner' [3] [5]	Used to request the set of Stored Jobs associated with the Authenticated User have reached the 'completed' state. A Printer that lists the 'owner' keyword in its "job-storage-access-supported" Printer Description attribute MUST support this keyword.
'stored-public' [3]	Used to request the set of public Stored Jobs have reached the 'completed' state. A Printer that lists the 'public' keyword in its "job-storage-access-supported" Printer Description attribute MUST support this keyword.

Notes:

[1] REQUIRED for Printers that support Job Proof Print (section 4.2.2)
[2] REQUIRED for Printers that support Job Proof and Suspend (section 4.2.1)
[3] REQUIRED for Printers that support Job Storage (section 4.4)
[4] REQUIRED for Printers that support Job Storage and Job Storage Groups (section 6.1.4.3)
[5] A Printer MAY respond with an authentication challenge

9. Obsolete Attributes and Values

9.1 Obsolete Attributes

Table 21 lists the attributes defined in [PWG5100.11-2010] that are OBSOLETE.

Table 21 - Obsolete Attributes

Attribute	Explanation
feed-orientation	Unnecessary as the feed orientation is determined by the input tray.
feed-orientation-default	Unnecessary as the feed orientation is determined by the input tray.
feed-orientation-supported	Unnecessary as the feed orientation is determined by the input tray.
job-save-disposition	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
pdl-init-file	The PDL Init File minor feature [PWG5100.11-2010] has been removed.
pdl-init-file-default	The PDL Init File minor feature [PWG5100.11-2010] has been removed.
pdl-init-file-entry	The PDL Init File minor feature [PWG5100.11-2010] has been removed.
pdl-init-file-entry-supported	The PDL Init File minor feature [PWG5100.11-2010] has been removed.
pdl-init-file-location	The PDL Init File minor feature [PWG5100.11-2010] has been removed.
pdl-init-file-location-supported	The PDL Init File minor feature [PWG5100.11-2010] has been removed.
pdl-init-file-name	The PDL Init File minor feature [PWG5100.11-2010] has been removed.
pdl-init-file-name-supported	The PDL Init File minor feature [PWG5100.11-2010] has been removed.
pdl-init-file-name-subdirectory-supported	The PDL Init File minor feature [PWG5100.11-2010] has been removed.

Attribute	Explanation
save-disposition	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-disposition-supported	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-document-format	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-document-format-default	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-document-format-supported	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-info	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-info-supported	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-location	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-location-default	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-location-supported	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-name	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-name-supported	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
save-name-subdirectory-supported	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.

9.2 Obsolete Values

Table 22 lists the values defined in [PWG5100.11-2010] that are OBSOLETE.

Table 22 - Obsolete Values

Attribute	Value	Explanation
job-password-encryption	'md2'	The algorithm itself is considered obsolete.
job-password-encryption	'md4'	The algorithm itself is considered obsolete.
job-password-encryption	'md5'	The algorithm itself is considered obsolete.
job-password-encryption	'sha'	The algorithm itself is considered obsolete.

Attribute	Value	Explanation
job-state-reasons	'job-saved-successfully'	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
job-state-reasons	'job-saved-with-errors'	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
job-state-reasons	'job-saved-with-warnings'	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
job-state-reasons	'job-saving'	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.
which-jobs	'saved'	The Job Save and Reprint feature [PWG5100.11-2010] has been replaced by the Job Storage feature.

10. Conformance Requirements

This section summarizes the Conformance Requirements detailed in the definitions in this document for Client and Printer objects (servers or devices).

10.1 Printer Conformance Requirements

A Printer claiming conformance with this specification MUST support:

17. The REQUIRED attributes in section 6:

18. "printer-storage" (section 6.5.1)

19. "printer-storage-description" (section 6.5.3)

20. "printer-service-contact-col" (section 6.4.16)

21. The internationalization considerations defined in section 11; and

22. The security considerations defined in section 12.

The Printer MUST also support at least one of the features defined in section 4 of this specification.

10.1.1 Job Release

A Printer supporting the Button Press method for the Job Release feature defined in section 4.3 MUST support:

23. The "job-release-action" attribute and its 'button-press' keyword (section 6.1.3);

24. The 'job-release' keyword for the "ipp-features-supported" Printer Description attribute (section 8.1); and

25. The 'job-held-for-release' and 'job-held-for-button-press' keywords for the "job-state-reasons" Job Status attribute (section 8.2).

A Printer supporting the Owner Authorized method for the Job Release feature defined in section 4.3 MUST support:

26. The "job-release-action" attribute and its 'owner-authorized' keyword (section 6.1.3);

27. The 'job-release' keyword for the "ipp-features-supported" Printer Description attribute (section 8.1); and

28. The 'job-held-for-release' and 'job-held-for-authorization' keywords for the "job-state-reasons" Job Status attribute (section 8.2).

A Printer supporting the Job Password method for the Job Release feature defined in section 4.3 MUST support:

29. The "job-release-action" attribute and its 'job-password' keyword (section 6.1.3);

30. The "job-password" operation attribute (section 6.1.1);

31. The "job-password-encryption" operation attribute (section 6.1.2);

32. The "job-password-encryption-supported" Printer Description attribute (section 6.4.3);

33. The "job-password-length-supported" Printer Description attribute (section 6.4.4);

34. The "job-password-repertoire-configured" Printer Description attribute (section 6.4.5);

35. The "job-password-repertoire-supported" Printer Description attribute (section 6.4.6);

36. The "job-password-supported" Printer Description attribute (section 6.4.7);

37. The 'job-release' keyword for the "ipp-features-supported" Printer Description attribute (section 8.1); and

38. The 'job-held-for-release' and 'job-password-wait' keywords for the "job-state-reasons" Job Status attribute (section 8.2).

10.1.2 Job Storage

A Printer claiming support for the Job Storage feature defined in section 4.4 MUST support:

39. The "job-storage" operation attribute (section 6.1.3);

40. The 'job-storage' keyword for the "ipp-features-supported" Printer Description attribute (section 8.1);

41. The 'stored-public' and 'stored-owner' keywords for the "which-jobs" operation attribute (section 8.4); and

42. The 'job-printed-successfully', 'job-printed-with-errors', 'job-printed-with-warnings', 'job-stored', 'job-stored-with-errors', 'job-stored-with-warnings', and 'job-storing' keywords for the "job-state-reasons" Job Status attribute (section 8.2).

10.1.3 Job Print Policy

A Printer claiming support for the Job Print Policy feature defined in section 4.1 MUST support:

43. The Get-User-Printer-Attributes operation (section 5.1); and

44. The 'print-policy' keyword for the "ipp-features-supported" Printer Description attribute (section 8.1).

10.1.4 Job Proof and Suspend

A Printer claiming support for the Job Proof and Suspend feature defined in section 4.2.1 MUST support:

45. The "proof-copies" Job Template attribute (section 6.2.2);

46. The 'proof-and-suspend' keyword for the "ipp-features-supported" Printer Description attribute (section 8.1);

47. The 'proof-and-suspend' keyword for the "which-jobs" operation attribute (section 8.4); and

48. The 'job-suspended-for-approval' keyword for the "job-state-reasons" Job Status attribute (section 8.2).

10.1.5 Job Proof Print

A Printer claiming support for the Job Proof Print feature defined in section 4.2.2 MUST support:

49. The "proof-print" Job Template attribute (section 6.2.3); and

50. The 'proof-print' keyword for the "ipp-features-supported" Printer Description attribute (section 8.1); and

51. The 'proof-and-suspend' keyword for the "which-jobs" operation attribute (section 8.4).

10.2 Client Conformance Requirements

A Client claiming conformance with this specification MUST support:

52. The internationalization considerations defined in section 11; and

53. The security considerations defined in section 12.

The Client MUST also support at least one of the features defined in section 4 of this specification.

10.2.1 Job Release

A Client supporting the Button Press method for the Job Release feature defined in section 4.3 MUST support:

54. The "job-release-action" attribute and its 'button-press' keyword (section 6.1.3).

A Client supporting the Owner Authorized method for the Job Release feature defined in section 4.3 MUST support:

55. The "job-release-action" attribute and its 'owner-authorized' keyword (section 6.1.3).

A Client supporting the Job Password method for the Job Release feature defined in section 4.3 MUST support:

56. The "job-release-action" attribute and its 'job-password' keyword (section 6.1.3);

57. The "job-password" operation attribute (section 6.1.1); and

58. The "job-password-encryption" operation attribute (section 6.1.2).

10.2.2 Job Storage

A Client claiming support for the Job Storage feature defined in section 4.4 MUST support:

59. The "job-storage" operation attribute (section 6.1.3); and

60. The 'stored-public' and 'stored-owner' keywords for the "which-jobs" operation attribute (section 8.4).

10.2.3 Job Print Policy

A Client claiming support for the Job Print Policy feature defined in section 4.1 MUST support:

61. The Get-User-Printer-Attributes operation (section 5.1).

10.2.4 Job Proof and Suspend

A Printer claiming support for the Job Proof and Suspend feature defined in section 4.2.1 MUST support:

62. The "proof-copies" Job Template attribute (section 6.2.2); and

63. The 'proof-and-suspend' keyword for the "which-jobs" operation attribute (section 8.4).

10.2.5 Job Proof Print

A Client claiming support for the Job Proof Print feature defined in section 4.2.2 MUST support:

64. The "proof-print" Job Template attribute (section 6.2.3); and

65. The 'proof-print' keyword for the "which-jobs" operation attribute (section 8.4).

11. Internationalization Considerations

For interoperability and basic support for multiple languages, conforming implementations MUST support the Universal Character Set (UCS) Transformation Format -- 8 bit (UTF-8) [STD63] encoding of Unicode [UNICODE] [ISO10646] and the Unicode Format for Network Interchange [RFC5198].

Implementations of this specification SHOULD conform to the following standards on processing of human-readable Unicode text strings, see:

66. Unicode Bidirectional Algorithm [UAX9] – left-to-right, right-to-left, and vertical

67. Unicode Line Breaking Algorithm [UAX14] – character classes and wrapping

68. Unicode Normalization Forms [UAX15] – especially NFC for [RFC5198]

69. Unicode Text Segmentation [UAX29] – grapheme clusters, words, sentences

70. Unicode Identifier and Pattern Syntax [UAX31] – identifier use and normalization

71. Unicode Collation Algorithm [UTS10] – sorting

72. Unicode Locale Data Markup Language [UTS35] – locale databases

Implementations of this specification are advised to also review the following informational documents on processing of human-readable Unicode text strings:

73. Unicode Character Encoding Model [UTR17] – multi-layer character model

74. Unicode Character Property Model [UTR23] – character properties

75. Unicode Conformance Model [UTR33] – Unicode conformance basis

12. Security Considerations

In addition to the security and privacy considerations described in Internet Printing Protocol/1.1 [STD92], implementations of this specification SHOULD conform to the following standards on processing of human-readable Unicode text strings:

- Unicode Security Mechanisms [UTS39] – detecting and avoiding security attacks

- Unicode Security FAQ [UNISECFAQ] – common Unicode security issues

12.1 "job-password" and "job-password-encryption"

 A Client uses Secure Transport when supplying the "job-password-encryption" operation attribute (section 6.1.2) in a Job Creation or Validate-Job request specifying a value of 'none', to protect the cleartext password in transit. A Client ought to use Secure Transport whenever the Client supplies the "job-password" operation attribute (section 6.1.1) in a Job Creation or Validate-Job request.

If a Printer receives a "job-password" operation attribute (section 6.1.1), then the Printer MUST protect the received password value at rest. A Printer MUST NOT return a "job-password" value in any IPP operation response.

The Printer MUST preserve the Job's "job-password" for the Job's entire lifespan. If the Printer makes a copy of a Job via a Resubmit-Job or Reprocess-Job operation or some non-IPP mechanism, then the Printer MUST include the "job-password" in the new copy to maintain the password protections.

12.2 "job-storage"

A Printer creating a Stored Job (section 4.4.1) MUST protect the Stored Job and its Documents at rest (e.g., using encrypted secondary storage) to prevent unwanted disclosure.

13. IANA Considerations

13.1 Attribute Registrations

The attributes defined in this specification will be published by IANA according to the procedures in the Internet Printing Protocol/1.1 [STD92] in the following file:

>   https://www.iana.org/assignments/ipp-registrations

The registry entries will contain the following information:

```
Operation attributes:                                        Reference
----------------------------------------                     -------------
job-password (octetString(255))                              [PWG5100.11]
job-password-encryption (type2 keyword)                      [PWG5100.11]
job-release-action (type2 keyword)                           [PWG5100.11]
job-storage (collection)                                     [PWG5100.11]
  job-storage-access (type2 keyword)                         [PWG5100.11]
  job-storage-disposition (type2 keyword)                    [PWG5100.11]
  job-storage-group (name(MAX))                              [PWG5100.11]


Job Status attributes:                                       Reference
----------------------------------------                     -------------
job-release-action (type2 keyword)                           [PWG5100.11]
job-storage (collection)                                     [PWG5100.11]
  <Any "job-storage" member attribute>                       [PWG5100.11]
parent-job-id (integer(1:MAX))                               [PWG5100.11]
parent-job-uuid (uri(45))                                    [PWG5100.11]


Job Template attributes:                                     Reference
----------------------------------------                     -------------
feed-orientation(obsolete) (type2 keyword)                   [PWG5100.11]
job-cancel-after (integer(1:MAX))                            [PWG5100.11]
job-save-disposition(obsolete) (collection)                  [PWG5100.11]
pdl-init-file(obsolete) (1setOf collection)                  [PWG5100.11]
proof-copies (integer(1:MAX))                                [PWG5100.11]
proof-print(deprecated) (collection)                         [PWG5100.11]
  proof-print-copies (integer (0:MAX))                       [PWG5100.11]
  media (type2 keyword | name(MAX))                          [PWG5100.11]
  media-col (collection)                                     [PWG5100.11]


Printer Description attributes:                              Reference
----------------------------------------                     -------------
feed-orientation-default(obsolete) (type2 keyword)           [PWG5100.11]
feed-orientation-supported(obsolete) (type2 keyword)         [PWG5100.11]
job-cancel-after-default (integer(1:MAX))                    [PWG5100.11]
job-password-encryption-supported (1setOf type2 keyword)     [PWG5100.11]
```

```
job-password-length-supported (rangeOfInteger(4:765))            [PWG5100.11]
job-password-repertoire-configured (1setOf (type2 keyword | name(MAX)))  [PWG5100.11]
job-password-repertoire-supported (1setOf (type2 keyword | name(MAX)))   [PWG5100.11]
job-password-supported (integer(0:255))                         [PWG5100.11]
job-release-action-default (type2 keyword)                      [PWG5100.11]
job-release-action-supported (1setOf type2 keyword)             [PWG5100.11]
job-storage-access-supported (1setOf type2 keyword)             [PWG5100.11]
job-storage-disposition-supported (1setOf type2 keyword)        [PWG5100.11]
job-storage-group-supported (1setOf name(MAX))                  [PWG5100.11]
job-storage-supported (1setOf keyword)                          [PWG5100.11]
pdl-init-file-default(obsolete) (1setOf collection) (obsolete)  [PWG5100.11]
pdl-init-file-entry-supported(obsolete) (1setOf name(MAX)) (obsolete)  [PWG5100.11]
pdl-init-file-location-supported(obsolete) (1setOf uri) (obsolete)    [PWG5100.11]
pdl-init-file-name-supported(obsolete) (1setOf name(MAX)) (obsolete)  [PWG5100.11]
pdl-init-file-supported(obsolete) (1setOf type2 keyword) (obsolete)   [PWG5100.11]
printer-asset-tag (octetString(MAX))                            [PWG5100.11]
printer-detailed-status-messages (1setOf text(MAX))             [PWG5100.11]
printer-service-contact-col (collection)                        [PWG5100.11]
  contact-name (name(MAX))                                      [PWG5100.11]
  contact-uri (uri)                                             [PWG5100.11]
  contact-vcard (1setOf text(MAX))                              [PWG5100.11]
proof-copies-supported (rangeOfInteger(1:MAX))                  [PWG5100.11]
proof-print-copies-supported (rangeOfInteger(0:MAX))            [PWG5100.11]
proof-print-default(deprecated) (collection)                    [PWG5100.11]
proof-print-supported(deprecated) (1setOf keyword)              [PWG5100.11]
save-disposition-supported(obsolete) (1setOf keyword) (obsolete)  [PWG5100.11]
save-document-format-default(obsolete) (mimeMediaType) (obsolete)  [PWG5100.11]
save-document-format-supported(obsolete) (1setOf mimeMediaType) (obsolete)
                                                                [PWG5100.11]
save-location-default(obsolete) (uri) (obsolete)                [PWG5100.11]
save-location-supported(obsolete) (1setOf uri) (obsolete)       [PWG5100.11]
save-name-supported(obsolete) (boolean) (obsolete)              [PWG5100.11]


Printer Status attributes:                                      Reference
----------------------------------------                        -------------
printer-serial-number (text(255))                               [PWG5100.11]
printer-storage (1setOf octetString(MAX))                       [PWG5100.11]
printer-storage-description (1setOf text(MAX))                  [PWG5100.11]
```

13.2 Keyword Registrations

The keyword values defined in this specification will be published by IANA according to the procedures in IPP/1.1 Model and Semantics [STD92] in the following file:

https://www.iana.org/assignments/ipp-registrations

The registry entries will contain the following information:

```
Attribute (attribute syntax)
  Keyword Attribute Value                                       Reference
-----------------------------                                   -------------
feed-orientation(obsolete) (type2 keyword) (obsolete)           [PWG5100.11]

ipp-features-supported (1setOf type2 keyword)                   [PWG5100.13]
  job-release                                                   [PWG5100.11]
  job-storage                                                   [PWG5100.11]
  print-policy                                                  [PWG5100.11]
  proof-and-suspend                                             [PWG5100.11]
```

```
  proof-print                                                 [PWG5100.11]

job-release-action (type2 keyword)                            [PWG5100.11]
  none                                                        [PWG5100.11]
  button-press                                                [PWG5100.11]
  job-password                                                [PWG5100.11]
  owner-authorized                                            [PWG5100.11]

job-password-encryption (type2 keyword | name(MAX))           [PWG5100.11]
  none                                                        [PWG5100.11]
  md2(obsolete)                                               [PWG5100.11]
  md4(obsolete)                                               [PWG5100.11]
  md5(obsolete)                                               [PWG5100.11]
  sha(obsolete)                                               [PWG5100.11]
  sha2-224                                                    [PWG5100.11]
  sha2-256                                                    [PWG5100.11]
  sha2-384                                                    [PWG5100.11]
  sha2-512                                                    [PWG5100.11]
  sha2-512_224                                                [PWG5100.11]
  sha2-512_256                                                [PWG5100.11]
  sha3-224                                                    [PWG5100.11]
  sha3-256                                                    [PWG5100.11]
  sha3-384                                                    [PWG5100.11]
  sha3-512                                                    [PWG5100.11]
  sha3-512_224                                                [PWG5100.11]
  sha3-512_256                                                [PWG5100.11]
  shake-256                                                   [PWG5100.11]
  shake-512                                                   [PWG5100.11]

job-state-reasons (1setOf type2 keyword)                      [STD92]
  conflicting-attributes                                      [PWG5100.11]
  job-canceled-after-timeout                                  [PWG5100.11]
  job-held-for-authorization                                  [PWG5100.11]
  job-held-for-button-press                                   [PWG5100.11]
  job-held-for-release                                        [PWG5100.11]
  job-password-wait                                           [PWG5100.11]
  job-printed-successfully                                    [PWG5100.11]
  job-printed-with-errors                                     [PWG5100.11]
  job-printed-with-warnings                                   [PWG5100.11]
  job-resuming                                                [PWG5100.11]
  job-release-wait                                            [PWG5100.11]
  job-saved-successfully (obsolete)                           [PWG5100.11]
  job-saved-with-errors (obsolete)                            [PWG5100.11]
  job-saved-with-warnings (obsolete)                          [PWG5100.11]
  job-saving (obsolete)                                       [PWG5100.11]
  job-stored                                                  [PWG5100.11]
  job-storing                                                 [PWG5100.11]
  job-suspended-by-operator                                   [PWG5100.11]
  job-suspended-by-system                                     [PWG5100.11]
  job-suspended-by-user                                       [PWG5100.11]
  job-suspended-for-approval                                  [PWG5100.11]
  job-suspending                                              [PWG5100.11]
  unsupported-attributes-or-values                            [PWG5100.11]

job-storage-access-supported (1setOf type2 keyword)           [PWG5100.11]
  group                                                       [PWG5100.11]
  owner                                                       [PWG5100.11]
  public                                                      [PWG5100.11]

job-storage-disposition-supported (1setOf type2 keyword)      [PWG5100.11]
  none                                                        [PWG5100.11]
  print-and-store                                             [PWG5100.11]
```

```
  store-only                                                  [PWG5100.11]

which-jobs (type2 keyword)                                    [STD92]
  proof-print                                                [PWG5100.11]
  proof-and-suspend                                          [PWG5100.11]
  saved (obsolete)                                           [PWG5100.11]
  stored-group                                               [PWG5100.11]
  stored-owner                                               [PWG5100.11]
  stored-public                                              [PWG5100.11]
```

13.3 Enum Registrations

The enum values defined in this specification will be published by IANA according to the procedures in the Internet Printing Protocol/1.1 [STD92] in the following file:

https://www.iana.org/assignments/ipp-registrations

The registry entries will contain the following information:

```
Attributes (attribute syntax)
  Enum Value                                                 Enum Symbolic
Name                                                         Reference
  ----------                                                 ---------------
--                                                           -------------
operations-supported (1setOf type2 enum)                     [STD92]
  0x0066                                                     Get-User-
Printer-Attributes                                           [PWG5100.11]
```

13.4 Operation Registrations

The operations defined in this specification will be published by IANA according to the procedures in the Internet Printing Protocol/1.1 [STD92] in the following file:

https://www.iana.org/assignments/ipp-registrations

The registry entries will contain the following information:

```
Operation Name                                               Reference
--------------                                               -------------
Create-Job(Extension)                                        [PWG5100.11]
Get-Jobs(Extension)                                          [PWG5100.11]
Get-User-Printer-Attributes                                  [PWG5100.11]
Print-Job(Extension)                                         [PWG5100.11]
Print-URI(Extension)                                         [PWG5100.11]
Reprocess-Job(Extension)                                     [PWG5100.11]
Resubmit-Job(Extension)                                      [PWG5100.11]
Validate-Job(Extension)                                      [PWG5100.11]
```

14. Overview of Changes

14.1 IPP Enterprise Printing Extensions v2.0

The following changes were made for IPP Enterprise Printing Extensions v2.0:

- The Job Print Policy feature (section 4.1) adopted the Get-User-Printer-Attributes operation registered in 2017 defined to provide a Get-Printer-Attributes response filtered for the authenticated user;

- The Job Proof and Suspend feature (section 4.2.1) is defined to provide a simpler proof printing solution more congruent with vendor proof printing implementations already in the marketplace for many years, to replace the Job Proof Print feature (section 4.2.2), which is now DEPRECATED;

- The new Job Release feature (section 4.3) defines a system to manage authenticated Job release, extending the earlier Secure Print feature [PWG5100.11-2010] which was not interoperable with other features;

- The new Job Storage feature (section 4.4) provides a system to submit Jobs for persistent storage with clearly defined semantics, replacing the Job Save and Reprint feature [PWG5100.11-2010] which is now OBSOLETE;

- The Job Proof and Suspend feature, Job Release feature, and Job Storage feature were designed to interoperate with one another, to resolve a major design shortcoming of the features defined in "Internet Printing Protocol (IPP): Job and Printer Extensions – Set 2 (JPS2)" [PWG5100.11-2010];

- Added the new "parent-job-id" and "parent-job-uuid" Job Status attributes to identify a Job's parent Job in cases where the Job was created by duplicating another Job;

- Deprecated the "name(MAX)" syntax from the original definition of the "job-password-encryption" Job Template attribute, since the "type2 keyword" syntax allows for site-local or vendor-unique hashing algorithms;

- A Client can now include the "job-password" and "job-password-encryption" attributes in a Validate-Job request. This was disallowed in the previous version of this specification [PWG5100.11-2010];

- Adopted the "printer-asset-tag" and "printer-serial-number" attributes from [LAKESIDE20201201];

- Added the "printer-storage" and "printer-storage-description" attributes to provide a mapping of the Host Resources MIB for storage devices;

- "proof-print-default" is DEPRECATED and strongly discouraged because its semantics were not clearly defined, and its value was and remains unclear;

- Many attributes and keywords moved to "IPP Job Extensions v2.0" [PWG5100.7] because they don't specifically apply to the new "enterprise printing" focus of this specification; and

- Moved the "job-phone-number", "job-phone-number-default", "job-phone-number-supported", "job-recipient-name", "job-recipient-name-default", and "job-recipient-name-supported" attributes to IPP Production Printing Extensions v2.0 [PWG5100.3].

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