The Printer Working Group

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IPP Driverless Printing Extensions v2.0 (NODRIVER)

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Abstract: This specification defines new attributes, values, and operations to support features, capabilities, and status information traditionally associated with model-specific drivers.

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

https://ftp.pwg.org/pub/pwg/general/pwg-process30.pdf

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For additional information regarding the Printer Working Group visit:

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1. Introduction

This IPP Driverless Printing Extensions v2.0 specification defines new attributes, values, and operations to support features, capabilities, and status information traditionally associated with model-specific drivers.

Drivers implemented to support specific printer models usually include code tailored to those models' unique behavior, including color tuning, model-unique feature variants, and other specializations. These driver packages also include resources such as icon images, localized text, supported media lists, and support content ("help") targeting a specific printer model or models. Universal client drivers and their related Client printing solutions running have none of these model-specific enhancements. To approach feature parity, they instead depend on the Printer itself to supply its own model-specific information and resources to support a modern full-featured printing experience. While IPP/1.1, IPP/2.0 and other IPP specifications provide much of what is needed, some facilities were missing.

This specification defines new IPP attributes, attribute values and operations to support media selection, color management, color transformations, printer identification and location, presets, custom print quality settings, supplies status, formatting choices, printer icons, and a message catalog file format for supplying sets of localized string labels. This specification also defines a general method for expressing limits in IPP operation requests and a more extensible method for filtering objects and attributes.

This specification updates the previous version of this specification [PWG5100.13-2012]. Section 17 provides a list of changes made since the first version.

2. Terminology

2.1 Conformance Terminology

Capitalized terms, such as MUST, MUST NOT, RECOMMENDED, REQUIRED, SHOULD, SHOULD NOT, MAY, and OPTIONAL, have special meaning relating to conformance as defined in Key words for use in RFCs to Indicate Requirement Levels [BCP14]. The term CONDITIONALLY REQUIRED is additionally defined for a conformance requirement that applies when a specified condition is true.

The term DEPRECATED is used for previously defined and approved protocol elements that SHOULD NOT be used or implemented. The term OBSOLETE is used for previously defined and approved protocol elements that MUST NOT be used or implemented.

2.2 Printing Terminology

Normative definitions and semantics of printing terms are imported from the Internet Printing Protocol/1.1 [STD92].

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

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

Impression: The Document Content imposed upon one side of a Media Sheet by a marking engine, independent of the number of times that the sheet side passes any marker. An Impression contains one or more Input Pages that are imposed (scaled, translated, and/or rotated) during processing of the Document data. [STD92]

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]

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]

Media Sheet: A single instance of a medium, whether printing on one or both sides of the medium. Media Sheets also include sections of roll media. [STD92]

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

Set: A logical boundary between the delivered Media Sheets of a printed Job [STD92]. For example, in the case of a ten-page single Document with collated pages and a request for 50 copies, each of the 50 printed copies of the Document constitutes a Set. If the pages were uncollated, then 50 copies of each of the individual pages within the Document would represent each Set. Finishing processes operate on Sets. [STD92]

2.3 Protocol Role Terminology

The following protocol roles are defined to specify unambiguous conformance requirements:

Client: Initiator of outgoing connections and sender of outgoing operation requests (Hypertext Transfer Protocol -- HTTP/1.1 [RFC7230] User Agent).

Printer: Listener for incoming connections and receiver of incoming operation requests (Hypertext Transfer Protocol -- HTTP/1.1 [RFC7230] Server) that represents one or more Physical Devices or a Logical Device.

2.4 Other Terminology

Black Point Compensation: The mapping of the darkest color in a source Color Space to the darkest color in a destination Color Space, generally to improve the reproduction of dark colors and shadows.

Color Space: The interpretation of color in a Document, for example “RGB”, “Grayscale”, “CMYK”, and so forth.

End User: A person or software process that is 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]

Gamut: The range of colors that can be reproduced by a Printer or Color Space.

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

Job Creation Operation: any operation that causes the creation of a Job object, e.g., the Create-Job, Print-Job, and Print-URI operations defined in this document. [STD92]

Job Ticket: The operation and Job Template attributes supplied by a Client in a Job Creation Operation request that describe the End User's intent for Job and Document processing as well as descriptive information about the Job and its Document(s).

Kerberized Printing: Authenticated printing based on SPNEGO-based Kerberos and NTLM HTTP Authentication in Microsoft Windows [RFC4559], Transport Layer Security/1.3 [RFC8446], and Upgrading to TLS Within HTTP/1.1 [RFC2817].

Paid Imaging Services: Printing, facsimile, and scanning performed for a fee. The means of collecting payment is outside the scope of this specification.

Preset: A set of Job Template and operation attributes and values that are logically congruent and grouped together to all be applied to the Job Ticket in one step.

Printer Event: An Event caused by some change in the Printer that is not specific to a Job, e.g., 'printer-state-changed'. [RFC3995]

Printer Resident: Hosted by the Printer. Usually used in discussing Printer resources. If a Printer at ipps://myprinter.local.:631/ipp/print supports a "printer-xxx-resource (URI)" attribute, if the resource is Printer Resident, then it could provide that resource at "https://myprinter.local.:631/xxx-resource".

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

Site Local: Hosted nearby relative to another host on a computer network, requiring a small number of hops between two hosts, and not leaving a particular site.

Trigger: A condition that causes a Client to silently apply a Preset on behalf of an End User.

2.5 Acronyms and Organizations

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

ICC: International Color Consortium, https://www.color.org

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

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

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

3. Requirements

3.1 Rationale

The Internet Printing Protocol Version 2.0 Second Edition [PWG5100.12] defines:

1. A collection of existing IPP specifications that form the basis for IPP/2.0;
2. Standard Job Template attributes for document format, media size, print quality, and so forth;
3. Specific interoperability requirements, such as HTTP/1.1 support with chunking and IPP collection attribute support;
4. Unique version numbers and operation requirements for different classes of device.

Printing from universal IPP Clients with a sophistication that matches vendor-provided model-specific drivers requires supporting use cases not addressed by existing IPP standards. Therefore, this IPP Driverless Printing Extensions v2.0 specification defines IPP extensions to support:

1. Printer identification and geolocation;
2. Globally unique identifiers for all objects;
3. Job Template attribute and value constraint description and conflict resolution;
4. Extensible controls for the color rendition of a Document and for Client-managed color workflows;
5. Supply monitoring and control;
6. Roll feed media;
7. Printer Resident message catalog resources for providing localized labels for attribute names, enum values, and keyword values;
8. Printer Resident icon image resources;
9. Printer supplied "Presets" to logically bundle some feature choices together.

3.2 Use Cases

The IPP extensions defined in this IPP Driverless Printing Extensions v2.0 specification support the following use cases.

3.2.1 Select Printer Using Geo-Location

Jan is a student who is looking at photos on her laptop in an unfamiliar studying location. She chooses to print one of the photos. The Client discovers Printers on her network. The Client requests geolocation information for each discovered Printer. The Client uses its own location service facilities and the Printer discovery results to list the printers in order of proximity rather than alphabetic order. Jan selects the closest printer.

3.2.2 Select Printer with Confirmation

After selecting a Printer, Jan uses the Client to send an identification request to the Printer to flash a light or make a sound to confirm she selected the correct printer. Jan hears a repeating sound begin, helping her to locate the Printer she selected.

3.2.3 List a Printer Once When Discovered Over Multiple Interfaces

Gus is viewing a document on his tablet computer and taps the "Print" button. His tablet computer is on his company's LAN, and it also supports peer-to-peer wireless networking. The client software in the tablet uses discovery protocols on both the LAN and peer-to-peer interfaces to discover available printers. The client software collects results and detects that one printer was discovered over both interfaces. The client presents only one item in the discovery results list to provide a less confusing user experience. Gus selects the printer, and the tablet computer's client software uses heuristics to connect to the printer as quickly as possible.

3.2.4 Filter Discovered Printers by Capability

Gus is viewing a tax return on his tablet computer and wants to print it on printers that support Job Release [PWG5100.11]. When taps the "Print" button and his tablet computer discovers available printers, he uses controls in the discovery UI to filter the results to list only those printers that support the Job Release feature. The filtered results list a nearby printer. Gus chooses that printer, enables the Job Release feature, and sends the Job. Gus then goes to the chosen printer to release the Job so that he is present while it prints.

3.2.5 Print Using Loaded Media

Greta is viewing a photo on her phone and wants to print the photo on the largest borderless photographic media loaded on her printer. After Greta chooses to print and selects a printer, the client software queries the printer to report loaded media information such as media size, media type, coating, media weight, and input tray location. The client software pre-selects the largest borderless photographic media currently loaded in the printer and the highest print quality based on the type of job and media selection. Greta checked the settings, chose

to enable a few other settings, and taps "Print" to create the job. The client software creates the job and sends it to the Printer. Greta is impressed with the output and how easy it was to print a photo from her phone.

3.2.6 Print a Password-Protected Document

Tim is the treasurer of a small training company, and he has received a PDF document of a bank statement. The PDF document is password protected. He tries to print the PDF document, and the Client asks for the PDF's password before it can send the PDF as the Document Content for the Job. It creates the Job using Secure Transport and includes the document password in the Job Ticket. The Printer unlocks the PDF and prints the report.

3.2.7 Print from a Roll

Mike has a series of photos to print and a printer that has a roll of photo media instead of cut sheets of photo media. Mike creates and submits a print job with 20 photos to be printed on A6 media and requests that each photo in the job is to be cut from the roll media.

3.2.8 Preventing Two-Sided Printing on Transparency Media

Sven is a graduate student for an elderly, technology-averse professor who still uses an overhead projector and transparency media. He receives the set of slides from the professor via email with instructions to print one copy on transparency and 30 copies on plain paper as handouts. Sven starts by printing the 30 copies on plain paper, choosing to use two-sided printing to save paper. He then starts to set up the print job for the transparency slides. When Sven chooses "Transparency" media in the print dialog, his laptop presents a dialog informing him that this media type is not compatible with two-sided printing and provides a resolution to disable two-sided printing. Sven approves the resolution and submits the Job to the Printer. Both the plain paper handouts and the slides on transparency are printed as he was expecting them to be.

3.2.9 Supplies Status

Barbie is preparing to print a set of photos on her inkjet printer from her laptop. Software on the laptop presents a notification indicating that her cyan ink cartridge is critically low. She clicks on the notification to get to the printer driver's supplies status UI and sees that her magenta and black levels are also low. She clicks on a reorder link in the UI taken from the Printer, which takes her to a web page in her browser. She orders supplies.

3.2.10 Job or Document Processing Failures

Wawira submitted a job from her laptop to the workgroup printer near her cubicle. While processing the job, the printer encounters a document processing issue. The printer updates the job's processing status with messages describing the problem and possible resolutions. Wawira's laptop is monitoring the job's processing status and presents a notification dialog on the screen that presents the error description from the printer and a button to present more information.

3.2.11 Borderless Printing

Rick operates a print shop that has a number of expensive wide format printers. Paula is a customer that wants a photo poster printed using the full width of the 36" paper loaded, but with no white margins showing on the sides. Rick opens the photo in his system, chooses the photo media Paula prefers, and chooses job settings to enable overprinting at the edges to ensure there are no white areas.

3.2.12 Correlation of Multiple Printers

Felipe is an IT administrator who monitors and maintains multiple printers managed by several print servers. He runs management software that correlates printers registered with a directory service or dynamic discovery protocol to provide a hierarchical display of the available servers, printers, jobs, and current state.

3.2.13 Printer Resident Icons

Ava is at work and has a photo on her phone she wants to print. Her phone's print system searches for available printers using a discovery protocol and presents the results in a grid of icons with names below each icon. For some discovered printers that provide their own icons, it shows an icon that looks like the printer. For those printers that don't have a Printer Resident icon, Ava's phone just shows a generic icon. She doesn't know the name of the printer but recognizes the printer by its icon image and selects it.

3.2.14 Printer Resident Localization Resources

Ava is at work and has a photo on her phone she wants to print. She chooses a printer that has photo paper loaded. After a few seconds, the phone presents the selected printer's capabilities. She picks the photo media which has a vendor-specific brand name. She wants more information, so she taps on a "?" button and the media selection control, and some additional text describing the media is shown to her.

3.2.15 Manufacturer-Deployed Print Quality Mode

X Printers, a printer manufacturer, has developed printers with a unique print quality capability called "X Magic" that provides significant customer benefit compared to the standard print quality modes. The "X Magic" print quality mode depends on the printer having specific print engine mechanism that implements the requisite imaging technology. X Printers does not want to map an existing print quality mode to "X Magic" for those devices that support the technology, since that would cause inconsistent behavior and doing so would also prevent the "X Magic" feature from being clearly visible to its customers. X Printers includes localized labels and localized contextual help in the printers that support its "X Magic" feature.

Nozomi is an end user that buys an X Printers printer with the "X Magic" feature. When she taps on "Print", and looks at the print options, she sees "X Magic" available as a print quality option. She hovers her finger over the label, and a contextual help frame appears above that

describes the feature. She chooses "X Magic" because its description seems compelling to her, and taps "Print". The printer prints her document using the "X Magic" print quality setting.

3.2.16 Administrator-Deployed Print Quality Mode

A customer has agreed with its print service provider to pay for a unique print quality mode called "Eco-Draft", that is enabled through the service contract. This print quality mode will only be made available on select printers, facilitated by the print service provider's IT administration and deployment system.

This "Eco-Draft" print mode differs from the standard "Draft", "Normal" and "High" modes in that, when selected and indicated to the Printer, the Printer employs a unique combination of rendering selections to produce output generally comparable to "Draft" but with a significantly reduced ink or toner usage, and a corresponding reduction in per-page cost. “Eco-Draft” is offered as a new print quality setting unique to this deployment to preserve the conventional definition and user understanding of "Draft". A discernably unique quality value is important not only so that end users know they are using a different print quality, but also for job accounting reasons so that the billing system can bill pages using this quality level differently than the other familiar quality levels.

The IT administrators have a print policy defined so that users from different departments or role families have access to different print capabilities. Those in the Finance department will only be offered the “Eco-Draft” print quality option, while executives and those in the Marketing department will be offered "Eco-Draft" in addition to the standard “Draft”, “Normal” and “High” options. The different quality levels factor into the billing cost the IT administrators and their print service providers have negotiated.

3.2.17 Manufacturer-Deployed Color Transformation Preferences

X Printers, a printer manufacturer, has produced printers for many years. Its customers have asked X Printers to provide a “color output mode” control with a “legacy color compatibility mode” choice. X Printers implements this feature in its newer printers that have more accurate color output, to cause them to produce output that appears as though it was printed on an older printer whose output exhibited a different particular set of color output characteristics. The customers want to be able to select this “color output preference” on a per-job and/or per-Client basis, because some users have a need for this, but only in certain applications, while others do not.

The customers have also asked for a "print preview" to show them what the color would look like before printing. The printers that implement this new "legacy color compatibility mode" also supply a special "soft proofing" ICC profile so that the client can present this accurately to the user.

3.2.18 Administrator-Deployed Color Transformation Preference

Fred is a print administrator at an architecture firm. He has been tasked with finding a way to supply a “blueprint output mode” to the architects in the office, that can be selected as an

option in the print dialog. When this option is selected, the submitted job will be output as though it was printed from a blueprinting machine. To produce this, the document color depth is flattened to a 1-bit monochrome, and then transformed so that the white background is rendered in Prussian blue (Web color #003153 or sRGB 0,49,83), and the "black" lines are rendered in white. Fred provisions the printer with settings and resources to describe the desired color transformation to its users' systems using an administrative interface to add this feature.

Lisa works in the office, and her laptop discovers this “Blueprint” color transformation option when it interrogates the printer for its capabilities. Her client device presents the “Blueprint” color transformation option in the print dialog. Lisa positions her mouse pointer over the option and sees a “tool tip” (snippet of descriptive text) over the “Blueprint” option, that describes what that will do. Lisa likes what the tool tip describes for the “Blueprint” option and selects it. The print preview in the print dialog shows her what the output will look like. She likes it more, so she clicks “Print”, and the job is printed as per the preview. Lisa is happy, and thanks Fred.

3.2.19 Settings to Influence Printer Color Processing

Juan is a graphic artist, and his team has a high-performance color printer. It has produced high quality output for all of the applications from which he and his team are printing. But then Juan encounters a problem. He is viewing a document in a particular application, prints the document, and realizes that the output is not meeting his needs. He is unable to find settings in the application that will allow it to produce satisfactory printed output without either changing the document in unacceptable ways or affecting other users of the printer. He looks in the print dialog and finds a set of "advanced processing settings", and through his experience and some educated experimentation figures out how to produce output that meets his customers' needs.

Knowing he will need these settings in the future, and knowing that his computer supports IPP Presets, he saves these settings as a Preset for future quick access.

3.2.20 Explicit Preset Selection

Bert has found a good recipe for gazpacho on the Web and wants to print the recipe to put it into his recipe binder. He clicks on the “Print” button in the web page. When the browser presents its print dialog, he selects the Preset labeled “Recipe for binder”. The “Recipe for binder” Preset specifies “2 pages per sheet” page layout, one-sided printing, trimming and punching. The Client applies the Preset to the settings in the print dialog. Bert clicks on “Print”; the Client prints the Job. Bert puts it into his recipe binder.

3.2.21 Implicit Preset Selection

Kelli is trying to print a photo. In the print dialog, she switches the selected media size from A4 to 4”x6”. Her Client has a Trigger for 4”x6” media size that names a Preset named “Photos”; the “Photos” Preset includes glossy photo media type, single- sided printing, and 'high' print quality. The Client acts on the Trigger by applying the settings in the “Photos”

Preset. Kelli is pleased that these choices were made automatically by her system, saving her time and effort.

3.2.22 Client Storing a Preset to Printer

Ernie has constructed his own Preset named “Better Binder Recipe”, and he would like to share it with Bert. Ernie selects that Preset and taps on the “Store Preset on Printer” button. The Preset is uploaded to the Printer. When Bert next goes to print, he sees the “Better Binder Recipe” Preset that Ernie added to the Printer and uses that for his next recipe printing tasks.

3.2.23 Audit Print Usage Via Job Accounting

Jane manages a shared office multifunction device and wants to know who prints, what kinds of Jobs are printed, how those Jobs are submitted, and where are they printed. She configures a Job Accounting service on her network for use with the Printer so that all Job and Printer Generated Metadata is available to the service and she can then generate reports showing the information she is interested in.

3.2.24 Audit Print Content Via Job Accounting

Bob is concerned that the students in his computer lab are printing inappropriate content on the school's color printer. He configures a server on his network to act as a print server that stores copies of every Job so that he can periodically review what is being printed.

3.2.25 Billing Via Job Accounting

Kate is the owner of a managed print service company that supplies printers and print servers to businesses. She collects information about each Job that is printed including whether the Job is printed in color, how many sheets are printed, how many sides are printed, and what finishing options (if any) are used. She uses the collected information to bill each business for their usage and to plan customer visits to perform maintenance or supply additional media, ink, and/or toner based on their usage.

3.2.26 Diagnosing and Debugging Printing Issues Via Job Accounting

Joe is a support technician at Kate's managed print service company. He uses the accounting data to reproduce problems specific to a particular Document, Job, or Client application.

3.2.27 Supplying Optional Information Via Job Accounting

Some of Kate's customers want to know what applications their End Users are printing from. Kate configures the printer server to request the application name from the Client with every Job, and then includes a separate informational report to her customers showing the amount of printing that has occurred for each application. Clients will then show the explicit consent UI whenever an End User submits a print Job.

3.3 Exceptions

The following subsections define exceptions in addition to those defined in the Internet Printing Protocol/1.1 [STD92].

3.3.1 Job or Document Processing Failures

While processing a job, the Printer reports Job or Document processing issues to the Client, which displays an error message as needed and asks the User or Operator to confirm the disposition of the Job. Processing failures include out-of-memory, missing resource, missing or incorrect password, and other conditions that prevent a particular Job or Document from printing.

3.4 Out of Scope

The following are out of scope for this specification:

1. Methods for geo-location and proximity detection for the Select Printer Using Geo-Location use case (section 3.2.1);
2. Constraining choice of document formats suitable for the Print use cases; and
3. Discovery protocols used to locate Printers.

3.5 Design Requirements

The design requirements for this specification are:

1. Support the use cases listed in section 3.2 by defining the following IPP extensions:
    a. A facility that allows a Client to correlate multiple Printers to a single device or server supporting the Printers;
    b. An operation and associated attributes to request that the Printer identify itself using visual or audio ;
    c. Printer precise geo-location and relative location;
    d. Printer discovery and selection metadata;
    e. Client-side Job Template attribute constraints and conflict resolution;
    f. Secure printing, identification, and metadata attributes and values;
    g. Media capability attributes;
    h. Input and output tray description;
    i. Limit and filtering attributes;

j. Color printing attributes;

k. ICC color management attributes;

l. Roll-fed printing attributes and values;

m. Supply level and status monitoring;

n. Localization attributes and a message catalog file format;

o. Attributes providing globally unique identifier attributes for all objects; and

p. Preset attributes.

2. Ensure that all IPP extensions follow the naming conventions defined in the IPP/1.1 Model and Semantics [STD92], including keyword value (lowercase) and hyphenation requirements; and

3. Ensure that all IPP extensions are compatible with, but not redundant with, existing IETF and PWG IPP operations and attributes.

The design recommendations for this specification are:

1. Prefer Printer Resident resources to better support this specification's use cases in scenarios where Internet access is unavailable, such as isolated or restricted networks or peer-to-peer networking technologies.

4. IPP Model

This specification extends the core features defined in the IPP/1.1 Model and Semantics [STD92] and other IPP specifications in several significant ways. Descriptions of each IPP extension are below.

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Table 1 - Design Requirements, Use Cases and Definitions Cross Reference

Design Requirement	Use Case(s)	Definitions
4. Define new Printer identification attributes and an identification operation	3.2.2, 3.2.3	5.1, 6.1.5, 6.6.12
5. Define new geo-location attributes	3.2.1	6.5.27
6. Define new Printer discovery and selection attributes	3.2.4	6.5.4, 6.5.31,

7. Define new attributes to support feature selection constraints and conflict resolution	3.2.8	6.5.5, 6.5.9
8. Define new secure printing, identification, and metadata attributes and values	3.2.6	6.3.2, 6.4.6, 8.8
9. Define new media capability attributes	3.2.7	**Error! Reference source not found.**, 9.2
10. Define new input and output tray attributes	**Error! Reference source not found.**, **Error! Reference source not found.**	6.5.34, 6.5.39
11. Define new limit and filtering attributes	**Error! Reference source not found.**, 3.2.4	6.1.4,
13. Define new color printing and print quality attributes	3.2.15, 3.2.16, 3.2.19	0, 6.2.4, **Error! Reference source not found.**, 9.4, **Error! R eference source not found.**
14. Define new color management and preview attributes	3.2.17, 3.2.18	6.5.23, 6.5.32
15. Define new roll-fed printing attributes and values	3.2.7, 3.2.11	6.2.2, 6.2.2.2, **Error! Reference source not found.**, 9.2, 9.3
16. Define new supply level and status monitoring attributes	3.2.9	6.6.9, 6.6.10, 6.6.11

17. Define new localization attributes and a message catalog file format	3.2.13	6.5.40, 6.5.41, 11
18. Define new globally unique identifier attributes for all objects	3.2.3	6.4.6, 6.7.1, 6.3.2, 6.6.12
19. Define new preset attributes	3.2.11	6.5.8, 6.5.10

4.1 Limits

The IPP/1.1 Model and Semantics [STD92] defined the "limit" operation attribute for the Get-Jobs operation to allow a Client to specify the maximum number of Jobs to include in the response. The IPP Event Notifications and Subscriptions [RFC3995] also defined the "limit" operation attribute for the Get-Subscriptions operation to allow a Client to specify the maximum number of Jobs to include in the response. Neither defined a way for the Client to specify the index of the first object to return.

This specification defines the new "first-index" operation attribute (section 6.1.4) and defines the semantics for the "limit" operation attribute for the Get-Printer-Attributes operation (section 8.3), Get-Subscriptions operation (section 8.4), Get-Jobs operation (section 8.5), and Get-Documents operation (section 8.6), to provide Clients with a general purpose way to specify limits in any operation request. A Printer that supports the "first-index" and "limit" operation attributes provides its values or objects in a consistent order such that a Client can expect to retrieve all the values or objects using a sequence of requests with increasing values for "first-index". For example, if a Client were to make a sequence of requests supplying the "limit" attribute with a value of 10, the Client would increment the value of "first-index" by 10 in each request ("first-index" = 1, "first-index" = 21, "first-index" = 41, ...). The Client would detect the end of the set when the number of values returned is less than the size of "limit". The Client can be confident that none of the responses will contain redundant values when the Printer implements consistent ordering for its values.

Existing conforming Printer implementations return the 'successful-ok-ignored-or-substituted-attributes' status code when they do not support the "first-index" or "limit" operation attributes for a given request. A Client can always request a limited set of values but needs to be prepared to handle receiving the complete set of values if the Printer doesn't support the "first-index" or "limit" operation attributes.

4.2 Filtering

The IPP/1.1 Get-Printer-Attributes operation [STD92] supports operation response attribute filtering using the "document-format" operation attribute. IPP/1.1 and IPP Event Notifications and Subscriptions [RFC3995] both support operation response attribute filtering based on the "requesting-user-name" operation attribute or most authenticated user for Job and Subscription operations. The Get-User-Printer-Attributes operation [PWG5100.11] provides

an operation similar to Get-Printer-Attributes that supports operation response attribute filtering based on the most authenticated user.

This specification extends response attribute filtering by defining the "printer-get-attributes-supported" Printer Description attribute (section 6.5.31) that provides the list of additional attributes the Printer will use to filter its response, so that a Client can determine which attributes and attribute values are supported for a particular type of Job. This specification also defines the new "ipp-features-supported" attribute (section 6.5.4) and "printer-kind" (section 6.5.35) to enable the Printer to declare support for high-level features and capabilities.

4.3 Constraints

Some Job Template and operation attributes and attribute values are "constrained" in that they cannot both exist in a single Job. Printers can express constraints between Job Template attributes or attribute values for practical reasons (e.g., two-sided printing on glossy photo or transparency media types), physical reasons (e.g., label printing from a paper tray), or possibly other reasons. The Client detects constraints in the Job Ticket using the new "job-constraints-supported" (section 6.5.5) Printer Description attributes to detect constraints in the Job Ticket. The Client resolves the detected constraint using the resolution referenced in the "job-resolvers-supported" (section 6.5.9) Printer Description attribute.

The Client can request the Printer perform constraint resolution by submitting a Validate-Job [STD92] or Validate-Document (section 5.2) request with the desired Job Template or Document Template attributes. The Printer supplies the "preferred-attributes" collection attribute (section 6.1.6) in the response indicating which substitute values will resolve the detected conflicts.

There is no Validate-Subscription operation because subscriptions always enforce attribute fidelity.

4.4 Printer Resources

This specification defines IPP attributes whose values are URIs pointing to resources such as printer icons, ICC profiles, and message catalog files. A supporting Client can retrieve these resources using the protocol corresponding to the URI's scheme. Section 12.2 provides Printer best practices for supporting Printer resources.

4.5 ICC Color Management and Color Mode Previews

This specification supports managed color workflow by defining the new "printer-icc-profiles" Printer Description attribute that lists the Printer's supported ICC color profile resources [ISO15076-1]. Clients can download and use the Printer's ICC color profile resources for color proofing and related workflows. This specification also defines the "print-rendering-intent" Job Template attributes to indicate how the Printer should handle rendering e.g. how

black pixels are rendered could vary depending on whether the Document contains predominately text or image content. Finally, this specification defines the "print-color-mode" Job Template attribute to request that the Printer perform a color transformation when processing the Job. The Client can present a color transformation preview to the End User using ICC profiles listed in the Printer's "print-color-mode-icc-profiles" Printer Description attribute.

4.6 Localization

This specification defines and registers an existing plain text message catalog file format (MIME media type "text/strings") used on NeXT's NeXTSTEP [NEXTSTEP] and Apple's macOS [MACOS] operating systems, that allows a Printer to provide a Client with localized textual values ("localized strings") for attribute names and/or attribute values. For example, a Printer that supports vendor-unique media sizes and "printer-state-reasons" keywords could provide the localized labels for these in its message catalogs. A Printer Description attribute allows the Client to discover the location of message catalogs for the language specified by the "attributes-natural-language" attribute in the Client request. Clients can also use the HTTP If-Modified-Since header to detect whether the referenced message catalog has been updated. The message catalog syntax also supports inline help content to be associated with a given attribute or attribute keyword / enum value.

4.7 Unique Identifiers

This specification defines new UUID attributes for the Printer, Job, Document and Subscription IPP object types so that each object may be uniquely identified. This specification also defines the "device-service-count" (section 6.6.1) and "device-uuid" (section 6.6.2) Printer Status attributes. The "device-uuid" attribute allows a Client to correlate multiple IPP-based services to a single device or server. The "device-service-count" attribute allows a Client to detect whether a particular device or server provides more than one IPP-based service, regardless of the type of service offered.

4.8 Presets and Triggers

There are circumstances where a group of settings are chosen and applied as a set, to achieve some common printing workflow or use case. For example, selecting a common photo media size such as 4”x6” implies a desire to print photos, and a sophisticated Client could implement heuristics that automatically choose other settings automatically, such as changing media type to glossy photo, setting the print quality to 'best', without requiring End Users engagement. Many Clients' vendor driver systems support such heuristics.

This specification defines the new "job-presets-supported" Printer Description attribute (section 6.5.8) which lists Presets for its Clients and allows a Printer to optionally accept new Presets defined on the Client. This specification also defines the new "job-triggers-supported" Printer Description attribute (section 6.5.10) to provide a way for a Client to implicitly select a Preset if the Job Ticket contains a matching set of attributes and values.

4.9 Print Quality

The "print-quality" Job Template attribute [STD92] is not easily extensible. This specification defines a "preset-category" member attribute (section 6.5.8.1) for the "job-presets-supported" Printer Description attribute (section 6.5.8) to identify Presets that represent print quality choices for the Printer.

This specification also defines the new "print-processing-attributes-supported" Printer Description attribute (section 6.5.24) that names all the Job Template attributes that affect the visual processing of a Job.

4.10 Client Metadata for Job Accounting

Job Accounting is used for recording information about Jobs and how Printers processed Jobs. This information is used for a variety of purposes. It can be very useful to have information about the Client submitting the Job, or other actors that were responsible for generating the originating document or spool file. This specification defines the "client-info" operation attribute (section 6.1.1) to let a Client supply name and version information about itself and any relevant components providing Job Ticket or content information for the Job.

5. New Operations

5.1 Identify-Printer

This CONDITIONALLY REQUIRED operation allows a Client to request the Printer to physically identify itself by flashing lights, making sounds, or presenting a message on the Console. A Printer MUST implement this operation if it is a Physical Device.

The Printer SHOULD only allow authorized users to perform this operation. The Printer MAY implement other safeguards to prevent abuse. 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.

5.1.1 Identify-Printer Request

An Identify-Printer request includes the following groups of attributes:

Group 1: Operation Attributes

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [STD92]

Target:

The "printer-uri" (uri) operation attribute which is the target for this operation as described in [STD92]

Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Client as described in [STD92]. In addition, the "requesting-user-uri" (section 6.1.7) attribute SHOULD be supplied by the Client as well.

"identify-actions" (1setOf type2 keyword) [section 6.1.5]:

The Client MAY supply this attribute. The Printer MUST support this attribute. The value(s) specify how the Printer will identify itself to the Client.

"message" (text(127)):

The Client MAY supply this attribute. The Printer MAY supports this attribute. It is a message to the user for purposes of identifying the Printer to the user.

5.1.2 Identify-Printer Response

The following attributes are part of the Identify-Printer Response:

Group 1: Operation Attributes

Status Message:

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

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [STD92].

Group 2: Unsupported Attributes

See [STD92] for details on returning Unsupported Attributes.

5.2 Validate-Document

This DEPRECATED operation allows a Client to verify operation and Document Template attributes it be used in a later Send-Document or Send-URI request. Printers that implement

the IPP Document Object [PWG5100.5] MUST implement this operation. This operation is similar to the Validate-Job operation [STD92] except that it validates attributes used for the Send-Document or Send-URI operations. The Validate-Document operation does not create a Document object. The Validate-Document operation does not require a preceding operation since it is only validating attributes to be used later.

Clients MUST NOT supply the "document-password" operation attribute (section 6.1.3) in a Validate-Document request. Printers MUST reject a Validate-Document request supplying a "document-password" operation attribute and return the 'client-error-bad-request' status code.

5.2.1 Validate-Document Request

The following groups of attributes are supplied as part of the Validate-Document Request:

Group 1: Operation Attributes

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [STD92].

Target:

The "printer-uri" (uri) operation attribute which is the target for this operation as described in [STD92].

Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Client as described in [STD92]. In addition, the "requesting-user-uri" (section 6.1.7) attribute SHOULD be supplied by the Client as well.

"document-name" (name(MAX))

The "document-name" attribute as described for the "Send-Document" operation [STD92].

"document-format" (mimeMediaType)

The "document-format" attribute as described for the "Send-Document" operation [STD92].

Group 2: Document Template Attributes

The client MAY supply a set of Document Template attributes and SHOULD omit Group 2 rather than sending an empty group. However, a Printer MUST be able to accept an empty group.

5.2.2 Validate-Document Response

The following attributes are part of the Validate-Document Response:

Group 1: Operation Attributes

Status Message:

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

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [STD92].

"preferred-attributes" (collection):

This attribute (defined in section 6.1.6) MAY be returned when conflicts are detected in the supplied Operation and Document Template attributes.

Group 2: Unsupported Attributes

See [STD92] for details on returning Unsupported Attributes.

6. New Attributes

6.1 Operation Attributes

Table 2 lists the operation attributes defined in this specification and associated conformance requirements for Printer support.

Table 2 - New Operation Attributes

Attribute	Printer Conformance
client-info	REQUIRED
document-metadata	REQUIRED
document-password	CONDITIONALLY REQUIRED
first-index	REQUIRED
identify-actions	CONDITIONALLY REQUIRED
preferred-attributes	RECOMMENDED
requesting-user-uri	REQUIRED

6.1.1 client-info (1setOf collection)

This REQUIRED operation attribute supplies information identifying the Client and software packages contributing content to the request by name and version. For Job Creation Operations, this can include the originating application and any intermediate modules transforming the Document content or the Job Ticket. The Printer MUST copy this attribute to the corresponding Job Status attribute of the same name (section 6.4.1) when processing Job Creation operation requests.

6.1.1.1 client-name (name(MAX))

This REQUIRED member attribute supplies the human-readable name of the Client or module contributing to the request.

6.1.1.2 client-patches (text(MAX) | 'no-value')

This REQUIRED member attribute supplies the list of patches installed. A Client supplies the 'no-value' out-of-band value if there are no patches to report.

6.1.1.3 client-string-version (text(MAX))

This REQUIRED member attribute supplies the human-readable version string.

6.1.1.4 client-version (octetString(64) | 'no-value')

This REQUIRED member attribute supplies the machine-readable version value. A Client supplies the 'no-value' out-of-band value if the module has only a string version value supplied by the "client-string-version" attribute (section 6.1.1.3).

6.1.2 document-metadata (1setOf octetString(MAX))

This REQUIRED operation attribute specifies one or more keyword/value pairs describing the Document supplied in the operation. Each element in the set consists of a keyword followed by "=" and a UTF-8 value string. Standard keywords are defined in The Dublin Core Metadata Element Set [RFC5013] and DCMI Metadata Terms [DCMITERMS]. Vendor or customer-defined keywords MUST use the prefix string "x-" to avoid future keyword name conflicts, for example "x-vendor-foo" or "x-customer-bar". Figure 1 provides a complete ABNF definition. The ABNF is also available externally [ABNF].

Printers MUST copy this attribute to the corresponding Job Status (section 6.4.1) or Document Status (section 6.3.1) attribute of the same name when processing Print-Job, Print-URI, Send-Document, or Send-URI requests (section 8.7).

Figure 1 - ABNF for "document-metadata" Values

```
document-metadata = dc-elements "=" *utf8-char /
                    dc-terms "=" *utf8-char /
                    x-keyword "=" *utf8-char
```



```
dc-elements = "contributor" / "coverage" / "creator" /
              "date" / "description" / "format" /
              "identifier" / "language" / "publisher" /
              "relation" / "rights" / "source" /
              "subject" / "title" / "type"

dc-terms    = "abstract" / "accessRights" / "accrualMethod" /
              "accrualPeriodicity" / "accrualPolicy" / "alternative" /
              "audience" / "available" / "bibliographicCitation" /
              "conformsTo" / "created" / "dateAccepted" /
              "dateCopyrighted" / "dateSubmitted" / "educationLevel" /
              "extent" / "hasFormat" / "hasPart" / "hasVersion" /
              "instructionalMethod" / "isFormatOf" / "isPartOf" /
              "isReferencedBy" / "isReplacedBy" / "isRequiredBy" /
              "issued" / "isVersionOf" / "license" / "mediator" /
              "medium" / "modified" / "provenance" / "references" /
              "replaces" / "requires" / "rightsHolder" / "spatial" /
              "tableOfContents" / "temporal" / "valid"

x-keyword   = "x-" 1*(ALPHA / DIGIT / "." / "-" / "_")

utf8-char   = %x20-7E /
              %xC0-DF.80-BF /
              %xE0-EF.80-BF.80-BF /
              %xF0-F7.80-BF.80-BF.80-BF
```

6.1.3 document-password (octetString(1023))

This CONDITIONALLY REQUIRED operation attribute supplies an unencrypted passphrase, OAuth token, or other typically alphanumeric string used to "unlock" a protected PDF Document provided with the Print-Job, Print-URI, Send-Document, or Send-URI operations (section 8.7). A Printer MUST support this operation attribute if it supports the "application/pdf" MIME media type in its "document-format-supported" Printer Description attribute [STD92]. A Printer MUST support this attribute if it supports the "document-password-supported" attribute (section 6.5.1). The "document-password-supported" Printer Description attribute indicates the maximum value length the Printer will accept for a supplied "document-password" operation attribute.

While this attribute's value is necessarily associated with the Document supplied in the operation, this attribute is not part of the Job or Document object. The Printer MUST NOT provide this attribute as a Job Status, Job Description, Document Status or Document Description attribute. The Printer MUST retain this value while the corresponding Document is retained.

Printers and Clients that support this attribute MUST support Secure Transport. A Client MUST negotiate a TLS session prior to sending a request supplying this attribute. A Printer MUST negotiate a TLS session prior to accepting a request supplying this attribute.

6.1.4 first-index (integer(1:MAX))

This REQUIRED operation attribute specifies the first object or element the Printer is to provide in the response for all attributes that use a "1setOf" syntax. If a Printer supports this operation attribute, it MUST consistently order the values in all attributes implemneting a "1setOf" syntax. The first value in each set has the index 1.

6.1.5 identify-actions (1setOf type2 keyword)

This CONDITIONALLY REQUIRED operation attribute specifies the action or actions the Printer takes to identify itself in response to an Identify-Printer request (section 5.1). A Printer MUST support this operation attribute if it implements the Identify-Printer operation. Table 3 lists the keywords defined in this specification.

Table 3 - "identify-actions" Keyword Values

Keyword	Description
display	Displays a message on the Console.
flash	Flashes lights or the display on the printer.
sound	Makes a sound.
speak	Speaks the default or Client-provided message.

Note: This specification does not define a "print" action due to security and accounting concerns.

6.1.6 preferred-attributes (collection)

This RECOMMENDED operation attribute is supplied by the Printer in a Validate-Job response (section 8.10) or Validate-Document response (section 5.2) when the Printer detects constraints between attribute values supplied in the request, to provide the Client with a preferred set of non-conflicting attributes and values acceptable by the Printer. Each member attribute in the collection names an operation, Job Template, or Document Template attribute supplied in the request with the corresponding replacement value(s). A supporting Client SHOULD adopt all the values supplied by this attribute as a set.

Note: This is semantically different than the collections listed by the "job-resolvers-supported" Printer Description attribute (section 6.5.9).

6.1.7 requesting-user-uri (uri)

This REQUIRED operation attribute supplies a URI uniquely identifying the End User submitting the request to augment the "requesting-user-name" operation attribute [STD92] since its value is often not unique (e.g. "John Doe"). The Printer MAY modify the value supplied based on information obtained from an authentication service [STD92].

The value MUST be a URI using one of the schemes listed by the Printer's "requesting-user-uri-schemes-supported" Printer Description attribute (section 6.5.43). Commonly used URI

schemes include the "urn" scheme [RFC4122] to encode a UUID, and the "mailto:" URI scheme [RFC6068] to encode an email address.

6.2 Job and Document Template Attributes

Table 4 lists the Job and Document Template attributes defined in this specification and associated conformance requirements for Printer support.

Table 4 - New Job and Document Template Attributes

Attribute	Printer Conformance
job-error-action	RECOMMENDED
media-overprint	CONDITIONALLY REQUIRED
media-overprint-type	CONDITIONALLY REQUIRED
print-color-mode	REQUIRED
print-rendering-intent	CONDITIONALLY REQUIRED

6.2.1 job-error-action (type2 keyword)

This RECOMMENDED Job Template attribute specifies the action a Printer takes when it encounters a Job processing error. Table 5 lists standard keyword values.

Table 5 - "job-error-action" Keyword Values

Keyword	Description
abort-job	Stop processing the Job and move it to the 'aborted' state. The 'aborted-by-system' keyword MUST be present in the "job-state-reasons" Job Description attribute.
cancel-job	Stop processing the Job as if the Printer had accepted a Cancel-Job request [STD92] for that Job. The 'job-canceled-by-user' keyword MUST be present in the "job-state-reasons" Job Description attribute.
continue-job	Continue processing the next Document in the Job or, if this is the last Document in the Job, move the Job to the 'completed' state.
suspend-job	Stop processing the Job and move it to the 'processing-stopped' state as if the Printer had accepted a Suspend-Current-Job request [RFC3998]. The 'job-suspended-by-user' keyword MUST be present in the "job-state-reasons" Job Description attribute.

6.2.2 media-overprint(collection)

This RECOMMENDED Job Template attribute is a collection that indicates how far and by what method the Printer expands each Impression beyond the media margins to "overprint" the Impression on the media. The collection has two members: "overprint-distance" (section 6.2.2.1) and "overprint-method" (section 6.2.2.2).

6.2.2.1 media-overprint-distance(integer(0:MAX))

This member attribute supplies how far in hundredths of millimeters (1/2540th of an inch) the Printer expands each Impression beyond the selected media size's margins. If the value of this member attribute is greater than the the selected media size's margins, then the Impression will "overprint" past the physical edges of the media. The value MUST be within the range supplied by the Printer's "media-overprint-distance-supported" Printer Description attribute (section 6.5.15).

6.2.2.2 media-overprint-method (type2 keyword)

This member attribute indicates the method the Printer uses to expand each Impression beyond the selected media size's margins. Table 6 lists the defined standard keyword values and their meanings. The value MUST be one of the keywords listed by the Printer's "media-overprint-method-supported" Printer Description attribute (section 6.5.16).

Table 6 - "media-overprint-type" Keyword Values

Keyword	Description
none	Impression's size not expanded
scale	Input Page scaled to expand the Impression's size
extend	Input Page edge pixel color values "extended" outward to expand the Impression's size

Figure 2 illustrates the 'scale' overprint method, where the entire Impression is scaled up to cover the additional area specified by "overprint-distance". expand the Impression on each side of the media where overprint would occur.

Figure 2 - Extending the marked area with "media-overprint"

Figure 3 illustrates the 'extend' overprint method, where the edge pixel values are extended outward overprint regions on each side of the media where overprint would occur.

Figure 3 - Extending the marked area with "media-overprint"

6.2.3 print-color-mode (type2 keyword)

This REQUIRED Job Template attribute indicates the color mode the Printer uses when printing a Job. The Printer MUST print the Job using the requested color mode or reject the Job. Table 7 lists the keyword values defined in this specification. Unregistered keywords SHOULD follow the implementation guidance in [STD92] section 7.3.

Table 7 - "print-color-mode" Keyword Values

Keyword	Description	Conformance
auto	Automatic based on Document	REQUIRED
auto-monochrome	Printer chooses monochrome or process-monochrome based on Document	RECOMMENDED
bi-level	1-colorant (typically black) threshold output	OPTIONAL (note 1)
color	Full-color output	CONDITIONALLY REQUIRED (note 2)
highlight	1-colorant + black output	OPTIONAL
monochrome	1-colorant (typically black) shaded/grayscale output	REQUIRED
process-bi-level	Process (2 or more colorants) threshold output	OPTIONAL

process-monochrome	Process (2 or more colorants) shaded/grayscale output	OPTIONAL (note 3)

Notes:
1 - Optional because the actual appearance is implementation-specific.
2 - Required for color Printers.
3 - Optional because process black on laser printers can be problematic.

6.2.4 print-rendering-intent (type2 keyword)

This CONDITIONALLY REQUIRED Job Template attribute specifies how the Printer maps out-of-gamut colors (or shades of gray) to device colors when printing. A Printer MUST support this attribute if it supports the "printer-icc-profiles" attribute (section 6.5.32). If supported, the Printer MUST print the Job using the requested rendering intent. Table 8 lists the standard keyword values.

Table 8 - "print-rendering-intent" Keyword Values

Keyword	Description	Conformance
absolute	Clip out-of-gamut colors to preserve in-gamut accuracy without adjusting the white point.	OPTIONAL
auto	Automatically determine the rendering intent based on the Document and Job Ticket.	REQUIRED
perceptual	Map out-of-gamut colors at the expense of in-gamut accuracy.	OPTIONAL
relative	Clip out-of-gamut colors to preserve in-gamut accuracy, adjusting the white point as necessary.	REQUIRED
relative-bpc	Clip out-of-gamut colors to preserve in-gamut accuracy, adjusting both the white and black points as necessary. (bpc = Black Point Compensation)	REQUIRED
saturation	Preserve saturated colors.	OPTIONAL

6.2.5 print-scaling (type2 keyword)

This REQUIRED Job Template attribute specifies how the Printer scales the Document's Input Pages to the requested media. Table 9 lists the keywords defined in this specification.

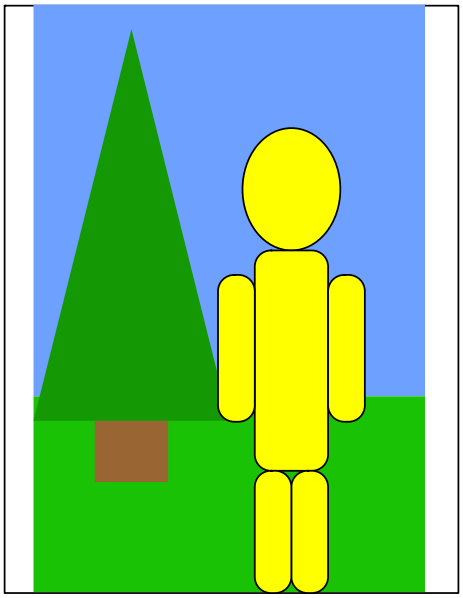
Table 9 - "print-scaling" Keyword Values

Keyword	Description

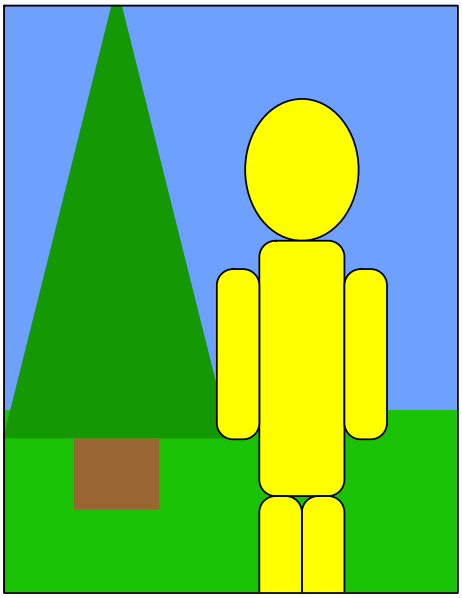
'auto'	If the “ipp-attribute-fidelity” attribute is true or the Input Pages are larger than the requested Media Sheets, scale the Document using the 'fit' method if the margins are non-zero, otherwise scale using the 'fill' method. If the “ipp-attribute-fidelity” attribute is false or unspecified and the Input Pages are smaller than the requested Media Sheets, scale using the 'none' method.
'auto-fit'	If the “ipp-attribute-fidelity” attribute is true or the Input Pages are larger than the requested Media Sheets, scale the Document using the ‘fit’ method. Otherwise, scale using the ‘none’ method.
'fill'	Scale the Document to fill the requested media size, preserving the aspect ratio of the Document data but potentially cropping portions of the Document.
'fit'	Scale the Document to fit the printable area of the requested media size, preserving the aspect ratio of the Document data without cropping the Document.
'none'	Do not scale the Document to fit the requested media size. If the Document is larger than the requested media, center and clip the resulting output. If the Document is smaller than the requested media, center the resulting output.

1147 The 'auto' value is typically the default. Figure 4 shows how a Printer scales a 3:2 aspect
1148 ratio photo image using the 'fit' and 'fill' values on US Letter and US Legal media.

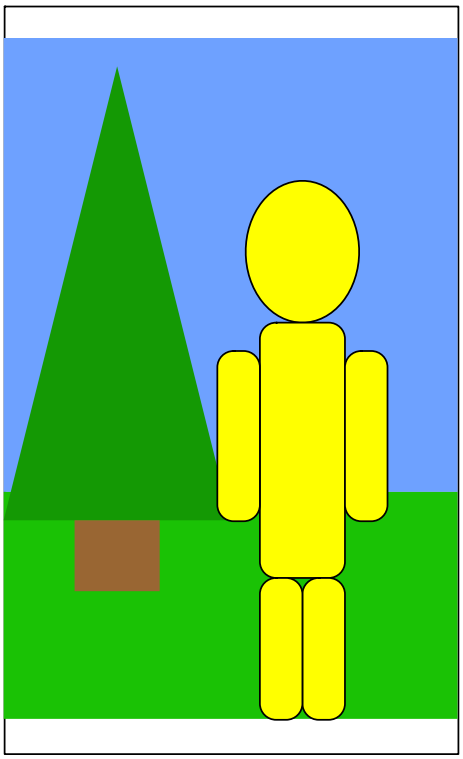
media='na_letter_8.5x11in'
print-scaling='fit'



media='na_letter_8.5x11in'
print-scaling='fill'



media='na_legal_8.5x14in'
print-scaling='fit'



media='na_legal_8.5x14in'
print-scaling='fill'

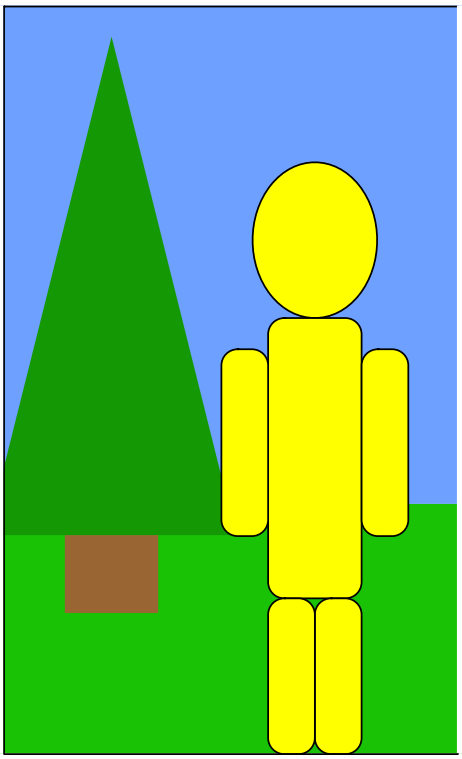


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Figure 4 - "print-scaling" Values

6.3 Document Status Attributes

Table 10 lists the Document Status attributes defined in this specification and associated conformance requirements for Printer support.

Table 10 - New Document Status Attributes

Attribute	Printer Conformance
document-metadata	CONDITIONALLY REQUIRED
document-uuid	CONDITIONALLY REQUIRED
pages	RECOMMENDED
pages-completed	RECOMMENDED

6.3.1 document-metadata (1setOf octetString(MAX))

This CONDITIONALLY REQUIRED Document Status attribute specifies one or more keyword/value pairs describing the Document. A Printer MUST support this attribute when it supports the IPP Document Object [PWG5100.5]. The Printer copies the "document-metadata" operation attribute to this attribute as described in section 8.7.

6.3.2 document-uuid (uri(45))

This CONDITIONALLY REQUIRED Document Status attribute specifies a globally unique identifier that MUST be a 45-octet "urn:uuid" URI [RFC4122]. The Printer generates the globally unique identifier when it creates a new Document object in response to a document creation operation, which can be part of a Job Creation Operation. A Printer MUST support this attribute if the Printer supports the IPP Document Object [PWG5100.5]. A Client MUST NOT use this attribute as a Document identifier in IPP Document operations. A Printer MAY use the value of this attribute as a Document identifier in other protocol bindings.

6.3.3 pages (integer(0:MAX))

This RECOMMENDED Document Status attribute indicates the total number of Input Pages for the Document. A Printer MUST support this attribute if it supports the "pages-completed" Document Status attribute (section 6.3.4).

6.3.4 pages-completed (integer(0:MAX))

This RECOMMENDED Document Status attribute indicates the total number of Input Pages of the Document that the Printer has processed. A Printer MUST support this attribute if it supports the "pages" Document Status attribute (section 6.3.3).

6.4 Job Status Attributes

Table 11 lists the Job Status attributes defined in this specification and associated conformance requirements for Printer support.

Table 11 - New Job Status Attributes

Attribute	Printer Conformance
client-info	CONDITIONALLY REQUIRED
document-metadata	CONDITIONALLY REQUIRED
job-originating-user-uri	RECOMMENDED
job-pages	RECOMMENDED
job-pages-completed	RECOMMENDED
job-uuid	REQUIRED

6.4.1 client-info (1setOf collection)

This CONDITIONALLY REQUIRED Job Status attribute lists the name and version information for the Client that created the Job, provided by the Client in the "client-info" operation attribute (section 6.1.1). If a Printer supports the "client-info" operation attribute, it MUST support this Job Status attribute.

6.4.2 document-metadata (1setOf octetString(MAX))

This CONDITIONALLY REQUIRED Job Status attribute specifies one or more keyword/value pairs describing the Document content supplied with this Job. The Printer MUST support this Job Status attribute if it doesn't support the IPP Document Object [PWG5100.5]. The Printer copies the "document-metadata" operation attribute to this attribute as defined in section 8.7.

6.4.3 job-originating-user-uri (uri)

This RECOMMENDED Job Status attribute supplies a URI that uniquely identifies the most authenticated user who instigated the Job Creation Operation as described in section 8.1.

6.4.4 job-pages (integer(0:MAX))

This RECOMMENDED Job Status attribute supplies the total number of Input Pages in all the Documents in the Job. A Printer MUST support this attribute if it supports the "job-pages-completed" Job attribute (section 6.4.5).

6.4.5 job-pages-completed (integer(0:MAX))

This RECOMMENDED Job Status attribute specifies the total number of Input Pages of the Documents in the Job the Printer has processed. A Printer MUST support this attribute if it supports the "job-pages" Job Status attribute (section 6.4.4).

6.4.6 job-uuid (uri(45))

This REQUIRED Job Status attribute specifies a globally unique identifier for the Job, which is used for tracking Jobs over a long period of time. The value MUST be a 45-octet "urn:uuid" URI [RFC4122]. The Printer generates the globally unique identifier when it creates the Job object in response to a Job Creation Operation. A Client MUST NOT use this attribute as the target in IPP Job requests. If a Printer receives an operation request supplying this attribute, then the Printer MUST reject the operation and return the 'client-error-bad-request' status code. A Printer MAY use the value of this attribute as a Job identifier for other protocol bindings.

6.5 Printer Description Attributes

Table 12 lists the Printer Description attributes defined in this specification and associated conformance requirements for Printer support.

Table 12 - New Printer Description Attributes

Attribute	Printer Conformance
document-password-supported	CONDITIONALLY REQUIRED
identify-actions-default	CONDITIONALLY REQUIRED
identify-actions-supported	CONDITIONALLY REQUIRED
ipp-features-supported	REQUIRED
jpeg-features-supported	CONDITIONALLY REQUIRED
jpeg-k-octets-supported	CONDITIONALLY REQUIRED
jpeg-features-supported	CONDITIONALLY REQUIRED
jpeg-features-supported	CONDITIONALLY REQUIRED
job-constraints-supported	RECOMMENDED
job-error-action-default	OPTIONAL
job-error-action-supported	OPTIONAL
job-presets-supported	RECOMMENDED
job-resolvers-supported	RECOMMENDED
job-triggers-supported	OPTIONAL
media-overprint-supported	OPTIONAL
media-overprint-type-supported	OPTIONAL
multiple-operation-time-out-action	OPTIONAL
pdf-k-octets-supported	CONDITIONALLY REQUIRED
pdf-features-supported	RECOMMENDED
pdf-versions-supported	CONDITIONALLY REQUIRED
preferred-attributes-supported	RECOMMENDED
print-color-mode-default	REQUIRED
print-color-mode-supported	REQUIRED
print-color-mode-icc-profiles	RECOMMENDED
print-quality-attributes-supported	OPTIONAL
print-rendering-intent-default	OPTIONAL
print-rendering-intent-supported	OPTIONAL

printer-geo-location	RECOMMENDED
printer-get-attributes-supported	REQUIRED
printer-icc-profiles	RECOMMENDED
printer-icons	REQUIRED
printer-input-tray	CONDITIONALLY REQUIRED
printer-mandatory-job-attributes	OPTIONAL
printer-organization	RECOMMENDED
printer-organizational-unit	RECOMMENDED
printer-output-tray	CONDITIONALLY REQUIRED
printer-strings-languages-supported	CONDITIONALLY REQUIRED
printer-strings-uri	CONDITIONALLY REQUIRED
requesting-user-uri-supported	RECOMMENDED

6.5.1 document-password-supported (integer(0:1023))

This OPTIONAL Printer Description attribute indicates the maximum number of octets the Printer will accept for a "document-password" operation attribute (section 6.1.3). A Printer that supports the "document-password" attribute MUST support this attribute.

Although the syntax allows a wider range of values, a Printer that supports this attribute MUST supply either a value in the range 255...1023, or 0 (zero) to indicate that the "document-password" operation attribute is not supported. A Printer MUST NOT supply a value in the range 1...254 for this attribute.

6.5.2 identify-actions-default (1setOf type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute indicates the default set of values the Printer will use for the "identify-actions" operation attribute (section 6.1.5) if the Client omits it from an Identify-Printer operation request (section 5.1). A Printer MUST support this attribute if it supports the Identify-Printer operation.

6.5.3 identify-actions-supported (1setOf type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute lists the values supported by the Printer for the "identify-actions" operation attribute (section 6.1.5). A Printer MUST support this attribute if it supports the Identify-Printer operation (section 5.1).

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

This REQUIRED Printer Description attribute lists the IPP extension features supported by the Printer. Table 13 lists the keywords defined in this specification. A Printer MUST supply 'none' if the set would otherwise be empty and MUST NOT supply the 'none' keyword if any other keyword is present.

Table 13 - "ipp-features-supported" Keyword Values

Keyword	Description

none	No extension features are supported.
document-object	IPP Document Object [PWG5100.5]
page-overrides	Page overrides from IPP Page Overrides [PWG5100.6]
production	IPP Production Printing Extensions [PWG5100.3]
subscription-object	IPP Event Notifications and Subscriptions [RFC3995]

6.5.5 job-constraints-supported (1setOf collection)

This RECOMMENDED Printer Description attribute lists collections of Job Template attributes and values that are incompatible with one another, likely causing the Printer to reject a Job Creation Operation supplying those attributes and values. A supporting Client uses these collections to recognize conflicting options and provide a resolution prior to Job Creation or validation. A Printer MUST support this attribute if it supports the “job-resolvers-supported” Printer Description attribute (section 6.5.9).

Each collection consists of two or more Job Template attributes and values that are constrained by one another, and a “resolver-name (name(MAX))” member attribute that names a matching collection in the Printer's “job-resolvers-supported” Printer Description attribute. Multiple collections in this attribute can name the same collection in “job-resolvers-supported”. Each Job Template attribute can supply more than one value to reduce the size of this attribute. Constraints for the "media-col" Job Template attribute [PWG5100.7] can be incomplete; that is, the "media-col" collection values can contain only those member attributes that contribute to the constraint.

Figure 5 illustrates how a constraint for duplex printing on transparency media could be specified by the Printer.

Figure 5 - Verbose "job-constraints-supported" and "job-resolvers-supported" Example

```
job-constraints-supported=
{
  resolver-name="A"
  sides="two-sided-short-edge"
  media-col={ media-type="transparency" }
},
{
  resolver-name="A"
  sides='two-sided-long-edge'
  media-col={ media-type='transparency' }
}

job-resolvers-supported=
{
  resolver-name="A"
  sides="one-sided"
  media-col={ media-type='stationery' }
}
```

To minimize the number of collections in "job-constraints-supported", a Printer MAY supply multiple values for each Job Template attribute named in a collection, using a "1setOf

syntax" representation, if the results will be semantically equivalent. Figure 6 illustrates a concise representation of the constraints described in Figure 5 where the number of collections in "job-constraints-supported" was able to be condensed from two to one.

Figure 6 - Concise "job-constraints-supported" and "job-resolvers-supported" Example

```
job-constraints-supported=
{
  resolver-name="A"
  sides="two-sided-long-edge","two-sided-short-edge"
  media-col={ media-type='transparency' }
}

job-resolvers-supported=
{
  resolver-name="A"
  sides="one-sided"
  media-col={ media-type='stationery' }
}
```

6.5.6 job-error-action-default (type2 keyword)

This OPTIONAL Printer Description attribute indicates the value the Printer will use for the "job-error-action" Job Template attribute (section 6.2.1) if a Client omits it from a Job Creation Operation.

6.5.7 job-error-action-supported (1setOf type2 keyword)

This OPTIONAL Printer Description attribute lists the keywords the Printer will accept for the "job-error-action" Job Template attribute (section 6.2.1).

6.5.8 job-presets-supported (1setOf collection)

This RECOMMENDED Printer Description attribute lists the collections describing the Printer's Presets. Each collection supplies a REQUIRED “preset-name” member attribute (section 6.5.8.2), a RECOMMENDED "preset-category" member attribute (section 6.5.8.1), and one or more Job Template attributes and values supported by the Printer. A Client copies all Job Template attributes and values from the selected Preset to the Job Ticket, including member attributes that the Client does not natively support, when the End User selects a Preset. The set of attribute values MUST NOT conflict with one another as described by a collection in the “job-constraints-supported” Printer Description attribute (section 6.5.5).

6.5.8.1 preset-category (type2 keyword)

This RECOMMENDED member attribute specifies the preset category. Table 14 lists the keywords defined in this specification. A Printer that supports 'print-quality' presets MUST provide a 'print-quality' preset for each value listed by its "print-quality-supported" Printer Description attribute [STD92].

Table 14 - "preset-category" Keywords

Keyword	Description
feature	A Preset that selects a particular Printer feature.
print-quality	A Preset that selects a particular print quality level or visual processing mode for the Printer.
site	A Preset defined by the local administrator for a site-specific activity or workflow.

6.5.8.2 preset-name (keyword | name(MAX))

This member attribute specifies the unique name for the Preset. Values can be localized using the message catalog provided at the URL specified by the “printer-strings-uri” Printer Description attribute (section 6.5.41) or inline if the "name" syntax is used.

6.5.8.3 Examples

Below is an example “job-presets-supported” attribute, which includes 5 collections, described using PAPI notation [PAPI]:

```
job-presets-supported={
  preset-name='draft'
  preset-category='print-quality'
  print-content-optimize='text'
  printer-resolution=300dpi
},{
  preset-name='normal'
  preset-category='print-quality'
  print-content-optimize='text-and-graphic'
  printer-resolution=600dpi
},{
  preset-name='high'
  preset-category='print-quality'
  print-content-optimize='auto'
  printer-resolution=1200dpi
},{
  preset-name='photo'
  preset-category='print-quality'
  print-content-optimize='photo'
  print-rendering-intent='relative-bpc'
  printer-resolution=1200dpi
},{
 preset-name='Marketing Flyers'
 preset-category='site'
 finishings=96(fold-letter)
 media='na_legal_8.5x14in'
 orientation-requested=4(landscape)
 print-content-optimize='text-and-graphic'
 print-rendering-intent='saturation'
 printer-resolution=1200dpi
}
```


6.5.9 job-resolvers-supported (1setOf collection)

This RECOMMENDED Printer Description attribute lists the set of collections that each provide a list of named resolutions for conflicts between constrained sets of Job Template attribute values described by the "job-constraints-supported" Printer Description attribute (section 6.5.5). The Printer MUST support this attribute if it supports the “job-constraints-supported” Printer Description attribute.

Each collection consists of a “resolver-name (name(MAX))” member attribute and one or more Job Template attributes and values that will resolve the conflict. A Client MUST only change as many Job Template attributes as are needed to resolve the constraint and MUST try each value in the order they are provided in the collection. The Printer MAY list all of the constrained attributes in order to avoid constraint/resolver loops.

Resolvers containing the "media-col" Job Template attribute [PWG5100.7] may provide an incomplete value; that is, the "media-col" collection value can contain only those member attributes that need to be changed to resolve the constraint.

The “resolver-name” member attribute value MUST be used by at least one collection in the “job-constraints-supported” attribute. Constraint resolvers MUST NOT create loops, such that the resolver for constraint “A” causes constraint “B”, but the resolver for constraint “B” causes constraint “A”.

For example, a resolver for duplex printing on transparency media would be encoded as a collection containing “resolver-name”, “sides”, and “media-col” member attributes. The “sides” member attribute would have the value 'one-sided' while the “media-col” member attribute would provide a "media-type" member attribute with the value 'stationery.

6.5.10 job-triggers-supported (1setOf collection)

This OPTIONAL Printer Description attribute lists the Triggers stored on the Printer. Each collection supplies one or more Job Template attributes with values and a "preset-name (keyword | name(MAX))" member attribute. When the attributes and values in the Job Ticket on a supporting Client match those in one of this attribute's collections, that will "trigger" the Client to select the matching Preset from the Printer's "job-presets-supported" Printer Description attribute (section 6.5.8).

6.5.10.1 Examples

Here is an example “job-triggers-supported” attribute, which includes 2 collections, described using PAPI notation [PAPI]:

```
job-triggers-supported=
{
   preset-name="draft-preset"
   media-col=
   {
      media-type='stationery-recycled'
   }
```



```
},
{
   preset-name="photo-preset"
   media-col=
   {
      media-type='photographic','photographic-glossy','photographic-matte'
   }
}
```

In this example, if the user selects the 'stationery-recycled' media type, that will trigger the Client to apply the “draft-preset” Preset from “job-presets-supported”.

6.5.11 jpeg-features-supported (1setOf type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute lists the optional features that a Printer supports for a Document identified by the "image/jpeg" MIME media type. A Printer that lists the "image/jpeg" MIME media type in its "document-format-supported" Printer Description attribute [STD92] MUST support this attribute. Table 17 lists the keywords defined in this specification.

Table 15 - "jpeg-features-supported" Keywords

Keyword	Description
'none'	The Printer only supports the baseline JFIF format; this keyword only appears by itself.
'arithmetic'	The Printer supports arithmetic encoding.
'cmyk'	The Printer supports CMYK images.
'deep'	The Printer supports more than 8 bits per component.
'icc'	The Printer supports embedded ICC profiles.
'lossless'	The Printer supports lossless JPEG encoding.
'progressive'	The Printer supports progressive encoding.

6.5.12 jpeg-k-octets-supported (rangeOfInteger(0:MAX))

This CONDITIONALLY REQUIRED Printer Description attribute indicates the minimum and maximum allowable sizes the Printer will accept for a Document identified by the "image/jpeg" MIME media type, measured in 1K octets (1024 octets or 1KB). Although this attribute is defined as a range for consistency with "job-k-octets-supported" [STD92], the lower bound for this attribute is always 0. A Printer that lists the "image/jpeg" MIME media

type in its "document-format-supported" Printer Description attribute [STD92] MUST support this attribute.

6.5.13 jpeg-x-dimension-supported (rangeOfInteger(0:65535))

This CONDITIONALLY REQUIRED Printer Description attribute indicates the maximum horizontal dimension the Printer will accept for a Document identified by the "image/jpeg" MIME media type, measured in samples per line. Per the JPEG File Information Format Version 1.02 [JFIF], the lower bound is always 0. A Printer that lists the "image/jpeg" MIME media type in its "document-format-supported" Printer Description attribute [STD92] MUST support this attribute.

6.5.14 jpeg-y-dimension-supported (rangeOfInteger(1:65535))

This CONDITIONALLY REQUIRED Printer Description attribute specifies the maximum vertical dimension the Printer will accept for a Document identified by the "image/jpeg" MIME media type, measured in lines. Per the JPEG File Information Format Version 1.02 [JFIF], the lower bound is always 1. A Printer that lists the "image/jpeg" MIME media type in its "document-format-supported" Printer Description attribute [STD92] MUST support this attribute.

6.5.15 media-overprint-distance-supported (1setOf integer(0:MAX))

This CONDITIONALLY REQUIRED Printer Description attribute indicates the range of supported values the Printer will accept for the "media-overprint-distance" member (section 6.2.2.1) of the "media-overprint" Job Template attribute (section 6.2.2). If the Printer supports the "media-overprint" attribute, then it MUST support this attribute.

6.5.16 media-overprint-method-supported (1setOf type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute indicates the keywords the Printer will accept for the "media-overprint-method" member (section 6.2.2.2) of the "media-overprint" Job Template attribute (section 6.2.2). A Printer supporting the "media-overprint" attribute MUST support either 'scale' or 'extend', and MAY support both. If the Printer supports the "media-overprint" attribute, then it MUST support this attribute.

6.5.17 multiple-operation-time-out-action (type2 keyword)

This CONDITIONALLY REQUIRED Printer Description attribute indicates the action the Printer takes when an "open" Job (e.g. instantiated but not completed) times out. A Printer that supports the Create-Job operation [STD92] MUST support this attribute. Table 16 lists the available actions.

Table 16 - "multiple-document-time-out-action" Keyword Values

Keyword	Description

abort-job	The Printer closes the Job, moves it to the 'aborted' state, and adds the 'aborted-by-system' keyword to the Job's "job-state-reasons" Job Description attribute [STD92].
hold-job	The Printer closes the Job, moves it to the 'pending-held' state, adds the 'job-hold-until-specified' keyword to the Job's "job-state-reasons" Job Description attribute [STD92] , and sets the Job's "job-hold-until" Job Template attribute to 'indefinite'.
process-job	The Printer closes the Job and moves it to the 'pending' or 'processing' state, if the Job has more than one Document. If the Job has no Documents, the Printer takes the action described for the 'abort-job' keyword.

1450 **6.5.18 pdf-k-octets-supported (rangeOfInteger(0:MAX))**

1451 This CONDITIONALLY REQUIRED Printer Description attribute indicates the minimum and
1452 maximum allowable sizes the Printer will accept for a Document identified by the
1453 "application/pdf" MIME media type, measured in 1K octets (1024 octets or 1KB). Although
1454 this attribute is defined as a range for consistency with "job-k-octets-supported" [STD92],
1455 the lower bound for this attribute is always 0. A Printer that lists the "application/pdf" MIME
1456 media type in its "document-format-supported" Printer Description attribute [STD92] MUST
1457 support this attribute.

1458 **6.5.19 pdf-versions-supported (1setOf type2 keyword)**

1459 This CONDITIONALLY REQUIRED Printer Description attribute lists the Printer's support
1460 for the requirements in the listed specifications. A Printer that lists the "application/pdf" MIME
1461 media type in its "document-format-supported" Printer Description attribute [STD92] MUST
1462 support this attribute. Table 17 lists the keywords defined in this specification.

1463 **Table 17 - "pdf-versions-supported" Keywords**

Keyword	Description
'none'	PDF files are not supported; this keyword only appears by itself.
'adobe-1.3'	Adobe PDF Language Reference, Version 1.3 [ADOBEPDF1.3]
'adobe-1.4'	Adobe PDF Language Reference, Version 1.4 [ADOBEPDF1.4]
'adobe-1.5'	Adobe PDF Language Reference, Version 1.5 [ADOBEPDF1.5]
'adobe-1.6'	Adobe PDF Language Reference, Version 1.6 [ADOBEPDF1.6]
'adobe-1.7'	Adobe PDF Language Reference, Version 1.7 [ADOBEPDF1.7] Equivalent to 'iso-32000-1_2008'.

'iso-15930-1_2001'	"Graphic technology -- Prepress digital data exchange -- Use of PDF -- Part 1: Complete exchange using CMYK data (PDF/X-1 and PDF/X-1a)" [ISO15930-1]
'iso-15930-3_2002'	"Graphic technology -- Prepress digital data exchange -- Use of PDF -- Part 3: Complete exchange suitable for colour-managed workflows (PDF/X-3)" [ISO15930-3]
'iso-15930-4_2003'	"Graphic technology -- Prepress digital data exchange using PDF -- Part 4: Complete exchange of CMYK and spot colour printing data using PDF 1.4 (PDF/X-1a)" [ISO15930-4]
'iso-15930-6_2003'	"Graphic technology -- Prepress digital data exchange using PDF -- Part 6: Complete exchange of printing data suitable for colour-managed workflows using PDF 1.4 (PDF/X-3)" [ISO15930-6]
'iso-15930-7_2010'	"Graphic technology -- Prepress digital data exchange using PDF -- Part 7: Complete exchange of printing data (PDF/X-4) and partial exchange of printing data with external profile reference (PDF/X-4p) using PDF 1.6" [ISO15930-7]
'iso-15930-8_2010'	"Graphic technology -- Prepress digital data exchange using PDF -- Part 8: Partial exchange of printing data using PDF 1.6 (PDF/X-5)" [ISO15930-8]
'iso-16612-2:2010'	"Graphic technology -- Variable data exchange -- Part 2: Using PDF/X-4 and PDF/X-5 (PDF/VT-1 and PDF/VT-2)" [ISO16612-2]
'iso-19005-1_2005'	"Document Management – Electronic document file format for long term preservation – Part 1: Use of PDF 1.4 (PDF/A-1)" [ISO19005-1]
'iso-19005-2_2011'	"Document management – Electronic document file format for long-term preservation – Part 2: Use of ISO 32000-1 (PDF/A-2)" [ISO19005-2]
'iso-19005-3_2012'	"Document management -- Electronic document file format for long-term preservation -- Part 3: Use of ISO 32000-1 with support for embedded files (PDF/A-3)" [ISO19005-3]
'iso-23504-1_2020'	"Document management applications — Raster image transport and storage — Part 1: Use of ISO 32000 (PDF/R-1)" [ISO23504-1]
'iso-32000-1_2008'	"Document management—Portable document format—Part 1: PDF 1.7" [ISO32000-1]

'iso-32000-2_2017'	"Document management—Portable document format—Part 1: PDF 2.0" [ISO32000-2]
'pwg-5102.3'	"Portable Document Format: Image Streamable (PDF/is) [PWG5102.3]

6.5.20 preferred-attributes-supported (boolean)

This RECOMMENDED Printer Description attribute indicates whether the Printer supports the "preferred-attributes" operation attribute (section 6.1.6) in a Validate-Job (section 8.10) or Validate-Document (section 5.2) operation response.

6.5.21 print-color-mode-default (type2 keyword)

This REQUIRED Printer Description attribute indicates the default value supplied by the Printer if a Client omits the "print-color-mode" Job Template attribute (section 6.2.3) from a Job Creation Operation.

6.5.22 print-color-mode-supported (1setOf type2 keyword)

This REQUIRED Printer Description attribute lists the Printer's supported "print-color-mode" keywords. A Printer MUST support this attribute if it supports the "print-color-mode" Job Template attribute (section 6.2.3).

If unregistered keywords are among those listed by this attribute, the Printer SHOULD supply for all unregistered keywords:

- A preview ICC profile listed by its "print-color-mode-icc-profiles" Printer Description attribute (section 6.5.23);
- A localized user-presentable label in the message catalogs (section 11.1) referenced by the Printer's "printer-strings-uri" Printer Description attribute (section 6.5.41);
- Supply localized "tooltip" contextual help content (section 11.2) in the message catalogs (section 11.1) referenced by the Printer's "printer-strings-uri" Printer Description attribute (section 6.5.41).

6.5.23 print-color-mode-icc-profiles (1setOf collection)

This RECOMMENDED Printer Description attribute lists a set of collections that each supply a reference to an ICC profile for previewing the color transformation the Printer will perform when a Client supplies the corresponding "print-color-mode" keyword in a Job Creation Operation. The profiles listed by this attribute are for previewing color transformations, not for color management, which are supplied by the "printer-icc-profiles" Printer Description attribute (section 6.5.32), as discussed in section 4.5.

A Printer SHOULD support this attribute if its "print-color-mode-supported" Printer Description attribute (section 6.5.22) lists unregistered keywords. Each collection in the set MUST have a unique "print-color-mode" value.

6.5.23.1 print-color-mode (type2 keyword)

This REQUIRED member attribute names the print color mode. The Printer MUST supply a keyword listed by the Printer's "print-color-mode-supported" attribute (section 6.5.22).

6.5.23.2 profile-uri (uri)

This REQUIRED member attribute references a Printer Resident or Site Local ICC color profile for previewing the color mode named by the collection's "print-color-mode" member attribute (section 6.5.23.1). The Printer MUST supply an "https" or "http" scheme URI for this member attribute. The Printer SHOULD supply a URI that follows the Printer resources best practices in section 12.2.

6.5.24 print-processing-attributes-supported (1setOf keyword)

This REQUIRED attribute lists the Job and Document Template attributes that specify processing variables such as algorithms, rendering behaviors, and resource limits, to enable a Client to present these in a group to the End User. Printers that support the "media-overprint" (section 6.2.2), "print-color-mode" (section 6.2.3), “print-content-optimize” [PWG5100.7], "print-darkness" [IPPLABEL], “print-rendering-intent” (section 6.2.4), "print-speed" [IPPLABEL], and/or “printer-resolution” [STD92] Job Template attributes MUST list the supported attribute names in the "print-processing-attributes-supported" attribute. Other attribues, such as "media", "copies", "sides", "finishings" etc. that do not directly pertain tothis domain MUST NOT be listed.

Vendor-defined Job or Document Template attributes can be listed as well. All attributes listed by this attribute MUST use the 'boolean', 'enum', 'integer', 'keyword' or 'resolution' syntax types. Vendor-defined Printer Description attributes MUST use the 'boolean', '1setOf enum', '1setOf integer | rangeOfInteger', '1setOf keyword', or '1setOf resolution' types.

6.5.25 print-rendering-intent-default (type2 keyword)

This OPTIONAL Printer Description attribute indicates the value the Printer will use for the "print-rendering-intent" Job Template attribute (section 6.2.4) if the Client omits it from a Job Creation Operation.

6.5.26 print-rendering-intent-supported (1setOf type2 keyword)

This OPTIONAL Printer Description attribute lists the keywords the Printer supports for "print-rendering-intent" Job Template attribute (section 6.2.4). The Printer MUST list the 'relative' and 'relative-bpc' keywords.

6.5.27 print-scaling-default (type2 keyword)

This REQUIRED Printer Description attribute indicates the value the Printer will use for the "print-scaling" Job Template attribute (section 6.2.5) if the Client omits it from a Job Creation Operation.

6.5.28 print-scaling-supported (1setOf type2 keyword)

This REQUIRED Printer Description attribute lists the values the Printer will accept for the "print-scaling" Job Template attribute (section 6.2.5).

6.5.29 printer-dns-sd-name (name(63))

This REQUIRED Printer Description attribute provides the Printer's DNS-SD Instance Name [RFC6763]. For example, if the Printer registers its service instance “My Specific Printer._ipp._tcp.local.”, this attribute would supply “My Specific Printer”.

Printers that support changing the value using the Set-Printer-Attributes operation MUST list "printer-dns-sd-name" in the "printer-settable-attributes-supported" Printer attribute [RFC3380]. When a new name is set, the Printer MUST re-register all DNS-SD services associated with it. However, if the new name causes a collision with other network devices, the Printer MUST replace the value set with a non-conflicting name as required by Multicast DNS [RFC6762].

Note: Changing the DNS-SD Instance Name will cause Clients configured with DNS-SD print queues to suffer service outages due to SRV record resolution failures, and might prevent Users from recognizing the Printer during discovery / re-discovery.

6.5.30 printer-geo-location (uri | unknown)

This RECOMMENDED Printer Description attribute supplies the location of the associated device using a “geo:” URI scheme [RFC5870]. A Printer MUST supply the ’unknown’ out-of-band value [STD92] when its location has not been set. A Printer that supports this attribute MUST provide a way to set the location manually. If a Printer supports changing the value using the Set-Printer-Attributes operation [RFC3380], it MUST list "printer-geo-location" in the "printer-settable-attributes-supported" Printer Description attribute [RFC3380].

6.5.31 printer-get-attributes-supported (1setOf keyword)

This REQUIRED Printer Description attribute lists the operation and Job Template attributes the Printer will use to filter the set of attributes it returns in a Get-Printer-Attributes operation response. The "document-format" value is REQUIRED for all Printers to conform to IPP/1.1 [STD92]. All other values are OPTIONAL.

6.5.32 printer-icc-profiles (1setOf collection)

This RECOMMENDED Printer Description attribute lists the set of ICC profiles that characterize the Printer's rendering capabilities. Each collection supplies a "profile-name

(name(MAX))" member attribute and a "profile-uri (uri)" member attribute. A collection MAY also supply Job Template attributes and values that contribute to the Printer selecting that profile when processing a Job.

A Client uses these ICC profiles for Client-side color proofing and/or color management. The set of ICC profiles MAY be externally managed via IPP or other protocols.

6.5.32.1 profile-name (name(MAX))

This REQUIRED member attribute provides a unique name for a given ICC profile. A given "profile-name" value MAY appear in multiple collection values but MUST always be paired with the same "profile-uri" value. That is, a "profile-name" of "Glossy Paper, High Quality" might be listed multiple times but will always refer to the same "profile-uri", for example "https://example.com/glossy-high.icc".

The "profile-name" value SHOULD be localized by the Printer based on the value of the "attributes-natural-language" operation attribute.

6.5.32.2 profile-uri (uri)

This REQUIRED member attribute references an ICC color profile as a "https:" or "http:" URI. Standard vendor-supplied profiles SHOULD be Printer Resident so that Client printing does not require access to hosts other than the one hosting the Printer. The Printer SHOULD supply a URI that follows the Printer resources best practices in section 12.2.

6.5.33 printer-icons (1setOf uri)

This REQUIRED Printer Description attribute lists URIs for one or more Printer Resident icon images. The Printer MUST supply URIs that use the "https" or "http" scheme. The Printer SHOULD supply URIs that follow the Printer resources best practices in section 12.2.

The referenced images MUST be RGBA PNG [RFC2083] format, have square dimensions of 48x48, 128x128, or 512x512 pixels, represent the physical appearance of the Printer, provide an alpha channel to mask the background surrounding the Printer, and all show the same perspective/view of the Printer. If the Printer only supplies a reference to one image, that image MUST have dimensions of 128x128 pixels. A Printer MUST list images from smallest to largest dimensions.

6.5.34 printer-input-tray (1setOf octetString(MAX))

This CONDITIONALLY REQUIRED Printer Description attribute lists a set of text strings that describe the Printer's currently available input sources. Each string contains an unordered sequence of key/value pairs, structured according to the ABNF [STD68] in Figure 7. Table 18 lists the keys defined in this specification, derived from the relevant machine-readable (non-localized) columnar objects of each prtInputEntry from the prtInputTable object defined in IETF Printer MIB v2 [RFC3805]. A Printer MAY supply site-unique or vendor-unique

information using the "input-ext" rule defined in the ABNF. The ABNF is also available externally [ABNF].

Table 18 - "printer-input-tray" Keys

Key	IPP Datatype	Printer MIB Object	Conformance
level	Integer	prtInputCurrentLevel	REQUIRED
maxcapacity	Integer	prtInputMaxCapacity	REQUIRED
mediafeed	Integer	prtInputMediaDimFeedDirDeclared	REQUIRED
mediaxfeed	Integer	prtInputMediaDimXFeedDirDeclared	REQUIRED
name	String	prtInputName	REQUIRED
status	Integer	prtInputStatus	REQUIRED
type	String	prtInputType	REQUIRED
unit	String	prtInputCapacityUnit	RECOMMENDED
dimunit	String	prtInputDimUnit	RECOMMENDED
mediacolor	String	prtInputMediaColor	RECOMMENDED (1)
medianame	String	prtInputMediaName	RECOMMENDED (1)
mediatype	String	prtInputMediaType	RECOMMENDED (1)
mediaweight	Integer	prtInputMediaWeight	OPTIONAL (2)
index	Integer	prtInputIndex	DEPRECATED (3)

Notes:

1. RECOMMENDED because often unknown to the Printer.
2. OPTIONAL because most Printers can't sense loaded media weight.
3. DEPRECATED because correlation with the original MIB order is unimportant.

A Printer MUST support this attribute if it supports the "media-source" member attribute or the "media-source-properties" member attribute for the "media-col-ready" and "media-col-database" Printer Description attributes [PWG5100.7]. If supported, this attribute MUST have the same cardinality (contain the same number of values) as the "media-source-supported" Printer Description attribute [PWG5100.7]. The i^{th} value in the "printer-input-tray" attribute corresponds to the i^{th} value in the "media-source-supported" attribute.

A Printer MUST encode the values of "printer-input-tray" using printable characters from the Net-ASCII subset of the US-ASCII character set [RFC5198]. A Printer MUST NOT supply values that contain characters in the range 0x00 - 0x1F or 0x7F.

Figure 7 - ABNF for "printer-input-tray" Values

```
printer-input-tray  = *input-required *[input-optional]
    ; set of input elements encoded into one value

input-required      = input-req ";"
input-req           = input-type /
                      input-media-feed /
                      input-media-xfeed /
                      input-max-capacity /
                      input-level /
                      input-status /
                      input-name
```



```
input-optional      = input-opt ";"
input-opt           = input-index /
                      input-dim-unit /
                      input-unit /
                      input-media-name /
                      input-media-weight /
                      input-media-type /
                      input-media-color /
                      input-ext

input-type          = "type" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g.,
    ; 'sheetFeedAutoRemovableTray') of prtInputType in [RFC3805] mapped
    ; indirectly from the *label* in PrtInputTypeTC in [IANAPRT]

input-media-feed    = "mediafeed" "=" 1*[DIGIT / "-"]
    ; integer value as a numeric string mapped directly from
    ; prtInputMediaDimFeedDirDeclared in [RFC3805]

input-media-xfeed   = "mediaxfeed" "=" 1*[DIGIT / "-"]
    ; integer value as a numeric string mapped directly from
    ; prtInputMediaDimXFeedDirDeclared in [RFC3805]

input-max-capacity  = "maxcapacity" "=" 1*[DIGIT / "-"]
    ; integer value as a numeric string mapped directly from
    ; prtInputMaxCapacity in [RFC3805]

input-level         = "level" "=" 1*[DIGIT / "-"]
    ; integer value as a numeric string mapped directly from
    ; prtInputCurrentLevel in [RFC3805]

input-status        = "status" "=" 1*DIGIT
    ; integer value as a numeric string mapped directly from
    ; prtInputStatus in [RFC3805]

input-name          = "name" "=" 1*ALPHA
    ; string value as an alpha string mapped directly from
    ; prtInputName in [RFC3805]


input-dim-unit      = "dimunit" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'other') of
    ; prtInputDimUnit in [RFC3805] mapped indirectly from
    ; the *label* in PrtMediaUnitTC in [RFC3805]

input-unit          = "unit" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'other') of
    ; prtInputCapacityUnit in [RFC3805] mapped indirectly from
    ; the *label* in PrtCapacityUnitTC in [RFC3805]

input-media-name    = "medianame" "=" 1*ALPHA
    ; string value as an alpha string mapped directly from
    ; prtInputMediaName in [RFC3805]

input-media-weight  = "mediaweight" "=" 1*[DIGIT / "-"]
```



```
    ; integer value as a numeric string mapped directly from
    ; prtInputMediaWeight in [RFC3805]

input-media-type    = "mediatype" "=" 1*ALPHA
    ; string value as an alpha string mapped directly from
    ; prtInputMediaType in [RFC3805]

input-media-color   = "mediacolor" "=" 1*ALPHA
    ; string value as an alpha string mapped directly from
    ; prtInputMediaColor in [RFC3805]

input-ext           = input-extname "=" input-extvalue
input-extname       = 1*[ALPHA / DIGIT / "-"]
input-extvalue      = 1*[ALPHA / DIGIT / "-" / "." / ","]
    ; extension point for other MIB values not mapped


input-index        = "index" "=" 1*DIGIT
    ; integer value as a numeric string mapped directly from
    ; prtInputIndex in [RFC3805] (DEPRECATED)
```

6.5.34.1 Example of printer-input-tray

Figure 8 shows two rows of the machine-readable (non-localized) columnar objects from prtInputTable encoded into corresponding values of "printer-input-tray", presented using the "PAPI" textual syntax encoding [PAPI]. For readability, double-quotes (") are added at the start and end of each string, and line breaks are added after each semicolon. These are not encoded in the values.

Figure 8 - Example values for "printer-input-tray"

```
printer-input-tray[1] = "type=sheetFeedAutoRemovableTray;
                         mediafeed=110000;mediaxfeed=85000;
                         maxcapacity=500;
                         level=100;
                         status=8;
                         name=Tray1;
                         index=1;
                         dimunit=tenThousandthsOfInches;
                         unit=sheets;
                         medianame=na-letter;
                         mediaweight=-2;
                         mediatype=stationery;
                         mediacolor=blue;"

printer-input-tray[2] = "type=sheetFeedAutoRemovableTray;
                         mediafeed=110000;
                         mediaxfeed=85000;
                         maxcapacity=100;
                         level=20;
                         status=8;
                         name=Tray2;
                         index=2;
```



```
dimunit=tenThousandthsOfInches;
unit=sheets;
medianame=na-letter;
mediaweight=-2;
mediatype=photographic;
mediacolor=white;"
```

6.5.35 printer-kind (1setOf type2 keyword | name(MAX))

This REQUIRED Printer Description attribute lists the categories of printing that are supported by the Printer. This information is typically used to conveniently determine whether a Printer supports the kind of printing required by the Client software. Name values define site- or vendor-specific categories while keywords define standard categories. Table 18 lists the keywords defined in this specification.

Table 19 - "printer-kind" Keyword Values

Keyword	Description
'disc'	Supports printing on optical discs such as printable CD-Rs and DVD-Rs
'document'	Supports printing regular document printing on standard cut sheet media such as US Letter, US Legal, US Tabloid, ISO A4, and ISO A3 media
'envelope'	Supports printing on envelopes
'label'	Supports printing on cut labels
'large-format'	Supports printing on cut sheet sizes and roll media larger than ISO A3
'photo'	Supports printing with photographic print quality
'postcard'	Supports printing on postcards
'receipt'	Supports printing receipts on continuous rolls
'roll'	Supports printing Documents or photos on continuous rolls, typically on large-format printers

Printers that support changing the value using the Set-Printer-Attributes operation MUST list "printer-kind" in the "printer-settable-attributes-supported" Printer attribute [RFC3380]. The Get-Printer-Supported-Values operation returns the factory default category values for the Printer.

6.5.36 printer-mandatory-job-attributes (1setOf keyword)

This OPTIONAL Printer Description attribute lists the Job Template and operation attributes a Client MUST supply for a successful Job Creation operation. A Printer MAY reject the Job Creation Operation if the Client does not supply these attributes.

6.5.37 printer-organization (text(MAX))

This REQUIRED Printer Description attribute specifies the name of the organization (e.g., company, university, social club, etc.) that is administratively associated with this Printer. This attribute is semantically equivalent to the 'o' attribute type in the LDAP User Schema [RFC4519].

6.5.38 printer-organizational-unit (text(MAX))

This REQUIRED Printer Description attribute specifies the name of the organizational unit (e.g., 'Human Resources', 'Finance', etc.) that is functionally associated with this Printer. This attribute is semantically equivalent to the 'ou' attribute type in the LDAP User Schema [RFC4519].

6.5.39 printer-output-tray (1setOf octetString(MAX))

This CONDITIONALLY REQUIRED Printer Description attribute lists a set of text strings that describe the Printer's currently available output destinations. Each string contains an unordered sequence of key/value pairs, structured according to the ABNF [STD68] in Figure 9. Table 20 lists the keys defined in this specification, which are derived from the relevant machine-readable (non-localized) columnar objects of each prtOutputEntry from the prtOutputTable object defined in IETF Printer MIB v2 [RFC3805]. A Printer MAY supply site-unique or vendor-unique information using the "output-ext" rule defined in the ABNF. The ABNF is also available externally [ABNF].

Table 20 - "printer-output-tray" Keys

Key	IPP Datatype	Printer MIB Object	Conformance
maxcapacity	Integer	prtOutputMaxCapacity	REQUIRED
name	String	prtOutputName	REQUIRED
pagedelivery	String	prtOutputPageDeliveryOrientation	REQUIRED (1)
remaining	Integer	prtOutputRemainingCapacity	REQUIRED
stackingorder	String	prtOutputStackingOrder	REQUIRED (1)
status	Integer	prtOutputStatus	REQUIRED
type	String	prtOutputType	REQUIRED
unit	String	prtOutputCapacityUnit	RECOMMENDED
offsetstacking	String	prtOutputOffsetStacking	CONDITIONALLY REQUIRED (2)
index	Integer	prtOutputIndex	DEPRECATED (3)

Notes:

1. REQUIRED to support Client provided media load instructions for manual duplexing, envelope, and form printing.
2. CONDITIONALLY REQUIRED for output destinations that support jog offsets.
3. DEPRECATED because correlation with the original MIB order is unimportant.

A Printer MUST support this attribute if it supports the "output-bin" attribute [PWG5100.2]. If supported, this attribute MUST have the same cardinality (contain the same number of values) as the "output-bin-supported" Printer Description attribute [PWG5100.2]. The i^{th} value in this attribute corresponds to the i^{th} value in the "output-bin-supported" attribute.

A Printer MUST encode the values of "printer-output-tray" using printable characters from the Net-ASCII subset of the US-ASCII character set [RFC5198]. A Printer MUST NOT supply values containing control characters (0x00 - 0x1F and 0x7F).

Figure 9 - ABNF for "printer-output-tray" Values

```
printer-output-tray = *output-required *[output-optional]
    ; set of output elements encoded into one value

output-required     = output-req ";"
output-req          = output-type /
                      output-max-capacity /
                      output-page-delivery /
                      output-remaining /
                      output-stacking-order /
                      output-status /
                      output-name

output-optional     = output-opt ";"

output-opt          = output-index /
                      output-unit /
                      output-offset-stacking /
                      output-ext

output-type         = "type" "=" 1*ALPHA
    ; enumerated value as an alpha string
    ; (e.g., 'removableBin') of prtOutputType
    ; in [RFC3805] mapped indirectly from
    ; the *label* in PrtOutputTypeTC in [IANAPRT]

output-max-capacity = "maxcapacity" "=" 1*[DIGIT / "-"]
    ; integer value as a numeric string mapped directly from
    ; prtOutputMaxCapacity in [RFC3805]

output-remaining    = "remaining" "=" 1*[DIGIT / "-"]
    ; integer value as a numeric string mapped directly from
    ; prtOutputRemainingCapacity in [RFC3805]

output-status       = "status" "=" 1*DIGIT
    ; integer value as a numeric string mapped directly from
    ; prtOutputStatus in [RFC3805]

output-name         = "name" "=" 1*ALPHA
    ; string value as an alpha string mapped directly from
    ; prtOutputName in [RFC3805]

output-index        = "index" "=" 1*DIGIT
    ; integer value as a numeric string mapped directly from
    ; prtOutputIndex in [RFC3805]

output-unit         = "unit" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'other') of
    ; prtOutputCapacityUnit in [RFC3805] mapped indirectly from
    ; the *label* in PrtCapacityUnitTC in [RFC3805]

output-stacking-order = "stackingorder" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'firstToLast') of
    ; prtOutputStackingOrder in [RFC3805] mapped indirectly from
    ; the *label* in PrtOutputStackingOrderTC in [RFC3805]
```



```
output-page-delivery = "pagedelivery" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'faceUp') of
    ; prtOutputPageDeliveryOrientation in [RFC3805] mapped indirectly
    ; from the *label* in PrtOutputPageDeliveryOrientationTC in
    ; [RFC3805]

output-offset-stacking = "offsetstacking" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'notPresent') of
    ; prtOutputOffsetStacking in [RFC3805] mapped indirectly from
    ; the *label* in PresentOnOff in [RFC3805]

output-ext           = output-extname "=" output-extvalue
output-extname       = 1*[ALPHA / DIGIT / "-"]
output-extvalue      = 1*[ALPHA / DIGIT / "-" / "." / ","]
    ; extension point for other MIB values not mapped
```

6.5.39.1 Example of printer-output-tray

Figure 10 shows two rows of the machine-readable (non-localized) columnar objects from prtOutputTable encoded into corresponding values of "printer-output-tray", presented using the "PAPI" textual syntax encoding [PAPI].

Note: Line breaks are shown below for readability of this example. The 'nl' (0x0A) and 'lf' (0x0D) characters are among those disallowed for "printer-output-tray".

Figure 10 - Example values for "printer-output-tray"

```
printer-output-tray[1] = type=removableBin;
                         maxcapacity=500;
                         remaining=-3;
                         status=12;
                         name=LeftOutputBin;
                         index=1;
                         unit=sheets;
                         stackingorder=firstToLast;
                         pagedelivery=faceDown;
                         offsetstacking=notPresent;

printer-output-tray[2] = type=removableBin;
                         maxcapacity=300;
                         remaining=-3;
                         status=0;
                         name=RightOutputBin;
                         index=2;
                         unit=sheets;
                         stackingorder=firstToLast;
```



```
                                pagedelivery=faceDown;
                                offsetstacking=notPresent;
```

6.5.40 printer-strings-languages-supported (1setOf naturalLanguage)

This CONDITIONALLY REQUIRED Printer Description attribute lists the set of languages supported by the "printer-strings-uri" Printer Description attribute (section 6.5.41). The Printer MUST support this attribute if it supports the "printer-strings-uri" attribute.

6.5.41 printer-strings-uri (uri | no-value)

This CONDITIONALLY REQUIRED Printer Description attribute references a message catalog file (section 11.1) that supplies a Client with localized string values for keywords, enums, and other data types. A Printer MUST support this attribute if it supports unregistered attributes or unregistered values for standard attributes.

If supported, the Printer MUST return a URI corresponding to the language specified by the "attributes-natural-language" operation attribute or the no-value out-of-band value if the Printer does not have a localization for the specified language but otherwise supports the attribute. The Printer MUST supply an "https" or "http" scheme URI. The Printer SHOULD supply a URI that follows the Printer resources best practices in section 12.2.

Printers SHOULD provide localized string values for all supported Job Template attributes, keywords, and enums as well as localized string values for "document-state-reasons", "job-state-reasons", "notify-event", and "printer-state-reasons" keywords to help ensure all localized string values use the same language.

A Printer MUST support this attribute if it supports the "printer-strings-languages-supported" (section 6.5.40) attribute.

6.5.42 requesting-user-uri-supported (boolean)

This REQUIRED Printer Description attribute specifies whether the "requesting-user-uri" (section 6.1.7) operation, "job-originating-user-uri" (section 6.4.1) Job Description, and "notify-subscriber-user-uri" (section 6.7.2) Subscription Description attributes are supported. Printers MUST supply a value of 'true'.

6.5.43 requesting-user-uri-schemes-supported (1setOf uriScheme)

This RECOMMENDED Printer Description attribute lists the schemes the Printer supports for the "requesting-user-uri" operation attribute (section 6.1.7).

A Printer that supports this attribute SHOULD support the 'mailto' [RFC6068] and 'urn' schemes [RFC4122] [STD92].

6.6 Printer Status Attributes

Table 21 lists the Printer Status attributes defined in this specification, each with its corresponding conformance requirements.

Table 21 - New Printer Status Attributes

Attribute	Conformance
device-service-count	DEPRECATED
device-uuid	REQUIRED
printer-config-change-date-time	REQUIRED
printer-config-change-time	REQUIRED
printer-firmware-name	RECOMMENDED
printer-firmware-patches	CONDITIONALLY REQUIRED
printer-firmware-string-version	CONDITIONALLY REQUIRED
printer-firmware-version	CONDITIONALLY REQUIRED
printer-supply	CONDITIONALLY REQUIRED
printer-supply-description	CONDITIONALLY REQUIRED
printer-supply-info-uri	CONDITIONALLY REQUIRED
printer-uuid	CONDITIONALLY REQUIRED

6.6.1 device-service-count (integer(1:MAX))

This DEPRECATED Printer Status attribute indicates the number of Printer instances supported by the Imaging Device.

6.6.2 device-uuid (uri(45))

This REQUIRED Printer Status attribute supplies the globally unique identifier for the Imaging Device. The Printer MUST supply a 45-octet "urn:uuid:" URI [RFC4122].

6.6.3 printer-config-change-date-time (dateTime | 'unknown')

This REQUIRED Printer Status attribute supplies the most recent time any of the Printer's Printer Description attributes were changed, causing a 'printer-config-changed' Printer Event. The Printer updates this attribute's value with the value of its "printer-current-time" [STD92] attribute at power-up and whenever the 'printer-config-changed' Printer Event occurs.

After power-up, until the Printer has its clock set via whatever means it implements to do so, the "printer-current-time" Printer Status attribute will report the 'unknown' out-of-band value [STD92] and this attribute will also report the 'unknown' out-of-band value until the clock is set.

6.6.4 printer-config-change-time (integer(1:MAX))

This REQUIRED Printer Status attribute indicates the most recent time any of the Printer's Printer Description attributes were changed, causing a 'printer-config-changed' Printer Event. The Printer updates this attribute's value with the value of its "printer-up-time" Printer Status attribute [STD92] at power-up and whenever the 'printer-config-changed' Printer Event occurs.

6.6.5 printer-firmware-name (1setOf name(MAX))

This RECOMMENDED Printer Status attribute lists the set of names for each of the Printer's firmware components. This attribute is derived from the "FirmwareName" HCD Health Assessment attribute [PWG5110.1].

6.6.6 printer-firmware-patches (1setOf text(MAX))

This REQUIRED Printer Status attribute lists the set of patches applied to each of the Printer firmware components named by the "printer-firmware-name" Printer Status attribute (section 6.6.5). This attribute is derived from the "FirmwarePatches" HCD Health Assessment attribute [PWG5110.1]. A Printer MUST support this attribute if it supports the "printer-firmware-name" attribute. If this attribute is supported, this attribute MUST have the same cardinality (contain the same number of values) as the "printer-firmware-name" attribute. The ith value in this attribute corresponds to the ith value in the "printer-firmware-name" attribute. A supporting Printer MAY supply a zero-length value for the corresponding firmware that has no patches applied.

6.6.7 printer-firmware-string-version (1setOf text(MAX))

This REQUIRED Printer Status attribute lists the set of version strings for each of the Printer firmware components named by the "printer-firmware-name" Printer Status attribute (section 6.6.5), represented as a textual string. The format is implementation-defined and not intended for machine consumption. This attribute is derived from the "FirmwareStringVersion" HCD Health Assessment attribute [PWG5110.1]. A Printer MUST support this attribute if it supports the "printer-firmware-name" attribute. If this attribute is supported, this attribute MUST have the same cardinality (contain the same number of values) as the "printer-firmware-name" attribute. The ith value in this attribute corresponds to the ith value in the "printer-firmware-name" attribute.

6.6.8 printer-firmware-version (1setOf octetString(MAX))

This REQUIRED Printer Status attribute lists the set of versions for each of the Printer firmware components named by the "printer-firmware-name" Printer Status attribute (section 6.6.5). This attribute is derived from the "FirmwareVersion" HCD Health Assessment attribute [PWG5110.1]. A Printer MUST support this attribute if it supports the "printer-firmware-name" attribute. If this attribute is supported, this attribute MUST have the same cardinality (contain the same number of values) as the "printer-firmware-name" attribute.

The ith value in this attribute corresponds to the ith value in the "printer-firmware-name" attribute.

6.6.9 printer-supply (1setOf octetString(MAX))

This CONDITIONALLY REQUIRED Printer Status attribute lists a set of text strings that describe the Printer's currently installed consumable supplies. Each string contains an unordered sequence of key/value pairs, structured according to the ABNF [STD68] in Figure 11. Table 22 lists the keys defined in this specification, which are derived from the relevant machine-readable (non-localized) columnar objects from the prtMarkerSuppliesTable and prtMarkerColorantTable objects defined in IETF Printer MIB v2 [RFC3805]. Printers that have consumable or fillable supplies MUST support this attribute. A Printer MAY supply site-unique or vendor-unique information using the "supply-ext" rule defined in the ABNF. The ABNF is also available externally [ABNF].

Table 22 - "printer-supply" Keys

Key	IPP Datatype	Printer MIB Object	Conformance
type	String	prtMarkerSuppliesType	REQUIRED
maxcapacity	Integer	prtMarkerSuppliesMaxCapacity	REQUIRED
level	Integer	prtMarkerSuppliesLevel	REQUIRED
colorantname	String	prtMarkerColorantValue	REQUIRED (1)
class	String	prtMarkerSuppliesClass	RECOMMENDED
unit	String	prtMarkerSuppliesSupplyUnit	RECOMMENDED
index	Integer	prtMarkerSuppliesIndex	DEPRECATED (2)
markerindex	Integer	prtMarkerSuppliesMarkerIndex	DEPRECATED (2)
colorantindex	Integer	prtMarkerColorantIndex	DEPRECATED (3)
colorantrole	String	prtMarkerColorantRole	DEPRECATED (3)
coloranttonality	Integer	prtMarkerColorantTonality	DEPRECATED (3)

Notes:

1. A Printer provides 'no-color' for a supply that do not have a colorant value, and 'multi-color' for a supply that has multiple colorant values.
2. DEPRECATED because correlation with the MIB is unnecessary.
3. DEPRECATED because not widely implemented and of limited value.

A Printer MUST encode the values of "printer-supply" using the Net-ASCII subset of the US-ASCII character set [RFC5198]. A Printer MUST NOT supply values that contain characters in the range 0x00 - 0x1F or 0x7F.

Figure 11 - ABNF for "printer-supply" Values

```
printer-supply      = *supply-required *[supply-optional]
    ; set of supply elements encoded into one value

supply-required     = supply-req ";"
```



```
supply-req          = supply-type /
                      supply-max-capacity /
                      supply-level /
                      colorant-name

supply-optional     = supply-opt ";"
supply-opt          = supply-class /
                      supply-unit /
                      supply-index /
                      marker-index /
                      colorant-index /
                      colorant-role /
                      colorant-tonality /
                      supply-ext

supply-type         = "type" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'toner') of
    ; prtMarkerSuppliesType in [RFC3805] mapped indirectly from
    ; the *label* in PrtMarkerSuppliesTypeTC in [IANAPRT]

supply-max-capacity = "maxcapacity" "=" 1*[DIGIT / "-"]
    ; integer value as a numeric string mapped directly from
    ; prtMarkerSuppliesMaxCapacity in [RFC3805]

supply-level        = "level" "=" 1*[DIGIT / "-"]
    ; integer value as a numeric string mapped directly from
    ; prtMarkerSuppliesLevel in [RFC3805]

colorant-name       = "colorantname" "=" 1*ALPHA
    ; string value as an alpha string mapped directly from
    ; prtMarkerColorantValue in [RFC3805]

supply-index        = "index" "=" 1*DIGIT
    ; integer value as a numeric string mapped directly from
    ; prtMarkerSuppliesIndex in [RFC3805]

marker-index        = "markerindex" "=" 1*DIGIT
    ; integer value as a numeric string mapped directly from
    ; prtMarkerSuppliesMarkerIndex in [RFC3805]

supply-class        = "class" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'other') of
    ; prtMarkerSuppliesClass in [RFC3805] mapped indirectly from
    ; the *label* in PrtMarkerSuppliesClassTC in [RFC3805]

supply-unit         = "unit" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'other') of
    ; prtMarkerSuppliesSupplyUnit in [RFC3805] mapped indirectly from
    ; the *label* in PrtMarkerSuppliesSupplyUnitTC in [RFC3805]

colorant-index      = "colorantindex" "=" 1*DIGIT
    ; integer value as a numeric string mapped directly from
    ; prtMarkerColorantIndex in [RFC3805]

colorant-role       = "colorantrole" "=" 1*ALPHA
    ; enumerated value as an alpha string (e.g., 'other') of
```



```
    ; prtMarkerColorantRole in [RFC3805] mapped indirectly from
    ; the *label* in PrtMarkerColorantRoleTC in [RFC3805]

colorant-tonality   = "coloranttonality" "=" 1*DIGIT
    ; integer value as a numeric string mapped directly from
    ; prtMarkerColorantTonality in [RFC3805]

supply-ext           = supply-extname "=" supply-extvalue
    ; extension point for other MIB values not mapped
    ; or site-unique / vendor-unique additional info

supply-extname       = 1*[ALPHA / DIGIT / "-"]
supply-extvalue      = 1*[ALPHA / DIGIT / "-" / "." / ","]
```

6.6.9.1 Colorant Names in printer-supply

Table 23 lists the standard colorant names with their corresponding reference sRGBA values. Colorant names in "printer-supply" other than those defined in Table 23 or defined in PWG Media Standardized Names v2.0 (MSN2) [PWG5101.1] MUST conform to the Vendor Color Names or Custom Color Names extension formats defined in MSN2, e.g. "com.example-light-magenta_ff7fffff", etc.

Table 23 - "printer-supply" Standard Colorant Names

Name	sRGBA Value	Sample
no-color	Undefined	
black	0x000000FF	
light-black	0x808080FF	
blue	0x0000FFFF	
cyan	0x00FFFFFF	
light-cyan	0xE0FFFFFF	
gold	0xFFD700FF	
gray	0x808080FF	
dark-gray	0x404040FF	
light-gray	0xD3D3D3FF	
green	0x008000FF	
magenta	0xFF00FFFF	
light-magenta	0xFF77FFFF	
multi-color	Undefined	
orange	0xFFA500FF	
red	0xFF0000FF	
silver	0xC0C0C0FF	
white	0xFFFFFFFF	
yellow	0xFFFF00FF	
dark-yellow	0xFFCC00FF	
violet	0xEE82EEFF	

6.6.9.2 Example of printer-supply

Figure 12 shows seven rows of the machine-readable (non-localized) columnar objects from prtMarkerSuppliesTable and prtMarkerColorantTable encoded into the corresponding values of "printer-supply", presented using the "PAPI" textual syntax encoding [PAPI].

Note: Line breaks are shown below for readability of this example. The 'nl' (0x0A) and 'lf' (0x0D) characters are among those disallowed for "printer-supply".

Figure 12 - Example values for "printer-supply"

```
printer-supply[1] = "type=tonerCartridge;
                     maxcapacity=100;
                     level=56;
                     unit:percent;
                     colorantname=black;
                     class=supplyThatIsConsumed;"

printer-supply[2] = "type=tonerCartridge;
                     maxcapacity=100;
                     level=77;
                     unit:percent;
                     colorantname=cyan;
                     class=supplyThatIsConsumed;"

printer-supply[3] = "type=tonerCartridge;
                     maxcapacity=100;
                     level=19;
                     unit:percent;
                     colorantname=magenta;
                     class=supplyThatIsConsumed;"

printer-supply[4] = "type=tonerCartridge;
                     maxcapacity=100;
                     level=31;
                     unit:percent;
                     colorantname=yellow;
                     class=supplyThatIsConsumed;"

printer-supply[5] = "type=wasteToner;
                     maxcapacity=100;
                     level=67;
                     unit=percent;
                     colorantname=no-color;
                     class=other;"

printer-supply[6] = "type=fuser;
                     maxcapacity=100;
                     level=89;
                     unit:percent;
                     colorantname=no-color;
                     class:other;"
```



```
printer-supply[7] = "type=transferUnit;
                     maxcapacity=100;
                     level=84;
                     unit:percent;
                     colorantname=no-color;
                     class:other;"
```

6.6.10 printer-supply-description (1setOf textWithLanguage(MAX))

This CONDITIONALLY REQUIRED attribute lists the set of textual descriptions mapped from the SNMP prtMarkerSuppliesDescription object in the prtMarkerSuppliesTable defined in IETF Printer MIB v2 [RFC3805]. Printers that have consumable or fillable supplies MUST support this attribute.

This attribute MUST have the same cardinality (contain the same number of values) as the "printer-supply" attribute (section 6.6.9). The i^{th} value in the "printer-supply-description" attribute corresponds to the i^{th} value in the "printer-supply" attribute. The Printer MUST provide values in the character set specified by the "charset-configured" operation attribute [STD92], which might require conversion from the character set specified by prtGeneralCurrentLocalization [RFC3805] and prtLocalizationCharacterSet [RFC3808].

The Printer MUST set the naturalLanguage part for each value to match the natural language specified by prtGeneralCurrentLocalization [RFC3805], prtLocalizationLanguage [RFC3808], and prtLocalizationCountry [RFC3808].

6.6.10.1 Example of printer-supply-description

Figure 13 shows seven rows of the "printer-supply-description" values corresponding to the "printer-supply" values from Figure 12, presented using the "PAPI" textual syntax encoding [PAPI].

Note: The naturalLanguage part of each textWithLanguage value is not illustrated in this example.

Figure 13 - Example values for "printer-supply-description"

```
printer-supply-description[1] = "Black Toner Cartridge S/N:16859422"
printer-supply-description[2] = "Cyan Toner Cartridge S/N:16852765"
printer-supply-description[3] = "Magenta Toner Cartridge S/N:16859681"
printer-supply-description[4] = "Yellow Toner Cartridge S/N:16859372"
printer-supply-description[5] = "Waste Toner Bin S/N:16816815"
printer-supply-description[6] = "Fuser Kit S/N:16820223"
printer-supply-description[7] = "Transfer Kit S/N:16821304"
```

6.6.11 printer-supply-info-uri (uri)

This CONDITIONALLY REQUIRED attribute supplies an "https" or "http" scheme URI for a web page that provides controls for managing the Printer and its supplies, e.g., supply

replacement, head alignment, self-test pages, and so forth. Printers that have consumable or fillable supplies MUST support this attribute.

The web page MAY also provide supply part numbers, links for ordering supplies, and detailed instructions for replacing supplies. The URI MUST use the “http” or “https” scheme. The value SHOULD follow the Printer resources best practices in section 12.2.

6.6.12 printer-uuid (uri(45))

This REQUIRED attribute supplies the Printer's globally unique identifier encoded as a 45-octet "urn:uuid" URI [RFC4122]. The Printer MUST report the same "printer-uuid" value across power cycles and firmware updates. The Printer MUST report the same "printer-uuid" value on all its network interfaces. The Printer SHOULD use the same UUID value in other protocol bindings.

A Client cannot use the "printer-uuid" attribute as a Printer identifier in IPP Printer operations.

6.7 Subscription Status Attributes

Table 24 lists the Subscription Status attributes defined in this specification and associated conformance requirements for Printer support.

Table 24 - New Job Status Attributes

Attribute	Printer Conformance
notify-subscription-uuid	CONDITIONALLY REQUIRED
notify-subscriber-user-uri	CONDITIONALLY REQUIRED

6.7.1 notify-subscription-uuid (uri(45))

This CONDITIONALLY REQUIRED Subscription Status attribute specifies a globally unique identifier that MUST be a 45-octet "urn:uuid" URI [RFC4122]. The Printer generates the globally unique identifier when it creates a new Subscription object. A Printer MUST support this attribute if it supports "IPP: Event Notifications and Subscriptions" [RFC3995]. A Client MUST NOT use this attribute as a Subscription identifier in IPP subscription operations. A Printer MAY use the value of this attribute as a Subscription identifier for other protocol bindings.

6.7.2 notify-subscriber-user-uri (uri)

This CONDITIONALLY REQUIRED Subscription Status attribute supplies a URI for the most authenticated user who submitted the subscription creation request as defined in section 8.1. A Printer MUST support this attribute if it supports "IPP: Event Notifications and Subscriptions" [RFC3995].

7. Obsolete Attributes, Operations, and Values

7.1 Obsolete Attributes

Table 25 lists the attributes that are OBSOLETE.

Table 25 - Obsolete Attributes

Attribute	Explanation
job-pages-completed-current-copy	RFC 3381 is obsolete
pages-completed-current-copy	RFC 3381 is obsolete
pages-per-subset	Redundant with "job-pages-per-set" [PWG5100.1]
pages-per-subset-supported	"pages-per-subset" is obsolete

7.2 Obsolete Values

Table 26 lists the attribute values that are OBSOLETE.

Table 26 - Obsolete Values

Attribute	Value	Explanation
ipp-features-supported	'job-save'	The "job-save" attribute [PWG5100.11] is obsolete.

8. Additional Semantics for Existing Operations

8.1 All Operations: "requesting-user-uri"

Clients MAY supply and Printers MUST accept the "requesting-user-uri" operation attribute (section 6.1.7) whenever the Printer accepts the "requesting-user-name" operation attribute [STD92].

The Printer sets the "job-originating-user-uri" (section 6.4.1) or "notify-subscriber-user-uri" (section 6.7.2) attribute as applicable to the most authenticated URI that it can obtain from the authentication service over which the IPP operation was received. The Printer uses the "requesting-user-uri" operation attribute value supplied by the Client only if an authenticated URI is not available.

8.2 All Operations: "client-info"

Clients MAY supply and Printers MUST accept the "client-info" operation attribute (section 6.1.1).

When the operation is a Job Creation Operation, The Printer sets the "job-originating-user-uri" (section 6.4.1) or "notify-subscriber-user-uri" (section 6.7.2) attribute as applicable to the most authenticated URI that it can obtain from the authentication service over which the IPP operation was received. The Printer uses the "requesting-user-uri" operation attribute value supplied by the Client only if an authenticated URI is not available.

8.3 Get-Printer-Attributes Operation: "first-index" and "limit"

If a Printer supports the "media-col-database" Printer Description attribute [PWG5100.7] or the "finishings-col-database" [PWG5100.1], then the Printer SHOULD support the "first-index" (section 6.1.4) and "limit" ([STD92]) operation attributes to allow a Client to request limits to the number of "media-col-database" values or "finishings-col-database" values the Printer returns in the response.

8.4 Get-Subscriptions Operation: "first-index" and "limit"

If a Printer includes the 0x0019 'Get-Subscriptions' enum value [RFC3995] in its "operations-supported" Printer Description attribute [STD92], the Printer MUST support the "first-index" operation attribute (section 6.1.4) in conjunction with the "limit" operation attribute ([STD92]) to allow a Client to request the index of the first Subscription object returned in the response.

8.5 Get-Jobs Operation: "first-index" and "limit"

Clients MAY provide and Printers MUST support the "first-index" operation attribute (section 6.1.4) in conjunction with the "limit" operation attribute ([STD92]) to select the first Job object that is returned in the response.

8.6 Get-Documents Operation: "first-index" and "limit"

If the Printer supports the Get-Documents operation, Clients MAY provide and Printers MUST support the "first-index" operation attribute (section 6.1.4) in conjunction with the "limit" operation attribute [STD92] to select the first Document object that is returned in the response.

8.7 Print-Job, Print-URI, Send-Document, and Send-URI Operations: "document-metadata"

Clients MAY supply and Printers MUST support the "document-metadata" (section 6.1.1) operation attribute in the Print-Job, Print-URI, Send-Document, or Send-URI operations.

If the Printer conforms to the IPP Document Object [PWG5100.5], the Printer MUST copy the attribute value to the "document-metadata" Document Status attribute (section 6.3.1), otherwise the Printer MUST copy the attribute value to the "document-metadata" Job Status attribute (section 6.4.2).

8.8 Print-Job, Print-URI, Send-Document, and Send-URI Operations: "document-password"

If the Printer supports the "document-password" (section 6.1.3) operation attribute, Clients MAY supply it in a Print-Job, Print-URI, Send-Document, or Send-URI operation. The Printer MUST treat the attribute value as private and confidential, MUST retain the value as long as the corresponding Job and Document are retained, MUST NOT persist the value beyond the life of the Job or Document, MUST NOT return the value in the response to the request, and MUST NOT set any Job or Document object attribute with the value of the "document-password" attribute.

If the Printer receives a request supplying the "document-password" operation attribute prior to negotiation of a TLS session, it MUST return the 'client-error-bad-request' status code to the Client.

If the Printer determines that the supplied "document-password" value is not correct, it MUST return the 'client-error-document-password-error' (section 10.1) status code to the Client if a response has not already been sent and add the 'document-password-error' keyword to the "job-state-reasons" and, if supported, "document-state-reasons" attributes.

If the Printer determines that the supplied "document-password" value is correct but the Document does not allow printing, it MUST return the 'client-error-document-permission-error' status code to the Client if a response has not already been sent and add the 'document-permission-error' keyword to the "job-state-reasons" and, if supported, "document-state-reasons" attributes.

8.9 Validate-Job Operation: "document-password"

Clients MUST NOT send the "document-password" operation attribute (section 6.1.3) in a Validate-Job request. Printers MUST reject a Validate-Job request containing a "document-password" operation attribute and return the client-error-bad-request status code.

8.10 Validate-Job Operation: "preferred-attributes"

Printers MAY support returning the values for specific Job Template attributes that would actually be used (or that the Printer would prefer to use) based on the Job Creation attributes included in the Validate-Job request. Each Job Template attribute is returned as a member attribute in the "preferred-attributes" attribute in the Operation Attributes Group.

Printers indicate their support for this functionality by listing the Job Template attributes that may be returned in the "preferred-attributes-supported" Printer Description attribute (section 6.5.18).

8.11 Validate-Job Operation: "profile-uri-actual"

In a Validate-Job operation response, the Printer includes the "profile-uri-actual" operation attribute to indicate which ICC color profile the Printer will use for the given Job Template attributes. A Printer MUST support this attribute if it supports the "printer-icc-profiles" Printer Description attribute (section 6.5.32).

9. Additional Values and Semantics for Existing Attributes

9.1 document-state-reasons (1setOf type2 keyword) and job-state-reasons (1setOf type2 keyword)

Table 27 lists new "document-state-reasons" and "job-state-reasons" keyword values.

Table 27 - New "document-state-reasons" and "job-state-reasons" Keyword Values

Keyword	Description
document-password-error	The Printer detected an incorrect document content password and was unable to unlock the document for printing. This value MUST be supported if the "document-password" (section 6.1.3) operation attribute is supported.
document-permission-error	The Printer was able to unlock the document but the document permissions do not allow for printing. This value MUST be supported if the "document-password" (section 6.1.3) operation attribute is supported.
document-security-error	The Printer detected security issues (virus, trojan horse, or other malicious software) embedded within the document. Whether the Printer aborts the Job and moves it to the 'aborted' state or prints all Documents that do not contain detected security issues and moves the Job to the 'completed' state and adds the 'completed-with-errors' value in the job's "job-state-reasons" attribute depends on implementation and/or site policy. This value SHOULD be supported.
document-unprintable-error	The Printer determined that the document was unprintable. This reason icovers any issues of file size, format version, or complexity that

Keyword	Description
	would prevent the Printer from printing the document. Whether the Printer aborts the Job and moves it to the 'aborted' state or prints all Documents that do not contain detected security issues and moves the Job to the 'completed' state and adds the 'completed-with-errors' value in the job's "job-state-reasons" attribute depends on implementation and/or site policy. This value SHOULD be supported.

9.2 media-source (type2 keyword | name(MAX))

This specification adds the new 'virtual' keyword value for the "media-source" member of "media-col-ready" and "media-col-database" [PWG5100.7] to indicate a "virtual paper tray", which allows a Printer to indicate that it can produce a particular output size from some other media source (e.g. produce A4 output from A3 media, produce A3 output from A0 media using a cutter, etc.).

9.3 orientation-requested (type2 enum)

This specification defines the new 'none' (7) value for the "orientation-requested" Job Template attribute [STD92] to enable the Client to request that the Printer not perform any rotations for orientation.

9.4 print-content-optimize (type2 keyword)

This specification defines the new 'auto' value for the "print-content-optimize" Job Template attribute [PWG5100.7] to enable the Client to request that the Printer automatically determine the best optimizations to perform when printing the document.

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

Table 28 lists new keyword values for the "printer-state-reasons" Printer Description attribute that MUST be supported by Printers that report the corresponding Printer MIB [RFC3805] supply types.

Table 28 - New "printer-state-reasons" Keyword Values

Keyword	Description
cleaner-life-almost-over	A cleaning component corresponding to the Printer MIB prtMarkerSuppliesType values cleanerUnit(18) and fuserCleaningPad(19) is nearing the end of its service life.

cleaner-life-over	A cleaning component corresponding to the Printer MIB prtMarkerSuppliesType values cleanerUnit(18) and fuserCleaningPad(19) has reached the end of its service life.

9.6 uri-authentication-supported (1setOf type2 keyword)

This specification defines the new 'negotiate' keyword for the "uri-authentication-supported" Printer Status attribute [STD92] to indicate support for HTTP Negotiate authentication based on SPNEGO-based Kerberos and NTLM HTTP Authentication in Microsoft Windows [RFC4559].

10. Status Codes

10.1 client-error-document-password-error (0x418)

The Client has attempted to submit a Document using the Print-Job, Print-URI, Send-Document, or Send-URI operations with the wrong passphrase. The Client MAY try the request again with a new passphrase.

10.2 client-error-document-permission-error (0x419)

The Client has attempted to submit a Document using the Print-Job, Print-URI, Send-Document, or Send-URI operations that does not allow printing. The Client MUST NOT retry the request using the same document.

10.3 client-error-document-security-error (0x41A)

The Printer has detected security issues (virus, trojan horse, or other malicious software) embedded within the document and will not accept it for printing.

10.4 client-error-document-unprintable-error (0x41B)

The Printer has determined that the document is unprintable due to size, format version, or complexity and will not accept it for printing.

11. Localization Resources

The "printer-strings-uri" Printer Description attribute (section 6.5.41) provides the location of a language-specific, Printer Resident message catalog file resource that supplies localizations for attribute names, keyword values, and enum values.

11.1 Message Catalog File Format

This specification defines a new plain text message catalog format (MIME media type “text/strings”) based on the Apple “strings” file format to allow Printers to supply and Clients to present localized strings for supported attributes values. A sample English localization for registered IPP attributes, enum values, and keyword values is available on the PWG FTP server [PWG-CATALOG]. Boolean, dateTime, and integer values are not localizable using this format, and name and text values are presumed to already be localized [STD92].

Message catalog files consist of lines of UTF-8 encoded Unicode text following the general "KEY = VALUE" form. The KEY and VALUE elements can be wrapped in double quotes.:

```
"attribute-name" = "Localized Attribute Name Label";
"attribute-name.enum-value" = "Localized Enum Value Label";
"attribute-name.keyword-value" = "Localized Keyword Value Label";
/* Comment for/to localizers */
```

Lines in a Message Catalog file are terminated by either a single line feed (%x0A) or a combination of carriage return and line feed (%x0D.0A). All lines in a Message Catalog file MUST use identical line terminators for consistency. Attribute names and values are limited to the characters defined for the IPP keyword value syntax [STD92].

Control characters (%x00-1F, %x7F), the double quote (%x22), and the backslash (%x5C) MUST be escaped in localized strings using a subset of the C language syntax:

\"	A double quote (%x22)
\\	A backslash (%x5C)
\n	A line feed (%x0A)
\r	A carriage return (%x0D)
\t	A horizontal tab (%x09)
\###	An octet represented by 3 octal digits

A more complete example is in section 11.3.

11.2 Message Catalog Help Resources

A Message Catalog MAY also contain two types of "help" content. The "_tooltip" suffix can be used to specify brief help content suitable for contextual presentation such as when a mouse pointer is hovered over a label. The "_helpurl" suffix can be used to specify a URL to more detailed, rich and possibly lengthy help content that could be presented in a separate "help" window. The general form is like so:

```
"attribute-name._tooltip" = "Localized Attribute Name Tooltip"
```



```
"attribute-name._helpurl" = "URL to localized attribute help"

"attribute-name.enum-value._tooltip" = "Localized Enum Value Tooltip"
"attribute-name.enum-value._helpurl" = "URL to localized enum value help"

"attribute-name.keyword-value._tooltip" = "Localized Keyword Value Tooltip"
"attribute-name.keyword-value._helpurl" = "URL to localized keyword value help"
```

A more complete example is in section 11.3.

11.3 Message Catalog Example

A Printer that specifies two collections in its "media-col-ready" [PWG5100.7], one that specifies 'stationery' for its "media-type " value, and the other that specifies 'smi32473-eco-lite' for its "finishing-template" value, can implement among others the following attributes and values, represented using "PAPI" syntax:

```
printer-uri="https://myprinter.local.:631/ipp/print"
printer-strings-uri="https://myprinter.local.:631/ipp/en.strings"
media-col-ready={
    media-type="stationery"
    media-source="tray-1"
    media-size={
        x-dimension=21000
        y-dimension=29700
    }
    media-top-margin=500
    media-bottom-margin=500
    media-left-margin=500
    media-right-margin=500
},{
    media-type="smi32473-eco-lite"
    media-source="tray-2"
    media-color=white
    media-size={
        x-dimension=21590
        y-dimension=27940
    }
    media-bottom-margin=500
    media-left-margin=500
    media-right-margin=500
    media-top-margin=500
}
print-color-mode-supported=
  auto,
  color,
  monochrome,
  smi32473-magic-color,
  smi32473-blueprint
print-color-mode-icc-profiles={
    print-color-mode=smi32473-magic-color
    print-color-mode-profile-uri=https://myprinter.local.:631/sp/magic-color.icc
},{
    print-color-mode=smi32473-blueprint
```



```
    print-color-mode-profile-uri=https://myprinter.local.:631/sp/blueprint.icc
}
```

The Printer's Message Catalog corresponding to "attributes-natural-language" = 'en-us' might include the following:

```
media-type = "Media Type";
media-type.stationery = "Stationery";
media-type.stationery._tooltip = "Conventional Stationery";
media-type.stationery._helpurl = "//_help/media-types.html";
media-type.smi32473-eco-lite = "PWG Eco Lite";
media-type.smi32473-eco-lite._tooltip = "Lightweight paper that may tear";
media-type.smi32473-eco-lite._helpurl = "//_help/media-types.html#ecolite";
print-color-mode = "Print Color Mode";
print-color-mode.auto = "Automatic";
print-color-mode.auto-monochrome = "Auto Monochrome";
print-color-mode.bi-level = "Text";
print-color-mode.color = "Color";
print-color-mode.highlight = "Highlight";
print-color-mode.monochrome = "Monochrome";
print-color-mode.process-bi-level = "Process Text";
print-color-mode.process-monochrome = "Process Monochrome";
print-color-mode.smi32473-magic-color = "Magic Color";
print-color-mode.smi32473-magic-color._tooltip = "Makes the colors look
magical";
print-color-mode.smi32473-blueprint = "Blueprint";
print-color-mode.smi32473-blueprint._tooltip = "Blue background with white
foreground lines";
```

11.4 Message Catalog ABNF

Figure 14 provides the ABNF [STD68] for files conforming to the “text/strings” MIME media type. The ABNF is also available externally [ABNF].

Figure 14 - ABNF for the "text/strings" MIME Media Type

```
CATALOG       = *(MESSAGE / COMMENT / *WSP CFLF / *WSP LF)
MESSAGE       = *WSP DQUOTE %x61-7A *KEYWORD-CHAR DQUOTE
                *WSP "=" *WSP QUOTED-STRING *WSP ";" *WSP (CRLF / LF)
COMMENT       = *WSP "/*" 1*CHAR "*/" *WSP (CRLF / LF)
KEYWORD-CHAR  = %x61-7A / DIGIT / "-" / "." / "_"
QUOTED-STRING = DQUOTE 1*QUOTED-CHAR DQUOTE
QUOTED-CHAR   = %x20-21 /
                %x23-5B /
                %x5C.22 /                                   ; \" = "   (%x22)
                %x5C.5C /                                   ; \\ = \   (%x5C)
                %x5C.6E /                                   ; \n = lf  (%x0A)
                %x5C.71 /                                   ; \r = cr  (%x0D)
                %x5C.73 /                                   ; \t = ht  (%x09)
                %x5C.30-33.30-37.30-37 /                    ; \ooo (octal)
                %x5D-7E /
                %xC0-DF.80-BF /
                %xE0-EF.80-BF.80-BF /
```



```
%xF0-F7.80-BF.80-BF.80-BF
```

12. Implementation Guidance

12.1 Presets and Triggers

12.1.1 Storing Presets and Triggers

A Client might enable Users to construct new Presets and/or Triggers. In some cases, such as the use case described in section 3.2.22, the User may want to store one or more of those Presets and/or Triggers on the Printer. The Printer will have to advertise it supports updates to its set of Presets, and the Client will have to support identifying that the Printer supports Preset updates and setting an updated set of Presets in the Printer.

A Printer advertises its support for accepting new Presets and Triggers by: supporting the Set-Printer-Attributes and Get-Printer-Supported-Values operations; including Set-Printer-Attributes and Get-Printer-Supported-Values in its “operations-supported” Printer Description attribute [STD92]; including “job-presets-supported” and “job-triggers-supported” in its “printer-settable-attributes-supported” Printer Description attribute [RFC3380]; specifying via a Get-Printer-Supported-Values operation [RFC3380] response the values that the Printer allows in the Set-Printer-Attributes operation for the “job- presets-supported" and “job-triggers-supported” attributes. A Client that implements Printer Preset updates uses the above to detect Printer support.

A Client adds a Preset to a Printer using the Set-Printer-Attributes operation [RFC3380]. The Set-Printer-Attributes operation [RFC3380] semantic is the assignment of a new value to the specified attribute; the attribute and its value sent in the operation request will become the Printer's new attribute value if the operation is successful. For example, to add an additional Preset to a Printer's current “job-presets-supported” attribute, the Client would acquire the current value of the “job-presets-supported” attribute using a Get-Printer-Attributes operation, append or insert the new Preset collection into the set, then perform a Set-Printer-Attributes operation to apply the new set value to the Printer. The result of the Set-Printer-Attributes operation will indicate whether the Printer accepts the update. If the new value is accepted, the Printer will atomically update its “job-presets- supported” attribute. If the he Printer rejects the new value for some reason, it ought to return a suitable status code indicating the underlying cause of the rejection.

12.1.2 Presets User Experience Recommendations

Although user experience is outside the scope of this specification, Client implementors ought to consider several important factors when implementing support for IPP Presets to ensure a good user experience.

After the User selects a Preset, the Client ought to allow the User to change individual settings. For example, if a Preset named “photo” includes “print-quality” of 'high' (5) and “print-color-mode” of 'color', and the User selects that Preset, the Client ought to allow the

User to change the “print-quality” to some other value even after the User has selected that Preset.

A Client SHOULD list available Presets by name wherever it presents printing choices to the User. The individual Presets might have originated in the Printer, or they might be local to the Client. When a User selects a Preset, the Client copies all Preset member attributes to the Job Creation Operation.

Client implementors might want to consider appropriate behavior in response to the User changing a setting and then the User chooses a Preset that overrides that earlier selection. The Client could notify the User that the setting will be changed. Alternately, the Client could apply the Preset but not change the setting changed by the User, or let the selected Preset overwrite the previous User selection.

12.1.3 Triggers User Experience Recommendations

The Client applies the Preset specified by the Trigger upon detecting that the pending Job's settings values match all the Trigger's members. Client implementors ought to consider cases where Triggers are disabled, such as following manual selection by a user, or perhaps only allowing one Trigger per “print dialog session” to be used. A Trigger ought to be applied only in response to user input, and not in response to a value being set by another Preset, a constraint, or some other automatic selection implemented by the Client.

12.2 Printer Resources

Printers SHOULD:

- provide Printer Resident resources to allow a Client to only communicate with the network node hosting the Printer.
- provide resources using "https:" or "http:" scheme URIs.
- provide Secure Transport URIs (e.g. "https" scheme) in content that is itself provided by Secure Transport.
- provide Printer Resident resources at URIs whose port component matches the Printer's port number as specified by the Printer's "printer-uri" attribute, to ensure resource access even when other services are disabled on the Printer's network node. For example, if the value of "printer-uri" is "ipps://my-printer.local.:631/ipp/print", all the resource URIs SHOULD begin with "https://my-printer.local.:631/" rather than "https://my-printer.local.:443/".
- respond to an HTTP/HTTPS request for a valid resource with an HTTP 200 OK and the resource itself in the response. Printers SHOULD NOT return an HTTP 3XX redirection in response to an HTTP request for a valid resource.

- support the If-Modified-Since request header [RFC7232] to allow Clients to locally cache these resources to minimize network bandwidth usage and provide a responsive user interface. HTTP caching semantics [RFC7234], particularly with HTTP proxies [RFC7230] MUST be followed.

13. Conformance Requirements

13.1 Printer Conformance Requirements

For a Printer to claim conformance to this specification, it MUST support:

1. The required operations in section 5;
2. The required attributes and values defined in section 6;
3. The required additional semantics for existing operations defined in section 8;
4. The required additional values and semantics for existing operations defined in section 9;
5. The required status codes from section 10;
6. The required Localization Resources from section 11;
7. The internationalization considerations defined in section 14; and
8. The security considerations defined in section 15.

For a Printer to claim conformance with this specification, it MUST NOT support

9. The obsolete attributes in section 6.7.1;
10. The obsolete values in section 7.2.

13.2 Client Conformance Requirements

For a Client to claim conformance to this specification, it MUST support:

11. The required operations in section 5;
12. The required attributes and values defined in section 6;
13. The required additional semantics for existing operations defined in section 8;
14. The required additional values and semantics for existing operations defined in section 9;
15. The required status codes from section 10;
16. The required Localization Resources from section 11;
17. The internationalization considerations defined in section 14; and
18. The security considerations defined in section 15.

For a Client to claim conformance with this specification, it MUST NOT support

19. The obsolete attributes in section 6.7.1;
20. The obsolete values in section 7.2.

14. Internationalization Considerations

Tailor the following standard considerations.

For interoperability and basic support for multiple languages, conforming implementations MUST support:

1. The Universal Character Set (UCS) Transformation Format -- 8 bit (UTF-8) [STD63] encoding of Unicode [UNICODE] [ISO10646]; and
2. The Unicode Format for Network Interchange [RFC5198] which requires transmission of well-formed UTF-8 strings and recommends transmission of normalized UTF-8 strings in Normalization Form C (NFC) [UAX15].

Unicode NFC is defined as the result of performing Canonical Decomposition (into base characters and combining marks) followed by Canonical Composition (into canonical composed characters wherever Unicode has assigned them).

WARNING – Performing normalization on UTF-8 strings received from Clients and subsequently storing the results (e.g., in Job objects) could cause false negatives in Client searches and failed access (e.g., to Printers with percent-encoded UTF-8 URIs now 'hidden').

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

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

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

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

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

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

Unicode Collation Algorithm [UTS10] – sorting

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:

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

Unicode Character Property Model [UTR23] – character properties

Unicode Conformance Model [UTR33] – Unicode conformance basis

15. Security Considerations

The IPP extensions defined in this document require the same security considerations as defined in the Internet Printing Protocol/1.1 [STD92].

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

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

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

Unicode Security FAQ [UNISECFAQ] – common Unicode security issues

16. IANA Considerations

16.1 MIME Media Type Registration

Name : Michael Sweet

E-mail : iana@pwg.org

MIME media type name : text

MIME subtype name : Standards Tree – strings

Required parameters : NONE

Optional parameters : NONE

Encoding considerations :

UTF-8 encoded Unicode text.

Security considerations :

Localized strings may be arbitrarily large and could potentially cause a denial-of-service.

Localized strings may contain printf-style format characters that could cause a program to display unintended information or crash.

Interoperability considerations :

NONE

Published specification :

https://ftp.pwg.org/pub/pwg/candidates/cs-ippjobprinterext3v10-20120727-5100.13.pdf

Applications which use this media :

All Cocoa, NeXTStep, and OpenStep applications
CUPS
IPP Everywhere

Additional information :

1. Magic number(s) :

2. File extension(s) :

strings

3. Macintosh file type code :

Person to contact for further information :

1. Name : Michael Sweet

2. E-mail : iana@pwg.org

Intended usage : Common

Used for providing localizations of English keywords and numeric values.

Author/Change controller :

The Printer Working Group
c/o The IEEE Industry Standards and Technology Organization
445 Hoes Lane
Piscataway, NJ 08854
USA

16.2 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 location:

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

The registry entries will contain the following information:

```
Operation attributes:                                          Reference
```



```
-------------------------------------                                 ---------
client-info (1setOf collection)                                       [PWG5100.13]
  client-key (type2 keyword)                                          [PWG5100.13]
  client-name (name(MAX))                                             [PWG5100.13]
  client-patches (text(MAX) | 'no-value')                             [PWG5100.13]
  client-string-version (text(MAX))                                   [PWG5100.13]
  client-version (octetString(64) | 'no-value')                       [PWG5100.13]
document-metadata (1setOf octetString(MAX))                           [PWG5100.13]
document-password (octetString(1023))                                 [PWG5100.13]
first-index (integer(1:MAX))                                          [PWG5100.13]
identify-actions (1setOf type2 keyword)                               [PWG5100.13]
preferred-attributes (collection)                                     [PWG5100.13]
  <Any Template attribute>                                            [PWG5100.13]
requesting-user-uri (uri)                                             [PWG5100.13]

Job and Document Template attributes:                                 Reference
-------------------------------------                                 ---------
job-error-action (type2 keyword)                                      [PWG5100.13]
media-overprint (collection)                                          [PWG5100.13]
  media-overprint-distance (integer(0:MAX))                           [PWG5100.13]
  media-overprint-method (type2 keyword)                              [PWG5100.13]
print-color-mode (type2 keyword)                                      [PWG5100.13]
print-rendering-intent (type2 keyword)                                [PWG5100.13]
print-scaling (type2 keyword)                                         [PWG5100.13]

Job Status attributes:                                                Reference
--------------------------------------                                ---------
document-metadata (1setOf octetString(MAX))                           [PWG5100.13]
job-originating-user-uri (uri)                                        [PWG5100.13]
job-pages (integer(0:MAX)                                             [PWG5100.13]
job-pages-completed (integer(0:MAX)                                   [PWG5100.13]
job-uuid (uri(45))                                                    [PWG5100.13]

Document Status attributes:                                           Reference
---------------------------------------                               ---------
document-metadata (1setOf octetString(MAX))                           [PWG5100.13]
document-uuid (uri(45))                                               [PWG5100.13]
pages (integer(0:MAX)                                                 [PWG5100.13]
pages-completed (integer(0:MAX)                                       [PWG5100.13]

Printer Description attributes:                                       Reference
-------------------------------                                       ---------
document-password-supported (integer(0:1023))                         [PWG5100.13]
identify-actions-default (1setOf type2 keyword)                       [PWG5100.13]
identify-actions-supported (1setOf type2 keyword)                     [PWG5100.13]
ipp-features-supported (1setOf type2 keyword)                         [PWG5100.13]
job-constraints-supported (1setOf collection)                         [PWG5100.13]
job-error-action-default (type2 keyword)                              [PWG5100.13]
job-error-action-supported (1setOf type2 keyword)                     [PWG5100.13]
job-presets-supported (1setOf collection)                             [PWG5100.13]
  preset-category (type2 keyword)                                     [PWG5100.13]
  preset-name (keyword | name(MAX))                                   [PWG5100.13]
job-resolvers-supported (1setOf collection)                           [PWG5100.13]
job-triggers-supported (1setOf collection)                            [PWG5100.13]
  preset-name (keyword | name(MAX))                                   [PWG5100.13]
jpeg-features-supported (1setOf type2 keyword)                        [PWG5100.13]
```



```
jpeg-k-octets-supported (rangeOfInteger(0:MAX))                          [PWG5100.13]
jpeg-x-dimension-supported (rangeOfInteger(0:65535))                     [PWG5100.13]
jpeg-y-dimension-supported (rangeOfInteger(1:65535))                     [PWG5100.13]
media-overprint-distance-supported (1setOf integer(0:MAX))               [PWG5100.13]
media-overprint-method-supported (1setOf type2 keyword)                  [PWG5100.13]
multiple-operation-time-out-action (type2 keyword)                       [PWG5100.13]
pdf-k-octets-supported (rangeOfInteger(0:MAX))                           [PWG5100.13]
pdf-versions-supported (1setOf type2 keyword)
preferred-attributes-supported (boolean)                                 [PWG5100.13]
print-color-mode-default (type2 keyword)                                 [PWG5100.13]
print-color-mode-icc-profiles (1setOf collection)                        [PWG5100.13]
  print-color-mode (type2 keyword)                                       [PWG5100.13]
  profile-uri (uri)                                                      [PWG5100.13]
print-color-mode-supported (1setOf type2 keyword)                        [PWG5100.13]
print-rendering-intent-default (type2 keyword)                           [PWG5100.13]
print-rendering-intent-supported (1setOf type2 keyword)                  [PWG5100.13]
print-scaling-default (type2 keyword)                                    [PWG5100.13]
print-scaling-supported (1setOf type2 keyword)                           [PWG5100.13]
printer-dns-sd-name (name(63))                                           [PWG5100.13]
printer-geo-location (uri)                                               [PWG5100.13]
printer-get-attributes-supported (1setOf type2 keyword)                  [PWG5100.13]
printer-icc-profiles (1setOf collection)                                 [PWG5100.13]
  <Any Template attribute>                                               [PWG5100.13]
  profile-name (name(MAX))                                               [PWG5100.13]
  profile-url (uri)                                                      [PWG5100.13]
printer-icons (1setOf uri)                                               [PWG5100.13]
printer-input-tray (1setOf octetString(MAX))                             [PWG5100.13]
printer-kind (1setOf type2 keyword | name(MAX))                          [PWG5100.13]
printer-mandatory-job-attributes (1setOf type2 keyword)                  [PWG5100.13]
printer-organization (1setOf text(MAX))                                 [PWG5100.13]
printer-organizational-unit (1setOf text(MAX))                          [PWG5100.13]
printer-output-tray (1setOf octetString(MAX))                           [PWG5100.13]
printer-strings-languages-supported (1setOf naturalLanguage)            [PWG5100.13]
printer-strings-uri (uri | 'no-value')                                   [PWG5100.13]
requesting-user-uri-supported (boolean)                                  [PWG5100.13]
requesting-user-uri-schemes-supported (1setOf uriScheme)                 [PWG5100.13]

Printer Status attributes:                                               Reference
------------------------------                                           ---------
device-service-count (integer(1:MAX))                                    [PWG5100.13]
device-uuid (uri(45))                                                    [PWG5100.13]
printer-config-change-date-time (dateTime | 'unknown')                   [PWG5100.13]
printer-config-change-time (integer(1:MAX))                              [PWG5100.13]
printer-firmware-name (1setOf name(MAX))                                 [PWG5100.13]
printer-firmware-patches (1setOf text(MAX))                              [PWG5100.13]
printer-firmware-string-version(1setOf text(MAX))                        [PWG5100.13]
printer-firmware-version(1setOf octetString(MAX))                        [PWG5100.13]
printer-supply (1setOf octetString(MAX))                                 [PWG5100.13]
printer-supply-description (1setOf text(MAX))                            [PWG5100.13]
printer-supply-info-uri (uri)                                            [PWG5100.13]
printer-uuid (uri(45))                                                   [PWG5100.13]

Subscription Description attributes:                                     Reference
-----------------------------------                                      ---------
notify-subscriber-user-uri (uri)                                         [PWG5100.13]
notify-subscription-uuid (uri)                                           [PWG5100.13]
```


16.3 Type2 keyword Registrations

The keyword 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 location:

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

The registry entries will contain the following information:

```
Attributes (attribute syntax)
  Keyword Attribute Value                                          Reference
  -----------------------                                          ---------
document-state-reasons (1setOf type2 keyword)                      [PWG5100.5]
  document-password-error                                          [PWG5100.13]
  document-permission-error                                        [PWG5100.13]
  document-security-error                                          [PWG5100.13]
  document-unprintable-error                                       [PWG5100.13]

identify-actions (1setOf type2 keyword)                            [PWG5100.13]
  display      [PWG5100.13]
  flash        [PWG5100.13]
  sound        [PWG5100.13]
  speak        [PWG5100.13]
identify-actions-default (1setOf type2 keyword)                    [PWG5100.13]
  <Any "identify-actions" keyword value>                           [PWG5100.13]
identify-actions-supported (1setOf type2 keyword)                  [PWG5100.13]
  <Any "identify-actions" keyword value>                           [PWG5100.13]
ipp-features-supported (1setOf type2 keyword)                      [PWG5100.13]
  document-object                                                  [PWG5100.13]
  job-save     [PWG5100.13]
  none         [PWG5100.13]
  page-overrides                                                   [PWG5100.13]
  proof-print  [PWG5100.13]
  subscription-object                                              [PWG5100.13]

job-error-action (type2 keyword)                                   [PWG5100.13]
  abort-job    [PWG5100.13]
  cancel-job   [PWG5100.13]
  continue-job [PWG5100.13]
  suspend-job  [PWG5100.13]
job-error-action-default (type2 keyword)                           [PWG5100.13]
  <Any "job-error-action" keyword value>                           [PWG5100.13]
job-error-action-supported (1setOf type2 keyword)                  [PWG5100.13]
  <Any "job-error-action" keyword value>                           [PWG5100.13]

job-state-reasons (1setOf type2 keyword)                           [RFC8011]
  document-password-error                                          [PWG5100.13]
  document-permission-error                                        [PWG5100.13]
  document-security-error                                          [PWG5100.13]
  document-unprintable-error                                       [PWG5100.13]

jpeg-features-supported (1setOf type2 keyword)                     [PWG5100.13]
  none                                                             [PWG5100.13]
  arithmetic                                                       [PWG5100.13]
  cmyk                                                             [PWG5100.13]
```



```
    deep                                                              [PWG5100.13]
    icc                                                               [PWG5100.13]
    lossless                                                          [PWG5100.13]
    progressive                                                       [PWG5100.13]

multiple-operation-time-out-action (type2 keyword)                    [PWG5100.13]
    abort-job    [PWG5100.13]
    hold-job     [PWG5100.13]
    process-job  [PWG5100.13]

print-color-mode (type2 keyword)                                      [PWG5100.13]
    auto         [PWG5100.13]
    auto-monochrome                                                   [PWG5100.13]
    bi-level     [PWG5100.13]
    color        [PWG5100.13]
    highlight    [PWG5100.13]
    monochrome   [PWG5100.13]
    process-bi-level                                                  [PWG5100.13]
    process-monochrome                                                [PWG5100.13]
print-color-mode-default (type2 keyword)                              [PWG5100.13]
    <Any "print-color-mode" keyword value>                            [PWG5100.13]
print-color-mode-supported (1setOf type2 keyword)                     [PWG5100.13]
    <Any "print-color-mode" keyword value>                            [PWG5100.13]

print-content-optimize (type2 keyword)                                [PWG5100.7]
    auto         [PWG5100.13]

print-rendering-intent (type2 keyword)                                [PWG5100.13]
    absolute     [PWG5100.13]
    auto         [PWG5100.13]
    perceptual   [PWG5100.13]
    relative     [PWG5100.13]
    relative-bpc [PWG5100.13]
    saturation   [PWG5100.13]
print-rendering-intent-default (type2 keyword)                        [PWG5100.13]
    <Any "print-rendering-intent" keyword value>                      [PWG5100.13]
print-rendering-intent-supported (1setOf type2 keyword)               [PWG5100.13]
    <Any "print-rendering-intent" keyword value>                      [PWG5100.13]

printer-get-attributes-supported (1setOf type2 keyword)               [PWG5100.13]
    <Any Job Template attribute>
    <Any Operation attribute at the Job level>

printer-mandatory-job-attributes (1setOf type2 keyword)               [PWG5100.13]
    <Any Job Template attribute>
    <Any Operation attribute at the Job level>

printer-state-reasons (1setOf type2 keyword)                          [RFC8011]
    cleaner-life-almost-over                                          [PWG5100.13]
    cleaner-life-over                                                 [PWG5100.13]

uri-authentication-supported (1setOf type2 keyword)                   [RFC8011]
    negotiate                                                         [PWG5100.13]
```


16.4 Type2 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 location:

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

The registry entries will contain the following information:

Attributes (attribute syntax) Enum Value	Enum Symbolic Name	Reference
finishings (1setOf type2 enum)		[RFC8011]
60	trim-after-pages	[PWG5100.13]
61	trim-after-documents	[PWG5100.13]
62	trim-after-copies	[PWG5100.13]
63	trim-after-job	[PWG5100.13]
operations-supported (1setOf type2 enum)		[RFC8011]
0x003C	Identify-Printer	[PWG5100.13]
0x003D	Validate-Document	[PWG5100.13]
orientation-requested (type2 enum)		[RFC8011]
7	none	[PWG5100.13]

16.5 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 location:

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

The registry entries will contain the following information:

Operation Name	Reference
Create-Job (extension)	[PWG5100.13]
Create-Job-Subscription (extension)	[PWG5100.13]
Create-Printer-Subscription (extension)	[PWG5100.13]
Get-Documents (extension)	[PWG5100.13]
Get-Jobs (extension)	[PWG5100.13]
Get-Printer-Attributes (extension)	[PWG5100.13]
Get-Subscriptions (extension)	[PWG5100.13]
Identify-Printer	[PWG5100.13]
Print-Job (extension)	[PWG5100.13]
Print-URI (extension)	[PWG5100.13]
Send-Document (extension)	[PWG5100.13]
Send-URI (extension)	[PWG5100.13]
Validate-Document	[PWG5100.13]
Validate-Job (extension)	[PWG5100.13]

16.6 Status Code Registrations

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

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

The registry entries will contain the following information:

```
Value     Status Code Name                                        Reference
------    ----------------------------------------------          ---------
0x0400:0x04FF - Client Error:
 0x0418   client-error-document-password-error                    [PWG5100.13]
 0x0419   client-error-document-permission-error                  [PWG5100.13]
 0x041A   client-error-document-security-error                    [PWG5100.13]
 0x041B   client-error-document-unprintable-error                 [PWG5100.13]
```

17. Overview of Changes

17.1 IPP Driverless Printing Extensions v.2.0

The following changes were made to IPP Job and Printer Extensions - Set 3 [PWG5100.13-2012]:

- Renamed the specification to have a more specific and meaningful title;
- Resolved all errata from PWG errata tracking site (https://www.pwg.org/dynamo/issues.php?L+P-1+S-2+I0+E0+Z13+Q);
- Imported the IPP Presets registration document definitions to add them to this specification, and extended it by defining the new "preset-category" member attribute to provide a modern replacement for the venerable but non-extensible "print-quality" attribute;
- Defined the new "client-info" operation attribute to replace "document-format-details" for reporting client accounting information;
- Defined the new "requesting-user-uri-schemes-supported" Printer Description attribute;
- Imported the "jpeg-k-octets-supported", "jpeg-x-dimension-supported", "jpeg-y-dimension-supported", "pdf-k-octets-supported", "pdf-versions-supported", "print-scaling-default", "print-scaling-supported", "printer-dns-sd-name", and "printer-kind" Printer Description attributes from PWG 5100.16-2013;
- Reviewed and rewrote a number of the use cases and added new use cases that should have already been there;

- Rewrote the descriptions for "printer-input-tray", "printer-output-tray" and "printer-supply" to make them more concise and precise;
- Added message catalog syntax extensions and semantics for "_tooltip" and "_helpurl" (content from the latest draft of HELPME);
- Added extensions to "print-color-mode" and "print-quality" (content from the latest draft of PQI);
- Added "print-color-mode-icc-profiles" and "print-quality-hints-supported" (content from the latest draft of PQI);
- Added the "media-overprint" and "media-overprint-type" Job Template Attributes;
- The "subscription-uuid" attribute was corrected to be "notify-subscription-uuid" to match how it was registered in the IANA registry in 2012;
- The "multiple-operations-timeout-action" attribute's name was corrected to be "multiple-operations-time-out-action" to match how it was registered in the IANA registry in 2012; and
- Deprecated the "device-service-count" attribute because IPP System Service v1.0 [PWG5100.22]. provides a better solution and this attribute is almost entirely unused in the IPP ecosystem at large.

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Implementers of this specification document are encouraged to join the IPP Mailing List to participate in any discussions of clarification issues and review of registration proposals for additional attributes and values.

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

Robert Herriot - Xerox
Andrew Mitchell - Hewlett-Packard
Kirk Ocke - Xerox

20. Change History

This section will be removed when this document is published.

20.1 February 7, 2022

First Prototype draft. Updated with changes from November 2021 F2F and January 13, 2022 teleconference:

- Removed the "client-key" member of "client-info" because the consensus is that the PWG ought not engage in creating and maintaining its own OS / application name registry;
- Added in use cases from PWG 5199.11 "Job Accounting with IPP v1.0" to section 3;
- Added job accounting model justification in section 4;
- Added "client-info" subsection to section 8 for all operations; and
- Replaced all instances of "Job Creation Request" with "Job Creation Operation".

20.2 November 2, 2021

Updated to resolve feedback from the May 2021 F2F and the August 2021 F2F to finally stabilize this draft specification and get it close to prototype stage:

- Deleted many comments that were already resolved;
- Fixed definition of "print-processing-attributes-supported";
- Expanded and clarified the "preset-category" member of "job-presets-supported";
- Deprecated several keys for "printer-supply";
- Many editorial / language fixes.

20.3 May 1, 2021

Several changes:

- Replaced the "print-quality-col" with the extension to "job-presets-supported" described in the "IPP Print Quality Discussion" wiki page, including the "preset-category" member attribute.
- Added the "print-processing-attributes-supported" Printer Description attribute as a simplified and more appropriately named replacement for "print-quality-hints-supported".
- Restructured the wording of the design requirements (editorial changes)
- Rewrote and moved section 4.4 to become the new section 4.9 "Print Quality" that now describes the Print Quality extensibility feature as an extension of the Presets feature.
- Updates some of the IANA registrations but will wait for consensus approval on rest of document before completing that.
- Did NOT update attribute descriptions to match the new template (yet) to avoid a revision filled with confusing redlines that distract from the above technical20210501 changes.

20.4 October 29, 2020

A few additions and editorial changes:

- Fixed the URLs on the first page, which were not using the right file name (!).

- Adopted the "jpeg-features-supported" Printer Description attribute registered by Apple in 2015 (https://ftp.pwg.org/pub/pwg/ipp/registrations/apple-jpegfeatures-20151021.txt)

- Adopted the "printer-firmware-name", "printer-firmware-string-version", "printer-firmware-patches" and "printer-firmware-version" Printer Description attributes registered by Apple in 2019 (https://ftp.pwg.org/pub/pwg/ipp/registrations/apple-printer-firmware-20190724.txt)

- Fixed the first line of the description for "jpeg-k-octets-supported", "jpeg-x-dimension-supported", "jpeg-y-dimension-supported", "pdf-k-octets-supported", and "pdf-versions-supported" to match the current convention (e.g. "This CONDITIONALLY REQUIRED Printer Description attribute..." rather than "The "xxx-supported Printer Description attribute...")

- Added the "pdf-features-supported" attribute since there are some optional PDF features that a Printer might support but has no way to advertise this support.

20.5 October 27, 2020

Accepted all changes and made all edits as per the following minutes:

- ippv2-f2f-minutes-20200205.pdf

- ippv2-concall-minutes-20200220.pdf

- ippv2-concall-minutes-20200227.pdf

- ippv2-concall-minutes-20200312.pdf

- ippv2-concall-minutes-20200319.pdf

A summary of changes includes the following:

- Copied all content into a new copy of the Working Draft template to try to resolve MS Word formatting issues

- Defined the new "print-quality-col" Job Template attribute and related "print-quality-col-supported" and "print-quality-col-database" to provide a modern replacement for the venerable but non-extensible "print-quality" attribute, incorporating elements from the previously proposed "print-quality-hints-supported" / "print-quality-attributes-supported", which was removed

- Defined the new "client-info" operation attribute to provide a modern replacement for the deprecated "document-format-details" [PWG5100.7] [PWG5100.5] for reporting client metadata

- Defined the new "requesting-user-uri-schemes-supported" Printer Description attribute

- Imported the "jpeg-k-octets-supported", "jpeg-x-dimension-supported", "jpeg-y-dimension-supported", "pdf-k-octets-supported", "pdf-versions-supported", "print-scaling-default", "print-scaling-supported", "printer-dns-sd-name", and "printer-kind" Printer Description attributes from PWG 5100.16-2013

- Reviewed and rewrote a number of the use cases and added new use cases that should have already been there

- Rewrote the descriptions for "printer-input-tray", "printer-output-tray" and "printer-supply" to make them more concise

- Removed the proposed "eliminate-margins" because this use case is now supported by two new keywords for "imposition-template" ('banner', 'banner-compressed') defined in IPP Production Printing Extensions v2.0 [PPX].

- Removed section 11 “Relationship of Impressions, Pages, and Sheets” since RFC 8011 has clarified definitions. (That section’s content may end up being moved to 5100.19.)

20.6 February 4, 2020

Accepted all changes and made all recommended edits from the November F2F review, which stopped at section 6.2. Made substantial changes from the beginning:

- Reviewed and rewrote the Abstract and Introduction to better match the new title

- Reviewed and rewrote a number of the use cases and added new use cases that should have already been there

- Created table in section 4 mapping coordinating Use Cases and Design Requirements to the corresponding IPP additions defined in the body of the document

- Imported the IPP Presets registration document definitions to add them to this specification

- Resolved the "vendor-keyword" question for "print-color-mode" by adding "keyword" to the syntax and referring the reader to STD92 section 7.3.

- Modified a number of conformance requirements.

20.7 November 21, 2019

Updated yet again to address a few more issues:

- Added the 'virtual' keyword for "media-source" as per IPP teleconference minutes from 20191107
- Added 'enterprise' and 'production' keywords to "ipp-features-supported" as per 20190828 IPP F2F minutes
- Removed comments that should have been removed following their approval in earlier reviews.

20.8 November 20, 2019

Updated to resolve a few minor issues:

- Added the "eliminate-margins-supported" Printer Description attribute and listed it in Table 13
- Resolved text formatting problems in Table 4
- Removed "pages-per-subset" since it has been obsoleted.

20.9 October 3, 2019

Updated to resolve all issues from August 1, 2019 conference call and August 2019 F2F reviews:

- Resolved all errata comments
- Renamed "soft-proof-icc-profiles" to "print-color-mode-icc-profiles" but chose alternate member attribute names
- Refactored tables for "printer-input-tray", "printer-output-tray" and "printer-supply" to make them easier to read and reference / cross-reference with RFC 3805, and spell checked all OID names to hopefully eliminate all typos that were in the old 5100.13
- Added conformance tables to all section 6 subsections.
- Created a new section 12 "Printer Resource Best Practices" from old section 14.4 and referenced that for HTTP and URI best practices
- Refactored and updated the Conformance Requirements section
- Added "eliminate-margins" to support the "Eliminate Upper and Lower Margins" and "Banner printing" use cases requested by Canon and HP
- Added "media-overprint" to support the "Borderless adjustment setting" use case requested by Canon and HP
- Enhanced the description for "print-quality-hints-supported"

20.10 July 24, 2019

Copied in definitions for "soft-proof-icc-profiles" and "print-quality-hints-supported" and extensions for "print-color-mode" and "print-quality" (from the latest draft of PQI). Also resolved the following feedback from Mike Sweet's email to the IPP WG reflector:

- Drop "-5100.13" from the filename (that's just for published documents)
- Global: remove section references for all of the STD92 stuff (which would have been RFC2911 sections - they don't match up
- Global: fix "reference not found" issues (section 5.6.7 at least)
- I think much of the 1.x content should be moved to a new section 4 model, with the new operations starting in section 5 (in keeping with our current template)
- pages-per-subset should be deprecated, per our prior discussions on the subject (finishings 2.1 has the job-pages-per-set attribute)
- Might as well add the "auto-monochrome" value for print-color-mode as RECOMMENDED.
- Section 5.3 attributes that are READ-ONLY should be moved to a new Job Status Attributes section.
- Section 5.4 should be "Subscription Status Attributes"
- Section 5.5 attributes that are READ-ONLY should be moved to a new Document Status Attributes section.
- Section 5.5.3 (pages) attribute is READ-WRITE (Document Description), per prior registry correction
- Section 5.5.5 (pages-completed-current-copy) should be obsoleted since RFC 3381 has been obsoleted
- Section 5.6 attributes that are READ-ONLY should be moved to a new Printer Status Attributes section.
- Section 5.6.7, table 5: obsolete "job-save" since that spec is getting obsoleted, move "proof-print" to the new EPX spec? - Section 5.6.8: The examples seem to

3386 have a mix of quote styles, maybe "1setOf syntax" instead of "1setOf <type-def- for-
3387 job-template-attribute>"

3388 • Global: Remove all of the media-xxx attributes since those are part of Job
3389 Extensions v2.0

3390 • Section 5.6.17, table 6: fix title ("multiple-operation-time-out-action")

3391 • Section 5.6.18: Obsolete

3392 • Section 5.6.29 (printer-get-attributes-supported): Drop 'type2'

3393 • Section 5.6.33 (printer-mandatory-job-attributes): Drop 'type2'

3394 • Section 5.6.39.4 example should probably be expanded to include yellow and black
3395 (to be realistic), along with a wasteToner or wasteInk entry?

3396 • Section 5.6.40.2 sync up with printer-supply example changes

3397 • Section 6.10: Remove (all media-col stuff is in JOBEXT 2.0)

3398 • Section 7.2: Remove? I think these are now defined in Finishings 2.1?

3399 • Sections 7.6 and 7.7: Remove (all media-col stuff is in JOBEXT 2.0)

3400 • Section 9.1: Example on lines 1878 to 1881 uses left/right quotes instead of straight
3401 quotes

3402 • Section 10: Might want to wordsmith this now that STD92 has clarified things? Line
3403 1985 also has a typo ("page-range" instead of "page-ranges").

3404 • Table 15: Remove (obsolete) job-cover-back and job-cover-front attributes, change
3405 "pages-ranges" to "page-ranges", remove (obsolete) sheet-collate,

3406 • Section 11.2: "printer-config-change-time" (not printer-description-change-time),
3407 remove media-xxx references.

3408 • Global: Update RFC2616 references to the corresponding new RFC723x RFCs...

3409 • Section 16: Drop "using Address style", you should be listed as primary author,
3410 move/update others as appropriate

3411 References to PWG 5100.11 were left largely unchanged because it and related documents
3412 are in a state of flux.

20.11 July 10, 2019

Initial revision for v1.1.

- Copied all content from previous JPS3 MS Word document into latest template
- Resolved all errata from PWG errata tracking site (https://www.pwg.org/dynamo/issues.php?L+P-1+S-2+I0+E0+Z13+Q)
- Copied in message catalog syntax extensions and semantics for "_tooltip" and "_helpurl" from the latest draft of HELPME
- Copied in extensions for "print-color-mode", "print-quality", from the latest draft of PQI

