IPP Everywhere™ v1.1

Status: Stable

Abstract: This specification defines an IPP profile that supports network printing without vendor-specific driver software, including the transport, various discovery protocols, and standard document formats.

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1. Introduction

Mobile devices do not follow the traditional use models for printing services. For mobile devices, discovery of available printers and their capabilities is both more difficult than for traditional desktop systems and more important because of dynamically changing network attachment points.

Printer vendors and software vendors have defined and deployed many different document formats (page description languages) and also dialects of those document formats, increasing the traditional desktop system need for model-specific printer drivers. While there are millions of model-specific printer drivers available for traditional desktop systems, this printer driver model is clearly not practical for mobile devices.

IPP Everywhere™ allows Clients, particularly mobile Internet devices, to easily support printing using IPP but without the use of vendor-specific drivers through the adoption of standard document formats, discovery protocols, and schemas.

2. Terminology

2.1 Printing Terminology

Normative definitions and semantics of printing terms are imported from IETF Printer MIB v2 [RFC3805], IETF Finisher MIB [RFC3806], and IETF Internet Printing Protocol/1.1 [STD92].

Device: A Logical or Physical Device associated with one or more Printers [STD92].

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.

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.

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.

Output Device: a single Logical or Physical Device

Physical Device: a hardware implementation of a endpoint device, e.g., a marking engine, a fax modem, etc.
2.2 Protocol Role Terminology

This document also defines the following protocol roles 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.

2.3 Other Terminology

*Direct Imaging*: Printing, facsimile, and scanning performed by direct communication from the Client to an Imaging Device or local print server.

*Directory Service*: A Service providing query and enumeration of information using names or other identifiers.

*Discovery*: Finding Printers by querying or browsing local network segments or Enumeration of Directory or Name Services.

*Enumeration*: Listing Printers that are registered with a Directory or other Service.

*Indirect Imaging*: Printing, facsimile, and scanning performed by communication from the Client and/or Imaging Device to an intermediary service in a different administrative domain, for example when the Client communicates with a third-party print service or when an Imaging Device communicates with a Cloud service.

*Network Accessible Device*: A Device that can be directly accessed by a Client.

*Network Accessible/Accessibility*: Refers to the ability of one device to communicate directly with another, for example a Client is able to connect to a Device, query for supported attributes, submit Job creation requests, and so forth.

*Operator*: A person or automata that typically oversees the Printer. The Operator is allowed to query and manage the Printer, Jobs and Documents based on site policy.

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

*Secure Print*: A print job using the "document-password", "job-password", and/or "job-password-encryption" operation attributes to provide document and/or physical security.

See [PWG5100.11] and [PWG5100.13].
Service: Software providing access to physical, logical, or virtual resources and (typically) processing of queued Jobs.

User: A person or automata using a Client to communicate with a Printer.

2.4 Acronyms and Organizations

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


3. Requirements

3.1 Rationale

Given the following existing specifications and the need for a standard method of Direct Imaging without traditional vendor-specific driver software, this specification should:

1. Use existing protocols and schema to support discovery, identification, and auto-configuration of Imaging Devices,
2. Use existing IPP specifications to support job submission to and monitoring of Imaging Devices,
3. Encourage support for printing through standard document formats, and
4. Discourage the further proliferation of vendor-specific page description languages, formats, discovery protocols, interfaces, and transports

The Internet Printing Protocol/1.1 [STD92] defines the core Internet Printing Protocol.

IPP Version 2.0, 2.1, and 2.2 [PWG5100.12] defines:

1. A collection of existing IPP specifications that form the basis for IPP/2.0
2. Standard job template attributes
3. Specific interoperability requirements, such as HTTP/1.1 support with chunking and IPP collection attribute support
4. New version number and operation requirements for different classes of Imaging Devices

The IPP URL Scheme [RFC3510] defines the 'ipp' URI scheme and the IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472] defines the 'ipps' URI scheme used for IPP.

The IPP: Job and Printer Extensions - Set 3 [PWG5100.13] define new attributes and operations required for mobile printing and printing with generic drivers.

The IPP Transaction-Based Printing Extensions [PWG5100.16] define attributes required for Paid Imaging Services.

The IPP Job Password Repertoire [REPERTOIRE] defines attributes that articulate the repertoire of allowable password strings.

The IPP Presets [PRESETS] define attributes for predefined sets of Job Template values.

The IPP Privacy Attributes v1.0 [PRIVACY] define attributes for specifying the privacy policies of Jobs and Printers.

The PWG Raster Format [PWG5102.4] defines a minimal file format for transmission of multi-page color and grayscale bitmap images.
The Document management -- Portable document format -- Part 1: PDF 1.7 [ISO32000] defines:

1. A rich file format for transmission of multi-page color and grayscale vector and bitmap images
2. Standard page attributes to support page size, orientation, and duplex functionality

The JPEG File Interchange Format Version 1.02 [JFIF] defines a compact file format for transmission of photographic images

The Bonjour Printing Specification version 1.2 [BONJOUR] defines:

1. Multicast DNS for use on link-local networks [RFC6762]
2. Discovery of Printers using Domain Name System (DNS) service (SRV) lookups [RFC6763]
3. Automatic address assignment for both IPv4 [RFC3927] and IPv6
4. DNS text (TXT) record keys to support auto-configuration, capabilities, identification, and protocol selection


3.2 Use Cases

3.2.1 Select Printer

Print selection is part of most Print use cases - Jane selects a Printer, implicitly or explicitly, and the remainder of the use case applies to the selected Printer. A Printer can be a Logical Printer (Service) or a Physical Printer (section 2.1). Selection use cases can often be combined, for example Selection Using a Directory Service (section 3.2.1.4) with Selection Using Properties (section 3.2.1.9).

In order to simplify the selection use cases, common exceptions are listed as separate use cases in section 3.2.3.

Precondition: For all of the following use cases, the Printer is Network Accessible to be selected, either directly or through an intermediate Service.

3.2.1.1 Select the Last Used Printer

The Client User Interface provides the last used Printer as a selection. Jane then confirms the selection of the last used Printer.
The last used Printer may be automatically selected by the Client User Interface and may be affected by the current network topology or geo-location, for example the last used Printer may be tracked on a per-network (e.g., default router or other criteria), per-location (e.g., geo-location), or per-Service (e.g., current local server) basis.

### 3.2.1.2 Select Printer Using Name or Address

The Client User Interface asks Jane for a name or address for the Printer. She then provides a Printer name or address through the Client User Interface. Finally, the Client User Interface queries the Printer for valid Service Uniform Resource Identifiers (URIs).

The Printer name can be a DNS Service Discovery (DNS-SD) Service name, a fully-qualified domain name, or other unique identifying name. The Printer address can be a numeric IP address or other unique identifying number.

### 3.2.1.3 Select Printer Using URI

The Client User Interface asks Jane for a Service URI for the Printer. She then provides a URI through the Client User Interface or cancels selection.

For example, Jane could supply an IPP URI: "ipp://example.com/port1" as reported by the Printer's network configuration page.

### 3.2.1.4 Select Printer Using a Directory Service

The Client obtains a list of Printers on behalf of Jane from the Directory Service and validates that each Printer supports one or more Client-supported Service protocols. The Client User Interface then asks Jane to select one of the supported Printers. Finally, she selects a Printer.

Preconditions: One or more Printers are listed in a Directory Service and that Directory Service is Network Accessible to the Client.

### 3.2.1.5 Select Printer Using a Cloud Service

The Client obtains a list of Printers on behalf of Jane from the Cloud Service(s). The Client User Interface then asks Jane to select one of the Printers. Finally, she selects a Printer.

Preconditions: The Client and one or more Printers are registered with a Cloud Service, and that Cloud Service is Network Accessible to both the Client and Printers. The Client and Printers may be registered with multiple Cloud Services, and both may maintain multiple identities for a particular Cloud Service.

### 3.2.1.6 Select Printer Using a Discovery Protocol

The Client initiates Discovery on behalf of Jane and maintains a dynamic list of Network Accessible Printers during selection. The Client User Interface asks Jane to select one of...
the Network Accessible Printers, updating those Printers as they come and go. Finally, she selects a Printer and the Client terminates Discovery.

Preconditions: The Printer is Network Accessible to the Client and supports a common Discovery Protocol.

### 3.2.1.7 Select Printer Using Geo-Location

The Client initiates Enumeration of Printers within a geographic area using Services and/or Discovery Protocols, hiding duplicate Printers that are reported by multiple Service and/or Discovery Protocols. The Client User Interface asks Jane to select one of the Printers. Finally, she selects a Printer.

Preconditions: Both the Client and Printer have access to geo-location information to allow for Enumeration within a geographic area, and both support common Discovery Protocol(s).

### 3.2.1.8 Select Printer Using Out of Band Method

Jane asks the Client User Interface to identify the Printer using a built-in camera, Near-Field Communications (NFC) chip, or other sensing technology. The Client initiates identification to obtain a Service URI and descriptive information. The Client User Interface then asks Jane to confirm the selection of the identified Printer. Finally, she confirms the selection.

Precondition: The Printer and Client support a common identifying technology such as NFC, Quick Response Codes (QRCodes), or bar codes.

### 3.2.1.9 Select Printer Using Properties

Jane selects a Printer using properties such as Service, capability, or description properties of the Printer. Service properties include the application (printing) protocol, security, or restrictions such as the maximum number of pages allowed in a job. Capability properties include values such as media, duplex, finishing, color support, and so forth. Description properties include values such as location, speed, color support, and job size. The properties may be provided by a combination of user input, policy, and/or software heuristic.

Jane asks the Client User Interface to select using properties. The Client obtains a list of Printers for Jane that meet the given properties provided by the Client software, policy, and/or user and validates that each Printer supports one or more Client-supported Service protocols. The Client User Interface then asks Jane to select one of the supported Printers. Finally, she selects a Printer.

### 3.2.2 Print

Each of the use cases in this section begin by initiating a print action, selecting a Printer (section 3.2.1), querying the Printer status, capabilities, and status information, and displaying of any status information important to the User. Each use case generally ends with Jane collecting the printout from the Printer.
Preconditions: For all of the following use cases, the Printer must be Network Accessible to the Client in order to be selected, either directly or through an intermediate Service. Also, the document to be printed must be Network Accessible to the Printer and in a format suitable for the Printer or converted by the Client or Service into a suitable format.

3.2.2.1 Print a Document

Jane has a Client connected to the Wi-Fi network in her business and has a document to print prior to a meeting that is stored on her phone.

After Jane initiates a print action and selects a Printer, she specifies the processing intent for the Job and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and attached document data. The Printer validates the Job Ticket and document data and then prints the document.

3.2.2.2 Print a Document by Reference

Jane has a Client connected to the Wi-Fi network in her business and is viewing a document on a server that she would like to print.

After Jane initiates a print action and selects a Printer, she specifies the processing intent for the Job and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and document URI. The Printer validates the Job Ticket and document URI and then prints the document.

3.2.2.3 Print Using Loaded Media

Jane is viewing a photo and would like to print the photo on the largest borderless photographic media loaded on her Printer.

After Jane initiates a print action from the phone and selects a Printer, the Client photo application automatically selects the largest borderless photographic media loaded on the Selected Printer and the highest print quality. Jane selects additional processing intent for the Job and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and local photo. The Printer validates the Job Ticket and document data and then prints the photo.

Preconditions: Printer can report loaded media information such as size, orientation, type, coating, and weight. This may be detected automatically or manually entered by the User or Operator when loading the media.

3.2.2.4 Print a Secure Form

The treasurer of a small training company that is holding a meeting and seminar at a resort needs to print out 20 checks for training personnel. He uses an accounting program to enter the hours worked, bonuses, reimbursable expenses, and so forth and prints the checks on a printer provided by the resort using check blanks he brought to the meeting.
The treasurer loads check blanks into the Printer and configured the loaded media as necessary at the Printer. After he initiates a print action from the accounting program, selects a Printer for printing, and selects checks to be printed, the Client User Interface displays a preview of the printed checks and he confirms that the checks are correctly paginated and oriented and the amounts, payees and signature are correct. The Client automatically selects the check blank media. The treasurer selects additional processing intent for the Job and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and document data containing the check information, correctly oriented for the check blank media. He waits for the checks to be printed and removes any excess media from the Printer.

Preconditions: Printer can report loaded media information such as size, orientation, type, coating, and weight. This may be detected automatically or manually entered by the User or Operator when loading the media.

3.2.2.5 Print with Special Formatting

At a seminar located at a country resort, an assistant has been asked to provide 80 sets of ten keywords/phrases, clearly printed on 2-inch by 1-inch paper slips for use in a get acquainted exercise. Costs are to be minimized. The assistant has a laptop with a word processor program. The resort has a Wi-Fi network available to Users and a networked MFD at the business center. The attendant at the business center will charge for any printed sheets removed from the premises.

After the assistant initiates a print action from the word processor and selects a Printer, he selects the processing intent for the Job and confirms the print action. The word processor produces document data using the media information (size and margins) in the Job Ticket so that 2-inch by 1-inch slips are spread evenly over each page and sends a print job request to the Printer with the Job Ticket and document. The Printer validates the Job Ticket and document data and then prints the document.

3.2.2.6 Print and Select at Printer

One or more Printers are associated with a Service that allows Users to release and print Jobs at any associated Printer. Each User may release a job at a given Printer by providing a Personal Identification Number (PIN) and/or other unique identification/authorization information such as a username and password or IDentification (ID) card.

After initiating a print action and selecting a Service, Jane specifies the processing intent and PIN for the Job and confirms the print action. The Client sends a print job request to the Service with the Job Ticket and local document. The Service validates the Job Ticket and document data and then holds the document until released by Jane at the Printer.

Precondition: The Client and Printer support a common authorization or identification system. The capability of associated Printers are the same or the User selects a best-effort job processing intent.
3.2.2.7 Print to a Service

John is flying to New York for a presentation and doesn't want to carry the presentations.

John arrives in New York and goes online from his mobile phone. After initiating a print action, he selects a local print provider, reviewing the provider web pages as needed. He then specifies the processing intent as 10 color copies, printed duplex and stapled on the left side, with the covers on 80lb. stock and the internal pages on 24lb. stock. After confirming the print action, John goes to the provider and picks up his presentations, paying with his corporate credit card.

3.2.2.8 Print to a Recipient

The recipient may release a job at a given Printer by providing a PIN and/or other unique identification/authorization information such as a username and password or ID card.

After initiating a print action and selecting a Printer, Jane specifies the processing intent, specifies John as the recipient, and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and local document. The Printer validates the Job Ticket and document data and then holds the document until released by John. Finally, John collects the printout from the Printer.

3.2.2.9 Print with a Proof Copy

After initiating a print action and selecting a Printer, John specifies the processing intent, requests a proof print, and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and local document. The Printer validates the Job Ticket and document data and then prints a proof copy of the document. John collects the proof printout from the Printer and verifies correct output. John then initiates a full print of the document from the Client or Printer to produce part or all of the final output.

3.2.3 Exceptions

3.2.3.1 Print Action Canceled

Jane cancels the print action UI. The Client then discontinues any active printer selection, print job submission, or other operations and cancels any incomplete print job submission as needed.

3.2.3.2 Select Printer Canceled

John cancels selection of a Printer. The Client then discontinues any active discovery, enumeration, or query operations as needed.
3.2.3.3 Printer No Longer Network Accessible after Selection

After selecting a Network Accessible Printer, the Client, selected Printer, or network suffers a failure preventing the Client from communicating with the Printer. Typically this will display an error message on the Client and cancel the print request.

3.2.3.4 Not Authorized

After confirming the print request, the Printer responds that the User is not authorized to print the Job document(s). The reason for the authorization failure may involve general access to the Printer, Job document(s), or disallowed Job Ticket values, for example a User may not be allowed to print in color.

Precondition: The Printer has access to a file, database, or Service that provides authorization information.

3.2.3.5 Needs Authentication

After confirming the print request or selecting the Printer, the User is asked to authenticate with the Printer in order to gain access.

Precondition: The Printer has access to a file, database, or Service that provide authentication and authorization information.

3.2.3.6 Not Accepting Jobs

After confirming the print request, the Client discovers that the Printer is no longer accepting jobs, displays an error message, and cancels the print request.

3.2.3.7 Job Ticket or Document Format Not Supported

After confirming the print request, the Printer rejects the request because the job ticket or document format is not supported. The Client displays an error message and cancels the print request.

3.2.3.8 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 resources, and other conditions that prevent a particular Job or document from printing.

3.2.3.9 Printer Fault

While processing a Job, the Printer reports faults to the Client, which displays an error message as needed and asks the User or Operator to confirm the disposition of the Job. Printer faults include "out of paper" and other conditions that stop the processing of Jobs.
3.2.3.10 Printer Warning

While processing a Job, the Printer reports warnings to the Client, which provides a warning message as needed. Printer warnings include "low toner" and other advisory conditions that do not stop the processing of Jobs and do not require immediate attention.

3.3 Out of Scope

The following elements of the use cases are considered out of scope for this specification:

1. The actual method of geo-location and geographic area detection for the Select Printer Using Geo-Loca
2. The actual method of payment for the Print to a Service (section 3.2.2.7) use case
3. Constraining choice of document formats suitable for the Print use cases
4. Definition of new discovery protocols used to find Network Accessible Printers (however, extension of existing protocols is still in scope)

3.4 Design Requirements

The IPP Everywhere™ design should:

1. Define conformance profiles that reference the IPP/2.0 versions [PWG510.12];
2. Follow the naming conventions defined in the Internet Printing Protocol/1.1 [STD92], including keyword value case (lower) and hyphenation requirements;
3. Define conformance requirements for both Printers and Clients; and
4. Support printing with vendor-neutral Client software from any Client to any Printer using a variety of discovery protocols, IPP for the transport, and standard document formats.
4. Discovery Protocols

Printers representing Physical Devices MUST and Printers representing Logical Devices (i.e. print servers) SHOULD support DNS-SD based Discovery. Printers MAY support other Discovery protocols such as LDAP and SLP.

Clients MUST support DNS-SD. Clients MAY support other Discovery protocols such as LDAP and SLP.

4.1 Printer Description Attributes Used in Discovery

Table 1 lists the Printer Description attributes that would normally be used for Discovery or filtering of discovered Printers based on one or more specified Printer attribute values.

4.2 DNS Service Discovery (DNS-SD)

DNS Service Discovery (DNS-SD) [RFC6762] uses service (SRV) records and traditional unicast and multicast DNS (mDNS) [RFC6763] queries. This discovery protocol is collectively defined in the Bonjour Printing Specification version 1.2.1 [BONJOUR] and extended in this specification.

Printers that support DNS-SD MUST support mDNS and MAY support dynamic DNS updates via Dynamic Updates in the Domain Name System (DNS UPDATE) [RFC2136] and other mechanisms.

4.2.1 Service (SRV) Instance Name

Printers MUST NOT use a service instance name containing a unique identifier by default. A unique identifier MAY be added to the instance if there is a name collision.

Printers that support DNS-SD MUST advertise the "_ipp._tcp" (generic IPP) and "_print._sub._ipp._tcp" (IPP Everywhere™) services over mDNS.

Printers that support DNS-SD and the "ipps" URI scheme [RFC7472] MUST advertise the "_ipps._tcp" (generic IPPS) and "_print._sub._ipps._tcp" (IPP Everywhere™ Secure) services over mDNS.

The domain portion of the service instance name MUST BE "local." for mDNS.

4.2.2 Geo-Location (LOC)

Printers MUST publish LOC records [RFC1876] over mDNS to provide the physical location of the Printer. Printers MUST allow the User to configure the geo-location manually. If the accuracy of the geo-location is unknown, a value of $9 \times 10^9$ meters ($0 \times 99$) MUST be used.
Table 1 - Attributes in Discovery Protocols

<table>
<thead>
<tr>
<th>IPP Attribute</th>
<th>DNS-SD TXT Key</th>
<th>LDAP/SLP Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>color-supported</td>
<td>Color</td>
<td>printer-color-supported</td>
</tr>
<tr>
<td>copies-supported</td>
<td>Copies</td>
<td>printer-copies-supported</td>
</tr>
<tr>
<td>device-service-count (note 2)</td>
<td>(note 2)</td>
<td>printer-device-service-count (note 1)</td>
</tr>
<tr>
<td>device-uuid</td>
<td>DUUID</td>
<td>printer-device-uuid (note 1)</td>
</tr>
<tr>
<td>document-formats-supported</td>
<td>pdl</td>
<td>printer-document-format-supported</td>
</tr>
<tr>
<td>finishings-supported</td>
<td>Bind, Punch, Sort, Staple</td>
<td>printer-finishings-supported</td>
</tr>
<tr>
<td>ipp-features-supported (subtype)</td>
<td></td>
<td>printer-ipp-features-supported</td>
</tr>
<tr>
<td>media-supported</td>
<td>PaperCustom, PaperMax</td>
<td>printer-media-supported</td>
</tr>
<tr>
<td>multiple-document-handling</td>
<td>Collate</td>
<td>printer-pages-per-minute</td>
</tr>
<tr>
<td>pages-per-minute (note 2)</td>
<td>(note 2)</td>
<td>printer-pages-per-minute-color</td>
</tr>
<tr>
<td>pages-per-minute-color (note 2)</td>
<td>(note 2)</td>
<td>printer-charge-info (note 1)</td>
</tr>
<tr>
<td>printer-charge-info (note 2)</td>
<td>chargeuri</td>
<td>printer-charge-info-uri (note 1)</td>
</tr>
<tr>
<td>printer-device-id</td>
<td>usb_CMD, usb_MDL, usb_MFG</td>
<td>printer-device-id (note 1)</td>
</tr>
<tr>
<td>printer-geo-location (LOC record)</td>
<td>(instance)</td>
<td>printer-geo-location (note 1)</td>
</tr>
<tr>
<td>printer-info (instance)</td>
<td></td>
<td>printer-info</td>
</tr>
<tr>
<td>printer-location</td>
<td>note</td>
<td>printer-location</td>
</tr>
<tr>
<td>printer-make-and-model</td>
<td>ty</td>
<td>printer-make-and-model</td>
</tr>
<tr>
<td>printer-more-info</td>
<td>adminurl</td>
<td>printer-more-info</td>
</tr>
<tr>
<td>printer-name (instance)</td>
<td></td>
<td>printer-name</td>
</tr>
<tr>
<td>printer-organization (note 2)</td>
<td>O</td>
<td>printer-organization-unit</td>
</tr>
<tr>
<td>printer-organizational-unit (note 2)</td>
<td>(note 2)</td>
<td>printer-uri-supported</td>
</tr>
<tr>
<td>printer-uri-supported (service + host + port)</td>
<td>RP</td>
<td></td>
</tr>
<tr>
<td>printer-uuid</td>
<td>UUID</td>
<td>printer-uuid (note 1)</td>
</tr>
<tr>
<td>sides-supported</td>
<td>Duplex</td>
<td>printer-sides-supported</td>
</tr>
<tr>
<td>uri-authentication-supported</td>
<td>air</td>
<td>printer-xri-supported</td>
</tr>
<tr>
<td>uri-security-supported</td>
<td>TLS</td>
<td>printer-xri-supported</td>
</tr>
</tbody>
</table>

Note 1: Extension attribute to RFC 7612.
Note 2: Available via subsequent IPP Get-Printer-Attributes request.

4.2.3 Text (TXT)

Printers MUST publish a text (TXT) record that provides service information over mDNS.
Printers that support dynamic DNS updates MUST publish separate TXT records for each domain that is updated. The following subsections define new key/value pairs in addition to those required by the Bonjour Printing Specification [BONJOUR].
Table 3 lists all of the key/value pairs that are defined with the corresponding default values. Printers SHOULD omit key/value pairs when the value matches the default value for the corresponding key to limit the size of the TXT record.

The combined length of a TXT key/value pair ("key=value") cannot exceed 255 octets. This limit is sometimes smaller than the limit imposed by the corresponding IPP attribute.

For example, the IPP "printer-more-info" attribute has a maximum length of 1023 octets, however the corresponding "adminurl" key cannot represent a value longer than 246 octets (255 - 9 octets for "adminurl="). Printers MUST truncate long strings as described in section 13.

The combined length of all TXT key/value pairs provided by the Printer SHOULD BE 400 octets or less for unicast DNS and MUST NOT exceed 1300 octets for multicast DNS.

Printers MUST provide the "rp" TXT key/value pair within the first 400 octets of the TXT record. Table 2 shows the priority of TXT key/value pairs.

<table>
<thead>
<tr>
<th>Most Important Access Keys</th>
<th>Identification Keys</th>
<th>Capability Keys</th>
<th>Least Important Keys</th>
</tr>
</thead>
<tbody>
<tr>
<td>rp</td>
<td>UUID</td>
<td>Color</td>
<td>Product</td>
</tr>
<tr>
<td>txtvers</td>
<td>DUUID</td>
<td>Duplex</td>
<td>usb_MFG</td>
</tr>
<tr>
<td>priority</td>
<td>ty</td>
<td>Copies</td>
<td>usb_MDL</td>
</tr>
<tr>
<td>qtotal</td>
<td></td>
<td>Collate</td>
<td>usb_CMD</td>
</tr>
<tr>
<td>note</td>
<td></td>
<td>PaperMax</td>
<td>pdl</td>
</tr>
<tr>
<td>air</td>
<td></td>
<td>PaperCustom</td>
<td></td>
</tr>
<tr>
<td>TLS</td>
<td></td>
<td>Bind</td>
<td></td>
</tr>
<tr>
<td>adminurl</td>
<td></td>
<td>Punch</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sort</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Staple</td>
<td></td>
</tr>
</tbody>
</table>

Clients MUST ignore incomplete key/value pairs at the end of a truncated TXT record.
### Table 3 - DNS TXT Record Keys

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>adminurl</td>
<td>The Printer-resident configuration page URL as reported by the &quot;printer-more-info&quot; Printer Description attribute.</td>
<td>&quot; (empty string)</td>
</tr>
<tr>
<td>air</td>
<td>The type of authentication information that is required for the Printer. See section 4.2.3.1.</td>
<td>'none'</td>
</tr>
<tr>
<td>Bind</td>
<td>'T' if the Printer can bind output, 'F' otherwise.</td>
<td>'U' (note 1)</td>
</tr>
<tr>
<td>Collate</td>
<td>'T' if the Printer can collate copies, 'F' otherwise.</td>
<td>'U' (note 1)</td>
</tr>
<tr>
<td>Color</td>
<td>'T' if the Printer supports color printing, 'F' otherwise.</td>
<td>'U' (note 1)</td>
</tr>
<tr>
<td>Copies</td>
<td>'T' if the Printer can make copies on its own, 'F' otherwise.</td>
<td>'U' (note 1)</td>
</tr>
<tr>
<td>Duplex</td>
<td>'T' if the Printer supports duplex printing, 'F' otherwise.</td>
<td>'U' (note 1)</td>
</tr>
<tr>
<td>DUUID</td>
<td>The UUID of the Device without the &quot;urn:uuid:&quot; prefix as reported by the &quot;device-uuid&quot; Printer Description attribute.</td>
<td>&quot; (empty string)</td>
</tr>
<tr>
<td>note</td>
<td>The location of the Printer as reported by the &quot;printer-location&quot; Printer Description attribute.</td>
<td>&quot; (empty string)</td>
</tr>
<tr>
<td>PaperCustom</td>
<td>'T' if the Printer supports custom media sizes, 'F' otherwise.</td>
<td>'U' (note 1)</td>
</tr>
<tr>
<td>PaperMax</td>
<td>The maximum media size supported by the Printer: '&lt;legal-A4', 'legal-A4', 'isoC-A2', '&gt;isoC-A2'.</td>
<td>'legal-A4'</td>
</tr>
<tr>
<td>pdl</td>
<td>A comma-delimited list of supported MIME media types. See section 4.2.3.2.</td>
<td>&quot; (empty string)</td>
</tr>
<tr>
<td>priority</td>
<td>The priority for the service from 0 to 99, where 0 is the highest priority and 99 is the lowest priority.</td>
<td>'50'</td>
</tr>
<tr>
<td>Punch</td>
<td>'T' if the Printer can punch output, 'F' otherwise.</td>
<td>'U' (note 1)</td>
</tr>
<tr>
<td>qtotal</td>
<td>The number of queues for this Printer. MUST have the value '1'. See section 4.2.3.3</td>
<td>'1'</td>
</tr>
<tr>
<td>rp</td>
<td>The remote print queue name, which is the resource path portion of the Printer URI without the leading slash.</td>
<td>&quot; (empty string)</td>
</tr>
<tr>
<td>Sort</td>
<td>'T' if the Printer can sort output, 'F' otherwise.</td>
<td>'U' (note 1)</td>
</tr>
<tr>
<td>Staple</td>
<td>'T' if the Printer can staple output, 'F' otherwise.</td>
<td>'U' (note 1)</td>
</tr>
<tr>
<td>TLS</td>
<td>The maximum TLS version supported or 'none' if no version of TLS is supported. See section 4.2.3.4.</td>
<td>'none'</td>
</tr>
<tr>
<td>txtvers</td>
<td>The major version of the Bonjour Printing Specification. MUST have the value '1'.</td>
<td>'1'</td>
</tr>
<tr>
<td>ty</td>
<td>The make and model of the Printer as reported by the &quot;printer-make-and-model&quot; Printer Description attribute.</td>
<td>&quot; (empty string)</td>
</tr>
<tr>
<td>UUID</td>
<td>The UUID of the Printer without the 'urn:uuid:' prefix as reported by the &quot;printer-uuid&quot; Printer Description attribute.</td>
<td>&quot; (empty string)</td>
</tr>
</tbody>
</table>

Note 1: The value 'U' means "undefined".

### 4.2.3.1 air

The "air" key defines the type of authentication information that is required for imaging. The name "air" comes from the CUPS "auth-info-required" Printer Description attribute.
[CUPSIPP] that extends the "uri-authentication-supported" Printer Description attribute [STD92]. The following values are supported:

'verification'; Authentication using Secure Sockets Layer (SSL) and Transport Layer Security (TLS) certificates. This is equivalent to the 'certificate' value for the "uri-authentication-supported" Printer Description attribute.

'negotiate'; Kerberized authentication is required [RFC4559]. This is equivalent to the 'negotiate' value [PWG5100.13] for the "uri-authentication-supported" Printer Description attribute.

'none'; No authentication is required. This is equivalent to the 'none' value for the "uri-authentication-supported" Printer Description attribute.

'oath'; OAuth 2.0 authentication [RFC6749] is required using the Bearer method [RFC6750]. This is equivalent to the 'oath' value [PWG5100.18] for the "uri-authentication-supported" Printer Description attribute.

'username,password'; Username + password authentication is required. This is equivalent to the 'basic' or 'digest' values for the "uri-authentication-supported" Printer Description attribute.

The default value for the "air" key is 'none'.

4.2.3.2 pdl

The REQUIRED "pdl" (Page Description Language) key lists the supported MIME media types. Because the total length of a key/value pair is 255 octets, the "pdl" value is typically a subset of the values reported by the "document-format-supported" Printer Description attribute. Printers SHOULD populate the "pdl" key with a comma-delimited list of the REQUIRED and preferred Multipurpose Internet Mail Extensions (MIME) media types and MUST NOT list the 'application/octet-stream' MIME media type.

4.2.3.3 qtotal

The "qtotal" key defines the number of services supported by the Printer with this service instance name. While the Bonjour Printing Specification [BONJOUR] does allow Printers to advertise multiple services with the same name using multiple TXT records, historically this functionality has caused interoperability and stability issues for Printers and Clients that support multiple network interfaces, e.g., Wi-Fi and Ethernet. Therefore, Printers MUST NOT advertise multiple services using the same name and MUST always use the default value (1) for the "qtotal" key and advertise the default (print) service in the TXT record. Printers with multiple print service endpoints MAY advertise multiple uniquely named services, each providing a single TXT record for their corresponding information.
4.2.3.4 TLS

The "TLS" key defines the highest version of TLS that is supported for encrypted communications with the Printer. The following values are currently defined:

- 'none'; No encryption is supported. This is equivalent to the value 'none' for the "uri-security-supported" Printer Description attribute.
- '1.0'; TLS 1.0 [RFC2246] encryption is supported. This is equivalent to the value 'tls' for the "uri-security-supported" Printer Description attribute.
- '1.1'; TLS 1.1 [RFC4346] encryption is supported. This is equivalent to the value 'tls' for the "uri-security-supported" Printer Description attribute.
- '1.2'; TLS 1.2 [RFC5246] encryption is supported. This is equivalent to the value 'tls' for the "uri-security-supported" Printer Description attribute.
- '1.3'; TLS 1.3 [RFC-TLS1.3] encryption is supported. This is equivalent to the value 'tls' for the "uri-security-supported" Printer Description attribute.

The default value of the "TLS" key is 'none'. Version numbers correspond to the currently defined TLS protocol versions as defined by the IETF and are not limited to the version numbers shown above. Printers that support IPPS MUST report the TLS key.

4.2.3.5 UUID

The REQUIRED "UUID" key provides the value of the "printer-uuid" Printer Description attribute [RFC4122] [PWG 5100.13] without the leading "urn:uuid:". For example, if a Printer reports a "printer-uuid" value of:

urn:uuid:12345678-9ABC-DEF0-1234-56789ABCDEF0

The "UUID" key will have a value of:

12345678-9ABC-DEF0-1234-56789ABCDEF0

Note: The "printer-uuid" value is used instead of "device-uuid" because DNS-SD identifies services and not devices.

4.2.3.6 DUUID

The "DUUID" key provides the value of the "device-uuid" Printer Description attribute [RFC4122] [PWG 5100.13] without the leading "urn:uuid:". For example, if a Printer reports a "device-uuid" value of:

urn:uuid:12345678-9ABC-DEF0-1234-56789ABCDEF0

The "DUUID" key will have a value of:
4.3 LDAP and SLP Discovery

LDAP and SLP discovery use the schema defined in Lightweight Directory Access Protocol (LDAP): Schema for Printer Services [RFC4511] [RFC4515] [RFC7612].

Both LDAP and SLP impose hard limits on the lengths of string values, typically 127 or 255 octets depending on the attribute. These limits are sometimes smaller than the limits imposed by the corresponding IPP attributes.

For example, the IPP "printer-device-id" attribute has a maximum length of 1023 octets, however the corresponding LDAP "printer-device-id" attribute has a maximum length of 255 octets. Printers MUST truncate long strings as defined in section 13.
5. Protocol Binding

Printers and Clients MUST support IPP/2.0, IPP/2.1, and/or IPP/2.2 [PWG5100.12] and the IPP Job and Printer Extensions - Set 3 [PWG5100.13].

While this specification defines an IPP binding, the same set of Semantic Elements can be applied to any protocol that conforms to the PWG Semantic Model.

5.1 HTTP Features

In addition to the IPP over HTTP conformance requirements defined in section 7.3 of IPP Version 2.0, 2.1, and 2.2 [PWG5100.12], Printers MUST support the following HTTP headers and status codes defined in HTTP/1.1 - Message Syntax and Routing [RFC7230], HTTP/1.1 - Semantics and Content [RFC7231], HTTP/1.1 - Conditional Requests [RFC7232], and HTTP/1.1 - Caching [RFC7234].

Clients and Printers MUST support IPP over HTTP [RFC3510] and SHOULD support IPP over HTTPS [RFC7472] with the most recent version of TLS [RFC8446].

5.1.1 Host

Printers MUST validate the Host request header and SHOULD use the Host value in generated URIs, including any port number.

5.1.2 If-Modified-Since, Last-Modified, and 304 Not Modified

Printers MUST support the If-Modified-Since request header (section 3.3 [RFC7232]), the corresponding response status ("304 Not Modified", section 4.1 [RFC7232]), and the Last-Modified response header (section 2.2 [RFC7232]).

The If-Modified-Since request header allows a Client to efficiently determine whether a particular resource file (icon, ICC profile, localization file, etc.) has been updated since the last time the Client requested it.

5.1.3 Cache-Control

Printers and Clients MUST conform to the caching semantics defined in [RFC7234]. Typically, most resource files provided by a Printer in a GET response will be cacheable but IPP responses in a POST response are not. Therefore, Printers MAY provide a Cache-Control header in GET responses with an appropriate "max-age" value and MUST provide a Cache-Control header in IPP POST responses with the value "no-cache".
5.2 IPP Operations

Table 4 lists the REQUIRED operations for an IPP Everywhere™ Printer. Additionally, Clients and Printers SHOULD support the Get-User-Printer-Attributes [GUPA] operation for per-User print policies.

Note: The Create-Job and Send-Document operations are required in order to support reliable Job management (e.g., cancellation) during Print Job submission, but Printers are not required to support multiple Document Jobs.

<table>
<thead>
<tr>
<th>Code</th>
<th>Operation Name</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0002</td>
<td>Print-Job</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>0x0004</td>
<td>Validate-Job</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>0x0005</td>
<td>Create-Job</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>0x0006</td>
<td>Send-Document</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>0x0008</td>
<td>Cancel-Job</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>0x0009</td>
<td>Get-Job-Attributes</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>0x000A</td>
<td>Get-Jobs</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>0x000B</td>
<td>Get-Printer-Attributes</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>0x0039</td>
<td>Cancel-My-Jobs</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>0x003B</td>
<td>Close-Job</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>0x003C</td>
<td>Identify-Printer (note 1)</td>
<td>PWG 5100.13</td>
</tr>
</tbody>
</table>

Note 1: RECOMMENDED for Logical Devices, REQUIRED otherwise.

5.3 IPP Printer Description Attributes

Table 5 lists the Printer Description attributes for an IPP Everywhere™ Printer. All attributes in the table are REQUIRED unless otherwise specified.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>charset-configured</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>charset-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>color-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>compression-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>copies-default (note 2)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>copies-supported (note 2)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>document-format-default</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>document-password-supported (note 2)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>feed-orientation-default (note 5)</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>feed-orientation-supported (note 5)</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>finishings-col-database (notes 3 and 7)</td>
<td>PWG 5100.1</td>
</tr>
<tr>
<td>finishings-col-default (notes 3 and 7)</td>
<td>PWG 5100.1</td>
</tr>
<tr>
<td>finishings-col-ready (notes 3 and 7)</td>
<td>PWG 5100.1</td>
</tr>
<tr>
<td>finishings-col-supported (notes 3 and 7)</td>
<td>PWG 5100.1</td>
</tr>
<tr>
<td>finishings-default (note 3)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>Attribute</td>
<td>Reference</td>
</tr>
<tr>
<td>-----------------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>finishings-ready (notes 3 and 7)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>finishings-supported (note 3)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>generated-natural-language-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>identify-actions-default</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>identify-actions-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>ipp-features-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>ipp-versions-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-account-id-default (note 1)</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>job-account-id-supported (note 1)</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>job-accounting-user-id-default (note 1)</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>job-accounting-user-id-supported (note 1)</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>job-constraints-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>job-creation-attributes-supported</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>job-ids-supported</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>job-password-supported (note 4)</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>job-password-encryption-supported (note 4)</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>job-resolvers-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-bottom-margin-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-col-database</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>media-col-database.media-source-properties (note 5)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-col-default</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>media-col-ready</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>media-col-ready.media-source-properties (note 5)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-col-supported</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>media-default</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>media-left-margin-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-ready</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>media-right-margin-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-size-supported</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>media-source-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>media-top-margin-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-type-supported</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>multiple-document-jobs-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>multiple-operation-timeout</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>multiple-operation-timeout-action</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>natural-language-configured</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>operations-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>orientation-requested-default</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>orientation-requested-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>output-bin-default</td>
<td>PWG 5100.2</td>
</tr>
<tr>
<td>output-bin-supported</td>
<td>PWG 5100.2</td>
</tr>
<tr>
<td>overrides-supported (note 2)</td>
<td>PWG 5100.6</td>
</tr>
<tr>
<td>page-ranges-supported (note 2)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>preferred-attributes-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>print-color-mode-default</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>print-color-mode-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>print-content-optimize-default</td>
<td>PWG 5100.7</td>
</tr>
<tr>
<td>print-content-optimize-supported</td>
<td>PWG 5100.7</td>
</tr>
<tr>
<td>print-rendering-intent-default (note 8)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>print-rendering-intent-supported (note 8)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>print-quality-default</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>print-quality-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>Attribute</td>
<td>Reference</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>printer-current-time (note 7)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-geo-location</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-get-attributes-supported</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-icc-profiles (notes 6 and 8)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-icons (note 6)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-info</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-location</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-make-and-model</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-mandatory-job-attributes (note 1)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-name</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-organization</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-organizational-unit</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-resolution-default</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-resolution-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>pwg-raster-document-resolution-supported</td>
<td>PWG 5102.4</td>
</tr>
<tr>
<td>pwg-raster-document-sheet-back</td>
<td>PWG 5102.4</td>
</tr>
<tr>
<td>pwg-raster-document-type-supported</td>
<td>PWG 5102.4</td>
</tr>
<tr>
<td>sides-default</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>sides-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>uri-security-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>uri-authentication-supported</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>which-jobs-supported</td>
<td>PWG 5100.11</td>
</tr>
</tbody>
</table>

Note 1: CONDITIONALLY REQUIRED for Printers that implement Paid Imaging services.

Note 2: REQUIRED for the "application/pdf" and "image/jpeg" MIME media types.

Note 3: CONDITIONALLY REQUIRED for Printers with finishers.

Note 4: CONDITIONALLY REQUIRED for Printers that support the Print to a Recipient (section 3.2.2.8) use case.

Note 5: CONDITIONALLY REQUIRED for Printers that support long-edge feed media.

Note 6: URIs MUST be absolute, SHOULD use the Host value (including port number) from the HTTP Host header (section 5.1.1), and MUST NOT use link-local addresses (section 8.4).

Note 7: RECOMMENDED due to its omission from IPP Everywhere™ 1.0, however it is needed for the underlying functionality.

Note 8: CONDITIONALLY REQUIRED for Printers that support ICC-based color management.
5.3.1 media-col-database (1setOf collection)

The REQUIRED "media-col-database" Printer attribute lists the supported combinations of "media-col" member attributes for a Printer. In addition to the requirements set forth in IPP: Job and Printer Extensions - Set 2 [PWG5100.11], this specification defines how a Printer advertises custom and roll-fed media capabilities in the "media-col-database" attribute.

Custom media sizes are described using rangeOfInteger values for the "x-dimension" and "y-dimension" member attributes of the "media-size" member attribute. Dimensions are provided for sheets in portrait orientation, that is the "x-dimension" ranges refer to the short axis and the "y-dimension" ranges refer to the long axis of the sheet. For example, a Printer supporting sheet media from 50x50mm to 330.2x482.6mm from the by-pass tray could report:

```plaintext
media-col-database=...,{
  media-size={
    x-dimension=5000-33020
    y-dimension=5000-48260
  }
  media-source='by-pass-tray' },...
```

Similarly, roll media sizes are also described using rangeOfInteger values, however the "x-dimension" value refers to the cross-feed (width) dimension and the "y-dimension" value refers to the feed (length) dimension. The supported ranges provide the capabilities of the Printer and not of any loaded media which is reported separately in the "media-col-ready" and "media-ready" attributes. For example, a Printer supporting rolls 8 to 60 inches wide and 6 inches to 300 feet long would report:

```plaintext
media-col-database=...,{
  media-size={
  }
```
5.3.2 media-col-ready (1setOf collection)

The REQUIRED "media-col-ready" Printer attribute lists the loaded media combinations of "media-col" member attributes for a Printer. In addition to the requirements set forth in IPP: Production Printing Attributes - Set 1 [PWG5100.3], this specification defines how a Printer advertises manually-fed and roll-fed media in the "media-col-ready" attribute.

Manual feed media sizes MUST NOT be reported in the "media-col-ready" attribute. By definition the 'manual-feed' media source requires the Printer to ask the User/Operator to load the requested media, thus the media can never be "ready" for use. However, many Printers offer a multi-purpose tray that serves as both a manual feed source and an ad-hoc paper tray. Printers that provide such a multi-purpose tray MUST advertise media loaded in the tray using a different media source such as 'by-pass-tray'.

Roll media sizes are described using an integer value for the "x-dimension" and a rangeOfInteger value for the "y-dimension" member attributes of the "media-size" member attribute. The "x-dimension" value refers to the width of the loaded roll, the lower bound of the "y-dimension" value refers to the minimum length allowed, and the upper bound of the "y-dimension" value refers to the remaining length of the loaded roll or, if the remainder is not known, the maximum length allowed.

5.3.3 media-ready (1setOf (type3 keyword | name(MAX))

The REQUIRED "media-ready" Printer attribute lists the loaded media for a Printer. In addition to the requirements set forth in the Internet Printing Protocol/1.1 [STD92], this specification defines how a Printer advertises custom, manually-fed, and roll-fed media in the "media-ready" attribute.

Manual feed media sizes MUST NOT be reported in the "media-ready" attribute. By definition the 'manual-feed' media source requires the Printer to ask the User/Operator to load the requested media, thus the media can never be "ready" for use. However, many Printers offer a multi-purpose tray that serves as both a manual feed source and an ad-hoc paper tray. Printers that provide such a multi-purpose tray MUST advertise media loaded in the tray.

Custom media sizes are described using the "custom" self-describing media size names defined in section 5 of the PWG Media Standardized Names [PWG5101.1] specification. For example, a custom media size of 4x8 inches might be listed with the name "custom_current_4x8in". The size name MUST include the source name if more than one custom size is loaded, for example "custom_current.tray-1_4x8in".

Similarly, roll media sized are described using "roll" self-describing media size names with the width of the loaded roll and a length of 0. For example, a 36 inch roll might be listed with...
the name "roll_current_36x0in". As for custom sizes, the size name MUST include the
source name if more than one roll is loaded, for example "roll_current.roll-1_36x0in".

5.3.4 media-size-supported (1setOf collection)

The REQUIRED "media-size-supported" Printer attribute lists the supported media sizes for
a Printer. In addition to the requirements set forth in [PWG5100.3], this specification defines
how a Printer advertises custom and roll-fed media in the "media-size" attribute.

Custom media sizes are described using rangeOfInteger values for the "x-dimension" and
"y-dimension" member attributes. Dimensions are provided for sheets in portrait orientation,
that is the "x-dimension" ranges refer to the short axis and the "y-dimension" ranges refer
to the long axis of the sheet. For example, a Printer supporting sheet media from 50x50mm
to 330.2x482.6mm from the by-pass tray would report:

```
media-size-supported=...,{
  x-dimension=5000-33020
  y-dimension=5000-48260 },...
```

Similarly, roll media sizes are also described using rangeOfInteger values, however the "x-
dimension" value refers to the cross-feed (width) dimension and the "y-dimension" value
refers to the feed (length) dimension. The supported ranges provide the capabilities of the
Printer and not of any loaded media which is reported separately in the "media-col-ready"
and "media-ready" attributes. For example, a Printer supporting rolls 8 to 60 inches
and 6 inches to 300 feet long would report:

```
media-size-supported=...,{
  x-dimension=20320-152400
  y-dimension=1524-9144000 },...
```

5.3.5 media-supported (1setOf (type3 keyword | name(MAX)))

The REQUIRED "media-supported" Printer attribute lists the supported media sizes for a
Printer. In addition to the requirements set forth in the Internet Printing Protocol/1.1 [STD92],
this specification defines how a Printer advertises custom and roll-fed media in the "media-
supported" attribute.

Custom media sizes are described using two self-describing media names. The
"custom_min_WIDTHxHEIGHTUnits" value provides the minimum custom media
dimensions and the "custom_max_WIDTHxHEIGHTUnits" value provides the maximum
custom media dimensions. The size name MUST include the source name if different
dimensions are supported by each source. Dimensions are provided for sheets in portrait
orientation, that is the "WIDTH" values refer to the short axis and the "HEIGHT" values refer
to the long axis of the sheet. For example, a Printer supporting sheet media from 50x50mm
to 330.2x482.6mm from the by-pass tray could report:

```
media-supported=...,
  custom_max.by-pass-tray_330.2x482.6mm,
  custom_min.by-pass-tray_50x50mm,...
```
Similarly, roll media sizes are described using the "roll_min_WIDTHxHEIGHTunits" and "roll_max_WIDTHxHEIGHTunits" names. The "WIDTH" values refer to the supported roll widths while the "HEIGHT" values refer to the supported roll lengths. The size name MUST include the source name if the Printer supports multiple source with different roll limits.

For example, a Printer supporting a single roll 8 to 60 inches wide and 6 inches to 300 feet long would report:

```
media-supported=...,roll_max_60x3600in,roll_min_8x6in, ...
```

A Printer supporting two rolls, one 8 to 60 inches wide and 6 inches to 300 feet long and the other 8 to 36 inches wide and 6 inches to 150 feet long would report:

```
media-size-supported=...,roll_max.roll-1_60x3600in,roll_min.roll-1_8x6in,
roll_max.roll-2_36x1800in,roll_min.roll-2_8x6in,...
```

5.3.6 pdl-override-supported (type2 keyword)

The REQUIRED "pdl-override-supported" Printer attribute informs the Client whether Job Ticket information embedded in the Document data for a Job is overridden by Job Template attributes.

When reporting capabilities for the 'application/pdf', 'image/jpeg', or 'image/pwg-raster' MIME media types, Printers MUST report either 'attempted' [STD92] or 'guaranteed' [PWG5100.11] for the "pdl-override-supported" Printer attribute.

5.4 IPP Printer Status Attributes

Table 5 lists the Printer Status attributes for an IPP Everywhere™ Printer. All attributes in the table are REQUIRED unless otherwise specified.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>pages-per-minute</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>pages-per-minute-color</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-alert</td>
<td>PWG 5100.9</td>
</tr>
<tr>
<td>printer-alert-description</td>
<td>PWG 5100.9</td>
</tr>
<tr>
<td>printer-config-change-date-time</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-config-change-time</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-is-accepting-jobs</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-more-info (note 1)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-state</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-state-change-date-time</td>
<td>RFC 3995</td>
</tr>
<tr>
<td>printer-state-change-time</td>
<td>RFC 3995</td>
</tr>
<tr>
<td>printer-state-message</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-state-reasons</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-strings-languages-supported (note 2)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-strings-uri (notes 1 and 2)</td>
<td>PWG 5100.13</td>
</tr>
</tbody>
</table>
### Attribute Reference

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>printer-supply</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-supply-description</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-supply-info-uri (note 1)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>printer-up-time</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-uri-supported (note 1)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>printer-uuid</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>pwg-raster-document-resolution-supported</td>
<td>PWG 5102.4</td>
</tr>
<tr>
<td>pwg-raster-document-sheet-back</td>
<td>PWG 5102.4</td>
</tr>
<tr>
<td>pwg-raster-document-type-supported</td>
<td>PWG 5102.4</td>
</tr>
<tr>
<td>queued-job-count</td>
<td>RFC 8011</td>
</tr>
</tbody>
</table>

883  
Note 1: URIs MUST be absolute, SHOULD use the Host value (including port number) from the HTTP Host header (section 5.1.1), and MUST NOT use link-local addresses (section 8.4).

887  
Note 2: RECOMMENDED due to its omission from IPP Everywhere™ 1.0, however it is needed for the underlying functionality.

890  **5.4.1 printer-uri-supported (1setOf uri)**

892  The REQUIRED "printer-uri-supported" Printer attribute provides 'ipp' and 'ipps' URIs that can be used to access the Printer. Printers SHOULD advertise URIs with a resource path of the form "/ipp/print" or "/ipp/print/queueuname".
5.5 IPP Operation Attributes

Table 8 lists the REQUIRED operation attributes for an IPP Everywhere™ Printer.

Table 8 - REQUIRED IPP Everywhere™ Operation Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>compression</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>document-format</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>document-name</td>
<td>RFC 8011, PWG 5100.5</td>
</tr>
<tr>
<td>document-password (note 1)</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>first-index</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>first-job-id</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>identify-actions</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>ipp-attribute-fidelity</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-ids</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>job-mandatory-attributes (note 3)</td>
<td>PWG 5100.7</td>
</tr>
<tr>
<td>job-name</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-password (note 2)</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>job-password-encryption (note 2)</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>last-document</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>limit</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>requesting-user-name</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>requesting-user-uri</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>which-jobs</td>
<td>RFC 8011, PWG 5100.11</td>
</tr>
</tbody>
</table>

Note 1: CONDITIONALLY REQUIRED for Printers that support the "application/pdf" MIME media type.

Note 2: CONDITIONALLY REQUIRED for Printers that support the Print to a Recipient (section 3.2.2.8) use case.

Note 3: CONDITIONALLY REQUIRED for Printers that implement Paid Imaging services.

Table 9 - RECOMMENDED IPP Everywhere™ Operation Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>job-authorization-uri</td>
<td>PWG 5100.16</td>
</tr>
<tr>
<td>job-impressions-estimated</td>
<td>PWG 5100.16</td>
</tr>
</tbody>
</table>
5.6 IPP Job Description Attributes

Table 10 lists the REQUIRED Job Description attributes for an IPP Everywhere™ Printer.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>job-name</td>
<td>RFC 8011</td>
</tr>
</tbody>
</table>

5.7 IPP Job Status Attributes

Table 10 lists the REQUIRED Job Status attributes for an IPP Everywhere™ Printer.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>date-time-at-completed</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>date-time-at-creation</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>date-time-at-processing</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-id</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-impressions</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-impressions-completed</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-originating-user-name</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-printer-up-time</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-printer-uri (note 1)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-state</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-state-message</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-state-reasons</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-uri (note 1)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>job-uuid</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>time-at-completed</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>time-at-creation</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>time-at-processing</td>
<td>RFC 8011</td>
</tr>
</tbody>
</table>

Note 1: URIs MUST be absolute, SHOULD use the Host value from HTTP header (section 5.1.1), and MUST NOT use link-local addresses (section 8.4).

5.7.1 job-id (integer)

The REQUIRED "job-id" Job Description attribute contains the ID of the Job. In order to support reliable job submission and management, Printers MUST NOT reuse "job-id" values since the last power cycle of the Printer and SHOULD NOT reuse "job-id" values for the life of the Printer as described in section 3.1.2.3.9 of the Internet Printing Protocol/1.1: Implementer's Guide [RFC3196].
5.7.2 job-uri (uri)

The REQUIRED "job-uri" Job Description attribute contains the absolute URI of the Job. In order to support reliable job submission and management, Printers MUST NOT reuse "job-uri" values since the Printer was last powered up and SHOULD NOT reuse "job-uri" values for the life of the Printer as described in section 3.1.2.3.9 of the Internet Printing Protocol/1.1: Implementer's Guide [RFC3196]. In addition, the "job-uri" value SHOULD be derived from the "job-id" value as described in the IPP URL Scheme [RFC3510].

5.8 IPP Job Template Attributes

Table 12 lists the Job Template attributes for an IPP Everywhere™ Printer. All attributes in the table are REQUIRED unless otherwise specified.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>copies (note 2)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>feed-orientation (note 5)</td>
<td>PWG 5100.11</td>
</tr>
<tr>
<td>finishings (note 4)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>finishings-col (note 4)</td>
<td>PWG 5100.1</td>
</tr>
<tr>
<td>finishings-col.finishing-template (note 4)</td>
<td>PWG 5100.1</td>
</tr>
<tr>
<td>job-account-id (note 1)</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>job-accounting-user-id (note 1)</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>media</td>
<td>RFC 8011</td>
</tr>
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<td>media-col</td>
<td>PWG 5100.3</td>
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<tr>
<td>media-col.media-bottom-margin</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-col.media-left-margin</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-col.media-right-margin</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-col.media-size</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>media-col.media-source</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-col.media-top-margin</td>
<td>PWG 5100.13</td>
</tr>
<tr>
<td>media-col.media-type</td>
<td>PWG 5100.3</td>
</tr>
<tr>
<td>multiple-document-handling (note 3)</td>
<td>RFC 8011</td>
</tr>
<tr>
<td>orientation-requested</td>
<td>RFC 8011</td>
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<td>output-bin</td>
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<td>PWG 5100.6</td>
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<td>overrides-document-numbers (note 6)</td>
<td>PWG 5100.6</td>
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<td>RFC 8011</td>
</tr>
<tr>
<td>sides</td>
<td>RFC 8011</td>
</tr>
</tbody>
</table>
Note 1: CONDITIONALLY REQUIRED for Printers that implement paid imaging services.

Note 2: CONDITIONALLY REQUIRED for the "application/pdf" and "image/jpeg" MIME media types.

Note 3: CONDITIONALLY REQUIRED for Printers that support the "application/pdf" MIME media type.

Note 4: CONDITIONALLY REQUIRED for Printers with finishers.

Note 5: CONDITIONALLY REQUIRED for Printers that support long-edge feed media.

Note 6: CONDITIONALLY REQUIRED for Printers that support multiple-Document Jobs.

Note 7: CONDITIONALLY REQUIRED for Printers that support ICC-based color management.

Table 13 - RECOMMENDED IPP Everywhere™ Job Template Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>job-account-type</td>
<td>PWG 5100.16</td>
</tr>
<tr>
<td>print-scaling</td>
<td>PWG 5100.16</td>
</tr>
</tbody>
</table>
6. Document Formats

Printers MUST support documents conforming to the PWG Raster Format [PWG5102.4] ("image/pwg-raster"). Color Printers MUST and monochrome Printers SHOULD support documents conforming to the JPEG File Information Format Version 1.02 [JFIF] ("image/jpeg"), specifically the metadata and JPEG subset defined in the Standard of the Camera & Imaging Products Association, CIPA DC-008-Translation-2016, Exchangeable image file format for digital still cameras: Exif Version 2.31 [EXIF].

IPP/2.1 and IPP/2.2 Printers MUST and IPP/2.0 Printers SHOULD support documents conforming to Document management — Portable document format — Part 1: PDF 1.7 [ISO32000] ("application/pdf"). IPP/2.0, IPP/2.1, and IPP/2.2 Printers are defined in [PWG5100.12].

6.1 Supporting Long-Edge Feed Media with PWG Raster Format Documents

Printers that support long-edge feed media MUST support the "feed-orientation" Job Template attribute and corresponding "feed-orientation-default" and "feed-orientation-supported" Printer attributes. In addition, Printers that support long-edge feed media MUST report the "media-source-properties" member attribute in the "media-col-database" and "media-col-ready" Printer attributes.

When submitting a PWG Raster document in a job or document creation request, Clients MUST additionally query the Printer for the "feed-orientation-supported", "media-col-database", and/or "media-col-ready" Printer attributes in order to provide a document in the correct orientation and dimensions for the Printer.

Figures 2 through 5 show how raster data must be formatted for each feed orientation.
Figure 1 - PWG Raster Bitmaps with Portrait Feed Orientation

Figure 2 - PWG Raster Bitmaps with Landscape Feed Orientation
Figure 3 - PWG Raster Bitmaps with Reverse Landscape Feed Orientation

Figure 4 - PWG Raster Bitmaps with Reverse Portrait Feed Orientation
7. Additional Values for Existing Attributes

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

This specification defines the REQUIRED keyword 'ipp-everywhere' for the "ipp-features-supported" Printer attribute.

8. Additional Semantics for Existing Value Tags

This specification amends the definition of the nameWithLanguage, nameWithoutLanguage, naturalLanguage, textWithLanguage, textWithoutLanguage, and URI value tags defined in the Internet Printing Protocol/1.1 [STD92] with additional restrictions to improve interoperability.

8.1 nameWithLanguage and nameWithoutLanguage

Name values MUST NOT contain characters in the "C0 Control Character Set" or the DEL character as defined in Unicode Format for Network Interchange [RFC5198]. Printers MUST transcode and filter values from MIBs and other sources to conform to the added restrictions.

8.2 naturalLanguage

NaturalLanguage values MUST conform to and be compared as defined in Tags for Identifying Languages [BCP47]. The shortest language tag MUST be used, e.g., "en" instead of "eng" for English. Printers SHOULD also support legacy language tags such as:

'no'; replaced by 'nb' (Norwegian Bokmål),
'zh-cn'; replaced by 'zh-hans' (Simplified Chinese), and
'zh-tw'; replaced by 'zh-hant' (Traditional Chinese)

8.3 textWithLanguage and textWithoutLanguage

Text values MUST NOT contain the DEL character or characters in the "C0 Control Character Set" other than CR, LF, and HT [RFC5198]. Printers MUST transcode and filter values from MIBs and other sources to conform to the added restrictions.

8.4 uri

URI values MUST be in absolute form, i.e., "ipp://hostname.local/ipp/print" is acceptable but "/ipp/print" is not. URI values MUST NOT contain link-local addresses in the host field.
Printers MUST NOT generate URI values with link-local addresses and SHOULD NOT generate URI values with IP addresses obtained via Dynamic Host Control Protocol (DHCP) [RFC2131] or other auto-configuration protocols. Printers SHOULD use the HTTP Host: header value when generating URIs for use in Client responses.

9. Conformance Requirements

This section summarizes the Conformance Requirements detailed in the definitions in this document for Clients and Printers.

9.1 Conformance Requirements for Clients

In order for a Client to claim conformance to this specification a Client MUST support the following:

1. DNS Service Discovery as defined in section 4.2
2. IPP/2.0 as defined in section 5
3. The REQUIRED operations listed in Table 4
4. The REQUIRED Printer Description attributes listed in Table 5
5. The REQUIRED operation attributes listed in Table 8
6. The REQUIRED Job Template attributes listed in Table 12
7. The REQUIRED Job Description attributes listed in Table 10
8. The REQUIRED document formats listed in section 5.8
9. The "feed-orientation-supported" Printer attribute and "media-source-properties" member attribute of the "media-col-database" and "media-col-ready" Printer attributes as reported by the Printer and defined in section 6.1
10. The internationalization considerations as defined in section 10
11. The security considerations as defined in section 0

9.2 Conformance Requirements for Printers

In order for a Printer to claim conformance to this specification a Printer MUST support the following:

1. DNS Service Discovery as defined in section 4.2
2. IPP/2.0 as defined in section 5
3. The REQUIRED operations listed in Table 4
4. The REQUIRED Printer Description attributes listed in Table 5
5. The REQUIRED operation attributes listed in Table 8
6. The REQUIRED Job Template attributes listed in Table 12
7. The REQUIRED Job Description attributes listed in Table 10
8. The REQUIRED document formats listed in section 5.8
9. The 'ipp-everywhere' value for the "ipp-features-supported" Printer Description attribute as defined in section 7.1
10. The additional semantics for attribute values as defined in section 8
11. The internationalization considerations as defined in section 10
12. The security considerations as defined in section 0
13. The safe string truncation rules as defined in section 13

9.3 Conditional Conformance Requirements for Printers

Printers that support the "image/jpeg" [JFIF] MIME media type MUST support:

1. The "copies-default", and "copies-supported" Printer Description attributes as defined in section 5.3.
2. The "copies" Job Template attribute as defined in section 5.8.

Printers that support the "application/pdf" [ISO32000] MIME media type MUST support:

1. The "copies-default", "copies-supported", "document-password-supported", and "page-ranges-supported" Printer Description attributes as defined in section 5.3.
2. The "document-password" Operation attribute as defined in section 5.4, and
3. The "copies", "multiple-document-handling", "overrides", and "page-ranges" Job Template attributes as defined in section 5.8.

Printers that support the Print to a Recipient use case (section 3.2.2.8) MUST support:

1. The "job-password-supported" and "job-password-encryption-supported" Printer Description attributes as defined in section 5.3, and
2. The "job-password" and "job-password-encryption" Operation attributes as defined in section 5.4.

Printers that provide Paid Print services MUST support:

1. The "job-account-id-default", "job-account-id-supported", "job-accounting-user-id-default", "job-accounting-user-id-supported", "job-mandatory-attributes-default", "job-mandatory-attributes-supported", and "printer-mandatory-job-attributes" Printer Description attributes as defined in section 5.3,
2. The "job-mandatory-attributes" operation attribute as defined in section 5.4, and
3. The "job-account-id" and "job-accounting-user-id" Job Template attributes as defined in section 5.8.

Printers that support long-edge feed media MUST support:

1. The "feed-orientation-default" and "feed-orientation-supported" Printer Description attributes as defined in section 5.3.
2. The "media-source-properties" member attribute of the "media-col-database" and "media-col-ready" Printer Description attributes as defined in section 5.3.
3. The "feed-orientation" Job Template attribute as defined in section 5.8.
Printers that support ICC-based color management MUST support:

4. The "print-rendering-intent-default", "print-rendering-intent-supported", and "printer-icc-profiles" Printer Description attributes as defined in section 5.3.

5. The "print-rendering-intent" Job Template attribute as defined in section 5.8.

10. Internationalization 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:
1108 Unicode Character Encoding Model [UTR17] – multi-layer character model
1109 Unicode Character Property Model [UTR23] – character properties
1110 Unicode Conformance Model [UTR33] – Unicode conformance basis

1111 11. Security Considerations

1112 The IPP extensions defined in this document require the same security considerations as defined in the Internet Printing Protocol/1.1 [STD92]. In addition, Printers MUST validate the HTTP Host request header in order to protect against DNS rebinding attacks.

1115 Implementations of this specification SHOULD conform to the following standard on processing of human-readable Unicode text strings, see:


1118 Implementations of this specification are advised to also review the following informational document on processing of human-readable Unicode text strings:

1120 Unicode Security FAQ [UNISECFAQ] – common Unicode security issues

1121 12. IANA Considerations

12.1 Attribute Value Registrations

1122 The keyword attribute values defined in this document will be published by IANA according to the procedures in the Internet Printing Protocol/1.1 [STD92] in the following file:

1125 http://www.iana.org/assignments/ipp-registrations

1126 The registry entries will contain the following information:

1127 Attributes (attribute syntax)  Reference
1128 Keyword Attribute Value  -------------------------  ---------
1130 ipp-features-supported (lsetOf type2 keyword)  [PWG5100.13]
1131 ipp-everywhere  [PWG5100.14]

1132 13. Safe String Truncation

1133 Strings can be truncated or omitted when transferred over alternate protocols. Printers MUST truncate long strings at logical boundaries. The following subsections describe how this truncation is performed for different kinds of strings.
13.1 Plain Text Strings

Plain text strings MUST be truncated at the end of a valid character sequence. For example, strings using the UTF-8 transformation format of ISO 10646 [STD0063] [ISO10646-1] SHOULD be represented using the Unicode Format for Network Interchange [RFC5198] and MUST be truncated at the end of a valid UTF-8 sequence.

For example, the 9 octet UTF-8 sequence 0x48.65.CA.81.6C.6C.6F.C2.81 (Héloï) would be shortened to fit within 6 octets by composing the é (0x65.CA.81 becomes 0xC3.A9) and removing the trailing UTF-8 sequence 0xC2.81 (¡), resulting in the 6 octet UTF-8 sequence 0x48.C3.A9.6C.6C.6F (Hélo).

13.2 URIs

URIs MUST be truncated so that the URI remains valid and accepted by the Printer. For example, the 46 octet URI "ipp://printer.example.com/ipp/really-long-name" might be shortened to fit within 32 octets by removing the last path name component, resulting in the 29 octet URI "ipp://printer.example.com/ipp". Similarly, the 52 octet URI "ipp://printer.example.com/ipp?query-string" might be shortened to fit within 32 octets by removing the query string.

As recommended by the Uniform Resource Identifier (URI): Generic Syntax [STD66], Printers SHOULD omit the port number from the URI when it has the default value, e.g., 80 for "http", 443 for "https", and 631 for "ipp" and "ipps" URIs.

13.3 MIME Media Types

MIME media type strings MUST be truncated at the end of the media subtype, removing any parameters that are included with the media type. If the resulting string still exceeds the maximum length it MUST be discarded. For example, the 24 octet MIME media type "text/plain;charset=utf-8" would be shortened to fit within 16 octets by removing the trailing parameter, resulting in the 10 octet MIME media type "text/plain".

13.4 Delimited Lists

Delimited Lists combine one or more string types listed in the previous sections, separated by a delimiting character such as a comma or semicolon. Delimited lists MUST first be shortened by removal of unnecessary path components (URIs) and parameters (MIME media types) and second truncated at a delimiting character. For example, the 40 octet list of MIME media types "text/plain;charset=utf-8,application/pdf" would be shortened to fit within 32 octets by removing the MIME media type parameter, resulting in the 26 octet list "text/plain,application/pdf". The same list would be shortened to fit within 16 octets by also removing the last MIME media type, resulting in the 10 octet list "text/plain".
14. Overview of Changes

14.1 IPP Everywhere™ v1.1

The following changes were made to PWG 5100.14-2013: IPP Everywhere [PWG5100.14-2013]:

- References now point to the current versions of dependent documents and specifications at the time of publication;

- Requirements for WS-Discovery have been removed due to a lack of implementations, which effectively made WS-Discovery support OPTIONAL;

- References to OpenXPS and SSDP have been removed;

- The "printer-device-id" Printer Description attribute and associated DNS-SD TXT record keys are no longer required;

- DNS-SD is now RECOMMENDED for Printers representing Logical Devices (print servers);

- ICC attributes are now CONDITIONALLY REQUIRED for printers that support ICC-based color management;

- JPEG support is now CONDITIONALLY REQUIRED for color printers;


- IPP Finishings 2.1 and the "finishings-col" Job Template attribute are now RECOMMENDED;

- The "printer-strings-languages-supported" and "printer-strings-uri" Printer Status attributes are now RECOMMENDED to support localization; and

- Printer Status and Job Status attributes are now listed in a separate section to match STD 92 and the IANA IPP registry.
15. References

15.1 Normative References


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1331
<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
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</table>
1365 TR8350.2, January 2000,
1366 http://earth-info.nga.mil/GandG/publications/tr8350.2/wgs84fin.pdf
1367 [X.520] International Telecommunication Union, "Information technology -
1368 Open Systems Interconnection - The Directory: Selected attribute
1370

15.2 Informative References

1374 https://www.cups.org/doc/spec-ipp.html
1376 PWG 5100.14-2013, January 2013,
1377 https://ftp.pwg.org/pub/pwg/candidates/cs-ippeve10-20130128-
1378 5100.14.pdf
1383 [UTR17] Unicode Consortium "Unicode Character Encoding Model", UTR#17,
1384 November 2008, https://www.unicode.org/reports/tr17
1385 [UTR23] Unicode Consortium "Unicode Character Property Model", UTR#23,
1386 May 2015, https://www.unicode.org/reports/tr23
1387 [UTR33] Unicode Consortium "Unicode Conformance Model", UTR#33,
1388 November 2008, https://www.unicode.org/reports/tr33
1389 [UNISECFAQ] Unicode Consortium "Unicode Security FAQ", November 2013,
1390 https://www.unicode.org/faq/security.html
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Send comments to the PWG IPP Mailing List:
	ipp@pwg.org (subscribers only)

To subscribe, see the PWG web page:
	http://www.pwg.org/

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

The editors would like to especially thank the following individuals who also contributed significantly to the development of this document:

Andrew Mitchell
Jerry Thrasher - Lexmark
Peter Zehler - Xerox
17. Change History

17.1 January 28, 2019

- Status: Stable
- Updated reference to v1.0 to use -2013 suffix.
- Sections 3.1 and 15.1: Added references to 5100.16 and registration documents
- Section 5.3: Added recommended attributes table
- Section 5.5: Added recommended attributes table
- Sections 5.6 and 5.7: Tables used "Source" heading instead of "Reference"
- Section 5.8: Table 10 had wrong note for finishings-col, added finishings-col.finishing-template, made note 2 conditionally required, added recommended attributes table

17.2 September 26, 2018

- Removed the "compression-supplied", "document-format-supplied", "document-format-version", "document-format-version-supplied", and "document-name-supplied" attributes from the required attribute lists since the corresponding attributes are being obsoleted in PWG 5100.7.

17.3 August 24, 2018

- The current version of the Bonjour Printing Specification is 1.2.1.
- Section 4: DNS-SD is now required for physical devices and recommended for logical devices (print servers)
- Section 5.1: Clarified that the use of the Host header value includes the port number.
- Section 5.3: Moved printer-more-info to 5.4 Printer Status attributes
- Section 5.4: Added RECOMMENDED printer-strings-languages-supported and printer-strings-uri attributes from JPS3
- Section 6: Still recommend JPEG for monochrome printers
- Section 8.4: Clarified that we mean IP addresses from DHCP
- Section 9.3: Fixed section 5.3 references

- Section 10: Dropped UTR20 (now maintained by the W3C, but why do we care about XML here?)

- Section 12.1: Fixed STD 92 reference

- Section 14.1: Updated the change list

- Section 15.1: Fixed up STD 92 reference, added references to PWG 5100.18 (IPP INFRA) and RFCs 6749 and 6750 (OAuth 2.0), updated all Unicode references, dropped UTR20 (which is now maintained by the W3C)

17.4 July 4, 2018

- Status: Prototype

- RFC 8011 is now STD 92

- Updated Unicode to 11.0.0.

17.5 June 6, 2018

- Section 5.7: Fixed cross-reference to Table 10.

- Section 14.1: Cleaned up WS-Discovery bullet.

- Section 15.2: Updated Bonjour Printing specification reference.

17.6 April 17, 2018

- Removed all references to 1284 device IDs and associated information.

17.7 April 16, 2018

- Made sure IPP Everywhere™ consistently has trademark symbol.

- Section 1: Drop examples of mobile devices.

- Section 4.2.3.4: TLS key required for IPPS.

- Section 5.1: Fix typos.
• Section 5.2: Made Identify-Printer operation recommended for logical devices, required otherwise.

• Sections 5.3 and 5.8: Made print-rendering-intent and printer-icc-profiles conditionally required for printers that support ICC-based color management.

• Section 5.3.6: Clarify pdl-overide-supported values and usage.

• Section 5.7: Deleted stray "note 7"

• Section 9.3: Added ICC attributes here.

• Section 14: Reworded for present tense, clarified why WS-Discovery has been removed, removed reason for removing OpenXPS and SSDP.

17.8 April 3, 2018

• Make JPEG support conditionally required for color printers.

17.9 February 9, 2018

• Initial v1.1 draft

• Updated template

• Updated abstract (can't call it a standard in the abstract)

• Updated spec references to current versions

• Dropped all mention of UPNP, SSDP, WS-Discovery, and OpenXPS (never implemented)

• Added a new "Overview of Changes" chapter that documents the high-level changes since the original IPP Everywhere specification

• Now recommend support for the Get-User-Printer-Attributes operation

• Now recommend support for the "finishings-col" attributes (PWG 5100.1)

• Now recommend support for TLS 1.3

• Now recommend using a resource path of /ipp/print or /ipp/print/name in Printer URIs

• Issue 11: printer-current-time is now listed as an IPP Everywhere attribute, although only RECOMMENDED since it was missing in the 1.0 spec. (all of the date-time
attributes were previously required, so printer-current-time would have implicitly been required)

- Issue 12: The reference to PWG 5100.12 has been corrected

- Issue 13: The reference to the EXIF specification has been updated.

- Issue 13: The reference to PWG 5101.1 has been updated.

- Issue 14: Clarified the pdl-override-supported requirements ('attempted' or 'guaranteed')

- Issue 15: Clarified that relative URIs ('//ipp/print') are not allowed in IPP.

- Issue 26: "job-preferred-attributes-supported" should have been "preferred-attributes-supported"

- Issue 31: Incorrect references to PWG 5101.2 have been changed to PWG 5101.1 (MSN)

- Issue 33: The notes concerning IPP/2.x conformance changes were confusing and have been removed

- Issue 34: Table 6: overrides-supported now correctly references "note 2" (conditionally required).

- Issue 35: overrides-supported.document-numbers is now CONDITIONALLY REQUIRED

- Fixed attribute examples to use PAPI encoding

- Fixed notes concerning "copies" to indicate that support is required for JPEG and PDF documents

- Separated Printer Status attributes from Printer Description

- Separated Job Status attributes from Job Description