



The Printer Working Group

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## Internet Printing Protocol/2.x Fourth Edition (BASE)

**Status: Approved**

Abstract: This specification defines the 2.0, 2.1, and 2.2 versions of the Internet Printing Protocol.

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

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

This document is available at:

<https://ftp.pwg.org/pub/pwg/standards/std-ippbase23-20241108-5100.12.docx>

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To meet this objective, the PWG documents the results of their work as open standards that define print related protocols, interfaces, procedures, and conventions. A PWG standard is a stable, well understood, and technically competent specification that is widely used with multiple independent and interoperable implementations. Printer manufacturers and vendors of printer related software benefit from the interoperability provided by voluntary conformance to these standards.

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## 1. Introduction

The Internet Printing Protocol consists of dozens of IETF, PWG, and Wi-Fi Alliance IPP extension specifications as well as many vendor extensions. IPP is used by billions of client devices, printers, and print services every day.

This document defines three IPP protocol versions compatible with the IETF Internet Printing Protocol/1.1 [STD92]: IPP/2.0 for home and workgroup printing, IPP/2.1 for enterprise printing, and IPP/2.2 for production printing. Section 15 provides a detailed history of the Internet Printing Protocol and its development within the IETF and PWG.

Note: The IPP Everywhere v1.1 [PWG5100.14] specification defines a complete driverless printing profile based on IPP/2.0 that is a common baseline for both Client and Printer implementations. IPP Everywhere defines a different method of disclosing named features instead of version numbers representing broad categories of printers and print services.

## 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]. This specification defines the following additional capitalized conformance terms:

***CONDITIONALLY REQUIRED***: A **MUST** conformance requirement that applies only when a specified condition is true.

***DEPRECATED***: A **SHOULD NOT** conformance requirement for previously defined and approved protocol elements that are planned to be removed from use.

***OBSOLETE***: A **MUST NOT** conformance requirement for previously defined and approved protocol elements that have been removed from use.

### 2.2 Printing Terminology

The following printing terms are used in this document:

***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 [PWG5100.5].

***Enterprise Printer***: A high availability Output Device that is shared by large groups of people to produce medium to high volumes of hardcopy output.

*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].

*Managed Printer*: An Enterprise Printer that is centrally controlled by a cloud or local server.

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

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

*Photo Printer*: A Workgroup Printer that is optimized for printing of photographs.

*Production Printer*: A high volume and/or large format Output Device that is used to deliver finished hardcopy output such as books, magazines, business cards, posters, and so forth.

*Workgroup Printer*: An Output Device that is used by a single End User or small groups of people to produce low volumes of hardcopy output.

## 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 [STD99] User Agent) [STD92].

*Printer*: Listener for incoming connections and receiver of incoming operation requests (Hypertext Transfer Protocol -- HTTP/1.1 [STD99] Server) that represents one or more Physical Devices or a Logical Device [STD92].

## 2.4 Acronyms and Organizations

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

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

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

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

## 3. Requirements

### 3.1 Rationale

Given the following existing specifications:

1. Internet Printing Protocol/1.1 [STD92]
2. Internet Printing Protocol: Job and Printer Set Operations [RFC3380]
3. Internet Printing Protocol: IPP URL Scheme [RFC3510]
4. Internet Printing Protocol: Event Notifications and Subscriptions [RFC3995]
5. Internet Printing Protocol: The 'ippget' Delivery Method for Event Notifications [RFC3996]
6. Internet Printing Protocol: Job and Printer Administrative Operations [RFC3998]
7. IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472]
8. IPP Finishings v3.0 [PWG5100.1]
9. IPP "output-bin" attribute extension [PWG5100.2]
10. IPP Production Printing Extensions v2.0 [PWG5100.3]
11. IPP Document Object v1.2 [PWG5100.5]
12. IPP Page Overrides [PWG5100.6]
13. IPP Job Extensions v2.1 [PWG5100.7]
14. IPP "-actual" attributes [PWG5100.8]
15. IPP Printer State Extensions [PWG5100.9]
16. IPP Enterprise Printing Extensions v2.0 [PWG5100.11]
17. PWG Media Standardized Names v2.1 [PWG5101.1]
18. PWG Command Set Format for IEEE 1284 Device ID v1.0 [PWG5107.2]

And given the need for common baseline protocol feature support, this specification should:

1. Standardize profiles of the IPP extensions for advanced printing functionality and reliable interoperability;
2. Encourage adoption of modern IPP-based printing infrastructures; and
3. Discourage the further proliferation of vendor proprietary IPP operations and attributes that damage IPP interoperability by duplicating IETF or PWG IPP standard operations and attributes.

### 3.2 Use Cases

See the informal descriptions of the IPP/2.0, IPP/2.1, and IPP/2.2 target printing environments in section 4.

#### 3.2.1 IPP/2.0 Printer

Alice, Bob, and Charlie are graphic artists who share a printer down the hall. They all load paper when needed. Alice and Bob have convinced Charlie that he should load the toner cartridges. But they do use many paper sizes.



### 3.2.2 IPP/2.1 Printer

Joe and his colleagues send large documents to a printer in a building across the street in a 'glasshouse' with some web servers.

Both Joe and the operator Sue in the glasshouse manage lots of jobs - they need to hold and release jobs. Joe wants to keep track of his jobs - he needs to subscribe for job events.

Sue is expected to manage several printers - she needs to enable and disable printers, i.e., enable/disable accepting new jobs over input channels.

### 3.2.3 IPP/2.2 Printer

Louise works in accounting for a big wholesaler in Kansas City. She sends variable data jobs, e.g., different names, addresses, and balance owed amounts formatted onto a pre-printed form, to a printer in Chicago.

Her friend Sam is a night-shift operator in Chicago. Sam makes sure that job resources, e.g., the pre-printed forms for Louise's jobs, are loaded when needed. He often needs to pause the printer after the current 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 Out of Paper

The printer runs out of paper while printing a job. The printer reports the change in state either by sending a notification to a Client device or in response to a Client query.

## 3.4 Out of Scope

The following are considered out of scope for this specification:

1. Definition of new IPP attributes, objects, or operations.

## 3.5 Design Requirements

The design requirements for this specification are:

1. Define conformance profiles that reference IETF IPP and PWG IPP specifications;
2. Define conformance requirements for both IPP Printers and IPP Clients; and
3. Define IANA registration information for new values of "ipp-versions-supported".

## **4. Model**

This specification extends the Internet Printing Protocol/1.1 [STD92] model to address three general printing environments.

### **4.1 Internet Printing Protocol/1.1**

The Internet Printing Protocol/1.1 [STD92] does not target a specific class of output devices and only requires conformance to the PWG Media Standardized Names v2.1 (MSN) [PWG5101.1] specification. It serves as the basis for the 2.x protocol versions.

### **4.2 Internet Printing Protocol/2.0**

This IPP conformance level is targeted to a Workgroup Printer where a small number of users are typically physically located close to the device and the device is typically managed by the local users. The device is typically a low speed IPP/2.0 Printer with a limited feature set tailored to the requirements of a small group of users. Routine maintenance, such as loading paper and clearing paper jams, is usually performed by the current user. The configuration of the IPP/2.0 Printer for special jobs, such as the need for a unique paper size or color, is also handled by the user requiring the changed configuration.

IPP/2.0 also includes Photo Printers that are optimized for printing of photographs.

### **4.3 Internet Printing Protocol/2.1**

This IPP conformance level is targeted to an Enterprise Printer with more users and devices with higher speed and duty cycle ratings than IPP/2.0 Printers, but the primary difference is in the supported features, physical location, and maintenance of the device. An IPP/2.1 Printer is typically located in a central location with most users not very close physically. An End User's access to the IPP/2.1 Printer may be limited and maintenance is typically performed by assigned, trained personnel. Features such as paper size and type are typically fixed by site policies and are not easily modified for special use. IPP/2.1 Printers often have more post-processing features (such as punching, folding, stapling, etc.) than IPP/2.0 Printers.

IPP/2.1 also includes Managed Printers where one or more Enterprise Printers are centrally controlled by a cloud or local server.

### **4.4 Internet Printing Protocol/2.2**

This IPP conformance level is targeted to a Production Printer with high speed and very high duty cycle devices as compared to IPP/2.0 and IPP/2.1 Printers. One example of this environment is a data center where jobs are centrally scheduled rather than sent ad-hoc from a group of End Users. This class of Printer is expected to consume significantly more

supplies (such as paper, toner, etc.) and have a larger memory capacity than the other classes.

## 5. IPP/2.x Requirements

This section specifies the HTTP and IPP standards that are RECOMMENDED or REQUIRED for each IPP protocol version defined in this specification. By design, each IPP conformance level builds on the required functionality of all lower versions.

All the IETF and PWG specification requirements for each IPP protocol version are summarized below in Table 1 to simplify design, implementation, and testing.

**Table 1 - Specifications for IPP Protocol Versions**

<b>IETF or PWG Specification</b>	<b>IPP/1.1 Support</b>	<b>IPP/2.0 Support</b>	<b>IPP/2.1 Support</b>	<b>IPP/2.2 Support</b>
PWG 5100.1		REQUIRED	REQUIRED	REQUIRED
PWG 5100.2		REQUIRED	REQUIRED	REQUIRED
PWG 5100.3				REQUIRED
PWG 5100.5			RECOMMENDED	REQUIRED
PWG 5100.6			RECOMMENDED	REQUIRED
PWG 5100.7		RECOMMENDED	REQUIRED	REQUIRED
PWG 5100.8			RECOMMENDED	REQUIRED
PWG 5100.9		RECOMMENDED	REQUIRED	REQUIRED
PWG 5100.11			REQUIRED	REQUIRED
PWG 5101.1		REQUIRED	REQUIRED	REQUIRED
RFC 2817	C. REQUIRED (1)	C. REQUIRED (1)	C. REQUIRED (1)	REQUIRED
RFC 2818	C. REQUIRED (1)	C. REQUIRED (1)	C. REQUIRED (1)	REQUIRED
RFC 3380		RECOMMENDED	REQUIRED	REQUIRED
RFC 3510	REQUIRED	REQUIRED	REQUIRED	REQUIRED
RFC 3995		RECOMMENDED	REQUIRED	REQUIRED
RFC 3996		RECOMMENDED	REQUIRED	REQUIRED
RFC 3998		RECOMMENDED	REQUIRED	REQUIRED
RFC 7472	C. REQUIRED (1)	C. REQUIRED (1)	C. REQUIRED (1)	REQUIRED
RFC 8446	RECOMMENDED	RECOMMENDED	RECOMMENDED	REQUIRED
STD 92	REQUIRED	REQUIRED	REQUIRED	REQUIRED
STD 99	REQUIRED	REQUIRED	REQUIRED	REQUIRED

Note 1: CONDITIONALLY REQUIRED if TLS [RFC8446] is supported.

## 5.1 IPP/2.0 Requirements

An IPP/2.0 Printer MUST support the following specifications:

1. Internet Printing Protocol/1.1: [STD92];
2. Internet Printing Protocol/1.1: IPP URL Scheme [RFC3510];
3. IPP Finishings v3.0 (FIN) [PWG5100.1] (for “finishings” attribute);
4. IPP “output-bin” attribute extension [PWG5100.2]; and
5. PWG Media Standardized Names 2.1 [PWG5101.1] (for “media” attribute).

An IPP/2.0 Printer SHOULD support the following specifications:

1. IPP Job Extensions v2.1 [PWG5100.7] (for “media-col” attributes);
2. IPP Printer State Extensions [PWG5100.9];
3. Internet Printing Protocol: Job and Printer Set Operations [RFC3380];
4. Internet Printing Protocol: Event Notifications and Subscriptions [RFC3995];
5. Internet Printing Protocol: The ‘ippget’ Delivery Method for Event Notifications [RFC3996];
6. Internet Printing Protocol: Job and Printer Administrative Operations [RFC3998];
7. IPP over HTTPS Transport Binding and ‘ipps’ URI Scheme [RFC7472]; and
8. The Transport Layer Security (TLS) Protocol Version 1.3 [RFC8446].

## 5.2 IPP/2.1 Requirements

An IPP/2.1 Printer MUST support:

1. All the REQUIRED specifications for IPP/2.0;
2. Multiple document Jobs and the Create-Job and Send-Document operations;
3. Internet Printing Protocol: Job and Printer Set Operations [RFC3380];
4. Internet Printing Protocol: Event Notifications and Subscriptions [RFC3995];
5. Internet Printing Protocol: The ‘ippget’ Delivery Method for Event Notifications [RFC3996];
6. Internet Printing Protocol: Job and Printer Administrative Operations [RFC3998];
7. IPP Job Extensions v2.1 [PWG5100.7];
8. IPP Printer State Extensions [PWG5100.9]; and
9. IPP Enterprise Printing Extensions v2.0 [PWG5100.11].

An IPP/2.1 Printer SHOULD support the following specifications:

1. IPP Document Object v1.2 [PWG5100.5];
2. IPP Page Overrides [PWG5100.6];
3. IPP “-actual” Attributes [PWG5100.8];
4. IPP over HTTPS Transport Binding and ‘ipps’ URI Scheme [RFC7472]; and
5. The Transport Layer Security (TLS) Protocol Version 1.3 [RFC8446].

## 5.3 IPP/2.2 Requirements

An IPP/2.2 printer MUST support the following specifications:

1. All the REQUIRED specifications for IPP/2.0;
2. All the REQUIRED specifications for IPP/2.1;
3. IPP Production Printing Extensions v2.0 [PWG5100.3];
4. IPP Document Object v1.2 [PWG5100.5];
5. IPP Page Overrides [PWG5100.6];
6. IPP “-actual” Attributes [PWG5100.8];
7. IPP Enterprise Printing Extensions v2.0 [PWG5100.11];
8. IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472].
9. The Transport Layer Security (TLS) Protocol Version 1.3 [RFC8446].

## 6. HTTP Features

Printers MUST support the following HTTP headers and status codes defined in Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing [STD99].

Clients and Printers MUST support IPP over HTTP [RFC3510]. Clients and Printers that support TLS/1.2 or higher [RFC8446] MUST support IPP over HTTPS [RFC7472].

### 6.1 Cache-Control

Printers and Clients MUST conform to the caching semantics defined in [STD99]. 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".

### 6.2 Content-Length or Transfer-Encoding

Printers and Clients MUST use the Content-Length or Transfer-Encoding headers to specify the length of the IPP message that is sent or received.

If a Printer receives an IPP request from a Client without a Content-Length or Transfer-Encoding header, then it MUST return HTTP status 400 (Bad Request) to indicate that the Client has supplied a bad request message.

### 6.3 Content-Type

Printers and Clients MUST use the Content-Type header to specify the MIME media type of the HTTP message. The Content-Type value for IPP messages is "application/ipp" [STD92].

If a Printer receives an IPP request from a Client without a Content-Type header containing the value "application/ipp", then it MUST return HTTP status 400 (Bad Request) to indicate that the Client has supplied a bad request message.

## 6.4 Expect

Clients SHOULD use the Expect header with a value of "100-continue" when sending IPP requests and Printers MUST support the Expect header with a value of "100-continue". When received, Printers typically send one of the following HTTP status codes as soon as enough of the IPP request has been received to determine whether a Client can continue to send its request:

**100 (Continue):** The IPP request does not need authentication and the Client can continue sending its request;

**200 (OK):** The IPP request has been processed successfully;

**401 (Not Authorized):** The IPP request requires authentication so the Client aborts sending its request to obtain credentials from the End User;

**403 (Forbidden):** The Printer will not accept a request from the Client so the Client aborts sending its request and notifies the End User;

**426 (Upgrade Required):** The Printer requires an encrypted connection to process this IPP request; or

**4xx (other errors):** Some other HTTP error status indicating that the IPP request cannot be processed.

Other 1xx, 2xx, and 3xx status codes are not allowed for IPP requests.

## 6.5 Host

Clients MUST supply a Host header in any request to the Printer [STD99].

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

## 6.6 If-Modified-Since, Last-Modified, and 304 Not Modified

Printers MUST support the If-Modified-Since request header [STD99], the corresponding response status ("304 Not Modified"), and the Last-Modified response header.

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.

## 7. IPP Operations

Table 2 lists the IPP operations defined in the dependent specifications for each IPP version.

**Table 2 - IPP Operations**

Operation Name	Reference	IPP/2.0 Support	IPP/2.1 Support	IPP/2.2 Support
Cancel-Current-Job	RFC 3998	RECOMMENDED	REQUIRED	REQUIRED
Cancel-Document	PWG 5100.5		RECOMMENDED	REQUIRED
Cancel-Job	STD 92	REQUIRED	REQUIRED	REQUIRED
Cancel-Jobs	PWG 5100.7	RECOMMENDED	REQUIRED	REQUIRED
Cancel-My-Jobs	PWG 5100.7	RECOMMENDED	REQUIRED	REQUIRED
Cancel-Subscription	RFC 3995		REQUIRED	REQUIRED
Close-Job (note 1)	PWG 5100.7	C. REQUIRED	REQUIRED	REQUIRED
Create-Job	STD 92	RECOMMENDED	REQUIRED	REQUIRED
Create-Job-Subscriptions	RFC 3995		RECOMMENDED	REQUIRED
Create-Printer-Subscriptions	RFC 3995		REQUIRED	REQUIRED
Disable-Printer	RFC 3998	RECOMMENDED	REQUIRED	REQUIRED
Enable-Printer	RFC 3998	RECOMMENDED	REQUIRED	REQUIRED
Get-Document-Attributes	PWG 5100.5		RECOMMENDED	REQUIRED
Get-Documents	PWG 5100.5		RECOMMENDED	REQUIRED
Get-Job-Attributes	STD 92	REQUIRED	REQUIRED	REQUIRED
Get-Jobs	STD 92	REQUIRED	REQUIRED	REQUIRED
Get-Notifications	RFC 3996		REQUIRED	REQUIRED
Get-Printer-Attributes	STD 92	REQUIRED	REQUIRED	REQUIRED
Get-Printer-Supported-Values	RFC 3380	RECOMMENDED	REQUIRED	REQUIRED
Get-Subscription-Attributes	RFC 3995		REQUIRED	REQUIRED
Get-Subscriptions	RFC 3995		REQUIRED	REQUIRED
Get-User-Printer-Attributes	PWG 5100.11		REQUIRED	REQUIRED
Hold-Job	STD 92		REQUIRED	REQUIRED
Hold-New-Jobs	RFC 3998		RECOMMENDED	REQUIRED
Pause-Printer	STD 92	RECOMMENDED	REQUIRED	REQUIRED
Pause-Printer-After-Current-Job	RFC 3998		RECOMMENDED	REQUIRED
Print-Job	STD 92	REQUIRED	REQUIRED	REQUIRED
Promote-Job	RFC 3998		RECOMMENDED	REQUIRED
Release-Held-New-Jobs	RFC 3998		RECOMMENDED	REQUIRED
Release-Job	STD 92		REQUIRED	REQUIRED
Renew-Subscription	RFC 3995		REQUIRED	REQUIRED
Restart-Printer	RFC 3998		RECOMMENDED	REQUIRED
Resubmit-Job	PWG 5100.7	RECOMMENDED	REQUIRED	REQUIRED
Resume-Job	RFC 3998		RECOMMENDED	REQUIRED
Resume-Printer	STD 92	RECOMMENDED	REQUIRED	REQUIRED
Schedule-Job-After	RFC 3998		RECOMMENDED	REQUIRED
Send-Document	STD 92	RECOMMENDED	REQUIRED	REQUIRED
Set-Document-Attributes	PWG 5100.5		RECOMMENDED	REQUIRED
Set-Job-Attributes	RFC 3380		REQUIRED	REQUIRED
Set-Printer-Attributes	RFC 3380	RECOMMENDED	REQUIRED	REQUIRED
Shutdown-Printer	RFC 3998		RECOMMENDED	REQUIRED
Suspend-Current-Job	RFC 3998		RECOMMENDED	REQUIRED
Validate-Job	STD 92	REQUIRED	REQUIRED	REQUIRED

Note 1: REQUIRED for Printers that support the Create-Job [STD92] operation.

## 7.1 Get-Printer-Attributes

The Get-Printer-Attributes operation [STD92] is unique in that it does not support authentication of any kind. The primary reason for this is that it is needed for discovering the supported URIs, security methods, and authentication methods for the Printer via the "printer-uri-supported", "printer-xri-supported", "uri-authentication-supported", and "uri-security-supported" attributes. The corresponding SNMP Printer MIB v2 [RFC3805] elements are likewise available without authentication.

Because some print services offer user-based policies, the Get-User-Printer-Attributes operation [PWG5100.11] was defined to provide an authenticated version of the Get-Printer-Attributes operation. For such services, the Get-Printer-Attributes operation can return the "xxx-default" and "xxx-supported" values corresponding to a guest printing account while Get-User-Printer-Attributes returns the values corresponding to the authenticated account.

### 7.1.1 Special Resource Path "/"

To support discovery using just an IP address or host name, Printers SHOULD support Get-Printer-Attributes requests with a resource path of "/". When responding to such requests, the Printer returns "printer-uri-supported" and "printer-xri-supported" values corresponding to the preferred/default Printer on the device.

For example, if a Printer has a host name of "printer.example.com" and a resource path of "/ipp/print", a Get-Printer-Attributes request sent to "ipp://printer.example.com/" would receive a "printer-uri-supported" value of "ipp://printer.example.com/ipp/print" in the response.

## 7.2 Get-Printer-Supported-Values

Unlike the Get-Printer-Attributes [STD92] and Get-User-Printer-Attributes [PWG5100.11] operations, the Get-Printer-Supported-Values operation [RFC3380] returns the complete list of supported values for all Printer Description attributes.



## 8. IPP Attributes

The following subsections define increased conformance requirements for various attributes.

### 8.1 Operation Attributes

Table 3 provides a summary of the conformance requirements for operation attributes in IPP/2.0, IPP/2.1, and/or IPP/2.2.

**Table 3 - Updated IPP Operation Attributes**

Attribute	Reference	IPP/2.0	IPP/2.1	IPP/2.2
status-message	STD92	RECOMMENDED	RECOMMENDED	REQUIRED

### 8.2 Job/Document Template Attributes

Table 4 provides a summary of the conformance requirements for Job and Document Template attributes in IPP/2.0, IPP/2.1, and/or IPP/2.2. Additional requirements for specific attributes are provided in the subsections below.

**Table 4 - Updated IPP Job/Document Template Attributes**

Attribute	Reference	IPP/2.0	IPP/2.1	IPP/2.2
copies	STD92	REQUIRED	REQUIRED	REQUIRED
finishings (note 1)	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED
finishings-col (note 1)	PWG5100.1	C. REQUIRED	C. REQUIRED	C. REQUIRED
job-hold-until	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-pages-per-set (note 1)	PWG5100.1	C.REQUIRED	C.REQUIRED	C.REQUIRED
job-priority	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-sheets	STD92	RECOMMENDED	REQUIRED	REQUIRED
media	STD92	REQUIRED	REQUIRED	REQUIRED
media-col (note 2)	PWG5100.7	RECOMMENDED	REQUIRED	REQUIRED
orientation-requested	STD92	REQUIRED	REQUIRED	REQUIRED
output-bin	PWG5100.2	REQUIRED	REQUIRED	REQUIRED
print-quality	STD92	REQUIRED	REQUIRED	REQUIRED
printer-resolution	STD92	REQUIRED	REQUIRED	REQUIRED
sides	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED

Note 1: REQUIRED for Printers that support finishing processes.

Note 2: RECOMMENDED for IPP/2.0 for compatibility with [PWG5100.12-2015]

#### 8.2.1 media (type2 keyword | name(MAX))

Printers MUST support this attribute. Values of the “media” attribute [STD92] MUST conform to the PWG Media Standardized Names v2.1 (MSN) [PWG5101.1].

## 8.2.2 print-quality (type2 enum) and printer-resolution (resolution)

The “print-quality” attribute has higher precedence than “printer-resolution”. If the Printer cannot support a requested combination, it returns the usual 'successful-ok-ignored-or-substituted-attributes' or 'client-error-conflicting-attributes' status code in the response to a Create-Job, Print-Job, Print-URI, or Validate-Job request.

## 8.2.3 sides (type2 keyword)

Printers that support duplex output MUST support this attribute with the values 'one-sided', 'two-sided-long-edge', and 'two-sided-short-edge'.

## 8.3 Printer Description Attributes

Table 5 provides a summary of the conformance requirements for Printer Description attributes in IPP/2.0, IPP/2.1, and/or IPP/2.2. Additional requirements for specific attributes are provided in the subsections below.

**Table 5 - Updated IPP Printer Description Attributes**

Attribute	Reference	IPP/2.0	IPP/2.1	IPP/2.2
color-supported	STD92	REQUIRED	REQUIRED	REQUIRED
copies-default	STD92	REQUIRED	REQUIRED	REQUIRED
copies-supported	STD92	REQUIRED	REQUIRED	REQUIRED
finishing-template-supported (note 1)	PWG5100.1	C. REQUIRED	C. REQUIRED	C. REQUIRED
finishings-col-database (note 1)	PWG5100.1	C. REQUIRED	C. REQUIRED	C. REQUIRED
finishings-col-default (note 1)	PWG5100.1	C. REQUIRED	C. REQUIRED	C. REQUIRED
finishings-col-ready (note 1)	PWG5100.1	C. REQUIRED	C. REQUIRED	C. REQUIRED
finishings-col-supported (note 1)	PWG5100.1	C. REQUIRED	C. REQUIRED	C. REQUIRED
finishings-default (note 1)	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED
finishings-ready (note 1)	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED
finishings-supported (note 1)	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED
job-hold-until-default	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-hold-until-supported	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-pages-per-set-supported	PWG5100.1	C. REQUIRED	C. REQUIRED	C. REQUIRED
job-priority-default	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-priority-supported	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-sheets-default	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-sheets-supported	STD92	RECOMMENDED	REQUIRED	REQUIRED
media-col-database (note 2)	PWG5100.7	RECOMMENDED	REQUIRED	REQUIRED
media-col-default (note 2)	PWG5100.7	RECOMMENDED	REQUIRED	REQUIRED
media-col-ready (note 2)	PWG5100.7	RECOMMENDED	RECOMMENDED	REQUIRED
media-col-supported (note 2)	PWG5100.7	RECOMMENDED	REQUIRED	REQUIRED
media-default	STD92	REQUIRED	REQUIRED	REQUIRED
media-ready	STD92	RECOMMENDED	RECOMMENDED	REQUIRED
media-size-supported (note 2)	PWG5100.7	RECOMMENDED	REQUIRED	REQUIRED
media-supported	STD92	REQUIRED	REQUIRED	REQUIRED
orientation-requested-default	STD92	REQUIRED	REQUIRED	REQUIRED
orientation-requested-supported	STD92	REQUIRED	REQUIRED	REQUIRED
output-bin-default	PWG5100.2	REQUIRED	REQUIRED	REQUIRED
output-bin-supported	PWG5100.2	REQUIRED	REQUIRED	REQUIRED

Attribute	Reference	IPP/2.0	IPP/2.1	IPP/2.2
print-quality-default	STD92	REQUIRED	REQUIRED	REQUIRED
print-quality-supported	STD92	REQUIRED	REQUIRED	REQUIRED
printer-info	STD92	REQUIRED	REQUIRED	REQUIRED
printer-location	STD92	REQUIRED	REQUIRED	REQUIRED
printer-make-and-model	STD92	REQUIRED	REQUIRED	REQUIRED
printer-more-info	STD92	REQUIRED	REQUIRED	REQUIRED
printer-name	STD92	REQUIRED	REQUIRED	REQUIRED
printer-resolution-default	STD92	REQUIRED	REQUIRED	REQUIRED
printer-resolution-supported	STD92	REQUIRED	REQUIRED	REQUIRED
sides-default	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED
sides-supported	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED

Note 1: REQUIRED for Printers that support finishing processes.

Note 2: RECOMMENDED for IPP/2.0 for compatibility with [PWG5100.12-2015]

### 8.3.1 printer-name (name(127))

This attribute is defined [STD92] as "a name that is more End User friendly than a URI" and is often used as the default name when configuring or selecting the Printer on the Client device. The default value SHOULD incorporate the make, model, and serial number of the Printer, e.g., "Example Model (SN123456)", and can typically be configured by the Administrator using the Set-Printer-Attributes [RFC3380] operation, the Printer's embedded web interface, and/or the Printer's console.

### 8.3.2 sides-default (type2 keyword)

Printers that support duplex output MUST support this attribute with the value 'one-sided', 'two-sided-long-edge', or 'two-sided-short-edge'.

### 8.3.3 sides-supported (1setOf type2 keyword)

Printers that support duplex output MUST support this attribute with the values 'one-sided', 'two-sided-long-edge', and 'two-sided-short-edge'.

## 8.4 Printer Status Attributes

Table 6 provides a summary of the conformance requirements for Printer Status attributes in IPP/2.0, IPP/2.1, and/or IPP/2.2. Additional requirements for specific attributes are provided in the subsections below.

**Table 6 - Updated IPP Printer Status Attributes**

Attribute	Reference	IPP/2.0	IPP/2.1	IPP/2.2
pages-per-minute	STD92	REQUIRED	REQUIRED	REQUIRED
pages-per-minute-color	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED
printer-alert	PWG5100.9	RECOMMENDED	REQUIRED	REQUIRED
printer-alert-description	PWG5100.9	RECOMMENDED	REQUIRED	REQUIRED

### 8.4.1 pages-per-minute-color (integer(0:MAX))

Printers that support more than one color, i.e. the value of "color-supported" is 'true', MUST support this attribute.

## 9. Conformance Requirements

### 9.1 Printer Conformance Requirements

For a Printer to claim conformance to IPP/2.0 as defined in this specification, a Printer MUST:

1. Conform to all REQUIRED specifications defined in section 5.1;
2. Support all REQUIRED IPP/2.0 Attributes defined in section 0;
3. Support all REQUIRED HTTP features defined in section 6;
4. Support all REQUIRED operations defined in section 7;
5. Support all REQUIRED attributes and values defined in section 8;
6. Conform to the Internationalization Considerations defined in section 10; and
7. Conform to the Security and Privacy Considerations defined in section 11.

For a Printer to claim conformance to IPP/2.1 as defined in this specification, a Printer MUST:

1. Conform to all REQUIRED specifications defined in sections 5.1 and 5.2;
2. Support all REQUIRED IPP/2.1 Attributes defined in section 0;
3. Support all REQUIRED HTTP features defined in section 6;
4. Support all REQUIRED operations defined in section 7;
5. Support all REQUIRED attributes and values defined in section 8;
6. Conform to the Internationalization Considerations defined in section 10; and
7. Conform to the Security and Privacy Considerations defined in section 11.

For a Printer to claim conformance to IPP/2.2 as defined in this specification, a Printer MUST:

1. Conform to all REQUIRED specifications defined in sections 5.1, 5.2, and 5.3;
2. Support all REQUIRED IPP/2.2 Attributes defined in section 0;
3. Support all REQUIRED HTTP features defined in section 6;
4. Support all REQUIRED operations defined in section 7;
5. Support all REQUIRED attributes and values defined in section 8;
6. Conform to the Internationalization Considerations defined in section 10; and
7. Conform to the Security and Privacy Considerations defined in section 11.

## 9.2 Client Conformance Requirements

For a Client to claim conformance to this specification, a Client **MUST**:

1. Conform to all **REQUIRED** specifications defined in section 5.1;
2. Support all **REQUIRED** HTTP features defined in section 6;
3. Conform to the Internationalization Considerations defined in section 10; and
4. Conform to the Security and Privacy Considerations defined in section 11, including the **RECOMMENDED** or **REQUIRED** TLS versions for IPP/2.0, IPP/2.1, and IPP/2.2 implementations.

## 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 IPP Clients and subsequently storing the results (e.g., in IPP Job objects) could cause false negatives in IPP Client searches and failed access (e.g., to IPP 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:

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 in XML and other Markup Languages [UTR20] – XML usage

Unicode Character Property Model [UTR23] – character properties

Unicode Conformance Model [UTR33] – Unicode conformance basis

## 11. Security and Privacy Considerations

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

Clients conforming to any version of IPP MUST support HTTP Basic [RFC7617] and HTTP Digest [RFC7616] authentication. Clients SHOULD conform to the IPP Authentication Methods v1.0 [PWG5199.10] including TLS and OAuth 2.0 support.

Printers conforming to IPP/2.2 MUST support TLS/1.3 [RFC8446] [RFC7525] or a later version.

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

## 12. IANA and PWG Considerations

### 12.1 Attribute Value Registrations

The 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 location:

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

The registry entries will contain the following information:

Attributes (attribute syntax) Keyword Attribute Value -----	Reference -----
ipp-versions-supported (1setOf type2 keyword)	[STD92]
2.0	[PWG5100.12]
2.1	[PWG5100.12]
2.2	[PWG5100.12]

## 13. References

### 13.1 Normative References

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## 15. The PWG Internet Printing Protocol (IPP) Workgroup

The PWG Internet Printing Protocol (IPP) workgroup is responsible for the continued development of IPP. The IPP home page provides access to the IPP mailing list, current working drafts, and published PWG specifications and IETF RFCs:

<https://www.pwg.org/ipp/>

The IPP Everywhere project and IPP Implementor's Guide 2.0 [PWG5100.19] provide useful supplemental information to this specification.

### 15.1 History of the Internet Printing Protocol

In the summer of 1996, Novell approached a number of companies to find out if they were interested to participate in a printing protocol project for the Internet. Xerox and others expressed some interest and suggested that the first step would be to develop a draft text and decide how to initiate the project. As result, a first draft document was developed in cooperation between Novell and Xerox. At this stage, the project was known as Lightweight Document Printing Application (LDPA). In a parallel effort, IBM had started working on a proposal for Internet printing using Web technology, under the name of HyperText Printing Protocol (HTPP). It was also known that Microsoft and HP had started work on a solution for a new generation of print services for Windows NT 5.0.

In parallel to the writing of initial draft texts, the initiators investigated how to start up the public standardization project. It was clear from the beginning that the initiators wanted the project to become an acknowledged project with the Internet Engineering Task Force (IETF), but first needed to get together a forum of experts before suggesting it to the IETF. The choice was to start the activity in the Printer Working Group (PWG), a group of people with representation from printer and print server vendors, which had previously developed the IETF Printer MIB specification.

After initial discussions in a couple of earlier meetings, the PWG started the IPP project in November 1996. Carl-Uno Manros from Xerox was chosen as the project chair and Scott Isaacson from Novell as the main editor. Steve Zilles from Adobe was later added as the IETF co-chair, with Don Wright from Lexmark, Bob Herriot from Sun, and Roger deBry from IBM as further editors. After some discussion, it was decided to pool the earlier efforts from Novell/Xerox and IBM into what is now named the Internet Printing Protocol (IPP) project. Some 20 companies involved with printers and/or print servers confirmed that they were interested in participating. After negotiation with the Application Area Directors in the IETF, they decided to hold a birds-of-a-feather (BOF) session for IPP in the December 1996 meeting of the IETF. The outcome of that meeting confirmed that there was widespread interest in developing a printing protocol for the Internet.

The IPP/1.0 specifications were published by the IETF as experimental documents in April 1999 [RFC2566] [RFC2567]. IPP/1.1 appeared as a proposed standard in September 2000 [RFC2910] [RFC2911], with extensions being published through March 2005 until the IETF IPP working group was concluded.

At the December 2007 face-to-face meeting, the PWG membership decided that something needed to be done to ensure interoperability with the increasing number of IPP/1.1 extensions, particularly for the collection syntax and media naming. This ultimately led to the publication of the first edition of IPP/2.0 that defined protocol versions 2.0 and 2.1 in July 2009 [PWG5100.10-2009]. This was followed by a second edition of IPP/2.0 that defined protocol version 2.2 in February 2011 [PWG5100.12-2011].

After successful interoperability testing of both IPP/1.1 and IPP/2.0 with multiple vendors' products, the PWG published a second errata update of IPP/2.0 in October 2015 [PWG5100.12-2015] as a PWG standard and worked with the IETF to publish IPP/1.1 as an Internet Standard in June 2018 [STD92].

## **16. Changes from PWG 5100.12-2015**

The following changes were made since the previous version of this document [PWG5100.12-2015]:

1. Updated all document references,
2. Greatly simplified the reference tables and list of attributes to only those that differ from the base standards,
3. Added new Unicode references, internationalization considerations, and security considerations.
4. Added a history of the development of the Internet Printing Protocol.