**IPP Version 2.0, 2.1, and 2.2**

**Status: Approved**

Abstract: This specification defines the IPP 2.0, 2.1, and 2.2 protocol versions. Each version defines a minimum set of supported IPP extensions to simplify development and interoperability of IPP Client and Printer implementations.

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

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

This document is available at:

http://ftp.pwg.org/pub/pwg/standards/std-ipp20-20151030-5100.12.docx

http://ftp.pwg.org/pub/pwg/standards/std-ipp20-20151030-5100.12.pdf

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Title: IPP Version 2.0, 2.1, and 2.2

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For additional information regarding the Printer Working Group visit:

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About the Internet Printing Protocol Workgroup

The Internet Printing Protocol (IPP) workgroup has developed a modern, full-featured network printing protocol, which is now the industry standard. IPP allows a print client to query a printer for its supported capabilities, features, and parameters to allow the selection of an appropriate printer for each print job. IPP also provides job information prior to, during, and at the end of job processing.

For additional information regarding IPP visit:

http://www.pwg.org/ipp/

Implementers of this specification are encouraged to join the IPP mailing list in order to participate in any discussions of the specification. Suggested additions, changes, or clarification to this specification, should be sent to the IPP mailing list for consideration.

Table of Contents

[1. Introduction 7](#_Toc434233928)

[1.1 IPP 2.x Versions 7](#_Toc434233929)

[1.2 Deprecation of IPP Operations 8](#_Toc434233930)

[2. Terminology 8](#_Toc434233931)

[2.1 Conformance Terminology 8](#_Toc434233932)

[2.2 Printing Terminology 8](#_Toc434233933)

[2.3 Protocol Role Terminology 8](#_Toc434233934)

[2.4 Acronyms and Organizations 9](#_Toc434233935)

[3. Requirements 10](#_Toc434233936)

[3.1 Rationale 10](#_Toc434233937)

[3.2 Use Cases 11](#_Toc434233938)

[3.2.1 IPP/2.0 Printer 11](#_Toc434233939)

[3.2.2 IPP/2.1 Printer 11](#_Toc434233940)

[3.2.3 IPP/2.2 Printer 11](#_Toc434233941)

[3.3 Exceptions 11](#_Toc434233942)

[3.3.1 Out of Paper 11](#_Toc434233943)

[3.4 Out Of Scope 12](#_Toc434233944)

[3.5 Design Requirements 12](#_Toc434233945)

[4. IPP Standards 13](#_Toc434233946)

[4.1 IPP/2.0 Standards 14](#_Toc434233947)

[4.2 IPP/2.1 Standards 14](#_Toc434233948)

[4.3 IPP/2.2 Standards 15](#_Toc434233949)

[5. IPP Operations 16](#_Toc434233950)

[5.1 Original IPP/1.1 Operations (Informative) 16](#_Toc434233951)

[5.2 IPP/2.0 Operations 17](#_Toc434233952)

[5.3 IPP/2.1 Operations 18](#_Toc434233953)

[5.4 IPP/2.2 Operations 20](#_Toc434233954)

[6. IPP Attributes 22](#_Toc434233955)

[6.1 Original IPP/1.1 Attributes 22](#_Toc434233956)

[6.2 IPP/2.0 Attributes 24](#_Toc434233957)

[6.2 IPP/2.1 Attributes 26](#_Toc434233958)

[6.3 IPP/2.2 Attributes 29](#_Toc434233959)

[7. Conformance Requirements 32](#_Toc434233960)

[7.1 IPP Printer Conformance Requirements 32](#_Toc434233961)

[7.2 IPP Client Conformance Requirements 32](#_Toc434233962)

[7.3 IPP over HTTP Conformance Requirements 33](#_Toc434233963)

[7.4 IPP over TLS Conformance Requirements 33](#_Toc434233964)

[7.5 IPP Unsupported Attributes Conformance Requirements 33](#_Toc434233965)

[8. IANA and PWG Considerations 35](#_Toc434233966)

[8.1 Attribute Value Registrations 35](#_Toc434233967)

[9. Internationalization Considerations 35](#_Toc434233968)

[10. Security Considerations 37](#_Toc434233969)

[11. References 37](#_Toc434233970)

[11.1 Normative References 37](#_Toc434233971)

[11.2 Informative References 41](#_Toc434233972)

[12. Editors’ Addresses 42](#_Toc434233973)

[13. The PWG Internet Printing Protocol (IPP) Workgroup 43](#_Toc434233974)

[14. Changes from PWG 5100.12-2011 43](#_Toc434233975)

List of Tables

[Table 1 - Summary of IETF/PWG Specifications and IPP Conformance Levels 13](#_Toc434233976)

[Table 2 - Original IPP/1.1 Required Operations 16](#_Toc434233977)

[Table 3 - IPP/2.0 Operations 17](#_Toc434233978)

[Table 4 - IPP/2.1 Operations 18](#_Toc434233979)

[Table 5 - IPP/2.2 Operations 20](#_Toc434233980)

[Table 6 - Required IPP Attributes 22](#_Toc434233981)

[Table 7 - Additional IPP/2.0 Attributes 25](#_Toc434233982)

[Table 8 - Additional IPP/2.1 Attributes 27](#_Toc434233983)

[Table 9 - Additional IPP/2.2 Attributes 30](#_Toc434233984)

1. Introduction

The IETF IPP/1.1 protocol specifications [RFC2910] [RFC2911] were published in September 2000. Since the publication of IPP/1.1, dozens of IETF and PWG IPP extension specifications have been approved and published and billions of IPP Clients and Printers are in use. Section 13 provides more information about the ongoing development of IPP.

* 1. IPP 2.x Versions

The purpose of this document is to group existing IETF and PWG IPP extension specifications and define a set of IPP versions, i.e., conformance levels, that provide simple, authoritative statements of the capabilities of an IPP Printer.

Below is a brief informal description of the targeted printing environments for each IPP version defined in this document:

**IPP/2.0**: This IPP conformance level is targeted to an environment 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/2.1**: This IPP conformance level is targeted to an environment 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. A 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/2.2**: This IPP conformance level is targeted to an environment 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.

* 1. Deprecation of IPP Operations

A few IPP operations defined in IETF RFCs have been deprecated by the PWG IPP workgroup. These deprecations are discussed in section 4.

1. Terminology
	1. Conformance Terminology

Capitalized terms, such as MUST, MUST NOT, RECOMMENDED, REQUIRED, SHOULD, SHOULD NOT, MAY, and OPTIONAL, have special meaning relating to conformance as defined in Key words for use in RFCs to Indicate Requirement Levels [RFC2119]. The following additional terms are defined:

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

*DEPRECATED*: An operation, attribute, or value that SHOULD NOT be used or supported in new implementations.

* 1. Printing Terminology

Normative definitions and semantics of printing terms are imported from IETF IPP/1.1 [RFC2911], IETF Printer MIB v2 [RFC3805], and IETF Finisher MIB [RFC3806].

* 1. Protocol Role Terminology

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

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

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

* 1. Acronyms and Organizations

*AAA*: Authentication, Authorization, and Accounting, http://www.ietf.org/rfc/rfc2903.txt, http://www.ietf.org/rfc/rfc2904.txt

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

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

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

*PWG*: Printer Working Group, http://www.pwg.org/

1. Requirements
	1. Rationale

The Printer MIB v2 [RFC3805] and Port Monitor MIB [PWG5107.1] define:

1. Model of Print Devices;
2. Operations for Print Devices, e.g., prtGeneralReset and prtConsoleDisable;
3. Groups of simple attributes for Print Devices, e.g., prtInputTable --> prtInputName and ppmPortTable --> ppmPortServiceNameOrURI; and
4. Conformance requirements for implementations of Printer MIB v2 and Port Monitor MIB.

IPP/1.1: Model and Semantics [RFC2911] defines:

1. Model of Print Services, Print Devices, and Print Jobs;
2. Operations for Print Services and Print Jobs, e.g., Pause-Printer and Create-Job;
3. Attributes for Print Services and Print Jobs, e.g., "printer-location" and "job-id"; and
4. Conformance requirements for implementations of IPP/1.1.

IPP/1.1: Encoding and Transport [RFC2910] defines:

1. Protocol Bindings for IPP/1.1: HTTP with optional upgrade to TLS;
2. Mappings of operations for Print Services and Print Jobs; and
3. Conformance requirements for implementations of IPP/1.1.

Later IETF and PWG standards-track specifications defined numerous IPP/1.1 extensions including:

1. New operations, e.g., Set-Printer-Attributes [RFC3380] and Resume-Job [RFC3998];
2. New attribute syntaxes, e.g., 'collection' [RFC3382]; and
3. New objects, e.g., Subscription [RFC3995] and Document [PWG5100.5]

Therefore, this IPP 2.0, 2.1, and 2.2 specification should:

1. Standardize profiles of the IPP/1.1 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.
	1. Use Cases

See the informal descriptions of the IPP/2.0, IPP/2.1, and IPP/2.2 target printing environments in section 1.1.

* + 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 - they need PWG Media Standardized Names 2.0 (MSN2) [PWG5101.1] used in the IPP 'media' attribute.

* + 1. 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.

###

* + 1. IPP/2.2 Printer

Louise works in Accounting for a big wholesaler in Kansas City. She sends variable data jobs, e.g., different user names, user 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 has to make 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.

* 1. Exceptions

The following exceptions apply to all IPP versions.

* + 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.

* 1. Out Of Scope

The following are out of scope for this specification:

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

The design for this IPP 2.0, 2.1, and 2.2 specification should:

1. Define conformance profiles that reference IETF IPP and PWG IPP specifications;
2. Follow the naming conventions defined in IETF IPP/1.1 [RFC2911], including keyword value case (lower) and hyphenation requirements;
3. Define conformance requirements for both IPP Printers and IPP Clients; and
4. Define IANA registration information for new values of “ipp-versions-supported” and for deprecated operations.
5. IPP Standards

This section specifies the IPP standards that are REQUIRED, RECOMMENDED, or OPTIONAL at each IPP conformance level defined in this specification. Each IPP conformance level requires support for most of the required functionality of all lower versions (by intentional design).

All of the IETF and PWG specification requirements for each IPP conformance level are summarized below in Table 1, in order to simplify IPP design, implementation, and testing.

Notes:

1. Empty cells below represent OPTIONAL conformance requirements.
2. The last 3 rows in this table represent the transport layer security requirements for each IPP version, i.e., support for TLS/1.0 [RFC2246], TLS/1.1 [RFC4346], and TLS/1.2 [RFC5246].

Table - Summary of IETF/PWG Specifications and IPP Conformance Levels

| **IETF or PWGSpecification** | **IPP/1.1****Support** | **IPP/2.0****Support** | **IPP/2.1****Support** | **IPP/2.2****Support** |
| --- | --- | --- | --- | --- |
| [PWG5100.1] |  | REQUIRED | REQUIRED | REQUIRED |
| [PWG5100.2] |  | REQUIRED | REQUIRED | REQUIRED |
| [PWG5100.3] |  |  | REQUIRED | REQUIRED |
| [PWG5100.5] |  |  |  | REQUIRED |
| [PWG5100.6] |  |  | RECOMMENDED | REQUIRED |
| [PWG5100.7] |  |  | REQUIRED | REQUIRED |
| [PWG5100.8] |  |  |  | REQUIRED |
| [PWG5100.9] |  | RECOMMENDED | REQUIRED | REQUIRED |
| [PWG5100.11] |  |  | RECOMMENDED | REQUIRED |
| [PWG5101.1] |  | REQUIRED | REQUIRED | REQUIRED |
| [PWG5107.2] |  | RECOMMENDED | RECOMMENDED | REQUIRED |
| [RFC2910] | REQUIRED | REQUIRED | REQUIRED | REQUIRED |
| [RFC2911] | REQUIRED | REQUIRED | REQUIRED | REQUIRED |
| [RFC3380] |  |  | REQUIRED | REQUIRED |
| [RFC3382] |  |  | REQUIRED | REQUIRED |
| [RFC3510] | REQUIRED | REQUIRED | REQUIRED | REQUIRED |
| [RFC3995] |  |  | REQUIRED | REQUIRED |
| [RFC3996] |  |  | REQUIRED | REQUIRED |
| [RFC3998] |  |  | REQUIRED | REQUIRED |
| [RFC5246] |  | RECOMMENDED | RECOMMENDED | REQUIRED |
| [RFC7472] |  | RECOMMENDED | RECOMMENDED | RECOMMENDED |

* 1. IPP/2.0 Standards

An IPP/2.0 Printer MUST support the following specifications:

1. Internet Printing Protocol/1.1: Encoding and Transport [RFC2910]
2. Internet Printing Protocol/1.1: Model and Semantics [RFC2911]
3. Internet Printing Protocol/1.1: IPP URL Scheme [RFC3510]
4. IPP Finishings 2.0 (FIN) [PWG5100.1] (for “finishings” attribute)
5. Internet Printing Protocol (IPP): “output-bin” attribute extension [PWG5100.2]
6. PWG Media Standardized Names 2.0 [PWG5101.1] (for “media” attribute)

An IPP/2.0 Printer SHOULD support the following specifications:

1. Internet Printing Protocol (IPP): Production Printing Attributes – Set 1 (for “media-col” attributes) [PWG5100.3]
2. Internet Printing Protocol (IPP) Printer State Extensions [PWG5100.9]
3. PWG Command Set Format for IEEE 1284 Device ID v1.0 [PWG5107.2]
4. Internet Printing Protocol (IPP): The 'collection' Attribute Syntax [RFC3382]
5. The Transport Layer Security (TLS) Protocol Version 1.2 [RFC5246]
6. IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472]
	1. IPP/2.1 Standards

In addition to the specifications listed in section 4.1, an IPP/2.1 Printer MUST support the following specifications:

1. Internet Printing Protocol (IPP): Job and Printer Set Operations [RFC3380]
2. Internet Printing Protocol (IPP): The 'collection' Attribute Syntax [RFC3382]
3. Internet Printing Protocol (IPP): Event Notifications and Subscriptions [RFC3995]
4. Internet Printing Protocol (IPP): The ‘ippget’ Delivery Method for Event Notifications [RFC3996]
5. Internet Printing Protocol (IPP): Job and Printer Administrative Operations [RFC3998]
6. Internet Printing Protocol (IPP): Production Printing Attributes – Set 1 (for “media-col” attributes) [PWG5100.3]
7. Standard for the Internet Printing Protocol (IPP): Job Extensions [PWG5100.7]
8. Internet Printing Protocol (IPP) Printer State Extensions [PWG5100.9]

An IPP/2.1 Printer SHOULD support the following specifications:

1. Standard for the Internet Printing Protocol (IPP): Page Overrides [PWG5100.6]
2. Internet Printing Protocol (IPP): Job and Printer Operations – Set 2 (JPS2) [PWG5100.11]
3. PWG Command Set Format for IEEE 1284 Device ID v1.0 [PWG5107.2]
4. The Transport Layer Security (TLS) Protocol Version 1.2 [RFC5246]
5. IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472]
	1. IPP/2.2 Standards

In addition to the specifications listed in sections 4.1 and 4.2, an IPP/2.2 printer MUST support the following specifications:

1. Standard for the Internet Printing Protocol (IPP): Document Object [PWG5100.5]
2. Standard for the Internet Printing Protocol (IPP): Page Overrides [PWG5100.6]
3. Standard for the Internet Printing Protocol (IPP): “-actual” Attributes [PWG5100.8]
4. Internet Printing Protocol (IPP): Job and Printer Operations – Set 2 (JPS2) [PWG5100.11]
5. PWG Command Set Format for IEEE 1284 Device ID v1.0 [PWG5107.2]
6. The Transport Layer Security (TLS) Protocol Version 1.2 [RFC5246]

An IPP/2.2 Printer SHOULD support the following specifications:

1. IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472]
2. IPP Operations

IPP/2.0, IPP/2.1, and IPP/2.2 specify higher conformance requirements for some IPP Operations in comparison to previous IPP specifications. Many IPP Operations were defined in their source specifications as optional. If they remained optional in this specification, the desired interoperability objective would not be achieved.

* 1. Original IPP/1.1 Operations (Informative)

The following IPP operations in Table 2 were originally specified as required in IPP/1.1. See note 1 before Table 3 in section 5.2 for a discussion of the Validate-Job operation.

Table - Original IPP/1.1 Required Operations

|  |  |  |
| --- | --- | --- |
| **Code** | **Operation Name** | **Source** |
| 0x0002 | Print-Job | [RFC2911] |
| 0x0004 | Validate-Job | [RFC2911] |
| 0x0008 | Cancel-Job | [RFC2911] |
| 0x0009 | Get-Job-Attributes | [RFC2911] |
| 0x000A | Get-Jobs | [RFC2911] |
| 0x000B | Get-Printer-Attributes | [RFC2911] |

* 1. IPP/2.0 Operations

The conformance requirements for each IPP operation in an IPP/2.0 implementation are defined in Table 3. An IPP/2.0 implementation MAY include support for additional IPP operations other than those specified in this list.

Notes:

1. The Validate-Job operation is reduced to RECOMMENDED in IPP/2.0. To improve Job accounting, Validate-Job SHOULD be supported by a Printer to allow the Client to verify End User access and authorization rights.
2. The Restart-Job operation is DEPRECATED in IPP/2.0 because it destroys accounting information. Instead use the Resubmit-Job [PWG5100.11] operation.
3. The Purge-Jobs operation is DEPRECATED in IPP/2.0 because it destroys accounting information. Instead use the Cancel-Jobs or Cancel-My-Jobs [PWG5100.11] operations, as appropriate.

Table - IPP/2.0 Operations

| **Code** | **Operation Name** | **Source** | **Support** |
| --- | --- | --- | --- |
| 0x0002 | Print-Job | [RFC2911] | REQUIRED |
| 0x0003 | Print-URI | [RFC2911] | OPTIONAL |
| 0x0004 | Validate-Job (note 1) | [RFC2911] | RECOMMENDED |
| 0x0005 | Create-Job | [RFC2911] | OPTIONAL |
| 0x0006 | Send-Document | [RFC2911] | OPTIONAL |
| 0x0007 | Send-URI | [RFC2911] | OPTIONAL |
| 0x0008 | Cancel-Job | [RFC2911] | REQUIRED |
| 0x0009 | Get-Job-Attributes | [RFC2911] | REQUIRED |
| 0x000A | Get-Jobs | [RFC2911] | REQUIRED |
| 0x000B | Get-Printer-Attributes | [RFC2911] | REQUIRED |
| 0x000C | Hold-Job | [RFC2911] | OPTIONAL |
| 0x000D | Release-Job | [RFC2911] | OPTIONAL |
| 0x000E | Restart-Job (note 2) | [RFC2911] | DEPRECATED |
| 0x0010 | Pause-Printer | [RFC2911] | OPTIONAL |
| 0x0011 | Resume-Printer | [RFC2911] | OPTIONAL |
| 0x0012 | Purge-Jobs (note 3) | [RFC2911] | DEPRECATED |
| 0x002C | Reprocess-Job | [RFC3998] | OPTIONAL |
| 0x0038 | Cancel-Jobs (note 3) | [PWG5100.11] | OPTIONAL |
| 0x0039 | Cancel-My-Jobs (note 3) | [PWG5100.11] | OPTIONAL |
| 0x003A | Resubmit-Job (note 2) | [PWG5100.11] | OPTIONAL |

* 1. IPP/2.1 Operations

The conformance requirements (some higher than in IPP/2.0) for each IPP operation in an IPP/2.1 implementation are defined in Table 4. An IPP/2.1 implementation MAY include support for additional IPP operations other than those specified in this list.

Notes:

1. The Validate-Job operation is REQUIRED in IPP/2.1.
2. The Restart-Job operation is DEPRECATED in IPP/2.1 because it destroys accounting information. Instead use the Resubmit-Job [PWG5100.11] operations.
3. The Purge-Jobs operation is DEPRECATED in IPP/2.1 because it destroys accounting information. Instead use the Cancel-Jobs or Cancel-My-Jobs [PWG5100.11] operations, as appropriate.
4. The Activate-Printer and Deactivate-Printer operations are DEPRECATED in IPP/2.1 because they are redundant compound operations (Enable-Printer/Resume-Printer and Disable-Printer/Pause-Printer).
5. The Delete-Document operation is DEPRECATED in IPP/2.1 because it destroys accounting information. Instead use the Cancel-Document [PWG5100.5] operation.
6. The Cancel-Jobs, Cancel-My-Jobs, Resubmit-Job, and Close-Job [PWG5100.11] operations are RECOMMENDED in IPP/2.1 for extended Job management and reprint features - see notes 2 and 3 above.

Table - IPP/2.1 Operations

| **Code** | **Operation Name** | **Source** | **Support** |
| --- | --- | --- | --- |
| 0x0002 | Print-Job | [RFC2911] | REQUIRED |
| 0x0003 | Print-URI | [RFC2911] | OPTIONAL |
| 0x0004 | Validate-Job (note 1) | [RFC2911] | REQUIRED |
| 0x0005 | Create-Job | [RFC2911] | REQUIRED |
| 0x0006 | Send-Document | [RFC2911] | REQUIRED |
| 0x0007 | Send-URI | [RFC2911] | OPTIONAL |
| 0x0008 | Cancel-Job | [RFC2911] | REQUIRED |
| 0x0009 | Get-Job-Attributes | [RFC2911] | REQUIRED |
| 0x000A | Get-Jobs | [RFC2911] | REQUIRED |
| 0x000B | Get-Printer-Attributes | [RFC2911] | REQUIRED |
| 0x000C | Hold-Job | [RFC2911] | REQUIRED |
| 0x000D | Release-Job | [RFC2911] | REQUIRED |
| 0x000E | Restart-Job (note 2) | [RFC2911] | DEPRECATED |
| 0x0010 | Pause-Printer | [RFC2911] | REQUIRED |
| 0x0011 | Resume-Printer | [RFC2911] | REQUIRED |
| 0x0012 | Purge-Jobs (note 3) | [RFC2911] | DEPRECATED |
| 0x0013 | Set-Printer-Attributes | [RFC3380] | REQUIRED |
| 0x0014 | Set-Job-Attributes | [RFC3380] | REQUIRED |
| 0x0015 | Get-Printer-Supported-Values | [RFC3380] | REQUIRED |
| 0x0016 | Create-Printer-Subscriptions | [RFC3995] | REQUIRED |
| 0x0017 | Create-Job-Subscriptions | [RFC3995] | OPTIONAL |
| 0x0018 | Get-Subscription-Attributes | [RFC3995] | REQUIRED |
| 0x0019 | Get-Subscriptions | [RFC3995] | REQUIRED |
| 0x001A | Renew-Subscription | [RFC3995] | REQUIRED |
| 0x001B | Cancel-Subscription | [RFC3995] | REQUIRED |
| 0x001C | Get-Notifications | [RFC3996] | REQUIRED |
| 0x0022 | Enable-Printer | [RFC3998] | REQUIRED |
| 0x0023 | Disable-Printer | [RFC3998] | REQUIRED |
| 0x0024 | Pause-Printer-After-Current-Job | [RFC3998] | OPTIONAL |
| 0x0025 | Hold-New-Jobs | [RFC3998] | OPTIONAL |
| 0x0026 | Release-Held-New-Jobs | [RFC3998] | OPTIONAL |
| 0x0027 | Deactivate-Printer (note 4) | [RFC3998] | DEPRECATED |
| 0x0028 | Activate-Printer (note 4) | [RFC3998] | DEPRECATED |
| 0x0029 | Restart-Printer | [RFC3998] | OPTIONAL |
| 0x002A | Shutdown-Printer | [RFC3998] | OPTIONAL |
| 0x002B | Startup-Printer | [RFC3998] | OPTIONAL |
| 0x002C | Reprocess-Job | [RFC3998] | OPTIONAL |
| 0x002D | Cancel-Current-Job | [RFC3998] | OPTIONAL |
| 0x002E | Suspend-Current-Job | [RFC3998] | OPTIONAL |
| 0x002F | Resume-Job | [RFC3998] | OPTIONAL |
| 0x0030 | Promote-Job | [RFC3998] | OPTIONAL |
| 0x0031 | Schedule-Job-After | [RFC3998] | OPTIONAL |
| 0x0033 | Cancel-Document | [PWG5100.5] | OPTIONAL |
| 0x0034 | Get-Document-Attributes | [PWG5100.5] | OPTIONAL |
| 0x0035 | Get-Documents | [PWG5100.5] | OPTIONAL |
| 0x0036 | Delete-Document (note 5) | [PWG5100.5] | DEPRECATED |
| 0x0037 | Set-Document-Attributes | [PWG5100.5] | OPTIONAL |
| 0x0038 | Cancel-Jobs (note 3, 6) | [PWG5100.11] | RECOMMENDED |
| 0x0039 | Cancel-My-Jobs (note 3, 6) | [PWG5100.11] | RECOMMENDED |
| 0x003A | Resubmit-Job (note 2, 6) | [PWG5100.11] | RECOMMENDED |
| 0x003B | Close-Job (note 6) | [PWG5100.11] | RECOMMENDED |

* 1. IPP/2.2 Operations

The conformance requirements (some higher than in IPP/2.1) for each IPP operation in an IPP/2.2 implementation are defined in Table 5. An IPP/2.2 implementation MAY include support for additional IPP operations other than those specified in this list.

Notes:

1. The Validate-Job operation is REQUIRED in IPP/2.2.
2. The Restart-Job operation is DEPRECATED in IPP/2.2 because it destroys accounting information. Instead use the Resubmit-Job [PWG5100.11] operation.
3. The Purge-Jobs operation is DEPRECATED in IPP/2.2 because it destroys accounting information. Instead use the Cancel-Jobs or Cancel-My-Jobs [PWG5100.11] operations, as appropriate.
4. The Activate-Printer and Deactivate-Printer operations are DEPRECATED in IPP/2.2 because they are redundant compound operations (Enable-Printer/Resume-Printer and Disable-Printer/Pause-Printer).
5. The Delete-Document operation is DEPRECATED in IPP/2.2 because it destroys accounting information. Instead use the Cancel-Document [PWG5100.5] operation.

Table - IPP/2.2 Operations

| **Code** | **Operation Name** | **Source** | **Support** |
| --- | --- | --- | --- |
| 0x0002 | Print-Job | [RFC2911] | REQUIRED |
| 0x0003 | Print-URI | [RFC2911] | OPTIONAL |
| 0x0004 | Validate-Job (note 1) | [RFC2911] | REQUIRED |
| 0x0005 | Create-Job | [RFC2911] | REQUIRED |
| 0x0006 | Send-Document | [RFC2911] | REQUIRED |
| 0x0007 | Send-URI | [RFC2911] | OPTIONAL |
| 0x0008 | Cancel-Job | [RFC2911] | REQUIRED |
| 0x0009 | Get-Job-Attributes | [RFC2911] | REQUIRED |
| 0x000A | Get-Jobs | [RFC2911] | REQUIRED |
| 0x000B | Get-Printer-Attributes | [RFC2911] | REQUIRED |
| 0x000C | Hold-Job | [RFC2911] | REQUIRED |
| 0x000D | Release-Job | [RFC2911] | REQUIRED |
| 0x000E | Restart-Job (note 2) | [RFC2911] | DEPRECATED |
| 0x0010 | Pause-Printer | [RFC2911] | REQUIRED |
| 0x0011 | Resume-Printer | [RFC2911] | REQUIRED |
| 0x0012 | Purge-Jobs (note 3) | [RFC2911] | DEPRECATED |
| 0x0013 | Set-Printer-Attributes | [RFC3380] | REQUIRED |
| 0x0014 | Set-Job-Attributes | [RFC3380] | REQUIRED |
| 0x0015 | Get-Printer-Supported-Values | [RFC3380] | REQUIRED |
| 0x0016 | Create-Printer-Subscriptions | [RFC3995] | REQUIRED |
| 0x0017 | Create-Job-Subscriptions | [RFC3995] | OPTIONAL |
| 0x0018 | Get-Subscription-Attributes | [RFC3995] | REQUIRED |
| 0x0019 | Get-Subscriptions | [RFC3995] | REQUIRED |
| 0x001A | Renew-Subscription | [RFC3995] | REQUIRED |
| 0x001B | Cancel-Subscription | [RFC3995] | REQUIRED |
| 0x001C | Get-Notifications | [RFC3996] | REQUIRED |
| 0x0022 | Enable-Printer | [RFC3998] | REQUIRED |
| 0x0023 | Disable-Printer | [RFC3998] | REQUIRED |
| 0x0024 | Pause-Printer-After-Current-Job | [RFC3998] | REQUIRED |
| 0x0025 | Hold-New-Jobs | [RFC3998] | REQUIRED |
| 0x0026 | Release-Held-New-Jobs | [RFC3998] | REQUIRED |
| 0x0027 | Deactivate-Printer (note 4) | [RFC3998] | DEPRECATED |
| 0x0028 | Activate-Printer (note 4) | [RFC3998] | DEPRECATED |
| 0x0029 | Restart-Printer | [RFC3998] | REQUIRED |
| 0x002A | Shutdown-Printer | [RFC3998] | REQUIRED |
| 0x002B | Startup-Printer | [RFC3998] | REQUIRED |
| 0x002C | Reprocess-Job | [RFC3998] | REQUIRED |
| 0x002D | Cancel-Current-Job | [RFC3998] | REQUIRED |
| 0x002E | Suspend-Current-Job | [RFC3998] | REQUIRED |
| 0x002F | Resume-Job | [RFC3998] | REQUIRED |
| 0x0030 | Promote-Job | [RFC3998] | REQUIRED |
| 0x0031 | Schedule-Job-After | [RFC3998] | REQUIRED |
| 0x0033 | Cancel-Document | [PWG5100.5] | REQUIRED |
| 0x0034 | Get-Document-Attributes | [PWG5100.5] | REQUIRED |
| 0x0035 | Get-Documents | [PWG5100.5] | REQUIRED |
| 0x0036 | Delete-Document (note 5) | [PWG5100.5] | DEPRECATED |
| 0x0037 | Set-Document-Attributes | [PWG5100.5] | REQUIRED |
| 0x0038 | Cancel-Jobs (note 3) | [PWG5100.11] | REQUIRED |
| 0x0039 | Cancel-My-Jobs (note 3) | [PWG5100.11] | REQUIRED |
| 0x003A | Resubmit-Job (note 2) | [PWG5100.11] | REQUIRED |
| 0x003B | Close-Job | [PWG5100.11] | REQUIRED |

1. IPP Attributes

This section specifies the IPP attributes that MUST be implemented for conformance to IPP/2.0, IPP/2.1, and IPP/2.2 and also provides a summary of the original required IPP/1.1 Attributes.

* 1. Original IPP/1.1 Attributes

Table 6 lists the IPP attributes that are REQUIRED in all versions of IPP.

Table - Required IPP Attributes

| **Attribute Name** | **Object** | **Source** |
| --- | --- | --- |
| attributes-charset | All (operation/all) | [RFC2911] |
| attributes-natural-language | All (operation/all) | [RFC2911] |
| charset-configured | Printer | [RFC2911] |
| charset-supported | Printer | [RFC2911] |
| compression | Job | [RFC2911] |
| compression-supported | Printer | [RFC2911] |
| document-format | Job | [RFC2911] |
| document-format-default | Printer | [RFC2911] |
| document-format-supported | Printer | [RFC2911] |
| document-name | Job | [RFC2911] |
| generated-natural-language-supported | Printer | [RFC2911] |
| ipp-attribute-fidelity | Job | [RFC2911] |
| ipp-versions-supported | Printer | [RFC2911] |
| job-id | Job | [RFC2911] |
| job-name | Job | [RFC2911] |
| job-originating-user-name | Job | [RFC2911] |
| job-printer-up-time | Job | [RFC2911] |
| job-printer-uri | Job | [RFC2911] |
| job-state | Job | [RFC2911] |
| job-state-reasons | Job | [RFC2911] |
| job-uri | Job | [RFC2911] |
| limit | Printer (operation) | [RFC2911] |
| my-jobs | Printer (operation) | [RFC2911] |
| natural-language-configured | Printer | [RFC2911] |
| operation-id (note 1) | All (parameter) | [RFC2911] |
| operations-supported | Printer | [RFC2911] |
| pdl-override-supported | Printer | [RFC2911] |
| printer-is-accepting-jobs | Printer | [RFC2911] |
| printer-name | Printer | [RFC2911] |
| printer-state | Printer | [RFC2911] |
| printer-state-reasons | Printer | [RFC2911] |
| printer-up-time | Printer | [RFC2911] |
| printer-uri | All (operation) | [RFC2911] |
| printer-uri-supported | Printer | [RFC2911] |
| queued-job-count | Printer | [RFC2911] |
| request-id (note 1) | All (parameter) | [RFC2911] |
| requested-attributes | All (operation) | [RFC2911] |
| requesting-user-name | All (operation) | [RFC2911] |
| status-code (note 1) | All (parameter) | [RFC2911] |
| time-at-completed | Job | [RFC2911] |
| time-at-creation | Job | [RFC2911] |
| time-at-processing | Job | [RFC2911] |
| uri-authentication-supported | Printer | [RFC2911] |
| uri-security-supported | Printer | [RFC2911] |
| version-number (note 1) | All (parameter) | [RFC2911] |
| which-jobs | Printer (operation) | [RFC2911] |

## 6.2 IPP/2.0 Attributes

In addition to the attributes listed in Table 6, and except as noted below, IPP/2.0 implementations MUST support the applicable IPP attributes listed in Table 7. An IPP/2.0 implementation MAY also support additional IPP attributes that are not listed in these tables.

Notes:

1. Values of the “media” attribute that contain media size names and media type names MUST conform to the PWG Media Standardized Names 2.0 (MSN) [PWG5101.1].
2. The “pages-per-minute-color” attribute is CONDITIONALLY REQUIRED for IPP/2.0 implementations that support more than 1 color, i.e., the value of “color-supported” is ‘true’.
3. The “media-ready” attribute is RECOMMENDED for IPP/2.0 implementations for improved user experience.
4. The “printer-alert” and “printer-alert-description” attributes [PWG5100.9] are RECOMMENDED in IPP/2.0 for reliable device management.
5. The “printer-device-id” attribute [PWG5107.2] is RECOMMENDED in IPP/2.0 for reliable driver selection.
6. The “status-message” response attribute [RFC2911] is RECOMMENDED in IPP/2.0 for internationalization.
7. The “job-creation-attributes-supported” attribute [PWG5100.11] is RECOMMENDED in IPP/2.0 for reliable Job Creation operations.
8. The “print-quality” attribute has higher precedence than “printer-resolution”, if the IPP Printer cannot support a requested combination, and returns the usual successful-ok-ignored-or-substituted-attributes status code.

Table - Additional IPP/2.0 Attributes

| **Attribute Name** | **Object**  | **Source** |
| --- | --- | --- |
| color-supported | Printer  | [RFC2911] |
| copies | Job | [RFC2911] |
| copies-default | Printer  | [RFC2911] |
| copies-supported | Printer  | [RFC2911] |
| finishings | Job | [RFC2911] |
| finishings-default | Printer  | [RFC2911] |
| finishings-supported | Printer  | [RFC2911] |
| job-creation-attributes-supported (note 7) | Printer | [PWG5100.11] |
| media (note 1) | Job | [RFC2911] |
| media-default (note 1) | Printer  | [RFC2911] |
| media-ready (note 3) | Printer  | [RFC2911] |
| media-supported (note 1) | Printer  | [RFC2911] |
| orientation-requested | Job  | [RFC2911] |
| orientation-requested-default | Printer  | [RFC2911] |
| orientation-requested-supported | Printer  | [RFC2911] |
| output-bin | Job | [PWG5100.2] |
| output-bin-default | Printer | [PWG5100.2] |
| output-bin-supported | Printer | [PWG5100.2] |
| pages-per-minute | Printer | [RFC2911] |
| pages-per-minute-color (note 2) | Printer | [RFC2911] |
| print-quality (note 8) | Job | [RFC2911] |
| print-quality-default | Printer  | [RFC2911] |
| print-quality-supported | Printer  | [RFC2911] |
| printer-alert (note 4) | Printer | [PWG5100.9] |
| printer-alert-description (note 4) | Printer | [PWG5100.9] |
| printer-device-id (note 5) | Printer | [PWG5107.2] |
| printer-info | Printer  | [RFC2911] |
| printer-location | Printer  | [RFC2911] |
| printer-make-and-model | Printer  | [RFC2911] |
| printer-more-info | Printer  | [RFC2911] |
| printer-resolution (note 8) | Job  | [RFC2911] |
| printer-resolution-default | Printer  | [RFC2911] |
| printer-resolution-supported | Printer  | [RFC2911] |
| sides | Job | [RFC2911] |
| sides-default | Printer  | [RFC2911] |
| sides-supported | Printer  | [RFC2911] |
| status-message (note 6) | All (response) | [RFC2911] |

* 1. IPP/2.1 Attributes

In addition to the attributes listed in Table 6 and Table 7, and except as noted below, IPP/2.1 implementations MUST support the applicable IPP attributes listed in Table 8. An IPP/2.1 implementation MAY also support additional IPP attributes that are not listed in these tables.

Notes:

1. The “media-col”, “media-col-default”, and “media-col-supported” attributes [PWG5100.3] are REQUIRED in IPP/2.1.
2. The specified “media-col” member attributes are REQUIRED in IPP/2.1 implementations – all other “media-col” member attributes not listed in Table 8 are OPTIONAL in IPP/2.1. In addition, values of the “media-col.media-color” and “media-col.media-type” attributes MUST conform to the PWG Media Standardized Names 2.0 (MSN) [PWG5101.1].
3. The “media-col-ready” attribute is RECOMMENDED for IPP/2.1 implementations for improved user experience.
4. The “job-ids”, “job-ids-supported”, “proof-print”, and “which-jobs-supported” attributes [PWG5100.11] are RECOMMENDED in IPP/2.1 - see note 6 in section 5.3.
5. The “printer-device-id” attribute [PWG5107.2] is RECOMMENDED in IPP/2.1 for reliable driver selection.
6. The “printer-state-reasons” attribute is REQUIRED in IPP/2.1 to support the complete mapping of prtAlertCode [RFC3805] [PWG5100.9] for all applicable alert code values.
7. The “overrides”, “overrides-actual”, and “overrides-supported” attributes [PWG5100.6] are RECOMMENDED in IPP/2.1.
8. The “status-message” response attribute [RFC2911] is RECOMMENDED in IPP/2.1 for internationalization.
9. The “job-creation-attributes-supported” attribute [PWG5100.11] is RECOMMENDED in IPP/2.1 for reliable Job Creation operations.
10. The “printer-alert” and “printer-alert-description” attributes [PWG5100.9] are REQUIRED in IPP/2.1 for reliable device management.

Table - Additional IPP/2.1 Attributes

| **Attribute Name** | **Object** | **Source** |
| --- | --- | --- |
| compression-supplied | Job | [PWG5100.7] |
| document-format-supplied | Job | [PWG5100.7] |
| document-format-version | Job (operation) | [PWG5100.7] |
| document-format-version-supplied | Job | [PWG5100.7] |
| document-name-supplied | Job | [PWG5100.7] |
| ippget-event-life | Printer | [RFC3996] |
| job-creation-attributes-supported (note 9) | Printer | [PWG5100.11] |
| job-hold-until | Job | [RFC2911] |
| job-hold-until-default | Printer | [RFC2911] |
| job-hold-until-supported | Printer | [RFC2911] |
| job-ids (note 4) | Printer (operation) | [PWG5100.11] |
| job-ids-supported (note 4) | Printer | [PWG5100.11] |
| job-priority | Job | [RFC2911] |
| job-priority-default | Printer | [RFC2911] |
| job-priority-supported | Printer | [RFC2911] |
| job-settable-attributes-supported | Printer | [RFC3380] |
| job-sheets | Job | [RFC2911] |
| job-sheets-default | Printer | [RFC2911] |
| job-sheets-supported | Printer | [RFC2911] |
| last-document | Job (operation) | [RFC2911] |
| media-col (note 1) | Job | [PWG5100.3] |
| media-col-default (note 1) | Printer | [PWG5100.3] |
| media-col-ready (note 3) | Printer | [PWG5100.3] |
| media-col-supported (note 1) | Printer | [PWG5100.3] |
| media-col.media-color (note 2) | Job | [PWG5100.3] |
| media-col.media-key (note 2) | Job | [PWG5100.3] |
| media-col.media-size (note 2) | Job | [PWG5100.3] |
| media-col.media-type (note 2) | Job | [PWG5100.3] |
| multiple-operation-time-out | Printer | [RFC2911] |
| notify-charset | Subscription | [RFC3995] |
| notify-events | Subscription | [RFC3995] |
| notify-events-default | Printer | [RFC3995] |
| notify-events-supported | Printer | [RFC3995] |
| notify-get-interval | Printer (response) | [RFC3996] |
| notify-job-id | Subscription | [RFC3995] |
| notify-lease-duration | Subscription | [RFC3995] |
| notify-lease-duration-default | Printer | [RFC3995] |
| notify-lease-duration-supported | Printer | [RFC3995] |
| notify-lease-expiration-time | Subscription | [RFC3995] |
| notify-max-events-supported | Printer | [RFC3995] |
| notify-natural-language | Subscription | [RFC3995] |
| notify-printer-up-time | Subscription | [RFC3995] |
| notify-printer-uri | Subscription | [RFC3995] |
| notify-pull-method | Subscription | [RFC3995] |
| notify-pull-method-supported | Printer | [RFC3995] |
| notify-sequence-number | Subscription | [RFC3995] |
| notify-sequence-numbers | Printer (operation) | [RFC3996] |
| notify-status-code | All (operation) | [RFC3996] |
| notify-subscribed-event | Subscription | [RFC3995] |
| notify-subscriber-user-name | Subscription | [RFC3995] |
| notify-subscription-id | Subscription | [RFC3995] |
| notify-subscription-ids | Printer (operation) | [RFC3996] |
| notify-text | Subscription | [RFC3995] |
| notify-time-interval | Subscription | [RFC3995] |
| notify-user-data | Subscription | [RFC3995] |
| notify-wait | Printer (operation) | [RFC3996] |
| output-device-assigned | Job | [RFC3998] |
| overrides (note 7) | Job | [PWG5100.6] |
| overrides-actual (note 7) | Job | [PWG5100.6] |
| overrides-supported (note 7) | Printer | [PWG5100.6] |
| printer-alert (note 10) | Printer | [PWG5100.9] |
| printer-alert-description (note 10) | Printer | [PWG5100.9] |
| printer-device-id (note 5) | Printer | [PWG5107.2] |
| printer-settable-attributes-supported | Printer | [RFC3380] |
| printer-state-change-time | Printer | [RFC3995] |
| printer-state-reasons (note 6) | Printer | [RFC2911] & [PWG5100.9] |
| proof-print (note 4) | Job | [PWG5100.11] |
| status-message (note 8) | All (response) | [RFC2911] |
| which-jobs-supported (note 4) | Printer | [PWG5100.11] |

* 1. IPP/2.2 Attributes

In addition to the attributes listed in Table 6, Table 7, and Table 8, and except as noted below, IPP/2.1 implementations MUST support the applicable IPP attributes listed in Table 9. An IPP/2.2 implementation MAY also support additional IPP attributes not listed in these tables.

Notes:

1. The “job-ids” operation attribute [PWG5100.11] is REQUIRED in IPP/2.2, for use in the Get-Jobs [RFC2911], Cancel-Jobs [PWG5100.11], and Cancel-My-Jobs [PWG5100.11] operations.
2. The “job-ids-supported”, “proof-print”, and “which-jobs-supported” attributes [PWG5100.11] are REQUIRED in IPP/2.2.
3. The “printer-device-id” attribute [PWG5107.2] is REQUIRED in IPP/2.2 for reliable driver selection.
4. The “overrides”, “overrides-actual”, and “overrides-supported” attributes [PWG5100.6] are REQUIRED in IPP/2.2.
5. The “media-col-ready” attribute is RECOMMENDED for IPP/2.2 implementations for improved user experience.
6. The “status-message” response attribute [RFC2911] is REQUIRED in IPP/2.2 for internationalization.
7. The “job-creation-attributes-supported” attribute [PWG5100.11] is REQUIRED in IPP/2.2 for reliable Job Creation operations.
8. The “document-format-detected”, “document-format-supplied”, “document-name”, and “document-name-supplied” attributes are REQUIRED in IPP/2.2 for the Document object [PWG5100.5], in addition to the Job object [PWG5100.7] requirements in IPP/2.1.

Table - Additional IPP/2.2 Attributes

| **Attribute Name** | **Object** | **Source** |
| --- | --- | --- |
| copies-actual | Job | [PWG5100.8] |
| document-job-id | Document | [PWG5100.5] |
| document-job-uri | Document | [PWG5100.5] |
| document-format-detected (note 8) | Document | [PWG5100.5] |
| document-format-supplied (note 8) | Document | [PWG5100.5] |
| document-message | Job/Document | [PWG5100.7] &[PWG5100.5] |
| document-message-supplied | Job/Document | [PWG5100.7] &[PWG5100.5] |
| document-name (note 8) | Document | [PWG5100.5] |
| document-name-supplied (note 8) | Document | [PWG5100.5] |
| document-number | Document | [PWG5100.5] |
| document-printer-uri | Document | [PWG5100.5] |
| document-state | Document | [PWG5100.5] |
| document-state-reasons | Document | [PWG5100.5] |
| finishings-actual | Job | [PWG5100.8] |
| job-creation-attributes-supported (note 7) | Printer | [PWG5100.11] |
| job-mandatory-attributes | Job (operation) | [PWG5100.7] |
| job-hold-until-actual | Job | [PWG5100.8] |
| job-ids (note 1) | Printer (operation) | [PWG5100.11] |
| job-ids-supported (note 2) | Printer | [PWG5100.11] |
| job-priority-actual | Job | [PWG5100.8] |
| job-sheets-actual | Job | [PWG5100.8] |
| last-document | Document | [PWG5100.5] |
| media-actual | Job | [PWG5100.8] |
| media-col-actual | Job | [PWG5100.8] |
| media-col-ready (note 5) | Printer | [PWG5100.3] |
| multiple-document-handling | Job | [PWG5100.5] |
| multiple-document-handling-actual | Job | [PWG5100.8] |
| multiple-document-jobs-supported | Printer | [RFC2911] |
| number-of-documents | Job | [PWG5100.5] |
| number-up | Job | [RFC2911] |
| number-up-actual | Job | [PWG5100.8] |
| number-up-default | Printer | [RFC2911] |
| number-up-supported | Printer | [RFC2911] |
| output-bin-actual | Job | [PWG5100.8] |
| orientation-requested-actual | Job | [PWG5100.8] |
| overrides (note 4) | Job | [PWG5100.6] |
| overrides-actual (note 4) | Job | [PWG5100.6] |
| overrides-supported (note 4) | Printer | [PWG5100.6] |
| page-ranges | Job | [RFC2911] |
| page-ranges-actual | Job | [PWG5100.8] |
| page-ranges-supported | Printer | [RFC2911] |
| print-quality-actual | Job | [PWG5100.8] |
| printer-device-id (note 3) | Printer | [PWG5107.2] |
| printer-message-from-operator | Printer | [RFC2911] |
| printer-resolution-actual | Job | [PWG5100.8] |
| proof-print (note 2) | Job | [PWG5100.11] |
| sides-actual | Job | [PWG5100.8] |
| status-message (note 6) | All (response) | [RFC2911] |
| which-jobs-supported (note 2) | Printer | [PWG5100.11] |

1. Conformance Requirements
	1. IPP Printer Conformance Requirements

To claim conformance to this specification, an IPP Printer implementation MUST:

1. Support all REQUIRED IPP Operations defined in section 5 of this specification;
2. Support all REQUIRED IPP Attributes defined in section 6 of this specification;.
3. Conform to the requirements for an IPP Object specified in section 5.2 of [RFC2911];
4. Conform to the IPP Job and Printer Administrative operation requirements specified in section 11 of [RFC3998];
5. Conform to the Internationalization Considerations defined in section 9 of this specification; and
6. Conform to the Security Considerations defined in section 10 of this specification, including the RECOMMENDED or REQUIRED TLS versions for IPP/2.0, IPP/2.1, and IPP/2.2 implementations.
	1. IPP Client Conformance Requirements

To claim conformance to this specification, an IPP Client MUST:

1. Explicitly identify the implemented set of IPP Operations defined in section 5 of this specification;
2. Explicitly identify the implemented set of IPP Attributes defined in section 6 of this specification;
3. Conform to the requirements for an IPP Client specified in section 5.1 of [RFC2911];
4. Conform to the Internationalization Considerations defined in section 9 of this specification; and
5. Conform to the Security Considerations defined in section 10 of this specification, including the RECOMMENDED or REQUIRED TLS versions for IPP/2.0, IPP/2.1, and IPP/2.2 implementations.
	1. IPP over HTTP Conformance Requirements

The IPP/1.1: Encoding and Transport [RFC2910] requires implementation of IPP/1.1 transport over HTTP/1.1 as defined in [RFC7230] [RFC7231] [RFC7232] [RFC7233] [RFC7234] [RFC7235]. Historically, some IPP implementations have not implemented an HTTP/1.1 transport (i.e., have only supported HTTP/1.0) or else have not implemented complete HTTP/1.1 support.

To claim conformance to this specification, an IPP Printer or IPP Client implementation MUST:

1. Support the complete HTTP/1.1 protocol as defined in [RFC7230] [RFC7231] [RFC7232] [RFC7233] [RFC7234] [RFC7235];
2. Support chunking as defined in section 4.1 of [RFC7230];
3. Support the Expect header as defined in section 5.1.1 of [RFC7231].
	1. IPP over TLS Conformance Requirements

To claim conformance to this specification, an IPP Printer or IPP Client that supports TLS MUST:

1. Support the HTTP Upgrade protocol as defined in [RFC2817]; and
2. Support the required minimum cipher suite for interoperability defined in the claimed TLS specification.

IPP/2.0 and IPP/2.1 implementations SHOULD and IPP/2.2 implementations MUST conform to the Transport Layer Security (TLS) Version 1.2 [RFC5246] or a higher version. IPP implementations SHOULD conform to the Recommendations for Secure Use of Transport Layer Security (TLS) and Datagram Transport Layer Security (DTLS) [BCP195].

##

* 1. IPP Unsupported Attributes Conformance Requirements

The IPP/1.1: Model and Semantics [RFC2911] requires that IPP attributes received, that are not supported or not understood, must be processed according to the procedures defined therein, and that an appropriate status code must be returned. Historically, some IPP implementations have not conformed to this requirement, causing communication problems and failed IPP printing operations.

To claim conformance to this specification, an IPP Printer or IPP Client implementation MUST:

1. Correctly process unsupported attributes, values, or groups as defined in sections 3.1.7, 3.1.8, 3.2.1.2, 3.3.5.1, 3.3.7.1, 4.1.2.3, and 13.1.2.2 in [RFC2911];
2. Correctly process unsupported collection attributes as defined in section 7 in [RFC3382];
3. Correctly support reading the IPP no-value tag (section 4.1 of [RFC2911]) as a valid value for an attribute that normally would be encoded as an enum, integer, name, or keyword value tag; and
4. Correctly process (or ignore) collection values as defined by [RFC3382], even if the IPP implementation does not support the collection attribute itself.
5. IANA and PWG Considerations
	1. Attribute Value Registrations

The attributes defined in this document will be published by IANA according to the procedures in IPP/1.1 Model and Semantics [RFC2911] section 6.1 in the following file:

http://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) [RFC2911]

 2.0 [PWG5100.12]

 2.1 [PWG5100.12]

 2.2 [PWG5100.12]

1. Internationalization Considerations

IPP/1.1 [RFC2911] requires conforming IPP Printer implementations to support the UTF-8 [RFC3629] encoding of Unicode [UNICODE] [ISO10646].

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

1. Security Considerations

The IPP versions defined in this document require the same security considerations as defined in the IPP/1.1: Model and Semantics [RFC2911].

To claim conformance to this specification, an IPP Printer or IPP Client implementation that supports Transport Layer Security (TLS) MUST support the mandatory cipher suite(s) required in the claimed TLS specification and SHOULD conform to the Recommendations for Secure Use of Transport Layer Security (TLS) and Datagram Transport Layer Security (DTLS) [BCP195].

An IPP/2.2 implementation MUST support TLS/1.2 [RFC5246] 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

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1. 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:

http://www.pwg.org/ipp/

The IPP Everywhere project and IPP Implementor’s Guide 2.0 specification provide useful supplemental information to this specification.

1. Changes from PWG 5100.12-2011

The following changes were made since PWG Candidate Standard 5100.12-2011:

1. The title was changed from "IPP/2.0 Second Edition" to "IPP 2.0, 2.1, and 2.2".
2. Dropped all references to (experimental) IPP/1.0.
3. Dropped all references to RFC 3381 progress attributes.
4. Dropped all references to versions of TLS prior to 1.2.
5. Added new Unicode references, internationalization considerations, and security considerations.
6. Added reference and section to PWG IPP workgroup to point to ongoing work on IPP.
7. Added reference to the "ipps" URI scheme (RFC 7472).
8. Added IPP/2.0 recommendations for the collection attribute syntax and "media-col" attribute.
9. Added reference to TLS best practices (BCP195).
10. Deprecated several operations that have been deprecated by the PWG IPP workgroup.
11. Addressed editorial errata reported to the PWG IPP workgroup.