14 February 2011
Candidate Standard 5100.12-2011

The Printer Working Group

Internet Printing Protocol Version 2.0 Second Edition (IPP/2.0 SE)

Status: Approved

Abstract: Since the release of IPP/1.1 (RFC 2910 and RFC 2911), numerous extensions to the IPP protocol have been published as IETF RFCs or PWG Candidate Standards. Many IPP developers are not aware of the existence of many of these extensions, and there is no published document that references all of these extension specifications. As a consequence, only some of the extensions have been implemented.

This specification combines all of the previous IPP IETF or PWG IPP extensions into a new base IPP/2.0 conformance level and two new extended IPP/2.1 and IPP/2.2 conformance levels. No new IPP functionality is specified in this document, beyond that defined in the previous IPP extensions.

Implementation of this specification will allow printing applications to easily determine the capabilities of an IPP Printer without the need for extensive queries to the IPP Printer.

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

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

This document is available at:

ftp://ftp.pwg.org/pub/pwg/candidates/cs-ipp20-20110214-5100.12.pdf

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The Printer Working Group (or PWG) is a Program of the IEEE Industry Standards and Technology Organization (ISTO) with member organizations including printer manufacturers, print server developers, operating system providers, network operating systems providers, network connectivity vendors, and print management application developers. The group is chartered to make printers and the applications and operating systems supporting them work together better. All references to the PWG in this document implicitly mean "The Printer Working Group, a Program of the IEEE ISTO." In order to meet this objective, the PWG will document the results of their work as open standards that define print related protocols, interfaces, procedures and conventions. Printer manufacturers and vendors of printer related software will benefit from the interoperability provided by voluntary conformance to these standards.

In general, a PWG standard is a specification that is stable, well understood, and is technically competent, has multiple, independent and interoperable implementations with substantial operational experience, and enjoys significant public support.

For additional information regarding the Printer Working Group visit: http://www.pwg.org

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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.

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1 Introduction (Informative)

The original IPP/1.0 protocol specifications, [RFC2565] and [RFC 2566], were published by the IETF in April 1999.The subsequent IPP/1.1 protocol specifications, [RFC2910] and [RFC2911], were published by the IETF in September 2000. Since the publication of IPP/1.1, numerous IETF and PWG IPP extension specifications have been approved and published.

1.1 New IPP Versions

The purpose of this document is to provide a single reference to all of the existing IETF or PWG IPP extension specifications and to define new IPP versions (i.e., conformance levels) that provide simple statements of the capabilities of an IPP Printer.

In sections 5 and 6, this document defines the new IPP/2.0, IPP/2.1, and IPP/2.2 conformance levels. Below is a brief informal description of the targeted printing environments:

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.

2 Terminology

2.1 Conformance Terminology

The capitalized key words "MUST", "MUST NOT", "REQUIRED", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document shall be interpreted as defined in [RFC2119].

2.2 Printing Terminology

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

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

IPP Client - Initiator of outgoing IPP session requests and sender of outgoing IPP operation requests (HTTP/1.0 Client [RFC1957] / HTTP/1.1 Client [RFC2616]).

IPP Printer - Listener for incoming IPP session requests and receiver of incoming IPP operation requests (HTTP/1.0 Server [RFC1957] / HTTP/1.1 Server [RFC2616]).

3 Requirements

Per the PWG Process, this section specifies the formal rationale for developing an IPP Version 2.0 specification, based on existing printing industry standards. This section also describes simple use models for IPP/2.0, IPP/2.1, and IPP/2.2 environments and defines design requirements for IPP Version 2.0.

3.1 Rationale

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

(a) Model of Print Devices
(b) Operations for Print Devices
- prtGeneralReset
- prtConsoleDisable

(c) Groups of simple attributes for Print Devices
- prtInputTable --> prtInputName
- ppmPortTable --> ppmPortServiceNameOrURI

(d) Conformance requirements for implementations of Printer MIB v2 and Port Monitor MIB

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

(a) Model of Print Services, Print Devices, and Print Jobs
(b) Operations for Print Services and Print Jobs
- Pause-Printer
- Print-Job

(c) Attributes for Print Services and Print Jobs
- printer-location
- job-id

(d) Conformance requirements for implementations of IPP/1.1

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

(a) Protocol Bindings for IPP/1.1
- HTTP with optional upgrade to TLS

(b) Mappings of operations for Print Services and Print Jobs.
(c) Conformance requirements for implementations of IPP/1.1

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

(a) New operations
- Set-Printer-Attributes [RFC3380]
- Resume-Job [RFC3998]

(b) New attribute syntaxes
- collection [RFC3382]

(c) New objects
- Subscription [RFC3995]

Therefore an IPP Version 2.0 specification should:

(a) Standardize profiles of the IPP/1.1 extensions for advanced printing functionality and reliable interoperability
(b) Encourage adoption of modern IPP-based printing infrastructures
(c) 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 Models

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

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 - they need PWG Media Standardized Names [PWG5101.1] used in the IPP 'media' attribute.

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 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.

3.3 Design Requirements

The IPP Version 2.0 design should:

(1) Define conformance profiles that reference all previous 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”.

4 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).

Note: The original Experimental IETF IPP/1.0 conformance level (now Obsolete) was defined in [RFC2565] and [RFC2566]. The subsequent standards-track IETF IPP/1.1 conformance level was defined in [RFC2910] and [RFC2911].

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

IETF or PWG Specification	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]		OPTIONAL	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
[RFC3381]			REQUIRED	REQUIRED
[RFC3382]			REQUIRED	REQUIRED
[RFC3510]	REQUIRED	REQUIRED	REQUIRED	REQUIRED
[RFC3995]			REQUIRED	REQUIRED
[RFC3996]			REQUIRED	REQUIRED
[RFC3998]		OPTIONAL	REQUIRED	REQUIRED
[RFC2246]	RECOMMENDED	RECOMMENDED	RECOMMENDED	RECOMMENDED
[RFC4346]		RECOMMENDED	RECOMMENDED	RECOMMENDED
[RFC5246]			RECOMMENDED	REQUIRED

4.1 IPP/2.0 Standards

An IPP/2.0 Printer MUST support the following IETF or PWG specifications:

[RFC2910] Internet Printing Protocol/1.1: Encoding and Transport

[RFC2911] Internet Printing Protocol/1.1: Model and Semantics

[RFC3510] Internet Printing Protocol: IPP URL Scheme

[PWG5100.1] Internet Printing Protocol: “finishings” attribute values extension

[PWG5100.2] Internet Printing Protocol: “output-bin” attribute extension

[PWG5101.1] PWG Standard for Media Size Names (for “media” attribute)

An IPP/2.0 Printer SHOULD support the following specifications:

[PWG5100.9] Internet Printing Protocol: Printer State Extensions

[PWG5107.2] Command Set Format for IEEE 1284 Device ID

[RFC2246] Transport Layer Security 1.0

[RFC4346] Transport Layer Security 1.1

An IPP/2.0 Printer MAY support the following specifications:

[RFC3998] Internet Printing Protocol: Job and Printer Administrative Operations

[PWG5100.11] Internet Printing Protocol: Job and Printer Operations – Set 2 (JPS2)

4.2 IPP/2.1 Standards

An IPP/2.1 Printer MUST support the IETF or PWG specifications required for IPP/2.0 plus the following:

[RFC3380] Internet Printing Protocol: Job and Printer Set Operations

[RFC3381] Internet Printing Protocol: Job Progress Attributes

[RFC3382] The 'collection' Attribute Syntax (for “media-col” and other attributes)

[RFC3995] Internet Printing Protocol: Event Notifications and Subscriptions

[RFC3996] Internet Printing Protocol: The ‘ippget’ Delivery Method for Event Notifications

[RFC3998] Internet Printing Protocol: Job and Printer Administrative Operations

[PWG5100.3] Internet Printing Protocol: Production Printing Attributes – Set 1 (for “media-col” attributes)

[PWG5100.7] Internet Printing Protocol: Job Extensions

[PWG5100.9] Internet Printing Protocol: Printer State Extensions

An IPP/2.1 Printer SHOULD support the following specifications:

[PWG5100.6] Internet Printing Protocol: Page Overrides

[PWG5100.11] Internet Printing Protocol: Job and Printer Operations – Set 2 (JPS2)

[PWG5107.2] Command Set Format for IEEE 1284 Device ID

[RFC2246] Transport Layer Security 1.0

[RFC4346] Transport Layer Security 1.1

[RFC5246] Transport Layer Security 1.2

4.3 IPP/2.2 Standards

An IPP/2.2 printer MUST support the IETF or PWG specifications defined for IPP/2.1 plus the following:

[PWG5100.5] Internet Printing Protocol: Document Object

[PWG5100.6] Internet Printing Protocol: Page Overrides

[PWG5100.8] Internet Printing Protocol: “-actual” Attributes

[PWG5100.11] Internet Printing Protocol: Job and Printer Operations – Set 2 (JPS2)

[PWG5107.2] Command Set Format for IEEE 1284 Device ID

[RFC5246] Transport Layer Security 1.2

An IPP/2.2 Printer SHOULD support the following specifications:

[RFC2246] Transport Layer Security 1.0

[RFC4346] Transport Layer Security 1.1

5 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.

5.1 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 Validate-Job.

Table 2 - Original IPP/1.1 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]

5.2 IPP/2.0 Operations

The following IPP Operations in Table 3 are defined in their respective source documents. The conformance requirements for each IPP Operation in an IPP/2.0 implementation are defined below. Note that an IPP/2.0 implementation MAY also include support for additional IPP operations other than those specified in this list.

Notes:

(1) Validate-Job is not widely supported in existing IPP/1.1 implementations and can only validate the Job attributes included in a Print-Job or Create-Job operation, but not the Job document data (for interpreter errors). However, Validate-Job can be used to validate end user access and authorization rights to an IPP Printer before attempting a (possibly rejected) Job creation operation on the IPP Printer. Therefore, Validate-Job is reduced to RECOMMENDED in IPP/2.0. To improve Job accounting, Validate-Job SHOULD be used to verify end user access and authorization rights instead of Create-Job (also defined in [RFC2911]).

(2) Restart-Job is OPTIONAL and DEPRECATED in IPP/2.0 because it destroys accounting information. Instead use Reprocess-Job defined in [RFC3998] or Resubmit-Job defined in [PWG5100.11] as appropriate.

(3) Purge-Jobs is OPTIONAL and DEPRECATED in IPP/2.0 because it destroys accounting information. Instead use Cancel-Jobs (Operator) or Cancel-My-Jobs (End User), both defined in [PWG5100.11], as appropriate

Table 3 - 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]	OPTIONAL – DEPRECATED
0x0010	Pause-Printer	[RFC2911]	OPTIONAL
0x0011	Resume-Printer	[RFC2911]	OPTIONAL
0x0012	Purge-Jobs (note 3)	[RFC2911]	OPTIONAL – DEPRECATED
0x002C	Reprocess-Job (note 2)	[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

5.3 IPP/2.1 Operations

The following IPP Operations in Table 4 are included in their respective source documents. The conformance requirements (some higher than in IPP/2.0) for each IPP Operation in an IPP/2.1 implementation are defined below. Note that an IPP/2.1 implementation MAY also include support for additional IPP operations other than those specified in this list.

Notes:

(1) Validate-Job is REQUIRED in IPP/2.1 (as in IPP/1.1), for strict IPP/1.1 compatibility. See note 1 before Table 2 in section 5.2 for further discussion of Validate-Job.
(2) Restart-Job is OPTIONAL and DEPRECATED in IPP/2.1 because it destroys accounting information. Instead use Reprocess-Job defined in [RFC3998] or Resubmit-Job defined in [PWG5100.11] as appropriate.
(3) Purge-Jobs is OPTIONAL and DEPRECATED in IPP/2.1 because it destroys accounting information. Instead use Cancel-Jobs (Operator) or Cancel-My-Jobs (End User) as appropriate, both defined in [PWG5100.11].
(4) Activate-Printer and Deactivate-Printer are OPTIONAL and DEPRECATED in IPP/2.1, because they are not widely implemented and are redundant compound operations (Enable/Resume and Disable/Pause) designed to close theoretical race conditions.
(5) Delete-Document is OPTIONAL and DEPRECATED in IPP/2.1 because it destroys accounting information. Instead use Cancel-Document defined in [PWG5100.5].
(6) Cancel-Jobs, Cancel-My-Jobs, Resubmit-Job, and Close-Job are RECOMMENDED in IPP/2.1 for extended Job management and reprint features (see note 2 and note 3 above).

Table 4 - 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]	OPTIONAL – DEPRECATED
0x0010	Pause-Printer	[RFC2911]	REQUIRED
0x0011	Resume-Printer	[RFC2911]	REQUIRED
0x0012	Purge-Jobs (note 3)	[RFC2911]	OPTIONAL – 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	[RFC3995]	REQUIRED
0x0022	Enable-Printer	[RFC3998]	REQUIRED
0x0023	Disable-Printer	[RFC3998]	REQUIRED

Code	Operation Name	Source	Support
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]	OPTIONAL – DEPRECATED
0x0028	Activate-Printer (note 4)	[RFC3998]	OPTIONAL – DEPRECATED
0x0029	Restart-Printer	[RFC3998]	OPTIONAL
0x002A	Shutdown-Printer	[RFC3998]	OPTIONAL
0x002B	Startup-Printer	[RFC3998]	OPTIONAL
0x002C	Reprocess-Job (note 2)	[RFC3998]	RECOMMENDED
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]	OPTIONAL – 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

5.4 IPP/2.2 Operations

The following IPP Operations in Table 5 are included in their respective source documents. The conformance requirements (some higher than in IPP/2.1) for each IPP Operation in an IPP/2.2 implementation are defined below. Note that an IPP/2.2 implementation MAY also include support for additional IPP operations other than those specified in this list.

Notes:

(1) Validate-Job is REQUIRED in IPP/2.2 (as in IPP/1.1), for strict IPP/1.1 compatibility. See note 1 before Table 3 in section 5.2 for further discussion of Validate-Job.
(2) Restart-Job is OPTIONAL and DEPRECATED in IPP/2.2 because it destroys accounting information. Instead use Reprocess-Job defined in [RFC3998] or Resubmit-Job defined in [PWG5100.11] as appropriate.
(3) Purge-Jobs is OPTIONAL and DEPRECATED in IPP/2.2 because it destroys accounting information. Instead use Cancel-Jobs (Operator) or Cancel-My-Jobs (End User) as appropriate, both defined in [PWG5100.11].
(4) Activate-Printer and Deactivate-Printer are OPTIONAL and DEPRECATED in IPP/2.2, because they are not widely implemented and are redundant compound operations (Enable/Resume and Disable/Pause) designed to close theoretical race conditions.
(5) Delete-Document is OPTIONAL and DEPRECATED in IPP/2.2 because it destroys accounting information. Instead use Cancel-Document defined in [PWG5100.5].

Table 5 - 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]	OPTIONAL – DEPRECATED
0x0010	Pause-Printer	[RFC2911]	REQUIRED
0x0011	Resume-Printer	[RFC2911]	REQUIRED
0x0012	Purge-Jobs (note 3)	[RFC2911]	OPTIONAL – 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	[RFC3995]	REQUIRED
0x0022	Enable-Printer	[RFC3998]	REQUIRED
0x0023	Disable-Printer	[RFC3998]	REQUIRED

Code	Operation Name	Source	Support
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]	OPTIONAL – DEPRECATED
0x0028	Activate-Printer (note 4)	[RFC3998]	OPTIONAL – DEPRECATED
0x0029	Restart-Printer	[RFC3998]	REQUIRED
0x002A	Shutdown-Printer	[RFC3998]	REQUIRED
0x002B	Startup-Printer	[RFC3998]	REQUIRED
0x002C	Reprocess-Job (note 2)	[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]	OPTIONAL – 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

6 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.

6.1 Original IPP/1.1 Attributes

The following IPP attributes in Table 6 were originally specified as required in IPP/1.1 [RFC2911]. All of these IPP attributes are REQUIRED in IPP/2.0, IPP/2.1, and IPP/2.2 (see following sections).

Notes:

1. The required parameters for all operations and/or responses are defined in section 3.1.1 of IETF IPP/1.1 [RFC2911] and are listed below.

Table 6 - Original IPP/1.1 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]

Attribute Name	Object	Source
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

The following IPP attributes in Table 7 are REQUIRED, unless otherwise specified in notes below, in an IPP/2.0 implementation, in addition to all the IPP attributes listed in Table 6 in section 6.1 above. Note that an IPP/2.0 implementation MAY also include support for additional IPP attributes other than those specified in this list.

Notes:

1. Values of the “media” attribute that contain media size names and media type names MUST conform to [PWG5101.1] for IPP/2.0 implementations.

2. The “pages-per-minute-color” attribute is only required for IPP/2.0 implementations if the printer supports more than 1 color (i.e., the value of “color-supported” is ‘true’).

3. The “media-ready” attribute is OPTIONAL for IPP/2.0 implementations, because it often cannot be supported by remote IPP spoolers.

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 installation.

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 can’t support a requested combination, and returns the usual successful-ok-ignored-or-substituted-attributes status-code.

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468 **Table 7 - Attributes in IPP/2.0**

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 (RECOMMENDED – note 7)	Printer	[PWG5100.11]
media (note 1)	Job	[RFC2911]
media-default (note 1)	Printer	[RFC2911]
media-ready (OPTIONAL – 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 (REQUIRED for color – note 2)	Printer	[RFC2911]
print-quality (note 8)	Job	[RFC2911]
print-quality-default	Printer	[RFC2911]
print-quality-supported	Printer	[RFC2911]
printer-alert (RECOMMENDED - note 4)	Printer	[PWG5100.9]
printer-alert-description (RECOMMENDED - note 4)	Printer	[PWG5100.9]
printer-device-id (RECOMMENDED - 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 (RECOMMENDED – note 6)	All (response)	[RFC2911]

6.3 IPP/2.1 Attributes

The following IPP attributes in Table 8 are REQUIRED, unless otherwise specified in notes below, in an IPP/2.1 implementation, in addition to all the IPP attributes listed in sections 6.1 and 6.2 above. Note that an IPP/2.1 implementation MAY also include support for additional IPP attributes other than those specified in this list.

Notes:

1. The “media-col”, “media-col-default”, and “media-col-supported” attributes are REQUIRED in IPP/2.1 implementations (see note 2 below) and are normatively defined in [PWG5100.3] and only briefly described in an *example* in [RFC3382].

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 per original specification of this collection in [PWG5100.3]. Values of “media-col.media-color”, “media-col.media-size”, and “media-col.media-type” attributes MUST conform to [PWG5101.1] for IPP/2.1 implementations.

3. The “media-col-ready” attribute is OPTIONAL for IPP/2.1 implementations, because it often cannot be supported by remote IPP spoolers.

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 installation.

6. The “printer-state-reasons” attribute is REQUIRED in IPP/2.1 to support the complete mapping of prtAlertCode [RFC3805] that is defined in [PWG5100.9] for all alert code values supported in the implementation.

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.

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Table 8 - 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 (RECOMMENDED – note 9)	Printer	[PWG5100.11]
job-hold-until	Job	[RFC2911]
job-hold-until-default	Printer	[RFC2911]
job-hold-until-supported	Printer	[RFC2911]
job-ids (RECOMMENDED - note 4)	Printer (operation)	[PWG5100.11]
job-ids-supported (RECOMMENDED - 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	[RFC3382] & [PWG5100.3]
media-col-default (note 1)	Printer	[RFC3382] & [PWG5100.3]
media-col-ready (OPTIONAL – note 3)	Printer	[RFC3382] & [PWG5100.3]
media-col-supported (note 1)	Printer	[RFC3382] & [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]

Attribute Name	Object	Source
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-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 (RECOMMENDED - note 7)	Job	[PWG5100.6]
overrides-actual (RECOMMENDED - note 7)	Job	[PWG5100.6]
overrides-supported (RECOMMENDED - note 7)	Printer	[PWG5100.6]
printer-alert (note 10)	Printer	[PWG5100.9]
printer-alert-description (note 10)	Printer	[PWG5100.9]
printer-device-id (RECOMMENDED - 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 (RECOMMENDED - note 4)	Job	[PWG5100.11]
status-message (RECOMMENDED – note 8)	All (response)	[RFC2911]
which-jobs-supported (RECOMMENDED - note 4)	Printer	[PWG5100.11]

6.4 IPP/2.2 Attributes

The following IPP attributes are REQUIRED, unless otherwise specified in notes below, in an IPP/2.2 implementation, in addition to all the IPP attributes listed in sections 6.1, 6.2, and 6.3 above. Note that an IPP/2.2 implementation MAY also include support for additional IPP attributes other than those specified in this list.

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 installation.
4. The “overrides”, “overrides-actual”, and “overrides-supported” attributes [PWG5100.6] are REQUIRED in IPP/2.2.
5. The “media-col-ready” attribute is OPTIONAL for IPP/2.2 implementations, because it often cannot be supported by remote IPP spoolers.
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.

525 **Table 9 - IPP/2.2 Attributes**

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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]
media-actual	Job	[PWG5100.8]
media-col-actual	Job	[PWG5100.8]
media-col-ready (OPTIONAL – 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]

7 Conformance Requirements

7.1 IPP Printer Conformance Requirements

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

(a) support all REQUIRED IPP Operations defined in section 5 of this specification;
(b) support all REQUIRED IPP Attributes defined in section 6 of this specification;.
(c) conform to the requirements for an IPP Object specified in section 5.2 of [RFC2911];
(d) conform to the IPP Job and Printer Administrative operation requirements specified in section 11 of [RFC3998];
(e) conform to the Internationalization Considerations defined in section 9 of this specification; and
(f) 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.

7.2 IPP Client Conformance Requirements

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

(a) explicitly identify the implemented set of IPP Operations defined in section 5 of this specification;
(b) explicitly identify the implemented set of IPP Attributes defined in section 6 of this specification;
(c) conform to the requirements for an IPP Client specified in section 5.1 of [RFC2911];
(d) conform to the Internationalization Considerations defined in section 9 of this specification; and
(e) 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.

7.3 IPP over HTTP Conformance Requirements

The IPP/1.1 specification [RFC2911] requires implementation of IPP/1.1 transport over HTTP/1.1 as defined in [RFC2616]. 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:

(a) support the complete HTTP/1.1 protocol as defined in [RFC2616];
(b) support chunking as defined in section 3.6.1 of [RFC2616];
(c) support the Expect header as defined in section 5.3 of [RFC2616].

7.4 IPP over TLS Conformance Requirements

To claim conformance to this specification, an IPP Printer or IPP Client that supports TLS/1.0 [RFC2246] or later TLS specification MUST:

(a) support the HTTP Upgrade protocol as defined in [RFC2817]; and
(b) support the required minimum cipher suite for interoperability defined in the claimed TLS specification.

7.5 IPP Unsupported Attributes Conformance Requirements

The IPP/1.1 specification [RFC2911] requires that IPP Attributes received, that are not supported or not understood, must be processed according to the defined procedures, 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:

(a) 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];
(b) correctly process unsupported collection attributes as defined in section 7 in [RFC3382];
(c) correctly support reading the IPP noValue tag as a valid value for an attribute that normally would be encoded as an enum, integer, name, or keyword value tag;
(d) correctly process (or ignore) collection values as defined by [RFC3382], even if the IPP implementation does not support the collection attribute itself.

8 IANA and PWG Considerations

This section contains the exact registration information for IANA to update the procedures defined in [RFC2911].

The registry entry will contain the following information:

```
Section 9 (References)

[PWG5100.12] PWG IPP Version 2.0 Second Edition, PWG 5100.12, February 2011.
             ftp://ftp.pwg.org/pub/pwg/candidates/
                 cs-ipp20-20110214-5100.12.pdf

Section 2 (Keyword Attribute Values)

The following new keyword values are defined for the ipp-versions-supported
attribute [RFC2911]:
   '2.0':   Meets all the conformance requirements of IPP version 2.0, as
     specified in [PWG5100.12], in addition to the requirements for IPP/1.1 as
     specified in [RFC2911] and [RFC2910].
   '2.1':   Meets all the conformance requirements of IPP version 2.1, as
     specified in [PWG5100.12], in addition to the requirements for IPP 2.0 as
     specified above.
   '2.2':   Meets all the conformance requirements of IPP version 2.2, as
     specified in [PWG5100.12], in addition to the requirements for IPP 2.1 as
     specified above.

Attribute (attribute syntax)
  Keyword Attribute Value                        Reference
  -----------------------                        ---------
ipp-versions-supported                           [RFC2911]
  2.0                                            [PWG5100.12]
  2.1                                            [PWG5100.12]
  2.2                                            [PWG5100.12]
```

9 Internationalization Considerations

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

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

(a) MUST support UTF-8 as defined in [RFC3629]; and

(b) SHOULD support Network Unicode as defined in [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').

10 Security Considerations

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 required in the claimed TLS specification (summarized in the table below).

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

Table 10 - TLS Cipher Suite Requirements in IPP Versions

IPP Version	TLS Version	TLS Requirement in IPP	Mandatory TLS Cipher Suite
IPP/1.1	1.0 [RFC2246]	should per [RFC2911]	TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA
IPP/2.0	1.1 [RFC4346]	SHOULD	TLS_RSA_WITH_3DES_EDE_CBC_SHA
IPP/2.1	1.2 [RFC5246]	SHOULD	TLS_RSA_WITH_AES_128_CBC_SHA
IPP/2.2	1.2 [RFC5246]	MUST	TLS_RSA_WITH_AES_128_CBC_SHA

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Makoto "Mac" Matsuda	Brother
Joe Murdock	Sharp
Glen Petrie	Epson
Jerry Thrasher	Lexmark
Ted Tronson	Novell
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Bill Wagner	TIC
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Peter Zehler	Xerox

