

11 January 2009
Working Draft



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The Printer Working Group

The Printer Working Group (PWG)

Internet Printing Protocol Version 2.0 (IPP/2.0)

Status: Prototype Draft

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

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This specification combines all previous IPP IETF or PWG standards-track documents into a new base IPP/2.0 conformance level and defines one additional conformance level with an extended set of defined requirements. No new IPP functionality or features, beyond that included in the previous IPP extensions, is specified in this document.

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.

<ftp://ftp.pwg.org/pub/pwg/ipp/ippv2-wd/wd-ipp20-20090111.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>

Contact information:

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

IPP Web Page:

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

IPP Mailing List:

ipp@pwg.org

Instructions for subscribing to the IPP mailing list can be found at the following link:

<http://www.pwg.org/mailhelp.html>

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 release of IPP/1.1, an additional 16 IPP IETF or PWG standards-track extension specifications have been approved and published. Seven of these IPP extension specifications were published by the IETF and the remaining nine were published by the PWG.

The purpose of this document is to provide a single reference to all of the existing IPP IETF or PWG standards-track specifications and to define a new set of IPP/2.x versions that provide simple statements of the capabilities of an IPP Printer with respect to these IPP IETF or PWG standards-track extension specifications. IPP/2.x interoperable function sets are defined in section 2, Terminology below.

2 Terminology (Normative)

This section defines the following terms that are used throughout this document:

Capitalized terms, such as MUST, MUST NOT, REQUIRED, SHOULD, SHOULD NOT, MAY, NEED NOT, and OPTIONAL, have special meaning relating to conformance as defined in [RFC2119]. If an implementation supports an IPP version defined in this document, then these terms apply; otherwise, they do not. These terms define conformance to this document only; they do not affect conformance to other documents, unless explicitly stated otherwise.

IPP/2.0 – This IPP function set is targeted to an environment where a small number of users are typically physically located very close to the device. 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 function set is targeted to an environment with more users and to devices with higher speed, and higher duty cycle rating than a IPP/2.0 Printer, 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.

3 Requirements (Informative)

3.1 Rationale for IPP/2.0

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

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- Deleted: IPP/2.2 – This IPP function set definition is guided by an environment with high speed and a very high duty cycle devices compared to the IPP/2.0 and IPP/2.1. One example of this environment is a data center where jobs are centrally scheduled rather than sent ad-hoc from a group of users. This class of printer is expected to consume ... [1]
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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 16 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]
 - Document [PWG5100.5]

Some IPP Printers currently support functionality standardized in these IPP/1.1 extensions in a proprietary manner. In order to support user requirements for advanced printing functionality, there is a clear need to standardize profiles of these IPP/1.1 extensions for reliable interoperability and to encourage adoption of modern IPP-based infrastructure.

3.2 Use Models

See the [description](#) of IPP/2.0 and IPP/2.1 function sets in section 2, Terminology.

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).

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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.¶

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4 Required IPP Standards (Normative)

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This section specifies the IPP standards required at each IPP version level. Each IPP version level requires support for the complete required functionality of all lower versions (by intentional design).

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4.1 Version 1.0

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An IPP/1.0 Printer must support the following specifications.

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[RFC2565] Internet Printing Protocol/1.0: Encoding and Transport

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[RFC2566] Internet Printing Protocol/1.0: Model and Semantics

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4.2 Version 1.1

The IPP/1.1 protocol specifications supersede and obsolete the IPP/1.0 protocol specifications. An IPP/1.1 Printer must support the following specifications.

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

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

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[RFC3510] Internet Printing Protocol: IPP URL Scheme

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RFC 3510... (April 2003) ... [6]

4.3 Version 2.0

An IPP/2.0 Printer MUST support the IPP specifications required for IPP/1.1 plus the following.

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

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[PWG5100.2] Internet Printing Protocol: "output-bin" attribute extension (February 2001)

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[PWG5101.1] PWG Standard for Media Size Names

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4.4 Version 2.1

An IPP/2.1 Printer MUST support the IPP specifications required for IPP/2.0 plus the following.

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

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[RFC3381] Internet Printing Protocol: Job Progress Attributes

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[RFC3382] The 'collection' Attribute Syntax

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[RFC3995] Internet Printing Protocol: Event Notifications and Subscriptions

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

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

Deleted: ... (March 2005) ... [16]

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

Deleted: ... (October 2003) ... [17]

[PWG5100.7] Internet Printing Protocol: Job Extensions

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The IPP/2.2 printer shall support the IPP specifications defined for IPP/2.1 plus the following.¶
PWG 5100.3 Internet Printing Protocol: Production Printing Attributes – Set 1 (February 2001)¶
PWG 5100.5 Internet Printing Protocol: Document Object (October 2003)¶
PWG 5100.6 Internet Printing Protocol: Page Overrides (October 2003)¶
PWG 5100.8 Internet Printing Protocol: "actual" Attributes (March 2003)¶

[PWG510x.y] Internet Printing Protocol: Printer State Extensions (TBD)

[[[PWG Secretary – replace with assigned number and approval date after IPP PSX is approved]]]

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5 Required IPP Operations (Normative)

IPP/2.0 and IPP2.1 specify higher conformance requirements for the IPP Operations defined in the various previous IPP specifications. Many IPP Operations were defined in their source specifications as optional and, if they remained optional in this specification, the desired interoperability objective would not be achieved. Therefore, this section specifies the conformance requirements for each previously optional IPP Operation based upon the associated IPP/2.x version.

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5.1 Original Required Operations

The following IPP Operations were originally specified as required in their respective defining documents. For IPP/2.x implementations, these operations MUST also be implemented if the defining specification is included in the specific IPP/2.x version implemented.

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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]
0x0016	Create-Printer-Subscriptions	[RFC3995]
0x0018	Get-Subscription-Attributes	[RFC3995]
0x0019	Get-Subscriptions	[RFC3995]
0x001A	Renew-Subscription	[RFC3995]
0x001B	Cancel-Subscription	[RFC3995]
0x001C	Get-Notifications	[RFC3996]
0x0033	Cancel-Document	[PWG5100.5]
0x0034	Get-Document-Attributes	[PWG5100.5]
0x0035	Get-Documents	[PWG5100.5]

5.2 Version 2.0 Operations

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

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Code	Operation Name	Source	Support
0x0002	Print-Job	[RFC2911]	REQUIRED
0x0003	Print-URI	[RFC2911]	OPTIONAL
0x0004	Validate-Job	[RFC2911]	REQUIRED
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	[RFC2911]	OPTIONAL
0x0010	Pause-Printer	[RFC2911]	OPTIONAL
0x0011	Resume-Printer	[RFC2911]	OPTIONAL
0x0012	Purge-Jobs	[RFC2911]	OPTIONAL

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5.3 Version 2.1 Operations

The following IPP Operations are included in their respective defining documents. The conformance requirements for each IPP Operation in an IPP/2.1 implementation is defined below. Note that an IPP/2.1 implementation MAY also include support for additional IPP operations other than specified in this list.

Code	Operation Name	Source	Support
0x0002	Print-Job	[RFC2911]	REQUIRED
0x0003	Print-URI	[RFC2911]	OPTIONAL
0x0004	Validate-Job	[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	[RFC2911]	REQUIRED
0x0010	Pause-Printer	[RFC2911]	REQUIRED
0x0011	Resume-Printer	[RFC2911]	REQUIRED
0x0012	Purge-Jobs	[RFC2911]	REQUIRED
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
0x0024	Pause-Printer-After-Current-Job	[RFC3998]	OPTIONAL
0x0025	Hold-New-Jobs	[RFC3998]	OPTIONAL
0x0026	Release-Held-New-Jobs	[RFC3998]	OPTIONAL
0x0027	Deactivate-Printer	[RFC3998]	OPTIONAL
0x0028	Activate-Printer	[RFC3998]	OPTIONAL
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

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6 Conformance Requirements (Normative)

6.1 IPP Printer Conformance Requirements

To claim conformance to this specification, an IPP Printer implementation MUST support all REQUIRED IPP Operations (see section 5) and associated REQUIRED IPP Attributes (see section 11) specified for the claimed IPP 2.0 or 2.1 version in this specification. In addition, the IPP Printer implementation MUST comply with the conformance requirements for an IPP Object specified in section 5.2 of [RFC2911]. In addition, the IPP Printer implementation MUST conform to the IPP Job and Printer Administrative operation requirements, specified in section 11 of [RFC3998]. In addition, the IPP Printer implementation MUST conform to the Internationalization Considerations (see section 8) and Security Considerations (see section 9) defined in this specification.

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The following IPP Operations are included in the defining docu... [80]

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6.2 IPP Client Conformance Requirements

To claim conformance to this specification, an IPP Client MUST explicitly identify the set of IPP Operations (see section 5) and associated IPP Attributes (see section 11) included in the implementation. In addition, the IPP Client implementation MUST comply with conformance requirements for an IPP Client specified in section 5.1 of [RFC2911]. In addition, the IPP Client implementation MUST conform to the Internationalization Considerations (see section 8) and Security Considerations (see section 9) defined in this specification.

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6.3 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]. Some IPP implementations historically 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.

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To claim compliance with either IPP/2.0 or IPP/2.1, an IPP Printer or IPP Client implementation MUST support the complete HTTP/1.1 protocol as defined in [RFC2616], including chunking as defined in section 3.6.1 of [RFC2616] and the Expect header as defined in section 5.3 of [RFC2616].

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In addition, IPP/2.0 or IPP/2.1 implementations that support TLS/1.0 [RFC2246] or later TLS specification MUST support the HTTP Upgrade protocol as defined in [RFC2817].

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6.4 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. Some IPP implementations historically have not conformed to this requirement, causing communication problems and failed IPP printing operations.

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To claim compliance with either IPP/2.0 or IPP/2.1, an IPP Printer or IPP Client implementation MUST correctly process attributes, values, or groups that are not supported per [RFC2911], 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, including collection attributes as defined in [RFC3382], section 7.

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For example, IPP/2.0 or IPP/2.1 implementations MUST 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. Similarly, IPP/2.0 or IPP/2.1 implementations MUST correctly process (or ignore) collection values as defined by [RFC3382], even if the IPP implementation does not support the media-col attribute itself.

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7 IANA and PWG Considerations (Normative)

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

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 PWG 51XX.X, 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 PWG 51XX.X, in addition to the requirements for IPP 2.0 as specified above.

NOTE TO PWG Secretary: When this document is published, replace 51XX.X with the PWG document number assigned to this specification.

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8 Internationalization Considerations **(Normative)**

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

For interoperability and best practice support for multiple languages, IPP/2.0 conforming Printer implementations SHOULD support Network Unicode [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).

NOTE WELL - 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').

9 Security Considerations **(Normative)**

For interoperability and **increased** security, the required TLS support and mandatory cipher suite for each IPP version is **specified below**:

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Version	TLS Version	TLS Requirement	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

10 References

10.1 Normative References

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[PWG5100.1]

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Hypertext Transfer Protocol -- HTTP/1.1. R. Fielding, J. Gettys, J. Mogul, H. Frystyk, L. Masinter, P. Leach, T. Berners-Lee, [RFC 2616](#), June 1999.

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[RFC3196]

T. Hastings, C. Manros, K. Kugler, H. Holst, P. Zehler, "Internet Printing Protocol/1.1: Implementor's Guide", RFC 3196, November, 2001.
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11 Required IPP Attributes (Normative)

This section specifies the IPP attributes that MUST also be implemented for conformance to each of the IPP/2.x levels and also provides a summary of the IPP/1.1 required attributes.

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11.2 Version 2.0 Attributes

The following IPP Attributes **MUST** be supported by IPP/2.0 Printer implementations, in addition to all the IPP Attributes listed in section 11.1 above. Note that an IPP/2.0 implementation may also include support for additional IPP Attributes other than those specified in this list.

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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]
orientation-requested	Job	[RFC2911]
orientation-requested-default	Printer	[RFC2911]
orientation-requested-supported	Printer	[RFC2911]
output-bin	Job	[PWG5100.2]
media (note 1)	Job	[RFC2911]
media-default (note 1)	Printer	[RFC2911]
media-supported (note 1)	Printer	[RFC2911]
pages-per-minute	Printer	[RFC2911]
pages-per-minute-color (note 2)	Printer	[RFC2911]
print-quality	Job	[RFC2911]
print-quality-default	Printer	[RFC2911]
print-quality-supported	Printer	[RFC2911]
printer-info	Printer	[RFC2911]
printer-location	Printer	[RFC2911]
printer-make-and-model	Printer	[RFC2911]
printer-more-info	Printer	[RFC2911]
printer-resolution	Job	[RFC2911]
printer-resolution-default	Printer	[RFC2911]
printer-resolution-supported	Printer	[RFC2911]
sides	Job	[RFC2911]
sides-default	Printer	[RFC2911]
sides-supported	Printer	[RFC2911]

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Notes:

- Media names **MUST** conform to [PWG5101.1] for IPP/2.0 implementations.
- The pages-per-minute-color, 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').

11.3 Version 2.1 Attributes

The following IPP Attributes **MUST** be supported by IPP/2.1 implementations, in addition to all the IPP Attributes listed in sections 11.1 and 11.2 above. Note that an IPP/2.1 implementation may also include support for additional IPP Attributes other than those specified in this list.

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Attribute Name	Object	Source
compression-supplied	Job	[PWG5100.7]
ippget-event-life	Printer	[RFC3996]
job-hold-until	Job	[RFC2911]
job-hold-until-default	Printer	[RFC2911]
job-hold-until-supported	Printer	[RFC2911]
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	operation	[RFC2911]
media-col	Job	[RFC3382] & [PWG5100.3]
media-col-default	Printer	[RFC3382] & [PWG5100.3]
media-col-ready	Printer	[RFC3382] & [PWG5100.3]
media-col-supported	Printer	[RFC3382] & [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	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	operation	[RFC3996]
notify-subscribed-event	Subscription	[RFC3995]
notify-subscriber-user-name	Subscription	[RFC3995]
notify-subscription-id	Subscription	[RFC3995]
notify-subscription-ids	operation	[RFC3996]
notify-text	Subscription	[RFC3995]
notify-time-interval	Subscription	[RFC3995]
notify-user-data	Subscription	[RFC3995]
notify-wait	operation	[RFC3996]
output-device-assigned	Job	[RFC3998]
printer-alert	Printer	[PWG510x.y]

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printer-alert-description	Printer	[PWG510x.y]
printer-settable-attributes-supported	Printer	[RFC3380]
printer-state-change-time	Printer	[RFC3995]
printer-state-reasons	Printer	[RFC2911] & [PWG510x.y]

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12 Editors' Addresses (Informative)

Ron Bergman

Formerly at Ricoh Americas Corporation
Original principal editor of this specification through November 2008

Harry Lewis

InfoPrint Solutions Company
6300 Diagonal Highway
Boulder, CO 80301
Phone: 303-924-5337
Email: harryl@us.ibm.com

Ira McDonald

High North
PO Box 221
Grand Marais, MI 49839
Phone: 906-494-2434
Email: blueroofmusic@gmail.com

Michael R. Sweet

Apple Computer
1 Infinite Loop, MS 302-3PG
Cupertino, CA 95014
Phone: 408-974-8798
Email: msweet@apple.com

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

- [Shah Bhatti](#) [Samsung](#)
- [Lee Farrell](#) [Canon](#)
- [Glen Petrie](#) [Epson](#)
- [Jerry Thrasher](#) [Lexmark](#)
- [Ted Tronson](#) [Novell](#)
- [Paul Tykodi](#) [TCS](#)
- [Bill Wagner](#) [TIC](#)
- [Dave Whitehead](#) [Lexmark](#)
- [Craig Whittle](#) [Sharp](#)
- [Peter Zehler](#) [Xerox](#)

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The following IPP Attributes are required to be supported for IPP/2.2, in addition to all the attributes listed in paragraph 11.1 as required for IPP/1.1 implementations and all the attributes listed in paragraph 11.2 as required for IPP/2.0 implementations plus all the attributes listed in paragraph 11.3 as required for IPP/2.1 implementations. Note that an IPP/2.2 implementation may also include support for additional IPP Attributes other than those specified in this list.¶

Attribute Name ... [87]

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Deleted: Simi Valley, CA 93065 e-mail: Ron.Bergman@ricoh-usa.com

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13 Appendix X Document Revisions (Informative)

[PWG Secretary: This section must be removed when this document is approved!]

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A. Changes made to create 11 January, 2009 version

- Global – Corrected English usage and sentence structure throughout this specification
- Global – Added “(Normative)” or “(Informative)” to each major section title for clarity

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Global – Deleted all content for IPP/2.2 in all sections (to be added to a second edition of this specification) per discussion at PWG F2F in December 2008

Global – Corrected all normative keywords to uppercase (shall or must to MUST, should to SHOULD, may to MAY, required to REQUIRED, optional to OPTIONAL, etc.) per discussion at PWG F2F in December 2008

Global – Changed all “RFC 2911” to “[RFC2911]”, etc., per comments from Bill Wagner

Global – Changed all “IPP printer” (lowercase) to “IPP Printer” (capitalized) per IPP standard naming conventions

Global – Changed all “current IPP specifications” to “[previous/original] IPP specifications” as appropriate (because, when approved, *this* document will be a current IPP spec)

Global – Deleted all references to PWG 5100.6 and PWG 5100.8 (only applicable to IPP/2.2, to be added to a second edition of this specification) per discussion at PWG F2F in December 2008

Global – Added requirements and references for [PWG510x.y] (IPP PSX), per discussion at PWG F2F in December 2008

Cover Page – Changed document status from “Interim” to “Prototype” per PWG Process

Abstract – Clarified several sentences for accuracy

Section 1 – Clarified several sentences for accuracy

Section 6 – Added explicit normative conformance references to sections 5, 8, 9, and 11 per discussion at PWG F2F in December 2008

Section 11.3 – Added “printer-state-reasons” (new values), “printer-alert”, and “printer-alert-description” to IPP/2.1 Required Attributes per discussion at PWG F2F in December 2008

B. Changes made to create November 18, 2008 version

Changed document filename per PWG naming conventions

Global - Changed “IPV2.0” to “IPP/2.0”, etc., per IPP standard naming conventions

Global - Many small editorial changes for readability and English usage

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C. Changes made to create October 22, 2008 version

Section 6.1: Changed “1.2” to “2.1”.

Section 11: Added “...” and also provides a reference to the currently required version 1.1 attributes.”
Added an “Object” column to all tables in this section.

Section 11.2: Added “output-bin” entry.

Section 11.3: Added “output-device-assigned” and “printer-state-change-time”

Section 11.4: Added “copies-actual”, “document-format-detected”, “document-format-supplied”, “document-message”, “document-message-supplied”, “document-name”, “document-name-supplied”, “finishings-actual”, “job-hold-until-actual”, “job-priority-actual”, “job-sheets-actual”, “media-actual”, “media-col-actual”, “multiple-document-handling-actual”, “number-up-actual”, “output-bin-actual”, “orientation-requested-actual”, “overrides-actual”, “overrides-supported”, “page-ranges-actual”, “print-quality-actual”, “printer-resolution-actual”, and “sides-actual”.

Section 11.4: Changed “2.1” to “2.2”. Changed “document-job-url” to “document-job-uri”.

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D. Changes made to create October 10, 2008 version

Section 6.1: Added “ Also, IPPv1.2 and IPP/2.2 must conform to the Job and Printer Administrative operations requirements, as specified in [RFC3998] section 11.”

Section 7: Changed “ipp_versions_supported” to “ipp-versions-supported”
Changed “RFC EDITOR” to PWG Secretary”

Section 9: Revised to show requirements as a table. Restored requirements for IPP/1.1 removed in last update (9/29/2008)..

Section 11: Major changes

- Section 11.1 changed to apply to IPP/1.1, text modified, no changes to table.
- Section 11.2 New section for IPP/2.0.
- Section 11.3 was 11.2, text modified and new entries added to table.
- Section 11.4 was 11.3, text modified and new entries added to table.

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E. Changes made to create September 29, 2008 version

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Section 6: Moved 6.1 to 6.4, moved 6.2 to 6.3, added new sections 6.1 and 6.2

In 6.3 and 6.4, changed "current IPP" to "IPP/1.1".

Section 7: Replaced "this document" with "PWG 51XX.X" in three places. Added: " NOTE TO RFC EDITOR: When this document is published, replace 51XX.X with the PWG ISTO document number assigned to this specification."

Section 8: Replaced "For interoperability and basic support for multiple languages, IPP/1.1 conforming Printer implementations MUST support..."
With " IPP/1.1 [RFC2911] requires conforming Printer implementations to support..."

Section 9: Deleted " For interoperability and basic support for security, IPP/1.1 conforming Printer implementations SHOULD support TLS/1.0 [RFC2246] with a mandatory cipher suite of TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA."

Section 10.1: Reordered entries to maintain alphabetical/numeric order.

Section 11 Required Attributes: New section. Renumbered remaining sections

F. Changes made to create September 19, 2008 version

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Section 7 Added:

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 this document, in addition to the requirements for IPP/1.1 as specified in ~~[RFC2911]~~ [RFC2911] and RFC 2910 [RFC2910].

Deleted: RFC 2911

'2.1': Meets all the conformance requirements of IPP version 2.1, as specified in this document, 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 this document, in addition to the requirements for IPP 2.1 as specified above.

Section 8 Added:

For interoperability and basic support for multiple languages, IPP/1.1 conforming Printer implementations MUST support the UTF-8 [RFC3629] encoding of Unicode [UNICODE] [ISO10646].

For interoperability and best practice support for multiple languages, IPP/2.0 conforming Printer implementations SHOULD support Network Unicode [RFC5198] - which REQUIRES transmission of well-formed UTF-8 strings and RECOMMENDS transmission of normalized UTF-8 strings in Normalization Form C (NFC) [UAX15].

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).

NOTE WELL - 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').

Section 8 Removed:

In addition to the internationalization requirements in the referenced IPP specifications, it is strongly recommended the inclusion of Network Unicode [RFC5198] to provide support of multiple languages." Was " This document presents no internationalization considerations for IPP implementations beyond those covered in the referenced IPP Specifications."

Section 9 Added:

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For interoperability and basic support for security, IPP/1.1 conforming Printer implementations SHOULD support TLS/1.0 [RFC2246] with a mandatory cipher suite of LS_DHE_DSS_WITH_3DES_EDE_CBC_SHA.

For interoperability and better support for security, IPP/2.0 conforming Printer implementations SHOULD support TLS/1.1 [RFC4346] with a mandatory cipher suite of TLS_RSA_WITH_3DES_EDE_CBC_SHA.

For interoperability and best practice for security, IPP/2.1 conforming Printer implementations SHOULD support TLS/1.2 [RFC5246] with a mandatory cipher suite of TLS_RSA_WITH_AES_128_CBC_SHA.

For interoperability and best practice for security, IPP/2.2 conforming Printer implementations MUST support TLS/1.2 [RFC5246] with a mandatory cipher suite of TLS_RSA_WITH_AES_128_CBC_SHA.

Section 10 Added:

[ISO10646] "Information Technology - Universal Multiple-octet Coded Character Set (UCS)", ISO/IEC Standard 10646, 2006.

[RFC2246] T.Dierks, C. Allen, "Transport Layer Security 1.0", RFC 2246, January 1999, http://www.ietf.org/rfc/rfc2246.txt

[RFC3629] F. Yergeau, "UTF-8 Transformation of ISO 10646", RFC 3629, November 2003, http://www.ietf.org/rfc/rfc3629.txt

[RFC4346] T.Dierks, E. Rescorla, "Transport Layer Security 1.1", RFC 4346, April 2006, http://www.ietf.org/rfc/rfc4346.txt

[RFC5246] T.Dierks, E. Rescorla, "Transport Layer Security 1.2", RFC 5246, August 2008, http://www.ietf.org/rfc/rfc5246.txt

[UAX15] M. Davis, M. Duerst, "Unicode Normalization Forms", Unicode Standard Annex 15, March 2008, http://www.unicode.org/reports/tr15/

[UNICODE] M. Davis, et al, "Unicode Standard v5.1.0", Unicode Standard, April 2008, http://www.unicode.org/versions/Unicode5.1.0/

G. Changes made to create August 27, 2008 version.

Section 6.3: Removed entire section

Section 10: Removed references for [JFIF], [RFC2083], [PWG 5102.3], and [X-PRINT].

H. Changes made to create August 15, 2008 version.

Removed references to "Simple Workgroup Printer", "Enterprise Printer", and "Production Printer". Where appropriate these names were changed to "IPP/2.0", "IPP/2.1", and "IPP/2.2" respectively.

I. Changes made to create August 6, 2008 version.

Changed format of document location to conform to the PWG Process Specification.

Updated the Table Of Contents.

A global replacement of "Work Group" with "Workgroup".

Section 3 Added 3.1 Rational and 3.2 Use Models text.

Section 4.4 Added "[RFC3382] The 'collection' Attribute Syntax (September 2002)". Also, corrected publication dates for [RFC3380], [RFC3381], [RFC3996], and [RFC3998].

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Deleted: RFC 3382

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Section 5.2 Added " Note that a V2.0 implementation may also include support for additional IPP operations other than specified in this list."

Section 5.3 Added " Note that a V2.1 implementation may also include support for additional IPP operations other than specified in this list."

Section 6 Renamed "Conformance Requirements" was "IPv2 Protocol Addenda"

Current text in section 6 added to Section 6.1

Section 6.1 " Many implementations historically have not conformed to this requirement, causing communication problems and failed printing." was " It has been reported that many implementations do not conform to this requirement, which can result in problems with the host side communication processes."

Section 6.1 Added to end of second paragraph "..., including collection attributes as defined in [RFC3382](#), section 7."

Deleted: RFC 3382

Section 6.1 Added third paragraph " For example, implementations MUST 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. Similarly, implementations MUST correctly process (or ignore) collection values as defined by [RFC3382](#), even if the implementation does not support the media-col attribute itself."

Deleted: RFC 3382

Added Section 6.2 and 6.3.

Added Section 7 IANA and PWG Considerations (The remaining sections have been renumbered.)

Section 8 (was section 7): " In addition to the internationalization requirements in the referenced IPP specifications, it is strongly recommended the inclusion of Network Unicode [RFC5198] to provide support of multiple languages." Was " This document presents no internationalization considerations for IPP implementations beyond those covered in the referenced IPP Specifications."

Section 10: Added references for [JFIF], [RFC2083], [RFC2616], [RFC2817], [RFC5198], [PWG 5102.3], and [X-PRINT].

J. Changes made to create July 18, 2008 version.

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Abstract: Added "queries to the [IPP Printer](#)." to complete the last sentence in the abstract.

Deleted: IPP printer

Section 5.1: Removed "Create Job Subscriptions" (code = 0x0017) from table (an optional OP).

Section 5.2: Added all operations that are applicable to the specifications required for IPP/2.0.

Section 5.3: Added all operations that are applicable to the specifications required for IPP/2.1.

Section 5.4: Added all operations that are applicable to the specifications required for IPP/2.2.

Section 6: " are to be processed according to the defined procedures," was "are to be "gracefully" processed"

Section 6: " per [RFC2911](#), 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." was "per (TBD add reference)."

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IPP/2.2 – This IPP function set definition is guided by an environment with high speed and a very high duty cycle devices compared to the IPP/2.0 and IPP/2.1. One example of this environment is a data center where jobs are centrally scheduled rather than sent ad-hoc from a group of users. This class of printer is expected to consume significantly more supplies such as paper, toner, etc, and memory capacity than the other classes.

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5.4 Version 2.2 Operations

The following IPP Operations are included in the defining documents for IPP/2.2. The required support for each IPP Operation in a V2.2 implementation is defined as follows.

Code	Operation Name	Source	Support
0x0002	Print-Job	RFC 2911	required
0x0003	Print-URI	RFC 2911	optional
0x0004	Validate-Job	RFC 2911	required
0x0005	Create-Job	RFC 2911	required
0x0006	Send-Document	RFC 2911	required
0x0007	Send-URI	RFC 2911	optional
0x0008	Cancel-Job	RFC 2911	required
0x0009	Get-Job-Attributes	RFC 2911	required
0x000A	Get-Jobs	RFC 2911	required
0x000B	Get-Printer-Attributes	RFC 2911	required

0x000C	Hold-Job	RFC 2911	required
0x000D	Release-Job	RFC 2911	required
0x000E	Restart-Job	RFC 2911	required
0x0010	Pause-Printer	RFC 2911	required
0x0011	Resume-Printer	RFC 2911	required
0x0012	Purge-Jobs	RFC 2911	required
0x0013	Set-Printer-Attributes	RFC 3380	required
0x0014	Set-Job-Attributes	RFC 3380	required
0x0015	Get-Printer-Supported-Values	RFC 3380	required
0x0016	Create-Printer-Subscriptions	RFC 3995	required
0x0017	Create-Job-Subscriptions	RFC 3995	optional
0x0018	Get-Subscription-Attributes	RFC 3995	required
0x0019	Get-Subscriptions	RFC 3995	required
0x001A	Renew-Subscription	RFC 3995	required
0x001B	Cancel-Subscription	RFC 3995	required
0x001C	Get-Notifications	RFC 3995	required
0x0022	Enable-Printer	RFC 3998	required
0x0023	Disable-Printer	RFC 3998	required
0x0024	Pause-Printer-After-Current-Job	RFC 3998	required
0x0025	Hold-New-Jobs	RFC 3998	required
0x0026	Release-Held-New-Jobs	RFC 3998	required
0x0027	Deactivate-Printer	RFC 3998	required
0x0028	Activate-Printer	RFC 3998	required
0x0029	Restart-Printer	RFC 3998	required
0x002A	Shutdown-Printer	RFC 3998	required
0x002B	Startup-Printer	RFC 3998	required
0x002C	Reprocess-Job	RFC 3998	optional
0x002D	Cancel-Current-Job	RFC 3998	required
0x002E	Suspend-Current-Job	RFC 3998	required
0x002F	Resume-Job	RFC 3998	required
0x0030	Promote-Job	RFC 3998	required
0x0031	Schedule-Job-After	RFC 3998	required
0x0033	Cancel-Document	PWG 5100.5	required
0x0034	Get-Document-Attributes	PWG 5100.5	required
0x0035	Get-Documents	PWG 5100.5	required
0x0036	Delete-Document	PWG 5100.5	required
0x0037	Set-Document-Attributes	PWG 5100.5	required

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IPP/2.2	1.2 [RFC5246]	MUST	TLS_RSA_WITH_AES_128_CBC_SHA
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are required to be supported for

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are

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required to

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for

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a

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paragraph

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as required for IPP/1.1 implementations

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are to

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be as specified in

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This attribute

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only

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for

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paragraph

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as required for IPP/1.1 implementations and all the attributes listed in paragraph 11.2 as required for IPP/2.0 implementations

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11.4 Version 2.2 Attributes

The following IPP Attributes are required to be supported for IPP/2.2, in addition to all the attributes listed in paragraph 11.1 as required for IPP/1.1 implementations and all the attributes listed in paragraph 11.2 as required for IPP/2.0 implementations plus all the attributes listed in paragraph 11.3 as required for IPP/2.1 implementations. Note that an IPP/2.2 implementation may also include support for additional IPP Attributes other than those specified in this list.

Attribute Name	Object	Source
copies-actual	Job	PWG 5100.8
document-job-id	Document	PWG 5100.5
document-job-uri	Document	PWG 5100.5
document-format-detected	Document	PWG 5100.5
document-format-supplied	Job	PWG 5100.7
document-message	Document	PWG 5100.7
document-message-supplied	Job	PWG 5100.7
document-name	Document	PWG 5100.7
document-name-supplied	Job	PWG 5100.7
document-number	Document	PWG 5100.5
document-printer-uri	Document	PWG 5100.5
document-state	Document	PWG 5100.5
document-state-reasons	Document	PWG 5100.5
finishings-actual	Job	PWG 5100.8
job-mandatory-attributes	Job	PWG 5100.5
job-hold-until-actual	Job	PWG 5100.8
job-priority-actual	Job	PWG 5100.8
job-sheets-actual	Job	PWG 5100.8
media-actual	Job	PWG 5100.8
media-col-actual	Job	PWG 5100.8
multiple-document-handling	Job	PWG 5100.5
multiple-document-handling-actual	Job	PWG 5100.8
multiple-document-jobs-supported	Printer	RFC 2911
number-of-documents	Job	PWG 5100.5
number-up	Job	RFC 2911
number-up-actual	Job	PWG 5100.8
number-up-default	Printer	RFC 2911
number-up-supported	Printer	RFC 2911
output-bin-actual	Job	PWG 5100.8
orientation-requested-actual	Job	PWG 5100.8
overrides	Job	PWG 5100.6
overrides-actual	Job	PWG 5100.6
overrides-supported	Printer	PWG 5100.6
page-ranges	Job	RFC 2911
page-ranges-actual	Job	PWG 5100.8
page-ranges-supported	Printer	RFC 2911
print-quality-actual	Job	PWG 5100.8
printer-message-from-operator	Printer	RFC 2911
printer-resolution-actual	Job	PWG 5100.8
sides-actual	Job	PWG 5100.8

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Dave Whitehead Lexmark
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Lee Farrell
Glen Petrie
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