The Printer Working Group

The Printer Working Group (PWG)

Internet Printing Protocol Version 2
(IPPv2.X)

Status: Interim Draft

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/ISTO Specifications. Most current 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, very few of the extensions have been implemented.

This specification pulls together all current IPP documents into a new base 2 revision level and defines three conformance levels with an increasing set of defined functions. No IPP functionality or features, beyond that included in the current IPP extensions, is specified in this document.

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

About the IEEE-ISTO

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About the IEEE-ISTO PWG

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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> 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.

Table of Contents

Page 4 of 4

1 Introduction

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], followed in September 2000. Since the release of IPP 1.1, an additional 15 IPP extension specifications have been published. Seven of these extension specifications were published by the IETF and the remaining eight were published as PWG/ISTO specifications.

The purpose of this document is to provide a single reference to all the existing IPP specifications and to define a new set of IPP versions to provide a simple reference to the capabilities of an IPP printer relative to the support of the printer to the IPP extension specifications. The classification of interoperable function sets are defined in section 2, Terminology.

2 Terminology

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 RFC 2119 [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.

IPPv2.0 – This IPP function set definition is guided by an environment where a small number of users are normally physically located very close to the device. The device is typically a low speed printer or MFD with a limited feature set geared 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 printer for special jobs, such as the need for a unique paper size or color, is also handled by the user requiring the configuration.

IPPv2.1 – This IPP function set definition is guided by an environment with more users, and devices with higher speed, and higher duty cycle rating than a IPPv2.0 Printer, but the primary difference is in the features, location, and maintenance of the device. A IPPv2.1 printer is normally located in a central location with most users not physically close. The user's access to the printer may be limited and maintenance is only performed by assigned personnel. Features such as paper size and type are normally fixed and not easily modified for special use. IPPv2.1 printers tend to have more post-processing features, such as punching, folding, stapling, etc., than IPPv2.0 printers.

IPPv2.2 – This IPP function set definition is guided by an environment with high speed and a very high duty cycle devices compared to the IPPv2.0 and IPPv2.1. 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.

3 Requirements

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

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 14 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]

Current printers often 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 IPP-based infrastructure.

3.2 Use Models

See the guiding principles of IPPv2.0, IPPv2.1, and IPPv2.2 function sets in section 2, Terminology.

3.2.1. IPPv2.0 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. And they print lots of thumbnails of graphic images - they need standard IPP document formats.

3.2.2. IPPv2.1 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. IPPv2.2 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.

4 IPP Standards

This section defines the IPP standards supported at each IPP version level. Each version level must support the complete required functionality of all lower versions.

4.1 Version 1.0

RFC 2565 Internet Printing Protocol/1.0: Encoding and Transport (April 1999)

RFC 2566 Internet Printing Protocol/1.0: Model and Semantics (April 1999)

4.2 Version 1.1

The version 1.1 documents supersede and obsolete the IPP version 1.0 protocol specifications.

RFC 2910 Internet Printing Protocol/1.1: Encoding and Transport (September 2000)

RFC 2911 Internet Printing Protocol/1.1: Model and Semantics (September 2000)

RFC 3510 Internet Printing Protocol: IPP URL Scheme (April 2003)

4.3 Version 2.0

The IPPv2.0 printer shall support the IPP specifications defined for IPPv1.1 plus the following.

PWG 5100.1 Internet Printing Protocol: "finishings" attribute values extension (February 2001)

PWG 5100.2 Internet Printing Protocol: "output-bin" attribute extension (February 2001)

PWG 5101.1 PWG Standard for Media Size Names (February 2002)

4.4 Version 2.1

The IPPv2.1 printer shall support the IPP specifications defined for IPPv2.0 plus the following.

RFC 3380 Internet Printing Protocol: Job and Printer Set Operations (September 2002)

RFC 3381 Internet Printing Protocol: Job Progress Attributes (September 2002)

RFC 3382 The 'collection' Attribute Syntax (September 2002)

RFC 3995 Internet Printing Protocol: Event Notifications and Subscriptions (March 2005)

RFC 3996 Internet Printing Protocol: The 'ippget' Delivery Method for Event Notifications (March 2005)

RFC 3998 Internet Printing Protocol: Job and Printer Administrative Operations (March 2005)

PWG 5100.7 Internet Printing Protocol: Job Extensions (October 2003)

4.5 Version 2.2

The IPPv2.2 printer shall support the IPP specifications defined for IPPv2.1 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)

5 IPP Operations

IPP version 2.X also defines specific support requirements for the IPP Operations defined in the various IPP specifications. Many IPP Operations are currently defined in their source specifications as optional and, if they were to remain optional, the desired interoperability would not be achieved. This section defines the support requirements for each currently optional IPP Operation based upon the associated group.

5.1 Current Required Operations

The following IPP Operations are specified as required in their respective defining documents. For IPPv2.X implementations, these operations shall also be required if the defining specification is included in the specific 2.X version implemented.

Code	Operation Name	Source
0x0002	Print-Job	RFC 2911
0x0004	Validate-Job	RFC 2911
0x0008	Cancel-Job	RFC 2911
0x0009	Get-Job-Attributes	RFC 2911
0x000A	Get-Jobs	RFC 2911
0x000B	Get-Printer-Attributes	RFC 2911
0x0016	Create-Printer-Subscriptions	RFC 3995
0x0018	Get-Subscription-Attributes	RFC 3995
0x0019	Get-Subscriptions	RFC 3995
0x001A	Renew-Subscription	RFC 3995
0x001B	Cancel-Subscription	RFC 3995
0x001C	Get-Notifications	RFC 3996
0x0033	Cancel-Document	PWG 5100.5
0x0034	Get-Document-Attributes	PWG 5100.5
0x0035	Get-Documents	PWG 5100.5

5.2 Version 2.0 Operations

The following IPP Operations are included in the defining documents for IPPv2.0. The required support for each IPP Operation in a V2.0 implementation is defined as follows. Note that a V2.0 implementation may also include support for additional IPP operations other than specified in this list.

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	optional
0x0006	Send-Document	RFC 2911	optional
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	optional
0x000D	Release-Job	RFC 2911	optional
0x000E	Restart-Job	RFC 2911	optional
0x0010	Pause-Printer	RFC 2911	optional
0x0011	Resume-Printer	RFC 2911	optional
0x0012	Purge-Jobs	RFC 2911	optional

5.3 Version 2.1 Operations

The following IPP Operations are included in the defining documents for IPPv2.1. The required support for each IPP Operation in a V2.1 implementation is defined as follows. Note that a V2.1 implementation may also include support for additional IPP operations other than specified in this list.

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	optional
0x0025	Hold-New-Jobs	RFC 3998	optional
0x0026	Release-Held-New-Jobs	RFC 3998	optional
0x0027	Deactivate-Printer	RFC 3998	optional
0x0028	Activate-Printer	RFC 3998	optional
0x0029	Restart-Printer	RFC 3998	optional
0x002A	Shutdown-Printer	RFC 3998	optional
0x002B	Startup-Printer	RFC 3998	optional
0x002C	Reprocess-Job	RFC 3998	optional
0x002D	Cancel-Current-Job	RFC 3998	optional
0x002E	Suspend-Current-Job	RFC 3998	optional
0x002F	Resume-Job	RFC 3998	optional
0x0030	Promote-Job	RFC 3998	optional
0x0031	Schedule-Job-After	RFC 3998	optional

5.4 Version 2.2 Operations

The following IPP Operations are included in the defining documents for IPPv2.2. 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

6 Conformance Requirements

6.1 Printer Conformance Requirements To claim conformance to this specification, a printer vendor MUST support all IPP Operations and the associated Attributes specified as required for the indicated IPP 2.0, 2.1, or 2.2 version. In addition, the implementation MUST comply with the conformance requirement for an IPP Object, as specified in [RFC2911] section 5.2.

6.2 Client Conformance Requirements

To claim conformance to this specification, a client vendor MUST explicitly identify the IPP Operations and the associated Attributes included in the implementation. In addition, the implementation MUST comply with conformance requirement for an IPP CLient, as specified in [RFC2911] section 5.1.

6.3 HTTP Conformance

The IPPv1.1 specification [RFC2911] requires transport over HTTP/1.1 as defined in RFC 2616. Many implementations historically have not used a HTTP/1.1 transport or provided complete HTTP/1.1 support.

To claim compliance with any of the IPPv2 versions, an implementation MUST support the complete HTTP/1.1 protocol as defined in RFC 2616, including chunking as defined in section 3.6.1 and the Expect header as defined in section 5.3.

In addition, implementations supporting TLS encryption MUST support the HTTP Upgrade protocol as defined in RFC 2817.

6.4 IPP Unsupported Attributes

The IPPv1.1 specification [RFC2911] requires that IPP attributes received, that are not supported or not understood, are to be processed according to the defined procedures, and an appropriate status code returned.   Many implementations historically have not conformed to this requirement, causing communication problems and failed printing.

To claim compliance with any of the IPPv2 versions, an implementation MUST correctly process attributes, values, or groups that are not supported per RFC 2911, 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 RFC 3382, section 7.

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 RFC 3382, even if the implementation does not support the media-col attribute itself.

7 IANA and PWG Considerations

This section contains the exact registration information for IANA to update the procedures defined in TBD.

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 RFC 2911 [RFC2911] and RFC 2910 [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.

'2.2': Meets all the conformance requirements of IPP version 2.2, as specified in PWG 51XX.X, in addition to the requirements for IPP 2.1 as specified above.

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

8 Internationalization Considerations

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].

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

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.

10 References

10.1 Normative References

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[UNICODE] M. Davis, et al, "Unicode Standard v5.1.0", Unicode Standard, April 2008,
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10.2 Informative References

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     R. deBry, T. Hastings, R. Herriot, S. Isaacson, P. Powell, "Internet Printing Protocol/1.0: Model and
     Semantics", RFC 2566, April, 1999.
 [RFC2567]
     D. Wright, IETF IPP Design Goals, RFC 2567, April 1999.

 [RFC3196]
     T. Hastings, C. Manros, K. Kugler, H. Holst, P. Zehler, "Internet Printing Protocol/1.1:
     Implementor's Guide", RFC 3196, November, 2001.

11 Required Attributes

This section defines the IPP attributes required to be supported for conformance to each of the IPP version 2.X levels.

ISSUE: Should this section show the attributes that are required for IPPv1.1? Is this the same as IPPv2.0?

ISSUE: Should IPPv2.1 and IPPv2.2 also show all the attributes required? These tables show the added attributes from IPPv2.0 and IPP2.1.

11.1 Version 2.0 Attributes

The following IPP Attributes are included in the defining documents for IPPv2.0. The required support for each IPP Attribute in a V2.0 implementation is defined as follows. Note that a V2.0 implementation may also include support for additional IPP Attributes other than specified in this list.

Attribute Name	Source
attributes-charset	RFC 2911
attributes-natural-language	RFC 2911
charset-configured	RFC 2911
charset-supported	RFC 2911
compression	RFC 2911
compression-supported	RFC 2911
document-format	RFC 2911
document-format-default	RFC 2911
document-format-supported	RFC 2911
document-name	RFC 2911
generated-natural-language-supported	RFC 2911
Ipp-attribute-fidelity	RFC 2911
ipp-versions-supported	RFC 2911
job-id	RFC 2911
job-name	RFC 2911
job-originating-user-name	RFC 2911
job-printer-up-time	RFC 2911
job-printer-uri	RFC 2911
job-state	RFC 2911
job-state-reasons	RFC 2911
job-uri	RFC 2911
limit	RFC 2911
my-jobs	RFC 2911
natural-language-configured	RFC 2911
operations-supported	RFC 2911
pdl-override-supported	RFC 2911
printer-is-accepting-jobs	RFC 2911
printer-name	RFC 2911
printer-state	RFC 2911
printer-state-reasons	RFC 2911
printer-up-time	RFC 2911
printer-uri	RFC 2911
printer-uri-supported	RFC 2911
queued-job-count	RFC 2911
requested-attributes	RFC 2911
requesting-user-name	RFC 2911
time-at-completed	RFC 2911
time-at-creation	RFC 2911
time-at-processing	RFC 2911
uri-authentication-supported	RFC 2911
uri-security-supported	RFC 2911
which-jobs	RFC 2911

11.2 Version 2.1 Attributes

The following IPP Attributes are included in the defining documents for IPPv2.1. The required support for each IPP Attribute in a V2.1 implementation is defined as follows. Note that a V2.1 implementation may also include support for additional IPP Attributes other than specified in this list.

Attribute Name	Source
job-hold-until	RFC 2911
job-hold-until-default	RFC 2911
job-hold-until-supported	RFC 2911
last-document	RFC 2911
job-settable-attributes-supported	RFC 3380
printer-settable-attributes-supported	RFC 3380
media-col	RFC 3282
media-col-default	RFC 3382
media-col-ready	RFC 3382
media-col-supported	RFC 3382
notify-charset	RFC 3995
notify-events	RFC 3995
notify-events-default	RFC 3995
notify-events-supported	RFC 3995
notify-job-id	RFC 3995
notify-lease-duration	RFC 3995
notify-lease-duration-default	RFC 3995
notify-lease-duration-supported	RFC 3995
notify-lease-expiration-time	RFC 3995
notify-max-events-supported	RFC 3995
notify-natural-language	RFC 3995
notify-printer-up-time	RFC 3995
notify-printer-uri	RFC 3995
notify-pull-method	RFC 3995
notify-pull-method-supported	RFC 3995
notify-time-interval	RFC 3995
notify-sequence-number	RFC 3995
notify-subscribed-event	RFC 3995
notify-subscriber-user-name	RFC 3995
notify-subscription-id	RFC 3995
notify-text	RFC 3995
notify-user-data	RFC 3995
ippget-event-life	RFC 3996
notify-get-interval	RFC 3996
notify-sequence-numbers	RFC 3996
notify-subscription-ids	RFC 3996
notify-wait	RFC 3996
compression-supplied	PWG 5100.7

11.3 Version 2.2 Attributes

The following IPP Attributes are included in the defining documents for IPPv2.2. The required support for each IPP Attribute in a V2.2 implementation is defined as follows. Note that a V2.2 implementation may also include support for additional IPP Attributes other than specified in this list.

Attribute Name	Source
document-job-id	PWG 5100.5
document-job-url	PWG 5100.5
document-number	PWG 5100.5
document-printer-uri	PWG 5100.5
document-state	PWG 5100.5
document-state-reasons	PWG 5100.5
job-mandatory-attributes	PWG 5100.5
multiple-document-handling	PWG 5100.5
number-of-documents	PWG 5100.5
overrides	PWG 5100.6

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13 Appendix X Document Revisions

This section is to be removed when this document is approved!

A. Changes made to create September 29, 2008 version

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 "IPPv1.1".

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 LS_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

B. Changes made to create September 19, 2008 version

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 RFC 2911 [RFC2911] and RFC 2910 [RFC2910].

'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:

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/ve rsions/Unicode5.1.0/

C. 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].

D. 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 "IPPv2.0", "IPPv2.1", and "IPPv2.2" respectively.

E. 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 "RFC 3382 The 'collection' Attribute Syntax (September 2002)". Also, corrected publication dates for RFC 3380, RFC 3381, RFC 3996, and RFC 3998.

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 "IPPv2 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 RFC 3382, section 7."

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 RFC 3382, even if the implementation does not support the media-col attribute itself."

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].

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

Abstract: Added "queries to the IPP printer." to complete the last sentence in the abstract.

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 IPPv2.0.

Section 5.3: Added all operations that are applicable to the specifications required for IPPv2.1.

Section 5.4: Added all operations that are applicable to the specifications required for IPPv2.2.

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

Section 6: " per RFC 2911, 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)."