The Printer Working Group

IPP Version 2.0, 2.1, and 2.2

Status: Approved

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

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

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

This document is available at:

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

About the IEEE-ISTO

The IEEE-ISTO is a not-for-profit corporation offering industry groups an innovative and flexible operational forum and support services. The IEEE-ISTO provides a forum not only to develop standards, but also to facilitate activities that support the implementation and acceptance of standards in the marketplace. The organization is affiliated with the IEEE (http://www.ieee.org/) and the IEEE Standards Association (http://standards.ieee.org/).

For additional information regarding the IEEE-ISTO and its industry programs visit:

> http://www.ieee-isto.org

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

Contact information:

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

About the Internet Printing Protocol Workgroup

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

For additional information regarding IPP visit:

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

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

Table of Contents

List of Tables

1. Introduction

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

1.1 IPP 2.x Versions

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

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

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

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

IPP/2.2: This IPP conformance level is targeted to an environment with high speed and very high duty cycle devices as compared to IPP/2.0 and IPP/2.1 Printers. One example of this environment is a data center where jobs are centrally scheduled rather than sent ad-hoc from a group of End Users. This class of Printer is expected to consume significantly more supplies (such as paper, toner, etc.) and have a larger memory capacity than the other classes.

37 ## 1.2 Deprecation of IPP Operations

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

40 # 2. Terminology

41 ## 2.1 Conformance Terminology

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

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

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

50 ## 2.2 Printing Terminology

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

53 ## 2.3 Protocol Role Terminology

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

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

58 *Printer*: Listener for incoming IPP session requests and receiver of incoming IPP
59 operation requests (Hypertext Transfer Protocol -- HTTP/1.1 [RFC7230] Server) that
60 represents one or more Physical Devices or a Logical Device.
61

2.4 Acronyms and Organizations

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

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

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

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

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

3. Requirements

3.1 Rationale

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

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

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

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

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

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

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

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

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

1. Standardize profiles of the IPP/1.1 extensions for advanced printing functionality and reliable interoperability;
2. Encourage adoption of modern IPP-based printing infrastructures; and
3. Discourage the further proliferation of vendor proprietary IPP operations and attributes that damage IPP interoperability by duplicating IETF or PWG IPP standard operations and attributes.

3.2 Use Cases

See the informal descriptions of the IPP/2.0, IPP/2.1, and IPP/2.2 target printing environments in section 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 2.0 (MSN2) [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 Exceptions

The following exceptions apply to all IPP versions.

3.3.1 Out of Paper

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

131 **3.4 Out Of Scope**

132 The following are out of scope for this specification:

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

134 **3.5 Design Requirements**

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

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

143 4. IPP Standards

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

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

150 Notes:

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

155   **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]			RECOMMENDED	REQUIRED
[PWG5101.1]		REQUIRED	REQUIRED	REQUIRED
[PWG5107.2]		RECOMMENDED	RECOMMENDED	REQUIRED
[RFC2910]	REQUIRED	REQUIRED	REQUIRED	REQUIRED
[RFC2911]	REQUIRED	REQUIRED	REQUIRED	REQUIRED
[RFC3380]			REQUIRED	REQUIRED
[RFC3382]			REQUIRED	REQUIRED
[RFC3510]	REQUIRED	REQUIRED	REQUIRED	REQUIRED
[RFC3995]			REQUIRED	REQUIRED
[RFC3996]			REQUIRED	REQUIRED
[RFC3998]			REQUIRED	REQUIRED
[RFC5246]		RECOMMENDED	RECOMMENDED	REQUIRED
[RFC7472]		RECOMMENDED	RECOMMENDED	RECOMMENDED

156
157

158   **4.1 IPP/2.0 Standards**

159   An IPP/2.0 Printer MUST support the following specifications:

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

166   An IPP/2.0 Printer SHOULD support the following specifications:

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

174   **4.2 IPP/2.1 Standards**

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

177   1. Internet Printing Protocol (IPP): Job and Printer Set Operations [RFC3380]
178   2. Internet Printing Protocol (IPP): The 'collection' Attribute Syntax [RFC3382]
179   3. Internet Printing Protocol (IPP): Event Notifications and Subscriptions
180   [RFC3995]
181   4. Internet Printing Protocol (IPP): The 'ippget' Delivery Method for Event
182   Notifications [RFC3996]
183   5. Internet Printing Protocol (IPP): Job and Printer Administrative Operations
184   [RFC3998]
185   6. Internet Printing Protocol (IPP): Production Printing Attributes – Set 1 (for
186   "media-col" attributes) [PWG5100.3]
187   7. Standard for the Internet Printing Protocol (IPP): Job Extensions [PWG5100.7]
188   8. Internet Printing Protocol (IPP) Printer State Extensions [PWG5100.9]

189   An IPP/2.1 Printer SHOULD support the following specifications:

190   1. Standard for the Internet Printing Protocol (IPP): Page Overrides [PWG5100.6]
191   2. Internet Printing Protocol (IPP): Job and Printer Operations – Set 2 (JPS2)
192   [PWG5100.11]
193   3. PWG Command Set Format for IEEE 1284 Device ID v1.0 [PWG5107.2]
194   4. The Transport Layer Security (TLS) Protocol Version 1.2 [RFC5246]

195   5. IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472]

196 **4.3 IPP/2.2 Standards**

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

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

208 An IPP/2.2 Printer SHOULD support the following specifications:

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

210 **5. IPP Operations**

211 IPP/2.0, IPP/2.1, and IPP/2.2 specify higher conformance requirements for some IPP
212 Operations in comparison to previous IPP specifications. Many IPP Operations were
213 defined in their source specifications as optional. If they remained optional in this
214 specification, the desired interoperability objective would not be achieved.
215

216 **5.1 Original IPP/1.1 Operations (Informative)**

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

219   **Table 2 - Original IPP/1.1 Required Operations**

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

220 **5.2 IPP/2.0 Operations**

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

224 Notes:

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

234   **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]	DEPRECATED
0x0010	Pause-Printer	[RFC2911]	OPTIONAL
0x0011	Resume-Printer	[RFC2911]	OPTIONAL
0x0012	Purge-Jobs (note 3)	[RFC2911]	DEPRECATED
0x002C	Reprocess-Job	[RFC3998]	OPTIONAL
0x0038	Cancel-Jobs (note 3)	[PWG5100.11]	OPTIONAL
0x0039	Cancel-My-Jobs (note 3)	[PWG5100.11]	OPTIONAL
0x003A	Resubmit-Job (note 2)	[PWG5100.11]	OPTIONAL

235 **5.3 IPP/2.1 Operations**

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

239 Notes:

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

256   **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]	DEPRECATED
0x0010	Pause-Printer	[RFC2911]	REQUIRED
0x0011	Resume-Printer	[RFC2911]	REQUIRED
0x0012	Purge-Jobs (note 3)	[RFC2911]	DEPRECATED
0x0013	Set-Printer-Attributes	[RFC3380]	REQUIRED
0x0014	Set-Job-Attributes	[RFC3380]	REQUIRED
0x0015	Get-Printer-Supported-Values	[RFC3380]	REQUIRED

Code	Operation Name	Source	Support
0x0016	Create-Printer-Subscriptions	[RFC3995]	REQUIRED
0x0017	Create-Job-Subscriptions	[RFC3995]	OPTIONAL
0x0018	Get-Subscription-Attributes	[RFC3995]	REQUIRED
0x0019	Get-Subscriptions	[RFC3995]	REQUIRED
0x001A	Renew-Subscription	[RFC3995]	REQUIRED
0x001B	Cancel-Subscription	[RFC3995]	REQUIRED
0x001C	Get-Notifications	[RFC3996]	REQUIRED
0x0022	Enable-Printer	[RFC3998]	REQUIRED
0x0023	Disable-Printer	[RFC3998]	REQUIRED
0x0024	Pause-Printer-After-Current-Job	[RFC3998]	OPTIONAL
0x0025	Hold-New-Jobs	[RFC3998]	OPTIONAL
0x0026	Release-Held-New-Jobs	[RFC3998]	OPTIONAL
0x0027	Deactivate-Printer (note 4)	[RFC3998]	DEPRECATED
0x0028	Activate-Printer (note 4)	[RFC3998]	DEPRECATED
0x0029	Restart-Printer	[RFC3998]	OPTIONAL
0x002A	Shutdown-Printer	[RFC3998]	OPTIONAL
0x002B	Startup-Printer	[RFC3998]	OPTIONAL
0x002C	Reprocess-Job	[RFC3998]	OPTIONAL
0x002D	Cancel-Current-Job	[RFC3998]	OPTIONAL
0x002E	Suspend-Current-Job	[RFC3998]	OPTIONAL
0x002F	Resume-Job	[RFC3998]	OPTIONAL
0x0030	Promote-Job	[RFC3998]	OPTIONAL
0x0031	Schedule-Job-After	[RFC3998]	OPTIONAL
0x0033	Cancel-Document	[PWG5100.5]	OPTIONAL
0x0034	Get-Document-Attributes	[PWG5100.5]	OPTIONAL
0x0035	Get-Documents	[PWG5100.5]	OPTIONAL
0x0036	Delete-Document (note 5)	[PWG5100.5]	DEPRECATED
0x0037	Set-Document-Attributes	[PWG5100.5]	OPTIONAL
0x0038	Cancel-Jobs (note 3, 6)	[PWG5100.11]	RECOMMENDED
0x0039	Cancel-My-Jobs (note 3, 6)	[PWG5100.11]	RECOMMENDED
0x003A	Resubmit-Job (note 2, 6)	[PWG5100.11]	RECOMMENDED
0x003B	Close-Job (note 6)	[PWG5100.11]	RECOMMENDED

257   5.4 IPP/2.2 Operations

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

261   Notes:

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

275   **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]	DEPRECATED
0x0010	Pause-Printer	[RFC2911]	REQUIRED
0x0011	Resume-Printer	[RFC2911]	REQUIRED
0x0012	Purge-Jobs (note 3)	[RFC2911]	DEPRECATED
0x0013	Set-Printer-Attributes	[RFC3380]	REQUIRED
0x0014	Set-Job-Attributes	[RFC3380]	REQUIRED
0x0015	Get-Printer-Supported-Values	[RFC3380]	REQUIRED
0x0016	Create-Printer-Subscriptions	[RFC3995]	REQUIRED
0x0017	Create-Job-Subscriptions	[RFC3995]	OPTIONAL

Code	Operation Name	Source	Support
0x0018	Get-Subscription-Attributes	[RFC3995]	REQUIRED
0x0019	Get-Subscriptions	[RFC3995]	REQUIRED
0x001A	Renew-Subscription	[RFC3995]	REQUIRED
0x001B	Cancel-Subscription	[RFC3995]	REQUIRED
0x001C	Get-Notifications	[RFC3996]	REQUIRED
0x0022	Enable-Printer	[RFC3998]	REQUIRED
0x0023	Disable-Printer	[RFC3998]	REQUIRED
0x0024	Pause-Printer-After-Current-Job	[RFC3998]	REQUIRED
0x0025	Hold-New-Jobs	[RFC3998]	REQUIRED
0x0026	Release-Held-New-Jobs	[RFC3998]	REQUIRED
0x0027	Deactivate-Printer (note 4)	[RFC3998]	DEPRECATED
0x0028	Activate-Printer (note 4)	[RFC3998]	DEPRECATED
0x0029	Restart-Printer	[RFC3998]	REQUIRED
0x002A	Shutdown-Printer	[RFC3998]	REQUIRED
0x002B	Startup-Printer	[RFC3998]	REQUIRED
0x002C	Reprocess-Job	[RFC3998]	REQUIRED
0x002D	Cancel-Current-Job	[RFC3998]	REQUIRED
0x002E	Suspend-Current-Job	[RFC3998]	REQUIRED
0x002F	Resume-Job	[RFC3998]	REQUIRED
0x0030	Promote-Job	[RFC3998]	REQUIRED
0x0031	Schedule-Job-After	[RFC3998]	REQUIRED
0x0033	Cancel-Document	[PWG5100.5]	REQUIRED
0x0034	Get-Document-Attributes	[PWG5100.5]	REQUIRED
0x0035	Get-Documents	[PWG5100.5]	REQUIRED
0x0036	Delete-Document (note 5)	[PWG5100.5]	DEPRECATED
0x0037	Set-Document-Attributes	[PWG5100.5]	REQUIRED
0x0038	Cancel-Jobs (note 3)	[PWG5100.11]	REQUIRED
0x0039	Cancel-My-Jobs (note 3)	[PWG5100.11]	REQUIRED
0x003A	Resubmit-Job (note 2)	[PWG5100.11]	REQUIRED
0x003B	Close-Job	[PWG5100.11]	REQUIRED

276 **6. IPP Attributes**

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

280 **6.1 Original IPP/1.1 Attributes**

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

282   **Table 6 - Required IPP Attributes**

Attribute Name	Object	Source
attributes-charset	All (operation/all)	[RFC2911]
attributes-natural-language	All (operation/all)	[RFC2911]
charset-configured	Printer	[RFC2911]
charset-supported	Printer	[RFC2911]
compression	Job	[RFC2911]
compression-supported	Printer	[RFC2911]
document-format	Job	[RFC2911]
document-format-default	Printer	[RFC2911]
document-format-supported	Printer	[RFC2911]
document-name	Job	[RFC2911]
generated-natural-language-supported	Printer	[RFC2911]
ipp-attribute-fidelity	Job	[RFC2911]
ipp-versions-supported	Printer	[RFC2911]
job-id	Job	[RFC2911]
job-name	Job	[RFC2911]
job-originating-user-name	Job	[RFC2911]
job-printer-up-time	Job	[RFC2911]
job-printer-uri	Job	[RFC2911]
job-state	Job	[RFC2911]
job-state-reasons	Job	[RFC2911]
job-uri	Job	[RFC2911]
limit	Printer (operation)	[RFC2911]
my-jobs	Printer (operation)	[RFC2911]
natural-language-configured	Printer	[RFC2911]
operation-id (note 1)	All (parameter)	[RFC2911]
operations-supported	Printer	[RFC2911]
pdl-override-supported	Printer	[RFC2911]
printer-is-accepting-jobs	Printer	[RFC2911]
printer-name	Printer	[RFC2911]
printer-state	Printer	[RFC2911]
printer-state-reasons	Printer	[RFC2911]
printer-up-time	Printer	[RFC2911]

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]

283 **6.2 IPP/2.0 Attributes**

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

288 Notes:

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

308   **Table 7 - Additional IPP/2.0 Attributes**

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

6.2 IPP/2.1 Attributes

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

Notes:

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

340   **Table 8 - Additional IPP/2.1 Attributes**

Attribute Name	Object	Source
compression-supplied	Job	[PWG5100.7]
document-format-supplied	Job	[PWG5100.7]
document-format-version	Job (operation)	[PWG5100.7]
document-format-version-supplied	Job	[PWG5100.7]
document-name-supplied	Job	[PWG5100.7]
ippget-event-life	Printer	[RFC3996]
job-creation-attributes-supported (note 9)	Printer	[PWG5100.11]
job-hold-until	Job	[RFC2911]
job-hold-until-default	Printer	[RFC2911]
job-hold-until-supported	Printer	[RFC2911]
job-ids (note 4)	Printer (operation)	[PWG5100.11]
job-ids-supported (note 4)	Printer	[PWG5100.11]
job-priority	Job	[RFC2911]
job-priority-default	Printer	[RFC2911]
job-priority-supported	Printer	[RFC2911]
job-settable-attributes-supported	Printer	[RFC3380]
job-sheets	Job	[RFC2911]
job-sheets-default	Printer	[RFC2911]
job-sheets-supported	Printer	[RFC2911]
last-document	Job (operation)	[RFC2911]
media-col (note 1)	Job	[PWG5100.3]
media-col-default (note 1)	Printer	[PWG5100.3]
media-col-ready (note 3)	Printer	[PWG5100.3]
media-col-supported (note 1)	Printer	[PWG5100.3]
media-col.media-color (note 2)	Job	[PWG5100.3]
media-col.media-key (note 2)	Job	[PWG5100.3]
media-col.media-size (note 2)	Job	[PWG5100.3]
media-col.media-type (note 2)	Job	[PWG5100.3]
multiple-operation-time-out	Printer	[RFC2911]
notify-charset	Subscription	[RFC3995]
notify-events	Subscription	[RFC3995]
notify-events-default	Printer	[RFC3995]
notify-events-supported	Printer	[RFC3995]
notify-get-interval	Printer (response)	[RFC3996]
notify-job-id	Subscription	[RFC3995]
notify-lease-duration	Subscription	[RFC3995]
notify-lease-duration-default	Printer	[RFC3995]
notify-lease-duration-supported	Printer	[RFC3995]
notify-lease-expiration-time	Subscription	[RFC3995]
notify-max-events-supported	Printer	[RFC3995]
notify-natural-language	Subscription	[RFC3995]
notify-printer-up-time	Subscription	[RFC3995]
notify-printer-uri	Subscription	[RFC3995]
notify-pull-method	Subscription	[RFC3995]

Attribute Name	Object	Source
notify-pull-method-supported	Printer	[RFC3995]
notify-sequence-number	Subscription	[RFC3995]
notify-sequence-numbers	Printer (operation)	[RFC3996]
notify-status-code	All (operation)	[RFC3996]
notify-subscribed-event	Subscription	[RFC3995]
notify-subscriber-user-name	Subscription	[RFC3995]
notify-subscription-id	Subscription	[RFC3995]
notify-subscription-ids	Printer (operation)	[RFC3996]
notify-text	Subscription	[RFC3995]
notify-time-interval	Subscription	[RFC3995]
notify-user-data	Subscription	[RFC3995]
notify-wait	Printer (operation)	[RFC3996]
output-device-assigned	Job	[RFC3998]
overrides (note 7)	Job	[PWG5100.6]
overrides-actual (note 7)	Job	[PWG5100.6]
overrides-supported (note 7)	Printer	[PWG5100.6]
printer-alert (note 10)	Printer	[PWG5100.9]
printer-alert-description (note 10)	Printer	[PWG5100.9]
printer-device-id (note 5)	Printer	[PWG5107.2]
printer-settable-attributes-supported	Printer	[RFC3380]
printer-state-change-time	Printer	[RFC3995]
printer-state-reasons (note 6)	Printer	[RFC2911] & [PWG5100.9]
proof-print (note 4)	Job	[PWG5100.11]
status-message (note 8)	All (response)	[RFC2911]
which-jobs-supported (note 4)	Printer	[PWG5100.11]

6.3 IPP/2.2 Attributes

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

Notes:

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

367   **Table 9 - Additional IPP/2.2 Attributes**

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

page-ranges-supported	Printer	[RFC2911]
print-quality-actual	Job	[PWG5100.8]
printer-device-id (note 3)	Printer	[PWG5107.2]
printer-message-from-operator	Printer	[RFC2911]
printer-resolution-actual	Job	[PWG5100.8]
proof-print (note 2)	Job	[PWG5100.11]
sides-actual	Job	[PWG5100.8]
status-message (note 6)	All (response)	[RFC2911]
which-jobs-supported (note 2)	Printer	[PWG5100.11]

368 # 7. Conformance Requirements

369 ## 7.1 IPP Printer Conformance Requirements

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

371   1. Support all REQUIRED IPP Operations defined in section 5 of this specification;
372   2. Support all REQUIRED IPP Attributes defined in section 6 of this specification;.
373   3. Conform to the requirements for an IPP Object specified in section 5.2 of
374   [RFC2911];
375   4. Conform to the IPP Job and Printer Administrative operation requirements
376   specified in section 11 of [RFC3998];
377   5. Conform to the Internationalization Considerations defined in section 9 of this
378   specification; and
379   6. Conform to the Security Considerations defined in section 10 of this
380   specification, including the RECOMMENDED or REQUIRED TLS versions for
381   IPP/2.0, IPP/2.1, and IPP/2.2 implementations.

382 ## 7.2 IPP Client Conformance Requirements

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

384   1. Explicitly identify the implemented set of IPP Operations defined in section 5 of
385   this specification;
386   2. Explicitly identify the implemented set of IPP Attributes defined in section 6 of
387   this specification;
388   3. Conform to the requirements for an IPP Client specified in section 5.1 of
389   [RFC2911];
390   4. Conform to the Internationalization Considerations defined in section 9 of this
391   specification; and
392   5. Conform to the Security Considerations defined in section 10 of this
393   specification, including the RECOMMENDED or REQUIRED TLS versions for
394   IPP/2.0, IPP/2.1, and IPP/2.2 implementations.
395

396   **7.3 IPP over HTTP Conformance Requirements**

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

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

404   1. Support the complete HTTP/1.1 protocol as defined in [RFC7230] [RFC7231]
405   [RFC7232] [RFC7233] [RFC7234] [RFC7235];
406   2. Support chunking as defined in section 4.1 of [RFC7230];
407   3. Support the Expect header as defined in section 5.1.1 of [RFC7231].

408   **7.4 IPP over TLS Conformance Requirements**

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

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

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

418   **7.5 IPP Unsupported Attributes Conformance Requirements**

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

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

426   1. Correctly process unsupported attributes, values, or groups as defined in
427   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
428   [RFC2911];
429   2. Correctly process unsupported collection attributes as defined in section 7 in
430   [RFC3382];

431   3. Correctly support reading the IPP no-value tag (section 4.1 of [RFC2911]) as a
432   valid value for an attribute that normally would be encoded as an enum, integer,
433   name, or keyword value tag; and
434   4. Correctly process (or ignore) collection values as defined by [RFC3382], even if
435   the IPP implementation does not support the collection attribute itself.

436 **8. IANA and PWG Considerations**

437 **8.1 Attribute Value Registrations**

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

440   http://www.iana.org/assignments/ipp-registrations

441 The registry entries will contain the following information:

```
442     Attributes (attribute syntax)
443       Keyword Attribute Value                        Reference
444       ----------------------                        ---------
445     ipp-versions-supported (1setOf type2 keyword)    [RFC2911]
446       2.0                                            [PWG5100.12]
447       2.1                                            [PWG5100.12]
448       2.2                                            [PWG5100.12]
```

449 **9. Internationalization Considerations**

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

452 For interoperability and basic support for multiple languages, conforming implementations
453 MUST support:

454   1. The Universal Character Set (UCS) Transformation Format -- 8 bit (UTF-8)
455   [STD63] encoding of Unicode [UNICODE] [ISO10646]; and
456   2. The Unicode Format for Network Interchange [RFC5198] which requires
457   transmission of well-formed UTF-8 strings and recommends transmission of
458   normalized UTF-8 strings in Normalization Form C (NFC) [UAX15].

459 Unicode NFC is defined as the result of performing Canonical Decomposition (into base
460 characters and combining marks) followed by Canonical Composition (into canonical
461 composed characters wherever Unicode has assigned them).

462 WARNING – Performing normalization on UTF-8 strings received from IPP Clients and
463 subsequently storing the results (e.g., in IPP Job objects) could cause false negatives in
464 IPP Client searches and failed access (e.g., to IPP Printers with percent-encoded UTF-8
465 URIs now 'hidden').

466 Implementations of this specification SHOULD conform to the following standards on
467 processing of human-readable Unicode text strings:

468   Unicode Bidirectional Algorithm [UAX9] – left-to-right, right-to-left, and vertical

469   Unicode Line Breaking Algorithm [UAX14] – character classes and wrapping

470   Unicode Normalization Forms [UAX15] – especially NFC for [RFC5198]

471   Unicode Text Segmentation [UAX29] – grapheme clusters, words, sentences

472   Unicode Identifier and Pattern Syntax [UAX31] – identifier use and normalization

473   Unicode Collation Algorithm [UTS10] – sorting

474   Unicode Locale Data Markup Language [UTS35] – locale databases

475   Implementations of this specification are advised to also review the following informational
476   documents on processing of human-readable Unicode text strings:

477   Unicode Character Encoding Model [UTR17] – multi-layer character model

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

479   Unicode Character Property Model [UTR23] – character properties

480   Unicode Conformance Model [UTR33] – Unicode conformance basis

481 **10. Security Considerations**

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

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

489 An IPP/2.2 implementation MUST support TLS/1.2 [RFC5246] or a later version.

490 Implementations of this specification SHOULD conform to the following standard on
491 processing of human-readable Unicode text strings, see:

492   Unicode Security Mechanisms [UTS39] – detecting and avoiding security attacks

493 Implementations of this specification are advised to also review the following informational
494 document on processing of human-readable Unicode text strings:

495   Unicode Security FAQ [UNISECFAQ] – common Unicode security issues

496 **11. References**

497 **11.1 Normative References**

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

500 [PWG5100.1]   M. Sweet, "IPP Finishings 2.0", PWG 5100.1, December 2014,
501   http://ftp.pwg.org/pub/pwg/candidates/cs-ippfinishings20-20141219-
502   5100.1.pdf

503 [PWG5100.2]   T. Hastings, R. Bergman, "IPP "output-bin" attribute extension", PWG
504   5100.2, February 2001, http://ftp.pwg.org/pub/pwg/candidates/cs-
505   ippoutputbin10-20010207-5100.2.pdf

506 [PWG5100.3]   K. Ocke, T. Hastings, "IPP Production Printing Attributes – Set 1",
507   PWG 5100.3, February 2001,
508   http://ftp.pwg.org/pub/pwg/candidates/cs-ippprodprint10-20010212-
509   5100.3.pdf

510 [PWG5100.5]   D Carney, T. Hastings, P. Zehler, "Internet Printing Protocol:
511   Document Object", PWG 5100.5, October 2003,

| 512 | | http://ftp.pwg.org/pub/pwg/candidates/cs-ippdocobject10-20031031-5100.5.pdf |
| 513 | | |

514 [PWG5100.6]   P. Zehler, R. Herriot, K. Ocke, "Internet Printing Protocol: Page
515   Overrides", PWG 5100.6, October 2003,
516   http://ftp.pwg.org/pub/pwg/candidates/cs-ipppageoverride10-
517   20031031-5100.6.pdf

518 [PWG5100.7]   T. Hastings, P. Zehler, "IPP: Job Extensions", PWG 5100.7, October
519   2003, http://ftp.pwg.org/pub/pwg/candidates/cs-ippjobext10-
520   20031031-5100.7.pdf

521 [PWG5100.8]   D. Carney, H. Lewis, "Internet Printing Protocol: "-actual" Attributes",
522   PWG 5100.8, March 2003, http://ftp.pwg.org/pub/pwg/candidates/cs-
523   ippactuals10-20030313-5100.8.pdf

524 [PWG5100.9]   I. McDonald, C. Whittle, "IPP Printer State Extensions", PWG 5100.9,
525   July 2009, http://ftp.pwg.org/pub/pwg/candidates/cs-ippstate10-
526   20090731-5100.9.pdf

527 [PWG5100.11]   T. Hastings, D. Fullman, "IPP Job and Printer Extensions – Set 2
528   (JPS2)", PWG 5100.11, October 2010,
529   http://ftp.pwg.org/pub/pwg/candidates/cs-ippjobprinterext10-
530   20101030-5100.11.pdf

531 [PWG5101.1]   M. Sweet, R. Bergman, T. Hastings, "PWG Media Standardized
532   Names 2.0 (MSN2)", PWG 5101.1, March 2013,
533   http://ftp.pwg.org/pub/pwg/candidates/cs-pwgmsn20-20130328-
534   5101.1.pdf

535 [PWG5107.2]   I. McDonald, "PWG Command Set Format for IEEE 1284 Device ID",
536   PWG 5107.2, May 2010, http://ftp.pwg.org/pub/pwg/candidates/cs-
537   pmp1284cmdset10-20100531-5107.2.pdf

538 [RFC2119]   S. Bradner, "Key words for use in RFCs to Indicate Requirement
539   Levels", RFC 2119/BCP 14, March 1997,
540   http://tools.ietf.org/html/rfc2119

541 [RFC2817]   R. Khare, S. Lawrence, "Upgrading to TLS Within HTTP/1.1". RFC
542   2817, May 2000, http://tools.ietf.org/html/rfc2817

543 [RFC2910]   R. Herriot, S. Butler, P. Moore, R. Tuner, J. Wenn, "Internet Printing
544   Protocol/1.1: Encoding and Transport", RFC 2910, September, 2000.
545   http://tools.ietf.org/html/rfc2910

546 [RFC2911]   T. Hastings, R. Herriot, R. deBry, S. Isaacson, P. Powell, "Internet
547   Printing Protocol/1.1: Model and Semantics", RFC 2911, September
548   2000, http://tools.ietf.org/html/rfc2911

549 [RFC3380]   T. Hastings, R. Herriot, C. Kugler, H. Lewis, "Internet Printing Protocol
550   (IPP): Job and Printer Set Operations", RFC 3380, September 2002,
551   http://tools.ietf.org/html/rfc3380

552 [RFC3382]   R. deBry, R. Herriot, T. Hastings, K. Ocke, P. Zehler, "Internet
553   Printing Protocol (IPP): The 'collection' attribute syntax", RFC 3382,
554   September 2002, http://tools.ietf.org/html/rfc3382

555 [RFC3510]   R. Herriot, I. McDonald, "Internet Printing Protocol/1.1: IPP URL
556   Scheme", RFC 3510, April 2003, http://tools.ietf.org/html/rfc3510

557 [RFC3995]   R. Herriot, T. Hastings, "Internet Printing Protocol/1.1: IPP Event
558   Notifications and Subscriptions", RFC 3995, March 2005,
559   http://tools.ietf.org/html/rfc3995

560 [RFC3996]   R. Herriot, T. Hastings, H. Lewis, "Internet Printing Protocol (IPP):
561   The 'ippget' Delivery Method for Event Notifications", RFC 3996,
562   March 2005, http://tools.ietf.org/html/rfc3996

563 [RFC3998]   Kugler, Lewis, Hastings. "Internet Printing Protocol (IPP):Job and
564   Printer Administrative Operations", RFC 3998, March 2005,
565   http://tools.ietf.org/html/rfc3998

566 [RFC4122]   P. Leach, M. Mealling, R. Salz, "A Universally Unique IDentifier
567   (UUID) URN Namespace", RFC 4122, July 2005,
568   http://tools.ietf.org/html/rfc4122

569 [RFC5198]   J. Klensin, M. Padlipsky, "Unicode Format for Network Interchange",
570   RFC 5198, March 2008, http://tools.ietf.org/html/rfc5198

571 [RFC5246]   T.Dierks, E. Rescorla, "Transport Layer Security 1.2", RFC 5246,
572   August 2008, http://tools.ietf.org/html/rfc5246

573 [RFC6749]   D. Hardt, "The OAuth 2.0 Authorization Framework", RFC 6749,
574   October 2012, http://tools.ietf.org/html/rfc6749

575 [RFC7230]   R. Fielding, J. Reschke, "Hypertext Transfer Protocol (HTTP/1.1):
576   Message Syntax and Routing", RFC 7230, June 2014,
577   http://tools.ietf.org/html/rfc7230

578 [RFC7232]   R. Fielding, J. Reschke, "Hypertext Transfer Protocol (HTTP/1.1):
579   Conditional Requests", RFC 7232, June 2014,
580   http://tools.ietf.org/html/rfc7232

581 [RFC7472]   I. McDonald, M. Sweet, "IPP over HTTPS Transport Binding and
582   'ipps' URI Scheme", RFC 7472, March 2015,
583   http://tools.ietf.org/html/rfc7472

584   [RFC7616]   R. Shekh-Yusef, D. Ahrens, S. Bremer, "HTTP Digest Access
585   Authentication", RFC 7616, September 2015,
586   http://tools.ietf.org/html/rfc7616

587   [RFC7617]   J. Reschke, "The 'Basic' HTTP Authentication Scheme", RFC 7617,
588   September 2015, http://tools.ietf.org/html/rfc7617

589   [STD63]   F. Yergeau, "UTF-8, a transformation format of ISO 10646", RFC
590   3629/STD 63, November 2003, http://tools.ietf.org/html/rfc3629

591   [STD66]   T. Berners-Lee, R. Fielding, L. Masinter, "Uniform Resource Identifier
592   (URI): Generic Syntax", RFC 3986/STD 66, January 2005,
593   http://tools.ietf.org/html/rfc3986

594   [STD68]   D. Crocker, P. Overell, "Augmented BNF for Syntax Specifications:
595   ABNF", RFC 5234/STD 68, January 2008,
596   http://tools.ietf.org/html/rfc5234

597   [UAX9]   Unicode Consortium, "Unicode Bidirectional Algorithm", UAX#9, June
598   2014,
599   http://www.unicode.org/reports/tr9/tr9-31.html

600   [UAX14]   Unicode Consortium, "Unicode Line Breaking Algorithm", UAX#14,
601   June 2014,
602   http://www.unicode.org/reports/tr14/tr14-33.html

603   [UAX15]   Unicode Consortium, "Normalization Forms", UAX#15, June 2014,
604   http://www.unicode.org/reports/tr15/tr15-41.html

605   [UAX29]   Unicode Consortium, "Unicode Text Segmentation", UAX#29, June
606   2014,
607   http://www.unicode.org/reports/tr29/tr29-25.html

608   [UAX31]   Unicode Consortium, "Unicode Identifier and Pattern Syntax",
609   UAX#31, June 2014,
610   http://www.unicode.org/reports/tr31/tr31-21.html

611   [UNICODE]   Unicode Consortium, "Unicode Standard", Version 8.0.0, June 2015,
612   http://www.unicode.org/versions/Unicode8.0.0/

613   [UTS10]   Unicode Consortium, "Unicode Collation Algorithm", UTS#10, June
614   2014,
615   http://www.unicode.org/reports/tr10/tr10-30.html

616   [UTS35]   Unicode Consortium, "Unicode Locale Data Markup Language",
617   UTS#35, September 2014,
618   http://www.unicode.org/reports/tr35/tr35-37/tr35.html

619   [UTS39]   Unicode Consortium, "Unicode Security Mechanisms", UTS#39,
620   September 2014,
621   http://www.unicode.org/reports/tr39/tr39-9.html

11.2 Informative References

623   [BCP195]   Y. Sheffer, R. Holz, P. Saint-Andre, "Recommendations for Secure
624   Use of Transport Layer Security (TLS) and Datagram Transport Layer
625   Security (DTLS)", RFC 7525/BCP 195, May 2015,
626   http://tools.ietf.org/html/rfc7525

627   [PWG5100.19]   S. Kennedy, "IPP Implementor's Guide v2.0", PWG 5100.19, August
628   2015, http://ftp.pwg.org/pub/pwg/candidates/cs-ippig20-20150821-
629   5100.19.pdf

630   [RFC3196]   T. Hastings, C. Manros, K. Kugler, H. Holst, P. Zehler, "Internet
631   Printing Protocol/1.1: Implementor's Guide", RFC 3196, November
632   2001, http://tools.ietf.org/html/rfc3196

633   [UTR17]   Unicode Consortium "Unicode Character Encoding Model", UTR#17,
634   November 2008,
635   http://www.unicode.org/reports/tr17/tr17-7.html

636   [UTR20]   Unicode Consortium "Unicode in XML and other Markup Languages",
637   UTR#20, January 2013,
638   http://www.unicode.org/reports/tr20/tr20-9.html

639   [UTR23]   Unicode Consortium "Unicode Character Property Model", UTR#23,
640   November 2008,
641   http://www.unicode.org/reports/tr23/tr23-9.html

642   [UTR33]   Unicode Consortium "Unicode Conformance Model", UTR#33,
643   November 2008,
644   http://www.unicode.org/reports/tr33/tr33-5.html

645   [UNISECFAQ]   Unicode Consortium "Unicode Security FAQ", November 2013,
646   http://www.unicode.org/faq/security.html

12. Editors' Addresses

Michael R. Sweet
Apple Inc
10431 N De Anza Blvd
M/S 111-HOMC
Cupertino, CA 95014
Email: msweet@apple.com

Ira McDonald
High North
PO Box 221
Grand Marais, MI 49839
Email: blueroofmusic@gmail.com

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

Ron Bergman (original editor)
Shah Bhatti
Nancy Chen
Lee Farrell
Gail Giansiracusa
Tom Hastings
Harry Lewis (original editor)
Makoto "Mac" Matsuda
Joe Murdock
Glen Petrie
Jerry Thrasher
Ted Tronson
Paul Tykodi
Bill Wagner
Dave Whitehead
Craig Whittle
Peter Zehler

13. The PWG Internet Printing Protocol (IPP) Workgroup

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

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

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

14. Changes from PWG 5100.12-2011

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

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