The Printer Working Group

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Working Draft

Internet Printing Protocol/2.x Fourth Edition (BASE)

Status: Interim

Abstract: This specification defines the 2.0, 2.1, and 2.2 versions of the Internet Printing Protocol.

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

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

This document is available at:

https://ftp.pwg.org/pub/pwg/ipp/wd/wd-ippbase23-20220124.docx
https://ftp.pwg.org/pub/pwg/ipp/wd/wd-ippbase23-20220124.pdf

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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 system providers, network connectivity vendors, and print management application developers. The PWG 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.”

To meet this objective, the PWG documents the results of their work as open standards that define print related protocols, interfaces, procedures, and conventions. A PWG standard is a stable, well understood, and technically competent specification that is widely used with multiple independent and interoperable implementations. Printer manufacturers and vendors of printer related software benefit from the interoperability provided by voluntary conformance to these standards.

For additional information regarding the Printer Working Group visit:

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1. Introduction

The Internet Printing Protocol consists of dozens of IETF, PWG, and Wi-Fi Alliance IPP extension specifications as well as many vendor extensions. IPP is used by billions of client devices, printers, and print services every day.

This document defines three IPP protocol versions compatible with the IETF Internet Printing Protocol/1.1 [STD92]: IPP/2.0 for home and workgroup printing, IPP/2.1 for enterprise printing, and IPP/2.2 for production printing. Section 13 provides a detailed history of the Internet Printing Protocol and its development within the IETF and PWG.

Note: The IPP Everywhere v1.1 [PWG5100.14] specification defines a complete driverless printing profile based on IPP/2.0 that is a common baseline for both Client and Printer implementations. IPP Everywhere defines a different method of disclosing named features instead of version numbers representing broad categories of printers and print services.

2. Terminology

2.1 Conformance Terminology

Capitalized terms, such as MUST, MUST NOT, RECOMMENDED, REQUIRED, SHOULD, SHOULD NOT, MAY, and OPTIONAL, have special meaning relating to conformance as defined in Key words for use in RFCs to Indicate Requirement Levels [BCP14]. The term CONDITIONALLY REQUIRED is additionally defined for a conformance requirement that applies when a specified condition is true.

The term DEPRECATED is used for previously defined and approved protocol elements that SHOULD NOT be used or implemented. The term OBSOLETE is used for previously defined and approved protocol elements that MUST NOT be used or implemented.

2.2 Printing Terminology

Normative definitions and semantics of printing terms are imported from the Internet Printing Protocol/1.1 [STD92].

Document: An object created and managed by a Printer that contains the description, processing, and status information. A Document object may have attached data and is bound to a single Job.

Enterprise Printer: A high availability Output Device that is shared by large groups of people to produce medium to high volumes of hardcopy output.

Job: An object created and managed by a Printer that contains description, processing, and status information. The Job also contains zero or more Document objects.

Logical Device: a print server, software service, or gateway that processes jobs and either forwards or stores the processed job or uses one or more Physical Devices to render output.

Output Device: a single Logical or Physical Device

Physical Device: a hardware implementation of a endpoint device, e.g., a marking engine, a fax modem, etc.

Production Printer: A high volume and/or large format Output Device that is used to deliver finished hardcopy output such as books, magazines, business cards, posters, and so forth.

Workgroup Printer: An Output Device that is used by a single End User or small groups of people to produce low volumes of hardcopy output.

2.3 Protocol Role Terminology

The following protocol roles are defined to specify unambiguous conformance requirements:

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

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

2.4 Acronyms and Organizations

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

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

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

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

3. Requirements

3.1 Rationale

Given the following existing specifications:

1. Internet Printing Protocol/1.1 [STD92]
2. Internet Printing Protocol: Job and Printer Set Operations [RFC3380]
3. Internet Printing Protocol: IPP URL Scheme [RFC3510]
4. Internet Printing Protocol: Event Notifications and Subscriptions [RFC3995]
5. Internet Printing Protocol: The 'ippget' Delivery Method for Event Notifications [RFC3996]
6. Internet Printing Protocol: Job and Printer Administrative Operations [RFC3998]
7. IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472]
8. IPP Finishings v3.0 [PWG5100.1]
9. IPP "output-bin" attribute extension [PWG5100.2]
10. IPP Production Printing Extensions v2.0 [PWG5100.3]
11. IPP Document Object v1.1 [PWG5100.5]
12. IPP Page Overrides [PWG5100.6]
13. IPP Job Extensions v2.0 [PWG5100.7]
14. IPP "-actual" attributes [PWG5100.8]
15. IPP Printer State Extensions [PWG5100.9]
16. IPP Enterprise Printing Extensions v2.0 [PWG5100.11]
17. PWG Media Standardized Names v2.0 [PWG5101.1]
18. PWG Command Set Format for IEEE 1284 Device ID v1.0 [PWG5107.2]

And given the need for common baseline protocol feature support, this specification should:

1. Standardize profiles of the IPP 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 4.

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.

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 names, 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 makes 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 subsections define exceptions in addition to those defined in the Internet Printing Protocol/1.1 [STD92].

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.

3.4 Out of Scope

The following are considered out of scope for this specification:

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

3.5 Design Requirements

The design requirements for this specification are:

1. Define conformance profiles that reference IETF IPP and PWG IPP specifications;
2. Define conformance requirements for both IPP Printers and IPP Clients; and
3. Define IANA registration information for new values of “ipp-versions-supported”.

4. Model

This specification extends the Internet Printing Protocol/1.1 [STD92] model to address three general printing environments.

4.1 Internet Printing Protocol/1.1

The Internet Printing Protocol/1.1 [STD92] does not target a specific class of output devices and only requires conformance to the PWG Media Standardized Names v2.0 (MSN) [PWG5101.1] specification. It serves as the basis for the 2.x protocol versions.

4.2 Internet Printing Protocol/2.0

This IPP conformance level is targeted to a Workgroup Printer 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.

4.3 Internet Printing Protocol/2.1

This IPP conformance level is targeted to an Enterprise Printer 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. An 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.

4.4 Internet Printing Protocol/2.2

This IPP conformance level is targeted to a Production Printer 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.

5. IPP/2.x Requirements

This section specifies the IPP standards that are RECOMMENDED or REQUIRED for each IPP protocol version defined in this specification. By design, each IPP conformance level builds on the required functionality of all lower versions.

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

Table 1 - IPP Standards for IPP Protocol Versions

IETF or PWG Specification	IPP/1.1 Support	IPP/2.0 Support	IPP/2.1 Support	IPP/2.2 Support
PWG 5100.1		REQUIRED	REQUIRED	REQUIRED
PWG 5100.2		REQUIRED	REQUIRED	REQUIRED
PWG 5100.3				REQUIRED
PWG 5100.5			RECOMMENDED	REQUIRED
PWG 5100.6			RECOMMENDED	REQUIRED
PWG 5100.7		RECOMMENDED	REQUIRED	REQUIRED
PWG 5100.8			RECOMMENDED	REQUIRED
PWG 5100.9		RECOMMENDED	REQUIRED	REQUIRED
PWG 5100.11			REQUIRED	REQUIRED
PWG 5101.1		REQUIRED	REQUIRED	REQUIRED

IETF or PWG Specification	IPP/1.1 Support	IPP/2.0 Support	IPP/2.1 Support	IPP/2.2 Support
RFC 3380		RECOMMENDED	REQUIRED	REQUIRED
RFC 3510	REQUIRED	REQUIRED	REQUIRED	REQUIRED
RFC 3995		RECOMMENDED	REQUIRED	REQUIRED
RFC 3996		RECOMMENDED	REQUIRED	REQUIRED
RFC 3998		RECOMMENDED	REQUIRED	REQUIRED
RFC 7472	RECOMMENDED	RECOMMENDED	RECOMMENDED	REQUIRED
RFC 8446	RECOMMENDED	RECOMMENDED	RECOMMENDED	REQUIRED
STD 92	REQUIRED	REQUIRED	REQUIRED	REQUIRED

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5.1 IPP/2.0 Requirements

An IPP/2.0 Printer MUST support the following specifications:

1. Internet Printing Protocol/1.1: [STD92];
2. Internet Printing Protocol/1.1: IPP URL Scheme [RFC3510];
3. IPP Finishings v3.0 (FIN) [PWG5100.1] (for “finishings” attribute);
4. IPP “output-bin” attribute extension [PWG5100.2]; and
5. PWG Media Standardized Names 2.0 [PWG5101.1] (for “media” attribute).

An IPP/2.0 Printer SHOULD support the following specifications:

1. IPP Job Extensions v2.0 [PWG5100.7] (for “media-col” attributes);
2. IPP Printer State Extensions [PWG5100.9];
3. Internet Printing Protocol: Job and Printer Set Operations [RFC3380];
4. Internet Printing Protocol: Event Notifications and Subscriptions [RFC3995];
5. Internet Printing Protocol: The ‘ippget’ Delivery Method for Event Notifications [RFC3996];
6. Internet Printing Protocol: Job and Printer Administrative Operations [RFC3998];
7. IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472]; and
8. The Transport Layer Security (TLS) Protocol Version 1.3 [RFC8446].

5.2 IPP/2.1 Requirements

An IPP/2.1 Printer MUST support:

1. All of the REQUIRED specifications for IPP/2.0;
2. Multiple document Jobs and the Create-Job and Send-Document operations;
3. Internet Printing Protocol: Job and Printer Set Operations [RFC3380];
4. Internet Printing Protocol: Event Notifications and Subscriptions [RFC3995];
5. Internet Printing Protocol: The ‘ippget’ Delivery Method for Event Notifications [RFC3996];
6. Internet Printing Protocol: Job and Printer Administrative Operations [RFC3998];
7. IPP Job Extensions v2.0 [PWG5100.7];
8. IPP Printer State Extensions [PWG5100.9]; and
9. IPP Enterprise Printing Extensions v2.0 [PWG5100.11].

An IPP/2.1 Printer SHOULD support the following specifications:

1. IPP Document Object v1.1 [PWG5100.5];
2. IPP Page Overrides [PWG5100.6];
3. IPP “-actual” Attributes [PWG5100.8];
4. IPP over HTTPS Transport Binding and 'ipps' URI Scheme [RFC7472]; and
5. The Transport Layer Security (TLS) Protocol Version 1.3 [RFC8446].

5.3 IPP/2.2 Requirements

An IPP/2.2 printer MUST support the following specifications:

1. All of the REQUIRED specifications for IPP/2.0;
2. All of the REQUIRED specifications for IPP/2.1;
3. IPP Production Printing Extensions v2.0 [PWG5100.3];
4. IPP Document Object v1.1 [PWG5100.5];
5. IPP Page Overrides [PWG5100.6];
6. IPP “-actual” Attributes [PWG5100.8];
7. IPP Enterprise Printing Extensions v2.0 [PWG5100.11];
8. The Transport Layer Security (TLS) Protocol Version 1.3 [RFC8446].

An IPP/2.2 Printer SHOULD support the following specifications:

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

6. IPP Attributes

The following subsections define increased conformance requirements for various attributes.

6.1 Operation Attributes

Table 2 provides a summary of the conformance requirements for operation attributes in IPP/2.0, IPP/2.1, and/or IPP/2.2.

Table 2 - Updated IPP Operation Attributes

Attribute	Reference	IPP/2.0	IPP/2.1	IPP/2.2
status-message	STD92	RECOMMENDED	RECOMMENDED	REQUIRED

6.2 Job/Document Template Attributes

Table 3 provides a summary of the conformance requirements for Job and Document Template attributes in IPP/2.0, IPP/2.1, and/or IPP/2.2. Additional requirements for specific attributes are provided in the subsections below.

Table 3 - Updated IPP Job/Document Template Attributes

Attribute	Reference	IPP/2.0	IPP/2.1	IPP/2.2
copies	STD92	REQUIRED	REQUIRED	REQUIRED
job-hold-until	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-priority	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-sheets	STD92	RECOMMENDED	REQUIRED	REQUIRED
media	STD92	REQUIRED	REQUIRED	REQUIRED
orientation-requested	STD92	REQUIRED	REQUIRED	REQUIRED
output-bin	PWG5100.2	REQUIRED	REQUIRED	REQUIRED
print-quality	STD92	REQUIRED	REQUIRED	REQUIRED
printer-resolution	STD92	REQUIRED	REQUIRED	REQUIRED
sides	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED

6.2.1 media (type2 keyword | name(MAX))

Printers MUST support this attribute. Values of the “media” attribute [STD92] MUST conform to the PWG Media Standardized Names 2.0 (MSN) [PWG5101.1].

6.2.2 print-quality (type2 enum) and printer-resolution (resolution)

The “print-quality” attribute has higher precedence than “printer-resolution”. If the Printer cannot support a requested combination, it returns the usual 'successful-ok-ignored-or-substituted-attributes' or 'client-error-conflicting-attributes' status code in the response to a Create-Job, Print-Job, Print-URI, or Validate-Job request.

6.2.3 sides (type2 keyword)

Printers that support duplex output MUST support this attribute with the values 'one-sided', 'two-sided-long-edge', and 'two-sided-short-edge'.

6.3 Printer Description Attributes

Table 4 provides a summary of the conformance requirements for Printer Description attributes in IPP/2.0, IPP/2.1, and/or IPP/2.2. Additional requirements for specific attributes are provided in the subsections below.

Table 4 - Updated IPP Printer Description Attributes

Attribute	Reference	IPP/2.0	IPP/2.1	IPP/2.2
color-supported	STD92	REQUIRED	REQUIRED	REQUIRED
copies-default	STD92	REQUIRED	REQUIRED	REQUIRED
copies-supported	STD92	REQUIRED	REQUIRED	REQUIRED
job-hold-until-default	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-hold-until-supported	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-priority-default	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-priority-supported	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-sheets-default	STD92	RECOMMENDED	REQUIRED	REQUIRED
job-sheets-supported	STD92	RECOMMENDED	REQUIRED	REQUIRED
media-default	STD92	REQUIRED	REQUIRED	REQUIRED
media-ready	STD92	RECOMMENDED	RECOMMENDED	REQUIRED
media-supported	STD92	REQUIRED	REQUIRED	REQUIRED
orientation-requested-default	STD92	REQUIRED	REQUIRED	REQUIRED
orientation-requested-supported	STD92	REQUIRED	REQUIRED	REQUIRED
output-bin-default	PWG5100.2	REQUIRED	REQUIRED	REQUIRED
output-bin-supported	PWG5100.2	REQUIRED	REQUIRED	REQUIRED
pages-per-minute	STD92	REQUIRED	REQUIRED	REQUIRED
pages-per-minutes-color	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED
print-quality-default	STD92	REQUIRED	REQUIRED	REQUIRED
print-quality-supported	STD92	REQUIRED	REQUIRED	REQUIRED
printer-alert	PWG5100.9	RECOMMENDED	REQUIRED	REQUIRED
printer-alert-description	PWG5100.9	RECOMMENDED	REQUIRED	REQUIRED
printer-info	STD92	REQUIRED	REQUIRED	REQUIRED
printer-location	STD92	REQUIRED	REQUIRED	REQUIRED
printer-make-and-model	STD92	REQUIRED	REQUIRED	REQUIRED
printer-more-info	STD92	REQUIRED	REQUIRED	REQUIRED
printer-resolution-default	STD92	REQUIRED	REQUIRED	REQUIRED
printer-resolution-supported	STD92	REQUIRED	REQUIRED	REQUIRED
sides-default	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED
sides-supported	STD92	C. REQUIRED	C. REQUIRED	C. REQUIRED

6.3.1 pages-per-minutes-color (integer(0:MAX))

Printers that support more than one color, i.e. the value of "color-supported" is 'true', MUST support this attribute.

6.3.2 sides-default (type2 keyword)

Printers that support duplex output MUST support this attribute with the values 'one-sided', 'two-sided-long-edge', or 'two-sided-short-edge'.

6.3.3 sides-supported (1setOf type2 keyword)

Printers that support duplex output MUST support this attribute with the values 'one-sided', 'two-sided-long-edge', and 'two-sided-short-edge'.

7. Conformance Requirements

7.1 Printer Conformance Requirements

In order for a Printer to claim conformance to IPP/2.0 as defined in this specification, a Printer MUST:

1. Conform to all REQUIRED IPP Standards defined in section 5.1;
2. Support all REQUIRED IPP/2.0 Attributes defined in section 6 of this specification;
3. Conform to the Internationalization Considerations defined in section 8 of this specification; and
4. Conform to the Security Considerations defined in section 9 of this specification.

In order for a Printer to claim conformance to IPP/2.1 as defined in this specification, a Printer MUST:

1. Conform to all REQUIRED IPP Standards defined in sections 5.1 and 5.2;
2. Support all REQUIRED IPP/2.1 Attributes defined in section 6 of this specification;
3. Conform to the Internationalization Considerations defined in section 8 of this specification; and
4. Conform to the Security Considerations defined in section 9 of this specification.

In order for a Printer to claim conformance to IPP/2.2 as defined in this specification, a Printer MUST:

1. Conform to all REQUIRED IPP Standards defined in sections 5.1, 5.2, and 5.3;
2. Support all REQUIRED IPP/2.2 Attributes defined in section 6 of this specification;
3. Conform to the Internationalization Considerations defined in section 8 of this specification; and
4. Conform to the Security Considerations defined in section 9 of this specification.

7.2 Client Conformance Requirements

In order for a Client to claim conformance to this specification, a Client MUST:

1. Conform to all REQUIRED IPP Standards defined in section 5.1;
2. Conform to the Internationalization Considerations defined in section 8 of this specification; and
3. Conform to the Security Considerations defined in section 9 of this specification, including the RECOMMENDED or REQUIRED TLS versions for IPP/2.0, IPP/2.1, and IPP/2.2 implementations.

8. Internationalization Considerations

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

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

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

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

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

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

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

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

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

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

Unicode Collation Algorithm [UTS10] – sorting

Unicode Locale Data Markup Language [UTS35] – locale databases

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

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

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

Unicode Character Property Model [UTR23] – character properties

Unicode Conformance Model [UTR33] – Unicode conformance basis

9. Security Considerations

The IPP extensions defined in this document require the same security considerations as defined in the Internet Printing Protocol/1.1 [STD92].

Clients conforming to any version of IPP MUST support HTTP Basic [RFC7617] and HTTP Digest [RFC7616] authentication. Clients SHOULD conform to the IPP Authentication Methods v1.0 [PWG5199.10].

Printers conforming to IPP/2.2 MUST support TLS/1.3 [RFC8446] [RFC7525] or a later version.

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

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

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

Unicode Security FAQ [UNISECFAQ] – common Unicode security issues

10. IANA and PWG Considerations

10.1 Attribute Value Registrations

The attribute values defined in this document will be published by IANA according to the procedures in the Internet Printing Protocol/1.1 [STD92] in the following location:

https://www.iana.org/assignments/ipp-registrations

The registry entries will contain the following information:

```
Attributes (attribute syntax)
  Keyword Attribute Value                          Reference
  -----------------------                          ---------
ipp-versions-supported (1setOf type2 keyword)      [STD92]
  2.0                                              [PWG5100.12]
  2.1                                              [PWG5100.12]
  2.2                                              [PWG5100.12]
```

11. References

11.1 Normative References

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12. Editors' Addresses

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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:

https://www.pwg.org/ipp/

The IPP Everywhere project and IPP Implementor's Guide 2.0 [PWG5100.19] provide useful supplemental information to this specification.

13.1 History of the Internet Printing Protocol

In the summer of 1996, Novell approached a number of companies to find out if they were interested to participate in a printing protocol project for the Internet. Xerox and others expressed some interest and suggested that the first step would be to develop a draft text and decide how to initiate the project. As result, a first draft document was developed in cooperation between Novell and Xerox. At this stage, the project was known as Lightweight Document Printing Application (LDPA). In a parallel effort, IBM had started working on a proposal for Internet printing using Web technology, under the name of HyperText Printing Protocol (HTPP). It was also known that Microsoft and HP had started work on a solution for a new generation of print services for Windows NT 5.0.

In parallel to the writing of initial draft texts, the initiators investigated how to start up the public standardization project. It was clear from the beginning that the initiators wanted the project to become an acknowledged project with the Internet Engineering Task Force (IETF), but first needed to get together a forum of experts before suggesting it to the IETF. The choice was to start the activity in the Printer Working Group (PWG), a group of people with representation from printer and print server vendors, which had previously developed the IETF Printer MIB specification.

After initial discussions in a couple of earlier meetings, the PWG started the IPP project in November 1996. Carl-Uno Manros from Xerox was chosen as the project chair and Scott Isaacson from Novell as the main editor. Steve Zilles from Adobe was later added as the IETF co-chair, with Don Wright from Lexmark, Bob Herriot from Sun, and Roger deBry from IBM as further editors. After some discussion, it was decided to pool the earlier efforts from Novell/Xerox and IBM into what is now named the Internet Printing Protocol (IPP) project. Some 20 companies involved with printers and/or print servers confirmed that they were interested in participating. After negotiation with the Application Area Directors in the IETF, they decided to hold a birds-of-a-feather (BOF) session for IPP in the December 1996 meeting of the IETF. The outcome of that meeting confirmed that there was widespread interest in developing a printing protocol for the Internet.

The IPP/1.0 specifications were published by the IETF as experimental documents in April 1999 [RFC2566] [RFC2567]. IPP/1.1 appeared as a proposed standard in September 2000 [RFC2910] [RFC2911], with extensions being published through Match 2005 until the IETF IPP working group was concluded.

At the December 2007 face-to-face meeting, the PWG membership decided that something needed to be done to ensure interoperability with the increasing number of IPP/1.1 extensions, particularly for the collection syntax and media naming. This ultimately led to the publication of the first edition of IPP/2.0 that defined protocol versions 2.0 and 2.1 in July 2009 [PWG5100.10-2009]. This was followed by a second edition of IPP/2.0 that defined protocol version 2.2 in February 2011 [PWG5100.12-2011].

After successful interoperability testing of both IPP/1.1 and IPP/2.0 with multiple vendors' products, the PWG published a second errata update of IPP/2.0 in October 2015 [PWG5100.12-2015] as a PWG standard and worked with the IETF to publish IPP/1.1 as an Internet Standard in June 2018 [STD92].

14. Changes from PWG 5100.12-2015

The following changes were made since the previous version of this document [PWG5100.12-2015]:

1. Updated all document references,
2. Greatly simplified the reference tables and list of attributes to only those that differ from the base standards,
3. Added new Unicode references, internationalization considerations, and security considerations.
4. Added a history of the development of the Internet Printing Protocol.

15. Change History

This section will be removed when the document is published.

15.1 January 24, 2022

- Dropped PWG 5107.2 references throughout
- Added references to PWG 5199.10 (IPP Authentication Methods v1.0)
- Added definitions for Enterprise, Production, and Workgroup Printer, and use them in the paragraphs defining IPP/2.0, 2.1, and 2.2

15.2 October 20, 2021

- Status: Interim
- Section 5: Reworded, dropped note above table
- Table 1: Make RFC 7472 REQUIRED for IPP/2.2, Dropped brackets around spec numbers and added spaces (e.g. RFC 7472 instead of [RFC7472])
- Made PWG 5100.11 REQUIRED for IPP/2.1
- Section 9: Added reference to RFC 7525 (UTA), updated to TLS 1.3 or later, added mention/references for HTTP authentication
- Section 11: Updated RFC URLs to use data tracker site as the tools site is going away
- Section 13: Updated the IPP WG home page to use a https: URL.

15.3 April 21, 2021

- Title: Internet Printing Protocol/2.0 Fourth Edition (BASE)
- Moved sections 1.1 to 1.3 to a new section 4 (model)
- New section 4 (model)
- New section 4.1 (IPP/1.1)
- Section 5: Updated title and updated some of the conformance requirements to RECOMMENDED (where previously optional) where it made sense
- Section 5.x: Updated list of recommended specifications

15.4 February 11, 2021

- Updated all references
- Updated to match current document template
- Updated introduction to explain the current usage of protocol version
- Gutted the large attribute tables - now just list differences from the base standards in combined tables, like the IPP standards are shown
- Updated the conformance sections to split up the printer conformance to the three protocol versions

