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The Printer Working Group

IPP Everywhere

Status: Approved

Abstract: This standard defines an extension of IPP to support network printing without vendor-specific driver software, including the transport, various discovery protocols, and standard document formats.

This document is a PWG Candidate Standard. For a definition of a "PWG Candidate Standard", see: ftp://ftp.pwg.org/pub/pwg/general/pwg-process30.pdf

This document is available electronically at:

ftp://ftp.pwg.org/pub/pwg/candidates/cs-ippeve10-20130128-5100.14.docx
ftp://ftp.pwg.org/pub/pwg/candidates/cs-ippeve10-20130128-5100.14.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 systems providers, network connectivity vendors, and print management application developers. The group is chartered to make printers and the applications and operating systems supporting them work together better. All references to the PWG in this document implicitly mean "The Printer Working Group, a Program of the IEEE ISTO." In order to meet this objective, the PWG will document the results of their work as open standards that define print related protocols, interfaces, procedures and conventions. Printer manufacturers and vendors of printer related software will benefit from the interoperability provided by voluntary conformance to these standards.

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

For additional information regarding the Printer Working Group visit:

   http://www.pwg.org

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About the Internet Printing Protocol Work Group

The Internet Printing Protocol (IPP) working group 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.

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1. Introduction

New mobile devices (e.g., cellphones, PDAs, netbooks, etc.) do not follow the traditional use models for printing services. For mobile devices, discovery of available printers and their capabilities is both more difficult than for traditional desktop systems and more important because of dynamically changing network attachment points.

Printer vendors and software vendors have defined and deployed many different document formats (page description languages) and also dialects of those document formats, increasing the traditional desktop system need for model-specific printer drivers. While there are millions of model-specific printer drivers now available for traditional desktop systems, this printer driver model is clearly not practical for mobile devices.

The goal of IPP Everywhere is to allow Clients, particularly mobile Internet devices, to easily support printing using IPP but without the use of vendor-specific drivers through the adoption of standard document formats, discovery protocols, and schemas.

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 [RFC2119].

The term CONDITIONALLY REQUIRED is additionally defined for a conformance requirement that applies to a particular capability or feature.

2.2 Imaging Terminology

Normative definitions and semantics of printing terms are imported from IETF Printer MIB v2 [RFC3805], IETF Finisher MIB [RFC3806], and IETF Internet Printing Protocol/1.1: Model and Semantics [RFC2911].

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

Client: Initiator of outgoing IPP session requests and sender of outgoing IPP operation requests (Hypertext Transfer Protocol -- HTTP/1.1 [RFC2616] User Agent).

Device: A Logical or Physical Device associated with one or more Printers; also see section 2.3 of [RFC2911].

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.

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.

Physical Device: a device that renders output (typically on paper.)

Printer: Listener for incoming IPP session requests and receiver of incoming IPP operation requests (Hypertext Transfer Protocol -- HTTP/1.1 [RFC2616] Server) that represents one or more Physical Devices or a Logical Device.

Imaging Device: A printer or other device that acts as a Printer.

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.

2.3 Other Terminology

Direct Imaging: Printing, facsimile, and scanning performed by direct communication from the Client to an Imaging Device or local print server.

Directory Service: A Service providing query and enumeration of information using names or other identifiers.

Discovery: Finding Printers by querying or browsing local network segments or Enumeration of Directory or Name Services.

Enumeration: Listing Printers that are registered with a Directory or other Service.

Indirect Imaging: Printing, facsimile, and scanning performed by communication from the Client and/or Imaging Device to an intermediary service in a different administrative domain, for example when the Client communicates with a third-party print service or when an Imaging Device communicates with a Cloud service.

Network Accessible Device: A Device that can be directly accessed by a Client.

Network Accessible/Accessibility: Refers to the ability of one device to communicate directly with another, for example a Client is able to connect to a Device, query for supported attributes, submit Job creation requests, and so forth.

Operator: A person or automata that typically oversees the Printer. The Operator is allowed to query and manage the Printer, Jobs and Documents based on site policy.

Paid Imaging Services: Printing, facsimile, and scanning performed for a fee. The means of collecting payment is outside the scope of this specification.

Secure Print: A print job using the "document-password", "job-password", and/or "job-password-encryption" operation attributes to provide document and/or physical security. See [PWG5100.11] and [PWG5100.13].

Service: Software providing access to physical, logical, or virtual resources and (typically) processing of queued Jobs.

User: A person or automata using a Client to communicate with a Printer.

2.4 Acronyms and Organizations

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

IEEE: Institute of Electrical and Electronics Engineers, http://www.ieee.org/

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

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

NFC: Near Field Communications, http://www.nfc-forum.org/

OASIS: Organization for the Advancement of Structured Information Standards, http://www.oasis-open.org/

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

UPNP: Universal Plug-and-Play, http://www.upnp.org/

3. Requirements

3.1 Rationale for IPP Everywhere

Given the following existing specifications and the need for a standard method of Direct Imaging without traditional vendor-specific driver software, the IPP Everywhere Specification should:

1. Use existing protocols and schema to support discovery, identification, and auto-configuration of Imaging Devices,
2. Use the existing IPP specifications to support job submission to and monitoring of Imaging Devices,
3. Encourage support for printing through standard document formats, and
4. Discourage the further proliferation of vendor-specific page description languages, formats, discovery protocols, interfaces, and transports

The Internet Printing Protocol Version 2.0 Second Edition [PWG5100.12] defines:

1. A collection of existing IPP specifications that form the basis for IPP/2.0
2. Standard job template attributes
3. Specific interoperability requirements, such as HTTP/1.1 support with chunking and IPP collection attribute support
4. New version number and operation requirements for different classes of Imaging Devices

The IPP: Job and Printer Extensions - Set 3 [PWG5100.13] define new attributes and operations required for mobile printing and printing with generic drivers.

The PWG Raster Format [PWG5102.4] defines a minimal file format for transmission of multi-page color and grayscale bitmap images

The Document management -- Portable document format -- Part 1: PDF 1.7 [ISO32000] defines:

1. A rich file format for transmission of multi-page color and grayscale vector and bitmap images
2. Standard page attributes to support page size, orientation, and duplex functionality

The JPEG File Interchange Format Version 1.02 [JFIF] defines a compact file format for transmission of photographic images

The Open XML Paper Specification [ECMA388] defines a paginated document format based on Open Packaging Conventions (OPC) [ISO29500-2], Extensible Markup Language (XML) [XML11], and standard image and font formats with device-independent color.

The Bonjour Printing Specification version 1.0.2 [BONJOUR] defines:

1. Discovery of Printers using Domain Name System (DNS) service (SRV) lookups [RFC2782]
2. Multicast DNS for use on link-local networks [mDNS]
3. Automatic address assignment for both IPv4 [RFC3927] and IPv6
4. DNS text (TXT) record keys to support auto-configuration, capabilities, identification, and protocol selection

The Lightweight Directory Access Protocol (LDAP): Schema for Printer Services [RFC3712] defines a schema for Printer registrations and discovery via LDAP [RFC4510] and Service Location Protocol (SLP) [RFC2608] services.

The OASIS Web Services Dynamic Discovery (WS-Discovery) Version 1.1 [WS-DISCOVERY] defines a discovery protocol to locate services.

3.2 Use Cases

3.2.1 Select Printer

Printer selection is part of most Print use cases - Jane selects a Printer, implicitly or explicitly, and the remainder of the use case applies to the selected Printer. A Printer can be a Logical Printer (Service) or a Physical Printer (section 2.2). Selection use cases can often be combined, for example Selection Using a Directory Service (section 3.2.1.4) with Selection Using Properties (section 3.2.1.9).

In order to simplify the selection use cases, common exceptions are listed as separate use cases in section 3.2.3.

Precondition: For all of the following use cases, the Printer is Network Accessible to be selected, either directly or through an intermediate Service.

3.2.1.1 Select the Last Used Printer

The Client User Interface provides the last used Printer as a selection. Jane then confirms the selection of the last used Printer.

The last used Printer may be automatically selected by the Client User Interface and may be affected by the current network topology or geo-location, for example the last used Printer may be tracked on a per-network (e.g., default router or other criteria), per-location (e.g., geo-location), or per-Service (e.g., current local server) basis.

3.2.1.2 Select Printer Using Name or Address

The Client User Interface asks Jane for a name or address for the Printer. She then provides a Printer name or address through the Client User Interface. Finally, the Client User Interface queries the Printer for valid Service Uniform Resource Identifiers (URIs).

The Printer name can be a DNS Service Discovery (DNS-SD) Service name, a fully-qualified domain name, or other unique identifying name. The Printer address can be a numeric IP address or other unique identifying number.

3.2.1.3 Select Printer Using URI

The Client User Interface asks Jane for a Service URI for the Printer. She then provides a URI through the Client User Interface or cancels selection.

For example, Jane could supply an IPP URI: "ipp://example.com/port1" as reported by the Printer's network configuration page.

3.2.1.4 Select Printer Using a Directory Service

The Client obtains a list of Printers on behalf of Jane from the Directory Service and validates that each Printer supports one or more Client-supported Service protocols. The Client User Interface then asks Jane to select one of the supported Printers. Finally, she selects a Printer.

Preconditions: One or more Printers are listed in a Directory Service and that Directory Service is Network Accessible to the Client.

3.2.1.5 Select Printer Using a Cloud Service

The Client obtains a list of Printers on behalf of Jane from the Cloud Service(s). The Client User Interface then asks Jane to select one of the Printers. Finally, she selects a Printer.

Preconditions: The Client and one or more Printers are registered with a Cloud Service, and that Cloud Service is Network Accessible to both the Client and Printers. The Client and Printers may be registered with multiple Cloud Services, and both may maintain multiple identities for a particular Cloud Service.

3.2.1.6 Select Printer Using a Discovery Protocol

The Client initiates Discovery on behalf of Jane and maintains a dynamic list of Network Accessible Printers during selection. The Client User Interface asks Jane to select one of the Network Accessible Printers, updating those Printers as they come and go. Finally, she selects a Printer and the Client terminates Discovery.

Preconditions: The Printer is Network Accessible to the Client and supports a common Discovery Protocol.

3.2.1.7 Select Printer Using Geo-Location

The Client initiates Enumeration of Printers within a geographic area using Services and/or Discovery Protocols, hiding duplicate Printers that are reported by multiple Service and/or Discovery Protocols. The Client User Interface asks Jane to select one of the Printers. Finally, she selects a Printer.

Preconditions: Both the Client and Printer have access to geo-location information to allow for Enumeration within a geographic area, and both support common Discovery Protocol(s).

3.2.1.8 Select Printer Using Out of Band Method

Jane asks the Client User Interface to identify the Printer using a built-in camera, Near-Field Communications (NFC) chip, or other sensing technology. The Client initiates identification to obtain a Service URI and descriptive information. The Client User Interface then asks Jane to confirm the selection of the identified Printer. Finally, she confirms the selection.

Precondition: The Printer and Client support a common identifying technology such as NFC, Quick Response Codes (QRCodes), or bar codes.

3.2.1.9 Select Printer Using Properties

Jane selects a Printer using properties such as Service, capability, or description properties of the Printer. Service properties include the application (printing) protocol, security, or restrictions such as the maximum number of pages allowed in a job. Capability properties include values such as media, duplex, finishing, color support, and so forth, Description properties include values such as location, speed, color support, and job size. The properties may be provided by a combination of user input, policy, and/or software heuristic.

Jane asks the Client User Interface to select using properties. The Client obtains a list of Printers for Jane that meet the given properties provided by the Client software, policy, and/or user and validates that each Printer supports one or more Client-supported Service protocols. The Client User Interface then asks Jane to select one of the supported Printers. Finally, she selects a Printer.

3.2.2 Print

Each of the use cases in this section begin by initiating a print action, selecting a Printer (section 3.2.1), querying the Printer status, capabilities, and status information, and displaying of any status information important to the User. Each use case generally ends with Jane collecting the printout from the Printer.

Preconditions: For all of the following use cases, the Printer must be Network Accessible to the Client in order to be selected, either directly or through an intermediate Service.

Also, the document to be printed must be Network Accessible to the Printer and in a format suitable for the Printer or converted by the Client or Service into a suitable format.

3.2.2.1 Print a Document

Jane has a Client connected to the Wi-Fi network in her business and has a document to print prior to a meeting that is stored on her phone.

After Jane initiates a print action and selects a Printer, she specifies the processing intent for the Job and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and attached document data. The Printer validates the Job Ticket and document data and then prints the document.

3.2.2.2 Print a Document by Reference

Jane has a Client connected to the Wi-Fi network in her business and is viewing a document on a server that she would like to print.

After Jane initiates a print action and selects a Printer, she specifies the processing intent for the Job and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and document URI. The Printer validates the Job Ticket and document URI and then prints the document.

3.2.2.3 Print Using Loaded Media

Jane is viewing a photo and would like to print the photo on the largest borderless photographic media loaded on her Printer.

After Jane initiates a print action from the phone and selects a Printer, the Client photo application automatically selects the largest borderless photographic media loaded on the Selected Printer and the highest print quality. Jane selects additional processing intent for the Job and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and local photo. The Printer validates the Job Ticket and document data and then prints the photo.

Preconditions: Printer can report loaded media information such as size, orientation, type, coating, and weight. This may be detected automatically or manually entered by the User or Operator when loading the media.

3.2.2.4 Print a Secure Form

The treasurer of a small training company that is holding a meeting and seminar at a resort needs to print out 20 checks for training personnel. He uses an accounting program to enter the hours worked, bonuses, reimbursable expenses, and so forth and prints the checks on a printer provided by the resort using check blanks he brought to the meeting.

The treasurer loads check blanks into the Printer and configured the loaded media as necessary at the Printer. After he initiates a print action from the accounting program, selects a Printer for printing, and selects checks to be printed, the Client User Interface displays a preview of the printed checks and he confirms that the checks are correctly paginated and oriented and the amounts, payees and signature are correct. The Client automatically selects the check blank media. The treasurer selects additional processing intent for the Job and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and document data containing the check information, correctly oriented for the check blank media. He waits for the checks to be printed and removes any excess media from the Printer.

Preconditions: Printer can report loaded media information such as size, orientation, type, coating, and weight. This may be detected automatically or manually entered by the User or Operator when loading the media.

3.2.2.5 Print with Special Formatting

At a seminar located at a country resort, an assistant has been asked to provide 80 sets of ten keywords/phrases, clearly printed on 2-inch by 1-inch paper slips for use in a get acquainted exercise. Costs are to be minimized. The assistant has a laptop with a word processer program. The resort has a Wi-Fi network available to Users and a networked MFD at the business center. The attendant at the business center will charge for any printed sheets removed from the premises.

After the assistant initiates a print action from the word processor and selects a Printer, he selects the processing intent for the Job and confirms the print action. The word processor produces document data using the media information (size and margins) in the Job Ticket so that 2-inch by 1-inch slips are spread evenly over each page and sends a print job request to the Printer with the Job Ticket and document. The Printer validates the Job Ticket and document data and then prints the document.

3.2.2.6 Print and Select at Printer

One or more Printers are associated with a Service that allows Users to release and print Jobs at any associated Printer. Each User may release a job at a given Printer by providing a Personal Identification Number (PIN) and/or other unique identification/authorization information such as a username and password or IDentification (ID) card.

After initiating a print action and selecting a Service, Jane specifies the processing intent and PIN for the Job and confirms the print action. The Client sends a print job request to the Service with the Job Ticket and local document. The Service validates the Job Ticket and document data and then holds the document until released by Jane at the Printer.

Precondition: The Client and Printer support a common authorization or identification system. The capability of associated Printers are the same or the User selects a best-effort job processing intent.

3.2.2.7 Print to a Service

John is flying to New York for a presentation and doesn't want to carry the presentations. John arrives in New York and goes online from his mobile phone. After initiating a print action, he selects a local print provider, reviewing the provider web pages as needed. He then specifies the processing intent as 10 color copies, printed duplex and stapled on the left side, with the covers on 80lb. stock and the internal pages on 24lb. stock. After confirming the print action, John goes to the provider and picks up his presentations, paying with his corporate credit card.

3.2.2.8 Print to a Recipient

The recipient may release a job at a given Printer by providing a PIN and/or other unique identification/authorization information such as a username and password or ID card.

After initiating a print action and selecting a Printer, Jane specifies the processing intent, specifies John as the recipient, and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and local document. The Printer validates the Job Ticket and document data and then holds the document until released by John. Finally, John collects the printout from the Printer.

3.2.2.9 Print with a Proof Copy

After initiating a print action and selecting a Printer, John specifies the processing intent, requests a proof print, and confirms the print action. The Client sends a print job request to the Printer with the Job Ticket and local document. The Printer validates the Job Ticket and document data and then prints a proof copy of the document. John collects the proof printout from the Printer and verifies correct output. John then initiates a full print of the document from the Client or Printer to produce part or all of the final output.

3.2.3 Exceptions

3.2.3.1 Print Action Canceled

Jane cancels the print action UI. The Client then discontinues any active printer selection, print job submission, or other operations and cancels any incomplete print job submission as needed.

3.2.3.2 Select Printer Canceled

John cancels selection of a Printer. The Client then discontinues any active discovery, Enumeration, or query operations as needed.

3.2.3.3 Printer No Longer Network Accessible after Selection

After selecting a Network Accessible Printer, the Client, selected Printer, or network suffers a failure preventing the Client from communicating with the Printer. Typically this will display an error message on the Client and cancel the print request.

3.2.3.4 Not Authorized

After confirming the print request, the Printer responds that the User is not authorized to print the Job document(s). The reason for the authorization failure may involve general access to the Printer, Job document(s), or disallowed Job Ticket values, for example a User may not be allowed to print in color.

Precondition: The Printer has access to a file, database, or Service that provides authorization information.

3.2.3.5 Needs Authentication

After confirming the print request or selecting the Printer, the User is asked to authenticate with the Printer in order to gain access.

Precondition: The Printer has access to a file, database, or Service that provide authentication and authorization information.

3.2.3.6 Not Accepting Jobs

After confirming the print request, the Client discovers that the Printer is no longer accepting jobs, displays an error message, and cancels the print request.

3.2.3.7 Job Ticket or Document Format Not Supported

After confirming the print request, the Printer rejects the request because the job ticket or document format is not supported. The Client displays an error message and cancels the print request.

3.2.3.8 Job or Document Processing Failures

While processing a job, the Printer reports job or document processing issues to the Client, which displays an error message as needed and asks the User or Operator to confirm the disposition of the Job. Processing failures include out-of-memory, missing resources, and other conditions that prevent a particular Job or document from printing.

3.2.3.9 Printer Fault

While processing a Job, the Printer reports faults to the Client, which displays an error message as needed and asks the User or Operator to confirm the disposition of the Job. Printer faults include "out of paper" and other conditions that stop the processing of Jobs.

3.2.3.10 Printer Warning

While processing a Job, the Printer reports warnings to the Client, which provides a warning message as needed. Printer warnings include "low toner" and other advisory conditions that do not stop the processing of Jobs and do not require immediate attention.

3.3 Out of Scope

The following elements of the use cases are considered out of scope for this specification:

1. The actual method of geo-location and geographic area detection for the Select Printer Using Geo-Location (section 3.2.1.7) use case
2. The actual method of payment for the Print to a Service (section 3.2.2.7) use case
3. Constraining choice of document formats suitable for the Print use cases
4. Definition of new discovery protocols used to find Network Accessible Printers (however, extension of existing protocols is still in scope)

3.4 Design Requirements

The IPP Everywhere design should:

1. Define conformance profiles that reference the IPP/2.0 versions [PWG5100.12];
2. Follow the naming conventions defined in IETF IPP/1.1 [RFC2911], including keyword value case (lower) and hyphenation requirements;
3. Define conformance requirements for both Printers and Clients; and
4. Support printing with vendor-neutral Client software from any Client to any Printer using a variety of discovery protocols, IPP for the transport, and standard document formats.

4. Discovery Protocols

Printers MUST support DNS-SD and WS-Discovery based Discovery. Printers MAY support other Discovery protocols such as LDAP, SLP, and SSDP.

Clients MUST support DNS-SD and/or WS-Discovery. Clients MAY support other Discovery protocols such as LDAP, SLP, and SSDP.

4.1 Printer Description Attributes Used in Discovery

Table 1 lists the Printer Description attributes that would normally be used for Discovery or filtering of discovered Printers based on one or more specified Printer attribute values.

4.2 DNS Service Discovery (DNS-SD)

DNS Service Discovery [DNS-SD] uses service (SRV) records and traditional unicast and multicast DNS (mDNS) [mDNS] queries. This discovery protocol is collectively defined in the Bonjour Printing Specification version 1.0.2 [BONJOUR] and extended in this specification.

Printers MUST support mDNS and MAY support dynamic DNS updates via Dynamic Updates in the Domain Name System (DNS UPDATE) [RFC2136] and other mechanisms.

4.2.1 Service (SRV) Instance Name

Printers MUST NOT use a service instance name containing a unique identifier by default. A unique identifier MAY be added to the instance if there is a name collision.

Printers MUST advertise the "_ipp._tcp" (generic IPP) and "_ipp._tcp,_print" (IPP Everywhere) services over mDNS.

Printers supporting the "ipps" URI scheme [IPPS] MUST advertise the "_ipps._tcp" (generic IPPS) and "_ipps._tcp,_print" (IPP Everywhere Secure) services over mDNS.

The domain portion of the service instance name MUST BE "local." for mDNS.

4.2.2 Geo-Location (LOC)

Printers MUST publish LOC records [RFC1876] over mDNS to provide the physical location of the Printer. Printers MUST allow the User to configure the geo-location manually. If the accuracy of the geo-location is unknown, a value of $9x10^9$ meters (0x99) MUST be used.

Table 1 - Attributes in Discovery Protocols

IPP Attribute	DNS-SD TXT Key	LDAP/SLP Attribute
color-supported	Color	printer-color-supported
copies-supported	Copies	printer-copies-supported
device-service-count	(note 2)	printer-device-service-count (note 1)
device-uuid	DUUID	printer-device-uuid (note 1)
document-formats-supported	pdl	printer-document-format-supported
finishings-supported	Bind, Punch, Sort, Staple	printer-finishings-supported
ipp-versions-supported	(subtype)	printer-ipp-versions-supported
media-supported	PaperCustom, PaperMax	printer-media-supported
multiple-document-handling	Collate	-
pages-per-minute	(note 2)	printer-pages-per-minute
pages-per-minute-color	(note 2)	printer-pages-per-minute-color
printer-charge-info	(note 2)	printer-charge-info (note 1)
printer-charge-info-uri	chargeuri	printer-charge-info-uri (note 1)
printer-device-id	usb_CMD, usb_MDL, usb_MFG	printer-device-id (note 1)
printer-geo-location	(LOC record)	printer-geo-location (note 1)
printer-info	(instance)	printer-info
printer-location	note	printer-location
printer-make-and-model	ty	printer-make-and-model
printer-more-info	adminurl	printer-more-info
printer-name	(instance)	printer-name
printer-organization	(note 2)	O
printer-organizational-unit	(note 2)	OU
printer-uri-supported	(service + host + port) rp	printer-uri, printer-xri-supported
printer-uuid	UUID	printer-uuid (note 1)
sides-supported	Duplex	printer-sides-supported
uri-authentication-supported	air	printer-xri-supported
uri-security-supported	TLS	printer-xri-supported

Note 1: Extension attribute to RFC 3712.
Note 2: Available via subsequent IPP Get-Printer-Attributes request.

4.2.3 Text (TXT)

Printers MUST publish a text (TXT) record that provides service information over mDNS. Printers that support dynamic DNS updates MUST publish separate TXT records for each domain that is updated. The following subsections define new key/value pairs in addition to those required by the Bonjour Printing Specification [BONJOUR].

Table 3 lists all of the key/value pairs that are defined with the corresponding default values. Printers SHOULD omit key/value pairs when the value matches the default value for the corresponding key to limit the size of the TXT record.

The combined length of a TXT key/value pair ("key=value") cannot exceed 255 octets. This limit is sometimes smaller than the limit imposed by the corresponding IPP attribute.

For example, the IPP "printer-more-info" attribute has a maximum length of 1023 octets, however the corresponding "adminurl" key cannot represent a value longer than 246 octets (255 - 9 octets for "adminurl="). Printers MUST truncate long strings as described in section 13.

The combined length of all TXT key/value pairs provided by the Printer SHOULD BE 400 octets or less for unicast DNS and MUST NOT exceed 1300 octets for multicast DNS.

Printers MUST provide the "rp" TXT key/value pair within the first 400 octets of the TXT record. Table 2 shows the priority of TXT key/value pairs.

Table 2 - Priority of DNS TXT Key/Value Pairs

Most Important Access Keys	Identification Keys	Capability Keys	Least Important Keys
rp	UUID	Color	Product
txtvers	DUUID	Duplex	usb_MFG
priority	ty	Copies	usb_MDL
qtotal		Collate	usb_CMD
note		PaperMax	pdl
air		PaperCustom	
TLS		Bind	
adminurl		Punch	
		Sort	
		Staple	

Clients MUST ignore incomplete key/value pairs at the end of a truncated TXT record.

Table 3 - DNS TXT Record Keys

Key	Description	Default Value
adminurl	The Printer-resident configuration page URL as reported by the "printer-more-info" Printer Description attribute.	'' (empty string)
air	The type of authentication information that is required for the Printer. See section 4.2.3.1.	'none'
Bind	'T' if the Printer can bind output, 'F' otherwise.	'U' (note 1)
Collate	'T' if the Printer can collate copies, 'F' otherwise.	'U' (note 1)
Color	'T' if the Printer supports color printing, 'F' otherwise.	'U' (note 1)
Copies	'T' if the Printer can make copies on its own, 'F' otherwise.	'U' (note 1)
Duplex	'T' if the Printer supports duplex printing, 'F' otherwise	'U' (note 1)
DUUID	The UUID of the Device without the "urn:uuid:" prefix as reported by the "device-uuid" Printer Description attribute. See section 4.2.3.9.	'' (empty string)
note	The location of the Printer as reported by the "printer-location" Printer Description attribute.	'' (empty string)
PaperCustom	'T' if the Printer supports custom media sizes, 'F' otherwise.	'U' (note 1)
PaperMax	The maximum media size supported by the Printer: '<legal-A4', 'legal-A4', 'isoC-A2', '>isoC-A2'.	'legal-A4'
pdl	A comma-delimited list of supported MIME media types. See section 4.2.3.2.	'' (empty string)
priority	The priority for the service from 0 to 99, where 0 is the highest priority and 99 is the lowest priority.	'50'
product	The PostScript product name, typically the value reported by the "printer-make-and-model" Printer Description attribute with parenthesis, e.g., '(Example Model)'.	'' (empty string)
Punch	'T' if the Printer can punch output, 'F' otherwise.	'U' (note 1)
qtotal	The number of queues for this Printer. MUST have the value '1'. See section 4.2.3.3	'1'

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Key	Description	Default Value
rp	The remote print queue name, which is the resource path portion of the Printer URI without the leading slash.	'' (empty string)
Sort	'T' if the Printer can sort output, 'F' otherwise.	'U' (note 1)
Staple	'T' if the Printer can staple output, 'F' otherwise.	'U' (note 1)
TLS	The maximum TLS version supported or 'none' if no version of TLS is supported. See section 4.2.3.4.	'none'
txtvers	The major version of the Bonjour printing specification. MUST have the value '1'.	'1'
ty	The make and model of the Printer as reported by the "printer-make-and-model" Printer Description attribute.	'' (empty string)
usb_CMD	The IEEE 1284 Device ID command set value. See section 4.2.3.5.	'' (empty string)
usb_MDL	The IEEE 1284 Device ID model value. See section 4.2.3.7.	'' (empty string)
usb_MFG	The IEEE 1284 Device ID manufacturer value. See section 4.2.3.6.	'' (empty string)
UUID	The UUID of the Printer without the 'urn:uuid:' prefix as reported by the "printer-uuid" Printer Description attribute. See section 4.2.3.8.	'' (empty string)

Note 1: The value 'U' means "undefined".

4.2.3.1 air

The "air" key defines the type of authentication information that is required for imaging. The name "air" comes from the CUPS "auth-info-required" Printer Description attribute [CUPSIPP] that extends the "uri-authentication-supported" Printer Description attribute [RFC2911]. The following values are supported:

'certificate'; Authentication using Secure Sockets Layer (SSL) and Transport Layer Security (TLS) certificates. This is equivalent to the value 'certificate' for the "uri-authentication-supported" Printer Description attribute [RFC2911].

'negotiate'; Kerberized authentication is required [RFC4559]. This is equivalent to the 'negotiate' value for the "uri-authentication-supported" Printer Description attribute [PWG5100.13].

'none'; No authentication is required. This is equivalent to the value 'none' for the "uri-authentication-supported" Printer Description attribute [RFC2911].

'username,password'; Username + password authentication is required. This is equivalent to the values 'basic' or 'digest' for the "uri-authentication-supported" Printer Description attribute [RFC2911].

The default value for the "air" key is 'none'.

4.2.3.2 pdl

The REQUIRED "pdl" (Page Description Language) key lists the supported MIME media types. Because the total length of a key/value pair is 255 octets, the "pdl" value is typically a subset of the values reported by the "document-format-supported" Printer Description attribute. Printers SHOULD populate the "pdl" key with a comma-delimited list of the REQUIRED and preferred Multipurpose Internet Mail Extensions (MIME) media types and MUST NOT list the 'application/octet-stream' MIME media type.

4.2.3.3 qtotal

The "qtotal" key defines the number of services supported by the Printer with this service instance name. While the Bonjour Printing Specification [BONJOUR] does allow Printers to advertise multiple services with the same name using multiple TXT records, historically this functionality has caused interoperability and stability issues for Printers and Clients that support multiple network interfaces, e.g., Wi-Fi and Ethernet. Therefore, Printers MUST NOT advertise multiple services using the same name and MUST always use the default value (1) for the "qtotal" key and advertise the default (print) service in the TXT record. Printers with multiple print service endpoints MAY advertise multiple uniquely named services, each providing a single TXT record for their corresponding information.

4.2.3.4 TLS

The "TLS" key defines the highest version of TLS that is supported for encrypted communications with the Printer. The following values are currently defined:

'none'; No encryption is supported. This is equivalent to the value 'none' for the "uri-security-supported" Printer Description attribute.

'1.0'; TLS 1.0 [RFC2246] encryption is supported. This is equivalent to the value 'tls' for the "uri-security-supported" Printer Description attribute.

'1.1'; TLS 1.1 [RFC4346] encryption is supported. This is equivalent to the value 'tls' for the "uri-security-supported" Printer Description attribute.

'1.2'; TLS 1.2 [RFC5246] encryption is supported. This is equivalent to the value 'tls' for the "uri-security-supported" Printer Description attribute.

The default value of the "TLS" key is 'none'. Version numbers correspond to the currently defined TLS protocol versions as defined by the IETF and are not limited to the version numbers shown above.

4.2.3.5 usb_CMD

The REQUIRED "usb_CMD" key provides the COMMAND SET (CMD) [PWG5107.2] value from the "printer-device-id" Printer attribute.

4.2.3.6 usb_MFG

The REQUIRED "usb_MFG" key provides the MANUFACTURER (MFG) value from the "printer-device-id" Printer attribute.

4.2.3.7 usb_MDL

The REQUIRED "usb_MDL" key provides the MODEL (MDL) value from the "printer-device-id" Printer attribute.

4.2.3.8 UUID

The REQUIRED "UUID" key provides the value of the "printer-uuid" Printer Description attribute [RFC4122] [PWG 5100.13] without the leading "urn:uuid:". For example, if a Printer reports a "printer-uuid" value of:

        urn:uuid:12345678-9ABC-DEF0-1234-56789ABCDEF0

The "UUID" key will have a value of:

        12345678-9ABC-DEF0-1234-56789ABCDEF0

Note: The "printer-uuid" value is used instead of "device-uuid" because DNS-SD identifies services and not devices.

4.2.3.9 DUUID

The "DUUID" key provides the value of the "device-uuid" Printer Description attribute [RFC4122] [PWG 5100.13] without the leading "urn:uuid:". For example, if a Printer reports a "device-uuid" value of:

        urn:uuid:12345678-9ABC-DEF0-1234-56789ABCDEF0

The "DUUID" key will have a value of:

        12345678-9ABC-DEF0-1234-56789ABCDEF0

4.3 LDAP and SLP Discovery

LDAP and SLP discovery use the schema defined in Lightweight Directory Access Protocol (LDAP): Schema for Printer Services [RFC3712] [RFC4511] [RFC4515].

Both LDAP and SLP impose hard limits on the lengths of string values, typically 127 or 255 octets depending on the attribute. These limits are sometimes smaller than the limits imposed by the corresponding IPP attributes.

For example, the IPP "printer-device-id" attribute has a maximum length of 1023 octets, however the corresponding LDAP "printer-device-id" attribute has a maximum length of 255 octets. Printers MUST truncate long strings as defined in section 13.

4.4 SSDP Discovery

The Simple Service Discovery Protocol (SSDP) is a multicast protocol used to support discovery of Universal Plug-and-Play (UPnP) [UPNP1.1] network devices and services. This document defines a new device template named "Printer:2" that is compliant with the UPnP Device Architecture, Version 1.1. The goal of Printer:2 is to modify the UPnP Printer Device template as minimally as possible to support the discovery of Printers. In this case UPnP is being used as a Discovery Service for an Printer and provides basic information about the capabilities of a Print class device without having to query the Printer's IPP attributes. After Discovery, all additional communication with the device is done via IPP.
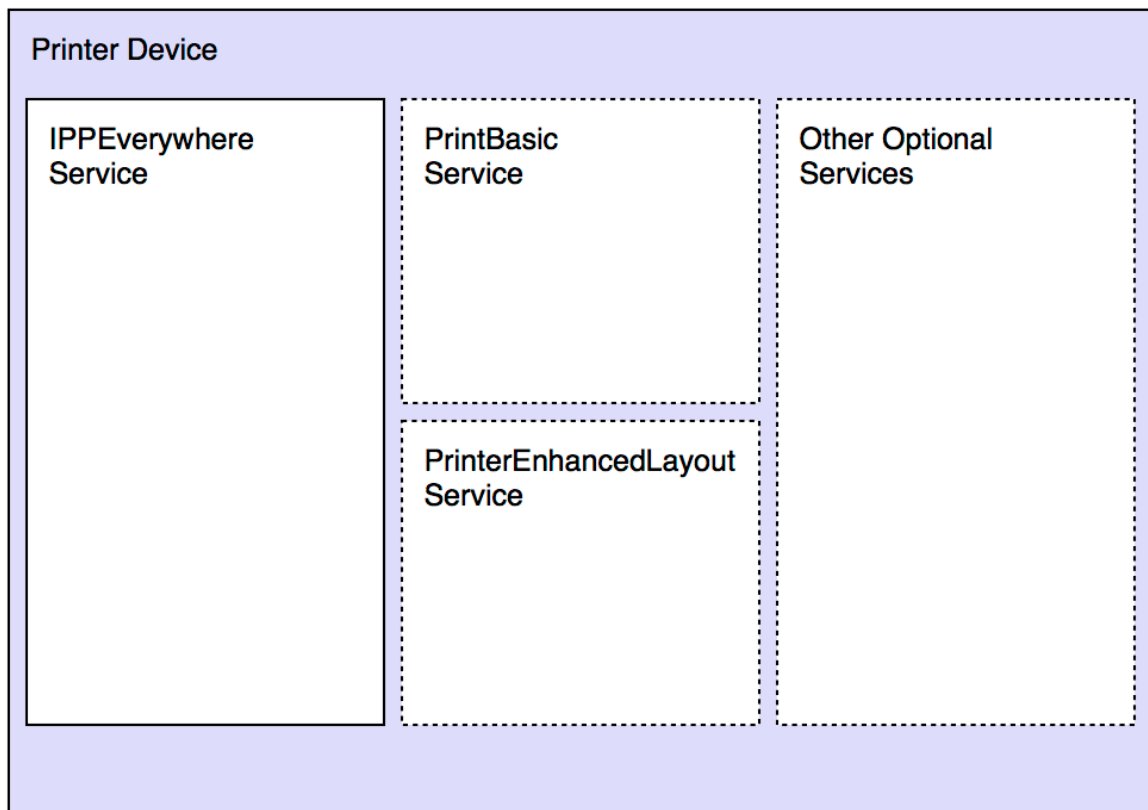
Figure 1 - UPnP Printer:2 Functional Diagram

Figure 1 illustrates a Printer Device with the required service being the IPPEverywhere Service. The Printer Device includes the location of the endpoints for communicating with the device. The Printer:2 advertisement includes the equivalent of the DNS-SD TXT records for the Printer discovered with Printer:2.

The IPPEverywhere Service is REQUIRED in a Printer:2 Device. Additional services MAY be present such as the optional PrintBasic service. The PrintBasic Service includes print-related attributes along with all Job-related attributes (e.g., JobName, DocumentFormat, Copies, etc). The optional PrintEnhancedLayout Service extends the PrintBasic service with additional operations and semantics. Both PrintBasic and PrintEnhancedLayout are OPTIONAL and provided only for legacy device support.

4.4.1 Device Definitions

4.4.1.1 Device Type

The following device type identifies a device that is compliant with this template:

```
urn:schemas-upnp-org:device:printer:2
```

4.4.1.2 Device Model

Products that expose devices of the type `printer:2` must implement minimum version numbers of all required embedded devices and services specified in Table 4.

Table 4 - Device Requirements for urn:schemas-upnp-org:printer:2

Device Type	Root	Req or Opt (note 1)	Service Type	Req or Opt (note 1)	Service ID (note 2)
Printer:2	Root	R	PrintBasic:1	O	1
			PrintEnhancedLayout:1	O	2
			IPPEverywhere:1	R	3

Note 1: R = Required, O = Optional, X = Non-standard.
Note 2: Prefixed by urn:upnp-org:serviceId:

4.4.1.3 Description of Device Requirements

The IPPEverywhere Service is a required service for a Printer:2 Device.

4.4.1.4 Relationships Between Services

The Printer Device only REQUIRES one service, the IPPEverywhere Service. When PrintBasic or PrintEnhancedLayout are implemented, they are independent of IPPEverywhere, although PrintEnhancedLayout has a strong tie to PrintBasic. Again, these optional services are only present for backward compatibility

4.4.2 Theory of Operation

4.4.2.1 Discovery

When a device is added to the network, the UPnP discovery protocol allows that device to advertise its services to User control points on the network. The UPnP discovery protocol is based on SSDP. The Printer Device must announce itself as:

1. a root device
2. a device UUID for its device type
3. a device type

4.4.2.2 Job Submission and Control

Job Submission and Control are handled through standard IPP operations.

4.4.3 XML Device Description

The following XML describes a typical Printer device:

```
<?xml version="1.0"?>
<root xmlns="urn:schemas-upnp-org:device-1-0">
<specVersion>
  <major>1</major>
  <minor>0</minor>
</specVersion>
<URLBase>base URL for all relative URLs</URLBase>
<device>
  <deviceType>urn:schemas-upnp-org:device:Printer:2</deviceType>
  <friendlyName>printer-info string</friendlyName>
  <manufacturer>manufacturer name</manufacturer>
  <manufacturerURL>URL to manufacturer site</manufacturerURL>
  <modelDescription>printer-make-and-model string</modelDescription>
  <modelName>model name</modelName>
  <modelNumber>model number</modelNumber>
  <modelURL>URL to model site</modelURL>
  <serialNumber>manufacturer's serial number</serialNumber>
  <UDN>urn:uuid:UUID</UDN>
  <UPC>Universal Product Code</UPC>
  <iconList>
    <icon>
      <mimetype>image/format</mimetype>
      <width>horizontal pixels</width>
      <height>vertical pixels</height>
      <depth>color depth</depth>
      <url>URL to icon</url>
    </icon>
    XML to declare other icons, if any, go here.
  </iconList>
  <serviceList>
    <service>
      <serviceType>urn:schemas-pwg.org:service:IPPEverywhere:1
```

```
            </serviceType>
        <serviceId>urn:upnp-org:serviceId:3</serviceId>
        <adminurl>printer-more-info string</adminurl>
        <note>printer-location string</note>
        <air>Type of authentication required for the services.</air>
        <tls>Version of TLS supported.</tls>
        <rp>This key is used to specify the print queue name.</rp>
        <pdlp>Comma-separated list of MIME types supported by
printing.</pdlp>
        <Bind>Set value to "T" if the printer is capable of binding its
output, "F" if its not.</Bind>
        <Collate>Set value to "T" if the printer is capable of generating
collated copies, "F" if its not.</Collate>
        <Color>Set value to "T" if the printer is capable of generating
color output, "F" if its not.</Color>
        <Copies>Set value to "T" if the printer is capable of generating
fast copies, "F" if its not.</Copies>
        <Duplex>Set value to "T" if the printer is capable of generating
two-sided output, "F" if its not.</Duplex>
        <PaperCustom>Set value to "T" if the printer can handle custom
paper sizes, "F" if its not.</PaperCustom>
        <PaperMax> "less-than-legal-A4", "legal-A4", "isoC-A2", or "greater-
than-isoC-A2"</PaperMax>
        <Punch> Set value to the number of holes of the hole puncher
supported by the printer.</Punch>
        <Sort> Set value to "T" if the printer is capable of sort- ing its
output, "F" if its not.</Sort>
        <Staple> Set value to "T" if the printer is capable of sta- pling
output, "F" if its not.</Sort>
      </service>
    </serviceList>
    <deviceList>
      Description of embedded devices added by UPnP vendor (if any) go here.
    </deviceList>
    <presentationURL>URL for presentation</presentationURL>
  </device>
</root>
```

4.5 WS-Discovery

Printers using OASIS Web Services Dynamic Discovery (WS-Discovery) Version 1.1 [WSDD-DISCOVERY-1.1] may be discovered using the IPP Everywhere namespace (http://www.pwg.org/schemas/2012/4/ipp-everywhere) and LDAP Printer Schema. Here is an example probe message:

```
<s:Envelope
    xmlns:a="http://schemas.xmlsoap.org/ws/2004/08/addressing"
    xmlns:d="http://schemas.xmlsoap.org/ws/2005/04/discovery"
    xmlns:ippe="http://www.pwg.org/schemas/2012/4/ipp-everywhere"
    xmlns:s="http://www.w3.org/2003/05/soap-envelope" >
  <s:Header>
    <a:Action>
      http://schemas.xmlsoap.org/ws/2005/04/discovery/Probe
```

```
        </a:Action>
        <a:MessageID>
          uuid:0a6dc791-2be6-4991-9af1-454778a1917a
        </a:MessageID>
        <a:To>urn:schemas-xmlsoap-org:ws:2005:04:discovery</a:To>
      </s:Header>
      <s:Body>
        <d:Probe>
          <d:Types>ippe:Print</d:Types>
          <d:Scopes
     MatchBy="http://schemas.xmlsoap.org/ws/2005/04/discovery/ldap" >
            ldap:///ou=engineering,o=examplecom,c=us
          </d:Scopes>
        </d:Probe>
      </s:Body>
    </s:Envelope>
```

5. Protocol Binding

Printers and Clients MUST support IPP/2.0, IPP/2.1, and/or IPP/2.2 as defined in Internet Printing Protocol 2.0 Second Edition [PWG5100.12] and the IPP Job and Printer Extensions - Set 3 [PWG5100.13].

While this specification defines an IPP binding, the same set of Semantic Elements can be applied to any protocol that conforms to the PWG Semantic Model.

5.1 HTTP Features

In additional to the IPP over HTTP conformance requirements defined in section 7.3 of the Internet Printing Protocol Version 2.0 Second Edition [PWG5100.12], Printers MUST support the following additional HTTP headers and status codes defined in Hypertext Transfer Protocol -- HTTP/1.1 [RFC2616].

5.1.1 Host

Printers MUST validate the Host request header and SHOULD use the Host value in generated URIs.

5.1.2 If-Modified-Since, Last-Modified, and 304 Not Modified

Printers MUST support the If-Modified-Since request header (section 14.25 [RFC2616]), the corresponding response status ("304 Not Modified", section 10.3.5 [RFC2616]), and the Last-Modified response header (section 14.29 [RFC2616]).

The If-Modified-Since request header allows a Client to efficiently determine whether a particular resource file (icon, ICC profile, localization file, etc.) has been updated since the last time the Client requested it.

5.1.3 Cache-Control

Printers and Clients MUST conform to the caching semantics defined in section 13 [RFC2616]. Typically, most resource files provided by a Printer in a GET response will be cacheable but IPP responses in a POST response are not. Therefore, Printers MAY provide a Cache-Control header in GET responses with an appropriate "max-age" value and MUST provide a Cache-Control header in IPP POST responses with the value "no-cache".

5.2 IPP Operations

Table 5 lists the REQUIRED operations for a Printer. The Create-Job and Send-Document operations are required in order to support reliable job management (e.g., cancellation) during print job submission, but Printers are not required to support multiple document jobs.

Table 5 - IPP Everywhere Required Operations

Code	Operation Name	Reference
0x0002	Print-Job	RFC 2911
0x0004	Validate-Job	RFC 2911
0x0005	Create-Job (note 1)	RFC 2911
0x0006	Send-Document (note 1)	RFC 2911
0x0008	Cancel-Job	RFC 2911
0x0009	Get-Job-Attributes	RFC 2911
0x000A	Get-Jobs	RFC 2911
0x000B	Get-Printer-Attributes	RFC 2911
0x0039	Cancel-My-Jobs (note 2)	PWG 5100.11
0x003B	Close-Job (note 2)	PWG 5100.11
0x003C	Identify-Printer (note 3)	PWG 5100.13

Note 1: REQUIRED in addition to those operations defined for the IPP/2.0 conformance level.
Note 2: REQUIRED in addition to those operations defined for the IPP/2.0 and IPP/2.1 conformance levels.
Note 3: REQUIRED in addition to those operations defined for the IPP/2.0, IPP/2.1, and IPP/2.2 conformance levels.

5.3 IPP Printer Description Attributes

Table 6 lists the REQUIRED Printer Description attributes for a Printer.

Table 6 - IPP Everywhere Required Printer Description Attributes

Attribute	Reference
charset-configured	RFC 2911
charset-supported	RFC 2911
color-supported	RFC 2911
compression-supported	RFC 2911
copies-default (note 5)	RFC 2911
copies-supported (note 5)	RFC 2911
document-format-default	RFC 2911
document-format-supported	RFC 2911
document-password-supported (note 5)	PWG 5100.13
feed-orientation-default (note 9)	PWG 5100.11

Attribute	Reference
feed-orientation-supported (note 9)	PWG 5100.11
finishings-default (note 7)	RFC 2911
finishings-supported (note 7)	RFC 2911
generated-natural-language-supported	RFC 2911
identify-actions-default (note 3)	PWG 5100.13
identify-actions-supported (note 3)	PWG 5100.13
ipp-features-supported (note 3)	PWG 5100.13
ipp-versions-supported	RFC 2911
job-account-id-default (note 4)	PWG 5100.3
job-account-id-supported (note 4)	PWG 5100.3
job-accounting-user-id-default (note 4)	PWG 5100.3
job-accounting-user-id-supported (note 4)	PWG 5100.3
job-constraints-supported (note 3)	PWG 5100.13
job-creation-attributes-supported (note 2)	PWG 5100.11
job-ids-supported (note 2)	PWG 5100.11
job-password-supported (note 8)	PWG 5100.11
job-password-encryption-supported (note 8)	PWG 5100.11
job-preferred-attributes-supported (note 3)	PWG 5100.13
job-resolvers-supported (note 3)	PWG 5100.13
media-bottom-margin-supported (note 3)	PWG 5100.13
media-col-database (note 2)	PWG 5100.11
media-col-database.media-source-properties (note 9)	PWG 5100.13
media-col-default (note 1)	PWG 5100.3
media-col-ready (note 2)	PWG 5100.3
media-col-ready.media-source-properties (note 9)	PWG 5100.13
media-col-supported (note 1)	PWG 5100.3
media-default	RFC 2911
media-left-margin-supported (note 3)	PWG 5100.13
media-ready (note 2)	RFC 2911
media-right-margin-supported (note 3)	PWG 5100.13
media-size-supported (note 1)	PWG 5100.3
media-source-supported (note 3)	PWG 5100.13
media-supported	RFC 2911
media-top-margin-supported (note 3)	PWG 5100.13
media-type-supported (note 1)	PWG 5100.3
multiple-document-jobs-supported (note 1)	RFC 2911
multiple-operation-timeout (note 1)	RFC 2911
multiple-operation-timeout-action (note 3)	PWG 5100.13
natural-language-configured	RFC 2911
operations-supported	RFC 2911
orientation-requested-default	RFC 2911
orientation-requested-supported	RFC 2911

Attribute	Reference
output-bin-default	PWG 5100.2
output-bin-supported	PWG 5100.2
overrides-supported (note 2)	PWG 5100.6
page-ranges-supported (note 6)	RFC 2911
pages-per-minute	RFC 2911
pages-per-minute-color	RFC 2911
print-color-mode-default (note 3)	PWG 5100.13
print-color-mode-supported (note 3)	PWG 5100.13
print-content-optimize-default (note 3)	PWG 5100.7
print-content-optimize-supported (note 3)	PWG 5100.7
print-rendering-intent-default (note 3)	PWG 5100.13
print-rendering-intent-supported (note 3)	PWG 5100.13
print-quality-default	RFC 2911
print-quality-supported	RFC 2911
printer-alert (note 2)	PWG 5100.9
printer-alert-description (note 2)	PWG 5100.9
printer-charge-info (note 4)	PWG 5100.13
printer-charge-info-uri (notes 4 and 10)	PWG 5100.13
printer-config-change-date-time (note 3)	PWG 5100.13
printer-config-change-time (note 3)	PWG 5100.13
printer-device-id (note 2)	PWG 5107.2
printer-geo-location (note 3)	PWG 5100.13
printer-get-attributes-supported (note 3)	PWG 5100.13
printer-icc-profiles (notes 3 and 10)	PWG 5100.13
printer-icons (notes 3 and 10)	PWG 5100.13
printer-info	RFC 2911
printer-is-accepting-jobs	RFC 2911
printer-location	RFC 2911
printer-make-and-model	RFC 2911
printer-mandatory-job-attributes (note 4)	PWG 5100.13
printer-more-info (note 10)	RFC 2911
printer-name	RFC 2911
printer-organization (note 3)	PWG 5100.13
printer-organizational-unit (note 3)	PWG 5100.13
printer-resolution-default	RFC 2911
printer-resolution-supported	RFC 2911
printer-state	RFC 2911
printer-state-change-date-time (note 2)	RFC 3995
printer-state-change-time (note 1)	RFC 3995
printer-state-message	RFC 2911
printer-state-reasons	RFC 2911
printer-supply (note 3)	PWG 5100.13
printer-supply-description (note 3)	PWG 5100.13
printer-supply-info-uri (notes 3 and 10)	PWG 5100.13

Attribute	Reference
printer-up-time	RFC 2911
printer-uri-supported (note 10)	RFC 2911
printer-uuid (note 3)	PWG 5100.13
pwg-raster-document-resolution-supported (note 3)	PWG 5102.4
pwg-raster-document-sheet-back (note 3)	PWG 5102.4
pwg-raster-document-type-supported (note 3)	PWG 5102.4
queued-job-count	RFC 2911
sides-default	RFC 2911
sides-supported	RFC 2911
uri-security-supported	RFC 2911
uri-authentication-supported	RFC 2911
which-jobs-supported (note 2)	PWG 5100.11

Note 1: REQUIRED in addition to those attributes defined for the IPP/2.0 conformance level.
Note 2: REQUIRED in addition to those attributes defined for the IPP/2.0 and IPP/2.1 conformance levels.
Note 3: REQUIRED in addition to those attributes defined for the IPP/2.0, IPP/2.1, and IPP/2.2 conformance levels.
Note 4: CONDITIONALLY REQUIRED for Printers that implement Paid Imaging services.
Note 5: CONDITIONALLY REQUIRED for Printers that support the "application/openxps" or "application/pdf" MIME media types.
Note 6: CONDITIONALLY REQUIRED for Printers that support the "application/openxps" or "application/pdf" MIME media types.
Note 7: CONDITIONALLY REQUIRED for Printers with finishers.
Note 8: CONDITIONALLY REQUIRED for Printers that support the Print to a Recipient (section 3.2.2.8) use case.
Note 9: CONDITIONALLY REQUIRED for Printers that support long-edge feed media.
Note 10: URIs SHOULD use Host value from HTTP header (section 5.1.1) and MUST NOT use link-local addresses (section 8.4).

5.3.1 media-col-database (1setOf collection)

The REQUIRED "media-col-database" Printer attribute lists the supported combinations of "media-col" member attributes for a Printer. In addition to the requirements set forth in IPP: Job and Printer Extensions - Set 2 [PWG5100.11], this specification defines how a Printer advertises custom and roll-fed media capabilities in the "media-col-database" attribute.

Custom media sizes are described using rangeOfInteger values for the "x-dimension" and "y-dimension" member attributes of the "media-size" member attribute. Dimensions are

provided for sheets in portrait orientation, that is the "x-dimension" ranges refer to the short axis and the "y-dimension" ranges refer to the long axis of the sheet. For example, a Printer supporting sheet media from 50x50mm to 330.2x482.6mm from the by-pass tray could report:

```
media-col-database = ...
                    { media-size = {
                          x-dimension = 5000-33020
                          y-dimension = 5000-48260 }
                      media-source = 'by-pass-tray' }
                    ...
```

Similarly, roll media sizes are also described using rangeOfInteger values, however the "x-dimension" value refers to the cross-feed (width) dimension and the "y-dimension" value refers to the feed (length) dimension. The supported ranges provide the capabilities of the Printer and not of any loaded media which is reported separately in the "media-col-ready" and "media-ready" attributes. For example, a Printer supporting rolls 8 to 60 inches wide and 6 inches to 300 feet long would report:

```
media-col-database = ...
                    { media-size = { x-dimension = 20320-152400
                                     y-dimension = 1524-9144000 }
                    ...
```

5.3.2 media-col-ready (1setOf collection)

The REQUIRED "media-col-ready" Printer attribute lists the loaded media combinations of "media-col" member attributes for a Printer. In addition to the requirements set forth in IPP: Production Printing Attributes - Set 1 [PWG5100.3], this specification defines how a Printer advertises manually-fed and roll-fed media in the "media-col-ready" attribute.

Manual feed media sizes MUST NOT be reported in the "media-col-ready" attribute. By definition the 'manual-feed' media source requires the Printer to ask the User/Operator to load the requested media, thus the media can never be "ready" for use. However, many Printers offer a multi-purpose tray that serves as both a manual feed source and an ad-hoc paper tray. Printers that provide such a multi-purpose tray MUST advertise media loaded in the tray using a different media source such as 'by-pass-tray'.

Roll media sizes are described using an integer value for the "x-dimension" and a rangeOfInteger value for the "y-dimension" member attributes of the "media-size" member attribute. The "x-dimension" value refers to the width of the loaded roll, the lower bound of the "y-dimension" value refers to the minimum length allowed, and the upper bound of the "y-dimension" value refers to the remaining length of the loaded roll or, if the remainder is not known, the maximum length allowed.

5.3.3 media-ready (1setOf (type3 keyword | name(MAX))

The REQUIRED "media-ready" Printer attribute lists the loaded media for a Printer. In addition to the requirements set forth in Internet Printing Protocol/1.1: Model and Semantics [RFC2911], this specification defines how a Printer advertises custom, manually-fed, and roll-fed media in the "media-ready" attribute.

Manual feed media sizes MUST NOT be reported in the "media-ready" attribute. By definition the 'manual-feed' media source requires the Printer to ask the User/Operator to load the requested media, thus the media can never be "ready" for use. However, many Printers offer a multi-purpose tray that serves as both a manual feed source and an ad-hoc paper tray. Printers that provide such a multi-purpose tray MUST advertise media loaded in the tray.

Custom media sizes are described using the "custom" self-describing media size names defined in section 5 of the PWG Media Standardized Names [PWG5101.1] specification. For example, a custom media size of 4x8 inches might be listed with the name "custom_current_4x8in". The size name MUST include the source name if more than one custom size is loaded, for example "custom_current.tray-1_4x8in".

Similarly, roll media sized are described using "roll" self-describing media size names with the width of the loaded roll and a length of 0. For example, a 36 inch roll might be listed with the name "roll_current_36x0in". As for custom sizes, the size name MUST include the source name if more than one roll is loaded, for example "roll_current.roll-1_36x0in".

5.3.4 media-size-supported (1setOf collection)

The REQUIRED "media-size-supported" Printer attribute lists the supported media sizes for a Printer. In addition to the requirements set forth in [PWG5100.3], this specification defines how a Printer advertises custom and roll-fed media in the "media-size" attribute.

Custom media sizes are described using rangeOfInteger values for the "x-dimension" and "y-dimension" member attributes. Dimensions are provided for sheets in portrait orientation, that is the "x-dimension" ranges refer to the short axis and the "y-dimension" ranges refer to the long axis of the sheet. For example, a Printer supporting sheet media from 50x50mm to 330.2x482.6mm from the by-pass tray would report:

```
media-size-supported = ...
                    { x-dimension = 5000-33020
                      y-dimension = 5000-48260 }
                    ...
```

Similarly, roll media sizes are also described using rangeOfInteger values, however the "x-dimension" value refers to the cross-feed (width) dimension and the "y-dimension" value refers to the feed (length) dimension. The supported ranges provide the capabilities of the Printer and not of any loaded media which is reported separately in the "media-col-

ready" and "media-ready" attributes. For example, a Printer supporting rolls 8 to 60 inches wide and 6 inches to 300 feet long would report:

```
media-size-supported = ...
                     { x-dimension = 20320-152400
                       y-dimension = 1524-9144000 }
                     ...
```

5.3.5 media-supported (1setOf (type3 keyword | name(MAX))

The REQUIRED "media-supported" Printer attribute lists the supported media sizes for a Printer. In addition to the requirements set forth in [RFC2911], this specification defines how a Printer advertises custom and roll-fed media in the "media-supported" attribute.

Custom media sizes are described using two self-describing media names. The "custom_min_WIDTHxHEIGHTunits" value provides the minimum custom media dimensions and the "custom_max_WIDTHxHEIGHTunits" value provides the maximum custom media dimensions. The size name MUST include the source name if different dimensions are supported by each source. Dimensions are provided for sheets in portrait orientation, that is the "WIDTH" values refer to the short axis and the "HEIGHT" values refer to the long axis of the sheet. For example, a Printer supporting sheet media from 50x50mm to 330.2x482.6mm from the by-pass tray could report:

```
media-supported = ...
                 custom_max.by-pass-tray_330.2x482.6mm
                 custom_min.by-pass-tray_50x50mm
                 ...
```

Similarly, roll media sizes are described using the "roll_min_WIDTHxHEIGHTunits" and "roll_max_WIDTHxHEIGHTunits" names. The "WIDTH" values refer to the supported roll widths while the "HEIGHT" values refer to the supported roll lengths. The size name MUST include the source name if the Printer supports multiple source with different roll limits.

For example, a Printer supporting a single roll 8 to 60 inches wide and 6 inches to 300 feet long would report:

```
media-supported = ...
                 roll_max_60x3600in
                 roll_min_8x6in
                 ...
```

A Printer supporting two rolls, one 8 to 60 inches wide and 6 inches to 300 feet long and the other 8 to 36 inches wide and 6 inches to 150 feet long would report:

```
media-size-supported = ...
                 roll_max.roll-1_60x3600in
                 roll_min.roll-1_8x6in
                 roll_max.roll-2_36x1800in
                 roll_min.roll-2_8x6in
```

. . .

5.3.6 printer-device-id (text(1023))

The REQUIRED "printer-device-id" Printer attribute provides the IEEE 1284 Device ID [IEEE1284] string for the Imaging Device. Because discovery protocols often have lower limits on the length of string values, Printers MUST list the Device ID key/value pairs in the following order:

1. All required (MANUFACTURER/MFG, MODEL/MDL, and COMMAND SET/CMD) key/value pairs,
2. All optional key/value pairs, and
3. All vendor key/value pairs

For interoperability, Printers MUST NOT report standard key/value pairs using non-standard abbreviations. For example, "MANU" is sometimes used as an abbreviation for "MANUFACTURER", however the only allowed abbreviation is "MFG".

The optional and vendor key/value pairs can be prioritized by Client software requirements. This allows the Printer to truncate the Device ID string on key/value boundaries as needed (section 13.4) without loss of critical information needed for selection of device-specific or generic driver software on the Client.

5.4 IPP Operation Attributes

Table 7 lists the REQUIRED operation attributes for a Printer.

Table 7 - IPP Everywhere Required Operation Attributes

Attribute	Reference
compression	RFC 2911
document-format	RFC 2911
document-format-version (note 1)	PWG 5100.7
document-name	RFC 2911, PWG 5100.5
document-password (note 4)	PWG 5100.13
first-index (note 3)	PWG 5100.13
first-job-id	RFC 2911
identify-actions (note 3)	PWG 5100.13
ipp-attribute-fidelity	RFC 2911
job-ids (note 2)	PWG 5100.11
job-mandatory-attributes (note 6)	PWG 5100.7
job-name	RFC 2911
job-password (note 5)	PWG 5100.11
job-password-encryption (note 5)	PWG 5100.11
last-document (note 1)	RFC 2911
limit	RFC 2911
requesting-user-name	RFC 2911
requesting-user-uri (note 3)	PWG 5100.13
which-jobs (note 2)	RFC 2911, PWG 5100.11

Note 1: REQUIRED in addition to those attributes defined for the IPP/2.0 conformance level.
Note 2: REQUIRED in addition to those attributes defined for the IPP/2.0 and IPP/2.1 conformance levels.
Note 3: REQUIRED in addition to those attributes defined for the IPP/2.0, IPP/2.1, and IPP/2.2 conformance levels.
Note 4: CONDITIONALLY REQUIRED for Printers that support the "application/openxps" or "application/pdf" MIME media types.
Note 5: CONDITIONALLY REQUIRED for Printers that support the Print to a Recipient (section 3.2.2.8) use case.
Note 6: CONDITIONALLY REQUIRED for Printers that implement Paid Imaging services.

5.5 IPP Job Template Attributes

Table 8 lists the REQUIRED Job Template attributes for a Printer.

Table 8 - IPP Everywhere Required Job Template Attributes

Attribute	Reference
copies (note 5)	RFC 2911
feed-orientation (note 8)	PWG 5100.11
finishings (note 7)	RFC 2911
job-account-id (note 4)	PWG 5100.3
job-accounting-user-id (note 4)	PWG 5100.3
media	RFC 2911
media-col (note 1)	PWG 5100.3
media-col.media-bottom-margin (note 3)	PWG 5100.13
media-col.media-left-margin (note 3)	PWG 5100.13
media-col.media-right-margin (note 3)	PWG 5100.13
media-col.media-size (note 1)	PWG 5100.3
media-col.media-source (note 3)	PWG 5100.13
media-col.media-top-margin (note 3)	PWG 5100.13
media-col.media-type (note 1)	PWG 5100.3
multiple-document-handling (note 6)	RFC 2911
orientation-requested	RFC 2911
output-bin	PWG 5100.2
overrides (note 2)	PWG 5100.6
page-ranges (note 6)	RFC 2911
print-color-mode (note 3)	PWG 5100.13
print-content-optimize (note 3)	PWG 5100.7
print-rendering-intent (note 3)	PWG 5100.13
print-quality	RFC 2911
printer-resolution	RFC 2911
sides	RFC 2911

Note 1: REQUIRED in addition to those attributes defined for the IPP/2.0 conformance level.
Note 2: REQUIRED in addition to those attributes defined for the IPP/2.0 and IPP/2.1 conformance levels.
Note 3: REQUIRED in addition to those attributes defined for the IPP/2.0, IPP/2.1, and IPP/2.2 conformance levels.
Note 4: CONDITIONALLY REQUIRED for Printers that implement paid imaging services.
Note 5: CONDITIONALLY REQUIRED for Printers that support the "application/openxps", "application/pdf", or "image/jpeg" MIME media types.
Note 6: CONDITIONALLY REQUIRED for Printers that support the "application/openxps" or "application/pdf" MIME media types.
Note 7: CONDITIONALLY REQUIRED for Printers with finishers.
Note 8: CONDITIONALLY REQUIRED for Printers that support long-edge feed media.

5.6 IPP Job Description Attributes

Table 9 lists the REQUIRED Job Description attributes for a Printer.

Table 9 - IPP Everywhere Required Job Description Attributes

Attribute	Source
compression-supplied (note 1)	PWG 5100.7
date-time-at-completed (note 2)	RFC 2911
date-time-at-creation (note 2)	RFC 2911
date-time-at-processing (note 2)	RFC 2911
document-format-supplied (note 1)	PWG 5100.7
document-format-version-supplied (note 1)	PWG 5100.7
document-name-supplied (note 1)	PWG 5100.7
job-id	RFC 2911
job-impressions (note 2)	RFC 2911
job-impressions-completed (note 2)	RFC 2911
job-name	RFC 2911
job-originating-user-name	RFC 2911
job-printer-up-time	RFC 2911
job-printer-uri (note 4)	RFC 2911
job-state	RFC 2911
job-state-message (note 3)	RFC 2911
job-state-reasons	RFC 2911
job-uri (note 4)	RFC 2911
job-uuid (note 3)	PWG 5100.13
time-at-completed	RFC 2911
time-at-creation	RFC 2911
time-at-processing	RFC 2911

Note 1: REQUIRED in addition to those attributes defined for the IPP/2.0 conformance level.
Note 2: REQUIRED in addition to those attributes defined for the IPP/2.0 and IPP/2.1 conformance levels.
Note 3: REQUIRED in addition to those attributes defined for the IPP/2.0, IPP/2.1, and IPP/2.2 conformance levels.
Note 4: URIs SHOULD use Host value from HTTP header (section 5.1.1) and MUST NOT use link-local addresses (section 8.4).

5.6.1 job-id (integer)

The REQUIRED "job-id" Job Description attribute contains the ID of the Job. In order to support reliable job submission and management, Printers MUST NOT reuse "job-id" values since the last power cycle of the Printer and SHOULD NOT reuse "job-id" values for the life of the Printer as described in section 3.1.2.3.9 of the Internet Printing Protocol/1.1: Implementer's Guide [RFC3196].

5.6.2 job-uri (uri)

The REQUIRED "job-uri" Job Description attribute contains the URI of the Job. In order to support reliable job submission and management, Printers MUST NOT reuse "job-uri" values since the Printer was last powered up and SHOULD NOT reuse "job-uri" values for the life of the Printer as described in section 3.1.2.3.9 of the Internet Printing Protocol/1.1: Implementer's Guide [RFC3196]. In addition, the "job-uri" value SHOULD be derived from the "job-id" value as described in the IPP URL Scheme [RFC3510].

6. Document Formats

Printers MUST support documents conforming to the PWG Raster Format [PWG5102.4] ("image/pwg-raster") and JPEG File Information Format Version 1.02 [JFIF] ("image/jpeg"), specifically the metadata and JPEG subset defined in the Standard of the Camera & Imaging Products Association, CIPA DC-008-Translation-2010, Exchangeable image file format for digital still cameras: Exif Version 2.3 [EXIF].

IPP/2.1 and IPP/2.2 Printers MUST and IPP/2.0 Printers SHOULD support documents conforming to Document management — Portable document format — Part 1: PDF 1.7 [ISO32000] ("application/pdf"). IPP/2.0, IPP/2.1, and IPP/2.2 Printers are defined in IPP/2.0 Second Edition [PWG5100.12].

Printers SHOULD support documents conforming to the Open XML Paper Specification [ECMA388] ("application/openxps").

6.1 Supporting Long-Edge Feed Media with PWG Raster Format Documents

Printers that support long-edge feed media MUST support the "feed-orientation" Job Template attribute and corresponding "feed-orientation-default" and "feed-orientation-supported" Printer attributes. In addition, Printers that support long-edge feed media MUST report the "media-source-properties" member attribute in the "media-col-database" and "media-col-ready" Printer attributes.

When submitting a PWG Raster document in a job or document creation request, Clients MUST additionally query the Printer for the "feed-orientation-supported", "media-col-database", and/or "media-col-ready" Printer attributes in order to provide a document in the correct orientation and dimensions for the Printer.

Figures 2 through 5 show how raster data must be formatted for each feed orientation.
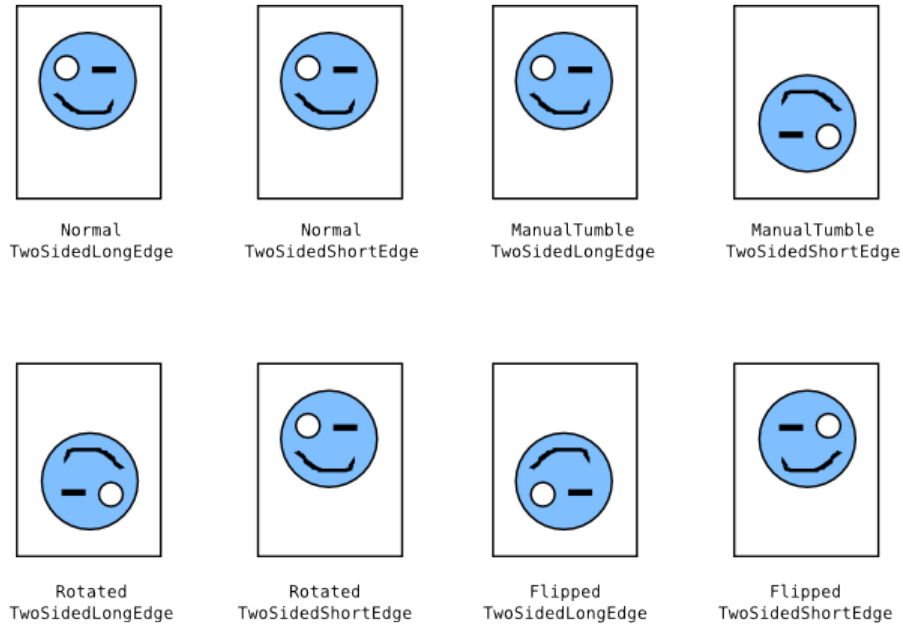
Figure 2 - PWG Raster Bitmaps with Portrait Feed Orientation
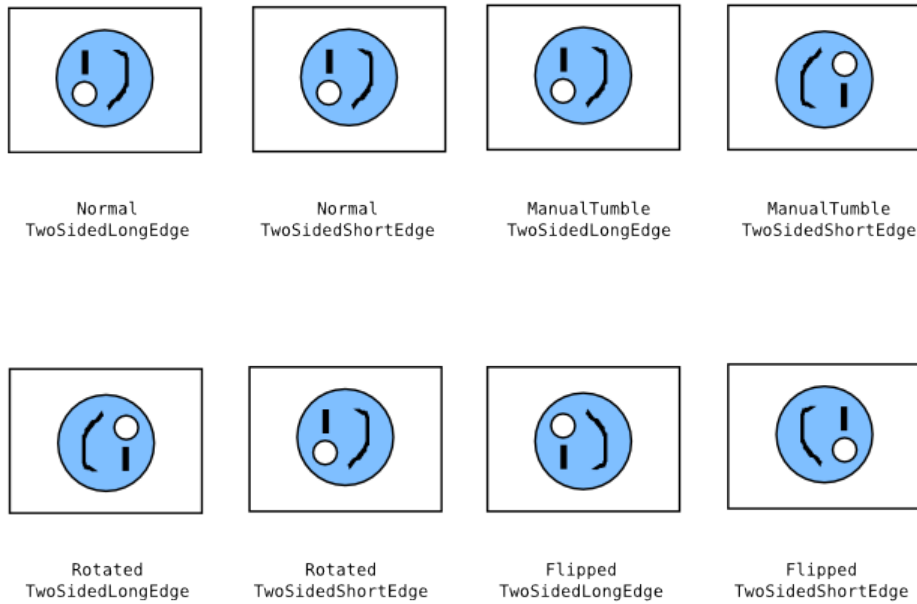
Figure 3 - PWG Raster Bitmaps with Landscape Feed Orientation
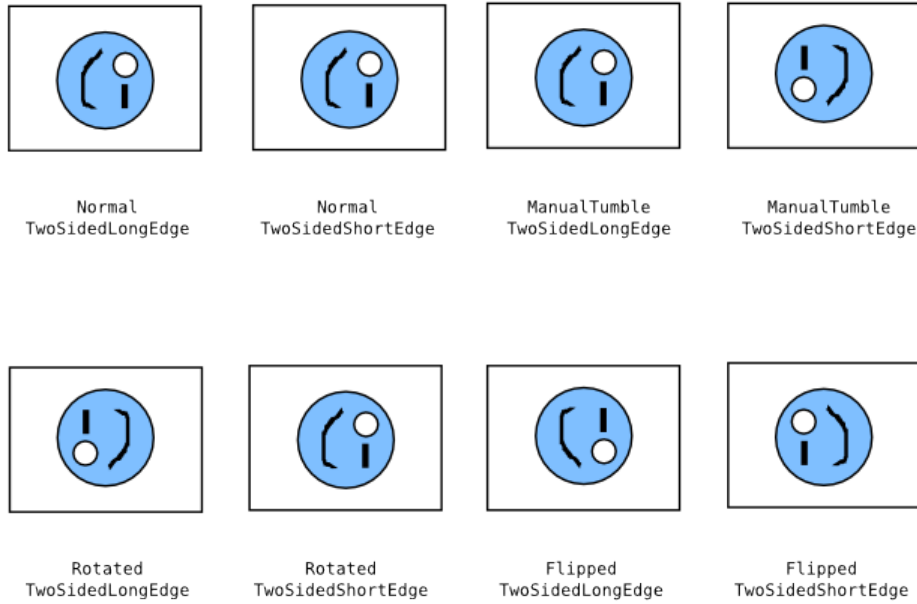
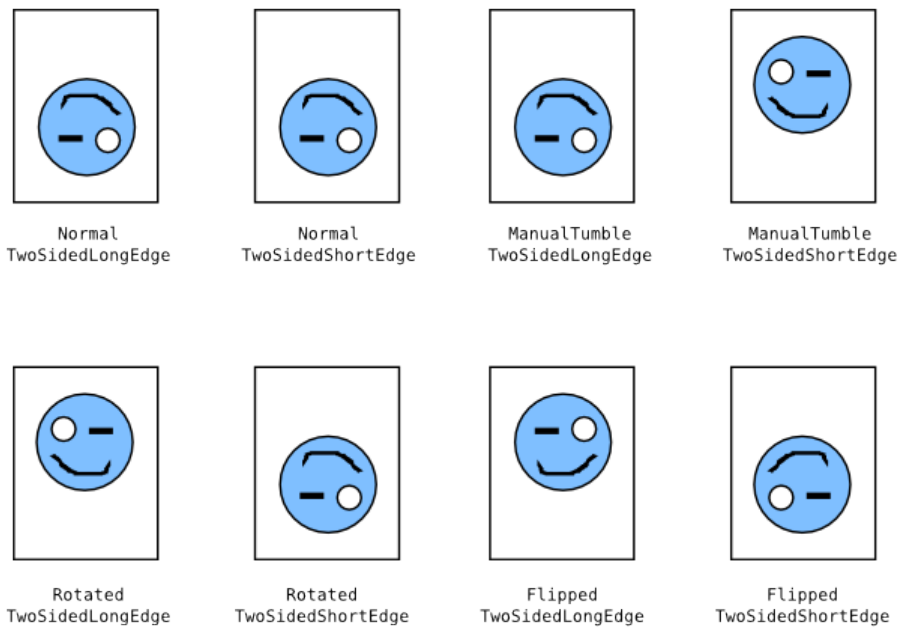**Figure 4 - PWG Raster Bitmaps with Reverse Landscape Feed Orientation**

Figure 5 - PWG Raster Bitmaps with Reverse Portrait Feed Orientation

7. Additional Values for Existing Attributes

7.1 ipp-features-supported (1setOf type2 keyword)

This specification defines the REQUIRED keyword 'ipp-everywhere' for the "ipp-features-supported" Printer attribute.

8. Additional Semantics for Existing Value Tags

This specification amends the definition of the nameWithLanguage, nameWithoutLanguage, naturalLanguage, textWithLanguage, textWithoutLanguage, and URI value tags defined in IPP/1.1: Model and Semantics [RFC2911] with additional restrictions to improve interoperability.

8.1 nameWithLanguage and nameWithoutLanguage

Name values MUST NOT contain characters in the "C0 Control Character Set" or the DEL character as defined in Unicode Format for Network Interchange [RFC5198]. Printers MUST transcode and filter values from MIBs and other sources to conform to the added restrictions.

8.2 naturalLanguage

NaturalLanguage values MUST conform to and be compared as defined in Content Language Headers [RFC3282], Matching of Language Tags [RFC4647], and Tags for Identifying Languages [RFC5646], which are the current set of RFCs replacing Tags for the Identification of Languages [RFC1766] that was used in IPP/1.1: Model and Semantics [RFC2911]. The shortest language tag MUST be used, e.g., "en" instead of "eng" for English. Printers SHOULD also support legacy language tags such as:

> 'no'; replaced by 'nb' (Norwegian Bokmål),
> 'zh-cn'; replaced by 'zh-hans' (Simplified Chinese), and
> 'zh-tw'; replaced by 'zh-hant' (Traditional Chinese)

8.3 textWithLanguage and textWithoutLanguage

Text values MUST NOT contain the DEL character or characters in the "C0 Control Character Set" other than CR, LF, and HT [RFC5198]. Printers MUST transcode and filter values from MIBs and other sources to conform to the added restrictions.

8.4 uri

URI values MUST NOT contain link-local addresses in the host field. Printers MUST NOT generate URI values with link-local addresses and SHOULD NOT generate URI values with addresses obtained via Dynamic Host Control Protocol (DHCP) [RFC2131] or other auto-configuration protocols. Printers SHOULD use the HTTP Host: header value when generating URIs for use in Client responses.

9. Conformance Requirements

This section summarizes the Conformance Requirements detailed in the definitions in this document for Clients and Printers.

9.1 Conformance Requirements for Clients

In order for a Client to claim conformance to this specification a Client MUST support the following:

1. DNS Service Discovery as defined in section 4.2 and/or WS-Discovery as defined in section 4.5
2. IPP/2.0 as defined in section 5
3. The REQUIRED operations listed in Table 5
4. The REQUIRED Printer Description attributes listed in Table 6
5. The REQUIRED operation attributes listed in Table 7
6. The REQUIRED Job Template attributes listed in Table 8
7. The REQUIRED Job Description attributes listed in Table 9
8. The REQUIRED document formats listed in section 6
9. The "feed-orientation-supported" Printer attribute and "media-source-properties" member attribute of the "media-col-database" and "media-col-ready" Printer attributes as reported by the Printer and defined in section 6.1
10. The internationalization considerations as defined in section 10
11. The security considerations as defined in section 11

9.2 Conformance Requirements for Printers

In order for a Printer to claim conformance to this specification a Printer MUST support the following:

1. DNS Service Discovery as defined in section 4.2
2. WS-Discovery as defined in section 4.5
3. IPP/2.0 as defined in section 5
4. The REQUIRED operations listed in Table 5
5. The REQUIRED Printer Description attributes listed in Table 6
6. The REQUIRED operation attributes listed in Table 7
7. The REQUIRED Job Template attributes listed in Table 8
8. The REQUIRED Job Description attributes listed in Table 9
9. The REQUIRED document formats listed in section 6
10. The 'ipp-everywhere' value for the "ipp-features-supported" Printer Description attribute as defined in section 7.1
11. The additional semantics for attribute values as defined in section 8
12. The internationalization considerations as defined in section 10
13. The security considerations as defined in section 11
14. The safe string truncation rules as defined in section 13

9.3 Conditional Conformance Requirements for Printers

Printers that support the "image/jpeg" [JFIF] MIME media type MUST support:

1. The "copies-default", and "copies-supported" Printer Description attributes as defined in section 5.3.
2. The "copies Job Template attribute as defined in section 5.5.

Printers that support the "application/openxps" [ECMA388] or "application/pdf" [ISO32000] MIME media types MUST support:

3. The "copies-default", "copies-supported", "document-password-supported", and "page-ranges-supported" Printer Description attributes as defined in section 5.3,
4. The "document-password" Operation attribute as defined in section 5.4, and
5. The "copies", "multiple-document-handling", "overrides", and "page-ranges" Job Template attributes as defined in section 5.5.

Printers that support the Print to a Recipient use case (section 3.2.2.8) MUST support:

1. The "job-password-supported" and "job-password-encryption-supported" Printer Description attributes as defined in section 5.3, and
2. The "job-password" and "job-password-encryption" Operation attributes as defined in section 5.4.

Printers that provide Paid Print services MUST support:

1. The "job-account-id-default", "job-account-id-supported", "job-accounting-user-id-default", "job-accounting-user-id-supported", "job-mandatory-attributes-default", "job-mandatory-attributes-supported", and "printer-mandatory-job-attributes" Printer Description attributes as defined in section 5.3,
2. The "job-mandatory-attributes" operation attribute as defined in section 5.4, and
3. The "job-account-id" and "job-accounting-user-id" Job Template attributes as defined in section 5.5.

Printers that support long-edge feed media MUST support:

1. The "feed-orientation-default" and "feed-orientation-supported" Printer Description attributes as defined in section 5.3.
2. The "media-source-properties" member attribute of the "media-col-database" and "media-col-ready" Printer Description attributes as defined in section 5.3.
3. The "feed-orientation" Job Template attribute as defined in section 5.5.

10. 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').

11. Security Considerations

The IPP extensions defined in this document require the same security considerations as defined in the IPP/1.1: Model and Semantics [RFC2911]. In addition, Printers MUST validate the HTTP Host request header in order to protect against DNS rebinding attacks.

12. IANA Considerations

12.1 Attribute Value Registrations

The keyword attribute values defined in this document will be published by IANA according to the procedures in the IPP Model and Semantics [RFC2911] section 6.1 in the following file:

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

The registry entries will contain the following information:

```
Attributes (attribute syntax)
  Keyword Attribute Value                          Reference
  ----------------------                           ---------
ipp-features-supported (1setOf type2 keyword)      [PWG5100.13]
  ipp-everywhere                                   [PWG5100.14]
```

13. Safe String Truncation

Strings can be truncated or omitted when transferred over alternate protocols. Printers MUST truncate long strings at logical boundaries. The following subsections describe how this truncation is performed for different kinds of strings.

13.1 Plain Text Strings

Plain text strings MUST be truncated at the end of a valid character sequence. For example, strings using the UTF-8 transformation format of ISO 10646 [STD0063][ISO10646-1] SHOULD be represented using the Unicode Format for Network Interchange [RFC5198] and MUST be truncated at the end of a valid UTF-8 sequence.

For example, the 9 octet UTF-8 sequence 0x48.65.CA.81.6C.6C.6F.C2.81 (Héllo¡) would be shortened to fit within 6 octets by composing the é (0x65.CA.81 becomes 0xC3.A9) and removing the trailing UTF-8 sequence 0xC2.81 (¡), resulting in the 6 octet UTF-8 sequence 0x48.C3.A9.6C.6C.6F (Héllo).

13.2 URIs

URIs MUST be truncated so that the URI remains valid and accepted by the Printer. For example, the 46 octet URI "ipp://printer.example.com/ipp/really-long-name" might be shortened to fit within 32 octets by removing the last path name component, resulting in the 29 octet URI "ipp://printer.example.com/ipp". Similarly, the 52 octet URI "ipp://printer.example.com/ipp?query-string" might be shortened to fit within 32 octets by removing the query string.

As recommended by the Uniform Resource Identifier (URI): Generic Syntax [STD66], Printers SHOULD omit the port number from the URI when it has the default value, e.g., 80 for "http", 443 for "https", and 631 for "ipp" and "ipps" URIs.

13.3 MIME Media Types

MIME media type strings MUST be truncated at the end of the media subtype, removing any parameters that are included with the media type. If the resulting string still exceeds the maximum length it MUST be discarded. For example, the 24 octet MIME media type "text/plain;charset=utf-8" would be shortened to fit within 16 octets by removing the trailing parameter, resulting in the 10 octet MIME media type "text/plain".

13.4 IEEE 1284 Device ID Strings

IEEE 1284 device identifier strings contain a list of delimited key/value pairs. Device ID strings MUST be truncated at the end of a value key/value pair with the shortest form of a key used. For example, the 57 octet IEEE 1284 device ID string "MANUFACTURER:Example;MODEL:Laser Printer;COMMAND SET:PS;" would be shortened to fix within 32 octets by substituting the abbreviated key names and removing the trailing key/value pair, resulting in the 32 octet string "MFG:Example;MDL:Laser Printer;".

13.5 Delimited Lists

Delimited Lists combine one or more string types listed in the previous sections, separated by a delimiting character such as a comma or semicolon. Delimited lists MUST first be shortened by removal of unnecessary path components (URIs) and parameters (MIME media types) and second truncated at a delimiting character. For example, the 40 octet list of MIME media types "text/plain;charset=utf-8,application/pdf" would be shortened to fit within 32 octets by removing the MIME media type parameter, resulting in the 26 octet list "text/plain,application/pdf". The same list would be shortened to fit within 16 octets by also removing the last MIME media type, resulting in the 10 octet list "text/plain".

14. References

14.1 Normative References

[ECMA388]   "Open XML Paper Specification", June 2009, Standard ECMA-388,
                   http://www.ecma-international.org/publications/standards/Ecma-
                   388.htm

[EXIF]   "Standard of the Camera & Imaging Products Association, CIPA DC-008-Translation-2010, Exchangeable image file format for digital still cameras: Exif Version 2.3", http://www.cipa.jp/english/hyoujunka/kikaku/pdf/DC-008-2010_E.pdf

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Implementers of this specification document are encourages to join the IPP Mailing List in order to participate in any discussions of clarification issues and review of registration proposals for additional attributes and values.

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