



The Printer Working Group

The Internet Printing Protocol in 2017: An Overview

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What is IPP?

- The Internet Printing Protocol (IPP) is a secure, high-level printing protocol that was originally developed 20 years ago that is supported by almost all printers sold today.
- IPP is used over traditional wired and wireless networks, Wi-Fi Direct, and USB.
- IPP is the core protocol for AirPrint, IPP Everywhere, Mopria, and Wi-Fi Direct Print Services.
- IPP semantics and data model were also used as the basis for Bluetooth BPP and Windows XPS printing.



IPP Features

- IPP provides a descriptive, extensible high-level protocol for expressing:
 - Printer information (identification, location, etc.)
 - Printer capabilities descriptions (supported media sizes and types, 2-sided printing, finishing operations, etc.)
 - User intent via a Job Ticket (number of copies, media size, media type, stapling, etc.)
 - Printer and Job status information (media low/empty, toner low/empty, paper jams, job waiting for input, etc.)
- Direct and indirect printing.
- Encrypted (TLS/HTTPS) communications, authentication, and access control.



IPP Use Cases

- Personal printing : letters, reports, presentations, photos, etc.
- Corporate printing : "follow me" printing where jobs are submitted to a central server and released at a nearby printer, various kinds of local print accounting, etc.
- Managed printing : remote print accounting, remote job processing, print-on-demand for saved documents, etc.
- Light production printing : small runs of books or other large reports, banners, brochures, signs, etc.
- Cloud (or isolated network) printing : personal printing to an accessible service with jobs printing locally



IPP Technologies

- IPP Foundations : IPP/1.1 and IPP/2.0
- IPP Service Types
 - IPP Print
 - IPP FaxOut
 - IPP Scan
 - IPP System
 - IPP 3D Print
- IPP Feature Capabilities
 - Media Sizes and Media Types
 - Finishing operations
- Additional Protocol Features
 - IPP Event Notifications and Subscriptions
 - IPP Shared Infrastructure Extensions
 - IPP Transaction Based Printing Extensions



IPP Foundations: IPP/1.1 and IPP/2.0

- IPP/1.1
 - RFC 8010 (2017) - IPP/1.1 Encoding and Transport
 - Replaced RFC 2910 (2000)
 - RFC 8011 (2017) - IPP/1.1 Model and Semantics
 - Replaced RFC 2911 (2000)
- IPP/2.0
 - PWG Standard 5100.12-2015
 - PWG Full Standard
 - Normatively differs from IPP/1.1, so version 2.x
 - Three levels: IPP/2.0, IPP/2.1, IPP/2.2
 - For different classes of devices
- IPPS
 - RFC 7472 (2015)
 - Internet Printing Protocol (IPP) over HTTPS Transport Binding and the 'ipps' URI Scheme



IPP Everywhere (PWG 5100.14)

- An IPP Print service supporting a vendor-neutral “driverless” print solution
- Foundational requirements for all Clients and Printers to ensure basic interoperability:
 - Discovery via mDNS / DNS-SD
 - “_print” subtype of “_ipp._tcp” for filtering
 - IPP/2.0
 - PWG Raster and JPEG document formats
- Printer Certification via IPP Everywhere Self-Certification program
 - Submitted passing certification lists product on the PWG IPP Everywhere page and entitles vendor to icon use





IPP FaxOut : PWG 5100.15-2013

- Supports outbound faxing by leveraging many facilities of IPP Print, with some learnings from IPP Everywhere
 - PWG Raster document format support required
- Removed deprecated IPP operations (e.g. Print-Job)
- Added requirements to disambiguate IPP FaxOut from IPP Print
 - Mandatory “/ipp/faxout” default resource path
 - New DNS-SD service subtype
- Added new FaxOut specific operations and attributes
 - Add-Document-Images Operation
 - input-attributes (collection)
 - confirmation-sheet-print (boolean)
 - cover-sheet-info (collection | no-value)
 - ...



IPP Scan : PWG 5100.17-2014

- Extends IPP to support scanning
 - Requires PDF 1.7 document format support
 - One new operation
 - 17 new attributes
 - DNS-SD service definition and default resource path for this service type



IPP System (PWG SYSTEM-2017)

- In development – expected to be completed in 2017 and approved in 2018
- Service for interfacing with the IPP System object
 - Container that hosts instances of IPP Printer, FaxOut, Scan, 3D Print service objects
- Operations aid in the creation and management of these objects
- Get-Printers operation lists all available Printers
 - Given the user name, list will be those Printers available for that particular user (may require authentication)
 - Important aspect of print policy: Printer discovery results filtered by user



IPP 3D Print : PWG 5100.21-2017

- Extends IPP with additional 3D printing attributes to bring IPP semantics and infrastructure and some design elements of IPP Everywhere to the 3D printing ecosystem
 - Required document format : 3MF
 - Service subtype and default resource path definition
- First version of IPP 3D Printing Extensions focused on supporting elements used in consumer / desktop FDM printers
 - Initial set of 20 material types (PLA and variants, ABS, wax, gold, titanium, chocolate, a few others)
- Ongoing liaison engagement with 3MF Consortium, ISO IEC JTC1 TC261, AMSC, others



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Capabilities



Evolution of Capabilities Definitions

- Evolution from keyword/enum-based attributes to the more contemporary collection-based attributes
 - “finishings-supported” → “finishings-col-database”
 - “media-supported” → “media-col-database”
- Allows the Printer to provide detailed, precise descriptions of its capabilities to a Client, to better support preview and for Client-side preflight checks
 - Not based on “magic numbers” and a-priori knowledge
 - 'staple-top-left' in “finishings-col-ready” provides the Printer's definition of 'staple-top-left', including the location of the staple relative to a specific reference edge, its size, rotation, etc.



Feature Definitions

- PWG 5100.1-2017 - Finishings 2.1
 - Expanded "finishings-col" definitions
- PWG 5100.2-2001 - Output Bin Extension
- PWG 5100.3-2001 - Production Printing Attributes
 - High-fidelity media descriptions via "media-col"
 - High-fidelity finishings descriptions via "finishings-col"
- PWG 5100.6-2003 - Page Overrides
- PWG 5100.9-2009 - Printer State Extensions
- PWG 5100.11-2010 - Job and Printer Extensions Set 2
 - saved jobs
 - password (or PIN) released jobs
- PWG 5100.13-2012 - Job and Printer Extensions Set 3
 - Printer identification and location
 - Job constraints and resolvers
 - Localization catalogs
 - Supplies levels
- PWG Whitepaper – IPP Job Password Repertoire
- PWG Whitepaper – IPP Presets
 - Printer-side ob Ticket templates / presets with names and optional triggers
- PWG Whitepaper – HTTP Authentication Schemes for IPP



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Other Resources



IPP Large System Support

- IPP Transaction Based Printing Extensions : PWG 5100.16-2013
 - User Accounts vs. Payment/Billing Accounts
 - PIN/Passcode Printing Release Printing
 - Priority of Service
 - Job Review
- IPP Shared Infrastructure Extensions : PWG 5100.18-2015
 - Enables IPP communications between an IPP Output Device and an IPP Print service in topologies where the IPP Print service is unable to initiate communications
 - e.g. when the IPP Print Service is a cloud print service and the IPP Output Device is behind a NAT router



Guidance on Implementation

- IPP/1.1 Implementor's Guide : RFC 3196 (2001)
 - Targeted at assisting the creators of IPP Printers

- IPP Implementor's Guide v2 : PWG 5100.19-2015
 - Targeted at assisting the creators of IPP Clients as well as Printers
 - Examines many of the common interactions between IPP Clients and Printers and qualitatively judges them, with best practices outlined



Sample Implementations and Tools

- PWG Github Site : <https://istopwg.github.io>
 - ippsample: Sample implementations
 - ipptool : submit IPP operations, validate responses
 - ippserver : simulate an IPP Printer
 - ippfind : find IPP printers easily
 - ipptransform : convert files
 - ippeveselfcert : IPP Everywhere Self Certification Tools project
 - Report defects, request enhancements, contribute to the project



2017 Work In Progress

- IPP System
 - Described earlier
- IPP Get-User-Printer-Attributes whitepaper
 - New operation to enable per-user IPP capabilities (print policy)
- IPP Presets
 - IPP attribute that bundles together a set of Job Template Attributes with a localizable label and an optional attribute trigger to apply the settings in a batch
- HTTP Authentication Schemes for IPP
 - Examination of different authentication schemes employed in HTTP / HTTPS and how they should be properly integrated into an IPP Client implementation



Opportunities for Contributions

- Extend IPP Everywhere™ certification to cover other IPP service types
- Tools to qualify the correctness of an IPP Client implementation
- Tools to validate the correctness of a PWG Raster document
- Others?

Other Questions / Comments

