The Printer Working Group

IPP 2018 State of the Union

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Smith Kennedy, HP Inc.
PWG Chair

What is IPP?

- The Internet Printing Protocol
- A secure, mature high-level printing protocol supported by almost all printers sold today.
  - IPP/1.1 (RFC 2910 / 2911) - September 2000
  - IPP/1.1 (RFC 8010 / 8011) - January 2017
    - Now Full Internet Standard (STD 92)
  - IPP/2.0 (PWG 5100.12) – October 2015
- Used over IP networks, Wi-Fi Direct, and USB connections.
- The foundational protocol for the most commonly deployed universal print solution systems in the market today
  - IPP Everywhere
  - AirPrint
  - Mopria
  - Wi-Fi Direct Print
- IPP semantics and data model were also 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 communications via TLS/HTTPS
- 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
  - Print
  - FaxOut
  - Scan
  - System
  - 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 Protocol Versions: IPP/1.1 and IPP/2.0

- IPP/1.1
  - IETF STD 92
    - 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)
    - **Achieved Full Internet Standard status as STD 92 in June 2018**

- IPP/2.0
  - PWG Standard 5100.12-2015
    - PWG Full Standard
    - Normative differences from IPP/1.1, hence the major version change
    - Three levels for progressively more sophisticated classes of devices
      - IPP/2.0 – Foundation for all modern IPP printers
      - IPP/2.1 – IPP/2.0 plus additional requirements for workgroup printers
      - IPP/2.2 – IPP/2.1 plus additional requirements for large high performance enterprise printers

- IPPS
  - RFC 7472 (2015)
    - Internet Printing Protocol (IPP) over HTTPS Transport Binding and the 'ipps' URI Scheme

IPP/1.1 and IPP/2.0 Normative Differences

IETF or PWG Specification	IPP/1.1 Support	IPP/2.0 Support	IPP/2.1 Support	IPP/2.2 Support
PWG 5100.1 : IPP Finishings		REQUIRED	REQUIRED	REQUIRED
PWG 5100.2 : IPP “output-bin” attribute extension		REQUIRED	REQUIRED	REQUIRED
PWG 5100.3 : IPP Production Printing Attributes – Set 1			REQUIRED	REQUIRED
PWG 5100.5 : IPP Document Object				REQUIRED
PWG 5100.6 : IPP Page Overrides			RECOMMENDED	REQUIRED
PWG 5100.7 : IPP Job Extensions			REQUIRED	REQUIRED
PWG 5100.8 : IPP “-actual” Attributes				REQUIRED
PWG 5100.9 : IPP Printer State Extensions v1		RECOMMENDED	REQUIRED	REQUIRED
PWG 5100.11 : IPP Job and Printer Extensions – Set 2			RECOMMENDED	REQUIRED
PWG 5101.1 : PWG Media Standardized Names 2.0 (MSN2)		REQUIRED	REQUIRED	REQUIRED
PWG 5107.2 : PWG Command Set Format for IEEE 1284 Device ID v1.0		RECOMMENDED	RECOMMENDED	REQUIRED
RFC 8010 – IPP/1.1 Encoding and Transport	REQUIRED	REQUIRED	REQUIRED	REQUIRED
RFC 8011 – IPP/1.1 Model and Semantics	REQUIRED	REQUIRED	REQUIRED	REQUIRED
RFC 3380 – IPP Job and Printer Set Operations			REQUIRED	REQUIRED
RFC 3382 – IPP: The 'collection' attribute syntax			REQUIRED	REQUIRED
RFC 3510 – IPP URL Scheme	REQUIRED	REQUIRED	REQUIRED	REQUIRED
RFC 3995 – IPP : Event Notifications and Subscriptions			REQUIRED	REQUIRED
RFC 3996 – IPP : The ’ippget’ Delivery Method for Event Notifications			REQUIRED	REQUIRED
RFC 3998 – IPP Job and Printer Administrative Operations			REQUIRED	REQUIRED
RFC 5246 - Transport Layer Security (TLS) Protocol v1.2		RECOMMENDED	RECOMMENDED	REQUIRED
RFC 7472 – (IPP) over HTTPS Transport Binding and the ’ipps’ URI Scheme		RECOMMENDED	RECOMMENDED	RECOMMENDED

Note: Table copied from PWG 5100.12-2015 Table 1 (page 13)

IPP Everywhere (PWG 5100.14)

- An IPP Print service definition supporting a complete, vendor-neutral "driverless" print solution

- <u>All</u> Clients and Printers MUST implement:
  - Discovery via mDNS / DNS-SD
    - "_print._sub._ipp._tcp" subtype of "_ipp._tcp" for filtering
  - IPP/2.0 + additional required IPP operations and attributes
  - PWG Raster and JPEG JFIF document formats
    - PDF optional

- IPP Everywhere Self-Certification program
  - Currently only certifying Printers
  - Successful test suite results submitted to PWG for product listing and permission to use the IPP Everywhere™ logo
    - 272 models listed today
    - More on the way

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-2019)

- In development – expected to be completed in 2018 and approved in 2019
- Service for interfacing with the IPP System object
  - Container that hosts instances of Printer, FaxOut, Scan, 3D Print service objects
  - Operations to create, manage and delete these objects
- Get-Printers operation lists all available Printers
  - With authentication, list will contain only those Printers available for that particular 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, ASTM F42/ISO 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 IPP Registration – IPP Job Password Repertoire
- PWG IPP Registration – IPP Presets
  - Printer-side Job Ticket templates / presets with names and optional triggers

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 service
    - ippfind : find IPP printers easily
    - ipptransform : convert files to different document formats
    - ippproxy : simulate an IPP Proxy service
  - ippeveselfcert : IPP Everywhere Self Certification Tools project
    - Report defects, request enhancements, contribute to the project

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What's New in 2018

What's New in 2018

- IPP Get-User-Printer-Attributes
  - 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
- IPP Privacy Attributes
  - Defines attributes for specifying the privacy policies of Document, Job, Printer, and Subscription objects.

2018 Work In Progress (1/4)

- IPP Everywhere™ v1.1
  - Q4 2018
  - Some normative requirements relaxed from v1.0
    - JPEG JFIF document format now REQUIRED only for color printers; RECOMMENDED for monochrome printers
    - IPP attributes related to ICC profile support no longer required
  - Removed unused or unimplemented technologies
    - OpenXPS document format
    - WS-Discovery discovery protocol

- IPP Everywhere™ Printer Self-Certification Manual v1.1
  - Q4 2018
  - Updates to support certification of IPP Everywhere™ v1.1 Printers
  - Adding certification for IPP Everywhere print servers

2018 Work In Progress (2/4)

- IPP System Service
  - Q1/Q2 2019
  - Described earlier
- IPP Job Reprint Password
  - Q3 2018
  - New attributes to enable password protected Saved Jobs [PWG 5100.11]
- IPP Encrypted Jobs and Documents
  - Q1 2019
  - Defines new encrypted IPP message formats (based on OpenPGP) that provide IPP with end-to-end encryption of IPP Job Template attributes, Document Template attributes, and Document data.
- IPP Authentication Methods
  - Q4 2018
  - White paper examining different authentication schemes employed in HTTP / HTTPS and how they should be properly implemented by IPP Clients and Printers to provide a quality user experience

2018 Work In Progress (3/4)

- IPP 3D Printing Extensions 1.1
  - Q4 2018
  - Additional attribute definitions and some normative changes

- PWG Safe G-Code Subset for 3D Printing
  - Q4 2018
  - Defines a "safe" subset of G-code for use in 3D printing with IPP along with the capabilities and parameters needed to allow a client to generate G-code compatible with the printer.

2018 Work In Progress (4/4)

- PWG / Linux OpenPrinting Google Summer of Code
  - Q3 2018
  - New 'ippdoclint' tool to validate correctness of IPP Everywhere supported document formats
    - PWG Raster
    - JPEG
    - PDF
  - Updates to 'ippserver'
  - New 'ipptool' test files for most / all PWG IPP standards

Opportunities for Contributions

- Extend IPP Everywhere™ certification to cover other IPP service types
- Tools to qualify the correctness of an IPP Client implementation
- Test coverage of individual “features” beyond IPP Everywhere™
- IPP 3D implementations in open source 3D printer firmware and clients
- Others?

More Information

- To contact contributors or officers of the PWG IPP Workgroup, get a listing of links to completed specifications, and/or to review and contribute to works in progress, visit the PWG IPP Workgroup Web page:

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

Other Questions / Comments