



The Printer Working Group

IPP Workgroup Session, Day 1

May 15, 2018

PWG IP Policy



- "This meeting is being held in accordance with the PWG Intellectual Property Policy"
 - http://www.pwg.org/chair/membership_docs/pwg-ip-policy.pdf
- TL;DR: Anything you say in a PWG meeting or email to a PWG address can be used in a PWG standard
 - (but please do read the IP policy above if you haven't done so)



May 15, 2018 (Pacific Standard Time)

When	What
09:00 - 10:15	PWG Plenary
10:15 - 10:30	Break
10:30 - 12:00	IPP 3D Topics
12:00 - 13:00	Lunch
13:00 - 13:30	OpenPrinting - Plenary
13:30 - 14:30	OpenPrinting - Status of Ghostscript/MuPDF
14:30 - 14:45	Break
14:45 - 15:45	OpenPrinting - CUPS Plenary
15:45 - 16:30	OpenPrinting - cups-filters
16:30 - 17:15	OpenPrinting - Google Summer of Code 2018

Agenda (con't)



May 16, 2018 (Pacific Standard Time)

When	What
09:00 - 09:30	IPP Workgroup Status
09:30 - 10:30	IPP Sample Code Demo
10:30 - 10:45	Break
10:45 - 11:30	IPP System Service
11:30 - 12:00	IPP Authentication Methods
12:00 - 13:00	Lunch
13:00 - 14:30	IPP Encrypted Jobs and Documents
14:30 - 14:45	Break
14:45 - 15:15	IPP Job Reprint Password
15:15 - 17:00	IPP Everywhere v1.1

Agenda (con't)



May 17, 2018 (Pacific Standard Time)

When	What
09:00 - 10:45	Imaging Device Security
10:45 - 11:00	Break
11:00 - 12:00	How to Use the Internet Printing Protocol
12:00 - 12:30	Next Steps
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IPP 3D Topics



- Status of IPP 3D Printing
- PWG Safe G-Code Subset for 3D Printing
- IPP 3D Printing Extensions v1.1
- Other liaisons and news



Status of IPP 3D Printing

- Lots of interest, but no shipping products (yet)
- For entry-level printers, primary concerns center around doing the slicing onboard the printer
 - Possible, but requires more powerful CPUs than are typically used (Arduino-class)
 - Client-side slicers often provide slicing options that are not exposed as IPP Job Template attributes
 - Using client-side or cloud slicing requires a suitable intermediate format (like we do for 2D printing using PWG Raster)
- Industry changes since IPP 3D v1.0 was published:
 - New 3MF Slice Extension format offers a lighter-weight pre-sliced version of 3MF files (not limited to FDM)
 - New FDM printers with more intelligent print heads and material handling capabilities
 - More multi-material printers, some with mixing capabilities

PWG Safe G-Code Subset for 3D Printing



- Interim draft:
 - <https://ftp.pwg.org/pub/pwg/ipp/wd/wd-pwgsafegcode10-20180426-rev.pdf>
- Best Practice document that defines a common subset of G-Code for FDM printers
 - Convenient format for adoption by existing 3D printers
 - Targeting only as a best practice document because G-Code isn't an ideal long-term intermediate format
- Discussion:
 - Other G-Code commands required?
 - Other Printer Description or Job Template attributes required?
- Proposed schedule:
 - Stable draft Q3 2018



IPP 3D Printing Extensions v1.1

- Initial draft:
 - <https://ftp.pwg.org/pub/pwg/ipp/wd/wd-ipp3d11-20180426-rev.pdf>
- Errata update to address specific implementation issues on entry-level 3D printers and enable support for generic cloud/local slicing services
- Changes:
 - Relax 3MF requirement
 - Recommend support for "standard" intermediate format (PWG Safe G-Code, 3MF Layer Extension)
 - Add "platform-shape" and other attributes as RECOMMENDED
 - Standardize "material-type" naming convention for materials defined by other standards/organizations
- Proposed schedule:
 - Prototype draft Q3 2018



IPP 3D Liaison Discussions

- ASTM Committee F42 on Additive Manufacturing Technologies
 - www.astm.org/COMMITTEE/F42.htm
- IEEE Consumer 3D Printing Working Group (P3030)
 - standards.ieee.org/develop/wg/C3DP.html
- ISO/IEC JTC 1 3D Printing and Scanning Study Group
 - www.iso.org/committee/45020.html
- 3D PDF Consortium
 - www.3dpdfconsortium.org
- 3MF Consortium
 - www.3mf.io
- Press requests
 - "3D Printing Industry" web site: www.3dprintingindustry.com



The Printer Working Group

IPP Workgroup Session, Day 2

May 16, 2018

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15:15 - 17:00	IPP Everywhere v1.1

Agenda (con't)



May 17, 2018 (Pacific Standard Time)

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- Current charter:
 - <http://ftp.pwg.org/pub/pwg/ipp/charter/ch-ipp-charter-20170615.pdf>
- The Internet Printing Protocol (IPP) workgroup is chartered with the maintenance of IPP, the IETF IPP registry, and support for new clients, network architectures (Cloud, SDN), service bindings for MFDs and Imaging Systems, and emerging technologies such as 3D Printing
- In addition, we maintain the IETF Finisher MIB, Job MIB, and Printer MIB registries, and handle synchronization with changes in IPP



- **IPP WG Co-Chairs:**
 - Paul Tykodi (TCS)
 - Ira McDonald (High North)
- **IPP WG Secretary:**
 - Michael Sweet (Apple)
- **IPP WG Document Editors:**
 - Ira McDonald (High North) – IPP System Service
 - Michael Sweet (Apple) – How to Use the Internet Printing Protocol, IPP 3D Printing Extensions v1.1, IPP Encrypted Jobs and Documents, IPP Everywhere v1.1, IPP Everywhere Printer Self-Certification Manual v1.1, IPP System Service, PWG Safe G-Code
 - Smith Kennedy (HP Inc.) – How to Use the Internet Printing Protocol, IPP Authentication Methods, IPP Encrypted Jobs and Documents, IPP Job Reprint Password
 - Peter Zehler (Xerox) - How to Use the Internet Printing Protocol

Status (1/3)



- **PWG Specifications in development:**
 - IPP 3D Printing Extensions v1.1 - Initial Draft
 - IPP Everywhere v1.1 - Interim Draft
 - IPP Everywhere Printer Self-Certification Manual v1.1 - Interim Draft
 - IPP System Service v1.0 - Prototype Draft
- **IPP Registration Documents in development:**
 - IPP Job Reprint Password - Interim Draft
- **IPP Best Practices in development:**
 - IPP Authentication Methods - Interim Draft
 - IPP Encrypted Jobs and Documents - Interim Draft
 - PWG Safe G-Code Subset for 3D Printing - Interim Draft
- **IPP Book in development:**
 - How to Use the Internet Printing Protocol - Interim Draft



- Recent IPP WG Approved Documents:
 - "IPP Get-User-Printer-Attributes" Registration
 - "IPP Presets" Registration
 - "Supporting Multi-Purpose Trays" Best Practice
 - "IPP Privacy Attributes" Registration
- Recent PWG Approved Documents:
 - PWG 3D Print Job Ticket and Associated Capabilities v1.0 (PJT3D)
 - PWG 5100.1-2017: IPP Finishings 2.1 (FIN)
 - PWG 5100.21-2017: IPP 3D Printing Extensions v1.0 (3D)
- Recent IETF RFCs:
 - RFC 8010: Internet Printing Protocol/1.1: Encoding and Transport
 - RFC 8011: Internet Printing Protocol/1.1: Model and Semantics

Status (3/3)



- Up-to-date pending IANA registrations online:
 - <http://www.pwg.org/ipp/ipp-registrations.xml>
 - Continue to maintain this in parallel for new specifications
 - Github repository: <https://github.com/istopwg/ippregistry>
- IPP Everywhere Printer Self-Certifications:
 - <https://www.pwg.org/printers>
 - 206 printers currently listed (more than doubled since August 2017)
 - Second 1.0 self-certification tools update released in October 2017
 - *Third 1.0 self-certification tools update in testing*
- IPP Sample Code:
 - Github repository:
 - <https://github.com/istopwg/ippsample>
 - Fork of CUPS code includes ippfind, ippproxy, ippserver, ipptool, ipptransform, and ipptransform3d



IETF IPP/1.1 Updates

- RFCs 8010 and 8011 have been published which replace (obsolete) RFCs 2910, 2911, 3381 (deprecated job progress attributes), and 3382 (collection attribute syntax)
- Published RFCs:
 - <http://tools.ietf.org/html/rfc8010>
 - <http://tools.ietf.org/html/rfc8011>
- **Pending:** Advance RFC 8010 and 8011 to IETF Internet Standard through status change
 - IESG process described in RFCs 2026 and 6410
 - Mike and Ira working on this



IPP Everywhere Self-Certification

- Resources:
 - <http://www.pwg.org/ipp/everywhere.html> (for tools/info)
 - <https://www.pwg.org/ippeveselfcert> (submission form)
 - <http://www.pwg.org/printers> (printer list)
 - <https://github.com/istopwg/ippeveselfcert> (Github repo)
- Released v1.0 Update 2 of self-certification tools on October 13th, 2017
 - v1.0 is tracking CUPS 2.2.x (current stable branch)
 - Update 3 in testing to fix minor issues and Windows packaging
- Planning future 1.1 errata update for manual and tools in 2018
 - v1.1 will track CUPS 2.3.x (current development branch)



Obsoleting "access-x509-certificate"

- "access-x509-certificate (1setOf text(MAX))"
 - Member attribute defined for "destination-accesses (1setOf collection)" and "document-access (1setOf collection)" operation attributes
 - Supposed to provide the X.509 public key and certificate used for TLS client authentication
- This member attribute cannot be implemented securely
 - Requires associated private key to use for TLS client certificate authentication
 - Providing the private key would allow the Printer to impersonate the Client indefinitely - violates TLS/X.509 best practices and would require revocation of the certificate
 - Without the private key, it is not possible to authenticate the holder of the certificate
- Recommend we formally mark it obsolete
 - No known implementations, no way to implement it securely/safely



IPP Sample Code

- Github Repository:
 - <https://github.com/istopwg/ippsample>
- Tracking CUPS 2.3
- Apache License Version 2.0
- Implements most IPP specifications and extensions
- Specific focus areas:
 - IPP Everywhere
 - IPP 3D
 - IPP Shared Infrastructure Extensions
 - IPP System Service
 - Authentication, authorization, and access control
 - Providing a gateway for legacy document formats: HP PCL, Safe G-Code
- Docker, Snapcraft, and Travis builds are available, AppImage and AppVeyor possibly in the future



IPP Sample Code (con't)

- IPP Everywhere support passes self-certification
- IPP 3D support is still a work-in-progress
 - All required bits are implemented
 - 3D transform functionality (for slicing and printer-specific commands) is using CuraEngine
 - CuraEngine integration needs to be updated for current release
 - Currently only single-extruder printers are supported
 - Printer can be directly connected via USB or get G-Code via INFRA extensions
 - Also want to support PWG Safe G-Code
 - Will probably setup CuraEngine to output PWG Safe G-Code and then use a common configuration file for printer-specific G-Code
 - Supports prototyping/development with Raspberry Pi or desktop systems



IPP Sample Code (con't)

- IPP Shared Infrastructure Extensions (INFRA) support is basically complete
 - Will add Register-Output-Device support as part of the System service prototyping
 - Still some room for improvement - do sparse updates of device attributes, and track the last "printer-config-change-time" value to determine whether an update is even needed
- IPP System Service prototyping almost complete
 - Status at <https://github.com/istopwg/ippsample/projects/1>
 - Prototyping experience will be covered after the break
 - A few major architectural changes:
 - Authentication support is now in place, with explicit administrative and authorized print groups
 - Subscriptions are now globally tracked (part of the System object) rather than tracked as part of a Printer object



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IPP Sample Code Demo

IPP System Service

IPP Shared Infrastructure Extensions

IPP 3D Printing Extensions



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Break



IPP System Service (SYSTEM)

- Current prototype draft at:
 - <https://ftp.pwg.org/pub/pwg/ipp/wd/wd-ippssystem10-20180504-rev.pdf>
- Combines and implements a concrete IPP binding of the following abstract Semantic Model 2.0 services and objects:
 - PWG 5108.06: System Object and System Control Service
 - PWG 5108.03: Network Resource Service
 - PWG 5109.1: Cloud Imaging Requirements and Model
- Discussion:
 - Register-Output-Device vs. Update-Output-Device-Attributes
 - Prototyping experience
 - "xxx-owner-col", "requesting-user-vcard", "xxx-power-state", and "timeout-predicate"
- Proposed Schedule:
 - Stable draft in Q2/Q3 2018

Register-Output-Device vs. Update-Output-Device-Attributes



- A question was asked about the difference between these two operations, and why Register-Output-Device was not included in PWG 5100.18
 - The PWG 5100.18 Infrastructure Printer is an IPP Printer (print service) and so must already exist for the Proxy to send an Update-Output-Device-Attributes request
 - The IPP System Service supports creation of IPP Printers (print services), both directly using the Create-Printer operation and indirectly using the Register-Output-Device operation (when a suitable Printer is not already created)
 - Thus, the Register-Output-Device operation allows a Proxy to "discover" the correct IPP Infrastructure Printer to use for subsequent Proxy operations such as Update-Output-Device-Attributes



Prototyping Experience

- "system-configured-printers" should allow a 'no-value' value when there are no Printers
- "system-configured-resources" should allow a 'no-value' value when there are no Resources
- "system-device-id" should not be required
 - Do we even need this?
- "system-settable-attributes-supported" should reference definition of "printer-settable-attributes-supported" (RFC 3380) and mention using 'none' value to indicate no attributes are currently settable.



Prototyping Experience (con't)

- "system-state" definition does not allow for some printers to be stopped and some to be idle and none processing.
 - Recommend that 'stopped' means all stopped, 'processing' means at least one 'processing', and 'idle' means at least one 'idle' and none 'processing'.
- "system-state-message" - is there a good reason to make this required? No way to do roll-up of the message, so the System would need to synthesize something or pick the most important "printer-state-message" value...
- "system-state-reasons" - not clear how to do the roll-up of these values since the severity suffix depends on the "printer-state"...



Prototyping Experience (con't)

- Notifications:
 - Attributes need to be added to System Description attributes:
 - ipp-get-event-life
 - notify-attributes-supported
 - notify-events-default
 - notify-events-supported
 - notify-lease-duration-default
 - notify-lease-duration-supported
 - notify-max-events-supported
 - notify-pull-method-supported
 - Also need "notify-system-uri" and "notify-system-up-time"
Subscription Status attributes



Prototyping Experience (con't)

- Resources

- "date-time-at-installed", "date-time-at-canceled" need to be "dateTime | no-value"
- "time-at-installed" and "time-at-canceled" need to be "integer | no-value"
- Additional "resource-type" keywords:
 - 'static-icc-profile' (instead of 'static-iccprofile')
 - 'static-strings' for localization files
 - 'static-other' for other static files



Prototyping Experience (con't)

- Create-Printer operation, "printer-creation-attributes-supported", and "system-mandatory-printer-attributes":
 - Can't require "printer-xri-supported" because it is set by System
 - Maybe add "printer-xri-requested" operation attribute to tell System what kind of authentication and security is wanted
 - Table 9 needs to be with "printer-creation-attributes-supported"
 - Drop "charset-configured", "pdl-override-supported"
 - Add "document-format-supported", "printer-geo-location"
 - The two attributes need to reference each other



Prototyping Experience (con't)

- Create-Printer operation - supported values
 - "document-format-xxx": need to address how Client knows which formats the System's job services can support
 - Added "document-format-supported (1setOf mimeType)" System Description attribute
 - "multiple-document-jobs-supported": need to address how Client knows whether the System's job services can support multiple document jobs
 - Added "multiple-document-printers-supported (boolean)" System Description attribute
 - "printer-service-type": need a list of supported service types
 - Added "printer-service-type-supported (1setOf type2 keyword)" System Description attribute



Prototyping Experience (con't)

- **Create-Printer operation - status codes**
 - 'client-error-printer-already-exists': The named Printer already exists
 - 'server-error-too-many-printers': The System has reached capacity and cannot create another Printer at this time.



Prototyping Experience (con't)

- System startup/restart user experience
 - Having all configured printers start in a disabled state (`printer-state='stopped'` and `printer-is-accepting-jobs='false'`) is not consistent with how most printers or services work in the real world
 - Turn the printer/server on, and all configured/enabled services are available after boot-up automatically
 - While the abstract Semantic Model definition has services disabled on startup, that does not mean that a concrete binding of that model needs to adhere strictly to that requirement
 - Restart-System is inconsistent with Restart-Printer (RFC 3998):

"The IPP Printer MUST accept the request in any state. The Printer object MUST initialize its Printer's "printer-state" to 'idle', remove the state reasons from its "printer-state-reasons" attribute, and change its "printer-is-accepting-jobs" attribute to 'true'."



Prototyping Experience (con't)

- System startup/restart user experience (con't)
 - Proposal:
 - Newly created Printers are disabled by default, allowing for further configuration
 - Existing Printers are started in the state they were in prior to their last shutdown
 - Administrators can use Disable-All-Printers to force Printers to be disabled on startup/restart



"xxx-owner-col"

- Rare to have full VCARD information or a URI for the authenticated user
 - PAM/POSIX/GECOS information generally doesn't include phone numbers or email addresses (OpenID does, however)
 - Providing an empty vCard or a dummy URI ("user:name") is a waste of resources
- No basic user name member attribute ("owner-name (name(MAX))")
- No support for 'unknown' out-of-band value
- Proposal:
 - Change all "xxx-owner-col" to be "collection | unknown"
 - Add REQUIRED "owner-name (name(MAX))" member attribute
 - Make "owner-uri" and "owner-vcard" RECOMMENDED
 - Guidance is use "owner-uri" for a single email address or telephone number, "owner-vcard" for full contact information



"xxx-owner-col" (con't)

- "job-owner-col"
 - Purpose is not clear - already have "job-originating-user-xxx" and "job-recipient-name"
 - Do we even need/want it? Or are we looking for a more complete version of "job-recipient-name"
 - Semantics of how the attribute is created are not clear
 - Synthesized vCard from "job-originating-user-xxx" will be incomplete
 - Jobs are owned by User, Job operations allow (by default) owner + admin/operator for access control
 - Other "xxx-owner-col" attributes are not used for access control (all admin/operator)
- "notify-owner-col"
 - Mentioned but never defined
 - Similar issues as "job-owner-col"



"xxx-owner-col" (con't)

- "system-owner-col"
 - "Identifies the System Owner" - purely as a means to contact the owner, or more than that? We should say!
- "printer-owner-col"
 - "Identifies the Printer Owner" - purely as a means to contact the owner, or more than that? We should say!
 - How do we populate the initial value - most authenticated user (insufficient info) from Create-Printer/Register-Output-Device request, copy the "system-owner-col" value, or ???
- "resource-owner-col"
 - "Identifies the Resource Owner" - purely as a means to contact the owner, or more than that? We should say!
 - How do we populate the initial value - most authenticated user (insufficient info), "system-owner-col" value, or ???



"requesting-user-vcard"

- Purpose of this operation attribute is not clear
 - Value is not authenticated and is not automatically copied to "xxx-owner-col" for Set operations - would only be used for Job and Subscription Creation Requests (all other "xxx-owner-col" attributes are READ-WRITE where the value is specified directly)
- Already have "requesting-user-name" and "requesting-user-uri" (email, telephone number, etc.) which have well-defined semantics - most authenticated values get copied to "job-originating-user-xxx"
 - As noted before, authentication does not typically provide enough information to synthesize a useful vCard value
- Propose we remove this attribute from IPP System completely



"xxx-power-state"

- The power state attributes are currently "type1 keyword", meaning they are keywords that can only be changed by a spec update
 - Usually we only use type1 for enums, since keywords are meant to support vendor extensions and self-describing values
- The Power MIB properties use enumerated (integer) values for the power states [PWG5106.4]
 - Would be more efficient to map them to enum values in IPP
- Propose making these "type1 enums" using the existing keyword values as the symbolic names for each of the (SNMP) enum values
 - More consistent with PWG 5106.4
 - Simpler implementation with less chance of bugs
- Also would like to move the discussion of power states, etc. to a subsection of 4.1 (IPP System Object)



"timeout-predicate"

- Also a type1 keyword, but the corresponding PWG 5106.4 value is an enum
 - No vendor extension points
- Propose changing to type1 enum, mapped directly from the SNMP values - none(3), activity(4), and inactivity(5)



IPP Authentication Methods

- Current white paper:
 - <https://ftp.pwg.org/pub/pwg/ipp/whitepaper/tb-ippauth-20180430-rev.pdf>
- Provides an overview of how HTTP authentication methods are used with IPP
 - Currently HTTP Basic, HTTP Digest, HTTP Bearer (OAuth 2.0), HTTP Negotiate (Kerberos)
 - Maybe HTTP MutualAuth and others in the future



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Lunch Break

Resuming at 1pm PT



IPP Encrypted Jobs and Documents

- Interim draft:
 - <https://ftp.pwg.org/pub/pwg/ipp/wd/wd-ipptrustnoone10-20180328-rev.pdf>
- Discussion:
 - How to get encrypted Job Receipt (i.e. Get-Encrypted-Job-Attributes or something like that)
 - Do we really need support for signed requests?
- Proposed schedule:
 - Prototype draft Q1 2019



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Break



IPP Job Reprint Password

- Interim draft:
 - <https://ftp.pwg.org/pub/pwg/ipp/wd/wd-ippreprintpwd-20180424-rev.pdf>
- Proposed schedule:
 - Prototype draft Q3 2018

IPP Everywhere v1.1



- Interim drafts:
 - <https://ftp.pwg.org/pub/pwg/ipp/wd/wd-ippeve11-20180417-rev.pdf>
 - <https://ftp.pwg.org/pub/pwg/ipp/wd/wd-ippeveselfcert11-20180404-rev.pdf>
- Discussion:
 - How long can vendors continue to submit 1.0 results after 1.1 is approved?
 - v1.0 manual says 12 months
 - Should we track the firmware version(s) associated with the certification?
- Proposed schedule:
 - Prototype drafts and beta tools Q3/Q4 2018



Self-Certification 1.1 Update

- Tool changes:
 - Align with conformance requirements in v1.1 spec
 - More tests for required operations: Cancel-My-Jobs, Close-Job, Identify-Printer
 - New OS requirements
 - Linux: Ubuntu LTS 18.04
 - macOS: 10.13 or later
 - Windows: 8 or later
- Portal changes:
 - Track implementation type: logical device (server) vs. physical device (printer)
 - Track specific capabilities (type of finishers, etc.)
 - Existing submissions will be updated by hand (only 2 have finishers, all are printers)



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"How to Use the Internet Printing Protocol"



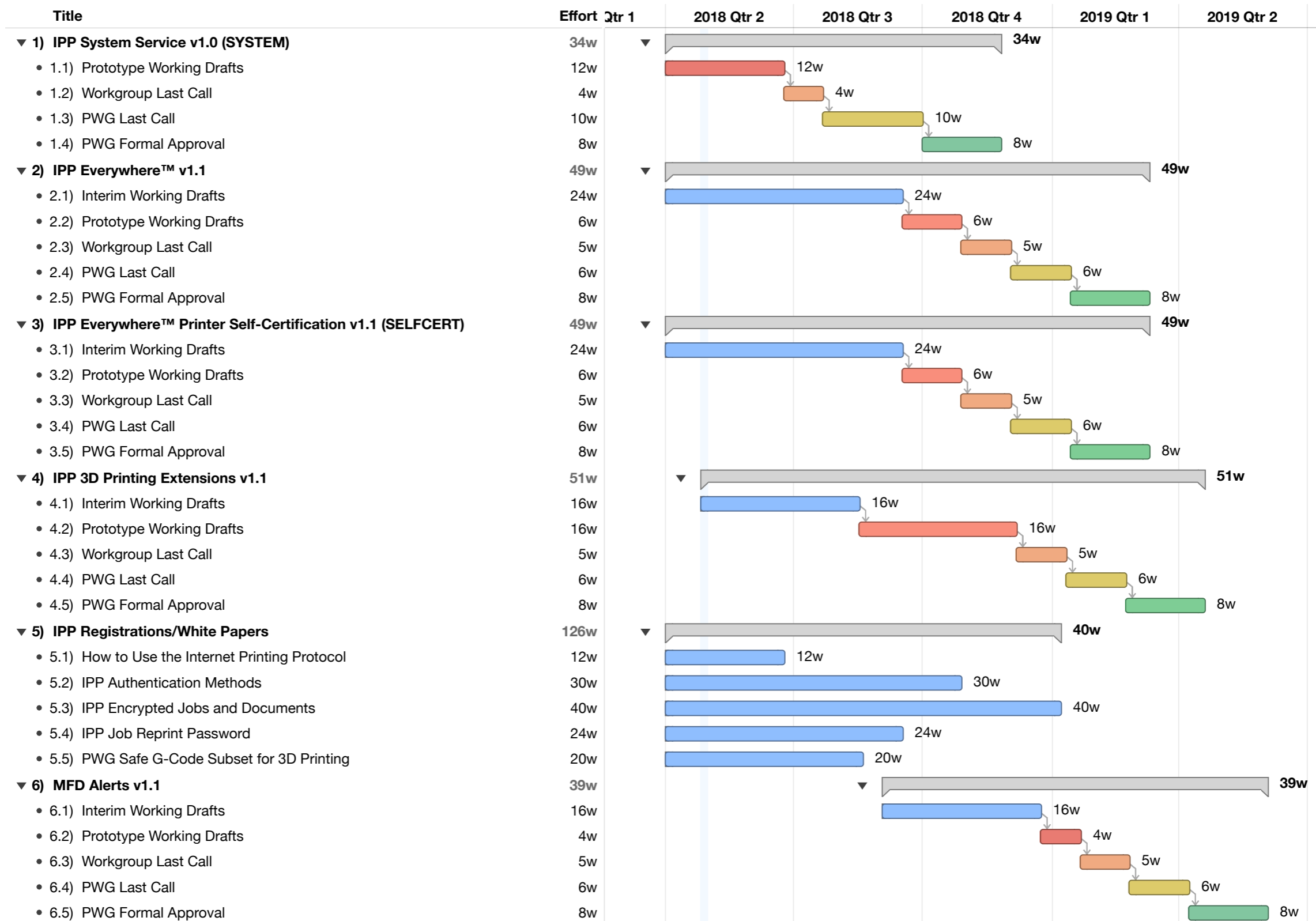
- Interim draft:
 - <https://ftp.pwg.org/pub/pwg/ipp/wd/wd-ippbook-20180430.html>
- A short introduction to IPP client development
- Target audience is developers new to IPP, typically enterprise web applications
- Development being tracked in a new Github repository in the "ippguide" directory:
 - <https://github.com/istopwg/pwg-books>
- Goal is to provide EPUB, PDF, and online HTML versions that we can point people to as needed
- Not our typical standards document!
- Volunteer editors (so far): Smith Kennedy (HP), Mike Sweet (Apple), Peter Zehler (Xerox)



The Printer Working Group

Next Steps

Next Steps





Next Steps (con't)

- Advance IPP/1.1 to IETF Internet Standard
 - Request change of status ASAP
- IPP Authentication Methods, IPP Job Reprint Password (Smith)
 - Continue developing as best practices/registrations
- "How to Use the Internet Printing Protocol" Book (Mike/Pete/Smith)
 - Publish stable version ASAP, post updates as needed
- IPP System Service (Ira/Mike)
 - Stable working draft in Q2/Q3 2018
- IPP Everywhere and Self-Certification v1.1 (Mike/Smith)
 - Prototype working drafts/beta tools in Q3/Q4 2018



Next Steps (con't)

- IPP 3D Printing Extensions v1.1 (Mike)
 - Prototype draft in Q3 2018
- PWG Safe G-Code Subset for 3D Printing (Mike)
 - Stable draft in Q3 2018
- MFD Alerts v1.1 (Ira/Mike/Smith - Errata Update)
 - Initial working draft in Q3/Q4 2018
- IPP Encrypted Jobs and Documents (Mike/Smith)
 - Stable draft in Q1 2019



More Information

- We welcome participation from all interested parties
- IPP Working Group web page
 - <https://www.pwg.org/ipp/index.html>
- Subscribe to the IPP mailing list
 - <https://www.pwg.org/mailman/listinfo/ipp>
- IPP WG holds bi-weekly phone conferences announced on the IPP mailing list
 - Next conference calls scheduled for Thursday, June 7 and 21, 2018 at 3pm ET