



- The Internet Printing Protocol workgroup recently developed PWG Candidate Standard 5100.21-2017: "IPP 3D Printing Extensions v1.0" as part of an effort to enable direct and service-based 3D printing
- IPP provides access control, authorization, and authentication over a secure transport
- IPP provides an abstract data model for representing materials, printer sub-units, and state
- IPP provides intent-based Job Tickets and Printer Capabilities - the User specifies *what* they want and the Printer determines *how* to do it
- IPP provides Job Receipts which record accounting information such as the material usage, processing times, and so forth
- IPP 3D requires support for the 3D Manufacturing File Format (3MF) and recommends support for PDF with U3D or PRC 3D content - no "machine instruction" formats like G-code



The Printer Working Group

Backup Materials



- IPP has been in 2D printers since 1999 (18 years), in 98%+ of all 2D printers sold in the world today
- Link to published IPP 3D spec on web page
- Also developing an XML schema (PJT3D) that provides the same Job Ticket, Printer Capabilities, and Job Receipt information in XML form suitable for embedding in documents and data exchange
 - Schedule: Likely publication in Q2 2017
- 1.0 specification has a focus on FDM/"desktop" printers
- Extensible model allows us to support other materials and technologies easily



AAA and Security

- IPP supports all of the standard HTTP authentication schemes (Basic, Digest, OAuth, MutualAuth, Negotiate, etc.) plus X.509 certificate validation over TLS
- Commonly used with LDAP-based authorization frameworks (ActiveDirectory, OpenDirectory, etc.)
- IPP 3D requires TLS (1.2 or higher) support



Abstract Data Model

- Every printer is different, so the PWG developed a high-level abstract data model to enable useful monitoring (for maintenance, availability/reliability, etc.)
- Key information is preserved (classes of sub-units, types of materials, temperatures, levels, etc.) without exposing implementation details that are not needed for the machine interface



Intent-Based Job Tickets

- IPP assumes that the printer knows how to print something - we don't tell the printer to move the extruder head or prepare a powder bed, we tell it we want an object printed with a certain material and a certain accuracy
- Job Ticket and Capabilities reflect the minimum information needed for the printer to process a job as the user intends
- *What, not how*



Job Receipts

- Records the actual Job Ticket values that were used, including how much of each material was used, errors that occurred during process, and so forth
- Primary usage is for accounting, but also can be used operationally for determining supply orders, maintenance periods, etc.

File Formats

- AMF was considered but rejected:
 - The whole spec isn't openly available (parts are summarized online)
 - Most implementations only support a subset of AMF since they follow what has been posted online and not the spec
- PDF is only recommended because:
 - Few implementations
 - Having two 3D formats embedded, neither of which is required, is an interoperability issue
 - Potential confusion over what PDF files contain 3D content and which content should be printed
- 3MF was chosen because:
 - Completely open and free specification
 - Multiple implementations, including an open source reference
 - Explicitly supports embedded job tickets