



The Printer Working Group

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## IPP Shared Infrastructure Extensions (INFRA)

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**Abstract:** As network infrastructure has become more complex, the traditional client-server model of printing is no longer sufficient to describe the interactions between the IPP Client and IPP Printer. This document defines an IPP Binding of the Cloud Imaging Model that allows IPP Printers to interface with shared services based in the network infrastructure, i.e., software-defined networks, and/or through Cloud-based solutions to remotely obtain and process Jobs and Documents, and provide state and configuration changes to those services.

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For additional information regarding the Printer Working Group visit:

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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

The Internet Printing Protocol/1.1: Model and Semantics [RFC2911] defines the general model for printing and a Client-Server interface to support communications with a Print Service that has one or more Output Devices - Figure 1 shows the IPP model and interface graphically. RFC 2911 does not define the interface between the Print Service and the Output Device. When the Print Service can initiate communications with the Output Device, the existing IPP model can be used with the Print Service acting as a Client to the Output Device's IPP Printer object. However, when the Print Service is unable to initiate communications with the Output Device, a new interface is required that allows the Output Device to retrieve and update Jobs and Documents, as well as provide current status and configuration of the Output Device to the Print Service.

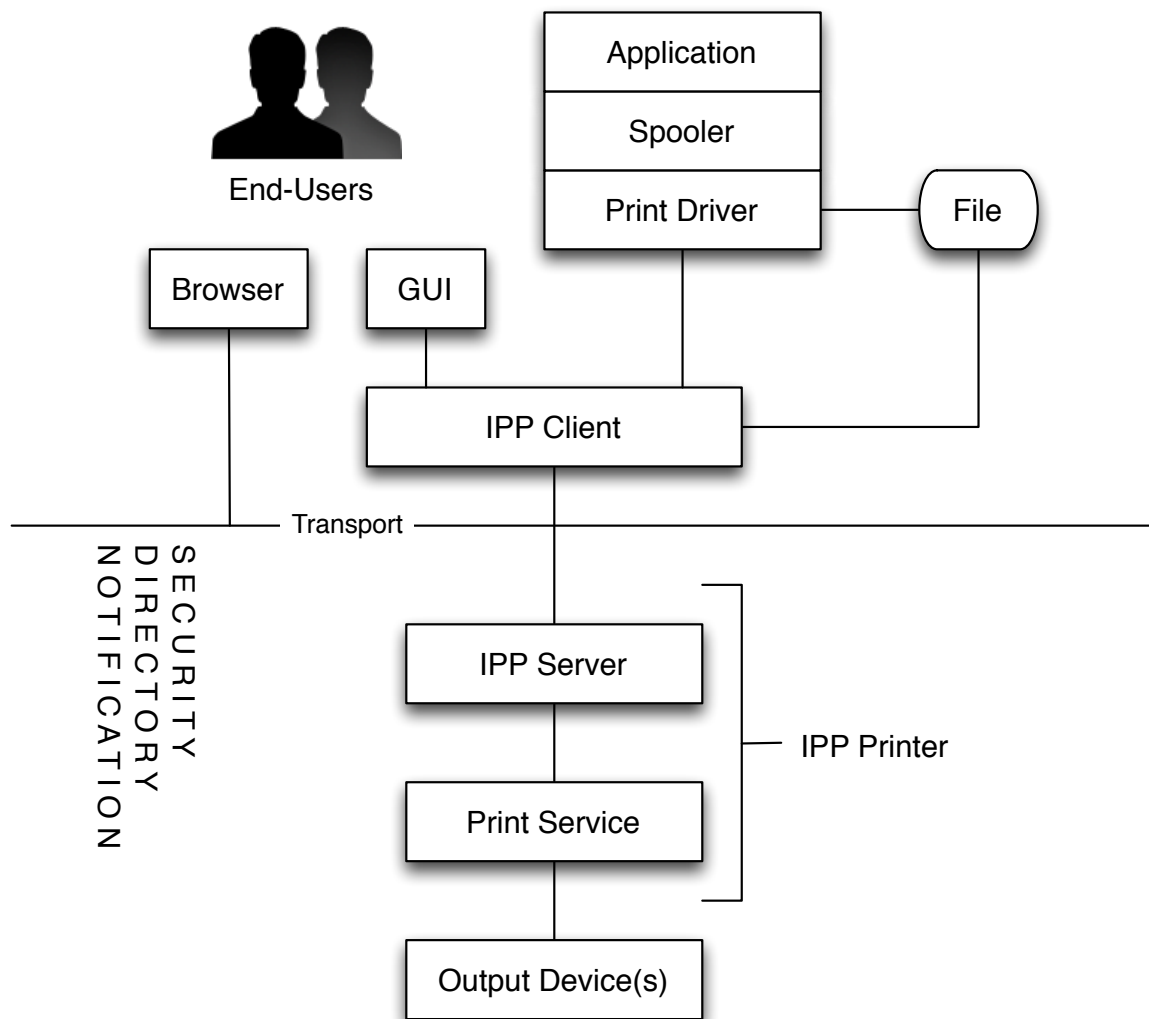


Figure 1 - IPP General Model [RFC2911]

This specification defines an IPP Binding of the Cloud Imaging Requirements and Model [PWG5109.1]. Figure 2 and Figure 3 show the extended model. While the focus is on IPP Cloud Printers, the same IPP Binding can be used in any environment where the Print Service is unable to initiate communications with the Output Device. This is common in many secure and multi-homed network environments, such as:

1. A gateway uses the IPP Binding defined by this specification to provide guest printing from an open Wi-Fi network to an Output Device on the secure corporate LAN. Clients on the open Wi-Fi network communicate with the gateway to submit print Jobs. Similarly, the corporate printers communicate with the gateway to retrieve the print-ready Documents to produce output.
2. A portable workstation/cart uses the IPP Binding defined by this specification to provide audited printing through a shared server. As the cart is moved to different rooms, floors, and buildings, the Client display communicates through different Wi-Fi network segments to the shared server to submit print Jobs. Similarly, the cart's printer also communicates with the shared server to retrieve the print-ready Documents to produce output.
3. A vendor uses the IPP Binding defined by this specification to support a release-printing solution. The user submits Jobs to the vendor's service and then goes to a managed printer at her organization, swiping her ID card in the printer's card reader. The printer then retrieves the print-ready Documents associated with her ID to produce output.

## 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 Printing 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].

*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.

*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.

*Late Binding*: delaying application or processing of Job Ticket intent until the last possible moment in order to preserve the fidelity of the output and minimize bandwidth. For example, applying "number-up" imposition in the Printer instead of the Infrastructure Printer whenever possible.

*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.

*Output Device*: a single Logical or Physical Device

*Physical Device*: a hardware implementation of an endpoint device, e.g., a marking engine, a fax modem, etc.

*Spooling Service*: A Printer that stores all of a Job's Document data so that it can be reprocessed as needed.

## 2.3 Protocol Role Terminology

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 [RFC7230] User Agent).

*Infrastructure Printer*: An IPP Printer that represents a Logical Device associated with both a Client and Proxy. For Cloud-based implementations, the Infrastructure Printer corresponds to a Cloud Imaging Service [PWG5109.1].

*Printer*: Listener for incoming IPP session requests and receiver of incoming IPP operation requests (Hypertext Transfer Protocol -- HTTP/1.1 [RFC7230] Server) that represents one or more Physical Devices or a Logical Device. For Cloud-based configurations, the Printer corresponds to a Local Imaging Service [PWG5109.1].

*Proxy*: A Client that sends configuration and status information to and retrieves and manages Jobs and Documents from an Infrastructure Printer on behalf of one or more Output Devices.

## 2.4 Other Terminology

*AAA Framework*: A common method for performing authentication, authorization, and accounting between multiple entities. See the Generic AAA Architecture [RFC2903] and AAA Authorization Framework [RFC2904] for background.

*Internet Accessible*: Refers to the ability of one device to communicate directly with another over the Internet, typically through a globally-routable IP address.

*IPP Binding*: The Internet Printing Protocol implementation of an abstract information model and associated set of abstract operations and data elements.

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

*Public Internet Accessible*: can be accessed via the public Internet without additional credentials or authentication.

*Shared Infrastructure*: Common network-accessible hardware and software used by an IPP Client, IPP Printer, and IPP Proxy.

*Sparse Update*: Refers to a partial update of an attribute's values where only the changed values are communicated to the Infrastructure Printer.

## **2.5 Acronyms and Organizations**

*AAA*: Authentication, Authorization, and Accounting [RFC2903][RFC2904]

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

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

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

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

## 3. Requirements

### 3.1 Rationale for IPP Shared Infrastructure Extensions

Existing specifications define the following:

1. IPP Everywhere [PWG5100.14] defines a profile of existing IPP specifications, standard Job Template attributes, and standard document formats.
2. The IPP: Event Notifications and Subscriptions [RFC3995] defines a standard model for asynchronous event notifications using IPP.
3. The IPP: The 'ippget' Delivery Method for Event Notifications [RFC3996] defines a polling interface for event notifications.
4. The PWG Raster Format [PWG5102.4] defines a minimal file format for transmission of multi-page color and grayscale bitmap images.
5. The Generic AAA Architecture [RFC2903] and AAA Authorization Framework [RFC2904] define the basic architecture of and requirements for AAA Frameworks used in Shared Infrastructure.
6. The Cloud Imaging Requirements and Model [PWG5109.1] defines an extension to the PWG Semantic Model for imaging in Cloud and software-defined network environments.

Therefore, this IPP Shared Infrastructure Extensions (IPPINFRA) specification should define an IPP Binding of the Cloud Imaging Requirements and Model to support printing in Cloud and software-defined network environments.

### 3.2 Use Cases

Each of the use cases in this section begin by the User (Jane) initiating a print action, selecting a Printer, 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 Infrastructure Printer is Network Accessible to the Client and Proxy while the Output Device/Printer is not Network Accessible. Also, the document to be printed is either Network Accessible to the Infrastructure Printer and in a format suitable for the Proxy, or converted by the Client or Infrastructure Printer into a suitable format for the Proxy.

#### 3.2.1 Print or Fax an Attached Document

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

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

Proxy for the desired Output Device validates the Job Ticket and document data and then fetches the Job and document data from the Infrastructure Printer and prints the document, providing status updates to the Infrastructure Printer as the document is printed.

### **3.2.2 Print or Fax 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 or fax.

After Jane initiates a print action and selects an Infrastructure Printer, she specifies the processing intent for the Job and confirms the print action. The Client sends a print Job request to the Infrastructure Printer with the Job Ticket and document URI. The Proxy validates the Job Ticket and document URI and then fetches the Job and Document data from the Infrastructure Printer and prints the document, providing status updates to the Infrastructure Printer as the Document is printed.

### **3.2.3 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 an Infrastructure 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 Proxy validates the Job Ticket and document data and then fetches the Job and photo from the Printer and prints the photo, providing status updates to the Printer as the photo is printed.

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

### **3.2.4 Print PDF Document to Non-PDF Printer**

Jane is viewing a PDF document on her laptop and would like to print the document on her consumer inkjet printer.

After Jane initiates a print action from her laptop and selects an Infrastructure Printer, she selects additional processing intent for the Job and confirms the print action. The Client sends a print Job request to the Printer with the attached PDF. The Infrastructure Printer converts the PDF document to PWG Raster. The Proxy validates the Job Ticket and document data and then fetches the Job and converted PWG Raster data from the Infrastructure Printer and prints the document, providing status updates to the Printer as the Document is printed.

### **3.2.5 Print a Document Securely Through an Untrusted Service**

Jane wants to print a document securely but needs to use a third-party Cloud solution to send the document to her printer. Both Jane's client and printer can process encrypted documents using a shared secret and are associated with the third-party Cloud solution which acts as an Infrastructure Printer.

After Jane initiates a print action from her client device and selects the printer hosted by the Cloud solution, she selects additional processing intent for the Job and confirms the print action. The Client encrypts the document data and sends a print Job request to the Cloud solution with the attached and encrypted document. The Cloud solution spools the encrypted document data but cannot process it. The Proxy then fetches the Job and encrypted document data, decrypts the document data using a shared secret, and prints the document.

### **3.2.6 Monitor Printer Supplies and Usage**

Jane provides managed printers to her customers, charging them for usage and replenishing supplies as needed. Since Jane has many customers in remote areas, she monitors each printer remotely to gather the page metrics and marker supply levels on a regular basis. She uses the page metrics to bill each customer for the pages that have been printed each month, and schedules supply deliveries when the marker supply levels show that replacements are needed.

## **3.3 Exceptions**

### **3.3.1 Printer Fault**

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

### **3.3.2 Printer Warning**

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

### **3.3.3 Lost Connection**

During a thunderstorm, the Proxy loses its persistent connection to the Infrastructure Printer. The Proxy retries its connection to the Infrastructure Printer until a successful connection is made. It then synchronizes the state of its Output Devices, Jobs, and Documents with the Infrastructure Printer and resumes processing of any fetchable Jobs.



### **3.4 Out of Scope**

The following are considered out of scope for this specification:

1. Definition of new authentication methods;
2. Definition of IPP operations for creating instances of Infrastructure Printers that are paired with Proxies;
3. Definition of IPP operations to support imaging services other than Print and FaxOut; and
4. Definition of secure printing mechanisms to support the use case in section 3.2.5.

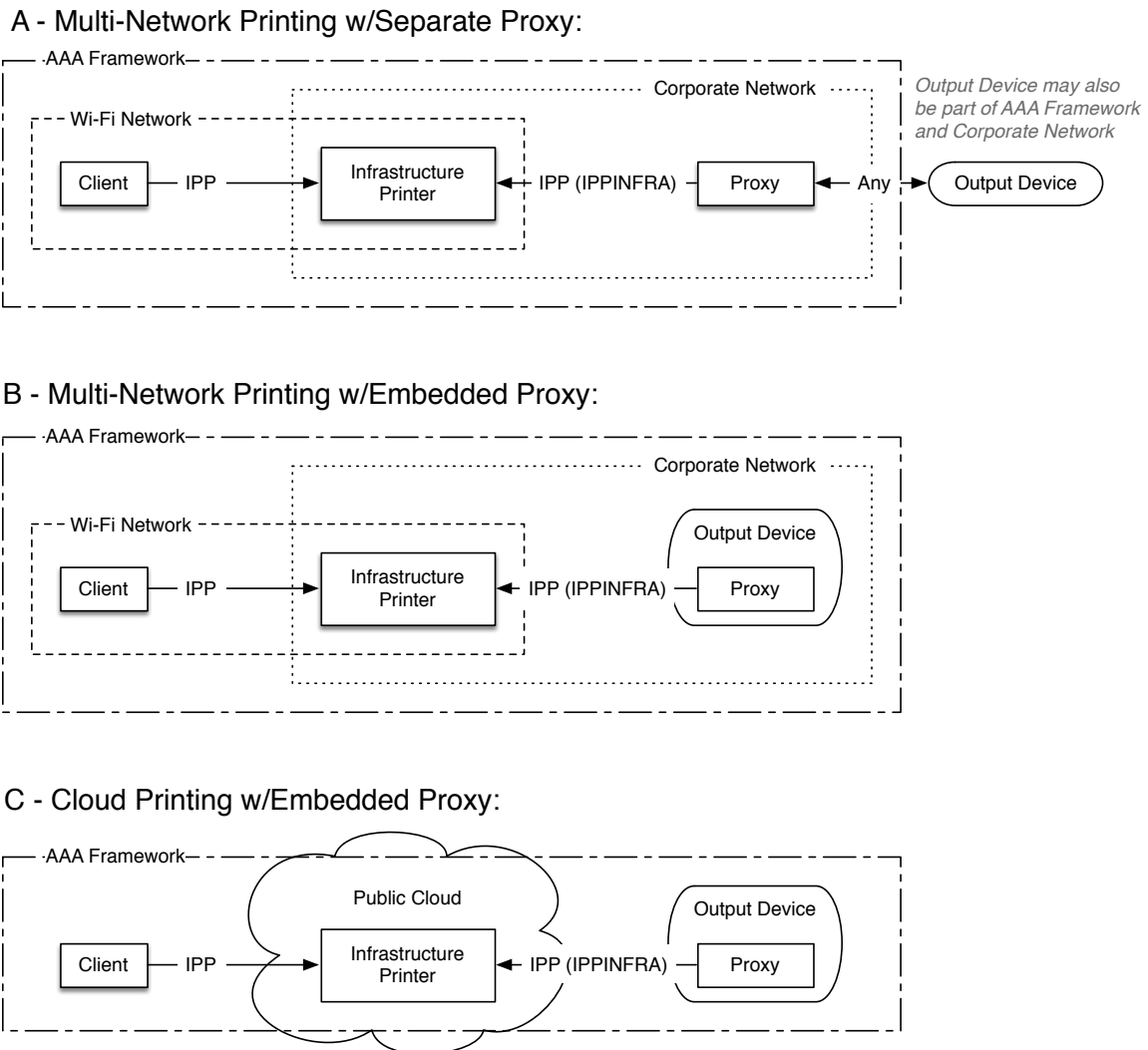
### **3.5 Design Requirements**

The design requirements for this specification are:

1. Define IPP attributes and values necessary for supporting the interface between Proxies and Infrastructure Printers,
2. Define IPP operations necessary for Proxies to fetch Print and FaxOut Jobs and documents from an Infrastructure Printer,
3. Define IPP operations necessary for Proxies to communicate status and configuration changes to an Infrastructure Printer,
4. Define security requirements necessary to support privacy, integrity, and auditing policies, and
5. Define sections to register all attributes, values, and operations with IANA.

### 4. Model

This specification defines the IPP Binding of the Cloud Imaging Model for the interface between a Proxy and Infrastructure Printer. Figure 2 A, B, and C show how the model can be applied graphically. For the purposes of this specification, the Client, Infrastructure Printer, Proxy, and Output Devices are pre-existing entities. Each of these entities belongs to a common AAA Framework.



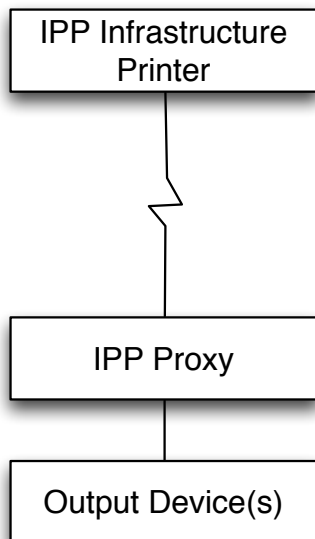
**Figure 2 - Shared Infrastructure IPP Model**

The Client is a standard IPP Client and sends IPP requests to the Infrastructure Printer to create Jobs, submit Documents, monitor status, and manage Jobs. The interaction between the Client and Infrastructure Printer is identical to that between a Client and a traditional IPP Printer object, with the addition that a Client may query the status and capabilities of an individual Output Device.

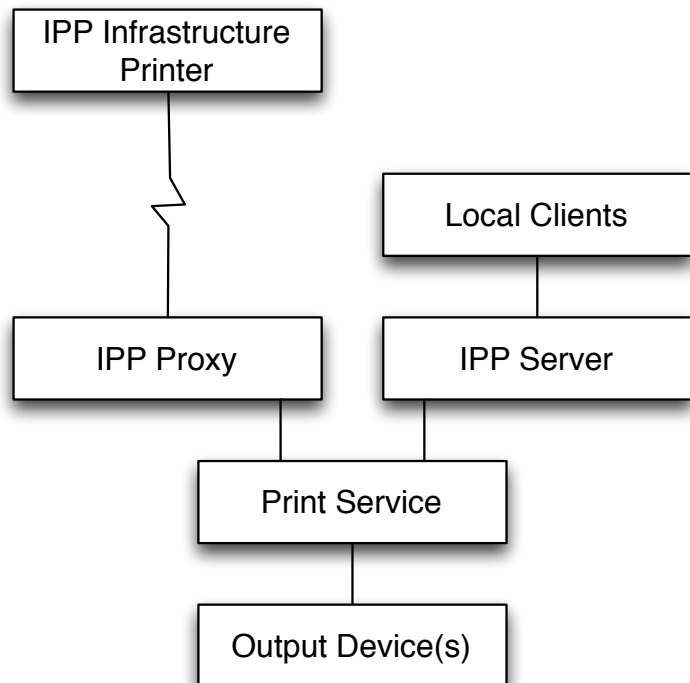
The Infrastructure Printer (section 4.1) is an IPP Printer that also supports the new operations defined in this specification. The Infrastructure Printer is a Spooling Service that manages Jobs and Documents on behalf of the Proxy and provides a view of the Output Devices' capabilities and status. The Infrastructure Printer can augment the capabilities of the Output Device for the Proxy, such as by providing document conversion, imposition, and copy generation.

The Proxy (section 4.2) also acts as an IPP Client but sends IPP requests for the new operations in order to retrieve Jobs and Documents, update the state of those Jobs and Documents, process document data on the Output Device, provide the state and capabilities of the Output Device, and respond to changes in Job state such as the User canceling the Job on the Infrastructure Printer. A Proxy MAY also be an IPP Printer that services IPP requests from local IPP Clients. Figure 3 shows two Proxy implementations of this model. Figure 4 shows a typical sequence of requests made to the Infrastructure Printer by both a Client and Proxy.

**IPP Proxy as Thin Gateway**



**IPP Proxy as Full Print Service**



**Figure 3 - Examples of IPP Proxy Implementations**

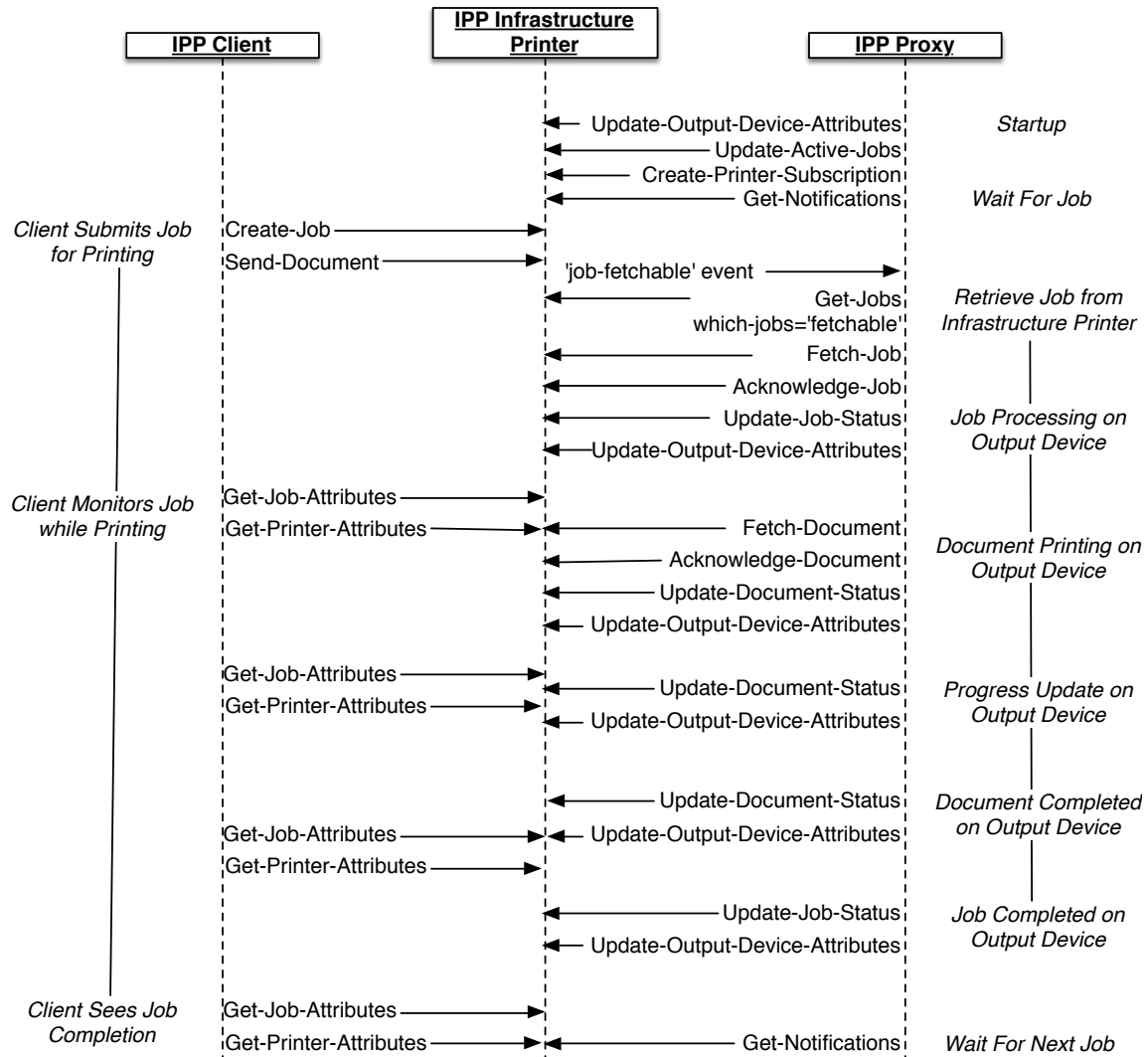


Figure 4 - IPP Shared Infrastructure Job Processing Sequence Diagram

### 4.1 IPP Infrastructure Printer

The Infrastructure Printer maintains the state and configuration of its own IPP Printer object as well as the recorded state and capabilities of each Output Device as provided by the Proxies. Output Devices are registered with the Infrastructure Printer when the Proxy provides updates state and capabilities. The Infrastructure Printer's state and capabilities are a composite of the Infrastructure Printer and Output Device's state and capabilities as provided by the Proxies. Changes to the Output Device state and capabilities trigger Infrastructure Printer state and configuration change event notifications, just as for changes on the Infrastructure Printer itself. The Infrastructure Printer MUST be in the 'stopped' state when there are no registered Output Devices.

A Client queries the composite state and configuration through the existing Get-Printer-Attributes operation - from the Client's perspective it is still talking directly to a typical IPP

Printer. The Infrastructure Printer provides a composite of the attributes and values of the Infrastructure Printer and Output Device(s). Clients that want to query only the state and configuration of a given Output Device, e.g., to collect accounting metrics and other Output Device specific information, use the new Get-Output-Device-Attributes (section 6.1) administrative operation.

Job and Document objects are maintained by the Infrastructure Printer. Some state information comes directly from the Proxy in the form of the "xxx-actual" attributes. Processing state is reported in separate attributes such as "output-device-job-state" and "output-device-document-state". A Client queries the Job or Document state through the existing Get-Job-Attributes and Get-Document-Attributes operations, respectively. Again, from the Client's perspective nothing is different from talking to a typical IPP Printer aside from receiving a few new attributes in the responses.

**Table 1 - Reported "printer-state" Values**

<b>Reported printer-state</b>	<b>Infrastructure Printer state</b>	<b>Proxy Output Device state (note 2)</b>
'idle'	'idle'	'idle'
'processing'	'idle'	'processing'
'stopped'	'idle'	'stopped'
'processing'	'processing'	'idle'
'processing'	'processing'	'processing'
'processing' (note 1)	'processing'	'stopped'
'stopped'	'stopped'	'idle'
'processing' (note 1)	'stopped'	'processing'
'stopped'	'stopped'	'stopped'

Note 1: The "printer-state-reasons" attribute MUST contain the value 'processing-to-stop-point'.

Note 2: The default Output Device "printer-state" value is 'stopped' until set otherwise.

#### 4.1.1 Job Processing on the Infrastructure Printer

Jobs are submitted to the Infrastructure Printer by the Client using the existing Create-Job, Print-Job, Print-URI, Send-Document, and Send-URI operations. Once the Job is created on the Infrastructure Printer, it is processed as described in the IPP/1.1 Model and Semantics [RFC2911] and as shown in Figure 5. Infrastructure Printers only do minimal pre-processing on behalf of the Proxy and SHOULD NOT perform any pre-processing for things that can be done by the Proxy in order to follow established Late Binding principles. For example, if a Proxy reports support for the "application/pdf" (PDF) MIME media type, the Infrastructure Printer SHOULD NOT perform any pre-processing of PDF document data unless the Proxy requests an alternate format or does not support one or more Job Template or Document Template attributes that were specified in the Job or Document creation request. Proxies MAY also be configured to report a subset of an Output Device's capabilities in order to offload processing to the Infrastructure Printer. Figure 6 shows how each document is processed by the Infrastructure Printer.

Infrastructure Printers MAY perform document data conversion and/or watermarking on behalf of a Proxy. When document conversion is performed, the Infrastructure Printer sets the "document-format-ready" Document Description attribute (section 7.2.1) and/or Job Description attribute (section 7.3.1) to indicate which formats are available for the Proxy to fetch. When converting document data to a format that consists of an ordered set of pages, the Infrastructure Printer MUST use the Job's "output-bin" Job Template attribute value and/or the corresponding "printer-output-tray" Printer attribute value to determine the proper output page ordering. For example, if the Job's "output-bin" value is 'face-up', the Infrastructure Printer MUST produce document data in reverse page order. Similarly, if the Job's "output-bin" value is 'tray-3', the Infrastructure Printer MUST lookup the corresponding "printer-output-tray" value and use the value of the 'stackingorder' property to determine whether to reverse the order of pages in the converted document data.

Infrastructure Printers MUST set the corresponding "xxx-actual" Job Description or Document Description attributes when applied during Document pre-processing. For example, if an Infrastructure Printer applies the "number-up" Job Template attribute to the submitted document data, it MUST also set the "number-up-actual" Job Description attribute to indicate that "number-up" has been applied.

Once any pre-processing of the document data is complete, the Infrastructure Printer adds the 'job-fetchable' keyword to the "job-state-reasons" attribute. This informs the Proxy that the Job is ready for output. The "job-state" value for a pre-processed Job is 'processing-stopped' until the Job is accepted by the Proxy using the Acknowledge-Job (section 5.3) operation.

During the remainder of the life of the Job, the Infrastructure Printer maintains the composite state of the Job and each Document, updating them whenever the Proxy sends Update-Job-Status (section 5.9) or Update-Document-Status (section 5.8) requests.

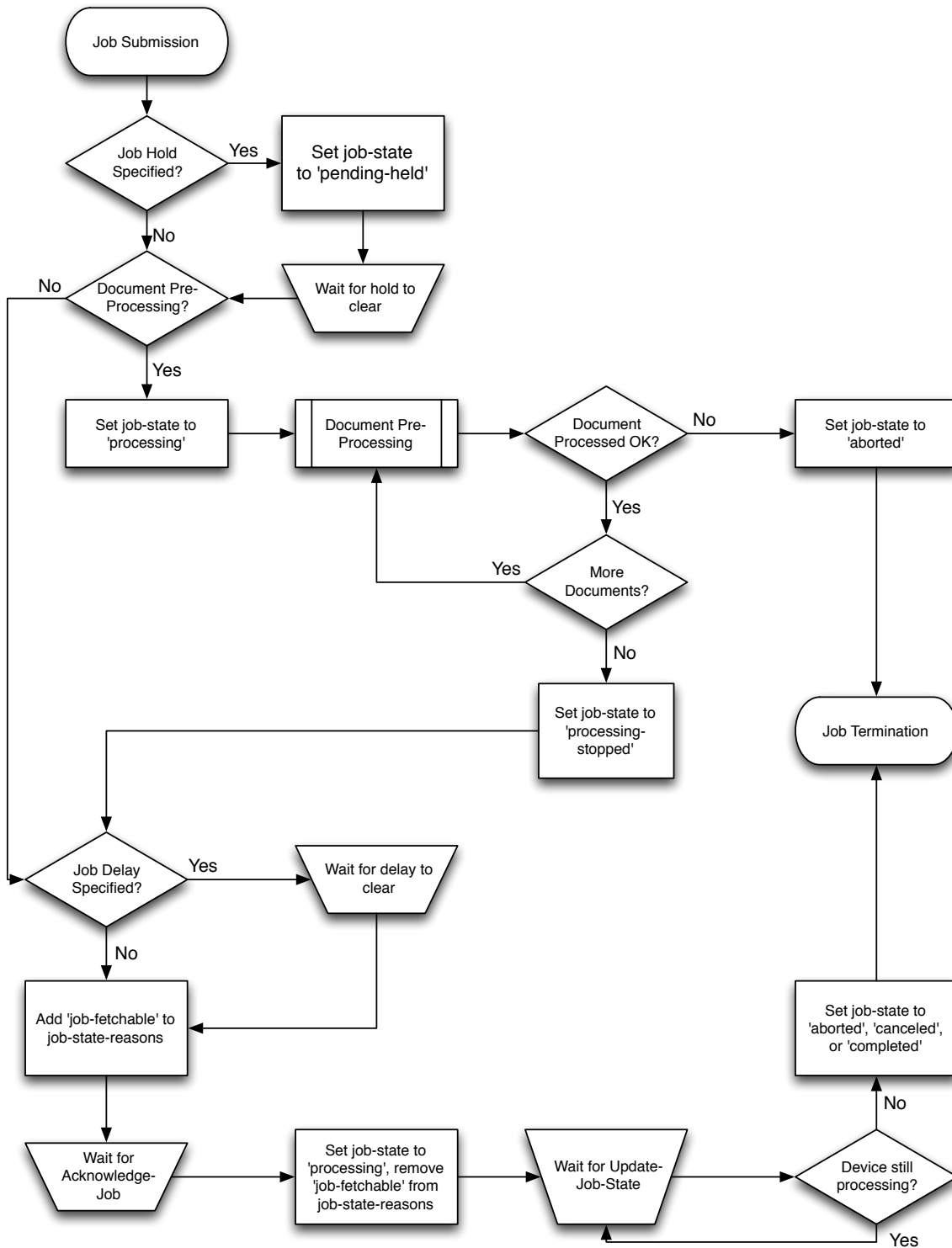
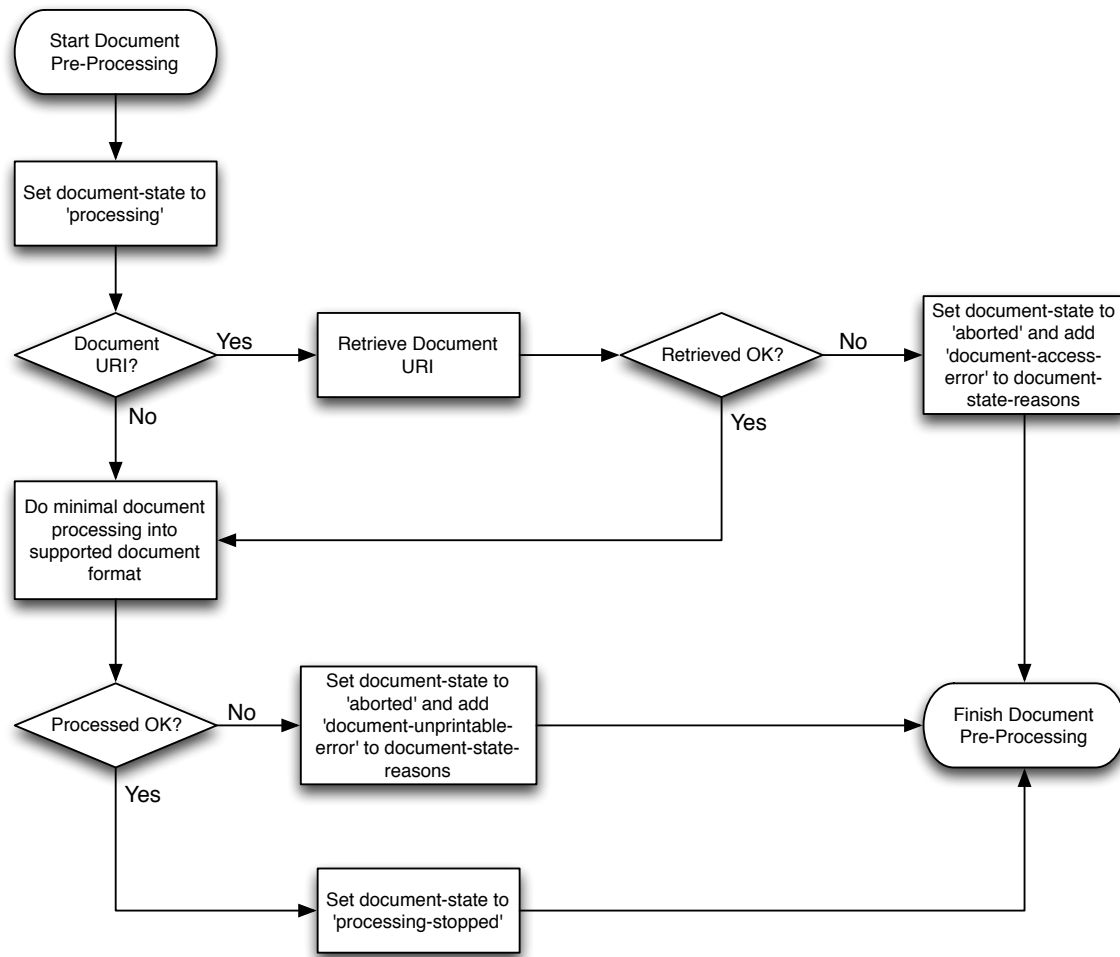


Figure 5 - IPP Infrastructure Printer Job Processing Flowchart



**Figure 6 - Infrastructure Printer Document Pre-Processing Flowchart**

#### 4.1.2 Job Cancellation on the Infrastructure Printer

Clients send Cancel-Current-Job, Cancel-Job, Cancel-Jobs, or Cancel-My-Jobs requests to the Infrastructure Printer to cancel Jobs. When a Job is in the 'pending', 'pending-held', or 'processing-stopped' state, the Infrastructure Printer can move the Job immediately to the 'canceled' state, add the 'canceled-by-user' or 'canceled-by-operator' keyword to the "job-state-reasons" attribute, and (if necessary) remove the 'job-fetchable' keyword from the "job-state-reasons" attribute. If the Job is in the 'processing' state, the Infrastructure Printer must coordinate the cancel with the Proxy.

If the Job is not yet processing on the Output Device, the Infrastructure Printer can move the Job immediately to the 'canceled' state or move it to 'processing-stopped' and add the 'processing-to-stop-point' keyword to the "job-state-reasons" attribute. Otherwise, the Infrastructure Printer moves the Job immediately to the 'processing-stopped' state, adds the 'canceled-by-user' or 'canceled-by-operator' keyword to the "job-state-reasons" attribute, and removes the 'job-fetchable' keyword from the "job-state-reasons" attribute.



The cancellation is then discovered by the Proxy through a Get-Notifications event notification or through a query using a Get-Jobs or Get-Job-Attributes request.

#### **4.1.3 Document Cancellation**

Infrastructure Printers conforming to the IPP Document Object [PWG5100.5] MUST also support the Cancel-Document operation. Much as for canceled Jobs, canceled Documents are coordinated with the Proxy through the "document-state" and "document-state-reasons" Document Description attributes. Cancellation of Documents is discovered by the Proxy through a Get-Notifications event notification with the new 'document-state-changed' and/or 'document-stopped' events, or through a query using a Get-Documents or Get-Document-Attributes request.

#### **4.1.4 Job and Document Change Requests**

Clients make changes to the Job or Document tickets by sending a Set-Job-Attributes or Set-Document-Attributes request, respectively, to the Infrastructure Printer. When changes to the Job or Document would require changes to the pre-processing of Document data and the Proxy has already fetched and acknowledged the Job, the Infrastructure Printer MUST reject the change return and return the 'client-error-not-possible' status code. Otherwise, if the Document data has already been pre-processed and the Infrastructure Printer supports re-processing of the Document data, the Infrastructure Printer MUST immediately remove the 'job-fetchable' keyword from the "job-state-reasons" Job attribute and the 'document-fetchable' keyword from any "document-state-reasons" Document attributes affected by the change. Pre-processing is then performed again according to the standard Job processing rules.

#### **4.1.5 Printer Identification**

The Client MAY send and an Infrastructure Printer SHOULD support the Identify-Printer operation, which allows a User to visually or audibly identify the Output Device. When an Identify-Printer request is received by the Infrastructure Printer, it adds the 'identify-printer-requested' keyword to the "printer-state-reasons" attribute and stores the "identify-actions" and "message" operation attributes for a subsequent Acknowledge-Identify-Printer (section 5.2) request from the Proxy. Only a single Identify-Printer request is saved by the Infrastructure Printer, so subsequent requests replace any pending request that has not yet been acknowledged.

The identification request is then discovered by the Proxy through a Get-Notifications event notification or through a query using a Get-Printer-Attributes request.

After the Infrastructure Printer receives an Acknowledge-Identify-Printer (section 5.2) request, it removes the 'identify-printer-requested' keyword from the "printer-state-reasons" attribute and clears the saved "identify-actions" and "message" values from the last Identify-Printer request.

#### **4.1.6 Administrative Job Operations: Suspend-Current-Job and Resume-Job**

Clients send the OPTIONAL Suspend-Current-Job or Resume-Job requests to the Infrastructure Printer to stop and start processing and output of a Job. When a Suspend-Current-Job request is received by the Infrastructure Printer and the Job state is 'processing', the Infrastructure Printer adds the 'job-suspended' and 'processing-to-stop-point' keywords to the "job-state-reasons" Job attribute. If the Infrastructure Printer is pre-processing Document data, it stops all pre-processing, moves the Job to the 'processing-stopped' state, and removes the 'processing-to-stop-point' keyword from the "job-state-reasons" Job attribute. Otherwise, the Proxy discovers the Job state change through a Get-Notifications event notification or through a query using a Get-Job-Attributes request. If the Job is in the 'pending' or 'processing-stopped' states, the Infrastructure Printer immediately removes any 'job-fetchable' keyword from the "job-state-reasons" Job attribute.

When a Resume-Job request is received by the Infrastructure Printer, it removes the 'job-suspended' keyword from the "job-state-reasons" Job attribute. If the Job is fetchable, the Infrastructure Printer adds the 'job-fetchable' keyword to the "job-state-reasons" Job attribute. If the Job was suspended during Document pre-processing, it will be returned to the 'processing' state and resume Document pre-processing when scheduled by the Infrastructure Printer. The Proxy discovers that a Job has been resumed through a Get-Notifications event notification or through a query using a Get-Job-Attributes or Get-Jobs request.

#### **4.1.7 Administrative Printer Operations: Pause-Printer, Pause-Printer-After-Current-Job, and Resume-Printer**

Clients send the OPTIONAL Pause-Printer, Pause-Printer-After-Current-Job, and Resume-Printer requests to the Infrastructure Printer to stop and start printing by the Infrastructure Printer. When a Pause-Printer request is received and the Infrastructure Printer state is 'idle', the Infrastructure Printer immediately changes its state to 'stopped', adds the 'printer-stopped' keyword to the "printer-state-reasons" Printer attribute, and removes the 'job-fetchable' keyword from the "job-state-reasons" attribute of any Jobs. If the Infrastructure Printer is currently processing a Job, it adds the 'moving-to-paused' keyword to the "printer-state-reasons" Printer attribute, the 'processing-to-stop-point' and 'printer-stopped' keywords to the "job-state-reasons" Job attribute, and coordinates stopping of the Job with the Proxy (see section 4.2.4).

When a Pause-Printer-After-Current-Job request is received, the Infrastructure Printer removes the 'job-fetchable' keyword from the "job-state-reasons" attribute of any Jobs and transitions to the 'stopped' state as defined in the IPP Job and Printer Administrative Operations [RFC3998].

When a Resume-Printer request is received, the Infrastructure Printer immediately sets the Infrastructure Printer state to 'idle', removes the 'printer-stopped' keyword from the "printer-state-reasons" Printer attribute, and adds the 'job-fetchable' keyword to the "job-state-reasons" attribute of any Jobs that are fetchable.

Infrastructure Printer state changes are discovered by the Proxy through a Get-Notifications event notification or through a query using a Get-Printer-Attributes request.

#### 4.1.8 Notifications

Infrastructure Printers MUST conform to the IPP Event Notifications and Subscriptions [RFC3995] and The 'ippget' Delivery Method for Event Notifications [RFC3996]. These allow both Clients and Proxies to efficiently monitor for state changes in Jobs, Documents, and Printers. This specification defines additional keywords for the "notify-events" attribute, which are defined in section 9.5. Infrastructure Printers MUST support the 'job-completed', 'job-config-changed', 'job-created', 'job-progress', 'job-state-changed', 'job-stopped', 'printer-config-changed', 'printer-queue-order-changed', 'printer-state-changed', and 'printer-stopped' events. Infrastructure Printers that conform to the IPP Document Object [PWG5100.5] MUST also support the 'document-config-changed', 'document-created', 'document-state-changed', and 'document-stopped' events.

#### 4.1.9 Resources

Infrastructure Printers SHOULD provide storage and hosting of static resources on behalf of the IPP Proxy. This specification defines the "printer-static-resource-directory-uri" (section 7.4.5), "printer-static-resource-k-octets-free" (section 7.5.1), and "printer-static-resource-k-octets-supported" (section 7.4.6) Printer attributes that specify the location, availability, and capacity of the static resource storage capability of the Infrastructure Printer.

The "printer-static-resource-directory-uri" attribute provides the location of the storage as a "http" or "https" URI. Proxies construct a resource URI by concatenating the "printer-static-resource-directory-uri" value, a single forward slash ("/"), and the resource filename consisting of "unreserved" characters as defined in the Uniform Resource Identifier (URI): Generic Syntax [STD66]. Figure 7 provides the ABNF [STD68][INFRA-ABNF] for a valid resource URI.

**Figure 7 - ABNF for Constructing Static Resource URIs**

```
resource-uri = scheme ":" hier-part "/" resource-name "." resource-ext
resource-name = 1*unreserved
resource-ext = "icc" / "icm" /           ; ICC color profiles
              "png" /                   ; PNG icon images
              "strings" /               ; Message catalogs
              1*unreserved             ; Other resources

; hier-part, scheme, and unreserved are imported from STD 66/RFC 3986
```

Infrastructure Printers that provide storage and hosting of static resources MUST support the HTTP DELETE, GET, and PUT request methods [RFC7230] for the given URI prefix, MUST support the HTTP "If-Unmodified-Since" header [RFC7232], and MUST authenticate DELETE and PUT requests using the same scheme and authority/realm as the IPP Printer URI. That is, if the Infrastructure Printer uses HTTP Basic authentication for

the "Example" realm, any DELETE or PUT requests to the "printer-static-resource-directory-uri" URI MUST also use HTTP Basic authentication for the "Example" realm.

## 4.2 IPP Proxy

The IPP Proxy is responsible for relaying state and configuration from the Output Device to the Infrastructure Printer and for relaying Jobs and Documents to the Output Device for processing. Conceptually the Proxy is an application gateway between the Output Device and Infrastructure Printer, but it may also interface with a full IPP Printer implementation that provides local printing services.

The Proxy tracks the current Output Device state and configuration, a persistent list of Infrastructure Printer Jobs that are being processed or have been recently completed, an Infrastructure Printer subscription identifier for event notifications, and credentials for authentication with the Infrastructure Printer.

Table 2 lists the Proxy operations defined in the Cloud Imaging Requirements and Model [PWG5109.MODEL] with the corresponding IPP operations.

**Table 2 - Proxy Operations**

Cloud Imaging Model Operation	IPP Operation
AcknowledgeDocument	Acknowledge-Document (section 5.1)
-	Acknowledge-Identify-Printer (section 5.2)
AcknowledgeJob	Acknowledge-Job (section 5.3)
	Deregister-Output-Device (section 5.4)
DeregisterSystem	-
FetchDocument	Fetch-Document (section 5.5)
FetchJob	Fetch-Job (section 5.6)
GetFetchableJobs	Get-Jobs (section 8.2)
GetJobDocuments	Get-Documents [PWG5100.5]
GetJobDocumentElements	Get-Document-Attributes [PWG5100.5]
GetJobElements	Get-Job-Attributes [RFC2911]
GetServiceNotifications	Get-Notifications [RFC3996]
RegisterSystem	-
UpdateActiveJobs	Update-Active-Jobs (section 5.7)
UpdateDocumentStatus	Update-Document-Status (section 5.8)
UpdateJobStatus	Update-Job-Status (section 5.9)
UpdateServiceElements	Update-Output-Device-Attributes (section 5.10)
UpdateSystemElements	-
UploadJobDocumentData	-

### 4.2.1 Startup

On startup, the Proxy initiates a connection to the Infrastructure Printer and sends a series of requests to provide the Infrastructure Printer with the configuration and state of one or more Output Devices, and to synchronize the state of all Jobs queued for the Output Devices.

The Proxy provides the Output Device's "xxx-supported", "xxx-ready", "xxx-default", and Printer Status attributes to the Infrastructure Printer in an Update-Output-Device-Attributes (section 5.10) request. The Infrastructure Printer then combines "xxx-supported" values with the values supported by the Infrastructure Printer itself. For example, the Proxy may only report support for the "image/pwg-raster" MIME media type value in "document-format-supported", however the Infrastructure Printer can add support for the "application/pdf" MIME media type, converting submitted PDF document data into PWG Raster Format data for the Proxy. This functionality is limited to software-based features such as file format support, copy generation, number-up imposition, Jobs with multiple Documents, etc. An Infrastructure Printer cannot add new hardware features to an Output Device such as finishers, input trays, media sizes, etc.

Similarly, the Proxy provides the "printer-state", "printer-state-reasons", "printer-state-message", and other READ-ONLY state values in Update-Output-Device-Attributes (section 5.10) requests for each Output Device to the Infrastructure Printer. The Infrastructure Printer merges these values to form the "printer-state", "printer-state-reasons", and "printer-state-message" Printer Status attributes.

Table 1 shows how the "printer-state" value is reported. The "printer-state-reasons" values are merged with duplicates removed. The value of the "printer-state-message" attribute is implementation defined.

Next the Proxy sends an Update-Active-Jobs (section 5.7) request to the Infrastructure Printer. The request includes a list of Infrastructure Printer Jobs known to the Proxy and their corresponding states in the Proxy. Jobs included in the list are updated as shown in Table 3. The states of Jobs that are not included in the request are updated as shown in Table 4.

Finally, the Proxy sends a Create-Printer-Subscription or Renew-Subscription request to the Infrastructure Printer in order to monitor the Infrastructure Printer for new Jobs, Job state changes, and Printer state and configuration changes.

### 4.2.2 Shutdown

A Proxy MAY send a Deregister-Output-Device (section 5.4) request to the Infrastructure Printer in order to remove the association between the Infrastructure Printer and Output Device. Typically this is done when the Output Device is being taken out of service permanently or for an extended period of time.

### 4.2.3 Output Device State/Capability Updates

The Proxy sends Update-Output-Device-Attributes (section 5.10) requests to the Infrastructure Printer whenever the capabilities or configuration of the Output Device change, for example when new media is loaded in the Output Device or when it runs out of media. The request contains the changed Printer attributes for the Output Device. The Proxy SHOULD send a Sparse Update of large attributes such as "media-col-database" or "media-col-ready". The mechanism for doing partial updates is described in sections 4.3 and 5.10.

Similarly, the Proxy sends an Update-Output-Device-Attributes (section 5.10) request to the Infrastructure Printer whenever the Output Device state changes, for example when the Output Device starts processing a Job.

### 4.2.4 Job Processing on the Proxy

The Proxy sends Get-Notifications requests to the Infrastructure Printer to determine when new Jobs are fetchable (Figure 4). Once an event notification is returned, the Proxy sends a Get-Jobs request to the Infrastructure Printer with the "which-jobs" operation attribute set to the value 'fetchable'. The Infrastructure Printer returns any Jobs whose "job-state-reasons" attribute contains the value 'job-fetchable' in the order of priority and submission. The Proxy then chooses one of the Jobs from the list and sends a Fetch-Job (section 5.6) request to the Infrastructure Printer followed by an Acknowledge-Job (section 5.3) request. The Fetch-Job response includes the operation and Job Template attributes sent by the Client in the Job creation request. The Job is no longer fetchable (and the 'job-fetchable' keyword is removed from the "job-state-reasons" attribute) once the Proxy receives a successful response to an Acknowledge-Job request.

The Proxy sends Fetch-Document (section 5.5) and Acknowledge-Document (section 5.1) requests to the Infrastructure Printer to obtain the document data or document URI for printing. The Infrastructure Printer sets the Document state to 'processing' for each as they are processed by the Proxy and Output Device. The Document is no longer fetchable (and the 'document-fetchable' keyword is removed from the "document-state-reasons" attribute) once the Proxy receives a successful response to an Acknowledge-Document request.

The response to a Fetch-Document request MAY include the "document-uri" Document Status attribute. If the Proxy is unable to access the Document URI, it MUST send an Acknowledge-Document request with the value 'client-error-document-access-error' for the "fetch-status-code" operation attribute. The Infrastructure Printer will then either a) abort the Job or b) dereference the Document URI and re-add the 'document-fetchable' keyword to the "document-state-reasons" attribute once the Document data is available to the Proxy. Thus, the Proxy MAY send multiple Fetch-Document requests before accepting the Document with an Acknowledge-Document request without the "fetch-status-code" operation attribute.

**Table 3 - IPP Infrastructure Printer Job States After Update-Active-Jobs and Update-Job-Status**

<b>Previous Infrastructure Printer job-state</b>	<b>output-device-job-state(s)</b>	<b>New Infrastructure Printer job-state</b>
'pending'	'processing'	'processing'
'pending'	'aborted'	'aborted'
'pending'	'canceled'	'canceled'
'pending-held'	<not applicable>	'pending-held' (note 1)
'processing'	'processing-stopped'	'processing-stopped'
'processing'	'aborted'	'processing' (note 2) 'aborted'
'processing'	'canceled'	'processing' (note 3) 'canceled'
'processing'	'completed'	'completed'
'processing-stopped'	'processing'	'processing'
'processing-stopped'	'aborted'	'aborted'
'processing-stopped'	'canceled'	'canceled'
'aborted'	<any value>	'aborted'
'canceled'	<any value>	'canceled'
'completed'	<any value>	'completed'

Note 1: Jobs in the 'pending-held' state cannot be fetchable or fetched, and so are not assigned to an Output Device.

Note 2: The 'processing' job-state is always combined with the 'aborted-by-system' and 'processing-to-stop-point' job-state-reasons keywords (section 4.3.7 of [RFC2911])

Note 3: The 'processing' job-state is always combined with the 'canceled-at-device' and 'processing-to-stop-point' job-state-reasons keywords (section 4.3.7 of [RFC2911])

**Table 4 - New Infrastructure Printer Job States for Missing Jobs After Update-Active-Jobs**

<b>Previous Infrastructure Printer job-state</b>	<b>Previous Infrastructure Printer job-state-reasons</b>	<b>New Infrastructure Printer job-state</b>
'pending'	-	'pending'
'pending-held'	-	'pending-held'
'processing'	'job-canceled-at-device'	'canceled'
'processing-stopped'	'job-canceled-by-operator' 'job-canceled-by-user'	'canceled'
'processing'	'aborted-by-system'	'aborted'
'processing-stopped'		
'processing'	Any other keywords	'processing-stopped'
'processing-stopped'		
'aborted'	-	'aborted'
'canceled'	-	'canceled'
'completed'	-	'completed'

The Proxy sends Update-Document-Status (section 5.8) requests to the Infrastructure Printer to report state changes for the current Document (progress, completed, aborted on error, etc.) as well as the "xxx-actual" Document receipt attributes. Similarly, the Proxy sends Update-Job-Status (section 5.9) requests to the Infrastructure Printer to report state changes for the current Job as well as the "xxx-actual" Job receipt attributes.

Proxies MUST set the corresponding "xxx-actual" Job Description or Document Description attributes when applied during Document output. For example, if an Proxy applies the "finishings" Job Template attribute, it MUST also set the "finishings-actual" Job Description attribute to indicate which "finishings" values were applied.

#### **4.2.5 Proxy/Output Device Job Control**

A Proxy cancels or aborts a Job by sending an Update-Job-Status (section 5.9) request to the Infrastructure Printer with the "job-state" operation attribute set to 'canceled' or 'aborted', respectively. Jobs that are canceled by the Proxy are recorded with the 'canceled-at-device' keyword in the Infrastructure Printer's "job-state-reasons" Job attribute. Jobs that are aborted by the Proxy are recorded with the 'aborted-by-system' keyword in the Infrastructure Printer's "job-state-reasons" Job attribute.

#### **4.2.6 Printer ICC Profiles, Icons, and Other URIs**

URIs reported by the Proxy to the Infrastructure Printer in an Update-Output-Device-Attributes (section 5.10) request MUST be Public Internet Accessible so that both the Infrastructure Printer and Client can access them. The following Printer attributes, if supported by the Proxy, MUST be reported with Public Internet Accessible URIs: "printer-icc-profiles" ("profile-uri" member attribute), "printer-icons", "printer-more-info-manufacturer", and "printer-strings-uri".

When supported by the Infrastructure Printer, Proxies SHOULD upload resource files that are not Public Internet Accessible to the Infrastructure Printer as described in section 4.1.9.

Proxies register different language versions of the "printer-strings-uri" attribute using multiple Update-Output-Device-Attributes requests with the "attributes-natural-language" operation attribute value specifying which language URI is being provided. Figure 8 shows the requests a Proxy would send when uploading both English and Japanese message catalogs.



**Figure 8 - Proxy Requests to Upload Multiple Message Catalogs**

```
PUT https://www.example.com/ipp/resource/01234567-89AB-CDEF-FEDC-
BA9876543210/en.strings
Host: www.example.com:631
Content-Type: text/strings
Content-Encoding: chunked
Authorization: Basic ...
```

... contents of English strings file ...

```
POST ipps://www.example.com/ipp/print
Host: www.example.com:631
Content-Type: application/ipp
Content-Encoding: chunked
Authorization: Basic ...
```

```
version=2.0
operation-code=Update-Output-Device-Attributes
request-id=1
attributes-charset='utf-8'
attributes-natural-language='en'
printer-uri='ipps://www.example.com/ipp/print'
output-device-uuid='urn:uuid:01234567-89AB-CDEF-FEDC-BA9876543210'
printer-strings-uri='https://www.example.com/ipp/resource/01234567-89AB-
CDEF-FEDC-BA9876543210/en.strings'
```

```
PUT https://www.example.com/ipp/resource/01234567-89AB-CDEF-FEDC-
BA9876543210/ja-JP.strings
Host: www.example.com:631
Content-Type: text/strings
Content-Encoding: chunked
Authorization: Basic ...
```

... contents of Japanese strings file ...

```
POST ipps://www.example.com/ipp/print
Host: www.example.com:631
Content-Type: application/ipp
Content-Encoding: chunked
Authorization: Basic ...
```

```
version=2.0
operation-code=Update-Output-Device-Attributes
request-id=2
attributes-charset='utf-8'
attributes-natural-language='ja-JP'
printer-uri='ipps://www.example.com/ipp/print'
output-device-uuid='urn:uuid:01234567-89AB-CDEF-FEDC-BA9876543210'
printer-strings-uri='https://www.example.com/ipp/resource/01234567-89AB-
CDEF-FEDC-BA9876543210/ja-JP.strings'
```

### 4.3 Security and Roles

In order for infrastructure printing to work, the Client, Infrastructure Printer, and Proxy MUST use a common AAA Framework. This specification does not mandate a particular framework - HTTP Basic, HTTP Digest, Kerberos, OAuth, and TLS certificate authentication all meet this requirement.

In addition to the User, Operator, and Administrator policy roles identified in the IPP/1.1 Model and Semantics [RFC2911], this specification defines a new Proxy policy role for the operations and attributes used by the Proxy.

### 4.4 Sparse Updates

Infrastructure Printers MUST support Sparse Updates of all Output Device attributes. Proxies SHOULD support Sparse Updates of Output Device attributes, particularly the "media-col-database" and "media-col-ready" attributes.

A Proxy performs a Sparse Update by appending the value number or a range of numbers to the attribute name, e.g, "media-col-database.4" specifies the fourth value while "media-col-database.4-8" specifies values four through eight. Section 5.10 describes how Sparse Updates work in detail.

### 4.5 Print By Reference

Infrastructure Printers SHOULD support the Send-URI operation. Proxies MAY support retrieval of document data from a URI and MUST report their capability to retrieve URIs in the "uri-schemes-supported" Printer attribute.

Client-submitted "document-uri" values MUST use URI schemes supported by the Infrastructure Printer and/or Proxy. Clients SHOULD attempt to verify that the URIs are Public Internet Accessible prior to submission.

Clients MAY supply access credentials for each "document-uri" using the "document-access" (section 7.1.1) operation attribute.

## 4.6 IPP Operations

Table 5 lists the standard IPP operations and their usage and conformance requirements for this specification. Client requirements are inherited from those in section 5.2 of IPP Everywhere [PWG5100.14].

Note: The Client and Proxy act as IPP Clients for the operations in Table 5 while the Infrastructure Printer acts as an IPP Server.

**Table 5 - IPP Operations**

<b>Operation</b>	<b>Client (note 1)</b>	<b>Infrastructure Printer</b>	<b>Proxy (note 1)</b>
Acknowledge-Document	MUST NOT	MUST	MUST
Acknowledge-Identify-Printer	MUST NOT	SHOULD	SHOULD
Acknowledge-Job	MUST NOT	MUST	MUST
Activate-Printer	MAY	MAY	MAY
Cancel-Current-Job	MAY	MAY	MUST NOT
Cancel-Document	MAY	MAY	MUST NOT
Cancel-Job	MUST	MUST	MUST NOT
Cancel-Jobs	MAY	SHOULD	MUST NOT
Cancel-My-Jobs	MUST	MUST	MUST NOT
Cancel-Subscription	SHOULD	MUST	MUST
Close-Job	MUST	MUST	MUST NOT
Create-Job	MUST	MUST	MUST NOT
Create-Job-Subscriptions	SHOULD	MUST	MAY
Create-Printer-Subscriptions	SHOULD	MUST	MUST
Deactivate-Printer	MAY	MAY	MAY
Delete-Document	(note 3)	(note 3)	(note 3)
Deregister-Output-Device	MUST NOT	MUST	MUST
Disable-Printer	MAY	MAY	MAY
Enable-Printer	MAY	MAY	MAY
Fetch-Document	MUST NOT	MUST	MUST
Fetch-Job	MUST NOT	MUST	MUST
Get-Document-Attributes	MAY	MUST (note 2)	MAY
Get-Documents	MAY	MUST (note 2)	MUST
Get-Job-Attributes	MUST	MUST	MAY
Get-Jobs	MAY	MUST	MUST
Get-Notifications	SHOULD	MUST	MUST
Get-Output-Device-Attributes	MAY	MUST	MAY
Get-Printer-Attributes	MUST	MUST	MAY
Get-Printer-Supported-Values	MAY	MUST	MAY
Get-Subscription-Attributes	MAY	MUST	MAY
Get-Subscriptions	MAY	MUST	MAY
Hold-Job	MAY	SHOULD	MUST NOT
Hold-New-Jobs	MAY	MAY	MAY

<b>Operation</b>	<b>Client (note 1)</b>	<b>Infrastructure Printer</b>	<b>Proxy (note 1)</b>
Identify-Printer	SHOULD	SHOULD	MUST NOT
Pause-Printer	MAY	MAY	MAY
Pause-Printer-After-Current-Job	MAY	MAY	MAY
Print-Job	MAY	MUST	MUST NOT
Print-URI	MAY	MAY	MUST NOT
Promote-Job	MAY	MAY	MUST NOT
Purge-Jobs	(note 3)	(note 3)	(note 3)
Release-Held-New-Jobs	MAY	MAY	MAY
Release-Job	MAY	SHOULD	MUST NOT
Renew-Subscription	SHOULD	MUST	MUST
Reprocess-Job	(note 3)	(note 3)	(note 3)
Restart-Job	(note 3)	(note 3)	(note 3)
Restart-Printer	MAY	MAY	MAY
Resubmit-Job	MAY	MAY	MUST NOT
Resume-Job	MAY	MAY	MUST NOT
Resume-Printer	MAY	MAY	MAY
Schedule-Job-After	MAY	MAY	MUST NOT
Send-Document	MUST	MUST (note 2)	MUST NOT
Send-URI	MAY	MAY	MUST NOT
Set-Document-Attributes	MAY	SHOULD	MUST NOT
Set-Job-Attributes	MAY	SHOULD	MUST NOT
Set-Printer-Attributes	MAY	SHOULD	MUST NOT
Shutdown-Printer	MAY	MAY	MAY
Startup-Printer	MAY	MAY	MAY
Suspend-Current-Job	MAY	MAY	MUST NOT
Update-Active-Jobs	MUST NOT	MUST	MUST
Update-Document-Status	MUST NOT	MUST (note 2)	MUST
Update-Job-Status	MUST NOT	MUST	MUST
Update-Output-Device-Attributes	MUST NOT	MUST	MUST
Validate-Document	SHOULD	MUST	MUST NOT
Validate-Job	SHOULD	MUST	MUST NOT

Note 1: Conformance requirements for Clients and Proxies are the ability to send requests for each operation. Proxies MAY also be IPP Printers that accept IPP requests from local Clients.

Note 2: Infrastructure Printers MUST support these operations for a single document Job.

Note 3: The Delete-Document, Purge-Jobs, Reprocess-Job, and Restart-Job operations destroy accounting information and therefore SHOULD NOT be used by Clients and MUST NOT be supported by Infrastructure Printers or Proxies.

## 4.7 IPP Operation Attributes

Table 6 lists the conformance requirements for operation attributes.

**Table 6 - IPP Operation Attributes**

<b>Attribute</b>	<b>Client</b>	<b>Infrastructure Printer</b>	<b>Proxy</b>	<b>Reference</b>
attributes-charset	MUST	MUST	MUST	RFC 2911
attributes-natural-language	MUST	MUST	MUST	RFC 2911
compression	SHOULD	MUST	MUST	RFC 2911
compression-accepted	MUST NOT	MUST	MUST	PWG 5100.17
document-access	MAY	SHOULD	SHOULD	Section 7.1.1
document-format	MUST	MUST	MUST	RFC 2911
document-format-accepted	MUST NOT	MUST	MUST	PWG 5100.17
document-format-version	MAY	MUST	MAY	PWG 5100.7
document-name	MUST	Note 1	MUST	RFC 2911, PWG 5100.5
document-number	MAY	MUST	MUST	PWG 5100.5
document-preprocessed	MUST NOT	MAY	MAY	Section 7.1.2
document-uri	MAY	SHOULD	SHOULD	RFC 2911
fetch-status-code	MUST NOT	MUST	MUST	Section 7.1.3
fetch-status-message	MUST NOT	MUST	SHOULD	Section 7.1.4
first-index	MAY	MUST	MAY	PWG 5100.13
identify-actions	SHOULD	SHOULD	SHOULD	PWG 5100.13
ipp-attribute-fidelity	MAY	MUST	MUST	RFC 2911
job-id	MUST	MUST	MUST	RFC 2911
job-ids	MAY	MUST	MUST	PWG 5100.11
job-impressions	MAY	MUST	MUST	RFC 2911
job-mandatory-attributes	MAY	MUST	MUST	PWG 5100.7
job-name	MUST	MUST	MUST	RFC 2911
last-document	MUST	MUST	MUST	RFC 2911
limit	MAY	MUST	MUST	RFC 2911
my-jobs	MAY	MUST	MAY	RFC 2911
notify-get-interval	MAY	MUST	MUST	RFC 3996
notify-sequence-numbers	MAY	MUST	MUST	RFC 3996
notify-subscription-id	MAY	MUST	MUST	RFC 3995
notify-subscription-ids	MAY	MUST	MUST	RFC 3996
notify-wait	MAY	MUST	MUST	RFC 3996

Attribute	Client	Infrastructure		Reference
		Printer	Proxy	
output-device-job-states	MUST NOT	MUST	MUST	Section 7.1.5
output-device-uuid	MAY	MUST	MUST	Section 7.1.6
printer-up-time	MAY	MUST	MUST	RFC 3996
printer-uri	MUST	MUST	MUST	RFC 2911
requested-attributes	MAY	MUST	MAY	RFC 2911
requesting-user-name	SHOULD	MUST	MUST	RFC 2911
requesting-user-uri	SHOULD	MUST	MUST	PWG 5100.13
status-message	SHOULD	MUST	MUST	RFC 2911
which-jobs	MAY	MUST	MUST	RFC 2911, PWG 5100.11

Note 1: Infrastructure Printers MUST support these attributes for a single document Job.

### 4.8 IPP Printer Description Attributes

Table 7 lists the conformance requirements for Printer Description attributes. For Infrastructure Printers the conformance requirements are to support the attribute. For Proxies the conformance requirements are the capability to send the attribute in an Update-Output-Device-Attributes request if supported by the proxied Output Device.

Table 7 - IPP Printer Description Attributes

Attribute	Infrastructure		Reference
	Printer	Proxy	
charset-configured	MUST	MUST	RFC 2911
charset-supported	MUST	MUST	RFC 2911
color-supported	MUST	MUST	RFC 2911
compression-supported	MUST	MUST	RFC 2911
copies-default	MUST	Note 1	RFC 2911
copies-supported	MUST	Note 1	RFC 2911
document-access-supported	SHOULD	SHOULD	Section 7.4.1
document-format-default	MUST	MUST	RFC 2911
document-format-supported	MUST	MUST	RFC 2911
document-password-supported	MUST	Note 1	PWG 5100.13
feed-orientation-default	MUST	MUST	PWG 5100.11
feed-orientation-supported	MUST	MUST	PWG 5100.11
finishings-col-database	MUST	MUST	PWG 5100.1
finishings-col-default	MUST	MUST	PWG 5100.1, PWG 5100.3
finishings-col-ready	MUST	MUST	PWG 5100.1, PWG 5100.3
finishings-col-supported	MUST	MUST	PWG 5100.1 PWG 5100.3

<b>Attribute</b>	<b>Infrastructure Printer</b>	<b>Proxy</b>	<b>Reference</b>
finishings-default	MUST	MUST	RFC 2911
finishings-ready	MUST	MUST	RFC 2911
finishings-supported	MUST	MUST	RFC 2911
generated-natural-language-supported	MUST	MUST	RFC 2911
identify-actions-default	SHOULD	SHOULD	PWG 5100.13
identify-actions-supported	SHOULD	SHOULD	PWG 5100.13
ipp-features-supported	MUST	MUST	PWG 5100.13
ipp-versions-supported	MUST	MUST	RFC 2911
ippget-event-life	MUST	MUST NOT	RFC 3996
job-constraints-supported	MUST	MUST	PWG 5100.13
job-creation-attributes-supported	MUST	MUST	PWG 5100.11
job-ids-supported	MUST	MUST NOT	PWG 5100.11
job-resolvers-supported	MUST	MUST	PWG 5100.13
media-bottom-margin-supported	MUST	MUST	PWG 5100.13
media-col-database	MUST	MUST	PWG 5100.11
media-col-database.media-source-properties	MUST	MUST	PWG 5100.13
media-col-default	MUST	MUST	PWG 5100.3
media-col-ready	MUST	MUST	PWG 5100.3
media-col-ready.media-source-properties	MUST	MUST	PWG 5100.13
media-col-supported	MUST	MUST	PWG 5100.3
media-default	MUST	MUST	RFC 2911
media-left-margin-supported	MUST	MUST	PWG 5100.13
media-ready	MUST	MUST	RFC 2911
media-right-margin-supported	MUST	MUST	PWG 5100.13
media-size-supported	MUST	MUST	PWG 5100.3
media-source-supported	MUST	MUST	PWG 5100.13
media-supported	MUST	MUST	RFC 2911
media-top-margin-supported	MUST	MUST	PWG 5100.13
media-type-supported	MUST	MUST	PWG 5100.3
multiple-document-handling-default	MUST	Note 2	RFC 2911
multiple-document-handling-supported	MUST	Note 2	RFC 2911
multiple-document-jobs-supported	MUST	MUST NOT	RFC 2911
multiple-operation-timeout	MUST	MUST NOT	RFC 2911
multiple-operation-timeout-action	MUST	MUST NOT	PWG 5100.13
natural-language-configured	MUST	MUST	RFC 2911
notify-attributes-supported	MUST	MUST NOT	RFC 3995
notify-events-default	MUST	MUST NOT	RFC 3995
notify-events-supported	MUST	MUST NOT	RFC 3995

<b>Attribute</b>	<b>Infrastructure Printer</b>	<b>Proxy</b>	<b>Reference</b>
notify-lease-duration-default	MUST	MUST NOT	RFC 3995
notify-lease-duration-supported	MUST	MUST NOT	RFC 3995
notify-max-events-supported	MUST	MUST NOT	RFC 3995
notify-pull-method-supported	MUST	MUST NOT	RFC 3995
oauth-authorization-server-uri	Note 3	MUST NOT	Section 7.4.3
operations-supported	MUST	MUST NOT	RFC 2911
orientation-requested-default	MUST	MUST	RFC 2911
orientation-requested-supported	MUST	MUST	RFC 2911
output-bin-default	MUST	MUST	PWG 5100.2
output-bin-supported	MUST	MUST	PWG 5100.2
overrides-supported	MUST	Note 2	PWG 5100.6
page-ranges-supported	MUST	Note 2	RFC 2911
print-color-mode-default	MUST	MUST	PWG 5100.13
print-color-mode-supported	MUST	MUST	PWG 5100.13
print-content-optimize-default	MUST	MUST	PWG 5100.7
print-content-optimize-supported	MUST	MUST	PWG 5100.7
print-rendering-intent-default	MUST	MUST	PWG 5100.13
print-rendering-intent-supported	MUST	MUST	PWG 5100.13
print-quality-default	MUST	MUST	RFC 2911
print-quality-supported	MUST	MUST	RFC 2911
printer-device-id	MUST	MUST	PWG 5107.2
printer-geo-location	MUST	MUST	PWG 5100.13
printer-get-attributes-supported	MUST	MUST NOT	PWG 5100.13
printer-icc-profiles	MUST	MAY	PWG 5100.13
printer-icons	MUST	MAY	PWG 5100.13
printer-info	MUST	MUST	RFC 2911
printer-is-accepting-jobs	MUST	MUST	RFC 2911
printer-location	MUST	MUST	RFC 2911
printer-make-and-model	MUST	MUST	RFC 2911
printer-name	MUST	MUST	RFC 2911
printer-organization	MUST	MUST	PWG 5100.13
printer-organizational-unit	MUST	MUST	PWG 5100.13
printer-resolution-default	MUST	MUST	RFC 2911
printer-resolution-supported	MUST	MUST	RFC 2911
printer-static-resource-directory-uri	SHOULD	SHOULD	Section 7.4.5
printer-static-resource-k-octets-supported	SHOULD	SHOULD	Section 7.4.6
printer-uri-supported	MUST	MUST NOT	RFC 2911
pwg-raster-document-resolution-supported	MUST	MUST	PWG 5102.4
pwg-raster-document-sheet-back	MUST	MUST	PWG 5102.4
pwg-raster-document-type-supported	MUST	MUST	PWG 5102.4



Attribute	Infrastructure		Reference
	Printer	Proxy	
sides-default	MUST	MUST	RFC 2911
sides-supported	MUST	MUST	RFC 2911
uri-security-supported	MUST	MUST NOT	RFC 2911
uri-authentication-supported	MUST	MUST NOT	RFC 2911
which-jobs-supported	MUST	MUST NOT	PWG 5100.11

Note 1: CONDITIONALLY REQUIRED for Printers that support the "application/openxps", "application/pdf", or "image/jpeg" MIME media types.

Note 2: CONDITIONALLY REQUIRED for Printers that support the "application/openxps" or "application/pdf" MIME media types.

Note 3: CONDITIONALLY REQUIRED for Infrastructure Printers that support the OAuth 2.0 authentication scheme.

## 4.9 IPP Printer Status Attributes

Table 8 lists the conformance requirements for Printer Status attributes. For Infrastructure Printers the conformance requirements are to support the attribute. For Proxies the conformance requirements are the capability to send the attribute in an Update-Output-Device-Attributes request if supported by the proxied Output Device.

**Table 8 - IPP Printer Status Attributes**

Attribute	Infrastructure		Reference
	Printer	Proxy	
pages-per-minute	MUST	MUST	RFC 2911
pages-per-minute-color	MUST	MUST	RFC 2911
printer-alert	MUST	MUST	PWG 5100.9
printer-alert-description	MUST	MUST	PWG 5100.9
printer-config-change-date-time	MUST	MUST	PWG 5100.13
printer-config-change-time	MUST	MUST	PWG 5100.13
printer-current-time	MUST	MUST	RFC 2911
printer-more-info	MUST	MUST NOT	RFC 2911
printer-state	MUST	MUST	RFC 2911
printer-state-change-date-time	MUST	MUST	RFC 3995
printer-state-change-time	MUST	MUST	RFC 3995
printer-state-message	MUST	MUST	RFC 2911
printer-state-reasons	MUST	MUST	RFC 2911
printer-static-resource-k-octets-free	SHOULD	SHOULD	Section 7.5.1
printer-supply	MUST	MUST	PWG 5100.13
printer-supply-description	MUST	MUST	PWG 5100.13
printer-supply-info-uri	MUST	MUST NOT	PWG 5100.13

Attribute	Infrastructure		Reference
	Printer	Proxy	
printer-up-time	MUST	MUST	RFC 2911
printer-uri-supported	MUST	MUST NOT	RFC 2911
printer-uuid	MUST	MUST NOT	PWG 5100.13
queued-job-count	MUST	MUST	RFC 2911

#### 4.10 IPP Document Description Attributes

Table 9 lists the Document Description attributes that MUST be supported by an Infrastructure Printer and Proxy.

Table 9 - IPP Document Description Attributes

Attribute	Infrastructure		Reference
	Printer	Proxy	
document-name	MUST	MUST	PWG 5100.5
impressions	MUST	MUST	PWG 5100.5

#### 4.11 IPP Document Status Attributes

Table 10 lists the Document Status attributes that MUST be supported by an Infrastructure Printer.

Table 10 - IPP Document Status Attributes

Attribute	Infrastructure		Reference
	Printer	Proxy	
attributes-charset	MUST		PWG 5100.5
attributes-natural-language	MUST		PWG 5100.5
compression	MUST		PWG 5100.5
date-time-at-completed	MUST		PWG 5100.5
date-time-at-creation	MUST		PWG 5100.5
date-time-at-processing	MUST		PWG 5100.5
document-format	MUST		PWG 5100.5
document-job-id	MUST		PWG 5100.5
document-number	MUST		PWG 5100.5
document-printer-uri	MUST		PWG 5100.5
document-state	MUST		PWG 5100.5
document-state-message	MUST		PWG 5100.5
document-state-reasons	MUST		PWG 5100.5
document-uri	SHOULD		PWG 5100.5
document-uuid	MUST		PWG 5100.13
impressions-completed	MUST		PWG 5100.5
last-document	MUST		PWG 5100.5
printer-up-time	MUST		PWG 5100.5

<b>Attribute</b>	<b>Infrastructure Printer</b>	<b>Reference</b>
time-at-completed	MUST	PWG 5100.5
time-at-creation	MUST	PWG 5100.5
time-at-processing	MUST	PWG 5100.5

## 4.12 IPP Document Template Attributes

Table 11 lists the conformance requirements for Document Template attributes. For Infrastructure Printers the conformance requirements are to support the attribute. For Proxies the conformance requirements are to support the attribute with the proxied Output Device.

**Table 11 - IPP Document Template Attributes**

<b>Attribute</b>	<b>Infrastructure Printer</b>	<b>Proxy</b>	<b>Reference</b>
copies	MUST	Note 1	RFC 2911
feed-orientation	MUST	MUST	PWG 5100.11
finishings	MUST	MUST	RFC 2911
finishings-col	MUST	MUST	PWG 5100.1, PWG 5100.3
media	MUST	MUST	RFC 2911
media-col	MUST	MUST	PWG 5100.3
media-col.media-bottom-margin	MUST	MUST	PWG 5100.13
media-col.media-left-margin	MUST	MUST	PWG 5100.13
media-col.media-right-margin	MUST	MUST	PWG 5100.13
media-col.media-size	MUST	MUST	PWG 5100.3
media-col.media-source	MUST	MUST	PWG 5100.13
media-col.media-top-margin	MUST	MUST	PWG 5100.13
media-col.media-type	MUST	MUST	PWG 5100.3
orientation-requested	MUST	MUST	RFC 2911
overrides	MUST	Note 2	PWG 5100.6
page-ranges	MUST	Note 2	RFC 2911
print-color-mode	MUST	MUST	PWG 5100.13
print-content-optimize	MUST	MUST	PWG 5100.7
print-rendering-intent	MUST	MUST	PWG 5100.13
print-quality	MUST	MUST	RFC 2911
printer-resolution	MUST	MUST	RFC 2911
sides	MUST	MUST	RFC 2911

Note 1: CONDITIONALLY REQUIRED for Printers that support the "application/openxps", "application/pdf", or "image/jpeg" MIME media types.

Note 2: CONDITIONALLY REQUIRED for Printers that support the "application/openxps" or "application/pdf" MIME media types.

### 4.13 IPP Event Notification Attributes

Table 12 lists the Event Notification attributes that MUST be supported by an Infrastructure Printer.

**Table 12 - IPP Event Notification Attributes**

Attribute	Infrastructure		Source
	Printer		
job-id	MUST		RFC 3995
job-impressions-completed	MUST		RFC 3995
job-state	MUST		RFC 3995
job-state-reasons	MUST		RFC 3995
job-uuid	MUST		PWG 5100.13
notify-charset	MUST		RFC 3995
notify-natural-language	MUST		RFC 3995
notify-printer-uri	MUST		RFC 3995
notify-sequence-number	MUST		RFC 3995
notify-subscribed-event	MUST		RFC 3995
notify-subscription-id	MUST		RFC 3995
notify-subscription-uuid	MUST		PWG 5100.13
notify-text	MUST		RFC 3995
notify-user-data	MUST		RFC 3995
printer-current-time	MUST		RFC 3995
printer-is-accepting-jobs	MUST		RFC 3995
printer-state	MUST		RFC 3995
printer-state-reasons	MUST		RFC 3995
printer-up-time	MUST		RFC 3995

### 4.14 IPP Job Description Attributes

Table 13 lists the Job Description attributes that MUST be supported by an Infrastructure Printer and Proxy.

**Table 13 - IPP Job Description Attributes**

Attribute	Infrastructure		Source
	Printer	Proxy	
job-impressions	MUST	MUST	RFC 2911
job-name	MUST	MUST	RFC 2911

## 4.15 IPP Job Status Attributes

Table 14 lists the Job Status attributes that MUST be supported by an Infrastructure Printer.

**Table 14 - IPP Job Status Attributes**

<b>Attribute</b>	<b>Infrastructure Printer</b>	<b>Source</b>
compression-supplied	MUST	PWG 5100.7
date-time-at-completed	MUST	RFC 2911
date-time-at-creation	MUST	RFC 2911
date-time-at-processing	MUST	RFC 2911
document-format-supplied	MUST	PWG 5100.7
document-format-version-supplied	MUST	PWG 5100.7
document-name-supplied	MUST	PWG 5100.7
job-id	MUST	RFC 2911
job-impressions-completed	MUST	RFC 2911
job-originating-user-name	MUST	RFC 2911
job-printer-up-time	MUST	RFC 2911
job-printer-uri	MUST	RFC 2911
job-state	MUST	RFC 2911
job-state-message	MUST	RFC 2911
job-state-reasons	MUST	RFC 2911
job-uri	MUST	RFC 2911
job-uuid	MUST	PWG 5100.13
time-at-completed	MUST	RFC 2911
time-at-creation	MUST	RFC 2911
time-at-processing	MUST	RFC 2911

## 4.16 IPP Job Template Attributes

Table 15 lists the conformance requirements for Job Template attributes. For Infrastructure Printers the conformance requirements are to support the attribute. For Proxies the conformance requirements are to support the attribute with the proxied Output Device.

**Table 15 - IPP Job Template Attributes**

Attribute	Infrastructure		Reference
	Printer	Proxy	
copies	MUST	Note 1	RFC 2911
feed-orientation	MUST	MUST	PWG 5100.11
finishings	MUST	MUST	RFC 2911
finishings-col	MUST	MUST	PWG 5100.1, PWG 5100.3
media	MUST	MUST	RFC 2911
media-col	MUST	MUST	PWG 5100.3
media-col.media-bottom-margin	MUST	MUST	PWG 5100.13
media-col.media-left-margin	MUST	MUST	PWG 5100.13
media-col.media-right-margin	MUST	MUST	PWG 5100.13
media-col.media-size	MUST	MUST	PWG 5100.3
media-col.media-source	MUST	MUST	PWG 5100.13
media-col.media-top-margin	MUST	MUST	PWG 5100.13
media-col.media-type	MUST	MUST	PWG 5100.3
multiple-document-handling	MUST	Note 2	RFC 2911
orientation-requested	MUST	MUST	RFC 2911
output-bin	MUST	MUST	PWG 5100.2
overrides	MUST	Note 2	PWG 5100.6
page-ranges	MUST	Note 2	RFC 2911
print-color-mode	MUST	MUST	PWG 5100.13
print-content-optimize	MUST	MUST	PWG 5100.7
print-rendering-intent	MUST	MUST	PWG 5100.13
print-quality	MUST	MUST	RFC 2911
printer-resolution	MUST	MUST	RFC 2911
sides	MUST	MUST	RFC 2911

Note 1: CONDITIONALLY REQUIRED for Printers that support the "application/openxps", "application/pdf", or "image/jpeg" MIME media types.

Note 2: CONDITIONALLY REQUIRED for Printers that support the "application/openxps" or "application/pdf" MIME media types.

## 4.17 IPP Subscription Status Attributes

Table 16 lists the Subscription Status attributes that MUST be supported by an Infrastructure Printer.

**Table 16 - IPP Subscription Status Attributes**

<b>Attribute</b>	<b>Infrastructure Printer</b>	<b>Reference</b>
notify-job-id	MUST	RFC 3995
notify-lease-expiration-time	MUST	RFC 3995
notify-printer-up-time	MUST	RFC 3995
notify-printer-uri	MUST	RFC 3995
notify-sequence-number	MUST	RFC 3995
notify-status-code	MUST	RFC 3995
notify-subscriber-user-name	MUST	RFC 3995
notify-subscriber-user-uri	MUST	PWG 5100.13
notify-subscription-id	MUST	RFC 3995
notify-subscription-uuid	MUST	PWG 5100.13

## 4.18 IPP Subscription Template Attributes

Table 17 lists the Subscription Template attributes that MUST be supported by an Infrastructure Printer.

**Table 17 - IPP Subscription Template Attributes**

<b>Attribute</b>	<b>Infrastructure Printer</b>	<b>Reference</b>
notify-charset	MUST	RFC 3995
notify-events	MUST	RFC 3995
notify-lease-duration	MUST	RFC 3995
notify-natural-language	MUST	RFC 3995
notify-pull-method	MUST	RFC 3995
notify-time-interval	MUST	RFC 3995
notify-user-data	MUST	RFC 3995
notify-user-data	MUST	RFC 3995

## 5. New Proxy to Infrastructure Printer Operations

All of the new operations defined in this section are sent by the Proxy to the Infrastructure Printer. For each operation, the "requesting-user-name" [RFC2911] and "requesting-user-uri" [PWG5100.13] operation attributes provide the unauthenticated identity of the Proxy owner, e.g., "Jane Smith" and "mailto:jane.smith@example.com".

### 5.1 Acknowledge-Document

The REQUIRED Acknowledge-Document operation notifies the Infrastructure Printer whether the Output Device has accepted the Document for processing. Once accepted, the Infrastructure Printer MUST remove the 'document-fetchable' keyword from the "document-state-reasons" attribute for the Document.

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

#### 5.1.1 Acknowledge-Document Request

The following groups of attributes are supplied as part of the Acknowledge-Document Request:

##### Group 1: Operation Attributes

###### Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

###### Target:

The "printer-uri" (uri), "job-id" (integer), and "document-number (integer)" operation attributes which are the target for this operation as described in [RFC2911] section 3.1.5.

###### "output-device-uuid" (uri):

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.



Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

"fetch-status-code" (type2 enum)

The Proxy MAY supply this attribute and the Infrastructure Printer MUST support this attribute. The Proxy provides this attribute when the status code for the corresponding Fetch-Document operation is not 'successful-ok' (0).

Note: The values for this enum attribute match those registered in the IANA IPP registry for status codes. Status code 0 (successful-ok) MUST NOT be sent by the Proxy and MUST NOT be accepted by the Infrastructure Printer since valid enum values start at 1.

"fetch-status-message" (text(MAX)):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute. It is a status message to the user for the corresponding Fetch-Document operation.

### 5.1.2 Acknowledge-Document Response

The following attributes are part of the Acknowledge-Document Response:

Group 1: Operation Attributes

Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

## 5.2 Acknowledge-Identify-Printer

The RECOMMENDED Acknowledge-Identify-Printer operation retrieves the most recent "identify-actions" and "message" attributes received by the Infrastructure Printer for use in identifying the Output Device to the User. Infrastructure Printers that support the Identify-Printer operation MUST support this operation.

If no Identify-Printer request for the Output Device is pending on the Infrastructure Printer, the 'client-error-not-possible' status code is returned.

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

### 5.2.1 Acknowledge-Identify-Printer Request

The following groups of attributes are supplied as part of the Acknowledge-Identify-Printer Request:

#### Group 1: Operation Attributes

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

Target:

The "printer-uri" (uri) operation attribute which is the target for this operation as described in [RFC2911] section 3.1.5.

"output-device-uuid" (uri):

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

### 5.2.2 Acknowledge-Identify-Printer Response

The following attributes are part of the Acknowledge-Identify-Printer Response:

#### Group 1: Operation Attributes

##### Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

##### Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

##### "identify-actions" (1setOf type2 keyword)

The value(s) of the "identify-actions" attribute supplied by the Client, or those that were defaulted by the Infrastructure Printer

##### "message" (text(MAX))

The value of the "message" attribute supplied by the Client, if any.

#### Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

### 5.3 Acknowledge-Job

The REQUIRED Acknowledge-Job operation notifies the Infrastructure Printer whether the Output Device has accepted the Job for processing. If the "fetch-status-code" is omitted or does not indicate an error, the Infrastructure Printer assigns the Job to the Output Device. If the Job has been assigned to another Output Device, the Infrastructure Printer returns the 'client-error-not-possible' status code. Once accepted, the Infrastructure Printer MUST remove the 'job-fetchable' keyword from the "job-state-reasons" attribute for the Job.

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

### 5.3.1 Acknowledge-Job Request

The following groups of attributes are supplied as part of the Acknowledge-Job Request:

#### Group 1: Operation Attributes

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

Target:

The "printer-uri" (uri) and "job-id" (integer) operation attributes which are the target for this operation as described in [RFC2911] section 3.1.5.

"output-device-uuid" (uri):

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

"fetch-status-code" (type2 enum)

The Proxy MAY supply this attribute and the Infrastructure Printer MUST support this attribute. The Proxy provides this attribute when the status code for the corresponding Fetch-Document operation is not 'successful-ok' (0).

Note: The values for this enum attribute match those registered in the IANA IPP registry for status codes. Status code 0 (successful-ok) MUST NOT be sent by the Proxy and MUST NOT be accepted by the Infrastructure Printer because valid enum values start at 1.

"fetch-status-message" (text(MAX)):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute. It is a status message to the user for the corresponding Fetch-Job operation.

### 5.3.2 Acknowledge-Job Response

The following attributes are part of the Acknowledge-Job Response:

#### Group 1: Operation Attributes

##### Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

##### Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

#### Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

### 5.4 Deregister-Output-Device

The REQUIRED Deregister-Output-Device operation removes the association of an Output Device with the Infrastructure Printer. If the Proxy has not previously sent an Update-Output-Device-Attributes request, the Infrastructure Printer returns the 'client-error-not-possible' status code.

The Deregister-Output-Device operation is the inverse of the Update-Output-Device-Attributes (section 5.10) operation, which creates an association between the Infrastructure Printer and Output-Device.

**Access Rights:** The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

### 5.4.1 Deregister-Output-Device Request

The following groups of attributes are supplied as part of the Deregister-Output-Device request:

#### Group 1: Operation Attributes

##### Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

##### Target:

The "printer-uri" (uri) operation attribute which is the target for this operation as described in [RFC2911] section 3.1.5.

##### "output-device-uuid" (uri):

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

##### Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

### 5.4.2 Deregister-Output-Device Response

The following attributes are part of the Deregister-Output-Device response:

#### Group 1: Operation Attributes

##### Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

##### Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

## Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

## 5.5 Fetch-Document

The REQUIRED Fetch-Document operation retrieves the operation, Document Template, and Document Description attributes for the specified Document along with any attached Document data. If the Document is not fetchable, the Infrastructure Printer returns the 'client-error-not-fetchable' status code. If the Job has been assigned to another Output Device, the Infrastructure Printer returns the 'client-error-not-possible' status code.

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

### 5.5.1 Fetch-Document Request

The following groups of attributes are supplied as part of the Fetch-Document Request:

#### Group 1: Operation Attributes

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

Target:

The "printer-uri" (uri), "job-id" (integer), and "document-number (integer)" operation attributes which are the target for this operation as described in [RFC2911] section 3.1.5.

"output-device-uuid" (uri):

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

"compression-accepted" (1setOf type2 keyword)

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute. It identifies the acceptable compression algorithms for the Document data being fetched in order of preference. The default is 'none' (no compression).

"document-format-accepted" (1setOf mimeMediaType)

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute. It identifies the acceptable formats of the Document data being fetched in order of preference. The default is the values of the "document-format-supported" Printer attribute reported by the Proxy in a previous Update-Output-Device-Attributes (section 5.10) request.

### 5.5.2 Fetch-Document Response

The following attributes are part of the Fetch-Document Response:

#### Group 1: Operation Attributes

Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

"compression" (type2 keyword)

The type of compression used for the Document data, if any.

"document-access" (collection | no-value)

The access credentials for the "document-uri", if any.

"document-password" (octetString)

The value of the "document-password" operation attribute submitted to the Infrastructure Printer, if any.

"document-preprocessed" (boolean)

'True' if the document data has been pre-processed by the Infrastructure Printer, 'false' otherwise.



#### Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

#### Group 3: Document Attributes

Document Template and Description attributes for the Document

"document-format" (mimeType)

The format of the returned Document data, if any.

"document-uri" (uri)

The URI of the referenced Document data, if any. This attribute is only returned when the corresponding Document was submitted by the Client using the Print-URI or Send-URI operations and the Proxy has reported support for the Document's URI scheme.

#### Group 4: Document data

The attached Document data, if any.

## 5.6 Fetch-Job

The REQUIRED Fetch-Job operation retrieves the operation, Job Template, and Job Description attributes for the specified Job. If the Job is not fetchable, for example because the Job is still incoming or has not been processed into a format supported by the Proxy, the Infrastructure Printer returns the 'client-error-not-fetchable' status code. If the Job has been assigned to another Output Device, the Infrastructure Printer returns the 'client-error-not-possible' status code.

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

### 5.6.1 Fetch-Job Request

The following groups of attributes are supplied as part of the Fetch-Job Request:

#### Group 1: Operation Attributes

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

**Target:**

The "printer-uri" (uri) and "job-id" (integer) operation attributes which are the target for this operation as described in [RFC2911] section 3.1.5.

**"output-device-uuid" (uri):**

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

**Requesting User:**

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

**5.6.2 Fetch-Job Response**

The following attributes are part of the Fetch-Job Response:

**Group 1: Operation Attributes****Status Message:**

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

**Natural Language and Character Set:**

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

**"job-password" (octetString)**

The value of the "job-password" operation attribute submitted to the Infrastructure Printer, if any.

**"job-password-encryption" (type2 keyword)**

The value of the "job-password-encryption" operation attribute submitted to the Infrastructure Printer, if any.

**Group 2: Unsupported Attributes**

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

### Group 3: Job Attributes

Job Template and Description attributes for the Job

## 5.7 Update-Active-Jobs

The REQUIRED Update-Active-Jobs operation synchronizes the Proxy and Infrastructure Printer's Job state (section 4.2.1).

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

### 5.7.1 Update-Active-Jobs Request

The following groups of attributes are supplied as part of the Update-Active-Jobs Request:

#### Group 1: Operation Attributes

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

Target:

The "printer-uri" (uri) operation attribute which is the target for this operation as described in [RFC2911] section 3.1.5.

"output-device-uuid" (uri):

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

"job-ids" (1setOf integer):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute. The attribute contains a list of Jobs that the Output Device has processed. If supplied, the Proxy MUST also supply the "output-device-job-states" operation attribute.

"output-device-job-states" (1setOf type1 enum):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute. The attribute contains a list of Job states for each Job in the "job-ids" attribute. If supplied, the Proxy MUST also supply the "job-ids" operation attribute.

### 5.7.2 Update-Active-Jobs Response

The following attributes are part of the Update-Active-Jobs Response:

#### Group 1: Operation Attributes

Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

"job-ids" (1setOf integer):

The Infrastructure Printer returns this attribute if there are any Jobs assigned to the Output Device that are either not listed in the request's "job-ids" attribute or have a different state, e.g. 'canceled'. If returned, the Infrastructure Printer MUST also return the "output-device-job-states" attribute.

"output-device-job-states" (1setOf type2 enum):

The Infrastructure Printer returns this attribute if there are any Jobs assigned to the Output Device that are either not listed in the request's "job-ids" attribute or have a different state. The attribute contains a list of Job states for each Job listed in the "job-ids" attribute of the response.

#### Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

"job-ids" (1setOf integer):

The Infrastructure Printer returns this attribute with any "job-ids" values that do not correspond to a Job assigned to the Output Device.

## 5.8 Update-Document-Status

The Update-Document-Status operation updates the Output Device Document state values for a given Document.

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

### 5.8.1 Update-Document-Status Request

The following groups of attributes are supplied as part of the Update-Document-Status Request:

#### Group 1: Operation Attributes

##### Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

##### Target:

The "printer-uri" (uri), "job-id" (integer), and "document-number (integer)" operation attributes which are the target for this operation as described in [RFC2911] section 3.1.5.

##### "output-device-uuid" (uri):

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

##### Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

#### Group 2: Document Attributes

##### "impressions-completed" (integer):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"k-octets-processed" (integer):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MAY support this attribute but MUST NOT accept this attribute if the Proxy has fetched proprocessed document data.

"media-sheets-completed" (integer)

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MAY support this attribute.

"output-device-document-state" (type2 enum):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"output-device-document-state-message" (text):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"output-device-document-state-reasons" (1setOf type2 keyword):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"pages-completed" (integer)

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MAY support this attribute.

### **5.8.2 Update-Document-Status Response**

The following attributes are part of the Update-Document-Status Response:

Group 1: Operation Attributes

Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

## Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

## 5.9 Update-Job-Status

The Update-Job-Status operation updates the Output Device Job state values for a given Job.

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

### 5.9.1 Update-Job-Status Request

The following groups of attributes are supplied as part of the Update-Job-Status Request:

#### Group 1: Operation Attributes

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

Target:

The "printer-uri" (uri) and "job-id" (integer) operation attributes which are the target for this operation as described in [RFC2911] section 3.1.5.

"output-device-uuid" (uri):

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

#### Group 2: Job Attributes

"job-impressions-completed" (integer):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"job-k-octets-completed" (integer):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MAY support this attribute but MUST NOT accept this attribute if the Proxy has fetched proprocessed document data.

"job-media-sheets-completed" (integer):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MAY support this attribute.

"job-pages-completed" (integer):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MAY support this attribute.

"output-device-job-state" (type2 enum):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"output-device-job-state-message" (text):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"output-device-job-state-reasons" (1setOf type2 keyword):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

### 5.9.2 Update-Job-Status Response

The following attributes are part of the Update-Job-Status Response:

#### Group 1: Operation Attributes

Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.



## Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

### 5.10 Update-Output-Device-Attributes

The Update-Output-Device-Attributes operation updates the Output Device Printer attribute values and, if necessary, creates an association between the Infrastructure Printer and Output Device. This allows the Proxy to provide the Infrastructure Printer with the current capability, informational, and status attributes of the Output Device.

The Update-Output-Device-Attributes operation is the inverse of the Deregister-Output-Device (section 5.4) operation, which removes the association between the Infrastructure Printer and Output-Device.

The Proxy SHOULD and the Infrastructure Printer MUST support Sparse Updates. For example, to update the third "media-col-database" value the Proxy sends a "media-col-database.3" attribute with a collection value. To replace values 12 to 30 with 3 values (deleting the excess 16), the Proxy sends a "media-col-database.12-30" attribute with three collection values. And to remove values 1 to 8, the Proxy sends a "media-col-database.1-8" attribute with the out-of-band delete-attribute value. Sparse Updates can be combined into a single request - the Infrastructure Printer processes the replacements and deletions in the order they are provided in the request.

If the Proxy sends attributes or values that are not supported, the Infrastructure Printer MUST return the 'successful-ok-ignored-or-substituted-attributes' status code and include the affected attributes or values in its response to the Proxy. The Proxy SHOULD then omit all returned attributes and values from subsequent Update-Output-Device-Attributes requests it sends over the same connection, however requests sent over new connections SHOULD include any previously omitted attributes in case the Infrastructure Printer changes, e.g., due to a software update.

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be a Proxy of the Printer object. Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

### 5.10.1 Update-Output-Device-Attributes Request

The following groups of attributes are supplied as part of the Update-Output-Device-Attributes Request:

#### Group 1: Operation Attributes

##### Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

##### Target:

The "printer-uri" (uri) operation attribute which is the target for this operation as described in [RFC2911] section 3.1.5.

##### "output-device-uuid" (uri):

The Proxy MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

##### Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Proxy as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Proxy as well.

#### Group 2: Printer Attributes

##### Default, ready, and supported attributes:

The Proxy OPTIONALLY supplies "xxx-default", "xxx-ready", and "xxx-supported" attributes. The Infrastructure Printer MUST support these attributes. The attributes correspond to any Job Template attributes supported by the Output Device.

##### "media-col-database" (1setOf collection):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

##### "printer-alert" (1setOf octetString):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"printer-alert-description" (text):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"printer-input-tray" (1setOf octetString):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"printer-output-tray" (1setOf octetString):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"printer-state" (type2 enum):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"printer-state-message" (text):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"printer-state-reasons" (1setOf type2 keyword):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"printer-supply" (1setOf octetString):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

"printer-supply-description" (1setOf octetString):

The Proxy OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute.

### 5.10.2 Update-Output-Device-Attributes Response

The following attributes are part of the Update-Output-Device-Attributes Response:

#### Group 1: Operation Attributes

##### Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

##### Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

#### Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

## 6. New Client to Infrastructure Printer Operations

The new operation defined in this section is sent by the Client to the Infrastructure Printer.

### 6.1 Get-Output-Device-Attributes

The Get-Output-Device-Attributes administrative operation returns the current Output Device attributes as reported by the Proxy to the Infrastructure Printer.

Note: Unlike the Get-Printer-Attributes operation, this operation does not support filtering of values because the Proxy has no way to communicate subset values based on document format or other attributes that might be used for filtering.

Access Rights: The authenticated user (see section 8.3 of [RFC2911]) performing this operation must be an operator or administrator of the Printer object (see Sections 1 and 8.5 of [RFC2911]). Otherwise, the Infrastructure Printer MUST reject the operation and return: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized' as appropriate.

#### 6.1.1 Get-Output-Device-Attributes Request

The following groups of attributes are supplied as part of the Get-Output-Device-Attributes Request:

##### Group 1: Operation Attributes

###### Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.1.

###### Target:

The "printer-uri" (uri) operation attribute which is the target for this operation as described in [RFC2911] section 3.1.5.

###### "output-device-uuid" (uri):

The Client MUST supply this attribute and the Infrastructure Printer MUST support this attribute. It provides the identity of the Output Device for the request.

###### Requesting User:

The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the Client as described in [RFC2911] section 8.3. In addition, the "requesting-user-uri" attribute SHOULD be supplied by the Client as well.

"requested-attributes" (1setOf type2 keyword):

The Client OPTIONALLY supplies this attribute. The Infrastructure Printer MUST support this attribute. The values are names of attributes or the group names "all", "document-description", "job-template", or "printer-description".

### **6.1.2 Get-Output-Device-Attributes Response**

The following attributes are part of the Get-Output-Device-Attributes Response:

#### Group 1: Operation Attributes

Status Message:

In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) and/or a "detailed-status-message" (text(MAX)) operation attribute as described in [RFC2911] sections 13 and 3.1.6.

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911] section 3.1.4.2.

#### Group 2: Unsupported Attributes

See [RFC2911] section 3.1.7 for details on returning Unsupported Attributes.

#### Group 3: Printer Attributes

Printer attributes that have been set by the Proxy using the Update-Output-Device-Attributes operation.

## 7. New Attributes

### 7.1 Operation Attributes

#### 7.1.1 document-access (collection | no-value)

The OPTIONAL "document-access" operation attribute allows the Client to provide authentication information for a referenced Document.

The collection value contains zero or more member attributes which provide the authentication information required for the Document. A Client MAY also provide the no-value out-of-band value to specify that no authentication information is necessary.

Printers specify which member attributes are supported using the "document-access-supported" Printer attribute (section 7.4.1).

##### 7.1.1.1 access-oauth-token (1setOf octetString(MAX))

The OPTIONAL "access-oauth-token" member attribute provides a Base64-encoded OAuth Access Token as defined in The OAuth 2.0 Authorization Framework [RFC6749]. When the size of the access token exceeds 1023 octets (the maximum size of an octetString value), the Client separates the token into multiple octetString values and sends the result as an ordered set to the Printer. The Printer reassembles each octetString to produce the complete access token value to be used to access the Document URI.

Printers that support this attribute MUST list 'access-oauth-token' in the "document-access-supported" Printer attribute.

##### 7.1.1.2 access-oauth-uri (uri)

The OPTIONAL "access-oauth-uri" member attribute is the authorization server that issued the "access-oauth-token" member attribute. See Authorization Server [RFC6749] section 1.1.

##### 7.1.1.3 access-password (text(MAX))

The OPTIONAL "access-password" member attribute provides a password string, typically for HTTP Basic or Digest authentication [RFC2617]. Clients MUST provide the password using the UTF-8 encoding [STD63] in Unicode Normalization Form C as required for Network Unicode [RFC5198]. Printers MUST convert the password, as needed, to whatever encoding is required to access the Document URI.

Printers that support this attribute MUST list 'access-password' in the "document-access-supported" Printer attribute.

#### **7.1.1.4 access-pin (text(MAX))**

The OPTIONAL "access-pin" member attribute provides a Personal Identification Number string. Clients MUST restrict the characters to the US ASCII digits '0' (code 48) through '9' (code 57) and Printers MUST reject values containing characters other than the digits '0' through '9'.

Printers that support this attribute MUST list 'access-pin' in the "document-access-supported" Printer attribute.

#### **7.1.1.5 access-user-name (text(MAX))**

The OPTIONAL "access-user-name" member attribute provides a user name string, typically for HTTP Basic or Digest authentication [RFC2617]. Clients MUST provide the user name using the UTF-8 encoding [STD63] in Unicode Normalization Form C as required for Network Unicode [RFC5198]. Printers MUST convert the user name, as needed, to whatever encoding is required by the Document URI.

Printers that support this attribute MUST list 'access-user-name' in the "document-access-supported" Printer attribute.

#### **7.1.1.6 access-x509-certificate (1setOf octetString(MAX))**

The OPTIONAL "access-x509-certificate" member attribute provides a PEM-encoded X.509 certificate identifying the User or Client that is making the request. When the size of the certificate exceeds 1023 octets (the maximum size of an octetString value), the Client separates the certificate into multiple octetString values and sends the result as an ordered set to the Printer. The Printer reassembles each octetString to produce the complete X.509 certificate to be used to access the Document URI.

Printers that support this attribute MUST list 'access-x509-certificate' in the "document-access-supported" Printer attribute and MUST provide an implementation-defined method for loading the corresponding private key that is used for authenticating the holder of the X.509 certificate.

#### **7.1.2 document-preprocessed (boolean)**

Specifies whether the Infrastructure Printer has pre-processed the document data returned by the Fetch-Document (section 5.5) operation.

#### **7.1.3 fetch-status-code (type2 enum)**

The status code send by the Proxy in Acknowledge-Document (section 5.1) and Acknowledge-Job (section 5.3) requests to provide the result code for a previous Fetch-Document (section 5.5) or Fetch-Job (section 5.6) request. The values include all IANA registered status codes except 'successful-ok' (0) since valid enum values start at 1. Proxies MUST NOT send and Infrastructure Printers MUST NOT accept "fetch-status-code" attributes whose values are 0.



#### **7.1.4 fetch-status-message (text(MAX))**

The status message returned by the Proxy as a result of an Acknowledge-Document (section 5.1), Acknowledge-Job (section 5.3), Fetch-Document (section 5.5), or Fetch-Job (section 5.6) operation.

#### **7.1.5 output-device-job-states (1setOf type1 enum)**

The list of "job-state" values corresponding to the Jobs identified by the "job-ids" operation attribute [PWG5100.13].

This attribute MUST have the same cardinality (contain the same number of values) as the "job-ids" attribute. The  $i^{\text{th}}$  value in the "output-device-job-states" attribute corresponds to the  $i^{\text{th}}$  value in the "job-ids" attribute.

#### **7.1.6 output-device-uuid (uri)**

The UUID [RFC4122] that identifies the Output Device to the Infrastructure Printer and Client.

### **7.2 Document Status Attributes**

#### **7.2.1 document-format-ready (1setOf mimeType)**

The "document-format-ready" Document Description attribute lists the MIME media types that may be fetched by the Proxy. This attribute is required if the Infrastructure Printer supports the IPP Document Object [PWG5100.5].

#### **7.2.2 output-device-document-state (type2 enum)**

The REQUIRED "output-device-document-state" Document Description attribute provides the "document-state" value on the Output Device.

#### **7.2.3 output-device-document-state-message (text(MAX))**

The REQUIRED "output-device-document-state-message" Document Description attribute provides the "document-state-message" value on the Output Device.

#### **7.2.4 output-device-document-state-reasons (1setOf type2 keyword)**

The REQUIRED "output-device-document-state-reasons" Document Description attribute provides the "document-state-reasons" value on the Output Device.

## 7.3 Job Status Attributes

### 7.3.1 document-format-ready (1setOf mimeType)

The REQUIRED "document-format-ready" Job Description attribute lists the MIME media types that may be fetched by the Proxy.

### 7.3.2 output-device-job-state (type2 enum)

The REQUIRED "output-device-job-state" Job Description attribute provides the "job-state" value on the Output Device.

### 7.3.3 output-device-job-state-message (text(MAX))

The REQUIRED "output-device-job-state-message" Job Description attribute provides the "job-state-message" value on the Output Device.

### 7.3.4 output-device-job-state-reasons (1setOf type2 keyword)

The REQUIRED "output-device-job-state-reasons" Job Description attribute provides the "job-state-reasons" value on the Output Device.

### 7.3.5 output-device-uuid-assigned (uri)

The REQUIRED "output-device-uuid-assigned" Job Description attributes provides the UUID for the Output Device that has been assigned to (or has acknowledged) the Job.

## 7.4 Printer Description Attributes

### 7.4.1 document-access-supported (1setOf type2 keyword)

The "document-access-supported" Printer attribute lists the supported member attributes of the "document-access" operation attribute (section 7.1.1). This attribute MUST be supported if the "document-access" attribute is supported.

### 7.4.2 fetch-document-attributes-supported (1setOf keyword)

The REQUIRED "fetch-document-attributes-supported" Printer attribute lists the attributes that can be specified in a Fetch-Document request and MUST include the value 'document-format-accepted'.

### 7.4.3 oauth-authorization-server-uri (uri | no-value)

The "oauth-authorization-server-uri" Printer attribute provides the authorization server used by the Printer. Printers that support the OAuth 2.0 Authorization Framework [RFC6749] MUST support this attribute.

#### **7.4.4 output-device-uuid-supported (1setOf uri)**

The REQUIRED "output-device-uuid-supported" Printer attribute lists the UUIDs of all Output Devices that are managed by the Infrastructure Printer. The values are the "printer-uuid" values reported by the Proxy to the Infrastructure Printer.

This attribute MUST have the same cardinality as the "output-device-supported" Printer attribute. The  $i^{\text{th}}$  value of the "output-device-uuid-supported" attribute corresponds to the  $i^{\text{th}}$  values of the "output-device-supported" attribute.

#### **7.4.5 printer-static-resource-directory-uri (uri)**

The RECOMMENDED "printer-static-resource-directory-uri" Printer Description attribute specifies a "http" or "https" URI that accepts HTTP DELETE, GET, and PUT requests for canceling, fetching, and creating static resources. The URI MUST use the path prefix "/ipp/resource" and SHOULD be tailored to the "output-device-uuid" value provided by the IPP Proxy in order to provide isolation between Output Device resources, for example "https://www.example.com/ipp/resource/01234567-89AB-CDEF-FEDC-BA9876543210" for an "output-device-uuid" value of 'urn:uuid:01234567-89AB-CDEF-FEDC-BA9876543210'.

#### **7.4.6 printer-static-resource-k-octets-supported (integer(0:MAX))**

The RECOMMENDED "printer-static-resource-k-octets-supported" Printer Description attribute specifies the total number of K octets (units of 1024 octets) that can be stored in the directory referenced by the "printer-static-resource-directory-uri" (section 7.4.5) attribute.

This attribute MUST be supported if the "printer-static-resource-directory-uri" (section 7.4.5) Printer Description attribute is supported.

### **7.5 Printer Status Attributes**

#### **7.5.1 printer-static-resource-k-octets-free (integer(0:MAX))**

The RECOMMENDED "printer-static-resource-k-octets-free" Printer Status attribute specifies the number of K octets (units of 1024 octets) that are available for storing additional resources in the directory referenced by the "printer-static-resource-directory-uri" (section 7.4.5) attribute.

This attribute MUST be supported if the "printer-static-resource-directory-uri" (section 7.4.5) Printer Description attribute is supported.

## **8. Additional Semantics for Existing Operations**

### **8.1 Print-URI, Send-URI: document-access**

This specification adds the new "document-access" (section 7.1.1) operation attribute to the Print-URI and Send-URI requests [RFC2911] to specify the access credentials for a referenced Document.

### **8.2 Get-Jobs: output-device-uuid, which-jobs='fetchable'**

This specification adds the new "output-device-uuid" (section 7.1.6) operation attribute for a Get-Jobs request to specify the Output Device UUID. When supplied, the Infrastructure Printer MUST limit the Jobs that are returned to those that have been assigned to the Output Device.

In addition, a new "which-jobs" value of 'fetchable' is defined. When supplied, the Infrastructure Printer MUST limit the Jobs that are returned to those whose "job-state-reasons" Job Description attribute contains the value 'job-fetchable'.

### **8.3 Get-Notifications: 'document-xxx' Events**

This specification adds new Document events (section 9.5). The Get-Notifications operation will return Document Description attributes for Document event notifications.

### **8.4 Get-Printer-Attributes: "output-device-uuid" Filter**

This specification adds the new "output-device-uuid" (section 7.1.6) operation attribute for a Get-Printer-Attributes request to specify the Output Device UUID. When supplied, the Infrastructure Printer MUST limit the composite attributes and values that are returned to those that correspond to the specified Output Device and the Infrastructure Printer itself.

### **8.5 Identify-Printer: "job-id" and "output-device-uuid" Target Attributes**

This specification adds the "job-id" [RFC2911] and new "output-device-uuid" (section 7.1.6) operation attributes for an Identify-Printer request to specify the Job ID or Output Device UUID, respectively. When supplied, the Infrastructure Printer MUST send the identify request to the Output Device assigned to the specified Job or with the specified UUID. If no "job-id" or "output-device-uuid" attribute is specified, the Infrastructure Printer sends the identify request to its implementation-defined default Output Device.

## 9. Additional Values for Existing Attributes

### 9.1 document-state (type1 enum)

This specification defines a new value of 'processing-stopped' (6) to indicate a Document that has been pre-processed and is awaiting further processing.

### 9.2 document-state-reasons (1setOf type2 keyword)

This specification defines a new keyword, 'document-fetchable', to indicate that a Document can be fetched using the Fetch-Document operation.

### 9.3 ipp-features-supported (1setOf type2 keyword)

This specification defines a new keyword, 'infrastructure-printer', to indicate that the Printer supports the Infrastructure Printer extensions defined here. Infrastructure Printers MUST include this value in their "ipp-features-supported" Printer attribute.

### 9.4 job-state-reasons (1setOf type2 keyword)

This specification defines a new keyword, 'job-fetchable', to indicate that a Job can be fetched using the Fetch-Job operation.

### 9.5 notify-events (1setOf type2 keyword)

This specification defines the following new notification event keywords:

'document-completed': The Document has reached a terminating state ('aborted', 'canceled', or 'completed') - this is a sub-event of 'document-state-changed'

'document-config-changed': The Document Template or Description attributes have been changed

'document-created': The Document has been created

'document-fetchable': The Document is now available via the Fetch-Document operation - this is a sub-event of 'document-state-changed'

'document-state-changed': The Document state has changed

'document-stopped': The Document has entered the 'processing-stopped' state - this is a sub-event of 'document-state-changed'

'job-fetchable': The Job is now available via the Fetch-Job operation - this is a sub-event of 'job-state-changed'

## 9.6 printer-state-reasons (1setOf type2 keyword)

This specification defines a new keyword, 'identify-printer-requested', to indicate that a pending Identify-Printer request exists.

## 9.7 uri-authentication-supported (1setOf type2 keyword)

This specification defines a new keyword, 'oauth', to indicate that a Printer is configured to use the OAuth 2.0 Authentication Framework [RFC6749].

## 9.8 which-jobs (type2 keyword)

This specification defines a new keyword, 'fetchable', to indicate that only those Jobs whose "job-state-reasons" Job Description attribute contains the value 'job-fetchable' are to be returned by the Get-Jobs operation.

# 10. Status Codes

## 10.1 client-error-not-fetchable (0x0420)

This REQUIRED status code indicates that the Job or Document object is currently not fetchable, either because the Job is incoming or the Document has not yet been pre-processed into a form supported by the Proxy.

# 11. Conformance Requirements

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

## 11.1 Conformance Requirements for Clients

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

1. The required IPP operations defined in section 4.6,
2. The required IPP operation attributes defined in section 4.7,
3. The required IPP Printer attributes defined in section 4.8,
4. The required IPP Job Template attributes defined in section 4.14,
5. The required IPP Job Description attributes defined in section 4.14,
6. The internationalization considerations in section 12, and
7. The security considerations in section 13.

## 11.2 Conformance Requirements for Infrastructure Printers

In order for an Infrastructure Printer to claim conformance to this specification, an Infrastructure Printer MUST support:

8. The required IPP operations defined in section 4.6,
9. The required IPP operation attributes defined in section 4.7,
10. The required IPP Printer attributes defined in section 4.8,
11. The required IPP Job Template attributes defined in section 4.14,
12. The required IPP Job Description attributes defined in section 4.14,
13. The new operations defined in section 5 and section 6,
14. The operation attributes defined in section 7.1,
15. The Document Description attributes defined in section 7.2,
16. The Job Description attributes defined in section 7.3,
17. The Printer Description attributes defined in section 7.4,
18. The additional semantics defined in section 8,
19. The additional values defined in section 9,
20. The status codes defined in section 10,
21. The internationalization considerations in section 12, and
22. The security considerations in section 13.

## 11.3 Conformance Requirements for Proxies

In order for a Proxy to claim conformance to this specification, a Proxy MUST support:

1. The required IPP operations defined in section 4.6,
2. The required IPP operation attributes defined in section 4.7,
3. The required IPP Printer attributes defined in section 4.8,
4. The required IPP Job Template attributes defined in section 4.14,
5. The required IPP Job Description attributes defined in section 4.14,
6. The new operations defined in section 5 and section 6,
7. The operation attributes defined in section 7.1,
8. The Document Description attributes defined in section 7.2,
9. The Job Description attributes defined in section 7.3,
10. The Printer Description attributes defined in section 7.4,
11. The additional semantics defined in section 8,
12. The additional values defined in section 9,
13. The status codes defined in section 10,
14. The internationalization considerations in section 12, and
15. The security considerations in section 13.

## 12. 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').

Implementations of this specification SHOULD conform to the following standards on processing of human-readable Unicode text strings, see:

Unicode Bidirectional Algorithm [UAX9] – left-to-right, right-to-left, and vertical

Unicode Line Breaking Algorithm [UAX14] – character classes and wrapping

Unicode Normalization Forms [UAX15] – especially NFC for [RFC5198]

Unicode Text Segmentation [UAX29] – grapheme clusters, words, sentences

Unicode Identifier and Pattern Syntax [UAX31] – identifier use and normalization

Unicode Collation Algorithm [UTS10] – sorting

Unicode Locale Data Markup Language [UTS35] – locale databases

Implementations of this specification are advised to also review the following informational documents on processing of human-readable Unicode text strings:

Unicode Character Encoding Model [UTR17] – multi-layer character model

Unicode in XML and other Markup Languages [UTR20] – XML usage

Unicode Character Property Model [UTR23] – character properties

Unicode Conformance Model [UTR33] – Unicode conformance basis



## 13. 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, Infrastructure Printers **MUST**:

1. Validate the HTTP Host request header in order to protect against DNS rebinding attacks,
2. Provide confidentiality of data in transit using TLS encryption [RFC5246] of Client and Proxy connections,
3. Authenticate Clients and Proxies using X.509 certificate validation, HTTP authentication methods, and/or other mechanisms, and
4. Provide confidentiality of Document and Job data at rest.

Clients and Proxies **MUST** authenticate their connections to Infrastructure Printers, such as by validating the Infrastructure Printer's X.509 certificate or using other in-band mutual authentication protocols.

Implementations of this specification **SHOULD** conform to the following standard on processing of human-readable Unicode text strings, see:

Unicode Security Mechanisms [UTS39] – detecting and avoiding security attacks

Implementations of this specification are advised to also review the following informational document on processing of human-readable Unicode text strings:

Unicode Security FAQ [UNISECFAQ] – common Unicode security issues

## 14. IANA and PWG Considerations

### 14.1 Attribute Registrations

The attributes defined in this document will be published by IANA according to the procedures in IPP Model and Semantics [RFC2911] section 6.2 in the following file:

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

The registry entries will contain the following information:

Operation attributes: -----	Reference -----
document-access (collection   no-value)	[PWG5100.18]
access-oauth-token (1setOf octetString(MAX))	[PWG5100.18]
access-oauth-uri (uri)	[PWG5100.18]
access-password (text(MAX))	[PWG5100.18]
access-pin (text(MAX))	[PWG5100.18]
access-user-name (text(MAX))	[PWG5100.18]
access-x509-certificate (1setOf octetString(MAX))	[PWG5100.18]
document-preprocessed (boolean)	[PWG5100.18]
fetch-status-code (type2 enum)	[PWG5100.18]
fetch-status-message (text(MAX))	[PWG5100.18]
output-device-job-states (1setOf type1 enum)	[PWG5100.18]
output-device-uuid (uri)	[PWG5100.18]
 Document Status attributes: -----	 Reference -----
document-format-ready (1setOf mimeType)	[PWG5100.18]
output-device-document-state (type2 enum)	[PWG5100.18]
output-device-document-state-message (text(MAX))	[PWG5100.18]
output-device-document-state-reasons (1setOf type2 keyword)	[PWG5100.18]
 Job Status attributes: -----	 Reference -----
document-format-ready (1setOf mimeType)	[PWG5100.18]
output-device-job-state (type2 enum)	[PWG5100.18]
output-device-job-state-message (text(MAX))	[PWG5100.18]
output-device-job-state-reasons (1setOf type2 keyword)	[PWG5100.18]
output-device-uuid-assigned (uri)	[PWG5100.18]
 Printer Description attributes: -----	 Reference -----
document-access-supported (1setOf type2 keyword)	[PWG5100.18]
fetch-document-attributes-supported (1setOf type2 keyword)	[PWG5100.18]
oauth-authorization-server-uri (uri   no-value)	[PWG5100.18]
output-device-uuid-supported (1setOf uri)	[PWG5100.18]
printer-static-resource-directory-uri (uri)	[PWG5100.18]
printer-static-resource-k-octets-supported (integer(0:MAX))	[PWG5100.18]

Printer Status attributes:	Reference
-----	-----
printer-static-resource-k-octets-free (integer(0:MAX))	[PWG5100.18]

## 14.2 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 -----
document-state-reasons (1setOf type2 keyword) document-fetchable	[PWG5100.5] [PWG5100.18]
ipp-features-supported (1setOf type2 keyword) infrastructure-printer	[PWG5100.13] [PWG5100.18]
job-state-reasons (1setOf type2 keyword) job-fetchable	[RFC2911] [PWG5100.18]
notify-events (1setOf type2 keyword) document-completed document-config-changed document-created document-fetchable document-state-changed document-stopped job-fetchable	[RFC3995] [PWG5100.18] [PWG5100.18] [PWG5100.18] [PWG5100.18] [PWG5100.18] [PWG5100.18] [PWG5100.18]
printer-state-reasons (1setOf type2 keyword) identify-printer-requested	[RFC2911] [PWG5100.18]
uri-authentication-supported (1setOf type2 keyword) oauth	[RFC2911] [PWG5100.18]
which-jobs (type2 keyword) fetchable	[RFC2911] [PWG5100.18]

### 14.3 Type2 enum Attribute Value Registrations

The enumerations defined in this document will be published by IANA according to the procedures in the IPP Model and Semantics [RFC2911] section 6.2 in the following file:

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

The registry entries will contain the following information:

Attributes (attribute syntax)		Reference
Enum Value	Enum Symbolic Name	
-----	-----	-----
document-state (type1 enum)		[PWG5100.5]
6	processing-stopped	[PWG5100.18]
fetch-status-code (type2 enum)		[PWG5100.18]
< all status code values other than 'successful-ok' >		[PWG5100.18]
operations-supported (1setOf type2 enum)		[RFC2911]
0x003F	Acknowledge-Document	[PWG5100.18]
0x0040	Acknowledge-Identify-Printer	[PWG5100.18]
0x0041	Acknowledge-Job	[PWG5100.18]
0x0042	Fetch-Document	[PWG5100.18]
0x0043	Fetch-Job	[PWG5100.18]
0x0044	Get-Output-Device-Attributes	[PWG5100.18]
0x0045	Update-Active-Jobs	[PWG5100.18]
0x0046	Deregister-Output-Device	[PWG5100.18]
0x0047	Update-Document-Status	[PWG5100.18]
0x0048	Update-Job-Status	[PWG5100.18]
0x0049	Update-Output-Device-Attributes	[PWG5100.18]
output-device-job-states (1setOf type1 enum)		[PWG5100.18]
< all job-state values >		[PWG5100.18]

## 14.4 Operation Registrations

The operations defined in this document will be published by IANA according to the procedures in the IPP Model and Semantics [RFC2911] section 6.2 in the following file:

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

The registry entries will contain the following information:

Operation Name	Reference
Acknowledge-Document	[PWG5100.18]
Acknowledge-Identify-Printer	[PWG5100.18]
Acknowledge-Job	[PWG5100.18]
Deregister-Output-Device	[PWG5100.18]
Fetch-Document	[PWG5100.18]
Fetch-Job	[PWG5100.18]
Get-Jobs (extension)	[PWG5100.18]
Get-Notifications (extension)	[PWG5100.18]
Get-Output-Device-Attributes	[PWG5100.18]
Get-Printer-Attributes (extension)	[PWG5100.18]
Identify-Printer (extension)	[PWG5100.18]
Print-URI (extension)	[PWG5100.18]
Send-URI (extension)	[PWG5100.18]
Update-Active-Jobs	[PWG5100.18]
Update-Document-Status	[PWG5100.18]
Update-Job-Status	[PWG5100.18]
Update-Output-Device-Attributes	[PWG5100.18]

## 14.5 Status Code Registrations

The status codes defined in this document will be published by IANA according to the procedures in the IPP Model and Semantics [RFC2911] section 6.6 in the following file:

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

The registry entries will contain the following information:

Value	Status Code Name	Reference
0x0400:0x04FF	- Client Error:	
0x0420	client-error-not-fetchable	[PWG5100.18]

## 14.6 Semantic Model Registrations

The IPP attributes, values, and operations defined in this specification and listed in the preceding sections that apply to the PWG Semantic Model are registered in the Cloud Imaging Requirements and Model [PWG5109.1].

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