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15   Internet Printing Protocol/1.0 & 1.1: **IPP Event Notification Specification**

17   Status of this Memo

18   This document is an Internet-Draft and is in full conformance with all provisions of Section 10 of
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27   **Abstract**

28   This document describes an extension to the IPP/1.0 & IPP/1.1 model that allows a client to subscribe to
29   printing related events. Subscriptions include "Per-Job subscriptions" and "Per-Printer subscriptions". One
30   or more Per-Job Submission subscriptions are specified by the client when submitting a job. Additional
31   Per-Job and Per-Printer subscriptions are created by performing separate explicit Create-Job-Subscription
32   Create-Printer-Subscription operations, respectively. Subscriptions are modeled as Subscription objects.
33   Four other operations are defined for sSubscription objects: gGet--aAttributes, gGet--sSubscriptions,
34   rRenew--a sSubscription, and cCancel-a sSubscription.

35   A subscription request and the Subscription object includes: the names of Job and/or Printer events, the
36   Notification Recipient URL, the text format if Human Consumable notification is requested, possibly some
37   opaque data, and the charset and natural language. In addition, the subscription request includes: the
38   requested lease time and persistency for the subscription. When the event occurs, a notification is
39   generated and delivered using the information specified in the subscription.

40   The full set of IPP documents includes:

41   Design Goals for an Internet Printing Protocol [IPP-REQ]
42   Rationale for the Structure and Model and Protocol for the Internet Printing Protocol [IPP-RAT]
43   Internet Printing Protocol/1.1: Model and Semantics [IPP-MOD]
44   Internet Printing Protocol/1.1: Encoding and Transport [IPP-PRO]
45   Internet Printing Protocol/1.0: Implementer's Guide [IPP-IIG]
46   Mapping between LPD and IPP Protocols [IPP LPD]
47
48   The "Design Goals for an Internet Printing Protocol" document takes a broad look at distributed printing
49   functionality, and it enumerates real-life scenarios that help to clarify the features that need to be included
50   in a printing protocol for the Internet. It identifies requirements for three types of users: end users,
51   operators, and administrators. It calls out a subset of end user requirements that are satisfied in IPP/1.0.
52   Operator and administrator requirements are out of scope for version 1.0. A few OPTIONAL operator
53   operations have been added to IPP/1.1.

54   The "Rationale for the Structure and Model and Protocol for the Internet Printing Protocol" document
55   describes IPP from a high level view, defines a roadmap for the various documents that form the suite of
56   IPP specifications, and gives background and rationale for the IETF working group's major decisions.

57   The "Internet Printing Protocol/1.1: Model and Semantics", describes a simplified model with abstract
58   objects, their attributes, and their operations that are independent of encoding and transport. It introduces a
59   Printer and a Job object. The Job object optionally supports multiple documents per Job. It also addresses
60   security, internationalization, and directory issues.

61   The "Internet Printing Protocol/1.1: Encoding and Transport" document is a formal mapping of the abstract
62   operations and attributes defined in the model document onto HTTP/1.1. It defines the encoding rules for a
63   new Internet MIME media type called "application/ipp". This document also defines the rules for
64   transporting over HTTP a message body whose Content-Type is "application/ipp". This document defines
65   a new scheme named 'ipp' for identifying IPP printers and jobs. Finally, this document defines
66   interoperability rules for supporting IPP/1.0 clients.

67   The "Internet Printing Protocol/1.0: Implementer's Guide" document gives insight and advice to
68   implementers of IPP clients and IPP objects. It is intended to help them understand IPP/1.0 and some of
69   the considerations that may assist them in the design of their client and/or IPP object implementations. For
70   example, a typical order of processing requests is given, including error checking. Motivation for some of
71   the specification decisions is also included.

72   The "Mapping between LPD and IPP Protocols" document gives some advice to implementers of gateways
73   between IPP and LPD (Line Printer Daemon) implementations.

74
75   **Table of Contents**

173

174

1 Introduction

176 This IPP notification specification is an extension to IPP/1.0 [RFC2568, RFC2569] and IPP/1.1 [ipp-mod,
177 ipp-pro]. This document in combination with the following documents is intended to meet the notification
178 requirements described in [ipp-not-req]:

179   Internet Printing Protocol/1.0 & 1.1: "Collection Attribute Syntax" [ipp-coll]
180   Internet Printing Protocol/1.0 & 1.1: "Job Progress Attributes" [ipp-prog]
181   Internet Printing Protocol/1.0 & 1.1: "Notification Change History" [ipp-not-hist]
182 In addition, each notification delivery method, whether REQUIRED or OPTIONAL, is described in
183 separate documents:
184   Internet Printing Protocol/1.0 & 1.1: "Notification Delivery Method xxx [TBD]
185   Internet Printing Protocol/1.0 & 1.1: "Notification Delivery Method yyy [TBD]
186

187 The rest of this document is laid out as follows:

188   - The rest of Section 1.1 is an overview of IPP Notification.

189   - Section 2 is the model for network entities that use IPP notification, including clients (desktop and
190   servers), IPP Printers (servers and devices), and Notification Recipients.

191   - Section 3 is the terminology used throughout the document.

192   - Section 4 is the object model for notification, including Job, Printer, and Subscription objects.

193   - Section 5 and 6 defines the Subscription object and its attributesnotification attributes for each of
194   the Subscription and Printer objects.

195   - Section 6 defines the Printer Description attributes

196   - Section 7 defines the Notification content of Human Consumable and Machine Consumable Event
197   Notification contentsformats.

198   - Sections 8 and 9 define the Per-Job and Per-Printer Subscription operations.

199   - Section 10 defines the out-of-band values.

200   - Section 11 and 12 define the conformance requirements and IANA requirements, respectively.

201   - Section 13 - 15 cover Internationalization, Security, and Status codes.

202   - Appendix A is a summary of the Notification Attribute usage

203   - Appendix B is a Change History

1.1 Notification Overview

205 A client can establish an event notification subscription so that when one of the specified events occurs, an
206 asynchronous Notification is sent to a specified Notification Recipient.

207   One or more Per-Job Submission subscriptions are specified by the client when submitting a job. One or
208   more Per-Job or Per-Printer subscriptions are created by performing separate explicit Create-Job-
209   Subscription or Create-Printer-Subscriptions operations, respectively.

210   A Per-Job or Per-Printer subscription request includes:

211   1.   the names of Job and/or Printer events that are of interest to the Notification Recipient

212   2.   the delivery method and address to use to deliver the notification to one Notification Recipient

213   3.   if Human Consumable notification content is to be sent, which text format

214   4.   some opaque data that the subscriber wants to be sent to the Notification Recipient in the
215   Notification, perhaps to identify either the subscriber or the ultimate recipient

216   5.   the charset to use in the Notification, if it is to be different than the one used in the request that
217   created the subscription

218   6.   the natural language to use in the Human Consumable Notification, if it is to be different than the
219   one used in the request that created the subscription

220   7.   the requested lease time in seconds for the subscription

221   8.   whether or not the subscription is requested to be persistent across power cycles.

222   For Per-Job subscriptions, a client requests job and printer event notification using the "job-notify"
223   operation attribute when creating a job with any of the Job Creation operation: Print-Job, Print-URI, and
224   Create-Job. The "job-notify" operation attributes may be submitted to the Validate-Job in order to be
225   validated. . The "job-notify" operation attribute contains one or more collection values, each consisting of
226   a number of member attributes that specify a subscription, so that a Job can have more than one Per-Job
227   subscription. The 'collection' is a new attribute syntax (see [ipp-coll]). The member attributes of each
228   collection value are copied to separate Subscription objects to populate the corresponding Subscription
229   Description attributes.

230   For Per-Printer subscriptions and Per-Job subscriptions created after the Job has been created, a client
231   requests job and printer event notification using new operations independent of any job. The Printer keeps
232   each subscription in a separate Subscription object. The Create-Job-Subscription and Create-Printer-
233   Subscription operations create an instance of the Subscription object supplying these new operation
234   attributes and returns a subscription-id (analogous to a job-id for a Job object). These operation attributes
235   are copied to the Subscription object as Subscription Description attributes and so may be queried using the
236   Get-Subscription-Attributes and Get-Subscriptions operations. The subscriber requests a lease time for
237   each Per-Printer subscription which MAY be infinite. The Printer grants a lease time according to its
238   configured policy. A client MUST renew the Subscription before the granted lease time expires using the
239   Renew-Subscription operation.

240   Table 1 summarizes the Per-Job and Per-Printer Subscription operations and their salient input operation
241   attributes.

242   **Table 1 - Summary of Per-Job and Per-Printer Subscription operations**

Operation:	Per-Job	Per-Printer	salient inputs beside printer-uri:
Print-Job, Print-URI, Create-Job	yes	no	1setOf {recipient, [events,] [text-format,] [user-data,] [charset,] [natural-language]}
Validate-Job	yes	no	1setOf {recipient, [events,] [text-format,] [user-data,] [charset,] [natural-language]}
Create-Printer-Subscription	no	yes	recipient, [events,] [text-format,] [user-data,] [charset,] [natural-language,] [lease-time-requested,] [persistence-requested]
Create-Job-Subscription	yes	no	recipient, job-id, [events,] [text-format,] [user-data,] [charset,] [natural-language,]
Get-Subscription-Attributes	yes	yes	subscription-id, [requested-attributes]
Get-Subscriptions	yes	yes	[job-id], [my-subscriptions,] [requested-attributes]
Renew-Subscription	yes	yes	subscription-id, [lease time-requested]
Cancel-Subscription	yes	yes	subscription-id

243

244   There are two steps that IPP notification must take regarding each event – an internal event recording, and
245   an external notification:

246   1) As an events occurs, the printer internally records in the job objects and the printer objects those
247   events which are required to be supported by the system and those that are subscribed to by a
248   notification recipient.

249   2) As an events occurs, the Printer searches the set of subscriptions for any interest in that event. As
250   the Printer finds that some notification recipient is interested in that event (the notification recipient
251   is subscribed to the event), the "request-id" sequence number for that event is incremented and a
252   notification is generated and delivered using the methods and target addresses identified in the
253   subscription. The "request-id" sequence number permits a Notification Recipient to detect duplicate
254   notifications due either to duplicate subscriptions or retries and to detect dropped notifications.

255   # 2   Model for Per-Job and Per-Printer Subscription and Event Notification

256   ## 2.1   Model for Per-Job Subscription and Notification

257   Per-Job subscriptions are created by a client (desktop or server acting as a client) as part of creation of the
258   job in an IPP Printer (printing device or server). More than one subscription may be submitted with a job.
259   Additional subscriptions may be associated with the job using the Create-Job-Subscription operation. The
260   IPP Printer object delivers a Notifications to the Notification Recipient supplied by the Client in each
261   subscription. A Notification Recipient can be the Job submitter or a third party.

262   Figure 1 shows the Per-Job subscription notification model for a simple Client - Printer relationship.
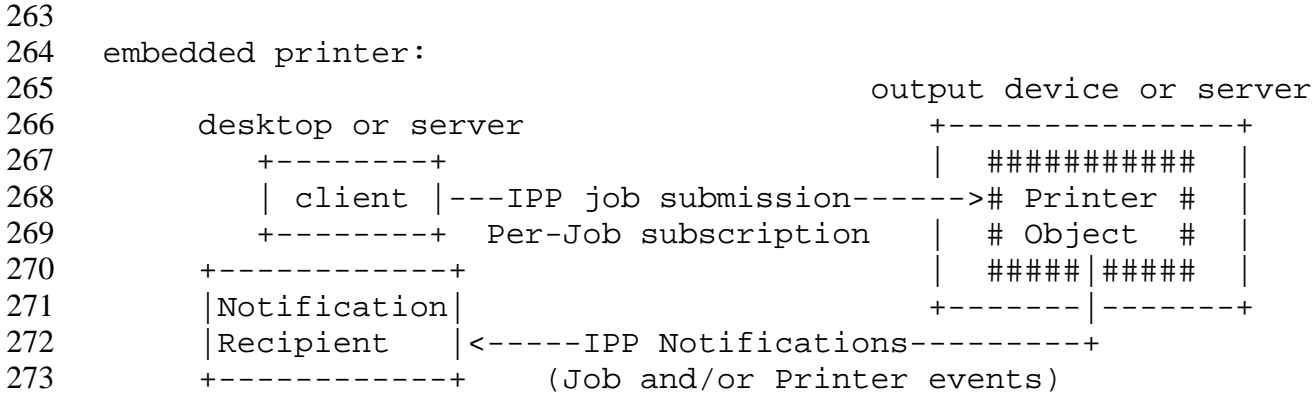
```
263
264  embedded printer:
265                                              output device or server
266      desktop or server                      +---------------+
267         +--------+                          |  ########### |
268         | client |---IPP job submission------># Printer  #  |
269         +--------+   Per-Job subscription    |  # Object  #  |
270      +------------+                          |  ####|##### |
271      |Notification|                          +-------|-------+
272      |Recipient   |<-----IPP Notifications---------+
273      +------------+     (Job and/or Printer events)
```
Figure 1 - Client-Printer Per-Job Subscription and Notification Model

Figure 2 shows a (spooling or non-spooling) Server that implements two Printer objects (1 and 2) that represent two devices. The devices A and B in turn each implement an IPP Printer object (3 and 4, respectively). The Server implementation has three choices for how to support Per-Job subscriptions to the client (and itself):

1. forward the Per-Job subscriptions to the down stream IPP Printer and let it perform the notification directly to the Notification Recipients supplied by the Client (Notifications(C)) and use Per-Printer Subscriptions for the Server's own purposes.

2. save the client-supplied Per-Job subscription on the Job object in the server and substitute its own Per-Job subscription with the Server as the Notification Recipient (Notifications(B)). Then the Server relays Notifications to the client-supplied Notification Recipients (Notifications(A)).

3. A combination of 1 and 2 in which the Server adds its own Per-Job subscriptions to those supplied by the client. Thus the IPP Job that goes to Printer object 4 has a combination of subscription information from both the Client and the Server. This latter approach is sometimes called "piggy-backing" because the Server is adding its Per-Job subscription information to that supplied by the client. Piggy-backing is especially useful, if device B also accepts (IPP or non-IPP) requests from other servers. Then when all the jobs from Server S have been completed by device B, there will be no more Job events sent to Server S. (Server S could still maintain a long term Per-Printer subscription with Printer D to that Server S can have Printer B's state track (shadow) that of Printer D or Server S could poll Printer D when queried about Printer B).

```
294
295                                                             device A
296                                server S              +------------+
297                          +------------+              | ##########|
298  +--------+    IPP Job   | ##########|    IPP Job    | # Printer #|
299  | client |--submission--->#  Printer #|---submission----->#  Object 3#|
300  +--------+    Per-Job    | #  Object 1#|    Per-Job    | ##########|
301           subscription  | ##########|  subscription  +------------+
302                         |            |              device B
303  +--------+    IPP Job   | ##########|              +------------+
304  | client |--submission--->#  Printer #|    IPP Job    | ##########|
305  +--------+    Per-Job    | #  Object 2#|---submission----->#  Printer #|
306           subscription  | ###|######|    Per-Job    | #  Object 4#|
307                         +----|---^---+  subscription  | ####|#|####|
308  +--------+                  |   |                    +-----|-|----+
309  |Notific-|<-Notifications(A)-+   +--- Notifications(B)-------+ |
310  |ation Re|<---------------Notifications(C)--------------------+
311  |cipient |
312  +--------+
313              Figure 2 - Client-Server-Printer Per-Job Subscription and Notification Model
```

2.2   Model for Per-Printer Subscription and Notification

Per-Printer subscriptions are created by a client (an end user, an operator, or a server acting as a client)
using a Create-Printer-Subscription operation that is independent of Job Submission. The Printer object
(printing device or server) creates a Subscription object to hold the attributes supplied by the subscriber.
The client creates separate Per-Printer subscriptions if more than one Notification Recipient is desired. The
Printer delivers Notifications to the Notification Recipient specified by each Per-Printer subscription. A
Notification Recipient may be the subscriber or a third party. Figure 3 shows the Per-Printer subscription
notification model for the Client - Printer relationship where the client may be an end user, an operator, or a
server acting as a client.

```
        desktop or server                        server or printing device
                                                 +---------------+
        +--------+                               | ##########    |
        | client |---Create-Printer-Subscription------># Printer #   |
        +--------+     (Per-Printer subscription)      | #  Object  #   |
                                                 | ####|#####    |
     +-----------+                               +------|------+
     |Notification|<----------IPP Notifications-------------+
     |Recipient   |    (Job and/or Printer events)
     +-----------+
```
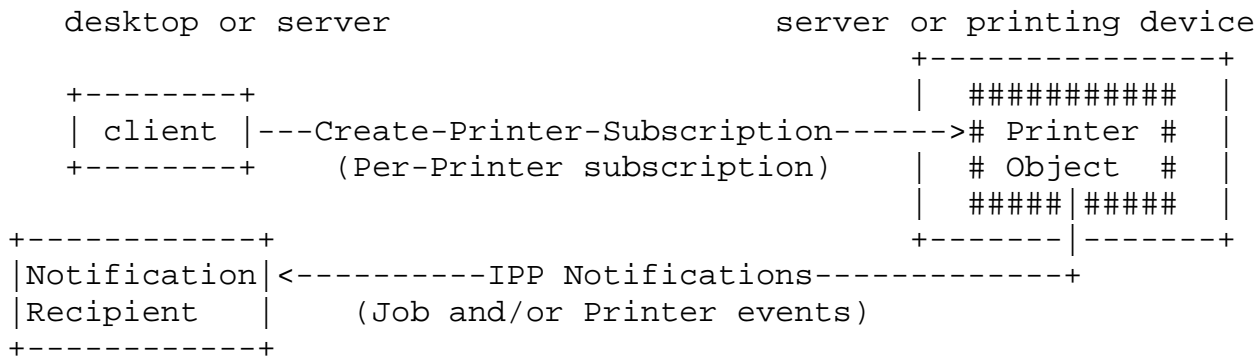
              Figure 3 - Client-Printer Per-Printer Subscription and Notification Model

335 ## 2.3   Relationship between the Printer object and the Notification Delivery Service

336 The IPP Notification model does not mandate that the IPP Printer object implement the full semantics of
337 subscription, report generation, and multiple delivery methods itself. This section describes two methods
338 of using third party notification services. The first is transparent to the client and the second is transparent
339 to the IPP Printer.

340 ### 2.3.1   Use of a Notification Service transparently to clients

341 An implementation may be configured to use some other notification service to either (1) delivery the
342 Notifications to the Notification Recipient(s) specified in the IPP Subscription or (2) keep the
343 Subscriptions, accept events, possibly format the notification in the natural language of the Notification
344 Recipient when a Human Consumable text format is used, and deliver the Notifications to the Notification
345 Recipient(s) indicated in the IPP Subscription. Figure 4 shows this partitioning.

```
                                        output device or server
        desktop or server               +---------------+
           +--------+                    |  ##########   |
           | client |---IPP subscription-------->#  Printer #   |
           +--------+                    |  #  Object   #   |
                                         |  #####|#####   |
                                    +-------|-------+
                                            |  Subscriptions
                                    *******| OR Events
        +------------+                    *        |
        |Notification|                 *  +------v--------+
        |Recipient   |<--IPP Notifications-----|  Notification   |
        +------------+                    *   | Service         |
                                          *   +---------------+
                                          *
                                          *
        *** = Implementation configuration opaque boundary
```
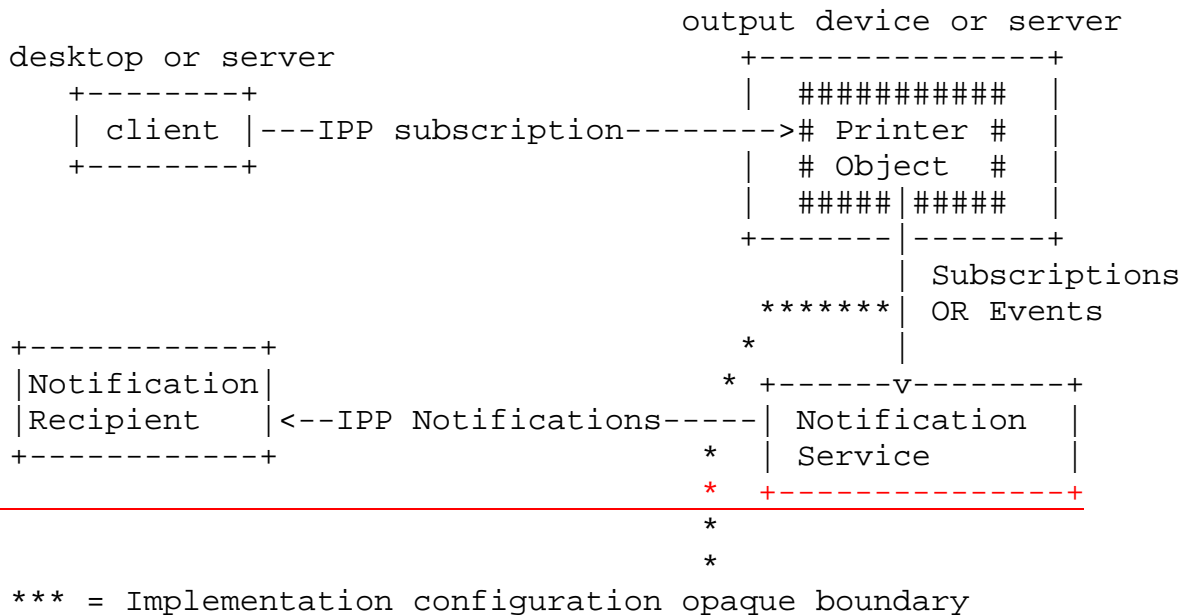
365 **Figure 4 - Opaque Use of a Notification Service Transparent to the Client**

366 In any case, the interface between the IPP Printer and the other notification service is outside the scope of
367 this document and is intended to be transparent to the client and this specification.

368 ### 2.3.2   Use of Notification Service transparently to the IPP Printer

369 Another way that a Notification Service can be used is if the Notification Recipient indicated in the IPP
370 Subscription is a notification service (transparent to the IPP Printer), which in turn forwards the
371 Notification to the Ultimate Notification Recipient using additional parameters in the IPP Subscription
372 (URI parameters or subscriber user data). In such cases, the Ultimate Notification Recipient has also
373 subscribed directly with the other notification service (by means outside this document). As far as the IPP
374 Printer is concerned, the IPP Subscription indicated that the IPP Printer is to delivery Notifications to the
375 Notification Recipient (Notification Service) using the specified notification delivery method. The method
376 that the Notification Recipient uses for delivering the notification to the Ultimate Notification Recipient is

377 beyond the scope of this document and is transparent to the IPP Printer. However, the client does have to
378 know how to pass additional information to the Notification Recipient in the IPP Subscription using either
379 extra parameters in the URI or subscriber user data. Examples of this latter approach are paging,
380 immediate messaging services, and NOS vendors infrastructure. Figure 5 shows this approach.
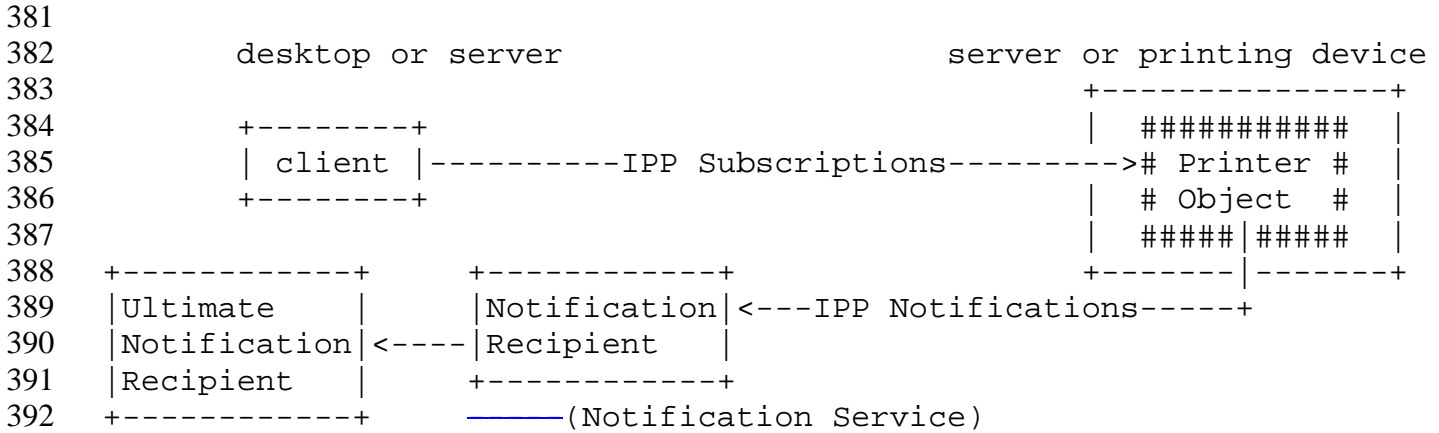
381
```
382        desktop or server                            server or printing device
383                                                     +---------------+
384        +--------+                                   |  ##########   |
385        | client |----------IPP Subscriptions--------># Printer #   |
386        +--------+                                   |  # Object  #  |
387                                                     |  #####|#####  |
388 +------------+      +------------+                  +-------|-------+
389 |Ultimate    |      |Notification|<---IPP Notifications-----+
390 |Notification|<----|Recipient   |
391 |Recipient   |      +------------+
392 +------------+          ——————(Notification Service)
```
393   **Figure 5 - Use of a Notification Service transparent to the IPP Printer**

3   Terminology

395 This section defines terminology used throughout this document.

3.1   Conformance Terminology

397 Capitalized terms, such as **MUST, MUST NOT, REQUIRED, SHOULD, SHOULD NOT, MAY,**
398   **NEED NOT,** and **OPTIONAL**, have special meaning relating to conformance to this specification.
399   These terms are defined in [ipp-mod section 13.1 on conformance terminology, most of which is
400   taken from RFC 2119 [RFC2119].
401   *Since support of this entire notification specification is OPTIONAL for conformance to*
402   *IPP/1.0 or IPP/1.1, the use of the term REQUIRED (R) in this document means*
403   *"REQUIRED if this notification specification is implemented". Likewise, the term*
404   *RECOMMENDED means "RECOMMENDED if this notification specification is*
405   *implemented" and OPTIONAL (O) means OPTIONAL if this notification specification is*
406   *implemented.*
407   **READ-ONLY** - indicates an attribute that MUST NOT be settable using the Set-Job-Attributes or Set-
408   Printer-Attributes operations (see [ipp-set2]).

3.2   Other terminology

410   **Job Submitting End User -** A human end user who submits a print job to an IPP Printer. This person
411   may or may not be within the same security domain as the Printer. This person may or may not be
412   geographically near the printer.
413   **Administrator** - A human user who established policy for and configures the print system.
414   **Operator -** A human user who carries out the policy established by the Administrator and controls the
415   day to day running of the print system.

Job Submitting Application - An application (for example, a batch application), acting on behalf of a Job Submitting End User, which submits a print job to an IPP Printer. The application may or may not be within the same security domain as the Printer. This application may or may not be geographically near the printer.

Security Domain - The set of network components which can communicate without going through a proxy or firewall. A security domain may be geographically very large, for example - anyplace within IBM.COM.

IPP Client (or client) - The software component (desktop or server) that sends an IPP operation request to an IPP Printer object (server or printing device) and accepts the resulting operation response from the IPP Printer object.

Job Recipient - A human who is the ultimate consumer of the print job. In many cases this will be the same person as the Job Submitting End User, but need not be.
Example: If I use IPP to print a document on a printer in a business partner's office, I am the Job Submitting End User, while the person I intend the document for in my business partner's office is the Job Recipient. Since one of the goals of IPP is to be able to print near the Job Recipient of the printed output, we would normally expect that person to be in the same security domain as, and geographically near, the Printer. However, this may not always be the case. For example, I submit a print job across the Internet to a Kinko's print shop. I am both the Submitting End User and the Job Recipient, but I am neither near nor in the same security domain as the Printer.

Job Recipient Proxy - A human acting on behalf of the Job Recipient. In particular, the Job Recipient Proxy physically picks up the printed document from the Printer, if the Job Recipient cannot perform that function. The Proxy is **by definition** geographically near and in the same security domain as the printer.
Example: I submit a print job from home to be printed on a printer at work. I'd like my secretary to pick up the print job and put it on my desk. In this case, I am acting as both Job Submitting End User and Job Recipient. My secretary is acting as a Job Recipient Proxy

Notification Subscriber (or **Subscriber**) - A client that requests the IPP Printer to send Event Notifications to one or more Notification Recipients. A Notification Subscriber may be:
1. a Job Submitting End User or Job Submitting Application (desktop or server) that is submitting a job or
2. an End User, an Operator, or an Administrator that is not submitting a job.

Subscription - A request by a Notification Subscriber to the IPP Printer to send Event Notifications to a specified Notification Recipient when the event occur. A Subscription is represented as a set of attributes that indicate the "what, where, who, and how" for notification. Notifications are generated for certain events (what) and delivered using various delivery methods (how) to certain addresses (where and who).

Per-Job Subscription - A Subscription that a client specifies as part of a create job operation (Print-Job, Print-URI, Create-Job), a Validate-Job operation, or an explicit Create-Job-Subscription operation with a Job object as the target.

Per-Printer Subscription - A Subscription that a client specifies using an explicit Create-Printer-Subscription operation with a Printer object as the target.

Notification Source - The entity that sends Event Notifications. It MAY be the IPP Printer itself or the IPP Printer MAY be configured to use a Notification Service to delivery Notifications transparently to the subscribing clients (see Figure 4).

Notification Recipient - The entity identified as a recipient within a subscription that receives IPP Notifications about Job and/or Printer events (see Figure 4 and Figure 5). A Notification Recipient

462   may be a: Job Submitting End User, Job Submitting Application (desktop or server), Job Recipient,
463   Job Recipient Proxy, a Notification Service, an Operator, or Administrator, etc., and their
464   representative or log file or usage statistics gathering application or other active or passive entities.
465   A Java Listener is an example of a Notification Recipient.
466   **Ultimate Notification Recipient** - The entity to which the Notification Recipient (stores and) forwards
467   an IPP Notification when the Notification Recipient is a Notification Service (see Figure 5).
468   **Event** - An event is some occurrence (either expected or unexpected) within the printing system of a
469   change of state, condition, or configuration of a Job or Printer object. A property of an event is that
470   it only occurs at one instant in time and does not span the time the physical event takes place. For
471   instance, jam-occurred and jam-cleared are two distinct events. The jam-occurred event is reported
472   only when the jam initially occurs and only if there is one or more event subscriptions outstanding
473   for that event.

474

475   Events can be classified along two dimensions:
476   - Either as Job Events or Printer Events, and
477   - Either as Errors, Warnings, or Reports

478

479   A Job event is some interesting state change in the Job object, and a Printer event is some
480   interesting change in the Printer object.

481

482   A report event is purely informational, such as 'job-completed' or 'accepting-jobs'. A warning is not
483   serious and processing continues. An error is serious and either the job is aborted or the printer
484   stops. These are typical uses of the terms report, warning, and error, although the actual usage is
485   implementation dependent.

486

487   An event occurs for a job or printer whether any entity has subscribed to be notified for that event or
488   not. A notification is only generated depending on the set of subscriptions outstanding.

489

490   **Notification** - When an event occurs, a Notification is generated that fully describes the event (what
491   the event was, where it occurred, when it occurred, etc.). Notifications are delivered to each
492   Notification Recipient that has a subscription that includes the event, if any. The Notification is
493   delivered to the address of the Notification Recipient using the notification delivery method defined
494   in the subscription. However, a Notification is sent ONLY if there is a corresponding subscription.
495   **Notification Delivery Method (**or **Delivery Method** for short**)** - Notifications are delivered using a
496   method, such as email, TCP/IP, etc.
497   **Immediate Notification -** Notifications that are delivered using a delivery method which is not store-
498   and-forward (e.g. TCP connection, UDP datagram). This can be on the order of several minutes
499   subject to network latency.
500   **Store and Forward Notification - A** Notification which are not necessarily delivered to Notification
501   Recipients immediately, but is queued for delivery by some intermediate network application, for
502   later retrieval. Email and Instant Messaging services are examples of a store and forward
503   notification delivery method.
504   **Human Consumable Notification -** Notifications that are intended to be consumed by human End
505   Users only. They are simple text that has been localized for the Notification Recipient as specified
506   in the subscription. Programs are not intended to parse Human Consumable Notification, since it is
507   localized and the content depends on implementation. There is no standardized format.

508   **Machine Consumable Notification -** Notifications that are intended for consumption by a program
509   only**.** They use the encoding of an IPP response. The Notification Recipient must localize the
510   contents, if displaying it to a human.

511 **4   Object Model for Notification**

512 This section describes the notification object model that adds a REQUIRED Subscription object which
513 together with the Job and Printer object provide the complete notification semantics.

514

515 The object relationships can be seen pictorially as:
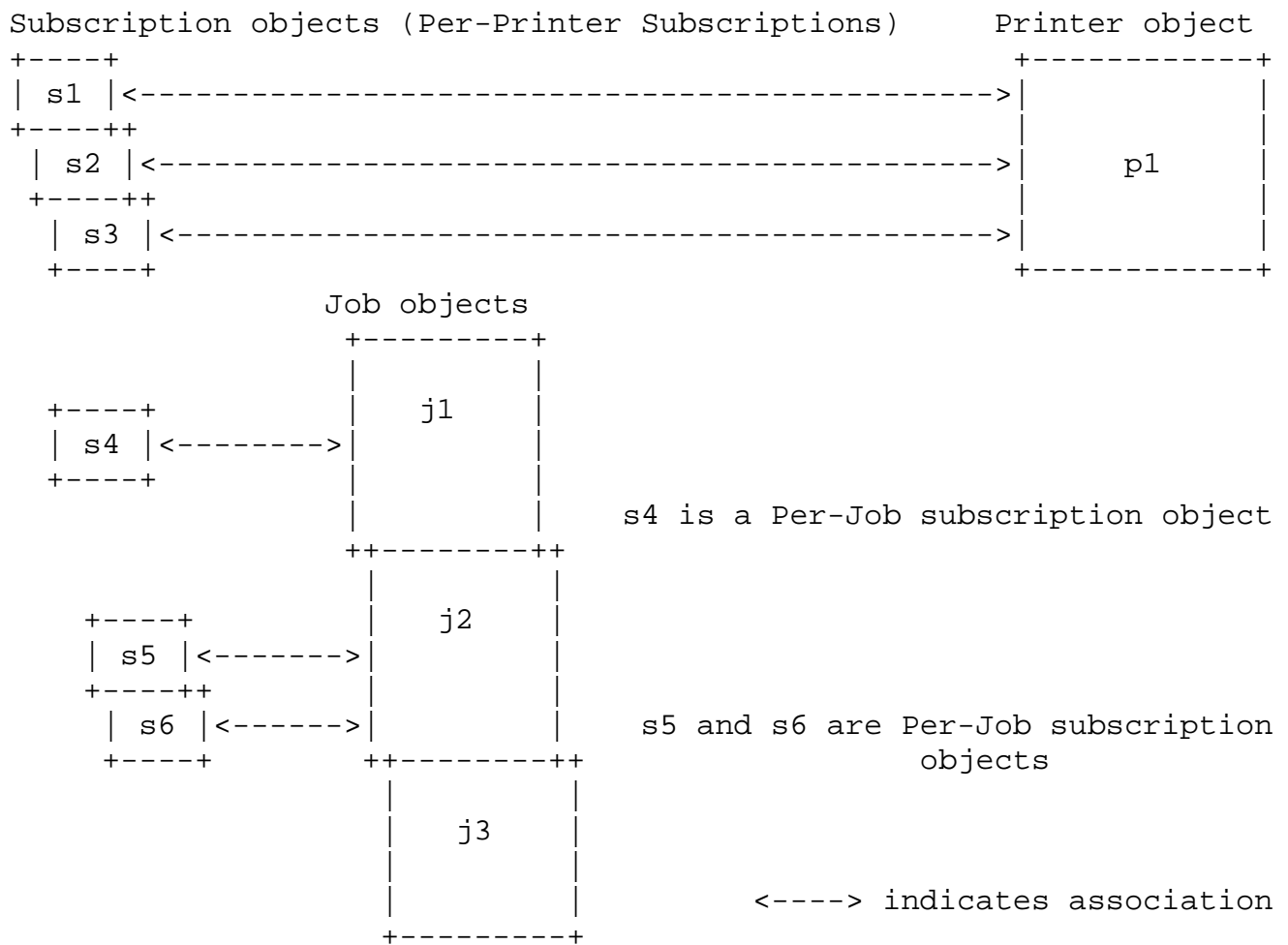
516
```
517     Subscription objects (Per-Printer Subscriptions)      Printer object
518     +----+                                                +-----------+
519     | s1 |<----------------------------------------------->|           |
520     +----++                                               |           |
521      | s2 |<---------------------------------------------->|    p1     |
522      +----++                                              |           |
523       | s3 |<--------------------------------------------->|           |
524       +----+                                               +-----------+
525                       Job objects
526                         +---------+
527                         |         |
528       +----+            |   j1    |
529       | s4 |<-------->|         |
530       +----+            |         |
531                         |         |      s4 is a Per-Job subscription object
532                         ++--------++
533                          |        |
534      +----+              |   j2    |
535      | s5 |<------->|        |
536      +----++             |        |
537       | s6 |<------>|        |      s5 and s6 are Per-Job subscription
538       +----+        ++--------++                  objects
539                          |        |
540                          |   j3    |
541                          |        |
542                          |        |      <----> indicates association
543                         +---------+
```
544   **Figure 6 - Object Model for Notification**

545   s1, s2, and s3 are Per-Printer Subscription objects and can identify Printer and/or Job events.

546   s4, s5, and s6 are Per-Job subscription objects and can identify Printer and/or Job events.

4.1   Object relationships

This sub-section defines the object relationships between the Printer, Job, and Subscription objects. Whether Per-Printer Subscription objects are actually contained in a Printer object or are just bi-directionally associated with them in some way is IMPLEMENTATION DEPENDENT and is transparent to the client. Similarly, whether Per-Job Subscription objects are actually contained in a Job object or are just bi-directionally associated with them in some way is IMPLEMENTATION DEPENDENT and is transparent to the client. The object relationships can be stated are defined as follows:

4.1.1   Printer object and Per-Printer Subscription objects

1. The Printer object contains (is associated with) zero or more Per-Printer Subscription objects (p1 contains s1-s3 Per-Printer Subscription objects).

2. A Per-Printer Subscription object (s1-s3) cannot be contained in (or associated with) more than one Printer object (p1).

3. Each Per-Printer Subscription object (s1, s2, and s3) is contained in (or is associated with) one Printer object (p1) and each represents one Per-Printer subscription.

4. Each "Per-Printer" Subscription object identifies one or more Job and/or Printer events. Such Job events are for *all* jobs on the Printer. Such Printer events are for *any* Printer event, no matter which job is processing and when no jobs are processing.

4.1.2   Job object and Per-Job Subscription objects

5. A Job object (j1, j2, j3) contains (is associated with) zero or more Per-Job subscription objects (s4-s6). Job j1 is associated with Per-Job subscription object s4, Job j2 is associated with Per-Job subscription objects s5 and s6, and Job j3 is not associated with any Per-Job subscription object. Note: the IPP notification interface semantics are defined so that an implementation MAY associate Per-Job Subscription objects with Job objects by having the Job objects actually contain its associated Per-Job Subscription objects or MAY just use some internal bi-directional linking mechanism between the Job and Subscription objects. Either implementation technique is transparent to the client.

6. A Per-Job Subscription object cannot be contained in (or associated with) more than one Job object.

7. Each Per-Job Subscription object is contained in (or associated with) one Job object and each represents one Per-Job Subscription.

7.8. Each "Per-Job" sSubscription object identifies one or more Job and/or Printer events. Such Job events are only for *this* job (different than "per-Printer" Subscriptions). Such Printer events are for *any* Printer event, no matter which job and when no jobs are processing (same as for "per-Printer" Subscriptions).

5   Subscription Object attributes

The following notification attributes are defined for the Subscription object. The definitions of the object attributes are specified here so that they can be referred to from the subsequence definitions of the operations that set them.

584   **Table 2 - Subscription object attributes**

Subscription object attributes:	Printer support	READ-ONLY, set by:
notify-recipient (uri)	REQUIRED	client - Job Creation, Create-Job-Subscription, and Create-Printer-Subscription
notify-events (1setOf type2 keyword)	REQUIRED	client - Job Creation, Create-Job-Subscription, and Create-Printer-Subscription
notify-text-format (mimeMediaType)	REQUIRED	client - Job Creation, Create-Job-Subscription, and Create-Printer-Subscription
subscriber-user-data (octetString(63))	REQUIRED	client - Job Creation, Create-Job-Subscription, and Create-Printer-Subscription
notify-charset (charset)	OOPTIONAL	client - Job Creation, Create-Job-Subscription, and Create-Printer-Subscription
notify-natural-languages (1setOf naturalLanguage)	OOPTIONAL	client - Job Creation, Create-Job-Subscription, and Create-Printer-Subscription

585

request-id (integer(0:MAX))	REQUIRED	initialized to 0, incremented by Printer - beginning of each event

586

subscription-id (integer(1:MAX))	REQUIRED	Printer - Job Creation, Create-Job-Subscription, and Create-Printer-Subscription
notify-lease-expiration-time (integer(0:MAX))	REQUIRED	Printer - Job Creation (set to 0) and Create-Printer-Subscription, Renew-Subscription
printer-uri (uri)	REQUIRED	Printer - Job Creation, Create-Job-Subscription, and Create-Printer-Subscription
subscriber-user-name (name(MAX))	OPTIONAL	Printer - Job Creation, Create-Job-Subscription, and Create-Printer-Subscription

587

notify-printer-up-time (integer(1:MAX))	REQUIRED	Printer - returned by Create-Printer-Subscription, Get-Subscription-Attributes, and Get-

		Subscriptions
notify-persistence-granted (boolean)	REQUIRED	Printer - returned by Create-Job-Subscription and Create-Printer-Subscription

588 Note: The Subscription object does not contain the "job-id" Subscription Description attribute. The Get-
589 Subscriptions operation has the "job-id" as an input operation attribute, so the "job-id" isn't returned in the
590 response. If an implementation needs such a link between Subscription objects and Job objects, then it
591 keeps such a link as in internal attribute. The intent is that whether Per-Job Subscription objects are
592 actually contained in a Job object or are just associated with them in some way is IMPLEMENTATION
593 DEPENDENT and is transparent to the client.

5.1   notify-recipient (uri)

595 This REQUIRED READ-ONLY Subscription object attribute describes both where (the address of the
596 Notification Recipient) and how (the delivery method) notifications are to be delivered to the Notification
597 Recipient when any of the events specified in the "notify-events" attribute occur.

598 There are potentially many different notification delivery methods for IPP notifications, standardized as
599 well as proprietary. This document does not define any of these delivery mechanisms; they will each be
600 described in separate complementary documents.

601 Each of the notification delivery method documents must provide at least the following information:

602   1) The URI scheme used.

603   2) The supported and default delivery format, and if not one of the specified types in Section 5.3,
604   description of the notification content.

605   3) Any content length restrictions imposed by the delivery protocol.

606   4) The latency of the delivery protocol used.

607   5) The reliability of the transport and delivery protocol used.

608   6)   The security aspects of the transport and delivery protocol used, e.g. how it is handled in firewalls.

609   7) How the delivery protocol is initiated, e.g. does it have to be initiated by the receiving user (pull), or
610   is it initiated by the notification service (push).

611 **ISSUE 1** - Once a number of delivery solutions have been developed and evaluated, we may want to make
612 one or several of them REQUIRED for implementation to ensure a minimum set of interoperability. Which
613 one or ones should be REQUIRED?

5.2   notify-events (1setOf type2 keyword)

615 This REQUIRED READ-ONLY Subscription object attribute identifies the job and/or printer events that
616 are to be delivered to the Notification Recipient as Notifications as defined in section 7. If the client did
617 not supply this attribute when supplying the subscription, the Printer object populates this attribute with its
618 "notify-events-default" attribute value (see section 6.2).

619 There are both job events and printer events. Each job and printer event is assigned a keyword to use in
620 this attribute and in the Notification. Job and printer events have the following semantics depending on
621 whether the subscription is a Per-Job or a Per-Printer subscription:

622   Job events: The semantics for job events depends on whether the subscription is a Per-Job
623   Subscription or a Per-Printer Subscription. For Per-Job Subscriptions, the Printer MUST
624   generate Notifications only for the job events of the job with which the Subscription is
625   associated. For Per-Printer Subscriptions, the Printer MUST generate Notifications for the
626   job events for any job submitted to the Printer.

627   For example, consider the event when there are 10 'pending' jobs, one 'processing' job, and
628   30 'completed' jobs and the 'processing' job completes. The Printer MUST generate a 'job-
629   completed' job event Notification if the job has a Per-Job Subscription that contained the
630   'job-completed' event in this attribute. The Printer MUST NOT generate Notifications for
631   any other jobs whose Per-Job Subscriptions contain the 'job-completed' event in this
632   attribute.

633   Printer events: The semantics for printer events does not depend on whether the subscription is a
634   Per-Job or a Per-Printer Subscription. For both Per-Job Subscriptions and Per-Printer
635   Subscriptions, the Printer MUST generate Notifications for printer events, no matter what
636   job is processing, including when no jobs are processing.

637   For example, consider the event when there are 10 'pending' jobs, one 'processing' job, and
638   30 'completed' jobs and the Printer enters the 'stopped' state. The Printer MUST generate a
639   'printer-state-changed' printer event Notification for each of the 11 'pending' and 'processing'
640   jobs whose Per-Job Subscriptions contain the 'printer-state-changed' event in this attribute.
641   The Printer MUST NOT generate Notifications for any of the 'completed' jobs' whose Per-
642   Job Subscriptions contain the 'printer-state-changed' event in this attribute.

643 The events are defined to be disjoint. For example, the 'job-state-changed' event does not include the 'job-
644 created' and 'job-completed' events. In order to get all three events, the client supplies all three keywords in
645 this attribute.

646 A Printer MUST support the events indicated as "REQUIRED" and MAY support of the events indicated
647 as "OPTIONAL".

648 The standard job event keyword values are:

649   **'none':** REQUIRED - no notifications of any events (an IPP object can use this value to indicate that it
650   is configured not to support event notification; a client would not subscribe to this event).
651   **'job-created':** REQUIRED - the Printer object has accepted a job creation operation (Print-Job, Print-
652   URI, or Create-Job) and the job's "time-at-creation" attribute value is set (see [ipp-mod] section
653   4.3.14.1). The Printer puts the job in the 'pending', 'pending-held' or 'processing' states.
654   Note: This event is separate from the 'job-state-changed' event so that it can be subscribed to
655   without having to get every job state change event for a Notification Recipient that is only
656   interested in when the job is first created.
657   **'job-completed':** REQUIRED - the job has reached one of the completed states, i.e., the value of the
658   job's "job-state" attribute has changed to: 'completed', 'aborted', or 'canceled'. The Job's "time-at-
659   completed" and "date-time-at-completed" (if supported) attributes are set (see [ipp-mod] section
660   4.3.14).
661   Note: This event is separate from 'job-state-changed' so that it can be subscribed to without having

662   to get every job state change event for a Notification Recipient that is only interested in when the
663   job is completed.
664   **'job-state-changed'**: REQUIRED - the job has changed from any state to any other state and/or a
665   value has been added or removed from the job's "job-state-reasons" attribute, except when the job is
666   created or when the job moves to any of the "completed" job states ('completed', 'aborted', or
667   'canceled').
668
669   This event also indicates that one or more values have been added to or removed from the Job's
670   "job-state-reasons" attribute, such as 'job-queued' or 'job-printing', whether or not the job's state has
671   changed. If job state reasons are added when the job is created, only the 'job-created' event is
672   generated, in order to keep the events disjoint. If job state reasons are added or removed when the
673   job is completed, only the 'job-completed' event is generated, in order to keep the events disjoint.
674
675   A client that wants to subscribe to all job state changes, including creation and completion, includes
676   the 'job-created', 'job-state-changed', and 'job-completed' in the notification subscription. When a
677   job is finally removed from the Job History (see [ipp-mod] 4.3.7.1) no event is generated, i.e.,
678   neither a 'job-state-changed' event nor a 'job-purged' event is generated.
679   **'job-config-changed':** OPTIONAL – when the configuration of a job has changed, i.e., the value of
680   the "job-message-from-operator" or any of the non-READ-ONLY Job attributes have changed, such
681   as any of the job template attributes or the "job-name" attribute. Typically, such a change is the
682   result of the user or the operator performing a Set-Job-Attributes operation (see [ipp-set2]) on the
683   Job object. The client performs a Get-Job-Attributes to find out the new values of the changed
684   attributes. This event is useful for GUI clients and drivers to update the job information to the user.
685   **'job-purged'**: OPTIONAL - when a 'not-completed' job (i.e., not 'completed', 'canceled', or 'aborted')
686   was purged from the printer using the Purge-Jobs operation. No event, including this event, is
687   generated when a job is aged out of the Job History or moved out explicitly with the Purge-Jobs
688   operation.
689   **'job-progress'** - a sheet or copy has completed. See separate [ipp-prog] spec.
690
691 The standard Printer event keywords values are:
692   **'none'**: REQUIRED - no notification of any events (an IPP object can use this value to indicate that it
693   is configured not to support event notification; a client would not subscribe to this event).
694   **'printer-restarted'**: OPTIONAL - when the printer is powered up or the Restart-Printer operation is
695   performed (see [ipp-set2]).
696   Note: This event is separate from the 'printer-state-changed' event so that it can be subscribed to
697   without having to get every printer state change event, for a Notification Recipient that is only
698   interested in when the Printer first comes up.
699   **'printer-shutdown'**: OPTIONAL - when the device is being powered down or the Shutdown-Printer
700   operation has been performed with either power-off or standby options (see [ipp-set2]).
701   Note: This event is separate from 'printer-state-changed' so that it can be subscribed to without
702   having to get every Printer state change event, for a Notification Recipient that is only interested in
703   when the Printer is powered down or shutdown.
704   **'printer-state-changed'**: REQUIRED - the Printer changed state, i.e., the value of the Printer's
705   "printer-state", "printer-state-reasons" (whether "printer-state" changed or not), and/or "printer-is-
706   accepting-jobs" attributes changed, except when the Printer starts up or is shutdown. If printer state
707   reasons are added when the Printer is started up, only the 'printer-restarted' event is generated, in

708   order to keep the events disjoint. If printer state reasons are added or removed when the printer is
709   powered-down or shutdown, only the 'printer-shutdown' event is generated, in order to keep the
710   events disjoint.
711
712   A client that wants to subscribe to all printer state changes, including restart and power-
713   down/shutdown, includes the 'printer-restarted', 'printer-state-changed', and 'printer-shutdown' in the
714   notification subscription.
715   **'printer-media-changed'**: OPTIONAL – when the media loaded on a printer has been changed, i.e.,
716   the "media-ready" attribute has changed. This event includes both an actual media change and
717   filling an empty input tray with the same or different media. The client must check the "media-
718   ready" Printer attribute (see [ipp-mod] section 4.2.11) separately to find out what new media was
719   loaded or filled.
720   **'printer-config-changed'**: OPTIONAL – when the configuration of a Printer has changed, i.e., the
721   value of the "printer-message-from-operator" or any non-READ-ONLY Printer attribute has
722   changed, except for "media-ready" (which has its own event), whether through the Set-Printer-
723   Attributes operation or by other means and whether initiated by a human or not. For example, any
724   "xxx-supported", "xxx-default", "printer-message-from-operator", etc. values have changed. The
725   client has to perform a Get-Printer-Attributes to find out the new values of these changed attributes.
726   This event is useful for GUI clients and drivers to update the available printer capabilities to the
727   user.
728   **'printer-queue-changed'**: OPTIONAL - the order of jobs in the Printer's queue has changed, so that an
729   application that is monitoring the queue can perform a Get-Jobs operation to determine the new
730   order. This event does not include when a job enters the queue (the 'job-created' event covers that)
731   and does not include when a job leaves the queue (the 'job-completed' event covers that).
732   **'printer-no-longer-full'**: OPTIONAL – when the Printer can now accept a Print-Job, Print-URI,
733   Create-Job, Send-Document, or Send-URI request. This event is used when there is more than one
734   client feeding a printer/server (fan-in), and the Printer may still be printing but has acquired more
735   buffer space to accept jobs. This event only occurs when the Printer did not have room to accept
736   jobs previously and rejected a Print-Job, Print-URI, Create-Job, Send-Document, or Send-URI
737   operation.
738   **'printer-almost-idle'**: OPTIONAL – when the Printer needs another Job in order to stay busy. This
739   event is used when a spooler is feeding more than one printer/server (fan-out), and the spooler holds
740   jobs until a Printer requests them, rather than committing jobs to IPP Printers before it is necessary.
741   This event MAY be used by a Printer implementation to request a new job from any subscribers
742   sufficiently ahead of time so that the device does not run out of work between jobs.
743

5.3   notify-text-format (mimeMediaType)

745   This REQUIRED READ-ONLY Subscription object attribute indicates the type of Human Consumable
746   format content that is to be sent in the Notifications. Depending on the delivery method definition
747   document [, the Human Consumable format is represented either (1) as the entire Notification content,
748   instead of the Machine Consumable format defined for the notification scheme, if any, (2) the value of the
749   "human-readable-report" (text(MAX)) attribute (see section) in the Machine Consumable form. Most
750   delivery methods are defined to have a particular Machine Consumable forms of notification content type
751   and to permit Human Consumable forms as well. An implementation MAY support one or more Human

752 Consumable formats, i.e., 'text' MIME media types, for those delivery methods that permit the Human
753 Consumable form.

754 If the 'text' MIME media type registration permits a charset parameter, than such a specification MUST be
755 used (instead of the "notify-charset" attribute) in order to indicate the charset to be used in the notification
756 content.

757 If the Subscriber did not supply this attribute when requesting the subscription, the Printer object populates
758 this Subscription object attribute with either the 'none' out-of-band value or one of the values of the
759 Printer's "notify-text-format-supported" attribute (see section 6.5), depending on whether or not the
760 delivery method as follows: If the delivery method defines a Machine Consumable form without a
761 "human-readable-report" attribute, the Printer sets the 'none' out-of-band value.   specified in the "notify-
762 recipient" attribute is defined to have a Machine Consumable format (usual), respectively. Otherwise, the
763 Printer sets the attribute to one of its "notify-text-format-supported" attribute values. In the latter case, the
764 value selected depends on the implementation, since there is no "notify-text-format-default" defined in this
765 document.

766 Standard mimeMediaType values are:

767   'none': This out-of-band value (see section 10.1) indicates that the Notification content is not to be
768   any of the text types, i.e., that the Machine Consumable, not the Human Consumable, form is to be
769   sent. Furthermore, the Machine Consumable Notification content MUST NOT include the "human-
770   readable-report" attribute, if defined for the delivery method. If the client omits supplying this
771   attribute, the meaning is the same as if the client supplied the 'none' value.
772
773   'text/plain; charset=utf-8': A plain text document containing characters from in ISO 10646
774   represented as UTF-8 [RFC2279] as defined in section 7.1.17.
775
776   'text/html': An HTML document data [rfc????] as defined in section 7.1.1.
777

5.4   subscriber-user-data (octetString(63))

779 This REQUIRED READ-ONLY Subscription object attribute holds opaque information being sent from
780 the Subscriber to the Notification Recipient, such as the identify of the Subscriber or a path or index to
781 some Subscriber information. Or it MAY contain a key that the Notification Recipient needs in order to
782 process the Notification, such as the ultimate recipient, if the Notification Recipient is a general application
783 that in turn forwards notifications and the ultimate recipient isn't included in the value of the "notify-
784 recipient" attribute. An Instant Messaging Service is an example of such a general application where the
785 "subscriber-user-data" might be the user's id for that messaging service and the "notification-recipient" is
786 the URL of the messaging service.

5.5   notify-charset (charset)

788 This OPTIONAL READ-ONLY Subscription object attribute specifies the charset to be used in the
789 Notification content sent to the Notification Recipient, whether the notification content is Machine
790 Consumable or Human Consumable. This attribute MUST NOT be used when the "notify-text-format"
791 attribute value specifies the charset parameter in its MIME media type value, e.g., 'text/plain; charset=utf-
792 8'.

793 **5.6   notify-natural-language (naturalLanguage)**

794 This OPTIONAL READ-ONLY Subscription object attribute specifies the natural language for the IPP
795 object to use in the Notification content that is sent to the Notification Recipient, whether the notification
796 content is Machine Consumable or Human Consumable.

797 **5.7   request-id**

798 This REQUIRED READ-ONLY Subscription object attribute holds the most recent request-id sequence
799 number delivered in a Notification content to the Notification Recipient. A value of 0 indicates that no
800 Notifications have been sent for this subscription. The first request-id sent for a subscription MUST be 1.
801 Each Notification Recipient has its own monotonically increasing series of request-ids, i.e., no gaps, in
802 order to be able to detect a missing notification.

803 **5.8   subscription-id (integer (1:MAX))**

804 This REQUIRED READ-ONLY Subscription object attribute uniquely identifies this Subscription object
805 instance on this Printer object or this Job object. The Printer object, on acceptance of a Create-Job-
806 Subscription or Create-Printer-Subscription request, generates an ID which identifies the new Subscription
807 object on that Printer or Job. The Printer returns the value of the "subscription-id" attribute as part of the
808 response to a Create-Job-Subscription or Create-Printer-Subscription request. The 0 value is not included
809 to allow for compatibility with "job-id" and with SNMP index values which also cannot be 0.

810 It is RECOMMENDED that Per-Printer Subscription objects be persistent. Then the Subscription objects
811 including the subscription-id remains unique across power-cycles. Even if an implementation does not
812 make Per-Printer subscription objects persist, the implementation SHOULD make every attempt not to re-
813 use subscription ids that subscribers might still think are valid. In other words, the Printer SHOULD at
814 least keep the next subscription-id to be assigned in non-volatile memory. Note: it is assumed that Per-Job
815 subscriptions are persistent if Jobs are persistent, in order to be consistent with the persistency of Job
816 objects. The [ipp-mod] RECOMMENDS that Job objects be persistent.

817 **5.9   notify-lease-expiration-time (integer(0:MAX))**

818 This REQUIRED READ-ONLY Subscription object attribute specifies the time in the future when the
819 subscription lease will expire, i.e., the "printer-up-time" value at which the lease will expire. When the
820 Printer object creates a Per-Printer Subscription object, it populates this attribute with the appropriate value.
821 When the indicated time arrives, the Printer MUST delete the Per-Printer Subscription object. Per-Job
822 Subscription objects always return a value of 0 since Per-Job Subscriptions don't have a lease, but exist for
823 the life-time of the Job instead.

824 A client is able to extend a lease of a Per-Printer subscription using the Renew-Subscription operation (see
825 section 8.3.3). A value of 0 indicates an infinite time, if such a policy is supported as indicated in the
826 "notify-lease-time-supported" (integer(0:MAX)) Printer Description attribute (see section 6.8) and the
827 subscriber is authorized to request an infinite lease. A Per-Job subscription cannot be renewed.

828 Note: In order to compute the number of seconds remaining in a Per-Printer Subscription lease, a client can
829 subtract the "notify-printer-up-time" Subscription object attribute (see section 5.12) from the "notify-lease-
830 expiration-time" Subscription object attribute.

831 ## 5.10 printer-uri (uri)

832 This REQUIRED READ-ONLY Subscription object attribute identifies the Printer object that created this
833 Subscription object. When a Printer object creates a Subscription object, it populates this attribute with the
834 Printer object URI that was used in the create request. This attribute permits a client to identify the Printer
835 object URI that was used to create this Subscription object, i.e., what security scheme was used.

836 ## 5.11 subscriber-user-name (name(MAX))

837 This OPTIONAL READ-ONLY Subscription object attribute contains the name of the user that created the
838 Subscription object. The Printer object sets this attribute to the most authenticated printable name that it
839 can obtain from the authentication service over which the IPP operation was received. This attribute is
840 intended to help a human user determine for which Per-Printer Subscriptions they are the Subscriber. Only
841 if such is not available, does the Printer object use the value supplied by the client in the "requesting-user-
842 name" operation attribute of the create operation (see [IPP-MOD] Sections 4.4.2, 4.4.3, and 8). For Per-Job
843 subscriptions created as part of the Job creation operation, the value of the "subscriber-user-name" is the
844 same as the "job-originating-user-name" Job attribute (see [ipp-mod] section 4.3.6).

845 The value of the "subscriber-user-name" is implementation dependent when a server accepts a request and
846 forwards it to a downstream IPP Printer (see Figure 2 and the [ipp-iig]).

847 Note: The Printer object needs to keep an internal originating user id of some form, typically as a
848 credential of a principal, with the Subscription object. Since such an internal attribute is implementation-
849 dependent and not of interest to clients, it is not specified as a Subscription Description attribute. This
850 originating user id is used for authorization checks (if any) on all subsequent operations.

851 ## 5.12 notify-printer-up-time (integer(1:MAX))

852 This REQUIRED READ-ONLY Subscription object attribute indicates the amount of time (in seconds)
853 that the Printer implementation has been up and running. This attribute is an alias for the Printer's "printer-
854 up-time" attribute" (see [ipp-mod] section 4.4.29), in an analogous way that the Job's "job-printer-up-time"
855 is an alias for "printer-up-time" (see [ipp-mod] section 4.3.13.4).

856 Note: A client can request this attribute in a Get-Subscription-Attributes or Get-Subscriptions request and
857 use the value returned in combination with the "notify-lease-expiration-time" (see section 5.9) in order to
858 display wall clock time equivalent to the user. The difference between this attribute and the 'integer' value
859 of the "notify-lease-expiration-time" attribute is the number of seconds in the future that the subscription
860 will expire. A client can compute the wall-clock time at which the subscription will expire by adding this
861 difference to the client's wall-clock time.

862 ## 5.13 notify-persistence-granted (boolean)

863 This REQUIRED Subscription object attribute whether or not the Per-Job or Per-Printer Subscription is
864 persistent, i.e., saved across power cycles in an implementation-define manner.

865   6   Printer Description Attributes related to Notification

866   This section defines the Printer Description attributes that are related to Notification. Table 3 lists the
867   Printer Description attributes and indicates the Printer support required for conformance: "R" indicates
868   REQUIRED, "O" indicates OPTIONAL, and "CR" indicates CONDITIONALLY REQUIRED, i.e.,
869   required if Human Consumable notification formats are supported.

870   **Table 3 - Printer Description attributes associated with Notification**

Printer object attributes:	Printer support	READ-ONLY, set by:
notify-schemes-supported (1setOf uriScheme)	R	Administrator/implementation
notify-events-default (1setOf type2 keyword)	R	Administrator/implementation
notify-events-supported (1setOf type2 keyword)	R	Administrator/implementation
max-events-supported (integer(5:MAX))	R	Administrator/implementation
notify-text-format-supported (1setOf mimeMediaType)	CR	Administrator/implementation
max-job-subscriptions-supported (integer(1:MAX))	R	Administrator/implementation
max-printer-subscriptions-supported (integer(0:MAX))	R	Administrator/implementation
notify-lease-time-supported (rangeOfInteger(0:MAX))	R	Administrator/implementation
notify-lease-time-default (integer(0:MAX))	R	Administrator/implementation
persistent-jobs-supported (boolean)	O	Administrator/implementation
persistent-subscriptions-supported (boolean)	O	Administrator/implementation
printer-state-change-time (integer(1:MAX))	O	Administrator/implementation
printer-state-change-date-time (dateTime)	O	Administrator/implementation

871

872   6.1   notify-schemes-supported (1setOf uriScheme)

873   This REQUIRED Printer attribute describes the notification delivery methods supported by this Printer
874   object. Standard values are defined in Section 5.1).

875   6.2   notify-events-default (1setOf type2 keyword)

876   This REQUIRED Printer attribute identifies the event values if the client does not supply the "notify-
877   events" operation attribute in either a Job creation request, Create-Job-Subscription, or the Create-Printer-
878   Subscription request. Any value in this attribute MUST also appear in the notify-events-supported
879   attribute, i.e., be a supported event.

880   6.3   notify-events-supported (1setOf type2 keyword)

881   This REQUIRED Printer attribute identifies the events supported by this Printer object for both Per-Job and
882   Per-Printer subscriptions which MUST be the same. Standard values are defined in Section 5.2.

6.4   max-events-supported (integer(5:MAX))

883

884   This REQUIRED Printer attribute specifies the maximum number of events that are supported in a single
885   Per-Job or Per-Printer subscription which must be the same. A Printer MUST support at least 5 events per
886   subscription, so that clients can depend on at least 5 events in a single subscription. If the number of events
887   supplied by a client in a subscription exceed this number, the Printer rejects the request and returns the
888   'server-error-too-many-events (see section 15.4). If notification is not supported, this attribute MUST NOT
889   be supported.

6.5   notify-text-format-supported (1setOf mimeMediaType)

890

891   This CONDITIONALLY REQUIRED Printer attributes identifies the MIME media types supported for
892   Human Consumable notification content for those notification delivery methods that support Human
893   Consumable format (most do). If an implementation supports any Human Consumable formats, it MUST
894   support this attribute and MUST support those Human Consumable formats for all notification delivery
895   methods that permit a Human Consumable format. If the implementation does not support any Human
896   Consumable MIME media types, then the 'none' MUST be the only value of this attribute or this attribute
897   MUST NOT be supported at all.

898   A client can determine what formats are supported for a notify-scheme as follows. The implementation
899   contains a hard coding of the Machine Consumable format (obtained from the specification). If the hard
900   coding (obtained from the specification) prohibits a Human Consumable format for the notify-scheme, or
901   the printer doesn't support the "notify-text-format-supported" attribute, there are no Human Consumable
902   formats for any notify-scheme. Otherwise, the attribute "notify-text-formats-supported" specifies the
903   supported mime types for those delivery schemes that are supported and permit a Human Consumable
904   format.

905   Note: The rationale for the "notify-text-format-supported" attribute is that the Machine Consumable format
906   seems easy to pick for each notify-scheme and thus easy to document. It is easy for a printer to support
907   most Machine Consumable formats. It is much harder to support a Human Consumable format because of
908   localization issues. Once the code is written to support a particular Human Consumable format, it is easy
909   to transmit it on any of the supported notify-schemes. Thus, if a vendor decides to support a notify-scheme,
910   it has already committed to implement the Machine Consumable format. This may be simple if existing
911   code can be reused, e.g. application/ipp and or more difficult if new code must be written, e.g. it is SNMP.

6.6   max-job-subscriptions-supported (integer(1:MAX))

912

913   This REQUIRED Printer attribute specifies the maximum number of Per-Job subscriptions that are
914   supported for a job, i.e., the maximum number of collection values for the "job-notify" operation attribute,
915   and/or the maximum number of subsequent Create-Job-Subscription operation requests in combination for
916   a job. A value of 0 indicates no effective maximum. A Printer MUST support at least 1 Per-Job
917   subscription. If the number of Per-Job subscriptions supplied by a client in a Job Creation request exceeds
918   the value of this attribute or would exceed some implementation-defined total number of Per-Job
919   Subscriptions for the Printer, the Printer MUST accept the Job Creation and ignore the excess
920   subscriptions. If a subsequent Create-Job-Subscription request would exceed this number, the Printer
921   rejects the request and returns the 'server-error-too-many-subscriptions' (see section 15.3).

6.7 max-printer-subscriptions-supported (integer(0:MAX))

This REQUIRED Printer attribute specifies the maximum number of Per-Printer subscriptions that are supported by multiple Create-Printer-Subscription requests, i.e., the maximum number of un-expired Per-Printer Subscription objects that the Printer supports at a time. A value of 0 indicates no effective maximum. A Printer MUST support at least 1 Per-Printer subscription. If the number of Per-Printer subscriptions exceeds the value of this attribute or would exceed some implementation-defined total number of Per-Printer Subscriptions for the Printer (if any), the Printer rejects the Create-Printer-Subscription request and returns the 'server-error-too-many-subscriptions' (see section 15.3).

6.8 notify-lease-time-supported (rangeOfInteger(0:MAX))

This REQUIRED Printer attribute specifies the range of values in seconds that are supported for the "notify-lease-time-requested" operation attribute in a Create-Printer-Subscription or Renew-Subscription request for a Per-Printer subscription. When the lease time expires for a Per-Printer Subscription without renewing, the Printer MUST delete the Subscription object. If the client requests a value outside this range, the Printer MUST grant a value that is in this range (see section 5.9). A value of 0 indicates an infinite lease, i.e., one that does not expire.

6.9 notify-lease-time-default (integer(0:MAX))

This REQUIRED Printer attribute specifies the value of the lease time that the Printer object has been configured to assume if the client does not supply a "notify-lease-time-requested" operation attribute in the Create-Printer-Subscription or Renew-Subscription requests.

6.10 persistent-jobs-supported (boolean)

This OPTIONAL Printer attribute indicates whether or not the Printer supports persistent Jobs, i.e., Jobs object that are preserved across power cycles. If Jobs are persistent, then Per-Job Subscriptions MUST also be persistent, since they are part of the Job object. It is RECOMMENDED that Jobs (and Per-Job Subscriptions) be persistent.

6.11 persistent-subscriptions-supported (boolean)

This OPTIONAL Printer attribute indicates whether or not the Printer supports persistent Per-Printer Subscriptions, i.e., Subscription objects that are preserved across power cycles. When this value is 'true' the implementation MAY support some that are persistent and some that are not. If the value is 'false' or the attribute is not supported, Per-Printer Subscriptions MUST NOT be persistent. It is RECOMMENDED that Per-Printer subscriptions be persistent.

6.12 printer-state-change-time (integer(1:MAX))

This OPTIONAL Printer attribute records the time, i.e., copy of the Printer's "printer-up-time" attribute, that the Printer's "printer-state" attribute was last changed. On power-up, the Printer populates the "printer-state-change-time" from its "printer-up-time" attribute, so that it always has a value.

956 **6.13 printer-state-change-date-time (dateTime)**

957 This OPTIONAL Printer attribute records the date and time, i.e., copy of the Printer's "printer-current-time"
958 attribute, that the Printer's "printer-state" attribute was last changed. On power-up, the Printer populates the
959 "printer-state-change-date-time" from its "printer-current-time" attribute, so that it always has a value.

960 # 7   Notification Content

961 This section defines the Notification content that is sent to a Notification Recipient when an event occurs.
962 The Notification MAY be sent by the IPP Printer or a third party Notification Service (see section 2.3).

963 There are two notification content types: Machine Consumable and Human Consumable, i.e., 'text' MIME
964 media type. For most notification delivery methods both content types are defined. Each Notification
965 Content type will either define one specific Machine Consumable form (usual) or indicate that no Machine
966 Consumable form is defined. In addition, each Notification Content type will indicates whether (usual) or
967 not Human Consumable forms are permitted. But the definition will not define the Human Consumable
968 forms. For those Human Consumable forms that a Printer implementation supports as indicated in the
969 Printer's "notify-text-format-supported" attribute, it MUST support for all Notification Content formats
970 supported that permit Human Consumable form.

971 ## 7.1   Notification content MIME media type formats

972 This section defines the Notification content that the Notification Source sends asynchronously to each
973 Notification Recipient based on the subscription information stored with the subscription. The Notification
974 is either in a ~~Machine Consumable or~~ Human Consumable or Machine Consumable form.

975 ### 7.1.1   Human Consumable form

976 If the notification delivery method is defined to permit Human Consumable forms then the following
977 RECOMMENDATIONS apply:

978 The text message SHOULD include information about the attributes in sections 7.2 and 7.3 for job events
979 or in sections 7.2 and 7.4 for printer events. This information is localized according to the information
980 about natural language and charset in the subscription.

981 An implementation MAY extend the contents of a Human Consumable notification by adding additional
982 information.

983 ### 7.1.2   Machine Consumable form

984 If the notification delivery method is defined to have a Machine Consumable form and that form is defined
985 to be the 'application/ipp' MIME media type [ipp-mod], then the following rules apply:

986   1.   The notification content MUST use the 'application/ipp' MIME media type [ipp-mod] using the
987   Get-Job-Attributes response encoding for job events and Get-Printer-Attributes response for
988   printer events.

989   2.   The attributes listed in sections 7.2 and 7.3 are sent in an Notification for Job events.

990   3.   The attributes listed in sections 7.2 and 7.4 are sent in an Notification for Printer events.

991   4.   For any 'text' or 'name' attribute value in any notification, the charset and natural language rules
992   that apply to all IPP operations apply to these attributes as well, since they are represented as
993   operation responses.

994   5.   The Unsupported Attributes Group in the response is not sent.

995   6.   If the values of any of the attributes sent in an notification content are not known, the value sent
996   in the report content is the out-of-band 'unknown' value, rather than omitting the attribute (see
997   the beginning of [ipp-mod] section 4.1).

998 **Issue 2 -** ~~Should we change the Notification Model to allow notification delivery methods that are request~~
999 ~~and response (in addition to the current model which has only one-directional notification delivery using~~
1000 ~~the 'application/ipp' operation response format?~~

1001 **Issue 3 -** ~~If the answer to Issue 2 is yes, should we change the format of the notification content using~~
1002 ~~'application/ipp' to always be a (new) Send-Notification operation request, whether the scheme returns a~~
1003 ~~response or not?~~

1004 An implementation MAY extend the contents of the Machine Consumable notification by adding additional
1005 attributes. Notification Recipients MUST be able to accept Notifications containing attributes they do not
1006 recognize. What a Notification Recipient does with an unrecognized attribute is implementation-
1007 dependent. Notification Recipients MAY attempt to display unrecognized attributes anyway or MAY
1008 ignore them.

7.2   Notification content attributes common to Job and Printer events

1010 This section lists the parameters and attributes that are included in both Job and Printer event Notifications.

1011 The notification delivery method either models the Notification as a (1) request if the IPP Printer sends the
1012 Notification to the Notification Recipient when the event occurs or as a (2) response if the IPP Printer is
1013 queried for the Notification by a Notification Recipient:

1014   Request: If the delivery method defines that the IPP Printer sends the Notification, then the delivery
1015   method also defines whether or not the Notification Recipient returns a response. If the IPP Printer
1016   sends a Notification request, it uses the "operation-id alternative for item #2 in Table 4:

1017   Response: If the delivery method defines that the IPP Printer supports an operation that returns a
1018   Notification as a response to the Notification Recipient, it uses the "status-code" alternative for item
1019   #2 in Table 4.

1020 Some events do not include all of these attributes as shown in Table 4. Each notification content contains a
1021 single Job or Printer event, whether that event was subscribed using the Job Submission Subscription
1022 mechanism or the Per-Printer subscription mechanism. If either kind of Subscription subscribed to both
1023 Job and Printer events, then the Printer ~~y~~ will ~~be~~ send~~t~~ or return them as separate Job Notification content
1024 and Printer Notification contents to the same Notification Recipient.

1025 Table 4 lists the attributes that are defined for use in Notifications and indicates the Printer support required
1026 for conformance: "R" indicates REQUIRED for Printers to support and "O" indicates OPTIONAL for
1027 Printers to support. References of the form "mod m.n.o" refer to [ipp-mod] sections.

1028   **Table 4 - Common Job and Printer Notification content attributes**

Attributes	Reference	Events	
		'job-progress'	all others
1. version-number (integer (0:32767))	mod 3.1.1	R	R
2. operation-id (integer (0:32767)) or status-code (integer (0:32767))	mod 3.1.1	R	R
3. request-id (integer (0:MAX))	5.7 & mod 3.1.1	R	R
4. attributes-charset (charset)	5.5 & mod 3.1.4	R	R
5. attributes-natural-language (naturalLanguage)	5.6 & mod 3.1.4	R	R
6. printer-uri (uri)	5.10	R	R
7. printer-name (name(127))	mod 4.4.4		R
8. job-id (integer(1:MAX))	mod 4.3.2	R	R**
9. job-name (name(MAX))	mod 4.3.5		R**
10. trigger-event (type2 keyword)	5.2	R	R
11. trigger-time (integer(MIN:MAX))	7.2	R	R
12. trigger-date-time (dateTime)	7.2		O
13. subscription-id (integer(1:MAX))	5.8	R	R
14. subscriber-user-name (name(MAX))	5.11	O	O
15. subscriber-user-data (octetString(63))	5.4	R	R
16. notify-text-format (mimeMediaType)	5.3	O	O
17. human-readable-report (text(MAX))		O	O

1029   Attribute Notes:

1030   "version-number" - the major and minor version number.

1031   "operation-id" - the operation id if the delivery method document models the Notification as the Printer
1032   sending the Notification to the Notification Recipient (whether the Notification Recipient returns a
1033   response or not).

1034   "status-code" - a value of 0x600 (hexadecimal 600) for a Job event and 0x601 (hexadecimal 601) for a
1035   Printer event if the delivery method document models the Notification as the Printer returning the
1036   Notification to the Notification Recipient as a response to a request.

1037   "request-id" - the sequence number for this subscription, starting at 1 for each subscription.

1038   "attributes-charset" - the value comes from the "notify-charset" attribute in the Subscription object.

1039   "attributes-natural-language" - the value comes from the "notify-natural-language" attribute in the
1040   Subscription object.

1041   "printer-uri" - the value comes from the "job-printer-uri" Job attribute for Per-Job subscriptions.

1042   **"job-id" and "job-name" - included in Printer event Notifications only for Per-Job subscriptions.

1043   "trigger-event" - the event that caused this Notification to be delivered.

1044   "trigger-time" - the "printer-up-time" value when the event occurred.

1045   "trigger-date-time" - the "printer-current-time" value when the event occurred - OPTIONAL to support.

1046   "job-name" - SNMP delivery method can truncate to less than 255 octets, since the Notification needs to fit
1047   into 484 octets or so on some transports that SNMP is defined for.

1048   "subscription-id" - the unique identifier for the Subscription object on this Printer.

1049   "subscriber-user-name" - the subscriber user name that created the Subscription object. SNMP delivery
1050   method can truncate to less than 255 octets, since the Notification needs to fit into 484 octets or so
1051   on some transports that SNMP is defined for.

1052   "subscriber-user-data" - opaque user data that may identify either the Subscriber and/or the ultimate
1053   Notification Recipient.

1054   "notify-text-format (mimeMediaType) - indicates the text MIME media type (see section 5.3) for the
1055   "human-readable-report" attribute. This attribute MUST be present if the "human-readable-report"
1056   (text(MAX)) attribute is present in order to unambiguously identify the format of its text value to
1057   the Notification Recipient.

1058   "human-readable-report (text(MAX)) - the human consumable text message (see section 7.1.1) that
1059   describes the event and is represented in the text format specified by the "notify-text-format"
1060   attribute. Whether or not this attribute is defined depends on the delivery method definition
1061   document and MUST be defined only for use in the Machine Consumable format. If this attribute is
1062   defined for use in the Machine Consumable Notification, then whether this attribute is REQUIRED
1063   or OPTIONAL also depends on the delivery method definition document.

7.3   Additional Notification content attributes for Job events *only*

1065   Table 5 lists the additional attributes that are included only in Job event Notifications and indicates the
1066   Printer support required for conformance: "R" indicates REQUIRED, "O" indicates OPTIONAL, and
1067   "CR" indicates CONDITIONALLY REQUIRED, i.e., REQUIRED in a Notification if the corresponding
1068   Job attributes are supported. Some events do not include all of these attributes as shown in Table 5.

1069   **Table 5 - Additional Notification content attributes for Job events *only***

Attributes	Reference	Events		
		'job-progress'	'job-completed'	all others
18. job-state (type1 enum)	mod 4.3.7	R	R	R

Attributes	Reference	Events		
		'job-progress'	'job-completed'	all others
19. job-state-reasons (1setOf type2 keyword)	mod 4.3.8	R	R	R
20. job-k-octets (integer(0:MAX))	mod 4.3.17.1	O	O	
21. job-k-octets-processed (integer(0:MAX))	mod 4.3.18.1	O	O	
22. job-impressions (integer(0:MAX))	mod 4.2.17.2	O	O	
impressions-interpreted (integer(-2:MAX))	[ipp-prog]	R		
23. job-impressions-completed (integer(0:MAX))	mod 4.3.18.2	CR	CR	
24. impressions-completed-current-copy (integer(-20:MAX))	[ipp-prog]	R		
25. job-media-sheets (integer(0:MAX))	mod 4.3.17.3	O	O	
26. job-media-sheets-completed (integer(0:MAX))	mod 4.3.18.3	CR	CR	
27. job-collation-type (type2 enum)	[ipp-prog]	R		
28. sheet-completed-copy-number (integer(-20:MAX))	[ipp-prog]	R		
29. sheet-completed-document-number(integer(-20:MAX))	[ipp-prog]	R		

1070 7.4 Additional Notification content attributes for Printer events *only*

1071 Table 6 lists the additional attributes that are included only in Printer event Notifications and indicates the
1072 Printer support required for conformance: "R" indicates REQUIRED and "O" indicates OPTIONAL.

1073 **Table 6 - Additional Notification content attributes for Printer events *only***

Attributes	Reference	Events
		all printer events
30. printer-state (type1 enum)	mod 4.4.11	R
31. printer-state-reasons (1setOf type2 keyword)	mod 4.4.12	R
32. printer-is-accepting-jobs (boolean)	mod 4.4.23	R

1074

1075 8 Operations for notification

1076 This section defines all of the operations for notification.

1077 **8.1   Operations for Per-Job Subscriptions *only***

1078 This section defines the operation requests and responses that are related to Per-Job subscriptions and its
1079 Subscription object.   Section 8.3 defines the REQUIRED operation requests and responses associated with
1080 the REQUIRED Per-Printer subscription and its Subscription object.

1081 **8.1.1   Job Creation Operations (Create-Job, Print-Job, Print-URI) and Validate-Job**

1082 The usual method for a client to associate one subscription with a Job is to specify the subscription when
1083 the job is created. For a Per-Job Subscription, the client supplies the "job-notify (1setOf collection)"
1084 operation attribute with the member attributes listed in Table 7 with any of the job creation operations
1085 (Create-Job, Print-Job, Print-URI), plus Validate-Job (which doesn't create a job or subscription). If the
1086 client does not supply the "job-notify" attribute in the create operation, there is no subscription made (either
1087 implicitly or explicitly).

1088 If a Printer does not support this notification specification, then it MUST ignore the "job-notify" operation
1089 attribute and return it in the response indicated as an attribute that is not supported. See [ipp-mod] section
1090 3.1.7 for details on returning Unsupported Attributes.

1091 **Table 7 - Member attributes of the "job-notify" collection operation attribute**

Member attribute of "job-notify" collection	Reference	REQUIRED in request	Printer support
notify-recipient (uri)	5.1	yes	REQUIRED
notify-events (1setOf type2 keyword)	5.2	no	REQUIRED
notify-text-format (mimeMediaType)	5.3	no	REQUIRED
subscriber-user-data (octetString(63))	5.4	no	REQUIRED
notify-charset (charset)	5.5	no	OPTIONAL
notify-natural-language (naturalLanguage)	5.6	no	OPTIONAL

1092

1093 See the referenced sections for a definition of these operation attributes, since they are copied to the
1094 Subscription object as the Subscription Description attributes described in section 5.

1095 The following rules apply to Per-Job subscriptions created as part of the Job Creation operations:

1096 1.   Any subscription can contain job events, printer events, or both.

1097 2.   The Job Submission Subscription is only valid while the job is "not-completed". The job is "not-
1098   completed" while it is in the 'pending', 'pending-held', 'processing', and 'processing-stopped' states. The
1099   job changes from being "not-completed" to "retained" when it is done processing and enters any of the
1100   'completed', 'canceled', or 'aborted' states. The job becomes "not-completed" again when it is restarted
1101   using the Restart-Job operation (see [ipp-mod]).

1102 3.   Since no job is created for the Validate-Job operation, the only purpose of supplying the subscription
1103   operation attributes in the Validate-Job operation is to validate that the values are supported; the Printer
1104   object does not establish a notification subscription as a result of the Validate-Job operation.

1105 4. Since a Job Submission Subscription is included within a job submission operation, any interest in job
1106   events is limited to "this job" only (the Job object created because of this job creation operation). There
1107   is no mechanism to subscribe to events for all jobs or specifically some job other than this job in a
1108   create operation. But see the Create-Printer-Subscription operation (section 8.2.1) for an explicit
1109   operation to subscribe for job and/or printer events independently of any particular job submission, i.e.,
1110   Per-Printer subscriptions.

1111 5. Event reporting only occurs when a notification recipient has specified a subscription to any event(s).

1112 6. The notification implementation MAY allow an administrator to configure a policy on what events may
1113   be dropped.

1114 7. If the OPTIONAL "notify-charset" attribute is not supported or the supplied value is not supported, the
1115   IPP Printer MUST return the attribute in the Unsupported Attributes Group but still accept the
1116   operation, as with all Job create operations. In this case, the Printer MUST use the natural language
1117   supplied in the "attributes-charset" Job creation operation attribute, if that natural language value is
1118   supported by the Printer, else the Printer object MUST use the Printer's "charset-configured" value. See
1119   the Print-Job operation in [ipp-mod].

1120 8. If the OPTIONAL "notify-natural-language" attribute is not supported or the supplied value is not
1121   supported, the IPP Printer MUST return the attribute in the Unsupported Attributes Group but still
1122   accept the operation, as with all Job create operations. In this case, the Printer MUST use the natural
1123   language supplied in the "attributes-natural-language" Job creation operation attribute, if that natural
1124   language value is supported by the Printer, else the Printer object MUST use the Printer's "natural-
1125   language-configured" value. See the Print-Job operation in [ipp-mod].

1126 9. If a collection contains other unrecognized, unsupported member attributes and/or conflicting values,
1127   the attribute returned in the Unsupported Group is a collection containing the unrecognized,
1128   unsupported member attributes, and/or conflicting values. The Printer MUST return the unrecognized
1129   member attributes with the out-of-band value of 'unsupported'. The Printer MUST return the
1130   unsupported member attributes and conflicting values with their unsupported values. See [ipp-coll].

1131 10. If the number of events supplied in the "notify-events" attribute exceeds the Printer's "max-events-
1132   supported" attribute, the Printer MUST accept the request with the status code 'successful-ok-ignored-
1133   or-substituted-attributes' and return the "job-notify" collection in the Unsupported Attributes Group
1134   with only the "job-events" member attribute containing the events that exceed the maximum.

1135 11. If the Per-Job subscriptions would exceed the limit of Per-Job subscriptions supported per job as
1136   specified by the Printer's "max-job-subscriptions-supported" attribute or would exceed some
1137   implementation-defined limit on the total number of Per-Job subscriptions for the Printer (if any), the
1138   Printer MUST accept the request with the status code 'successful-ok-ignored-subscriptions', MUST
1139   return the "job-notify" attribute in the Unsupported Attributes Group with only the collection value(s)
1140   that represent the excess subscriptions that are being ignored, and MUST perform the Job Creation
1141   operation (see section 8.1.1), since the job can still be printed.

1142   If the job is accepted and one or more subscriptions are ignored, the status code returned is 'successful-
1143   ok-ignored-subscriptions. This status code is returned even if other job attributes are unsupported or in
1144   conflict. That is, if an IPP Printer finds a warning that would allow it to return 'successful-ok-ignored-
1145   subscriptions' and either 'successful-ok-ignored-or-substituted-attributes' and/or 'successful-ok-
1146   conflicting-attributes', it must return 'successful-ok-ignored-subscriptions'. In other words, the

1147   precedence for returning success codes is: 'successful-ok-ignored-subscriptions', 'successful-ok-
1148   conflicting-attributes', and 'successful-ok-ignored-or-substituted-attributes'.

8.1.2 Create-Job-Subscription operation

1149

1150   The OPTIONNAL Create-Job-Subscription operation creates a Per-Job Subscription object . The client
1151   can specify one or more job and/or printer events to be delivered as notifications to one Notification
1152   Recipient. For the Per-Job subscription objects, the Job events are for this job only. The printer events are
1153   any events generated by that Printer for any job or when no job is involved at all (same as for Per-Job
1154   Subscriptions).

1155   The Printer returns a subscription id and the length of time for which it has granted a lease for the
1156   subscription.

1157   A client can unsubscribe using the Cancel-Subscription operation (section 8.3.4) and the subscription id.

1158   Two Create-Job-Subscription operations with the same events and same Notification Recipient MUST be
1159   kept as distinct subscriptions and be assigned distinct subscription ids. A Printer MUST allow such
1160   duplicate subscriptions such that Cancel-Subscription doesn't unsubscribe both subscriptions and MUST
1161   send the Notifications twice to the Notification Recipient, since the "request-id" is supposed to count
1162   monotonically for each subscription.

1163   If the Printer has a bounded set of concurrent Per-Job subscriptions and the request would exceed that
1164   bound, the Printer rejects the operation and returns the 'server-error-too-many-subscriptions' status code.
1165   The client SHOULD try again later.

1166   Access Rights: To create Per-Job subscription objects, the authenticated user (see [IPP-MOD] section 8.3)
1167   performing this operation MUST either be the job owner or have operator or administrator access rights for
1168   the Printer object (see [IPP-MOD] sections 1 and 8.5). Otherwise the IPP object MUST reject the
1169   operation and return: client-error-forbidden, client-error-not-authenticated, and client-error-not-authorized
1170   as appropriate.

1171   Request:

Group 1: Operation Attributes	Printer support
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
"printer-uri" (uri)	REQUIRED
"job-id" (integer(1:MAX))	REQUIRED
["requesting-user-name" (name(MAX))]	RECOMMENDED

1172

Group 2: Subscription Attributes	Printer support
"notify-recipient" (uri)	REQUIRED
["notify-events" (1setOf type2 keyword)]	REQUIRED
["notify-text-format" (mimeMediaType)]	REQUIRED
["subscriber-user-data" (octetString(63))]	REQUIRED
["notify-charset" (charset)]	OPTIONAL
["notify-natural-language" (naturalLanguage)]	OPTIONAL
["notify-persistence-requested" (boolean)]	OPTIONAL

1173   Response:

Group 1: Operation Attributes	Printer Support
"status-code" (type2 enum)	REQUIRED
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
["status-message" (text(255))]	OPTIONAL
["detailed-status-message" (text(MAX))]	OPTIONAL

1174

Group 2: Unsupported Attributes (see [ipp-mod] section 3.1.7)	REQUIRED

1175

Group 3: Subscriptions Attributes	REQUIRED
"subscription-id" (integer(1:MAX))	REQUIRED
"notify-persistence-granted" (boolean)	REQUIRED

1176   Attribute Notes:

1177   "job-id" (integer(1:MAX)) - the client MUST supply this attribute in order to create a Per-Job subscription
1178   for the Job identified by the "job-id" value.

1179   Note: Unlike all other operations on the Job object, the "job-uri" operation attribute is not defined
1180   for use with this operation.

1181   ISSUE 02 - Ok that "job-uri" isn't defined for use with the Create-Job-Subscription operation?

1182   "notify-recipient" (uri) - the client MUST supply this attribute in order to have a subscription.

1183   "notify-event" (1setOf type2 keyword) - if the client does not supply this attribute, the Printer populates the
1184   "notify-events" Subscription Description attribute from its "notify-events-default" Printer
1185   Description attribute.

1186   "notify-text-format" (mimeMediaType) - if the client supplies this attribute, the value indicates which
1187   Human Consumable text format is requested for use in the Notification using the delivery method
1188   that the client supplies in the "notify-recipient" attribute. If the client does not supply this attribute,
1189   the Machine-Consumable form of the delivery method that the client supplies in the "notify-
1190   recipient" attribute is used.

1191   "notify-persistence-requested" (boolean) - whether or not the Per-Job Subscription is to be persistent, i.e.,
1192   saved across power cycles. Note: Persistent trap registrations is a client option in SNMPv3
1193   [RFC2573].

1194   "notify-persistence-granted" (boolean) - whether or not this Subscription object instance is persistent. This
1195   attribute MUST be returned whether "notify-persistence-requested" is supported or not, so that the
1196   client knows which.

1197

8.2   Operations for Per-Printer Subscriptions *only*

1198

1199   This section defines the operation requests and responses associated with the Per-Printer subscription and
1200   its Subscription object.

8.2.1   Create-Printer-Subscription operation

1201

1202   The REQUIRED Create-Printer-Subscription operation creates a Per-Printer Subscription object . The
1203   client can specify one or more job and/or printer events to be delivered as notifications to one Notification
1204   Recipient. For the Per-Printer subscription objects, the job events are for any job submitted to the Printer.
1205   The printer events are any events generated by that Printer for any job or when no job is involved at all.

1206   The Printer returns a subscription id and the time at which the subscription lease expires (which may be
1207   earlier or later than the client requested).

1208   The client must renew the Per-Printer subscription using the Renew-Subscription operation (see section
1209   8.3.3) before the lease runs out in order to maintain the subscription. A client can unsubscribe using the
1210   Cancel-Subscription operation (section 8.3.4) and the subscription id.

1211   Two Create-Printer-Subscription operations with the same events and same Notification Recipient MUST
1212   be kept as distinct subscriptions and be assigned distinct subscription ids. A Printer MUST allow such
1213   duplicate subscriptions such that Cancel-Subscription doesn't unsubscribe both subscriptions and MUST
1214   send the Notifications twice to the Notification Recipient, since the "request-id" is supposed to count
1215   monotonically for each subscription.

1216   If the Printer has a bounded set of concurrent Per-Printer subscriptions and the request would exceed that
1217   bound, the Printer rejects the operation and returns the 'server-error-too-many-subscriptions' status code.
1218   The client SHOULD try again later.

1219   Access Rights: To create Per-Printer subscription objects, the authenticated user performing this operation
1220   MUST have Per-Printer subscription rights for this Printer. Otherwise the IPP object MUST reject the
1221   operation and return: client-error-forbidden, client-error-not-authenticated, and client-error-not-authorized
1222   as appropriate.

1223   Request:

Group 1: Operation Attributes	Printer support
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
"printer-uri" (uri)	REQUIRED
["requesting-user-name" (name(MAX))]	RECOMMENDED

1224

Group 2: Subscription Attributes	Printer support
"notify-recipient" (uri)	REQUIRED
["notify-events" (1setOf type2 keyword)]	REQUIRED
["notify-text-format" (mimeMediaType)]	REQUIRED
["subscriber-user-data" (octetString(63))]	REQUIRED
["notify-charset" (charset)]	OPTIONAL
["notify-natural-language" (naturalLanguage)]	OPTIONAL
["notify-lease-time-requested" (integer(0:MAX))]	REQUIRED
["notify-persistence-requested" (boolean)]	OPTIONAL

1225   Response:

Group 1: Operation Attributes	Printer Support
"status-code" (type2 enum)	REQUIRED
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
["status-message" (text(255))]	OPTIONAL
["detailed-status-message" (text(MAX))]	OPTIONAL

1226

Group 2: Unsupported Attributes (see [ipp-mod] section 3.1.7)	REQUIRED

1227

Group 3: Subscription Attributes	Printer support
"subscription-id" (integer(1:MAX))	REQUIRED
"notify-lease-expiration-time" (integer(0:MAX))	REQUIRED
"notify-printer-up-time" (integer(1:MAX))	REQUIRED
"notify-persistence-granted" (boolean)	REQUIRED
Group 2: Unsupported Attributes	REQUIRED

1228   ISSUE 5 - Ok that we aren't passing the operation attributes that are copied to the Subscription object in the
1229   new Subscription object attributes group? Some of the "notify-xxx" attributes aren't Subscription
1230   object attributes.

1231   Attribute Notes:

1232   "notify-recipient" (uri) - the client MUST supply this attribute in order to have a subscription.

1233   "notify-lease-time-requested" (integer(0:MAX) - the number of seconds requested for the subscription
1234   lease. A value of 0 indicates a request that the Per-Printer Subscription lease never expire.
1235   Supplying a 0 value MAY require authentication in order to be used, if 0 is supported at all.

1236   If the client does not supply this attribute, the Printer uses its "notify-lease-time-default" Printer
1237   Description attribute value (see section 6.9).

1238 "notify-event" (1setOf type2 keyword) - if the client does not supply this attribute, the Printer populates the
1239   "notify-events" Subscription Description attribute from its "notify-events-default" Printer
1240   Description attribute.

1241 "notify-text-format" (mimeMediaType) - if the client supplies this attribute, the value indicates which
1242   Human Consumable text format is requested for use in the Notification using the delivery method
1243   that the client supplies in the "notify-recipient" attribute. If the client does not supply this attribute,
1244   the Machine-Consumable form of the delivery method that the client supplies in the "notify-
1245   recipient" attribute is used.

1246 "notify-persistence-requested" (boolean) - whether or not the Per-Printer Subscription is to be persistent,
1247   i.e., saved across power cycles. Note: Persistent trap registrations is a client option in SNMPv3
1248   [RFC2573].

1249 "notify-lease-expiration-time" (integer(0:MAX)) - The Printer object MUST return this attribute which is
1250   the time in the future at which the subscription lease will expire, i.e., the "printer-up-time" value (in
1251   time ticks - see [ipp-mod] section 4.4.29) at which the Printer will delete the Subscription. A value
1252   of 0 indicates that the lease subscription will never expire.

1253 "notify-printer-up-time" (integer(1:MAX)) - The Printer object MUST return this attribute which is an alias
1254   for the Printer's "printer-up-time" Printer Description attribute. The client subtracts this value from
1255   the "notify-lease-expiration-time" value returned in order to determine the number of second in the
1256   future that the subscription will expire. This computed value may be less than the requester
1257   requested in the "notify-lease-time-requested" if it was greater than the MAX supported or more
1258   than the requester requested if it was less than the MIN supported, as indicated in the Printer's
1259   "notify-lease-time-supported" (rangeOfInteger(0:MAX)) attribute (see section 6.8).

1260 "notify-persistence-granted" - whether or not this Subscription object instance is persistent. This attribute
1261   MUST be returned whether "notify-persistence-requested" is supported or not, so that the client
1262   knows which.

1263

8.3 Common Operations for Per-Job and Per-Printer Subscriptions

1265 This section defines the operations that are common to both Per-Job and Per-Printer subscriptions.

1266   **8.3.1   Get-Subscription-Attributes operation**

1267   The REQUIRED Get-Subscription-Attributes returns the requested attributes of the identified Subscription
1268   object. See section 5.

1269   Request:

Group 1: Operation Attributes	Printer support
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
"printer-uri" (uri)	REQUIRED
["requesting-user-name" (name(MAX))]	RECOMMENDED
"subscription-id" (integer(1:MAX))	REQUIRED
["requested-attributes" (1setOf type2 keyword)]	REQUIRED

1270   Response:

Group 1: Operation Attributes	Printer support
"status-code" (type2 enum)	REQUIRED
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
["status-message" (text(255))]	OPTIONAL
["detailed-status-message (text(MAX))]	OPTIONAL
Group 2: Unsupported Attributes	REQUIRED
Group 3: <the requested Subscription object attributes>	REQUIRED

1271   This operation is similar to the Get-Printer-Attributes operation. If the client omits the "requested-
1272   attributes" operation attribute, the Printer MUST respond as if the client had supplied the 'all' value, i.e.,
1273   return all of the attributes supported for the Subscription object.

1274   **8.3.2   Get-Subscriptions operation**

1275   The REQUIRED Get-Subscriptions operation returns the requested attributes of the Subscription objects
1276   (see section 5).

1277   Request:

Group 1: Operation Attributes	Printer support
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
"printer-uri" (uri)	REQUIRED
["job-id" (integer(1:MAX))]	REQUIRED
["requesting-user-name" (name(MAX))]	RECOMMENDED
["limit" (integer(1:MAX))]	REQUIRED
["requested-attributes" (1setOf type2 keyword)]	REQUIRED
["my-subscriptions" (boolean)]	REQUIRED

1278   Response:

Group 1: Operation Attributes	Printer support
"status-code" (type2 enum)	REQUIRED
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
["status-message" (text)]	OPTIONAL
["detailed-status-message" (text(MAX))]	OPTIONAL
Group 2: Unsupported Attributes	REQUIRED
Group 3 to N:<the requested Subscription Attributes for each Subscription object in a separate group>	REQUIRED

1279

1280   Attribute Notes:

1281   This operation is similar to the Get-Jobs operation (see [ipp-mod]). If the client wants any attributes
1282   returned, including the "subscription-id", it must include the attribute keyword name in the "requested-
1283   attributes" operation attribute. If the "requested-attributes" operation attribute is omitted, the Printer MUST
1284   respond as if the client supplied the value: 'subscription-id'.

1285   "job-id" (integer(1:MAX)) - If the client supplies this attribute, all of the Per-Job Subscription objects for
1286   the identified job are candidates for return. It this attribute is omitted, all of the Per-Printer
1287   Subscription objects are candidates for return.

1288   "my-subscriptions" (boolean) - If the client supplies the "my-subscriptions" with a 'false' value or omits it,
1289   the Printer returns all subscriptions, subject to the security policy in force.

1290   Groups 3 to N: Subscription Object Attributes: The Printer object responds with one set of Subscription
1291   Object Attributes for each returned Subscription object. The Printer object ignores (does not
1292   respond with) any requested attribute or value which is not supported or which is restricted by the
1293   security policy in force, including whether the requesting user is the user that created the
1294   Subscription object (subscribing user) or not (see [ipp-mod] section 8).

1295   8.3.3   Renew-Subscription operation

1296   The REQUIRED Renew-Subscription operation permits a client to request the IPP Printer to extend the
1297   lease on a Subscription object instance. There is no way to renew a Per-Job subscription, since they are
1298   automatically canceled after the job completes and no longer has any documents, i.e., the job is no longer
1299   retained (see [ipp-mod] section 4.3.7.2). If the requested subscription object is a Per-Job subscription, the
1300   Printer MUST grant an infinite lease by returning a 0 value for the "notify-lease-expiration-time".
1301   *Access Rights*: The authenticated user (see [IPP-MOD] section 8.3) performing this operation MUST either
1302   be the owner of the Subscription object or have operator or administrator access rights for the Printer object
1303   (see [IPP-MOD] sections 1 and 8.5). Otherwise the IPP object MUST reject the operation and return:
1304   client-error-forbidden, client-error-not-authenticated, and client-error-not-authorized as appropriate.

1305   Request:

Group 1: Operation Attributes	Printer support
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
"printer-uri" (uri)	REQUIRED
["requesting-user-name" (name(MAX))]	RECOMMENDED
"subscription-id" (integer(1:MAX))	REQUIRED
["notify-lease-time-requested" (integer(0:MAX))]	REQUIRED

1306   Response:

Group 1: Operation Attributes	Printer support
"status-code" (type2 enum)	REQUIRED
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
["status-message" (text(255))]	OPTIONAL
["detailed-status-message" (text(MAX))]	OPTIONAL
"notify-lease-expiration-time" (integer(0:MAX))	REQUIRED
"notify-printer-up-time" (integer(1:MAX))	REQUIRED
Group 2: Unsupported Attributes	REQUIRED

1307   ISSUE 03 - Should Renew-Subscription Request have a Group 2 for its two Subscription attributes?

1308   ISSUE 04 - Should Renew-Subscription Response have a Group 3 for its two Subscription attributes?

1309   Attribute Notes:

1310   "notify-lease-time-requested" (integer(0:MAX) - the number of seconds requested for the Per-Printer
1311   subscription lease. Same as Create-Printer-Subscriptions (see section 8.2.1).

1312   "notify-lease-expiration-time" - the time in the future when the subscription will expire. Same as for the
1313   Create-Printer-Subscription operation (see section 8.2.1).

1314   "notify-printer-up-time" - the Printer object MUST return this attribute which is an alias for the Printer's
1315   "printer-up-time" Printer Description attribute. The client subtracts this value from the "notify-
1316   lease-expiration-time" value returned in order to determine the number of second in the future that
1317   the subscription will expire (see further explanation in section 8.2.1).

1318   Note: There is no way to change any of the Subscription object attributes, except the "notify-lease-
1319   expiration-time" attribute (using the Renew-Subscription operation). In order to change other attributes, a
1320   client can create a new Subscription object and then use the Cancel-Subscription operation to cancel the old
1321   one (or do this in the other order, in case there is a limit on the number of Subscription object instances, as
1322   long as a short window with no Notifications is ok).

1323   Note: There is no need to renew a Per-Job Subscription, since it is effectively the time that the Job is active
1324   (see section 8.1).

8.3.4   Cancel- Subscription operation

The REQUIRED Cancel- Subscription operation allows a client to remove a Subscription object. No more Notifications are delivered for that Subscription. Once performed, there is no way to use that Subscription in the future. Subscription-ids should not be reused immediately, so that a stale reference situation is not created. Same as for Cancel-Job and job-ids.

Access Rights: The authenticated user (see [IPP-MOD] section 8.3) performing this operation MUST either be the owner of the Subscription object or have operator or administrator access rights for the Printer object (see [IPP-MOD] sections 1 and 8.5). Otherwise the IPP object MUST reject the operation and return: client-error-forbidden, client-error-not-authenticated, and client-error-not-authorized as appropriate.

Request:

Group 1: Operation Attributes	Printer support
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
"printer-uri" (uri)	REQUIRED
["requesting-user-name" (name(MAX))]	RECOMMENDED
"subscription-id" (integer(1:MAX))	REQUIRED

Response:

Group 1: Operation Attributes	Printer support
"status-code" (type2 enum)	REQUIRED
"attributes-charset" (charset)	REQUIRED
"attributes-natural-language" (naturalLanguage)	REQUIRED
["status-message" (text(255))]	OPTIONAL
["detailed-status-message" (text(MAX))]	OPTIONAL
Group 2: Unsupported Attributes	REQUIRED

9   Comparison of Per-Job versus Per-Printer Subscriptions

Per-Job and Per-Printer subscriptions are quite similar. Either type of subscription can subscribe to Job events, Printer events, or both. Both types of subscriptions can be queried using the Get-Subscriptions and Get-Subscription-Attributes operations and canceled using the Cancel-Subscription operation. Both types of subscriptions create Subscription objects which have the same attributes defined. However, there are some semantic differences between Per-Job subscriptions and Per-Printer subscriptions. A Per-Job Submission Subscription is established by the client when submitting a job and after creating the job using the Create-Job-Subscription operation by specifying the "job-id" of the job. A Per-Printer Subscription is established between a client and a Printer using the Create-Printer-Subscription operation. Some specific differences are:

1. A client usually creates a Per-Job subscription as part of the Job Creation operations (Create-Job, Print-Job, and Print-URI), rather than using the OPTIONAL Create-Job-Subscription operation, especially since some Printer implementations MAY not support the Create-Job-Subscription operation, since it is OPTIONAL.

1351 2. For Per-Job subscriptions, the subscription is only valid while the job is "not-complete" (see sections
1352   7.2 and 7.3) while for the Per-Printer subscriptions, the subscription is valid until the time (in seconds)
1353   that the Printer returned in the "notify-lease-expiration-time" operation attribute expires.

1354 3. Job Events in a Per-Job subscription apply only to "one job" (the Job created by the job creation
1355   operation or references by the Create-Job-Subscription operation) while Job Events in a Per-Printer
1356   subscription apply to ALL jobs contained in the IPP Printer object.

1357 10 Out of Band Values

1358 This section defines out-of-band values (see [ipp-mod] section 4.1) for use with attributes defined in this
1359 and other documents.

1360 1.1 10.1 'none'

1361 This "out-of-band" value allows a client, in a request, to specify that the value of an Job Template attribute
1362 MUST be semantically equivalent to 'none.' This out-of-band value is needed since attributes that are of
1363 the 'collection', 'uri', 'mimeMediaType, 'name', or 'text' syntax can be problematic when a client wishes to
1364 specify that an xxx-default attribute MUST NOT be applied to the job. Unlike the 'keyword' or 'enum'
1365 attribute syntax, where the value of 'none' (or its equivalent) can be a standard value, other attribute
1366 syntaxes have no such mechanism.

1367 A Printer MUST support the use of the "out-of-band" value for any attribute that calls for its use, such as
1368 any Job Template attribute that has the 'collection' attribute syntax, if the Printer supports the use of the
1369 'collection' attribute syntax for that attribute.

1370 When a client sends a request to the printer object, the "out-of-band" value 'none' MUST only be used for
1371 Job Template attributes whose definitions explicitly indicate that the use of "out-of-band" value 'none' is
1372 allowed. A client MUST NOT use the "out-of-band" 'none' value for attributes whose definition does not
1373 explicitly call out its use.

'none'	The specified Job Template attribute in the request MUST NOT be applied to the job. Specifically, this value overrides the Printer's "xxx-default" attribute value for the Job Template attribute, if one exists.

1374 ISSUE 05 - The out-of-band 'none' value is also defined in the PWG Production Printing document.
1375 Should we keep the definition here in the Notification document? And/or should we move the definition to
1376 the 'collection' specification (ipp-coll) which is also defining the tag for the 'collection' attribute syntax that
1377 is the province of the IPP Transport and Encoding document?

1378 11 Conformance Requirements

1379 This section further enhances the Conformance Requirements detailed in [IPP-MOD] section 5. Extensions
1380 made to the events herein must be made such that new events or event attributes are backward compatible
1381 to clients who implemented early versions of this notification specification.

1382 It is OPTIONAL to implement this Event Notification specification. If this Event Notification specification
1383 is implemented, IPP objects MUST support all of the REQUIRED object attributes as defined in this
1384 document in the indicated sections:.

1385   1.   REQUIRED Subscription object attributes in section 5.

1386   2.   REQUIRED Printer Description object attributes in section 6.

1387   3.   REQUIRED attributes in Notification content in section 7.

1388 If IPP this Event Notification specification is implemented, the operations described in this
1389 documentsection 8 must MUST be supported as described in Table 8:

1390   **Table 8 - Conformance Requirements for Operations**

Attribute	Conformance requirements
"job-notify" in Job Creation operations (section 8.1.1)	REQUIRED
Create-Printer-Subscription (section 8.2.1)	REQUIRED
Create-Job-Subscription (section 8.1.2)	OPTIONAL
Get-Subscription-Attributes (section 8.3.1)	REQUIRED
Get-Subscriptions (section 8.3.2)	REQUIRED
Renew-Subscription (section 8.3.3)	REQUIRED
Cancel-Subscription (section 8.3.4)	REQUIRED

1391

12 IANA Considerations

1393 IANA will be called on to register URL schemes for notification delivery for use in the "notification-
1394 recipient" attribute, using the same procedures outlined in [ipp-mod].

13 Internationalization Considerations

1396 This IPP notification specification continues the internationalization of [ipp-mod] for attributes containing
1397 text strings and names. A subscribing client can specify a different natural language and charset for each
1398 Notification content delivered to a Notification Recipient.

1399 The Human Consumable Notification content is a 'text/plain; charset=utf-8' by default where the
1400 Notification Sender has localized the text message as requested by the subscriber for the intended
1401 Notification Recipient.

14 Security Considerations

1403 By far the biggest security concern is the abuse of notification: sending unwanted notifications to third
1404 parties (i.e., spam). The problem is made worse by notification addresses that may be redistributed to
1405 multiple parties (e.g. mailing lists). There exist scenarios where third party notification is required (see
1406 Scenario #2 and #3 in [ipp-not-req]). The fully secure solution would require active agreement of all
1407 recipients before sending out anything. However, requirement #9 in [ipp-req] ("There is no requirement for

1408   IPP Printer receiving the print request to validate the identity of an event recipient") argues against this.
1409   Certain systems may decide to disallow third party notifications (a traditional fax model).

1410   Clients submitting notification requests to the IPP Printer has the same security issues as submitting an
1411   IPP/1.1 print job request. The same mechanisms used by IPP/1.1 can therefore be used by the client
1412   notification submission. Operations that require authentication can use the HTTP authentication.
1413   Operations that require privacy can use the HTTP/TLS privacy.

1414   The notification access control model should be similar to the IPP access control model for Jobs. Creating
1415   a Per-Printer Notification Subscription object is associated with a user. Only the creator or an operator can
1416   cancel the subscription. The system may limit the listing of items to only those items owned by the user.
1417   Some subscriptions (e.g. those that have a lifetime longer than a job) can be done only by privileged users
1418   (users having operator and/or administrator access rights), if that is the authorization policy.

1419   The standard security concerns (delivery to the right user, privacy of content, tamper proof content) apply
1420   to the notification delivery. IPP should use the security mechanism of the delivery method used. Some
1421   delivery mechanisms are more secure than others. Therefore, sensitive notifications should use the delivery
1422   method that has the strongest security.

1423 15 Status Codes

1424   The following status codes are defined as extensions for notification:

1425 15.1 'successful-ok-ignored-subscriptions' (0x0003)

1426   The number of subscriptions supplied in a Job Creation operation (Create-Job, Print-Job, Print-URI)
1427   exceeds either the limit of Per-Job subscriptions supported per job as specified by the Printer's "max-job-
1428   subscriptions-supported" attribute or some implementation-defined limit on the total number of Per-Job
1429   subscriptions for the Printer (if any). The Printer MUST accept the request with this status code, MUST
1430   return the "job-notify" attribute in the Unsupported Attributes Group with only the collection value(s) that
1431   represent the excess subscriptions that are being ignored, and MUST perform the Job Creation operation
1432   (see section 8.1.1), since the job can still be printed.

1433   This status code is returned even if other job attributes are unsupported or in conflict. That is, if an IPP
1434   Printer finds a warning that would allow it to return 'successful-ok-ignored-subscriptions' and either
1435   'successful-ok-ignored-or-substituted-attributes' and/or 'successful-ok-conflicting-attributes', it must return
1436   'successful-ok-ignored-subscriptions'. In other words, the precedence for returning success codes is:
1437   'successful-ok-ignored-subscriptions', 'successful-ok-conflicting-attributes', and 'successful-ok-ignored-or-
1438   substituted-attributes'.

1439 15.2 client-error-uri-notification-scheme-not-supported (0x04??)

1440   The scheme of the client-supplied URI in a "notify-recipient" operation attribute in a Create-Printer-
1441   Subscription or Create-Printer-Subscription operation is not supported. See [ipp-mod] section 3.1.7.

1442   There is no corresponding Per-Job subscription error for a Job Creation operation, since the Printer object
1443   MUST ignore any errors in the "job-notify" operation attribute, MUST return the "notify-recipient"
1444   attribute in the Unsupported Attributes Group, and perform the Job Creation operation (see section 8.1.1),
1445   since the job can still be printed.

1446   **15.3 server-error-too-many-subscriptions (0x04??)**

1447   The bounded set of concurrent Per-Printer subscriptions supported by the Printer object would be exceeded
1448   if this request were accepted.

1449   Note: There is no corresponding Per-Job subscription error, since the Printer object MUST ignore any
1450   errors in the "job-notify" operation attribute and perform the Job Creation operation (see section 8.1.1),
1451   since the job can still be printed.

1452   **15.4 server-error-too-many-events (0x04??)**

1453   The client supplied more events in the "notify-events" operation attribute in a Create-Job-Subscription or
1454   Create-Printer-Subscription operation than the Printer supports, as indicated in its "max-events-supported"
1455   attribute (see section 6.4).

1456   There is no corresponding Per-Job subscription error for a Job Creation operation, since the Printer object
1457   MUST ignore any errors in the "job-notify" operation attribute, MUST return the "notify-events" attribute
1458   in the Unsupported Attributes Group with only the excess events that are being ignored, and perform the
1459   Job Creation operation (see section 8.1.1), since the job can still be printed.

1460   # 16 Additions to the IPP Encoding and Transport Document

1461   The Subscription object tag needs to be assigned in section 3.7.1 Delimiter Tags:

1462   **3.7.1 Delimiter Tags**

1463   The following table specifies the values for the delimiter tags:

Tag Value (Hex)	Delimiter
0x00	reserved
0x01	operation-attributes-tag
0x02	job-attributes-tag
0x03	end-of-attributes-tag
0x04	printer-attributes-tag
0x05	unsupported-attributes-tag
0x06	subscription-attributes-tag
0x07-0x0e	reserved for future delimiters
0x0F	reserved for future chunking-end-of-attributes-tag

1464   When an xxx-attributes-tag occurs in the protocol, it MUST mean that zero or more following attributes up
1465   to the next delimiter tag are attributes belonging to group xxx as defined in the model document, where xxx
1466   is operation, job, printer, unsupported, subscription.

1467   Doing substitution for xxx in the above paragraph, this means the following. When an operation-attributes-
1468   tag occurs in the protocol, it MUST mean that the zero or more following attributes up to the next delimiter
1469   tag are operation attributes as defined in the model document. When an job-attributes-tag occurs in the
1470   protocol, it MUST mean that the zero or more following attributes up to the next delimiter tag are job
1471   attributes or job template attributes as defined in the model document. When a printer-attributes-tag occurs
1472   in the protocol, it MUST mean that the zero or more following attributes up to the next delimiter tag are

1473 printer attributes as defined in the model document. When an unsupported-attributes-tag occurs in the
1474 protocol, it MUST mean that the zero or more following attributes up to the next delimiter tag are
1475 unsupported attributes as defined in the model document. When a subscription-attributes-tag occurs in the
1476 protocol, it MUST mean that the zero or more following attributes up to the next delimiter tag are
1477 subscription attributes as defined in the [ipp-not] document.

1478 Add a reference to [ipp-not].

1479 # 17 References

1480 [ipp-coll]
1481   deBry, R., , Hastings, T., Herriot, R., "Internet Printing Protocol/1.0 & 1.1: collection attribute
1482   syntax", <draft-ietf-ipp-collection-00.doc>, work in progress, September 9, 1999.

1483 [ipp-mod]
1484   deBry, R., , Hastings, T., Herriot, R., Isaacson, S., Powell, P., "Internet Printing Protocol/1.1: Model
1485   and Semantics", < draft-ietf-ipp-model-v11-04.txt>, work in progress, June 23, 1999.

1486 [ipp-not-hist]
1487   deBry, R., Lewis, H., Hastings, T., "Internet Printing Protocol/1.1: Requirements for IPP
1488   Notifications", <draft-ietf-ipp-not-change-history-00.doc>, work in progress, August 22, 1999.

1489 [ipp-not-req]
1490   deBry, R., Lewis, H., Hastings, T., "Internet Printing Protocol/1.1: Requirements for IPP
1491   Notifications", <draft-ietf-ipp-not-03.txt>, work in progress, August 11, 1999.

1492 ISSUE 06 - Should we add references to the notification delivery documents that are in progress?

1493 [ipp-pro]
1494   Herriot, R., Butler, S., Moore, P., Tuner, R., "Internet Printing Protocol/1.1: Encoding and
1495   Transport", <draft-ietf-ipp-protocol-v11-03.txt>, work in progress, June, 1999.

1496 [ipp-prog]
1497   Hastings, T., Bergman, R., Lewis, H., "Proposed Job Progress Attributes for IPP", <draft-ietf-ipp-
1498   prog.txt> work in progress, May 18, 1999.

1499 [ipp-set2]
1500   Kugler, C., , Hastings, T., "Internet Printing Protocol/1.0 & 1.1: Additional Operations, Set 2",
1501   <draft-ietf-ipp-set2.txt>, work in progress, August 22, 1999.

1502 [RFC2046]
1503   Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types. N. Freed & N. Borenstein.
1504   November 1996. (Obsoletes RFC1521, RFC1522, RFC1590), RFC 2046.

1505 [RFC2119]
1506   S. Bradner, "Key words for use in RFCs to Indicate Requirement Levels", RFC 2119 , March 1997

1507   [RFC2279]
1508   F. Yergeau , "UTF-8, a transformation format of ISO 10646", RFC 2279. January 1998.

1509   [RFC2566]
1510   deBry, R., , Hastings, T., Herriot, R., Isaacson, S., Powell, P., "Internet Printing Protocol/1.0: Model
1511   and Semantics", RFC 2566, April 1999.

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1559 # A.   Appendix - Summary of Notification Attribute Usage

1560   This appendix summarizes the usage of Notification attributes in the Job operation attribute collection, Job
1561   object, Subscription object, Notification content, Job operations, and Subscriptions operations.

Attributes	Objects		Notification content		Job operations		Subscription operations		
	Job	Subscription	Job Notification Content	Printer Notification Content	Job Creation Validate-Job	Create-Job-Subscription	Create-Printer-Subscription	Renew-Subscription	Cancel-Subscription
1. notify-recipient (uri)		R			R	R	R		
2. notify-events (1setOf type2 keyword)		R		~~100~~	[R]	[R]	[R]		
3. notify-text-format (mimeMediaType)		R	[O]	[O]	[R]	[R]	[R]		
4. human-readable-report (text(MAX))			[O]	[O]					
5. subscriber-user-data (octetString(63))		R	R	R	[R]	[R]	[R]		
6. attributes-charset (charset)	R		R (7)	R (7)	R	R	R	R	R
7. notify-charset (charset)		O			[O]	[O]	[O]		
8. attributes-natural-language (naturalLanguage)	R		R (9)	R (9)	R	R	R	R	R
9. notify-natural-language (naturalLanguage)		O			[O]	[O]	[O]		
10. notify-lease-time-requested (integer(0:MAX))							[R]	[R]	
11. notify-lease-expiration-time (integer(0:MAX))		R*					Return	Return	
12. notify-persistence-requested (boolean)						[O]	[O]		
13. notify-persistence-granted (boolean)		R				Return	Return		
14. trigger-event (type2 keyword)			R (2)	R (2)					
15. trigger-time (integer(MIN:MAX))			R	R					
16. trigger-date-time (dateTime)			[O]	[O]					
17. request-id (integer (0:MAX))		R	R	R					
18. subscription-id (integer(1:MAX))		R	R	R			Return	R	R

1562   Legend: "R" - REQUIRED for Printer to support;   "O" - OPTIONAL for Printer to support; "[ ]" - OPTIONAL for sender to send;
1563   Return - Printer MUST return; * - MUST be 0 for Per-Job Subscription objects; (n) means the value comes from the indicated
1564   Subscription Attribute

Attributes	Objects		Notification		Job operations		Subscription operations		
	Job	Subscription	Job Notification	Printer Notification	Job Creation Validate-Job	Create-Job-Subscription	Create-Printer-Subscription	Renew-Subscription	Cancel-Subscription
19. version-number (integer (0:32767))			R	R					
20. operation-id (integer (0:32767)) or status-code (integer (0:32767))			0x(600)	0x(601)					
21. job-printer-uri (uri)	R								
22. printer-uri (uri)		R	R	R	R	R	R	R	R
23. printer-name (name(127))			R	R					
24. job-id (integer(1:MAX))	R		R	Per-Jb		R			
25. job-name (name(MAX)) [SNMP can truncate]	R		R	Per-Jb					
26. requesting-user-name (name(MAX))	R								
27. subscriber-user-name (name(MAX))		R	O	O					
28. job-state (type1 enum)	R		R						
29. job-state-reasons (1setOf type2 keyword)	R		R						
30. notify-printer-up-time (integer(1:MAX))		R					Return	Return	
31. job-k-octets (integer(0:MAX))									
32. job-k-octets-processed (integer(0:MAX))	O		[pg/cp]						
33. job-impressions (integer(0:MAX))									
34. job-impressions-completed (integer(0:MAX))	O		[pg/cp]						
35. impressions-completed-current-copy (integer(:MAX))	O		[pg/cp]						
36. job-media-sheets (integer(0:MAX))									
37. job-media-sheets-completed (integer(0:MAX))	O		[pg/cp]						
38. job-collation-type (type2 enum)	O		[pg/cp]						
39. sheet-completed-copy-number (integer(-20:MAX))	O		[pg/cp]						
40. sheet-completed-document-number(integer(-20:MAX))	O		[pg/cp]						

1566   Legend: "R" - REQUIRED for Printer to support;   "O" - OPTIONAL for Printer to support;   "[ ]" - OPTIONAL for sender to send;
1567   "[pg/cp]" - REQUIRED in a 'job-progress' or 'job-completed' notification if the corresponding Job attributes are supported ; (nn) - an
1568   alternate source of the data in a Notification.

1569

		Objects	Notification		Job operations		Subscription operations		
Attributes		Printer object	Job Notification	Printer Notification	Job Creation, Validate-Job	Create-Job-Subscription	Create-Printer-Subscription	Renew-Subscription	Cancel-Subscription
41. printer-state (type1 enum)		R		R					
42. printer-state-reasons (1setOf type2 keyword)		R		R					
43. printer-is-accepting-jobs (boolean)		R		R					
44. notify-schemes-supported (1setOf uriScheme)		R							
45. notify-events-default (1setOf type2 keyword)		R							
46. notify-events-supported (1setOf type2 keyword)		R							
47. max-events-supported (integer(5:MAX))		R							
48. notify-text-format-supported (1setOf mimeMediaType)		CR							
49. max-job-subscriptions-supported (integer(1:MAX))		R							
50. max-printer-subscriptions-supported (integer(0:MAX))		R							
51. notify-lease-time-supported (rangeOfInteger(0:MAX))		R							
52. notify-lease-time-default (integer(0:MAX))		R							
53. persistent-jobs-supported (boolean)		O							
54. persistent-subscriptions-supported (boolean)		O							
55. printer-state-change-time (integer(1:MAX))		O							
56. printer-state-change-date-time (dateTime)		O							

1570   Legend: "R" - REQUIRED for Printer to support;   "O" - OPTIONAL for Printer to support; "[ ]" - OPTIONAL for sender to send;

1571   "CR" - CONDITIONALLY REQUIRED, i.e., REQUIRED if Human Consumable format supported;

1572

B.   Appendix: Change History

This section summarizes the changes to the document. Each sub-section is in reverse chronological order. Adding or removing ISSUES that don't change the document are not listed here.

1.118.1 Changes to the October 14, 1999 version to create the February 2, 2000 version

The following changes were made to the October 14, 1999 version to create the February 2, 2000 version based on the agreements reached at the October and December IPP WG meetings and reflected in the minutes:

1.   Added a Java Listener as an example of a Notification Recipient.

2.   Clarified the object relationships in section 4.1.

3.   Clarified how job events differ for Per-Job versus Per-Printer Subscriptions.

4.   Added the ability for the Machine Consumable form to contain a Human Readable "human-readable-report" (text) attribute so that both forms could be sent in the same Notification.

5.   Clarified that the 'none' value for notify-text-format (mimeMediaType) has to be out-of-band, not the text string 'none' as a mimeMediaType.

6.   Clarified that 'none' means send the Machine Consumable form without the "human-readable-report" (text) attribute, if it is defined.

7.   Clarified that Notification Recipients MUST be able to accept unrecognized attributes.

8.   Allowed the notification delivery method definition to be modeled as (1) a request with an operation code without a response, (2) a request with a operation code with a response or (3) a response with a status code.

9.   Added "notify-text-format" (mimeMediaType) and "human-readable-report" (text(MAX)) to be able to be sent in a Notification content, if the notification delivery method document permits it.

10. Added "job-k-octets" (integer(0:MAX)), "job-impressions" (integer(0:MAX)), and "job-media-sheets" (integer(0:MAX)) as OPTIONAL for Notification content for use in job-progress events to show the target values so that the Notification Recipient can show a thermometer.

11. Added a Subscription Attributes group (and subscription-attributes tag) the Create-Job-Subscription and Create-Printer-Subscription requests and responses.

12. Added the 'none' out-of-band value for use with "notify-text-format" (mimeMediaType) attribute.

13. Changed the job progress attributes from using -2 to mean 'unknown' as in the PWG Job Monitoring MIB, to use the 'unknown' out-of-band value.

1603

C.   Appendix: Full Copyright Statement

1605   Copyright (C) The Internet Society (1998,1999,2000). All Rights Reserved

1621