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17 Internet Printing Protocol/1.0 & 1.1: **IPP Event Notification Specification - Alternative**
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19 Status of this Memo

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29 **Abstract**

30 This document describes an extension to the IPP/1.0 & IPP/1.1 model that allows a client to subscribe to
31 printing related events. Subscriptions include "Per-Job subscriptions" and "Per-Printer subscriptions". One
32 or more Per-Job Submission subscriptions are specified by the client when submitting a job. Additional
33 Per-Job and Per-Printer subscriptions are created by performing separate explicit Create-Subscription
34 operations on the Printer. Subscriptions are modeled as Subscription objects. Four other operations are
35 defined for subscription objects: get attributes, get subscriptions, renew a subscription, and cancel a
36 subscription.

37 A subscription request and the Subscription object includes: the names of Job and/or Printer events, the
38 Notification Recipient URL, the Notification content MIME type, possibly some opaque data, and the
39 charset and natural language. In addition, the subscription request includes: the requested lease time and

40 persistency for the subscription. When the event occurs, a notification is generated and delivered using the
41 information specified in the subscription.

42 The full set of IPP documents includes:

43 Design Goals for an Internet Printing Protocol [IPP-REQ]

44 Rationale for the Structure and Model and Protocol for the Internet Printing Protocol [IPP-RAT]

45 Internet Printing Protocol/1.1: Model and Semantics [IPP-MOD]

46 Internet Printing Protocol/1.1: Encoding and Transport [IPP-PRO]

47 Internet Printing Protocol/1.0: Implementer's Guide [IPP-IIG]

48 Mapping between LPD and IPP Protocols [IPP LPD]

49

50 The "Design Goals for an Internet Printing Protocol" document takes a broad look at distributed printing
51 functionality, and it enumerates real-life scenarios that help to clarify the features that need to be included
52 in a printing protocol for the Internet. It identifies requirements for three types of users: end users,
53 operators, and administrators. It calls out a subset of end user requirements that are satisfied in IPP/1.0.
54 Operator and administrator requirements are out of scope for version 1.0. A few OPTIONAL operator
55 operations have been added to IPP/1.1.

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

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

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

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

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

76
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160

161 1 Introduction

162 This IPP notification specification is an extension to IPP/1.0 [RFC2568, RFC2569]. This document in
163 combination with the following documents is intended to meet the notification requirements described in
164 [ipp-not-req]:

- 165 Internet Printing Protocol/1.0 & 1.1: "Collection Attribute Syntax" [ipp-coll]
- 166 Internet Printing Protocol/1.0 & 1.1: "Job Progress Attributes" [ipp-prog]
- 167 Internet Printing Protocol/1.0 & 1.1: "Notification Change History" [ipp-not-hist]
- 168 Internet Printing Protocol/1.0 & 1.1: "Notification Delivery Method xxx [TBD]
- 169 Internet Printing Protocol/1.0 & 1.1: "Notification Delivery Method yyy [TBD]

170

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

- 172 - The rest of Section 1.1 is an overview of IPP Notification.
- 173 - Section 2 is the model for network entities that use IPP notification, including clients (desktop and
174 servers), IPP Printers (servers and devices), and Notification Recipients.
- 175 - Section 3 is the terminology used throughout the document.
- 176 - Section 4 is the object model for notification, including Job, Printer, and Subscription objects.
- 177 - Section 5 and 6 defines the notification attributes for each of the Subscription and Printer objects.
- 178 - Section 7 defines the content of Human Consumable and Machine Consumable Event Notification
179 contents.
- 180 - Sections 8 and 9 define the Per-Job and Per-Printer Subscription operations.
- 181 - Section 10 and 11 define the conformance requirements and IANA requirements, respectively.
- 182 - Section 12 - 14 cover Internationalization, Security, and Status codes.

183 1.1 Notification Overview

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

186 One or more Per-Job Submission subscriptions are specified by the client when submitting a job. One or
187 more Per-Job or Per-Printer subscriptions are created by performing separate explicit Create-Subscription
188 operations on the Printer.

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

- 190 1. the names of Job and/or Printer events that are of interest to the Notification Recipient
- 191 2. the delivery method and address to use to deliver the notification to one Notification Recipient
- 192 3. whether Human Consumable or Machine Consumable notification content is to be sent
- 193 4. some opaque data that the subscriber wants to be send to the Notification Recipient in the
194 Notification, perhaps to identify either the subscriber or the ultimate recipient

- 195 5. the charset to use in the Notification, if it is to be different than the one used in the request that
196 created the subscription
- 197 6. the natural language to use in the Human Consumable Notification, if it is to be different than the
198 one used in the request that created the subscription
- 199 7. the requested lease time in seconds for the subscription
- 200 8. whether or not the subscription is requested to be persistent across power cycles.

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

209
210 For Per-Printer subscriptions and Per-Job subscriptions created after the Job has been created, a client
211 requests job and printer event notification using new operations independent of any job. The Printer keeps
212 each subscription in a separate Subscription object. The Create-Subscription operation creates an instance
213 of the Subscription object supplying these new operation attributes and returns a subscription-id (analogous
214 to a job-id for a Job object). These operation attributes are copied to the Subscription object as
215 Subscription Description attributes and so may be queried using the Get-Subscription-Attributes and Get-
216 Subscriptions operations. The subscriber requests a lease time for each Per-Printer subscription which
217 MAY be infinite. The Printer grants a lease time according to its configured policy. A client MUST renew
218 the Subscription before the granted lease time expires using the Renew-Subscription operation.

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

221

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,] [content-type,] [user-data,] [charset,] [natural-language]}
Validate-Job	yes	no	1setOf {recipient, [events,] [content-type,] [user-data,] [charset,] [natural-language]}
Create-Subscription	yes	yes	recipient, [job-id], [events,] [content-type,][user-data,][charset,][natural-language,][lease-time-requested,] [persistence-requested]
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

222

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

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

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

234 **2 Model for Per-Job and Per-Printer Subscription and Event Notification**

235 **2.1 Model for Per-Job Subscription and Notification**

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

241 Figure 1 shows the Per-Job subscription notification model for a simple Client - Printer relationship.

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embedded printer:

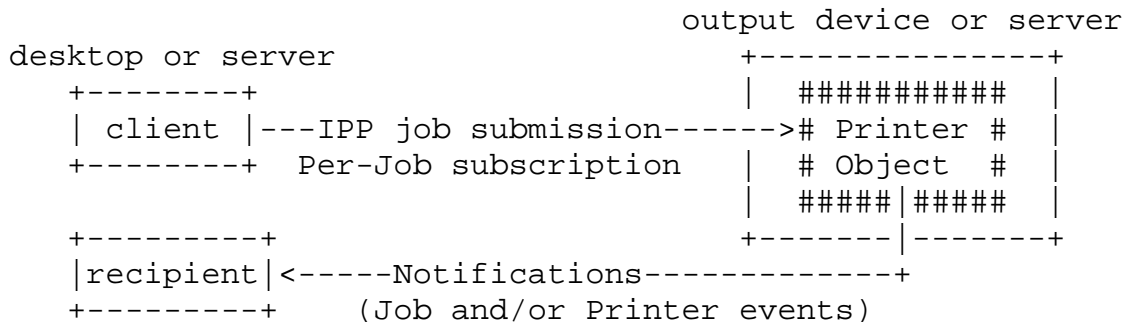


Figure 1 - Client-Printer Per-Job Subscription and Notification Model

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).

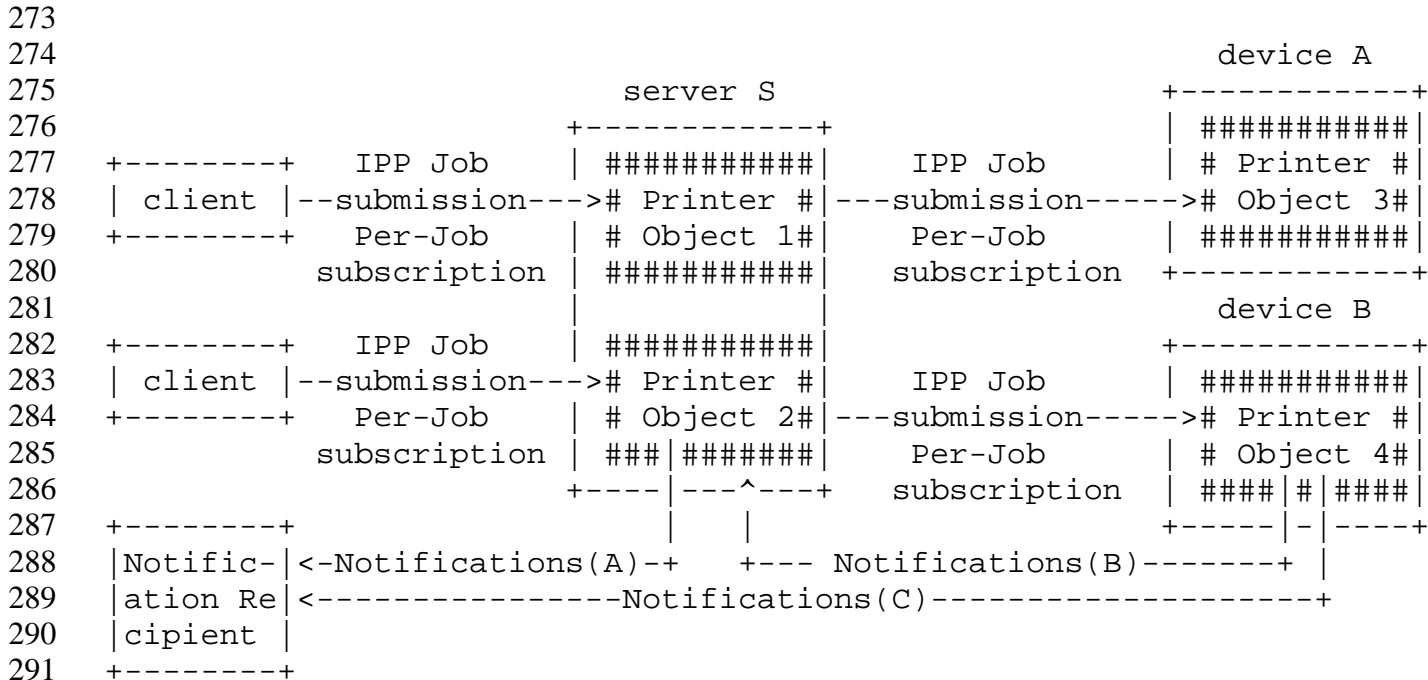


Figure 2 - Client-Server-Printer Per-Job Subscription and Notification Model

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-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.

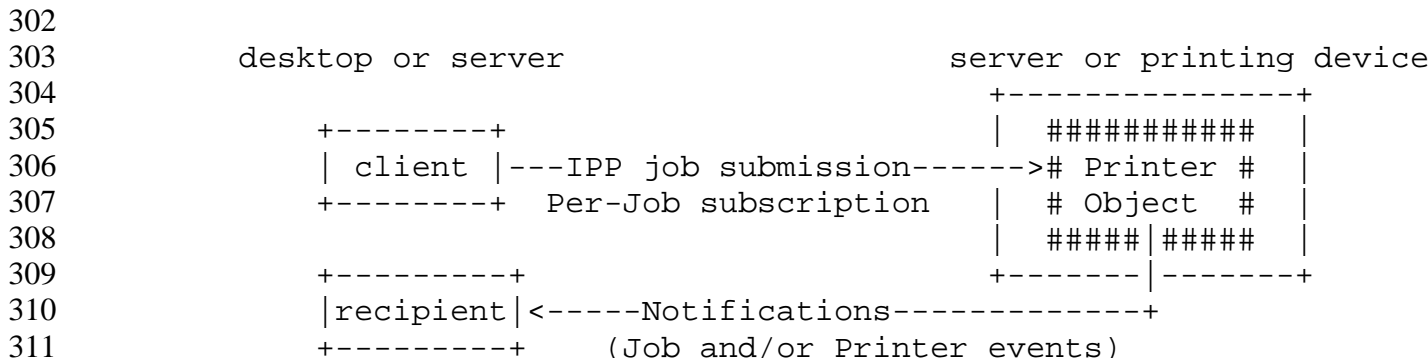
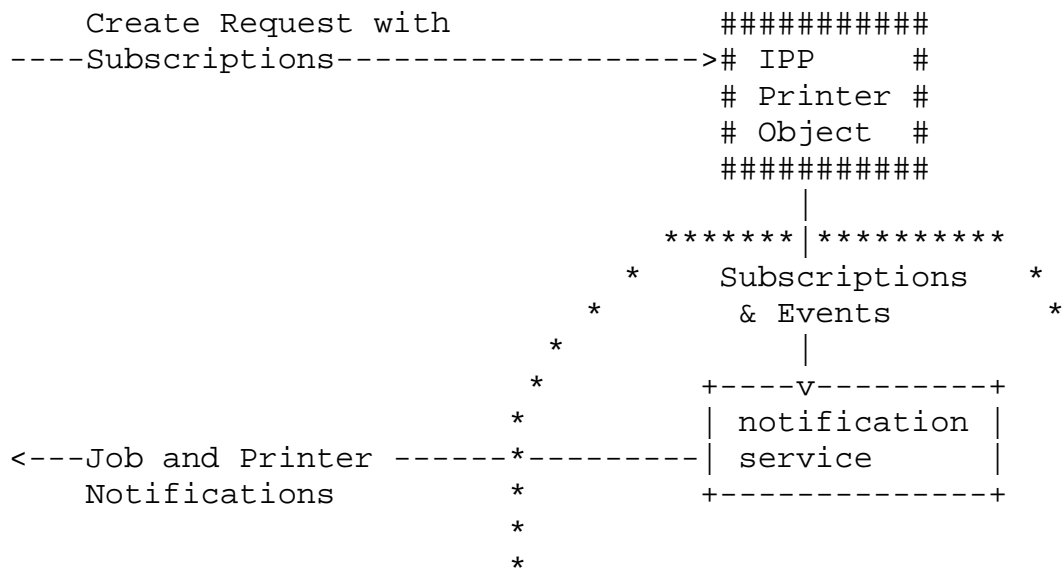


Figure 3 - Client-Printer Per-Printer Subscription and Notification Model

313 **2.3 Relationship between the Printer object and the Notification Delivery Service**

314 The IPP Notification model does not mandate that the IPP Printer object implement the full semantics of
 315 subscription, report generation, and multiple delivery methods itself. An implementation may be
 316 configured to use some other notification service. Figure 4 shows this partitioning.



334
 335 *** = Implementation configuration opaque boundary
 336

337 **Figure 4 - Opaque Use of a Notification Service**

338 If an IPP Printer does use some other notification service, it MAY do so in either of two ways:

- 339 1. The IPP Printer forwards the Subscriptions and the Events to the other notification service
 340 which then sends the Notifications to the proper Recipients.
- 341 2. The IPP Printer keeps the subscriptions and uses them to send Notifications to the other
 342 notification service which forwards them to Recipients that have also subscribed directly with
 343 the other notification service. Examples of this latter approach are paging and immediate
 344 messaging services.

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

347 **3 Terminology**

348 This section defines terminology used throughout this document.

349 **3.1 Conformance Terminology**

350 Capitalized terms, such as **MUST**, **MUST NOT**, **REQUIRED**, **SHOULD**, **SHOULD NOT**, **MAY**,
 351 **NEED NOT**, and **OPTIONAL**, have special meaning relating to conformance to this specification.

352 These terms are defined in [ipp-mod section 13.1 on conformance terminology, most of which is
353 taken from RFC 2119 [RFC2119].

354 *Since support of this entire notification specification is OPTIONAL for conformance to*
355 *IPP/1.0 or IPP/1.1, the use of the term REQUIRED in this document means*
356 *"REQUIRED if this notification specification is implemented". Likewise, the term*
357 *RECOMMENDED means "RECOMMENDED if this notification specification is*
358 *implemented".*

359 **READ-ONLY** - indicates an attribute that MUST NOT be settable using the Set-Job-Attributes or Set-
360 Printer-Attributes operations (see [ipp-set2]).

361 3.2 Other terminology

362 **Job Submitting End User** - A human end user who submits a print job to an IPP Printer. This person
363 may or may not be within the same security domain as the Printer. This person may or may not be
364 geographically near the printer.

365 **Administrator** - A human user who established policy for and configures the print system.

366 **Operator** - A human user who carries out the policy established by the Administrator and controls the
367 day to day running of the print system.

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

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

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

378 **Job Recipient** - A human who is the ultimate consumer of the print job. In many cases this will be the
379 same person as the Job Submitting End User, but need not be.

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

387 **Job Recipient Proxy** - A human acting on behalf of the Job Recipient. In particular, the Job Recipient
388 Proxy physically picks up the printed document from the Printer, if the Job Recipient cannot
389 perform that function. The Proxy is **by definition** geographically near and in the same security
390 domain as the printer.

391 Example: I submit a print job from home to be printed on a printer at work. I'd like my secretary to
392 pick up the print job and put it on my desk. In this case, I am acting as both Job Submitting End
393 User and Job Recipient. My secretary is acting as a Job Recipient Proxy

394 **Notification Subscriber (or Subscriber)** - A client that requests the IPP Printer to send Event
395 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-Subscription operation with a Job object as the target.

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

Notification Source - The entity that sends Event Notifications.

Notification Recipient - The entity identified as a recipient within a subscription that receives IPP Notifications about Job and/or Printer events. A Notification Recipient may be a: Job Submitting End User, Job Submitting Application (desktop or server), Job Recipient, Job Recipient Proxy, Operator, or Administrator, etc., and their representative or log file or usage statistics gathering application or other active or passive entities.

Notification Recipient Agent - A program which receives Notifications on behalf of the Notification Recipient. The agent may take some action on behalf of the recipient, forward the notification to the recipient via some alternative means (for example, page the recipient), or queue the notification for later retrieval by the recipient.

Event - An event is some occurrence (either expected or unexpected) within the printing system of a change of state, condition, or configuration of a Job or Printer object. A property of an event is that it only occurs at one instant in time and does not span the time the physical event takes place. For instance, jam-occurred and jam-cleared are two distinct events. The jam-occurred event is reported only when the jam initially occurs and only if there is one or more event subscriptions outstanding for that event.

Events can be classified along two dimensions:

- Either as Job Events or Printer Events, and
- Either as Errors, Warnings, or Reports

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

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

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

441 **Notification** - When an event occurs, a Notification is generated that fully describes the event (what
442 the event was, where it occurred, when it occurred, etc.). Notifications are delivered to each
443 Notification Recipient that has a subscription that includes the event, if any. The Notification is
444 delivered to the address of the Notification Recipient using the notification delivery method defined
445 in the subscription. However, a Notification is sent ONLY if there is a corresponding subscription.

446 **Notification Delivery Method** (or **Delivery Method** for short) - Notifications are delivered using a
447 method, such as email, TCP/IP, etc.

448 **Immediate Notification** - Notifications that are delivered using a delivery method which is not store-
449 and-forward (e.g. TCP connection, UDP datagram). This can be on the order of several minutes
450 subject to network latency.

451 **Store and Forward Notification** - A Notification which are not necessarily delivered to Notification
452 Recipients immediately, but is queued for delivery by some intermediate network application, for
453 later retrieval. Email is an example of a store and forward notification delivery method.

454 **Human Consumable Notification** - Notifications that are intended to be consumed by human End
455 Users only. They are simple text that has been localized for the Notification Recipient as specified
456 in the subscription. Programs are not intended to parse Human Consumable Notification, since it is
457 localized and the content depends on implementation. There is no standardized format.

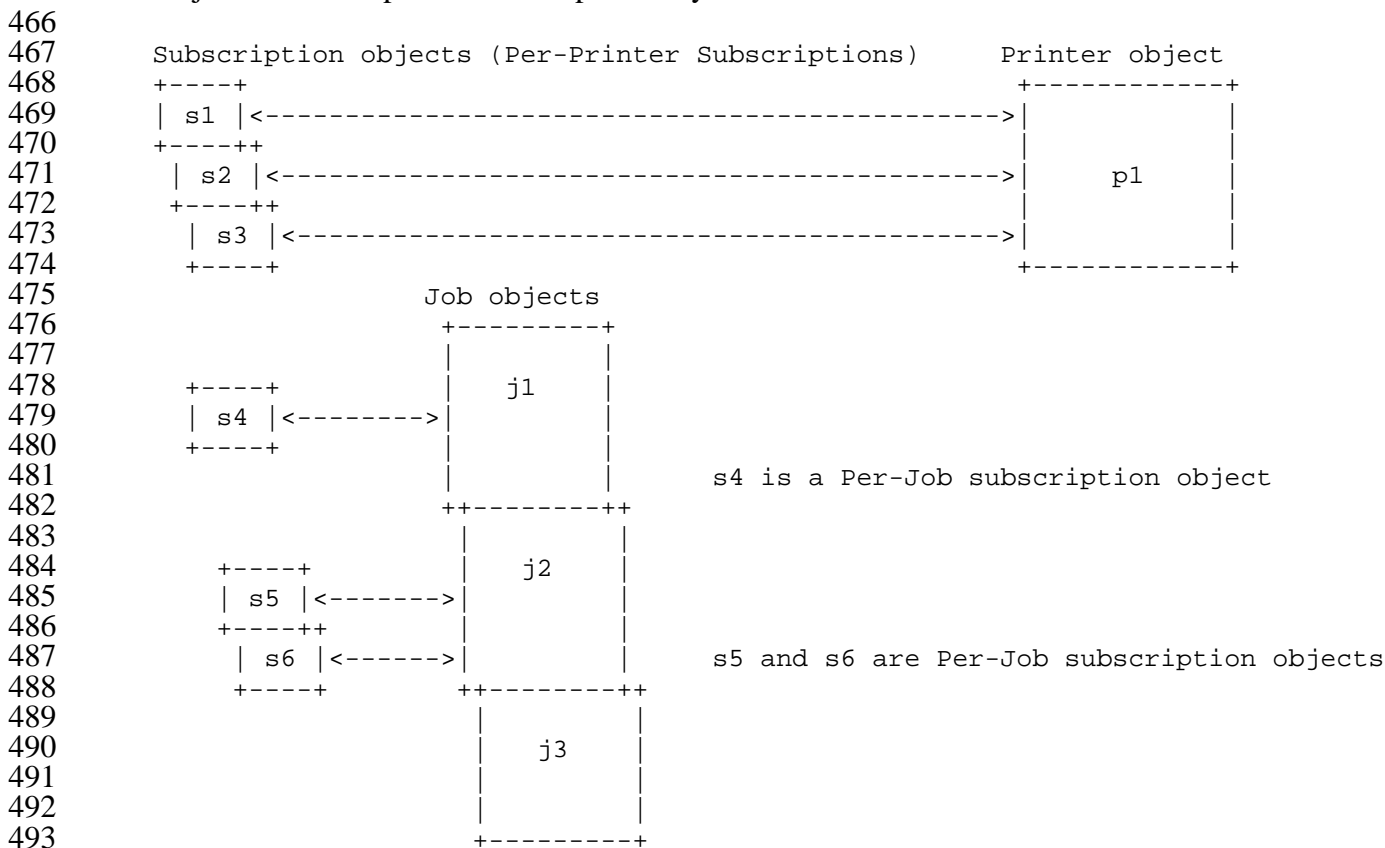
458 **Machine Consumable Notification** - Notifications that are intended for consumption by a program
459 only. They use the encoding of an IPP response. The Notification Recipient must localize the
460 contents, if displaying it to a human.

461 4 Object Model for Notification

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

464

465 The object relationships can be seen pictorially as:



494 **Figure 5 - Object Model for Notification**

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

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

497 **4.1 Object relationships**

498 The object relationships can be stated as follows:

- 499 1. The Printer object contains zero or more Per-Printer Subscription objects (p1 contains s1-s3 Per-Printer Subscription objects).
- 501 2. Each Per-Printer Subscription object (s1, s2, and s3) is contained in one Printer object (p1) and represents one Per-Printer subscription.
- 503 3. 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.
- 506 4. A Job object is associated with zero or more Per-Job subscription objects. 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 does 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

- 511 Subscription objects or MAY just use some internal bi-directional linking mechanism between the
512 Job and Subscription objects. Either implementation technique is transparent to the client.
- 513 5. Each "Per-Job" subscription object identifies one or more Job and/or Printer events. Such Job
514 events are only for *this* job (different than "per-Printer" Subscriptions). Such Printer events are for
515 *any* Printer event, no matter which job and when no jobs are processing (same as for "per-Printer"
516 Subscriptions).
- 517 6. A Per-Printer Subscription object cannot be contained in or associated with more than one Printer
518 object.
- 519 7. A Per-Job Subscription object cannot be contained in or associated with more than one Job object.

520 **5 Subscription Object attributes**

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

524

Table 2 - Subscription object attributes

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

525

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

526

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

527

notify-printer-up-time (integer(1:MAX))	R	Printer - returned by Get-Subscription-Attributes and Get-Subscriptions
---	---	---

528

529

530

531

532

533

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

534 **5.1 notify-recipient (uri)**

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

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

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

- 542 1) The URI scheme used.
- 543 2) The supported and default delivery format, and if not one of the specified types in Section 5.3,
544 description of the notification content.
- 545 3) Any content length restrictions imposed by the delivery protocol.
- 546 4) The latency of the delivery protocol used.
- 547 5) The reliability of the transport and delivery protocol used.
- 548 6) The security aspects of the transport and delivery protocol used, e.g. how it is handled in firewalls.
- 549 7) How the delivery protocol is initiated, e.g. does it have to be initiated by the receiving user (pull), or
550 is it initiated by the notification service (push).

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

554

555 **5.2 notify-events (1setOf type2 keyword)**

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

560 There are both job events and printer events. Each job and printer event is assigned a keyword to use in
561 this attribute and in the Notification.

562 The events are defined to be disjoint.

563 A Printer MUST support the events indicated as "REQUIRED".

564 The standard job event keyword values are:

565 **'none'**: REQUIRED - no notifications of any events (an IPP object can use this value to indicate that it
566 is configured not to support event notification; a client would not subscribe to this event).

567 **'job-created'**: REQUIRED - the Printer object has accepted a job creation operation (Print-Job, Print-
568 URI, or Create-Job) and the job's "time-at-creation" attribute value is set (see [ipp-mod] section
569 4.3.14.1). The Printer puts the job in the 'pending', 'pending-held' or 'processing' states.

570 Note: This event is separate from the 'job-state-changed' event so that it can be subscribed to

571 without having to get every job state change event for a Notification Recipient that is only
572 interested in when the job is first created.

573 **'job-completed'**: REQUIRED - the job has reached one of the completed states, i.e., the value of the
574 job's "job-state" attribute has changed to: 'completed', 'aborted', or 'canceled'. The Job's "time-at-
575 completed" and "date-time-at-completed" (if supported) attributes are set (see [ipp-mod] section
576 4.3.14).

577 Note: This event is separate from 'job-state-changed' so that it can be subscribed to without having
578 to get every job state change event for a Notification Recipient that is only interested in when the
579 job is completed.

580 **'job-state-changed'**: REQUIRED - the job has changed from any state to any other state and/or a
581 value has been added or removed from the job's "job-state-reasons" attribute, except when the job is
582 created or when the job moves to any of the "completed" job states ('completed', 'aborted', or
583 'canceled').

584
585 This event also indicates that one or more values have been added to or removed from the Job's
586 "job-state-reasons" attribute, such as 'job-queued' or 'job-printing', whether or not the job's state has
587 changed. If job state reasons are added when the job is created, only the 'job-created' event is
588 generated, in order to keep the events disjoint. If job state reasons are added or removed when the
589 job is completed, only the 'job-completed' event is generated, in order to keep the events disjoint.

590
591 A client that wants to subscribe to all job state changes, including creation and completion, includes
592 the 'job-created', 'job-state-changed', and 'job-completed' in the notification subscription. When a
593 job is finally removed from the Job History (see [ipp-mod] 4.3.7.1) no event is generated, i.e.,
594 neither a 'job-state-changed' event nor a 'job-purged' event is generated.

595 **'job-config-changed'**: OPTIONAL - when the configuration of a job has changed, i.e., the value of
596 the "job-message-from-operator" or any of the non-READ-ONLY Job attributes have changed, such
597 as any of the job template attributes or the "job-name" attribute. Typically, such a change is the
598 result of the user or the operator performing a Set-Job-Attributes operation (see [ipp-set2]) on the
599 Job object. The client performs a Get-Job-Attributes to find out the new values of the changed
600 attributes. This event is useful for GUI clients and drivers to update the job information to the user.

601 **'job-purged'**: OPTIONAL - when a 'not-completed' job (i.e., not 'completed', 'canceled', or 'aborted')
602 was purged from the printer using the Purge-Jobs operation. No event, including this event, is
603 generated when a job is aged out of the Job History or moved out explicitly with the Purge-Jobs
604 operation.

605 **'job-progress'** - a sheet or copy has completed. See separate [ipp-prog] spec.
606

607 The standard Printer event keywords values are:

608 **'none'**: REQUIRED - no notification of any events (an IPP object can use this value to indicate that it
609 is configured not to support event notification; a client would not subscribe to this event).

610 **'printer-restarted'**: OPTIONAL - when the printer is powered up or the Restart-Printer operation is
611 performed (see [ipp-set2]).

612 Note: This event is separate from the 'printer-state-changed' event so that it can be subscribed to
613 without having to get every printer state change event, for a Notification Recipient that is only
614 interested in when the Printer first comes up.

615 **'printer-shutdown'**: OPTIONAL - when the device is being powered down or the Shutdown-Printer
616 operation has been performed with either power-off or standby options (see [ipp-set2]).

Note: This event is separate from 'printer-state-changed' so that it can be subscribed to without having to get every Printer state change event, for a Notification Recipient that is only interested in when the Printer is powered down or shutdown.

'printer-state-changed': REQUIRED - the Printer changed state, i.e., the value of the Printer's "printer-state", "printer-state-reasons" (whether "printer-state" changed or not), and/or "printer-is-accepting-jobs" attributes changed, except when the Printer starts up or is shutdown. If printer state reasons are added when the Printer is started up, only the 'printer-restarted' event is generated, in order to keep the events disjoint. If printer state reasons are added or removed when the printer is powered-down or shutdown, only the 'printer-shutdown' event is generated, in order to keep the events disjoint.

A client that wants to subscribe to all printer state changes, including restart and power-down/shutdown, includes the 'printer-restarted', 'printer-state-changed', and 'printer-shutdown' in the notification subscription.

'printer-media-changed': OPTIONAL – when the media loaded on a printer has been changed, i.e., the "media-ready" attribute has changed. This event includes both an actual media change and filling an empty input tray with the same or different media. The client must check the "media-ready" Printer attribute (see [ipp-mod] section 4.2.11) separately to find out what new media was loaded or filled.

'printer-config-changed': OPTIONAL – when the configuration of a Printer has changed, i.e., the value of the "printer-message-from-operator" or any non-READ-ONLY Printer attribute has changed, except for "media-ready" (which has its own event), whether through the Set-Printer-Attributes operation or by other means and whether initiated by a human or not. For example, any "xxx-supported", "xxx-default", "printer-message-from-operator", etc. values have changed. The client has to perform a Get-Printer-Attributes to find out the new values of these changed attributes. This event is useful for GUI clients and drivers to update the available printer capabilities to the user.

'printer-queue-changed': OPTIONAL - the order of jobs in the Printer's queue has changed, so that an application that is monitoring the queue can perform a Get-Jobs operation to determine the new order. This event does not include when a job enters the queue (the 'job-created' event covers that) and does not include when a job leaves the queue (the 'job-completed' event covers that).

'printer-no-longer-full': OPTIONAL – when the Printer can now accept a Print-Job, Print-URI, Create-Job, Send-Document, or Send-URI request. This event is used when there is more than one client feeding a printer/server (fan-in), and the Printer may still be printing but has acquired more buffer space to accept jobs. This event only occurs when the Printer did not have room to accept jobs previously and rejected a Print-Job, Print-URI, Create-Job, Send-Document, or Send-URI operation.

'printer-almost-idle': OPTIONAL – when the Printer needs another Job in order to stay busy. This event is used when a spooler is feeding more than one printer/server (fan-out), and the spooler holds jobs until a Printer requests them, rather than committing jobs to IPP Printers before it is necessary. This event MAY be used by a Printer implementation to request a new job from any subscribers sufficiently ahead of time so that the device does not run out of work between jobs.

660 5.3 notify-content-type (mimeMediaType)

661 This REQUIRED READ-ONLY Subscription object attribute specifies the type of content that is to be sent
 662 in the notifications. Thus the subscriber can control whether the event notification content is Human
 663 Consumable or Machine Consumable. Most delivery methods support both forms of content type and
 664 MUST define one of them as the default. If a delivery method only supports one form of content type, then
 665 that form is also the default.

666 If the MIME media type registration permits a charset parameter, than such a specification MUST be used
 667 (instead of the "notify-attributes-charset" attribute) in order to indicate the charset to be used in the
 668 notification content.

669 If the Subscriber did not supply this attribute when requesting the subscription, the Printer object populates
 670 this attribute from the default value defined for the delivery method.

671 Standard mimeMediaType values are:

672 'application/ipp' - the Machine Consumable notification content using the 'application/ipp' MIME
 673 media type [ipp-mod] as defined in section 7.

674
 675 'text/plain; charset=utf-8': A plain text document in ISO 10646 represented as UTF-8 [RFC-2044]
 676 as defined in section 7.

677 ISSUE 2 - Should notify-content-type (mimeMediaType) be changed to notify-content-type (type2
 678 keyword), with values: 'human-consumable' and 'machine-readable'? Then content types that are neither
 679 'application/ipp' or 'text/plain; charset=utf-8' could be handled without having to be registered. For
 680 example, the 'snmp-ipp' is a trap MIB Machine Consumable format wouldn't not need to be registered (or
 681 have some special rule since the 'snmp-ipp' value doesn't have a registered MIME type and doesn't fit either
 682 'application/ipp' or 'text/plain'. Another advantage is that the charset would always be indicated in the
 683 "notify-attributes-charset" operation attribute, even for plain text.

684 ISSUE 3 - There is no good way for a client to discover which "notify-content-type" values are supported
 685 for each delivery method "notify-schemes-supported". Adding "notify-content-type-supported" doesn't
 686 work, since the delivery methods have to be paired with the content types. Instead, how about only having
 687 each scheme support one or the other content type? Then we don't need "notify-content-type" as all. For
 688 the 'mailto' scheme, we specify it is human-consumable, i.e., text, and then register a 'mailto-ipp' scheme
 689 which is the 'application/ipp' scheme.

690 5.4 subscriber-user-data (octetString(63))

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

699 **5.5 notify-attributes-charset (charset)**

700 This OPTIONAL READ-ONLY Subscription object attribute specifies the charset to be used in the
701 Notification content sent to the notification recipient. This attribute MUST NOT be used when the "notify-
702 content-type" attribute value specifies the charset parameter in its MIME media type value.

703 **ISSUE 4 - Should the Subscription object attributes "notify-attributes-charset (charset)" and "notify-
704 attributes-natural-languages (naturalLanguage)" be renamed to simply "attributes-charset (charset)" and
705 "attributes-natural-languages (naturalLanguage)" so that all IPP requests and objects have the same names?
706 Then the "notify-attributes-charset (charset)" and "notify-attributes-natural-languages (naturalLanguage)"
707 would only be operation attributes that set or reflect the "attributes-charset (charset)" and "attributes-
708 natural-languages (naturalLanguage)" Subscription object attributes.**

709 **5.6 notify-attributes-natural-languages (naturalLanguage)**

710 This OPTIONAL READ-ONLY Subscription object attribute specifies the natural language for the IPP
711 object to use in the Notification content that is sent to the Notification Recipient.

712 **5.7 request-id**

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

718 **5.8 subscription-id (integer (1:MAX))**

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

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

732 **5.9 notify-lease-expiration-time (integer(0:MAX))**

733 This REQUIRED READ-ONLY Subscription object attribute specifies the time in the future when the
734 subscription lease will expire, i.e., the "printer-up-time" value at which the lease will expire. When the
735 Printer object creates a Per-Printer Subscription object, it populates this attribute with the appropriate value.
736 When the indicated time arrives, the Printer MUST delete the Per-Printer Subscription object. Per-Job

737 Subscription objects always return a value of 0 since Per-Job Subscriptions don't have a lease, but exist for
738 the life-time of the Job instead.

739 A client is able to extend a lease of a Per-Printer subscription using the Renew-Subscription operation (see
740 section 8.2.4). A value of 0 indicates an infinite time, if such a policy is supported as indicated in the
741 "notify-lease-time-supported" (integer(0:MAX)) Printer Description attribute (see section 6.7) and the
742 subscriber is authorized to request an infinite lease. A Per-Job subscription cannot be renewed.

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

746 **5.10 printer-uri (uri)**

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

751 **5.11 subscriber-user-name (name(MAX))**

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

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

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

766 **5.12 notify-printer-up-time (integer(1:MAX))**

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

771 Note: A client can request this attribute in a Get-Subscription-Attributes or Get-Subscriptions request and
772 use the value returned in combination with the "notify-lease-expiration-time" (see section 5.9) in order to
773 display wall clock time equivalent to the user. The difference between this attribute and the 'integer' value
774 of the "notify-lease-expiration-time" attribute is the number of seconds in the future that the subscription

775 will expire. A client can compute the wall-clock time at which the subscription will expire by adding this
776 difference to the client's wall-clock time.

777 6 Printer Description Attributes related to Notification

778 This section defines the Printer Description attributes that are related to Notification.

779 **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
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

780 ISSUE 5 - Shouldn't we add a "number-of-printer-subscriptions" Printer Description attribute, since the
781 client is NOT assured that it can determine the number of outstanding Per-Printer Subscriptions by doing
782 Get-Subscriptions because of access control?

783 ISSUE 5a - Shouldn't we add a "number-of-job-subscriptions" Job Description attribute, since the client is
784 NOT assured that it can determine the number of outstanding Per-Job Subscriptions by doing Get-
785 Subscriptions because of access control and since there are no Job Descriptions attributes associated with
786 notification.

787 6.1 notify-schemes-supported (1setOf uriScheme)

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

790 6.2 notify-events-default (1setOf type2 keyword)

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

794 6.3 notify-events-supported (1setOf type2 keyword)

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

797 6.4 max-events-supported (integer(5:MAX))

798 This REQUIRED Printer attribute specifies the maximum number of events that are supported in a single
799 Per-Job or Per-Printer subscription which must be the same. A Printer MUST support at least 5 events per
800 subscription, so that clients can depend on at least 5 events in a single subscription. If the number of events
801 supplied by a client in a subscription exceed this number, the Printer rejects the request and returns the
802 'server-error-too-many-events (see section 14.3). If notification is not supported, this attribute MUST NOT
803 be supported.

804 6.5 max-job-subscriptions-supported (integer(1:MAX))

805 This REQUIRED Printer attribute specifies the maximum number of Per-Job subscriptions that are
806 supported in a single Job Creation request, i.e., the maximum number of collection values for the "job-
807 notify" operation attribute, and/or subsequent Create-Subscription operations adding Per-Job subscriptions
808 to the job object. A value of 0 indicates no effective maximum. A Printer MUST support at least 1 Per-Job
809 subscription. If the number of Per-Job subscriptions supplied by a client in a Job Creation request, the
810 Printer accepts the Job Creation and ignores the excess subscriptions. If a subsequent Create-Subscription
811 request would exceed this number, the Printer rejects the request and returns the 'server-error-too-many-
812 subscriptions' (see section 14.2).

813 6.6 max-printer-subscriptions-supported (integer(0:MAX))

814 This REQUIRED Printer attribute specifies the maximum number of Per-Printer subscriptions that are
815 supported by multiple Create-Subscription requests, i.e., the maximum number of un-expired Per-Printer
816 Subscription objects that the Printer supports at a time. A value of 0 indicates no effective maximum. A
817 Printer MUST support at least 1 Per-Printer subscription. If the number of Per-Printer subscriptions would
818 exceed this number, the Printer rejects the Create-Subscription request and returns the 'server-error-too-
819 many-subscriptions' (see section 14.2).

820 6.7 notify-lease-time-supported (rangeOfInteger(0:MAX))

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

827 6.8 notify-lease-time-default (integer(0:MAX))

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

831 6.9 persistent-jobs-supported (boolean)

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

836 6.10 persistent-subscriptions-supported (boolean)

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

842 6.11 printer-state-change-time (integer(1:MAX))

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

846 6.12 printer-state-change-date-time (dateTime)

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

850 7 Notification Content

851 This section defines the Notification content that is sent to a Notification Recipient when an event occurs.
 852 The Notification MAY be sent by the IPP Printer or a third party Notification Service (see section 2.3).
 853 There are two notification content types: Machine Consumable and Human Consumable. For most
 854 notification delivery methods both content types are defined. Some of the notification delivery methods are
 855 defined to support only one content type. A Printer MUST support all content types defined for a
 856 notification delivery method, if it supports that notification delivery method.

857 7.1 Notification content MIME media type formats

858 This section defines the Notification content that the Notification Source sends asynchronously to each
 859 Notification Recipient based on the subscription information stored with the subscription.

860 Notifications are generated using the following content formats:

861 **'application/ipp'** - Machine Consumable notification content using the 'application/ipp' MIME
 862 media type [ipp-mod] using the Get-Job-Attributes response encoding for job events and Get-
 863 Printer-Attributes for printer events. The attributes listed in sections 7.2 and 7.3 are sent in an
 864 notification for Job events. The attributes listed in sections 7.2 and 7.4 are sent in an
 865 notification for Printer events. For any 'text' or 'name' attribute value in any notification, the
 866 charset and natural language rules that apply to all IPP operations apply to these attributes as

well, since they are represented as operation responses. The Unsupported Attributes Group in the response is not sent. If the values of any of the attributes sent in a notification content are not known, the value sent in the report content is the out-of-band 'unknown' value, rather than omitting the attribute (see the beginning of [ipp-mod] section 4.1).

An implementation MAY extend the contents of the Machine Consumable notification by adding additional attributes.

'text/plain; charset=utf-8' - Human Consumable notification content type [RFC2046]. The text message SHOULD include information about the attributes in sections 7.2 and 7.3 for job events or in sections 7.2 and 7.4 for printer events. This information is localized according to the information about natural language and charset in the subscription.

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

7.2 Notification content attributes common to Job and Printer events

This section lists the parameters and attributes that are included in both Job and Printer event Notifications. Some events do not include all of these attributes as shown in Table 4. Each notification content contains a single Job or Printer event, whether that event was subscribed using the Job Submission Subscription mechanism or the Per-Printer subscription mechanism. If either kind of subscription subscribed to both Job and Printer events, then they will be sent as separate Job notification content and Printer notification contents to the same Notification Recipient. References of the form "mod m.n.o" refer to [ipp-mod] sections.

Table 4 - Common Job and Printer Notification content attributes

	Reference	Events	
Attributes		'job-progress'	all others
1. version-number (integer (0:32767))	mod 3.1.1	R	R
2. 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**

	Reference	Events	
Attributes		'job-progress'	all others
10. trigger-event (type2 keyword)	5.2	R	R
11. trigger-time (integer(MIN:MAX))		R	R
12. trigger-date-time (dateTime)			O
13. subscription-id (integer(1:MAX))	5.8	R	R
14. subscriber-user-name (name(MAX))	5.11		R
15. subscriber-user-data (octetString(63))	5.4		R

888 Attribute Notes:

889 "status-code" - a value of 600 for a Job event and 601 for a Printer event.

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

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

893 "attributes-natural-language" - the value comes from the "notify-attributes-natural-language" attribute in the
894 Subscription object.

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

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

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

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

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

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

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

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

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

908 **7.3 Additional Notification content attributes for Job events *only***909 This section lists the additional attributes that are included only in Job event Notifications. Some events do
910 not include all of these attributes as shown in Table 5.911 **Table 5 - Additional Notification content attributes for Job events *only***

		Events		
Attributes	Reference	'job-progress'	'job-completed'	all others
16. job-state (type1 enum)	mod 4.3.7		R	R
17. job-state-reasons (1setOf type2 keyword)	mod 4.3.8		R	R
18. job-k-octets-processed (integer(0:MAX))	mod 4.3.18.1	O	O	
19. job-impressions-completed (integer(0:MAX))	mod 4.3.18.2	O	O	
20. job-media-sheets-completed (integer(0:MAX))	mod 4.3.18.3	O	O	
21. job-collation-type (type2 enum)	[ipp-prog]	R		
22. sheet-completed-copy-number (integer(-2:MAX))	[ipp-prog]	R		
23. sheet-completed-document-number(integer(-2:MAX))	[ipp-prog]	R		
24. impressions-interpreted (integer(-2:MAX))	[ipp-prog]	R		
25. impressions-completed-current-copy (integer(-2:MAX))	[ipp-prog]	R		

912 **7.4 Additional Notification content attributes for Printer events *only***

913 Table 6 lists the additional attributes that are included only in Printer event Notifications.

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

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

915

916 **8 Operations for notification**

917 This section defines all of the operations for notification.

918 8.1 Operations for Per-Job Subscriptions *only*

919 This section defines the REQUIRED operation requests and responses that are related to Per-Job
 920 subscriptions. Section 8.2 defines the REQUIRED operation requests and responses associated with the
 921 REQUIRED Per-Printer subscription and its Subscription object.

922 8.1.1 Job Creation Operations (Create-Job, Print-Job, Print-URI) and Validate-Job

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

929 If a Printer does not support this notification specification, then it MUST ignore the "job-notify" operation
 930 attribute and return it in the response indicated as an attribute that is not supported. See [ipp-mod] section
 931 3.1.7 for details on returning Unsupported Attributes.

932 **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-content-type (mimeMediaType)	5.3	no	REQUIRED
subscriber-user-data (octetString(63))	5.4	no	REQUIRED
notify-attributes-charset (charset)	5.5	no	OPTIONAL
notify-attributes-natural-language (naturalLanguage)	5.6	no	OPTIONAL

933

934 See the referenced sections for a definition of these operation attributes, since they are copied to the [Job](#)
 935 [Subscription](#) object as the [Job-Subscription](#) Description attributes described in section 5.

936 The following rules apply to Per-Job subscriptions:

- 937 1. Any subscription can contain job events, printer events, or both.
- 938 2. The Job Submission Subscription is only valid while the job is "not-completed". The job is "not-
 939 completed" while it is in the 'pending', 'pending-held', 'processing', and 'processing-stopped' states. The
 940 job changes from being "not-completed" to "retained" when it is done processing and enters any of the
 941 'completed', 'canceled', or 'aborted' states. The job becomes "not-completed" again when it is restarted
 942 using the Restart-Job operation (see [ipp-mod]).
- 943 3. Since no job is created for the Validate-Job operation, the only purpose of supplying the subscription
 944 operation attributes in the Validate-Job operation is to validate that the values are supported; the Printer
 945 object does not establish a notification subscription as a result of the Validate-Job operation.
- 946 4. Since a Job Submission Subscription is included within a job submission operation, any interest in job
 947 events is limited to "this job" only (the Job object created because of this job creation operation). There

948 is no mechanism to subscribe to events for all jobs or specifically some job other than this job in a
 949 create operation. But see the Create-Subscription operation (section 8.2.1) for an explicit operation to
 950 subscribe for job and/or printer events independently of any particular job submission.

- 951 5. Event reporting only occurs when a notification recipient has specified a subscription to any event(s).
- 952 6. The notification implementation MAY allow an administrator to configure a policy on what events may
 953 be dropped.
- 954 7. If the OPTIONAL "notify-attributes-charset" attribute is not supported or the supplied value is not
 955 supported, the IPP Printer MUST return the attribute in the Unsupported Attributes Group but still
 956 accept the operation, as with all Job create operations. In this case, the Printer MUST use the natural
 957 language supplied in the "attributes-charset" Job creation operation attribute, if that natural language
 958 value is supported by the Printer, else the Printer object MUST use the Printer's "charset-configured"
 959 value. See the Print-Job operation in [ipp-mod].
- 960 8. If the OPTIONAL "notify-attributes-natural-language" attribute is not supported or the supplied value is
 961 not supported, the IPP Printer MUST return the attribute in the Unsupported Attributes Group but still
 962 accept the operation, as with all Job create operations. In this case, the Printer MUST use the natural
 963 language supplied in the "attributes-natural-language" Job creation operation attribute, if that natural
 964 language value is supported by the Printer, else the Printer object MUST use the Printer's "natural-
 965 language-configured" value. See the Print-Job operation in [ipp-mod].
- 966 9. If a collection contains other unrecognized, unsupported member attributes and/or conflicting value, the
 967 attribute returned in the Unsupported Group is a collection containing the unrecognized, unsupported
 968 member attributes, and/or conflicting values. The unrecognized member attributes have an out-of-band
 969 value of unsupported. The unsupported member attributes and conflicting values have their unsupported
 970 values. See [ipp-coll].

972 8.2 Common Operations for Per-Job and Per-Printer Subscriptions

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

974 8.2.1 Create-Subscription operation

975 The REQUIRED Create-Subscription operation creates either a Per-Job or a Per-Printer subscription by
 976 creating a Subscription object . The client can specify one or more job and/or printer events to be delivered
 977 as notifications to one Notification Recipient. For the Per-Job subscription, the Job events are for this job
 978 only. For the Per-Printer subscription, the job events are for any job submitted to the Printer. For both Per-
 979 Job and Per-Printer subscriptions, the printer events are any events generated by that Printer.

980 The Printer returns a subscription id and the length of time for which it has granted a lease for the
 981 subscription. If the requested subscription object is a Per-Job subscription, the Printer MUST grant an
 982 infinite lease by returning a 0 value for the "notify-lease-time-granted".

983 The client must renew the Per-Printer subscription using the Renew-Subscription operation (see section
 984 8.2.4) before the lease runs out in order to maintain the subscription. A client can unsubscribe using the
 985 Cancel-Subscription operation (section 8.2.5) and the subscription id.

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

991 If the Printer has a bounded set of concurrent subscriptions), the printer rejects the operation and returns the
 992 'server-error-too-many-subscriptions' status code. The client SHOULD try again later.

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

999 Request :

Group 1: Operation Attributes		Printer support
"attributes-charset" (charset)		R
"attributes-natural-language" (naturalLanguage)		R
"printer-uri" (uri)		R
["job-id" (integer(1:MAX))]		R
["requesting-user-name" (name(MAX))]		RECOMMENDED
["notify-recipient" (uri)]		R
["notify-events" (1setOf type2 keyword)]		R
["notify-content-type" (mimeMediaType)]		R
["subscriber-user-data" (octetString(63))]		R
["notify-attributes-charset" (charset)]		O
["notify-attributes-natural-language" (naturalLanguage)]		O
["notify-lease-time-requested" (integer(0:MAX))]		R
["notify-persistence-requested" (boolean)]		O

1000 Response :

Group 1: Operation Attributes		Printer Support
"status-code" (type2 enum)		R
"attributes-charset" (charset)		R
"attributes-natural-language" (naturalLanguage)		R
["status-message" (text(255))]		O
["detailed-status-message" (text(MAX))]		O
"subscription-id" (integer(1:MAX))		R
"notify-lease-expiration-time" (integer(0:MAX))		R
"notify-lease-time-granted" (integer(0:MAX))		R
"notify-persistence-granted" (boolean)		R
Group 2: Unsupported Attributes		R

1001 Attribute Notes:

1002 "job-id" (integer(1:MAX)) - the client supplies this attribute in order to create a Per-Job subscription for the
1003 Job identified by the "job-id" value. If "job-id" is not supplied, then the subscription is a Per-Printer
1004 subscription.

1005 "notify-recipient" (uri) - the client MUST supply this attribute in order to have a subscription.

1006 "notify-lease-time-requested" (integer(0:MAX)) - the number of seconds requested for the subscription
1007 lease. A value of 0 indicates a request that the Per-Printer Subscription lease never expire.
1008 Supplying a 0 value MAY require authentication in order to be used, if 0 is supported at all.
1009 If the client does not supply this attribute, the Printer uses its "notify-lease-time-default" value (see
1010 section 6.8).

1011 "notify-persistence-requested" (boolean) - whether or not the Per-Printer Subscription is to be persistent,
1012 i.e., saved across power cycles. Note: Persistent trap registrations is a client option in SNMPv3
1013 [RFC2573].

1014 "notify-lease-expiration-time" (integer(0:MAX)) - The Printer object MUST return this attribute which is
1015 the time in the future at which the subscription lease will expire, i.e., the "printer-up-time" value (in
1016 time ticks - see [ipp-mod] section 4.4.29) at which the Printer will delete the Subscription. A value
1017 of 0 indicates that the lease subscription will never expire. If the Subscription object is a Per-Job
1018 subscription, the Printer MUST return 0 indicating that the lease doesn't expire, since Per-Job
1019 subscriptions expire when the Job object is no longer retained.

1020 "notify-lease-time-granted" (integer(0:MAX)) - The Printer object MUST return this attribute which is the
1021 number of seconds of time actually granted. The value of "notify-lease-time-granted" may be less
1022 than the requester requested in the "notify-lease-time-requested" if it was greater than the MAX
1023 supported or more than the requester requested if it was less than the MIN supported, as indicated in
1024 the Printer's "notify-lease-time-supported" (rangeOfInteger(0:MAX)) attribute. If the Subscription
1025 object is a Per-Job subscription, the Printer MUST return 0 indicating that the lease doesn't expire,
1026 since Per-Job subscriptions expire when the Job object is no longer retained.

1027 **ISSUE 6 - Instead of Create-Subscription response returning "notify-lease-time-granted" which is NOT a**
1028 **Subscription object attribute, it is cleaner for implementation to return the "notify-printer-up-time"**
1029 **Subscription attribute instead, which is a Subscription object attribute. The client subtracts the "notify-**
1030 **printer-up-time" from the "notify-lease-expiration-time" to get the number of second remaining in the lease,**
1031 **just as it would for a Get-Subscript-Attributes response. OK to replace the "notify-lease-time-granted" with**
1032 **the "notify-printer-up-time" attribute in the response?**

1033 "notify-persistence-granted" - whether or not this Subscription object instance is persistent. This attribute
1034 MUST be returned whether "notify-persistence-requested" is supported or not, so that the client
1035 knows which.

1036 **ISSUE 7 - Should "notify-persistence-granted" be a Subscription object attribute too, so that all attributes**
1037 **returned in a response are Subscription object attributes?**

1038 **8.2.2 Get-Subscription-Attributes operation**

1039 The REQUIRED Get-Subscription-Attributes returns the requested attributes of the identified Subscription
 1040 object. See section 5.

1041 Request:

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

1042 Response:

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

1043 This operation is similar to the Get-Printer-Attributes operation. If the client omits the "requested-
 1044 attributes" operation attribute, the Printer MUST respond as if the client had supplied the 'all' value, i.e.,
 1045 return all of the attributes supported for the Subscription object.

1046 **8.2.3 Get-Subscriptions operation**

1047 The REQUIRED Get-Subscriptions operation returns the requested attributes of the Subscription objects
 1048 (see section 5).

1049 Request:

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

1050 Response:

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

1051

1052 Attribute Notes:

1053 This operation is similar to the Get-Jobs operation (see [ipp-mod]). If the client wants any attributes
 1054 returned, including the "subscription-id", it must include the attribute keyword name in the "requested-
 1055 attributes" operation attribute. If the "requested-attributes" operation attribute is omitted, the Printer MUST
 1056 respond as if the client supplied the value: 'subscription-id'.

1057 "job-id" (integer(1:MAX)) - If the client supplies this attribute, all of the Per-Job Subscription objects for
 1058 the identified job are candidates for return. If this attribute is omitted, all of the Per-Printer
 1059 Subscription objects are candidates for return.

1060 "my-subscriptions" (boolean) - If the client supplies the "my-subscriptions" with a 'false' value or omits it,
 1061 the Printer returns all subscriptions, subject to the security policy in force.

1062 Groups 3 to N: Subscription Object Attributes: The Printer object responds with one set of Subscription
 1063 Object Attributes for each returned Subscription object. The Printer object ignores (does not
 1064 respond with) any requested attribute or value which is not supported or which is restricted by the
 1065 security policy in force, including whether the requesting user is the user that created the
 1066 Subscription object (subscribing user) or not (see [ipp-mod] section 8).

1067 **8.2.4 Renew-Subscription operation**

1068 The REQUIRED Renew-Subscription operation permits a client to request the IPP Printer to extend the
 1069 lease on a Subscription object instance. There is no way to renew a Per-Job subscription, since they are
 1070 automatically canceled after the job completes and no longer has any documents, i.e., the job is no longer
 1071 retained (see [ipp-mod] section 4.3.7.2). If the requested subscription object is a Per-Job subscription, the
 1072 Printer MUST grant an infinite lease by returning a 0 value for the "notify-lease-time-granted".

1073 *Access Rights:* The authenticated user (see [IPP-MOD] section 8.3) performing this operation MUST either
 1074 be the owner of the Subscription object or have operator or administrator access rights for the Printer object
 1075 (see [IPP-MOD] sections 1 and 8.5). Otherwise the IPP object MUST reject the operation and return:
 1076 client-error-forbidden, client-error-not-authenticated, and client-error-not-authorized as appropriate.

1077 Request:

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

1078 Response:

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

1079 Attribute Notes:

1080 "notify-lease-time-requested" (integer(0:MAX) - the number of seconds requested for the Per-Printer
 1081 subscription lease. Same as Create-Subscriptions (see section 8.2.1).

1082 "notify-lease-expiration-time" - the time in the future when the subscription will expire. Same as for the
 1083 Create-Subscription operation (see section 8.1.1).

1084 "notify-lease-time-granted" - the lease time (number of seconds) actually granted. Same as for the Create-
 1085 Subscription operation (see section 8.1.1).

1086 **ISSUE 8 - Instead of Renew-Subscription response returning "notify-lease-time-granted" which is NOT a**
 1087 **Subscription object attribute, it is cleaner for implementation to return the "notify-printer-up-time"**
 1088 **Subscription attribute instead, which is a Subscription object attribute. Ok to replace the "notify-lease-**
 1089 **time-granted" with the "notify-printer-up-time" attribute in the response?**

1090 Note: There is no way to change any of the Subscription object attributes, except the "notify-lease-
 1091 expiration-time" attribute. In order to change other attributes, a client can create a new Subscription object
 1092 and then use the Cancel-Subscription operation to cancel the old one (or do this in the other order, in case
 1093 there is a limit on the number of Subscription object instances, as long as a short window with no
 1094 Notifications is ok).

1095 Note: There is no need to renew a Per-Job Subscription, since it is effectively the time that the Job is active
 1096 (see section 8.1.1).

1097 **8.2.5 Cancel- Subscription operation**

1098 The REQUIRED Cancel- Subscription operation allows a client to remove a Subscription object. No more
 1099 Notifications are delivered for that Subscription. Once performed, there is no way to use that Subscription

1100 in the future. Subscription-ids should not be reused immediately, so that a stale reference situation is not
 1101 created. Same as for Cancel-Job and job-ids.

1102 *Access Rights:* The authenticated user (see [IPP-MOD] section 8.3) performing this operation MUST either
 1103 be the owner of the Subscription object or have operator or administrator access rights for the Printer object
 1104 (see [IPP-MOD] sections 1 and 8.5). Otherwise the IPP object MUST reject the operation and return:
 1105 client-error-forbidden, client-error-not-authenticated, and client-error-not-authorized as appropriate.

1106 Request:

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

1107 Response:

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

1109 9 Comparison of Per-Job versus Per-Printer Subscriptions

1110 Per-Job and Per-Printer subscriptions are quite similar. Either type of subscription can subscribe to Job
 1111 events, Printer events, or both. Both types of subscriptions can be created using the Create-Subscription
 1112 operation, queried using the Get-Subscriptions and Get-Subscription-Attributes operations, and canceled
 1113 using the Cancel-Subscription operation. Both types of subscriptions create Subscription objects which
 1114 have the same attributes defined. However, there are some semantic differences between Per-Job
 1115 subscriptions and Per-Printer subscriptions. A Per-Job Submission Subscription is established by the client
 1116 when submitting a job and after creating the job using the Create-Subscription operation by specifying the
 1117 "job-id" of the job. A Per-Printer Subscription is established between a client and a Printer using the
 1118 Create-Subscription operation. Some specific differences are:

- 1119 1. A client usually creates a Per-Job subscription as part of the Job Creation operations (Create-Job, Print-
 1120 Job, and Print-URI), rather than using the Create-Subscription operation.
- 1121 2. For Per-Job subscriptions, the subscription is only valid while the job is "not-complete" (see sections
 1122 7.2 and 7.3) while for the Per-Printer subscriptions, the subscription is valid until the time (in seconds)
 1123 that the Printer returned in the "notify-lease-time-granted" operation attribute expires.
- 1124 3. Job Events in a Per-Job subscription apply only to "one job" (the Job created by the job creation
 1125 operation) while Job Events in a Per-Printer subscription apply to ALL jobs contained in the IPP Printer
 1126 object.

10 Conformance Requirements

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

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

If IPP Notification is implemented, the operations described in this document must be supported as described in Table 8:

Table 8 - Conformance Requirements for Operations

Attribute	Conformance requirements
"job-notify" in Job Creation operations (section 8.1.1)	REQUIRED
Create-Subscription (section 8.2.1)	REQUIRED
Get-Subscription-Attributes (section 8.2.2)	REQUIRED
Get-Subscriptions (section 8.2.3)	REQUIRED
Renew-Subscription (section 8.2.4)	REQUIRED
Cancel-Subscription (section 8.2.5)	REQUIRED

11 IANA Considerations

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

12 Internationalization Considerations

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

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

13 Security Considerations

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

1154 IPP Printer receiving the print request to validate the identity of an event recipient”) argues against this.
1155 Certain systems may decide to disallow third party notifications (a traditional fax model).

1156 Clients submitting notification requests to the IPP Printer has the same security issues as submitting an
1157 IPP/1.1 print job request. The same mechanisms used by IPP/1.1 can therefore be used by the client
1158 notification submission. Operations that require authentication can use the HTTP authentication.
1159 Operations that require privacy can use the HTTP/TLS privacy.

1160 The notification access control model should be similar to the IPP access control model for Jobs. Creating
1161 a Per-Printer Notification Subscription object is associated with a user. Only the creator or an operator can
1162 cancel the subscription. The system may limit the listing of items to only those items owned by the user.
1163 Some subscriptions (e.g. those that have a lifetime longer than a job) can be done only by privileged users
1164 (users having operator and/or administrator access rights), if that is the authorization policy.

1165 The standard security concerns (delivery to the right user, privacy of content, tamper proof content) apply
1166 to the notification delivery. IPP should use the security mechanism of the delivery method used. Some
1167 delivery mechanisms are more secure than others. Therefore, sensitive notifications should use the delivery
1168 method that has the strongest security.

1169 **14 Status Codes**

1170 The following status codes are defined as extensions for notification:

1171 **14.1 client-error-uri-notification-scheme-not-supported (0x04??)**

1172 The scheme of the client-supplied URI in a "notify-recipient" operation attribute in a Create-Subscription
1173 operation is not supported. See [ipp-mod] section 3.1.7.

1174 There is no corresponding Per-Job subscription error for a Job Creation operation, since the Printer object
1175 MUST ignore any errors in the "job-notify" operation attribute, MUST return the "notify-recipient"
1176 attribute in the Unsupported Attributes Group, and perform the Job Creation operation (see section 8.1.1),
1177 since the job can still be printed.

1178 **14.2 server-error-too-many-subscriptions (0x04??)**

1179 The bounded set of concurrent Per-Printer subscriptions supported by the Printer object would be exceeded
1180 if this request were accepted.

1181 Note: There is no corresponding Per-Job subscription error, since the Printer object MUST ignore any
1182 errors in the "job-notify" operation attribute and perform the Job Creation operation (see section 8.1.1),
1183 since the job can still be printed.

1184 **14.3 server-error-too-many-events (0x04??)**

1185 The client supplied more events in the "notify-events" operation attribute in a Create-Subscription that the
1186 Printer supports, as indicated in its "max-events-supported" attribute (see section 6.4).

1187 There is no corresponding Per-Job subscription error for a Job Creation operation, since the Printer object
1188 MUST ignore any errors in the "job-notify" operation attribute, MUST return the "notify-events" attribute

1189 in the Unsupported Attributes Group with only the excess events that are being ignored, and perform the
1190 Job Creation operation (see section 8.1.1), since the job can still be printed.

1191 **15 Additions to the IPP Encoding and Transport Document**

1192 The Subscription object tag needs to be assigned in section 3.7.1 Delimiter Tags:

1193 **3.7.1 Delimiter Tags**

1194 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

1195 When an xxx-attributes-tag occurs in the protocol, it MUST mean that zero or more following attributes up
1196 to the next delimiter tag are attributes belonging to group xxx as defined in the model document, where xxx
1197 is operation, job, printer, unsupported, subscription.

1198 Doing substitution for xxx in the above paragraph, this means the following. When an operation-attributes-
1199 tag occurs in the protocol, it MUST mean that the zero or more following attributes up to the next delimiter
1200 tag are operation attributes as defined in the model document. When an job-attributes-tag occurs in the
1201 protocol, it MUST mean that the zero or more following attributes up to the next delimiter tag are job
1202 attributes or job template attributes as defined in the model document. When a printer-attributes-tag occurs
1203 in the protocol, it MUST mean that the zero or more following attributes up to the next delimiter tag are
1204 printer attributes as defined in the model document. When an unsupported-attributes-tag occurs in the
1205 protocol, it MUST mean that the zero or more following attributes up to the next delimiter tag are
1206 unsupported attributes as defined in the model document. When a subscription-attributes-tag occurs in the
1207 protocol, it MUST mean that the zero or more following attributes up to the next delimiter tag are
1208 subscription attributes as defined in the [ipp-not] document.

1209 Add a reference to [ipp-not].

1210 **16 References**

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1284 A. Appendix - Summary of Notification Attribute Usage

1285 This appendix summarizes the usage of Notification attributes in the Job operation attribute collection, Job
1286 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-Subscription	Renew - Subscription	Cancel - Subscription
1. notify-recipient (uri)		R			[R]		[R]		
2. notify-events (1setOf type2 keyword)		R		100	[R]		[R]		
3. notify-content-type (mimeMediaType)		R			[R]		[R]		
4. subscriber-user-data (octetString(63))		R	R	R	[R]		[R]		
5. attributes-charset (charset)	R		R (6)	R (6)	R		R	R	R
6. notify-attributes-charset (charset)		O			[O]		[O]		
7. attributes-natural-language (naturalLanguage)	R		R (8)	R (8)	R		R	R	R
8. notify-attributes-natural-language (naturalLanguage)		O			[O]		[O]		
9. notify-lease-time-requested (integer(0:MAX))							[R]	[R]	
10. notify-lease-time-granted (integer(0:MAX))							Return	Return	
11. notify-lease-expiration-time (integer(0:MAX))		R*					Return	Return	
12. notify-persistence-requested (boolean)							[O]		
13. notify-persistence-granted (boolean)							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

1287 Legend: "R" - REQUIRED for Printer to support; "O" - OPTIONAL for Printer to support; "[]" - OPTIONAL for sender to send;
 1288 Return - Printer MUST return; * - MUST be 0 for Per-Job Subscription objects;.

1289

	Objects	Notification	Job operations	Subscription operations
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Attributes	Job	Subscription	Job Notification	Printer Notification	Job Creation Validate -Job		Create-Subscription	Renew - Subscription	Cancel - Subscription
19. version-number (integer (0:32767))			R	R					
20. status-code (integer (0:32767))			(600)	(601)					
21. job-printer-uri (uri)	R								
22. printer-uri (uri)		R	R	R	R		R	R	R
23. printer-name (name(127))			R	R					
24. job-id (integer(1:MAX))	R		R	Per-Jb			Per-Jb		
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	R	R					
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							
31. job-k-octets-processed (integer(0:MAX))	O		[pg/cp]						
32. job-impressions-completed (integer(0:MAX))	O		[pg/cp]						
33. job-media-sheets-completed (integer(0:MAX))	O		[pg/cp]						
34. job-collation-type (type2 enum)	O		[pg/cp]						
35. sheet-completed-copy-number (integer(-2:MAX))	O		[pg/cp]						
36. sheet-completed-document-number(integer(-2:MAX))	O		[pg/cp]						
37. impressions-interpreted (integer(-2:MAX))	O		[pg/cp]						
38. impressions-completed-current-copy (integer(-2:MAX))	O		[pg/cp]						

- 1290 Legend: "R" - REQUIRED for Printer to support; "O" - OPTIONAL for Printer to support; [] - OPTIONAL for sender to send;
1291 "Per-Jb" - REQUIRED if a Per-Job subscription;
1292 "[pg/cp]" - OPTIONAL in a 'job-progress' or 'job-completed' notification; (nn) - an alternate source of the data in a Notification.

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

1293 Legend: "R" - REQUIRED for Printer to support; "O" - OPTIONAL for Printer to support; "[]" - OPTIONAL for sender to send;

1294

1295 **18 Appendix C: Full Copyright Statement**

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