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6
7   **Internet Printing Protocol (IPP):**
8   **The 'indp' Delivery Method for Event Notifications and Protocol/1.0**
9

11   Status of this Memo

20   **Abstract**

21   ~~The IPP notification extension document [ipp-ntfy] defines operations that a client can perform in order to~~
22   ~~create Subscription Objects in a Printer and carry out other operations on them. The Subscription Object~~
23   ~~specifies that when one of the specified Events occurs, the Printer sends an asynchronous Event Notification~~
24   ~~to the specified Notification Recipient via the specified Delivery Method (i.e., protocol).~~

25   ~~The notification extension document [ipp-ntfy] specifies that each Delivery Method is defined in another~~
26   ~~document.~~ This document describes an extension to the Internet Printing Protocol/1.0 (IPP) [RFC2566,
27   RFC2565] and IPP/1.1 [RFC2911, RFC2910]. This document ~~is one such document, and it~~ specifies the
28   'indp' Delivery Method and Protocol/1.0 for use with the IPP Event Notification Specification [ipp-ntfy]. This
29   Delivery Method is a simple protocol consisting of a single operation: the Send-Notifications operation which
30   uses the same encoding and transport as IPP [RFC2565, RFC2910]. ~~This document defines version '1.0' of~~
31   ~~the protocol.~~

32   For this Delivery Method, when an Event occurs, the Printer immediately sends (pushes) an Event Notification
33   via the Send-Notifications operation to the Notification Recipient specified in the Subscription Object. The
34   Event Notification content consists of Machine Consumable attributes and a Human Consumable "notify-text"
35   attribute. The Notification Recipient returns a response to the Printer.

36

36   The full set of IPP documents includes:

37   Design Goals for an Internet Printing Protocol [RFC2567]
38   Rationale for the Structure and Model and Protocol for the Internet Printing Protocol [RFC2568]
39   Internet Printing Protocol/1.1: Model and Semantics [RFC2911]
40   Internet Printing Protocol/1.1: Encoding and Transport [RFC2910]
41   Internet Printing Protocol/1.1: Implementer's Guide [ipp-iig]
42   Mapping between LPD and IPP Protocols [RFC2569]
43   Internet Printing Protocol (IPP): IPP Event Notification Specification [ipp-ntfy]
44
45   The "Design Goals for an Internet Printing Protocol" document takes a broad look at distributed printing
46   functionality, and it enumerates real-life scenarios that help to clarify the features that need to be included in a
47   printing protocol for the Internet. It identifies requirements for three types of users: end users, operators, and
48   administrators. It calls out a subset of end user requirements that are satisfied in IPP/1.0. A few OPTIONAL
49   operator operations have been added to IPP/1.1.

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

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

57   The "Internet Printing Protocol/1.1: Encoding and Transport" document is a formal mapping of the abstract
58   operations and attributes defined in the model document onto HTTP/1.1 [RFC2616]. It defines the encoding
59   rules for a new Internet MIME media type called "application/ipp". This document also defines the rules for
60   transporting a message body over HTTP whose Content-Type is "application/ipp". This document defines a
61   new scheme named 'ipp' for identifying IPP printers and jobs.

62   The "Internet Printing Protocol/1.1: Implementer's Guide" document gives insight and advice to implementers
63   of IPP clients and IPP objects. It is intended to help them understand IPP/1.1 and some of the considerations
64   that may assist them in the design of their client and/or IPP object implementations. For example, a typical
65   order of processing requests is given, including error checking. Motivation for some of the specification
66   decisions is also included.

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

69   The "Internet Printing Protocol (IPP): IPP Event Notification Specification" document defines the semantics
70   for Subscription Creation Operations and the requirements for other Delivery Method documents to define a
71   Delivery Method to carry an Event Notifications to a Notification Recipient.

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128   **Tables**

136

1   Introduction

The "IPP Event Notification Specification" notification extension document [ipp-ntfy] defines an extension to Internet Printing Protocol/1.0 (IPP) [RFC2566, RFC2565] and IPP/1.1 [RFC2911, RFC2910]. This extension defines operations that a client can perform in order to create *Subscription Objects* in a Printer and carry out other operations on them. A Subscription Object represents a Subscription abstraction. A client associates Subscription Objects with a particular Job by performing the Create-Job-Subscriptions operation or by submitting a Job with subscription information. A client associates Subscription Objects with the Printer by performing a Create-Printer-Subscriptions operation. Four other operations are defined for Subscription Objects: Get-Subscriptions-Attributes, Get-Subscriptions, Renew-Subscription, and Cancel-Subscription. The Subscription Object specifies that when one of the specified *Events* occurs, the Printer sends an asynchronous *Event Notification* to the specified *Notification Recipient* via the specified *Delivery Method* (i.e., protocol).

The "IPP Event Notification Specification" notification extension document [ipp-ntfy] specifies that each Delivery Method is defined in another document. This document is one such document, and it specifies the 'indp' Delivery Method. This Delivery Method is a simple protocol consisting of a single operation: the Send-Notifications operation which uses the same encoding and transport as IPP. This document defines version '1.0' of the protocol.

For the 'indp' Delivery Method, an IPP Printer sends (pushes) a Send-Notifications operation request containing one or more Event Notifications to the Notification Recipient specified in the Subscription Object. The Event Notification content consists of Machine Consumable attributes and a Human Consumable "notify-text" attribute.

The Notification Recipient receives the Event Notification as a Send-Notifications operation, in the same way as an IPP Printer receives IPP operations. The Notification Recipient returns a response to the Printer.

2   Terminology

This section defines the following terms that are used throughout this document:

Terms such as attributes, keywords, and support. These terms have special meaning and are defined in the model terminology [RFC2911] section 12.2.

Capitalized terms, such as MUST, MUST NOT, REQUIRED, SHOULD, SHOULD NOT, MAY, NEED NOT, and OPTIONAL, have special meaning relating to conformance as specified in

166   RFC 2119 [RFC2119] and [RFC2911] section 12.1. These terms refer to conformance to
167   this document, if this document is implemented.

168   Capitalized terms, such as Notification Recipient, Event Notification, Printer, etc., that are defined in
169   [ipp-ntfy] with the same meanings and are not reproduced here.

170   **Event Notification Attributes Group** – The attributes group in a request that contains Event
171   Notification Attributes in a request or response.

3   Model and Operation

173   See [ipp-ntfy] for the description of the Event Notification Model and Operation. This Delivery Method takes
174   advantage of combining several Event Notifications into a single Compound Event Notification that is delivery
175   by a single Send-Notification operation to a single Notification Recipient.

176   When creating each Subscription object, the client supplies the "notify-recipient" (uri) Subscription Template
177   attribute. The "notify-recipient" attribute specifies both a single Notification Recipient that is to receive the
178   Notifications when subsequent events occur and the method for notification delivery that the IPP Printer is to
179   use. For the Notification Delivery Method defined in this document, the notification method is 'indp' and the
180   rest of the URI is the address of the Notification Recipient to which the IPP Printer will send the Send-
181   Notifications operation.

182   The 'indp' Notification Delivery Method defined in this document uses a client/server protocol paradigm. The
183   "client" in this relationship is the Printer described in [ipp-ntfy] while the "server" is the Notification Recipient.
184   The Printer invokes the Send-Notifications operation to communicate IPP Event Notification contents to the
185   Notification Recipient. The Notification Recipient only conveys information to the Printer in the form of
186   responses to the operations initiated by the Printer.

187   Printers that implement the 'indp' Notification Delivery Method will need to include an HTTP client stack while
188   Notification Recipients that implement this Delivery Method will need to support an HTTP server stack. See
189   section 10.2 for more details.

190   If the client wants the Printer to send Event Notifications via the 'indp' Delivery Method, the client MUST
191   choose a value for "notify-recipient-uri" attribute which conforms to the rules of section 5.2.1.

192   When an Event occurs, the Printer MUST immediately:

193   1. Find all pertinent Subscription Objects P according to the rules of section 9 of [ipp-ntfy], AND

194   2. Find the subset M of these Subscription Objects P whose "notify-recipient-uri" attribute has a scheme
195   value of 'indp', AND

196   3. For each Subscription Object in M, the Printer MUST

197   a) generate a Send-Notifications request as specified in section 8.1.1 AND

198   b) send the Send-Notifications request to the Notification Recipient specified by the address part of the
199   "notify-recipient-uri" attribute value (see section 5.2.1).

200   If several events occur sufficiently close to one another for the same or different Subscription objects, but with
201   the same Notification Recipient, the Printer MAY combine them into a single Send-Notifications request using
202   a separate Event Notification Attributes group for each event (see section 8.1.1).

203   **4   General Information**

204   If a Printer supports this Delivery Method, Table 1 lists its characteristics.

205   **Table 1 - Information about the Delivery Method**

Document Method conformance requirement	'indp' realization
1. What is the URL scheme name for the Delivery Method?	indp
2. Is the Delivery Method is REQUIRED, RECOMMENDED, or OPTIONAL for an IPP Printer to support?	RECOMMENDED
3. What transport and delivery protocol does the Printer use to deliver the Event Notification content, i.e., what is the entire network stack?	A Printer MUST support a complete HTTP/1.1 stack [RFC2616]
4. Can several Event Notifications be combined into a Compound Event Notification?	A Printer implementation MAY combine several Event Notifications into a single Event Notifications request as separate Event Notification Attributes Groups, see section 8.1.1
5. Is the Delivery Method initiated by the Notification Recipient (pull), or by the Printer (push)?	This Delivery Method is a push.
6. Is the Event Notification content Machine Consumable or Human Consumable?	Machine Consumable with the "notify-text" attribute being Human Consumable
7. What section in this document answers the following question? For a Machine Consumable Event Notification, what is the representation and encoding of values defined in section 9.1 of [ipp-ntfy] and the conformance requirements thereof? For a Human Consumable Event Notification, what is the representation and encoding of pieces of information defined in section 9.2 of [ipp-ntfy] and the conformance requirements thereof?	The representation and encoding is the same as IPP. See section 8.1.1
8. What are the latency and reliability of the transport and delivery protocol?	Same as for IPP/1.0 or IPP/1.1 itself (see [RFC2911]).
9. What are the security aspects of the transport and delivery protocol, e.g., how it is handled in firewalls?	See section 15
10. What are the content length restrictions?	They are the same as for IPP/1.0 and IPP/1.1 itself (see [RFC2911]).
11. What are the additional values or pieces of	A new Event Notifications attribute group (see

Document Method conformance requirement	'indp' realization
information that a Printer sends in an Event Notification and the conformance requirements thereof?	section 10.1) and additional status codes for use in the response (see section 9)
12. What are the additional Subscription Template and/or Subscription Description attributes and the conformance requirements thereof?	None
13. What are the additional Printer Description attributes and the conformance requirements thereof?	None

206
207   The remaining sections of this document parallel the sections of [ipp-ntfy].

208   # 5   Subscription object attributes

209   This section defines the Subscription object conformance requirements for Printers.

210   ## 5.1   Subscription Template Attribute Conformance

211   The 'indp' Delivery Method has the same conformance requirements for Subscription Template attributes as
212   defined in [ipp-ntfy]. The 'indp' Delivery Method does not define any addition Subscription Template
213   attributes.

214   ## 5.2   Additional Information about Subscription Template Attributes

215   This section defines additional information about Subscription Template attributes defined in [ipp-ntfy].

216   ### 5.2.1   notify-recipient-uri (uri)

217   This section describes the syntax of the value of this attribute for the 'indp' Delivery Method. The syntax for
218   values of this attribute for other Delivery Method is defined in other Delivery Method Documents.

219   In order to support the 'indp' Delivery Method and Protocol, the Printer MUST support the following syntax:

220   The 'indp://' URI scheme. The remainder of the URI indicates the host name or host address (and
221   optional path) of the Notification Recipient that is to receive the Send-Notification operation. See
222   section 12 for a complete definition of the syntax of the INDP URL.

223   ## 5.3   Subscription Description Attribute Conformance

224   The 'indp' Delivery Method has the same conformance requirements for Subscription Description attributes as
225   defined in [ipp-ntfy]. The 'indp' Delivery Method does not define any addition Subscription Description
226   attributes.

227   # 6   Printer Description Attributes

228   This section defines the Printer Description Attributes conformance requirements for Printers.

229   ## 6.1   Printer Description Attribute Conformance

230   The 'indp' Delivery Method has the same conformance requirements for Printer Description attributes as
231   defined in [ipp-ntfy]. The 'indp' Delivery Method does not define any addition Printer Description attributes.

232   ## 6.2   New Values for Existing Printer Description Attributes

233   This section defines additional values for existing Printer Description attributes.

234   ### 6.2.1   notify-schemes-supported (1setOf uriScheme)

235   The following "notify-schemes-supported" value is added in order to support the new Delivery Method
236   defined in this document:

237   'indp' - The IPP Notification Delivery Method defined in this document.

238   ### 6.2.2   operations-supported (1setOf type2 enum)

239   Table 2 lists the "operation-id" value added in order to support the new operation defined in this document.
240   The operation-id is assigned in the same name space as other operations that a Printer supports. However, a
241   Printer MUST NOT include this value in its "operations-supported" attribute unless it can accept the Send-
242   Notifications request.

243   **Table 2 – Operation-id assignments**

Value	Operation Name
0x001D	Send-Notifications

244

245 # 7   Attributes Only in Event Notifications

246 No additional attributes are defined only for use in Event Notifications besides those defined in [ipp-ntfy].

247 # 8   Operations for Notification

248 This section defines the operation for Event Notification using the 'indp' Delivery Method.

249 There is only one operation defined: Send-Notifications. Section 6.2.2 assigns of the "operation-id" for the
250 Send-Notifications operation and the following section defined the operation.

251 ## 8.1   Send-Notifications operation

252 This REQUIRED operation allows a Printer to send one or more Event Notifications to a Notification
253 Recipient using HTTP.

254 The Printer composes the information defined for an IPP Notification [ipp-ntfy] and sends it using the Sent-
255 Notifications operation to the Notification Recipient supplied in the Subscription object.

256 The Send-Notifications operations uses the operations model defined by IPP [RFC2566]. This includes, the
257 use of a URI as the identifier for the target of each operation, the inclusion of a version number, operation-id,
258 and request-id in each request, and the definition of attribute groups. The Send-Notifications operation uses
259 the Operation Attributes group, but currently has no need for the Unsupported Attributes, Printer Object
260 Attributes, and Job-Object Attributes groups. However, it uses a new attribute group, the Event Notification
261 Attributes group.

262 The Notification Recipient MUST accept the request in any state. There is no state defined for the Notification
263 Recipient for this Delivery Method.

264 Access Rights: Notification Recipient MAY enforce access rights. If the Printer receives a rejection with
265 these status codes: 'client-error-forbidden', 'client-error-not-authenticated', or 'client-error-not-authorized'
266 status code , the Printer SHOULD cancel the subscription.

267 ### 8.1.1   Send-Notifications Request

268 Every operation request MUST contains the following parameters (see [RFC2911] section 3.1.1):

269 - a "version-number"   '1.0' – the version of the 'indp' protocol is '1.0'.
270 - an "operation-id" - the value defined in Table 2

271   -   a "request-id" - the request id (see [RFC2911] section 3.1.2).
272
273   The following groups of attributes MUST be part of the Send-Notifications Request:

274   Group 1: Operation Attributes
275   Natural Language and Character Set:
276   The "attributes-charset" and "attributes-natural-language" attributes as defined in [RFC2911] section
277   3.1.4.1.

278   The Printer MUST use the values of "notify-charset" and "notify-natural-language", respectively,
279   from one Subscription Object associated with the Event Notifications in this request.

280   Normally, there is only one matched Subscription Object, or the value of the "notify-charset" and
281   "notify-natural-language" attributes is the same in all Subscription Objects. If not, the Printer MUST
282   pick one Subscription Object from which to obtain the value of these attributes. The algorithm for
283   picking the Subscription Object is implementation dependent. The choice of natural language is not
284   critical because 'text' and 'name' values can override the "attributes-natural-language" Operation
285   attribute. The Printer's choice of charset is critical because a bad choice may leave it unable to send
286   some 'text' and 'name' values accurately.

287   Target:
288   A copy of the Subscription object's "notify-recipient-uri" (uri) attribute which is the target of this
289   operation as described in [RFC2911] section 3.1.5, i.e., the URI of the 'indp' Notification Recipient
290   (see section 5.2.1).

291   Group 2 to N: Event Notification Attributes

292   In each group 2 to N, each attribute is encoded using the IPP rules for encoding attributes
293   [RFC2910] and may be encoded in any order. Note: the Get-Jobs response in [RFC2911] acts as
294   a model for encoding multiple groups of attributes.

295   Each Event Notification Group MUST contain all of attributes specified in [ipp-ntfy] section 9.1
296   ("Content of Machine Consumable Event Notifications") with exceptions denoted by asterisks in the
297   tables below.

298   The tables below are copies of the tables in [ipp-ntfy] section 9.1 ("Content of Machine Consumable
299   Event Notifications") except that each cell in the "Sends" column is a "MUST".

300   For an Event Notification for all Events, the Printer sends the following attributes.

301   **Table 3 – Attributes in Event Notification Content**

Source Value	Sends	Source Object
notify-subscription-id (integer(1:MAX))	MUST	Subscription
notify-printer-uri (uri)	MUST	Subscription
notify-subscribed-event (type2 keyword)	MUST	Event Notification
printer-up-time (integer(MIN:MAX))	MUST	Printer
printer-current-time (dateTime) *	MUST *	Printer
notify-sequence-number (integer (0:MAX))	MUST	Subscription
notify-charset (charset)	MUST	Subscription
notify-natural-language (naturalLanguage)	MUST	Subscription
notify-user-data (octetString(63)) **	MUST **	Subscription
notify-text (text (MAX))	MUST	Event Notification
attributes from the "notify-attributes" attribute, if any ***	MUST ***	Printer
attributes from the "notify-attributes" attribute, if any ***	MUST ***	Job
attributes from the "notify-attributes" attribute, if any ***	MUST ***	Subscription

302

303   * The Printer MUST send "printer-current-time" if and only if it supports the "printer-current-time"
304   attribute on the Printer object.

305   ** If the associated Subscription Object does not contain a "notify-user-data" attribute, the Printer
306   MUST send an octet-string of length 0.

307   *** If the "notify-attributes" attribute is present on the Subscription Object, the Printer MUST send
308   all attributes specified by the "notify-attributes" attribute. Note: if the Printer doesn't support the
309   "notify-attributes" attribute, it is not present on the associated Subscription Object and the Printer
310   does not send any client-requested attributes.

311   For Event Notifications for Job Events, the Printer sends the following additional attributes shown in
312   Table 4.

313   **Table 4 – Additional Attributes in Event Notification Content for Job Events**

Source Value	Sends	Source Object
job-id (integer(1:MAX))	MUST	Job
job-state (type1 enum)	MUST	Job
job-state-reasons (1setOf type2 keyword)	MUST	Job
job-impressions-completed (integer(0:MAX)) *	MUST *	Job

314
315   * The Printer MUST send the "job-impressions-completed" attribute in an Event Notification only
316   for the combinations of Events and Subscribed Events shown in Table 5.

317

318   **Table 5 – Combinations of Events and Subscribed Events for "job-impressions-completed"**

Job Event	Subscribed Job Event
'job-progress'	'job-progress'
'job-completed'	'job-completed'
'job-completed'	'job-state-changed'

319
320   For Event Notification for Printer Events, the Printer sends the following additional attributes shown
321   in Table 6.

322   **Table 6 – Additional Attributes in Event Notification Content for Printer Events**

Source Value	Sends	Source Object
printer-state (type1 enum)	MUST	Printer
printer-state-reasons (1setOf type2 keyword)	MUST	Printer
printer-is-accepting-jobs (boolean)	MUST	Printer

323

324   **8.1.2   Send-Notifications Response**

325   The Notification Recipient MUST return (to the client which is the Printer) the following sets of attributes as
326   part of a Send-Notifications response:

327   Every operation response contains the following REQUIRED parameters (see [RFC2911] section 3.1.1}:

328   -   a "version-number"
329   -   a "status-code"
330   -   the "request-id" that was supplied in the corresponding request
331
332   Group 1: Operation Attributes

333   Status Message:
334   As defined in [RFC2911].

335   The Notification Recipient can return any status codes defined in [RFC2911] and section 9.1 that
336   applies to all of the Event Notification Attribute groups. The following is a description of the
337   important status codes:

338   **'successful-ok':** the Notification Recipient received all of the Event Notification Attribute
339   Groups and was expecting each of them.

340   **'successful-ok-ignored-notifications':** the Notification Recipient was able to consume some,
341   but not all of the Event Notification Attributes Groups sent. The Event Notification
342   Attributes Groups with a "notify-status-code" attribute are the ones that were ignored or
343   are to be canceled.

344   **'client-error-ignored-all-notifications':** the Notification Recipient was unable to consume
345   any of the Event Notification Attributes Groups sent. The Event Notification Attributes
346   Groups with a "notify-status-code" attribute are the ones that were ignored or are to be
347   canceled.

348   Natural Language and Character Set:
349   The "attributes-charset" and "attributes-natural-language" attributes as defined in [RFC2911] section
350   3.1.4.1.

351   Group 2 to N: Notification Attributes

352   These groups MUST be returned if and only if the "status-code" parameter returned in Group 1 is anything but
353   the 'successful-ok' status code.

354   "notify-status-code" (type2 enum)
355   Indicates whether the Notification Recipient was able to consume the n-th Notification Report as
356   follows:

357   **'successful-ok'** - this Event Notification Attribute Group was consumed

358   **'client-error-not-found'** - this Event Notification Attribute Group was not able to be

359   consumed. The Printer MUST cancel the Subscription and MUST NOT attempt to send

360   any further Event Notifications from the associated Subscription object.

361   **'successful-ok-but-cancel-subscription'** - the Event Notification Attribute Group was

362   consumed, but the Notification Recipient wishes to cancel the Subscription object. The

363   Printer MUST cancel the Subscription and MUST NOT attempt to send any further Event

364   Notifications from the associated Subscription object.

9   Status Codes

366 This section lists status codes whose meaning have been extended and/or defined for returning in Event

367 Notification Attribute Groups as the value of the "notify-status-code" operation attribute. The code values are

368 allocated in the same space as the status codes in [RFC2911].

9.1   Additional Status Codes

370 The following status codes are defined as extensions for Notification and are returned as the value of the

371 "status-code" parameter in the Operation Attributes Group of a response (see [RFC2911] section 3.1.6.1).

372 Operations in this document can also return the status codes defined in section 13 of [RFC2911]. The

373 'successful-ok' status code is an example of such a status code.

9.1.1   successful-ok-ignored-notifications (0x0004)

375 The Notification Recipient was able to consume some, but not all, of the Event Notifications Attributes Groups

376 sent by the Printer in the Send-Notifications request. See section 8.1.2 for further details.

9.1.2   client-error-ignored-all-notifications (0x0416)

378 The Notification Recipient was unable to consume any of the Event Notification Attributes Groups sent by the

379 Printer. The Event Notification Attributes Groups with a "notify-status-code" attribute are the ones that were

380 ignored or are to be canceled. The Printer MAY remove subscriptions for future events which this client was

381 unable to consume.

382 **9.2   Status Codes returned in Event Notification Attributes Groups**

383 This section contains values of the "notify-status-code" attribute that the Notification Recipient returns in a
384 Event Notification Attributes Group in a response when the corresponding Event Notification Attributes
385 Group in the request:

386   1. was not consumed OR

387   2. was consumed, but the Notification Recipient wants to cancel the corresponding Subscription object

388 The following sections are ordered in decreasing order of importance of the status-codes.

389 **9.2.1   client-error-not-found (0x0406)**

390 This status code is defined in [RFC2911]. This document extends its meaning and allows it to be returned in
391 an Event Notification Attributes Group of a response.

392 The Notification Recipient was unable to consume this Event Notification Attributes Group because it was not
393 expected. See section 8.1.2 for further details.

394 **9.2.2   successful-ok-but-cancel-subscription (0x0006)**

395 The Notification Recipient was able to consume this Event Notification Attributes Group that the Printer sent,
396 but wants the corresponding Subscription object to be canceled none-the-less. See section 8.1.2 for further
397 details.

398 # 10 Encoding and Transport

399 This section defines the encoding and transport used by the 'indp' Delivery Method.

400 **10.1   Encoding of the Operation Layer**

401 The 'indp' Delivery Method uses the IPP operation layer encoding described in [RFC2910] and the Event
402 Notification Attributes Group tag allocated by [ipp-ntfy] as shown in Table 7:

403   **Table 7 – The "event-notification-attributes-tag" value**

Tag Value (Hex)	Meaning
0x07	"event-notification-attributes-tag"

404

10.2   Encoding of Transport Layer

406   The 'indp' Notification Delivery Method uses the IPP transport layer encoding described in [RFC2910].

407   It is REQUIRED that an 'indp' Notification Recipient implementation support HTTP over the IANA assigned
408   Well Known Port assigned to the 'indp' Delivery Method as its default port by IANA (see section 13), though
409   a Notification Recipient implementation MAY support HTTP over some other port as well.

11 Conformance Requirements

411   This section defines conformance requirements for Printers and Notification Recipients.

11.1   Conformance Requirements for Printers

413   The 'indp' Delivery Method is RECOMMENDED for a Printer to support.

414   IPP Printers that conform to this specification:

415   1. MUST meet the conformance requirements defined in [ipp-ntfy].

416   2. MUST support the conformance requirements for Subscription object attributes defined in section 5,
417   including the syntax for the "notify-recipient-uri" Subscription Object attribute defined in section 5.2.1.

418   3. MUST support the conformance requirements for Printer Description object attributes defined in section
419   6.

420   4. MUST support the 'indp' protocol by sending Event Notifications using the Send-Notifications operation
421   defined in section 8.1.

422   5. MUST send INDP URLs (e.g., in the "notify-recipient-uri" attribute in 'Send-Notifications') that conform
423   to the ABNF specified in section 12.5 of this document;

424   6. MUST send INDP the Send-Notifications operations via the port specified in the INDP URL (if present)
425   or otherwise via IANA assigned well-known port [TBD];

426   7. MUST convert INDP URLs for use in the Send-Notifications operation to their corresponding HTTP
427   URL forms for use in the HTTP layer by the same rules used to convert IPP URLs to their corresponding
428   HTTP URL forms (see section 5 'IPP URL Scheme' in [RFC2910]).

11.2   Conformance Requirements for INDP Notification Recipients

430   INDP Notification Recipients that conform to this specification:

431   1. MUST accept Send-Notifications requests and return Send-Notifications responses as defined in sections
432   8 and 9.

433   2. SHOULD reject received INDP URLs in "application/ipp" request bodies (e.g., in the "notify-recipient-
434   uri" attribute in 'Send-Notifications') that do not conform to the ABNF for INDP URLs specified in
435   section 12.5 of this document;

436   3. MUST listen for INDP operations on IANA-assigned well-known port [TBD], unless explicitly
437   configured by system administrators or site policies;

438   4. SHOULD NOT listen for INDP operations on any other port, unless explicitly configured by system
439   administrators or site policies.

12 INDP URL Scheme

12.1   INDP URL Scheme Applicability and Intended Usage

442   This section is intended for use in registering the "indp" URL scheme with IANA and fully conforms to the
443   requirements in [RFC2717]. This document defines the "indp" URL (Uniform Resource Locator) scheme for
444   specifying the location of an INDP Notification Recipient object which implements IPP Notification Delivery
445   Protocol (INDP) specified in this document.

446   The intended usage of the "indp" URL scheme is COMMON.

12.2   INDP URL Scheme Associated INDP Port

448   All INDP URLs which do NOT explicitly specify a port MUST be used over IANA-assigned well-known
449   port [TBD] for the INDP protocol.

450   See: IANA Port Numbers Registry [IANA-PORTREG].

451   12.3   INDP URL Scheme Associated MIME Type

452   All INDP protocol operations (requests and responses) MUST be conveyed in an "application/ipp" MIME
453   media type as registered in [IANA-MIMEREG]. INDP URLs MUST refer to INDP Notification Recipient
454   objects which support this "application/ipp" MIME media type.

455   See: IANA MIME Media Types Registry [IANA-MIMEREG].

456   12.4   INDP URL Scheme Character Encoding

457   The INDP URL scheme defined in this document is based on the ABNF for the HTTP URL scheme defined
458   in HTTP/1.1 [RFC2616], which is derived from the URI Generic Syntax [RFC2396] and further updated by
459   [RFC2732] and [RFC2373] (for IPv6 addresses in URLs). The INDP URL scheme is case-insensitive in the
460   'scheme' and 'host' (host name or host address) part; however the 'abs_path' part is case-sensitive, as in
461   [RFC2396]. Code points outside [US-ASCII] MUST be hex escaped by the mechanism specified in
462   [RFC2396].

463   12.5   INDP URL Scheme Syntax in ABNF

464   This section is intended for use in registering the "indp" URL scheme with IANA and fully conforms to the
465   requirements in [RFC2717]. This document defines the "indp" URL (Uniform Resource Locator) scheme for
466   specifying the location of an INDP Notification Recipient object which implements IPP Notification Delivery
467   Protocol (INDP) specified in this document.

468   The intended usage of the "indp" URL scheme is COMMON.

469   The IPP protocol places a limit of 1023 octets (NOT characters) on the length of a URI (see section 4.1.5
470   'uri' in [RFC2911]). An INDP Notification Recipient MUST return 'client-error-request-value-too-long' (see
471   section 13.1.4.10 in [RFC2911]) when a URI received in a request is too long.

472   Note: INDP Notification Recipients ought to be cautious about depending on URI lengths above 255 bytes,
473   because some older client or proxy implementations might not properly support these lengths.

474   INDP URLs MUST be represented in absolute form. Absolute URLs always begin with a scheme name
475   followed by a colon. For definitive information on URL syntax and semantics, see "Uniform Resource
476   Identifiers (URI): Generic Syntax and Semantics" [RFC2396]. This specification adopts the definitions of
477   "port", "host", "abs_path", and "query" from [RFC2396], as updated by [RFC2732] and [RFC2373] (for
478   IPv6 addresses in URLs).

479   The INDP URL scheme syntax in ABNF is as follows:

```
480        indp_URL = "indp:" "//" host [ ":" port ] [ abs_path [ "?" query
481        ]]
```

483   If the port is empty or not given, IANA-assigned well-known port [TBD] is assumed. The semantics are that
484   the identified resource (see section 5.1.2 of [RFC2616]) is located at the INDP Notification Recipient
485   listening for HTTP connections on that port of that host, and the Request-URI for the identified resource is
486   'abs_path'.

487   Note: The use of IP addresses in URLs SHOULD be avoided whenever possible (see [RFC1900]).

488   If the 'abs_path' is not present in the URL, it MUST be given as "/" when used as a Request-URI for a
489   resource (see section 5.1.2 of [RFC2616]). If a proxy receives a host name which is not a fully qualified
490   domain name, it MAY add its domain to the host name it received. If a proxy receives a fully qualified domain
491   name, the proxy MUST NOT change the host name.

492   **12.5.1   INDP URL Examples**

493   The following are examples of valid INDP URLs for Notification Recipient objects (using DNS host names):

```
494        indp://abc.com
495        indp://abc.com/listener
```

497   Note: The use of IP addresses in URLs SHOULD be avoided whenever possible (see [RFC1900]).

498   The following literal IPv4 addresses:

```
499        192.9.5.5                        ; IPv4 address in IPv4 style
500        186.7.8.9                        ; IPv4 address in IPv4 style
```

502   are represented in the following example INDP URLs:

```
503        indp://192.9.5.5/listener
504        indp://186.7.8.9/listeners/tom
```

506   The following literal IPv6 addresses (conformant to [RFC2373]):

```
507        ::192.9.5.5                      ; IPv4 address in IPv6 style
508        ::FFFF:129.144.52.38             ; IPv4 address in IPv6 style
509        2010:836B:4179::836B:4179        ; IPv6 address per RFC 2373
```

511   are represented in the following example INDP URLs:

```
512        indp://[::192.9.5.5]/listener
513        indp://[::FFFF:129.144.52.38]/listener
514        indp://[2010:836B:4179::836B:4179]/listeners/tom
515
```

12.5.2   INDP URL Comparisons

517 When comparing two INDP URLs to decide if they match or not, an INDP Client SHOULD use a case-
518 sensitive octet- by- octet comparison of the entire URLsthe comparer MUST use the same rules as those
519 defined for HTTP URI comparisons in [RFC2616], with these sole following exceptions:

520   •   A port that is empty or not given is MUST be treated as equivalent to the well-known port for that
521   INDP URL (port [TBD]);

522   ? Comparisons of host names MUST be case- insensitive;

523   ? Comparisons of scheme names MUST be case- insensitive;

524   ? An empty 'abs_path' is equivalent to an 'abs_path' of "/".

525 Characters other than those in the "reserved" and "unsafe" sets (see [RFC2396] and [RFC2732]) are
526 equivalent to their ""%" HEX HEX" encoding.

527 For example, the following three URIs are equivalent:

528   indp://abc.com/~smith/listener
529   indp://ABC.com/%7Esmith/listener
530   indp://ABC.com:/%7esmith/listener
531

13 IANA Considerations

533 IANA is requested to register the indp URL scheme as defined in section 12.

534 IANA is requested to assign a default system port (less than 1024) for use with the indp URL as defined in
535 section 12.

536 The rest of this section contains the exact information for IANA to add to the IPP Registries according to the
537 procedures defined in RFC 2911 [RFC2911] section 6.

538   *Note to RFC Editors: Replace RFC NNNN below with the RFC number for this document, so that*
539   *it accurately reflects the content of the information for the IANA Registry.*

540 **13.1   Operation Registrations**

541 The operations defined in this document will be published by IANA according to the procedures in RFC 2911
542 [RFC2911] section 6.4 with the following path:

543   ftp.isi.edu/iana/assignments/ipp/operations/

544 The registry entry will contain the following information:

```
545 Operations:                                         Ref.    Section:
546 Send-Notifications operation                        RFC NNNN   8.1
547
```

548 **13.2   Additional values of existing attributes**

549 **13.2.1   Additional values for the "notify-schemes-supported" Printer attribute**

550 The "notify-schemes-supported" uriScheme attribute value defined in this document will be published by
551 IANA according to the procedures in RFC 2911 [RFC2911] section 6.1 with the following path:

552   ftp.isi.edu/iana/assignments/ipp/attribute-values/notify-schemes-supported/

553 The registry entry will contain the following information:

```
554                                                     Ref.    Section:
555 indp                                                RFC NNNN  6.2.1
```

556 **13.2.2   Additional values for the "operations-supported" Printer attribute**

557 The "operations-supported" type2 enum attribute value defined in this document will be published by IANA
558 according to the procedures in RFC 2911 [RFC2911] section 6.1 with the following path:

559   ftp.isi.edu/iana/assignments/ipp/attribute-values/operations-supported/

560 The registry entry will contain the following information:

```
561                                      Value       Ref.    Section:
562 Send-Notifications                   0x001D      RFC NNNN  6.2.1
```

563 **13.3   Status code Registrations**

564 The status codes defined in this document will be published by IANA according to the procedures in RFC
565 2911 [RFC2911] section 6.6 with the following path:

566   ftp.isi.edu/iana/assignments/ipp/status-codes/

567   The registry entry will contain the following information:

```
568     Status codes:                                        Ref.       Section:
569     successful-ok-ignored-notifications (0x0004)    RFC NNNN      9.1.1
570     client-error-ignored-all-notifications (0x0416) RFC NNNN      9.1.2
571
```

572 14 Internationalization Considerations

573   When the client requests Human Consumable form by supplying the "notify-text-format" operation attribute
574   (see [ipp-ntfy]), the IPP Printer (or any Notification Service that the IPP Printer might be configured to use)
575   supplies and localizes the text value of the "human-readable-report" attribute in the Notification according to
576   the charset and natural language requested in the notification subscription.

577 15 Security Considerations

578   The IPP Model and Semantics document [RFC2911] discusses high level security requirements (Client
579   Authentication, Server Authentication and Operation Privacy). Client Authentication is the mechanism by
580   which the client proves its identity to the server in a secure manner. Server Authentication is the mechanism by
581   which the server proves its identity to the client in a secure manner. Operation Privacy is defined as a
582   mechanism for protecting operations from eavesdropping.

583   The Notification Recipient can cancel unwanted Subscriptions created by other parties without having to be
584   the owner of the subscription by returning the 'successful-ok-but-cancel-subscription' status code in the Send-
585   Notifications response returned to the Printer.

586 15.1   Security Conformance

587   Printers (client) MAY support Digest Authentication [RFC2617]. If Digest Authentication is supported, then
588   MD5 and MD5-sess MUST be supported, but the Message Integrity feature NEED NOT be supported.

589   Notification Recipient (server) MAY support Digest Authentication [RFC2617]. If Digest Authentication is
590   supported, then MD5 and MD5-sess MUST be supported, but the Message Integrity feature NEED NOT be
591   supported.

592   Notification Recipients MAY support TLS for client authentication, server authentication and operation
593   privacy. If a Notification Recipient supports TLS, it MUST support the
594   TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA cipher suite as mandated by RFC 2246 [RFC2246]. All

595   other cipher suites are OPTIONAL. Notification recipients MAY support Basic Authentication (described in
596   HTTP/1.1 [RFC2616]) for client authentication if the channel is secure. TLS with the above mandated cipher
597   suite can provide such a secure channel.

16 References

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18 Summary of Base IPP documents

669   The full set of base IPP documents includes:

670   Design Goals for an Internet Printing Protocol [RFC2567]
671   Rationale for the Structure and Model and Protocol for the Internet Printing Protocol [RFC2568]
672   Internet Printing Protocol/1.1: Model and Semantics [RFC2911]
673   Internet Printing Protocol/1.1: Encoding and Transport [RFC2910]
674   Internet Printing Protocol/1.1: Implementer's Guide [ipp-iig]
675   Mapping between LPD and IPP Protocols [RFC2569]
676   Internet Printing Protocol (IPP): IPP Event Notification Specification [ipp-ntfy]
677
678   The "Design Goals for an Internet Printing Protocol" document takes a broad look at distributed printing
679   functionality, and it enumerates real-life scenarios that help to clarify the features that need to be included in a
680   printing protocol for the Internet. It identifies requirements for three types of users: end users, operators, and
681   administrators. It calls out a subset of end user requirements that are satisfied in IPP/1.0 [RFC2566,
682   RFC2565]. A few OPTIONAL operator operations have been added to IPP/1.1 [RFC2911, RFC2910].

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

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

690 The "Internet Printing Protocol/1.1: Encoding and Transport" document is a formal mapping of the abstract
691 operations and attributes defined in the model document onto HTTP/1.1 [RFC2616]. It defines the encoding
692 rules for a new Internet MIME media type called "application/ipp". This document also defines the rules for
693 transporting a message body over HTTP whose Content-Type is "application/ipp". This document defines a
694 new the 'ipp' scheme named 'ipp' for identifying IPP printers and jobs.

695 The "Internet Printing Protocol/1.1: Implementer's Guide" document gives insight and advice to implementers
696 of IPP clients and IPP objects. It is intended to help them understand IPP/1.1 and some of the considerations
697 that may assist them in the design of their client and/or IPP object implementations. For example, a typical
698 order of processing requests is given, including error checking. Motivation for some of the specification
699 decisions is also included.

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

702 The "Internet Printing Protocol (IPP): IPP Event Notification Specification" document defines an extension to
703 IPP/1.0 [RFC2566, RFC2565] and IPP/1.1 [RFC2911, RFC2910]. This extension allows a client to
704 subscribe to printing related Events by creating a *Subscription Object* and defines the semantics for delivering
705 asynchronous *Event Notifications* to the specified *Notification Recipient* via a specified *Delivery Method*
706 (i.e., protocols) defined in (separate) Delivery Method documentsthe semantics for Subscription Creation
707 Operations and the requirements for other Delivery Method documents to define a Delivery Method to carry
708 an Event Notifications to a Notification Recipient.

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727
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