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10   **Internet Printing Protocol (IPP):**
11   **The 'indp' Delivery Method for Event Notifications and Protocol/1.0**

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14   Status of this Memo

24   **Abstract**

25   This document describes an extension to the Internet Printing Protocol/1.0 (IPP) [RFC2566, RFC2565]
26   and IPP/1.1 [RFC2911, RFC2910]. This document specifies the 'indp' Delivery Method and
27   Protocol/1.0 for use with the "IPP Event Notifications and Subscriptions" specification [ipp-ntfy].
28   When IPP Notification [ipp-ntfy] is supported, the Delivery Method defined in this document is one of
29   the RECOMMENDED Delivery Methods for Printers to support.

30   This Delivery Method is a simple protocol consisting of a single operation: the Send-Notifications
31   operation which uses the same encoding and transport as IPP [RFC2565, RFC2910]. For this Delivery
32   Method, when an Event occurs, the Printer immediately sends (pushes) an Event Notification via the
33   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
35   "notify-text" attribute. The Notification Recipient returns a response to the Printer.

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90   **Tables**

98

1 Introduction

The "IPP Event Notifications and Subscriptions" document [ipp-ntfy] defines an OPTIONAL extension to Internet Printing Protocol/1.0 (IPP) [RFC2566, RFC2565] and IPP/1.1 [RFC2911, RFC2910] (for a description of the base IPP documents, see section 18). That 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 Notifications and Subscriptions" 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. When IPP Notification [ipp-ntfy] is supported, the Delivery Method defined in this document is one of the RECOMMENDED Delivery Methods for Printers to support. 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:

This document uses the same terminology as [RFC2911], such as "client", "Printer", "attribute", "attribute value", "keyword", "operation", "request", "response", and "support".

130   Capitalized terms, such as MUST, MUST NOT, REQUIRED, SHOULD, SHOULD NOT, MAY,
131   NEED NOT, and OPTIONAL, have special meaning relating to conformance as defined in RFC
132   2119 [RFC2119] and [RFC2911] section 12.1. If an implementation supports the extension
133   defined in this document, then these terms apply; otherwise, they do not. These terms define
134   conformance to *this document only*; they do not affect conformance to other documents, unless
135   explicitly stated otherwise.

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

138   Other capitalized terms, such as Notification Recipient, Event Notification, Compound Event
139   Notification, Printer, etc., are defined in [ipp-ntfy], have the same meanings, and are not
140   reproduced here.

141 **3 Model and Operation**

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

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

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

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

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

161   When an Event occurs, the Printer MUST immediately:

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

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

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

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

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

169   If several events occur sufficiently close to one another for the same or different Subscription objects,
170   but with the same Notification Recipient, the Printer MAY combine them into a single Send-
171   Notifications request using a separate Event Notification Attributes group for each event (see section
172   8.1.1).

173   **4 General Information**

174   If a client or Printer supports this Delivery Method, Table 1 lists its characteristics.

175   **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

176
177   The remaining sections of this document parallel the sections of [ipp-ntfy].

5 Subscription object attributes

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

5.1 Subscription Template Attribute Conformance

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

5.2 Additional Information about Subscription Template Attributes

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

5.2.1 notify-recipient-uri (uri)

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

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

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

195 **5.3 Subscription Description Attribute Conformance**

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

199 # 6 New Values for Existing Printer Description Attributes

200 This Delivery Method does not define any additional Printer Description attribute from those defined in
201 [ipp-ntfy]. However, it does define additional values for existing Printer Description attributes defined
202 in [ipp-ntfy]. This section defines those additional values.

203 **6.1 notify-schemes-supported (1setOf uriScheme)**

204 The following value of the "notify-schemes-supported" Printer attribute (see [ipp-ntfy] section 5.3.1) is
205 added in order to support the new Delivery Method defined in this document:

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

207 **6.2 operations-supported (1setOf type2 enum)**

208 Table 2 lists the value of the "operation-id" operation parameter (see [RFC2911]) and the value of the
209 "operations-supported" Printer Description attribute (see [RFC2911]) added in order to support the
210 new operation defined in this document. The operation-id is assigned in the same name space as other
211 operations that a Printer supports. However, a Printer MUST NOT include this value in its
212 "operations-supported" attribute unless it can accept the Send-Notifications request.

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

Value	Operation Name
0x001D	Send-Notifications

214

215 **7 Attributes Only in Event Notifications**

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

218 **8 Operations for Notification**

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

220 There is only one operation defined: Send-Notifications. Section 6.2 assigns of the "operation-id" for
221 the Send-Notifications operation and the following section defined the operation.

222 **8.1 Send-Notifications operation**

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

225 The Printer composes the information defined for an IPP Notification [ipp-ntfy] and sends it using the
226 Send-Notifications operation to the Notification Recipient supplied in the Subscription object. The
227 ordering of separate Send-Notifications operations that a Printer sends MUST follow the "Event
228 Notification Ordering" requirements in [ipp-ntfy] section 9.

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

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

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

240 **8.1.1 Send-Notifications Request**

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

242   -   a "version-number"   '1.0' – the version of the 'indp' protocol is '1.0'.

243   -   an "operation-id" - the value defined in Table 2
244   -   a "request-id" - the request id (see [RFC2911] section 3.1.2).
245
246   The following groups of attributes MUST be part of the Send-Notifications Request:

247   Group 1: Operation Attributes
248   Natural Language and Character Set:
249   The "attributes-charset" and "attributes-natural-language" attributes as defined in [RFC2911]
250   section 3.1.4.1.

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

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

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

265   Group 2 to N: Event Notification Attributes

266   In each group 2 to N, each attribute is encoded using the IPP rules for encoding attributes
267   [RFC2910] and the attributes within a group MAY be encoded in any order. Note: the Get-
268   Jobs response in [RFC2911] acts as a model for encoding multiple groups of attributes. The
269   entire request is considered a single Compound Event Notification and MUST follow the
270   "Event Notification Ordering" requirements for Event Notifications within a Compound Event
271   Notification specified in [ipp-ntfy] section 9.

272   Each Event Notification Group MUST contain all of attributes specified in [ipp-ntfy] section
273   9.1 ("Content of Machine Consumable Event Notifications") with exceptions denoted by
274   asterisks in the tables below.

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

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

278   **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

279

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

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

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

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

290   **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

291
292   * The Printer MUST send the "job-impressions-completed" attribute in an Event Notification
293   only for the combinations of Events and Subscribed Events shown in Table 5.

294

295   **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'

296
297   For Event Notification for Printer Events, the Printer sends the following additional attributes
298   shown in Table 6.

299   **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

300

301 **8.1.2 Send-Notifications Response**

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

304   Every operation response contains the following REQUIRED parameters (see [RFC2911] section
305   3.1.1}:

306   -   a "version-number"
307   -   a "status-code"
308   -   the "request-id" that was supplied in the corresponding request
309
310   Group 1: Operation Attributes

311   Status Message:
312   As defined in [RFC2911].

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

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

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

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

326   Natural Language and Character Set:
327   The "attributes-charset" and "attributes-natural-language" attributes as defined in [RFC2911]
328   section 3.1.4.1.

329   Group 2 to N: Notification Attributes

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

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

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

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

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

338   send any further Event Notifications from the associated Subscription object.

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

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

341   The Printer MUST cancel the Subscription and MUST NOT attempt to send any

342   further Event Notifications from the associated Subscription object.

343 # 9 Status Codes

344 This section lists status codes whose meaning have been extended and/or defined for returning in Event
345 Notification Attribute Groups as the value of the "notify-status-code" operation attribute. The code
346 values are allocated in the same space as the status codes in [RFC2911].

347 ## 9.1 Additional Status Codes

348 The following status codes are defined as extensions for Notification and are returned as the value of
349 the "status-code" parameter in the Operation Attributes Group of a response (see [RFC2911] section
350 3.1.6.1). Operations in this document can also return the status codes defined in section 13 of
351 [RFC2911]. The 'successful-ok' status code is an example of such a status code.

352 ### 9.1.1 successful-ok-ignored-notifications (0x0004)

353 The Notification Recipient was able to consume some, but not all, of the Event Notifications Attributes
354 Groups sent by the Printer in the Send-Notifications request. See section 8.1.2 for further details.

355 ### 9.1.2 client-error-ignored-all-notifications (0x0416)

356 The Notification Recipient was unable to consume any of the Event Notification Attributes Groups sent
357 by the Printer. The Event Notification Attributes Groups with a "notify-status-code" attribute are the
358 ones that were ignored or are to be canceled. The Printer MAY remove subscriptions for future events
359 which this client was unable to consume.

360 ## 9.2 Status Codes returned in Event Notification Attributes Groups

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

364   1. was not consumed OR

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

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

368 **9.2.1 client-error-not-found (0x0406)**

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

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

373 **9.2.2 successful-ok-but-cancel-subscription (0x0006)**

374 The Notification Recipient was able to consume this Event Notification Attributes Group that the
375 Printer sent, but wants the corresponding Subscription object to be canceled none-the-less. See section
376 8.1.2 for further details.

377 **10 Encoding and Transport**

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

379 **10.1 Encoding of the Operation Layer**

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

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

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

383

384 **10.2 Encoding of Transport Layer**

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

386 It is REQUIRED that an 'indp' Notification Recipient implementation support HTTP over the IANA-
387 assigned well known system port assigned to the 'indp' Delivery Method as its default port by IANA
388 (see section 13), though a Notification Recipient implementation MAY support HTTP over some other
389 port as well.

390 **11 Conformance Requirements**

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

392 **11.1 Conformance Requirements for Printers**

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

394 IPP Printers that conform to this specification:

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

396 2. MUST support the conformance requirements for Subscription object attributes defined in section 5,
397 including the syntax for the "notify-recipient-uri" Subscription Object attribute defined in section
398 5.2.1.

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

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

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

405 6. MUST send the Send-Notifications operation via the port specified in the INDP URL (if present) or
406 otherwise via the IANA-assigned well-known system port xxx [TBA by IANA];

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

410 **11.2 Conformance Requirements for INDP Notification Recipients**

411 INDP Notification Recipients that conform to this specification:

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

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

417   3. MUST listen for INDP operations on IANA-assigned well-known system port xxx [TBA by IANA],
418   unless explicitly configured by system administrators or site policies;

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

421 **12 INDP URL Scheme**

422 **12.1 INDP URL Scheme Applicability and Intended Usage**

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

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

428 **12.2 INDP URL Scheme Associated INDP Port**

429   All INDP URLs which do NOT explicitly specify a port MUST be used over IANA-assigned well-
430   known system port xxx [TBA by IANA] for the INDP protocol.

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

432 **12.3 INDP URL Scheme Associated MIME Type**

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

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

437 **12.4 INDP URL Scheme Character Encoding**

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

444 **12.5 INDP URL Scheme Syntax in ABNF**

445 The IPP protocol places a limit of 1023 octets (NOT characters) on the length of a URI (see section
446 4.1.5 'uri' in [RFC2911]). An INDP Notification Recipient MUST return 'client-error-request-value-
447 too-long' (see section 13.1.4.10 in [RFC2911]) when a URI received in a request is too long.

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

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

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

456   indp_URL = "indp:" "//" host [":" port] [abs_path ["?" query]]
457
458 If the port is empty or not given, IANA-assigned well-known system port xxx [TBA by IANA] is
459 assumed. The semantics are that the identified resource (see section 5.1.2 of [RFC2616]) is located at
460 the INDP Notification Recipient listening for HTTP connections on that port of that host, and the
461 Request-URI for the identified resource is 'abs_path'.

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

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

467   **12.5.1 INDP URL Examples**

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

470   indp://abc.com
471   indp://abc.com/listener
472
473   Note: The use of IP addresses in URLs SHOULD be avoided whenever possible (see [RFC1900]).

474   The following literal IPv4 addresses:

475   192.9.5.5   ; IPv4 address in IPv4 style
476   186.7.8.9   ; IPv4 address in IPv4 style
477
478   are represented in the following example INDP URLs:

479   indp://192.9.5.5/listener
480   indp://186.7.8.9/listeners/tom
481
482   The following literal IPv6 addresses (conformant to [RFC2373]):

483   ::192.9.5.5   ; IPv4 address in IPv6 style
484   ::FFFF:129.144.52.38   ; IPv4 address in IPv6 style
485   2010:836B:4179::836B:4179   ; IPv6 address per RFC 2373
486
487   are represented in the following example INDP URLs:

488   indp://[::192.9.5.5]/listener
489   indp://[::FFFF:129.144.52.38]/listener
490   indp://[2010:836B:4179::836B:4179]/listeners/tom
491

492   **12.5.2 INDP URL Comparisons**

493   When comparing two INDP URLs to decide if they match or not, the comparer MUST use the same
494   rules as those defined for HTTP URI comparisons in [RFC2616], with the sole following exception:

495   • A port that is empty or not given MUST be treated as equivalent to the well-known system port
496   xxx [TBA by IANA] for that INDP URL;

497

498   **13 IANA Considerations**

499   IANA shall register the indp URL scheme as defined in section 12 according to the procedures of
500   [RFC2717] and assign a well-known system port.

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

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

505   **13.1 Operation Registrations**

506   The following table lists the operation defined in this document. This is to be registered according to
507   the procedures in RFC 2911 [RFC2911] section 6.4.

```
508      Operations:                                    Ref.
509   Section:
510   Send-Notifications operation                   RFC NNNN   8.1
511
```

512   The resulting operation registration will be published in the
513   ftp://ftp.iana.org/in-notes/iana/assignments/ipp/operations/
514   area.
515

516   **13.2 Additional attribute value registrations for existing attributes**

517   This section lists additional attribute value registrations for use with existing attributes defined in other
518   documents.

519   **13.2.1 Additional values for the "notify-schemes-supported" Printer attribute**

520   The following table lists the uriScheme value defined in this document as an additional uriScheme value
521   for use with the "notify-schemes-supported" Printer attribute defined in [ipp-ntfy]. This is to be
522   registered according to the procedures in RFC 2911 [RFC2911] section 6.1.

```
523   uriScheme Attribute Values:                    Ref.      Section:
524   indp                                           RFC NNNN   6.1
525
```

526   The resulting URI scheme attribute value registration will be published in the
527   ftp://ftp.iana.org/in-notes/iana/assignments/ipp/attribute-values/notify-schemes-supported/
528   area.

529

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

531 The following table lists the enum attribute value defined in this document as an additional type2 enum
532 value for use with the "operations-supported" Printer attribute defined in [RFC2911]. This is to be
533 registered according to the procedures in RFC 2911 [RFC2911] section 6.1.

```
534    type2 enum Attribute Values:            Value      Ref.      Section:
535    Send-Notifications                      0x001D     RFC NNNN   6.2
536
```

537 The resulting enum attribute value registration will be published in the
538 ftp://ftp.iana.org/in-notes/iana/assignments/ipp/attribute-values/operations-supported/
539 area.
540

13.3 Status code Registrations

542 The following table lists all the status codes defined in this document. These are to be registered
543 according to the procedures in RFC 2911 [RFC2911] section 6.6.

```
544    Status codes:                                   Ref.      Section:
545    successful-ok-ignored-notifications (0x0004)    RFC NNNN   9.1.1
546    client-error-ignored-all-notifications (0x0416) RFC NNNN   9.1.2
547
548    Status Codes in Event Notification Attributes Groups:
549    client-error-not-found (0x0406)                 RFC NNNN   9.2.1
550    successful-ok-but-cancel-subscription (0x0006)  RFC NNNN   9.2.2
551
```

552 The resulting status code registrations will be published in the
553 ftp://ftp.iana.org/in-notes/iana/assignments/ipp/status-codes/
554 area.
555

14 Internationalization Considerations

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

561 **15 Security Considerations**

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

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

570 **15.1 Security Conformance**

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

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

577 Notification Recipients MAY support TLS for client authentication, server authentication and operation
578 privacy. If a Notification Recipient supports TLS, it MUST support the
579 TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA cipher suite as mandated by RFC 2246 [RFC2246].
580 All other cipher suites are OPTIONAL. Notification recipients MAY support Basic Authentication
581 (described in HTTP/1.1 [RFC2616]) for client authentication if the channel is secure. TLS with the
582 above mandated cipher suite can provide such a secure channel.

583 **16 References**

584
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656 IPP Web Page: http://www.pwg.org/ipp/
657 IPP Mailing List: ipp@pwg.org
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659 To subscribe to the ipp mailing list, send the following email:

660   1) send it to majordomo@pwg.org
661   2) leave the subject line blank
662   3) put the following two lines in the message body:
663   subscribe ipp
664   end
665

666   Implementers of this specification document are encouraged to join the IPP Mailing List in order to
667   participate in any discussions of clarification issues and review of registration proposals for additional
668   attributes and values. In order to reduce spam the mailing list rejects mail from non-subscribers, so you
669   must subscribe to the mailing list in order to send a question or comment to the mailing list.

670 ## 18 Summary of Base IPP documents

671   The base IPP documents includes:

672   Design Goals for an Internet Printing Protocol [RFC2567]
673   Rationale for the Structure and Model and Protocol for the Internet Printing Protocol [RFC2568]
674   Internet Printing Protocol/1.1: Model and Semantics [RFC2911]
675   Internet Printing Protocol/1.1: Encoding and Transport [RFC2910]
676   Internet Printing Protocol/1.1: Implementer's Guide [ipp-iig]
677   Mapping between LPD and IPP Protocols [RFC2569]
678   Internet Printing Protocol (IPP): IPP Event Notifications and Subscriptions [ipp-ntfy]
679

680   The "Design Goals for an Internet Printing Protocol" document takes a broad look at distributed
681   printing functionality, and it enumerates real-life scenarios that help to clarify the features that need to
682   be included in a printing protocol for the Internet. It identifies requirements for three types of users:
683   end users, operators, and administrators. It calls out a subset of end user requirements that are satisfied
684   in IPP/1.0 [RFC2566, RFC2565]. A few OPTIONAL operator operations have been added to IPP/1.1
685   [RFC2911, RFC2910].

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

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

694   The "Internet Printing Protocol/1.1: Encoding and Transport" document is a formal mapping of the
695   abstract operations and attributes defined in the model document onto HTTP/1.1 [RFC2616]. It defines

696   the encoding rules for a new Internet MIME media type called "application/ipp". This document also
697   defines the rules for transporting a message body over HTTP whose Content-Type is "application/ipp".
698   This document defines the 'ipp' scheme for identifying IPP printers and jobs.

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

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

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

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