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10 **Internet Printing Protocol (IPP):**  
11 **The 'indp' Delivery Method for Event Notifications and Protocol/1.0**  
12

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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.

36

36

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99 

## 1 Introduction

100 The “IPP Event Notifications and Subscriptions” ~~Specification~~ document [ipp-ntfy] defines an  
101 OPTIONAL extension to Internet Printing Protocol/1.0 (IPP) [RFC2566, RFC2565] and IPP/1.1  
102 [RFC2911, RFC2910] (for a description of the base IPP documents, see section 18). ~~This That~~  
103 extension defines operations that a client can perform in order to create *Subscription Objects* in a  
104 Printer and carry out other operations on them. A Subscription Object represents a Subscription  
105 abstraction. A client associates Subscription Objects with a particular Job by performing the Create-  
106 Job-Subscriptions operation or by submitting a Job with subscription information. A client associates  
107 Subscription Objects with the Printer by performing a Create-Printer-Subscriptions operation. Four  
108 other operations are defined for Subscription Objects: Get-Subscriptions-Attributes, Get-Subscriptions,  
109 Renew-Subscription, and Cancel-Subscription. The Subscription Object specifies that when one of the  
110 specified *Events* occurs, the Printer sends an asynchronous *Event Notification* to the specified  
111 *Notification Recipient* via the specified *Delivery Method* (i.e., protocol).

112 The “IPP Event Notifications and Subscriptions” ~~Specification~~ document [ipp-ntfy] specifies that each  
113 Delivery Method is defined in another document. This document is one such document, and it specifies  
114 the ‘indp’ Delivery Method. When IPP Notification [ipp-ntfy] is supported, the Delivery Method  
115 defined in this document is one of the RECOMMENDED Delivery Methods for Printers to support.  
116 This Delivery Method is a simple protocol consisting of a single operation: the Send-Notifications  
117 operation which uses the same encoding and transport as IPP. This document defines version ‘1.0’ of  
118 the protocol.

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

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

126 

## 2 Terminology

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

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

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

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

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

141 Other ~~C~~capitalized terms, such as Notification Recipient, Event Notification, **Compound Event**  
142 **Notification**, Printer, etc., ~~that~~ are defined in [ipp-ntfy], have ~~with~~ the same meanings, and are not  
143 reproduced here.

### 144 3 Model and Operation

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

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

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

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

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

164 When an Event occurs, the Printer MUST immediately:

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

- 166 2. Find the subset M of these Subscription Objects P whose “notify-recipient-uri” attribute has a  
167 scheme value of ‘indp’, AND
- 168 3. For each Subscription Object in M, the Printer MUST
- 169 a) generate a Send-Notifications request as specified in section 8.1.1 AND
- 170 b) send the Send-Notifications request to the Notification Recipient specified by the address part of  
171 the “notify-recipient-uri” attribute value (see section 5.2.1).
- 172 If several events occur sufficiently close to one another for the same or different Subscription objects,  
173 but with the same Notification Recipient, the Printer MAY combine them into a single Send-  
174 Notifications request using a separate Event Notification Attributes group for each event (see section  
175 8.1.1).

## 176 4 General Information

177 If a [client or](#) Printer supports this Delivery Method, Table 1 lists its characteristics.

**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 information that a Printer sends in an Event Notification and the conformance requirements thereof?	A new Event Notifications attribute group (see section 10.1) and additional status codes for use in the response (see section 9)

Document Method conformance requirement	'indp' realization
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

179

180

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

## 181 5 Subscription object attributes

182

This section defines the Subscription object conformance requirements for Printers.

### 183 5.1 Subscription Template Attribute Conformance

184

The 'indp' Delivery Method has the same conformance requirements for Subscription Template

185

attributes as defined in [ipp-ntfy]. The 'indp' Delivery Method does not define any addition Subscription

186

Template attributes.

### 187 5.2 Additional Information about Subscription Template Attributes

188

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

#### 189 5.2.1 notify-recipient-uri (uri)

190

This section describes the syntax of the value of this attribute for the 'indp' Delivery Method. The

191

syntax for values of this attribute for other Delivery Method is defined in other Delivery Method

192

Documents.

193

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

194

syntax:

195

The 'indp://' URI scheme. The remainder of the URI indicates the host name or host address

196

(and optional path) of the Notification Recipient that is to receive the Send-Notification

197

operation. See section 12 for a complete definition of the syntax of the INDP URL.



### 198 5.3 Subscription Description Attribute Conformance

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

## 202 ~~6 Printer Description Attributes~~

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

### 204 ~~6.1 Printer Description Attribute Conformance~~

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

### 208 ~~6.2.6~~ New Values for Existing Printer Description Attributes

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

#### 212 ~~6.2.16.1~~ notify-schemes-supported (1setOf uriScheme)

213 The following ~~value of the~~ “notify-schemes-supported” ~~value~~ Printer attribute (see [ipp-ntfy] section  
 214 ~~5.3.1~~) is added in order to support the new Delivery Method defined in this document:

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

#### 216 ~~6.2.26.2~~ operations-supported (1setOf type2 enum)

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

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

Value	Operation Name
0x001D	Send-Notifications

223

## 224 7 Attributes Only in Event Notifications

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

## 227 8 Operations for Notification

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

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

### 231 8.1 Send-Notifications operation

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

234 The Printer composes the information defined for an IPP Notification [ipp-ntfy] and sends it using the  
235 Send-Notifications operation to the Notification Recipient supplied in the Subscription object. [The  
236 ordering of separate Send-Notifications operations that a Printer sends MUST follow the "Event  
237 Notification Ordering" requirements in \[ipp-ntfy\] section 9.](#)

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

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

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

#### 249 8.1.1 Send-Notifications Request

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

- 251 - a "version-number" '1.0' – the version of the 'indp' protocol is '1.0'.
  - 252 - an "operation-id" - the value defined in Table 2
  - 253 - a "request-id" - the request id (see [RFC2911] section 3.1.2).
- 254

255 The following groups of attributes MUST be part of the Send-Notifications Request:

256 Group 1: Operation Attributes

257 Natural Language and Character Set:

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

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

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

270 Target:

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

274 Group 2 to N: Event Notification Attributes

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

281 Each Event Notification Group MUST contain all of attributes specified in [ipp-ntfy] section  
282 9.1 ("Content of Machine Consumable Event Notifications") with exceptions denoted by  
283 asterisks in the tables below.

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

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

287

**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

288

289

290

\* The Printer MUST send “printer-current-time” if and only if it supports the “printer-current-time” attribute on the Printer object.

291

292

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

293

294

295

296

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

297

298

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

299

**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

300

301

302

\* The Printer MUST send the “job-impressions-completed” attribute in an Event Notification only for the combinations of Events and Subscribed Events shown in Table 5.

303

304 **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'

305

306

307

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

308 **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

309

310 **8.1.2 Send-Notifications Response**

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

313 Every operation response contains the following REQUIRED parameters (see [RFC2911] section  
314 3.1.1 }:

- 315 - a "version-number"
- 316 - a "status-code"
- 317 - the "request-id" that was supplied in the corresponding request

318

319 Group 1: Operation Attributes

320 Status Message:

321 As defined in [RFC2911].

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

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

327 **'successful-ok-ignored-notifications'**: the Notification Recipient was able to consume  
328 some, but not all of the Event Notification Attributes Groups sent. The Event

329 Notification Attributes Groups with a “notify-status-code” attribute are the ones that  
330 were ignored or are to be canceled.

331 **'client-error-ignored-all-notifications'**: the Notification Recipient was unable to  
332 consume any of the Event Notification Attributes Groups sent. The Event  
333 Notification Attributes Groups with a “notify-status-code” attribute are the ones that  
334 were ignored or are to be canceled.

335 Natural Language and Character Set:  
336 The "attributes-charset" and "attributes-natural-language" attributes as defined in [RFC2911]  
337 section 3.1.4.1.

338 Group 2 to N: Notification Attributes

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

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

344 **'successful-ok'** - this Event Notification Attribute Group was consumed  
345 **'client-error-not-found'** - this Event Notification Attribute Group was not able to be  
346 consumed. The Printer MUST cancel the Subscription and MUST NOT attempt to  
347 send any further Event Notifications from the associated Subscription object.  
348 **'successful-ok-but-cancel-subscription'** - the Event Notification Attribute Group was  
349 consumed, but the Notification Recipient wishes to cancel the Subscription object.  
350 The Printer MUST cancel the Subscription and MUST NOT attempt to send any  
351 further Event Notifications from the associated Subscription object.

## 352 9 Status Codes

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

### 356 9.1 Additional Status Codes

357 The following status codes are defined as extensions for Notification and are returned as the value of  
358 the “status-code” parameter in the Operation Attributes Group of a response (see [RFC2911] section  
359 3.1.6.1). Operations in this document can also return the status codes defined in section 13 of  
360 [RFC2911]. The ‘successful-ok’ status code is an example of such a status code.

### 361 **9.1.1 successful-ok-ignored-notifications (0x0004)**

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

### 364 **9.1.2 client-error-ignored-all-notifications (0x0416)**

365 The Notification Recipient was unable to consume any of the Event Notification Attributes Groups sent  
366 by the Printer. The Event Notification Attributes Groups with a “notify-status-code” attribute are the  
367 ones that were ignored or are to be canceled. The Printer MAY remove subscriptions for future events  
368 which this client was unable to consume.

## 369 **9.2 Status Codes returned in Event Notification Attributes Groups**

370 This section contains values of the “notify-status-code” attribute that the Notification Recipient returns  
371 in a Event Notification Attributes Group in a response when the corresponding Event Notification  
372 Attributes Group in the request:

- 373 1. was not consumed OR
- 374 2. was consumed, but the Notification Recipient wants to cancel the corresponding Subscription  
375 object

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

### 377 **9.2.1 client-error-not-found (0x0406)**

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

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

### 382 **9.2.2 successful-ok-but-cancel-subscription (0x0006)**

383 The Notification Recipient was able to consume this Event Notification Attributes Group that the  
384 Printer sent, but wants the corresponding Subscription object to be canceled none-the-less. See section  
385 8.1.2 for further details.

## 386 **10 Encoding and Transport**

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

## 388 10.1 Encoding of the Operation Layer

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

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

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

392

## 393 10.2 Encoding of Transport Layer

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

395 It is REQUIRED that an 'indp' Notification Recipient implementation support HTTP over the IANA-  
 396 assigned Well Known system Pport assigned to the 'indp' Delivery Method as its default port by  
 397 IANA (see section 13), though a Notification Recipient implementation MAY support HTTP over some  
 398 other port as well.

## 399 11 Conformance Requirements

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

### 401 11.1 Conformance Requirements for Printers

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

403 IPP Printers that conform to this specification:

- 404 1. MUST meet the conformance requirements defined in [ipp-ntfy].
- 405 2. MUST support the conformance requirements for Subscription object attributes defined in section 5,  
 406 including the syntax for the "notify-recipient-uri" Subscription Object attribute defined in section  
 407 5.2.1.
- 408 3. MUST support the conformance requirements for Printer Description object attributes defined in  
 409 section 6.
- 410 4. MUST support the 'indp' protocol by sending Event Notifications using the Send-Notifications  
 411 operation defined in section 8.1.
- 412 5. MUST send INDP URLs (e.g., in the "notify-recipient-uri" attribute in 'Send-Notifications') that  
 413 conform to the ABNF specified in section 12.5 of this document;



- 414 6. MUST send the Send-Notifications operation via the port specified in the INDP URL (if present) or  
415 otherwise via the IANA--assigned well-known system port xxx [TBA~~D~~ by IANA];
- 416 7. MUST convert INDP URLs for use in the Send-Notifications operation to their corresponding  
417 HTTP URL forms for use in the HTTP layer by the same rules used to convert IPP URLs to their  
418 corresponding HTTP URL forms (see section 5 'IPP URL Scheme' in [RFC2910]).

## 419 11.2 Conformance Requirements for INDP Notification Recipients

420 INDP Notification Recipients that conform to this specification:

- 421 1. MUST accept Send-Notifications requests and return Send-Notifications responses as defined in  
422 sections 8 and 9.
- 423 2. SHOULD reject received INDP URLs in "application/ipp" request bodies (e.g., in the "notify-  
424 recipient-uri" attribute in 'Send-Notifications') that do not conform to the ABNF for INDP URLs  
425 specified in section 12.5 of this document;
- 426 3. MUST listen for INDP operations on IANA-assigned well-known system port xxx [TBA~~D~~ by  
427 IANA], unless explicitly configured by system administrators or site policies;
- 428 4. SHOULD NOT listen for INDP operations on any other port, unless explicitly configured by system  
429 administrators or site policies.

## 430 12 INDP URL Scheme

### 431 12.1 INDP URL Scheme Applicability and Intended Usage

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

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

### 437 12.2 INDP URL Scheme Associated INDP Port

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

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

### 441 12.3 INDP URL Scheme Associated MIME Type

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

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

### 446 12.4 INDP URL Scheme Character Encoding

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

### 453 12.5 INDP URL Scheme Syntax in ABNF

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

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

459 The IPP protocol places a limit of 1023 octets (NOT characters) on the length of a URI (see section  
460 4.1.5 'uri' in [RFC2911]). An INDP Notification Recipient MUST return 'client-error-request-value-  
461 too-long' (see section 13.1.4.10 in [RFC2911]) when a URI received in a request is too long.

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

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

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

```
470 indp_URL = "indp:" "/" host [ ":" port ] [ abs_path [ "?" query ] ]  
471
```

472 If the port is empty or not given, IANA-assigned well-known [system](#) port [xxx](#) [TBA~~D~~ by IANA] is  
473 assumed. The semantics are that the identified resource (see section 5.1.2 of [RFC2616]) is located at

474 the INDP Notification Recipient listening for HTTP connections on that port of that host, and the  
475 Request-URI for the identified resource is 'abs\_path'.

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

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

### 481 12.5.1 INDP URL Examples

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

```
484 indp://abc.com  
485 indp://abc.com/listener  
486
```

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

488 The following literal IPv4 addresses:

```
489 192.9.5.5 ; IPv4 address in IPv4 style  
490 186.7.8.9 ; IPv4 address in IPv4 style  
491
```

492 are represented in the following example INDP URLs:

```
493 indp://192.9.5.5/listener  
494 indp://186.7.8.9/listeners/tom  
495
```

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

```
497 ::192.9.5.5 ; IPv4 address in IPv6 style  
498 ::FFFF:129.144.52.38 ; IPv4 address in IPv6 style  
499 2010:836B:4179::836B:4179 ; IPv6 address per RFC 2373  
500
```

501 are represented in the following example INDP URLs:

```
502 indp://[::192.9.5.5]/listener  
503 indp://[::FFFF:129.144.52.38]/listener  
504 indp://[2010:836B:4179::836B:4179]/listeners/tom  
505
```

### 506 12.5.2 INDP URL Comparisons

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

- 509       • A port that is empty or not given MUST be treated as equivalent to the well-known system port  
510       xxx [TBA by IANA] for that INDP URL ~~(port [TBD])~~;

511

## 512 13 IANA Considerations

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

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

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

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

### 521 13.1 Operation Registrations

522 The following table lists the operations defined in this document. This is to be registered will be  
523 published by IANA according to the procedures in RFC 2911 [RFC2911] section 6.4. ~~with the~~  
524 ~~following path:~~

525       <ftp://ftp.isi.edu/iana/assignments/ipp/operations/>

526 ~~The registry entry will contain the following information:~~

527	Operations:	Ref.	Section:
528	Send-Notifications operation	RFC NNNN	8.1

529  
530 The resulting operation registration will be published in the  
531 ftp://ftp.iana.org/in-notes/iana/assignments/ipp/operations/  
532 area.  
533

### 534 13.2 Additional attribute value registrations ~~of for~~ existing attributes

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

#### 537 13.2.1 Additional values for the “notify-schemes-supported” Printer attribute

538 The following table lists the uriScheme value defined in this document as an additional uriScheme value  
539 for use with the “notify-schemes-supported” ~~uriScheme-Printer~~ attribute defined in [ipp-ntfy]. ~~value~~

540 ~~defined in this document~~ This is to be registered ~~will be published by IANA~~ according to the  
 541 procedures in RFC 2911 [RFC2911] section 6.1. ~~with the following path:~~

542 ~~[ftp.isi.edu/iana/assignments/ipp/attribute-values/notify-schemes-supported/](ftp://ftp.isi.edu/iana/assignments/ipp/attribute-values/notify-schemes-supported/)~~

543 ~~The registry entry will contain the following information:~~

544 <u>uriScheme Attribute Values:</u>	Ref.	Section:
545 indp	RFC NNNN	6.1

547 The resulting URI scheme attribute value registration will be published in the  
 548 <ftp://ftp.iana.org/in-notes/iana/assignments/ipp/attribute-values/notify-schemes-supported/>  
 549 area.

### 551 13.2.2 Additional values for the “operations-supported” Printer attribute

552 The following table lists the enum attribute value defined in this document as an additional type2 enum  
 553 value for use with the “operations-supported” Printer attribute defined in [RFC2911]. ~~type2 enum~~  
 554 ~~attribute value defined in this document~~ This is to be registered ~~will be published by IANA~~ according to  
 555 the procedures in RFC 2911 [RFC2911] section 6.1. ~~with the following path:~~

556 ~~[ftp.isi.edu/iana/assignments/ipp/attribute-values/operations-supported/](ftp://ftp.isi.edu/iana/assignments/ipp/attribute-values/operations-supported/)~~

557 ~~The registry entry will contain the following information:~~

558 <u>type2 enum Attribute Values:</u>	Value	Ref.	Section:
559 Send-Notifications	0x001D	RFC NNNN	6.2

561 The resulting enum attribute value registration will be published in the  
 562 <ftp://ftp.iana.org/in-notes/iana/assignments/ipp/attribute-values/operations-supported/>  
 563 area.

### 565 13.3 Status code Registrations

566 The following table lists all the status codes defined in this document. These are to be registered ~~will be~~  
 567 ~~published by IANA~~ according to the procedures in RFC 2911 [RFC2911] section 6.6. ~~with the~~  
 568 ~~following path:~~

569 ~~[ftp.isi.edu/iana/assignments/ipp/status-codes/](ftp://ftp.isi.edu/iana/assignments/ipp/status-codes/)~~

570 ~~The registry entry will contain the following information:~~

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

574

575	<u>Status Codes in Event Notification Attributes Groups:</u>		
576	<u>client-error-not-found (0x0406)</u>	<u>RFC NNNN</u>	<u>9.2.1</u>
577	<u>successful-ok-but-cancel-subscription (0x0006)</u>	<u>RFC NNNN</u>	<u>9.2.2</u>
578			

579 The resulting status code registrations will be published in the  
580 <ftp://ftp.iana.org/in-notes/iana/assignments/ipp/status-codes/>  
581 area.  
582

## 583 14 Internationalization Considerations

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

## 588 15 Security Considerations

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

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

### 597 15.1 Security Conformance

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

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

604 Notification Recipients MAY support TLS for client authentication, server authentication and operation  
605 privacy. If a Notification Recipient supports TLS, it MUST support the  
606 TLS\_DHE\_DSS\_WITH\_3DES\_EDE\_CBC\_SHA cipher suite as mandated by RFC 2246 [RFC2246].  
607 All other cipher suites are OPTIONAL. Notification recipients MAY support Basic Authentication  
608 (described in HTTP/1.1 [RFC2616]) for client authentication if the channel is secure. TLS with the  
609 above mandated cipher suite can provide such a secure channel.

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681  
682  
683 IPP Web Page: <http://www.pwg.org/ipp/>

684 IPP Mailing List: [ipp@pwg.org](mailto:ipp@pwg.org)

685  
686 To subscribe to the ipp mailing list, send the following email:

687 1) send it to [majordomo@pwg.org](mailto:majordomo@pwg.org)

688 2) leave the subject line blank

689 3) put the following two lines in the message body:

690 subscribe ipp

691 end

692  
693 Implementers of this specification document are encouraged to join the IPP Mailing List in order to  
694 participate in any discussions of clarification issues and review of registration proposals for additional  
695 attributes and values. In order to reduce spam the mailing list rejects mail from non-subscribers, so you  
696 must subscribe to the mailing list in order to send a question or comment to the mailing list.

## 697 **18 Summary of Base IPP documents**

698 The base IPP documents includes:

699 Design Goals for an Internet Printing Protocol [RFC2567]

700 Rationale for the Structure and Model and Protocol for the Internet Printing Protocol [RFC2568]

701 Internet Printing Protocol/1.1: Model and Semantics [RFC2911]

702 Internet Printing Protocol/1.1: Encoding and Transport [RFC2910]

703 Internet Printing Protocol/1.1: Implementer's Guide [ipp-iig]

704 Mapping between LPD and IPP Protocols [RFC2569]

705 Internet Printing Protocol (IPP): IPP Event Notifications and Subscriptions Specification [ipp-ntfy]

706

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

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

717 The "Internet Printing Protocol/1.1: Model and Semantics" document describes a simplified model with  
718 abstract objects, their attributes, and their operations that are independent of encoding and transport. It

719 introduces a Printer and a Job object. The Job object optionally supports multiple documents per Job.  
720 It also addresses security, internationalization, and directory issues.

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

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

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

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

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