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Internet Printing Protocol (IPP):

The 'indp' Notification Delivery Method

Status of this Memo

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Abstract

The IPP Event Notification specification [ipp-ntfy] is an OPTIONAL extension to IPP/1.0, IPP/1.1, and future versions. [ipp-ntfy] requires the definition of one or more Delivery Methods in separate Delivery Method Documents for the Printer to dispatch Event Notifications to Notification Recipients. This Delivery Method Document defines the semantics and syntax of the 'indp' Notification Delivery Method. For this Delivery Method, an IPP Printer sends (pushes) an IPP Event Notifications request to the Notification Recipients using the Send-Notifications operation defined in this document. The Notification Recipient returns a response to the Printer. The Send-Notifications operation uses the same Encoding and Transport as IPP itself.

The full set of IPP documents includes:

Design Goals for an Internet Printing Protocol [RFC2567]
Rationale for the Structure and Model and Protocol for the Internet Printing Protocol [RFC2568]
Internet Printing Protocol/1.1: Model and Semantics [ipp-mod]
Internet Printing Protocol/1.1: Encoding and Transport [ipp-pro]
Internet Printing Protocol/1.1: Implementer's Guide [ipp-iig]
Mapping between LPD and IPP Protocols [RFC2569]
Internet Printing Protocol (IPP): IPP Event Notification Specification [ipp-ntfy]

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

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

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

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

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

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

63

64 **Table of Contents**

Tables

1 Introduction

The notification extension document [ipp-ntfy] 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. 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 notification extension document [ipp-ntfy] specifies that each Delivery Method is defined in another document. This document is one such document, and it specifies the ‘indp’ Delivery Method.

For the ‘indp’ Delivery Method, an IPP Printer sends (pushes) a Send-Notifications operation request containing one or more Event Notifications to a Notification Recipient. The Notification Recipient returns a response to the Printer. The Send-Notifications operation uses the same Encoding and Transport as IPP itself.

2 Terminology

This document uses terms such as "attributes", "keywords", and "support". These terms have special meaning and are defined in the model terminology [ipp-mod] section 12.2.

Capitalized terms, such as MUST, MUST NOT, REQUIRED, SHOULD, SHOULD NOT, MAY, NEED NOT, and OPTIONAL, have special meaning relating to conformance. These terms are defined in [ipp-mod] section 12.1 on conformance terminology, most of which is taken from RFC 2119 [RFC2119].

This document uses the capitalized terms, such as Notification Recipient, Event Notification, Printer, etc., that are defined in [ipp-ntfy] with the same meanings and are not reproduced here.

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

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

3 Model and Operation

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

When creating each Subscription object, the client supplies the "notify-recipient" (uri) Subscription Template attribute. The "notify-recipient" attribute specifies both a single Notification Recipient that is to receive the Notifications when subsequent events occur and the method for notification delivery that the IPP Printer is to use. For the Notification Delivery Method defined in this document, the notification

method is 'indp' and the rest of the URI is the address of the Notification Recipient to which the IPP Printer will send the Send-Notifications operation.

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

Printers that implement the 'indp' Notification Delivery Method will need to include an HTTP client stack while Notification Recipients that implement this Delivery Method will need to support an HTTP server stack. See section 11.2 for more details.

4 Summary of the 'indp' Delivery Method

Column 1 of Table 1 lists the conformance requirements for Delivery Method Documents as specified in [ipp-ntfy]. Column 2 indicates how this Delivery Method Document meets each requirement:

Table 1 - Summary of the 'indp' Delivery Method

Document Method conformance requirement	'indp' realization
1. MUST define a URL scheme name for the Delivery Method.	indp
2. MUST indicate whether the delivery method is REQUIRED or OPTIONAL for an IPP Printer to support if it supports Event Notification.	OPTIONAL
3. MUST define the transport and delivery protocol for the Event Notification content that a Printer MUST use, i.e., the entire network stack.	a complete HTTP stack [rfc2616]
4. MUST indicate whether or not several Event Notifications can be combined into a compound Event Notification.	yes, see section 9.1.1
5. MUST describe how the Delivery Method is initiated, i.e., is it initiated by the receiving user (pull), or is it initiated by the Printer (push).	initiated by the Printer (push)
6. MUST indicate whether the Delivery	Machine Consumable with the "notify-text"

Document Method conformance requirement	'indp' realization
Method is Machine Consumable or Human Consumable.	attribute being Human Consumable
7. MUST define the representation and encoding that a Printer MUST use for each value or piece of information listed in [ipp-ntfy] section 9 (9.1 for Machine Consumable Event Notification and/or section 9.2 for Human Consumable Event Notification).	The representation and encoding is the same as IPP. See section 9.1.1
8. MUST specify for each attribute in [ipp-ntfy] section 9 whether a Printer MUST, SHOULD, MAY, MUST NOT, SHOULD NOT or NEED NOT send the attribute in an Event Notification content.	See the Send-Notifications Request defined in section 9.1.1
9. MUST define what frequently occurring Events MUST be moderated, if any, and whether the moderation mechanism is configurable. Also whether Events are moderated by sending one per time unit or one per number of Events.	Frequently occurring Events NEED NOT be moderated because the Delivery Method is an efficient one and because the Printer can group multiple Event Notifications for the same Notification Recipient into a single Send-Notifications operations.
10. MUST discuss the latency and reliability of the transport and delivery protocol.	Same as for IPP/1.0 or IPP/1.1 itself (see [ipp-mod]).
11. MUST discuss the security aspects of the transport and delivery protocol, e.g., how it is handled in firewalls.	See section 14
12. MUST identify content length restrictions, if any.	They are the same as for IPP/1.0 and IPP/1.1 itself (see [ipp-mod]).
13. MAY define additional values or pieces of information that a Printer MUST, SHOULD or MAY send in a Notification content.	A new Event Notifications attribute group (see section 11.1) and additional status codes for use in the response (see section 10)
14. MAY define additional Subscription Template and/or Subscription Description attributes and the conformance requirements thereof.	none defined
15. MAY define additional Printer	none defined

Document Method conformance requirement	'indp' realization
Description attributes and the conformance requirements thereof.	

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

154 5 Subscription object attributes

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

156 5.1 Subscription Template Attribute Conformance

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

160 5.2 Subscription Description Attribute Conformance

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

164 6 Printer Description Attribute Conformance

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

168 7 New Values for Existing Printer Description Attributes

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

170 7.1 notify-schemes-supported (1setOf uriScheme)

171 The following “notify-schemes-supported” value is added in order to support the new Delivery Method
172 defined in this document:

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

7.2 operations-supported (1setOf type2 enum)

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

Table 2 – Operation-id assignments

Value	Operation Name
0x001D	Send-Notifications

8 Attributes Only in Event Notifications

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

9 Operations for Notification

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

There is only one operation defined: Send-Notifications. Section 7.2 assigns of the “operation-id” for the Send-Notifications operation and the following section defined the operation.

9.1 Send-Notifications operation

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

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

The Send-Notifications operations uses the operations model defined by IPP [rfc2566]. This includes, the use of a URI as the identifier for the target of each operation, the inclusion of a version number, operation-id, and request-id in each request, and the definition of attribute groups. The Send-Notifications operation uses the Operation Attributes group, but currently has no need for the Unsupported Attributes, Printer Object Attributes, and Job-Object Attributes groups. However, it uses a new attribute group, the Event Notification Attributes group.

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

Access Rights: To send Event Notifications to a Notification Recipient, the authenticated user (see [IPP-MOD] section 8.3) performing this operation MUST be the Printer that accepted a previous Subscription Creation operation (see [ipp-ntfy]). Otherwise the Notification Recipient MUST reject the operation and return: the ‘client-error-forbidden’, ‘client-error-not-authenticated’, or ‘client-error-not-authorized’ status code as appropriate.

ISSUE 01: Is this what the Access Rights section should say for a Send-Notifications request?

9.1.1 Send-Notifications Request

Every operation request MUST contains the following parameters (see [ipp-mod] section 3.1.1):

- a "version-number" ISSUE 02: What version number goes here?
- an "operation-id" - the value defined in Table 2
- a "request-id" - the contents of the Subscription object's "notify-sequence-number" after incrementing for the first try (see [ipp-ntfy]).

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

Group 1: Operation Attributes

Natural Language and Character Set:

The "attributes-charset" and "attributes-natural-language" attributes as defined in [ipp-mod] section 3.1.4.1.

Target:

A copy of the Subscription object's "notification-recipient-uri" (uri) attribute which is the target of this operation as described in [ipp-mod] section 3.1.5, i.e., the URI of the 'indp' Notification Recipient (see section 9.2).

Requesting User Name:

Unlike the other IPP operations, the “requesting-user-name” attribute SHOULD NOT be supplied by the client as described in [ipp-mod] section 8.3.

ISSUE 03: Ok that "requesting-user-name" SHOULD NOT be send in Send-Notifications?

Group 2 to N: Event Notification Attributes

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

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

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

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

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)	MUST	Event Notification
attributes from the “notify-attributes” attribute ***	MUST	Printer
attributes from the “notify-attributes” attribute ***	MUST	Job
attributes from the “notify-attributes” attribute ***	MUST	Subscription

ISSUE 04: Ok that "notify-text" has been changed from MAY to MUST?

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

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

*** 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.

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

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

* 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.

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’

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

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

9.1.2 Send-Notifications Response

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

Every operation response contains the following REQUIRED parameters (see [ipp-mod] section 3.1.1}:

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

Group 1: Operation Attributes

Status Message:
As defined in [ipp-mod].

The Notification Recipient can return any status codes defined in [ipp-mod] and section 10.1 that applies to all of the Event Notification Attribute groups. The following is a description of the important status codes:

'successful-ok': the Notification Recipient received all of the Event Notification Attribute Groups and was expecting each of them.
'successful-ok-ignored-notifications': the Notification Recipient was able to consume some, but not all of the Event Notification Attributes Groups sent. The Event Notification Attributes Groups with a “notify-status-code” attribute are the ones that were ignored or are to be canceled.
'client-error-ignored-all-notifications': the Notification Recipient was unable to consume any of the Event Notification Attributes Groups sent. The Event Notification Attributes Groups with a “notify-status-code” attribute are the ones that were ignored or are to be canceled.

Natural Language and Character Set:
The "attributes-charset" and "attributes-natural-language" attributes as defined in [ipp-mod] section 3.1.4.1.

Group 2 to N: Notification Attributes

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

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

306 **'successful-ok'** - this Event Notification Attribute Group was consumed
307 **'client-error-not-found'** - this Event Notification Attribute Group was not able to be consumed.
308 The Printer MUST cancel the Subscription and MUST NOT attempt to send any further Event
309 Notifications from the associated Subscription object.
310 **'successful-ok-but-cancel-subscription'** - the Event Notification Attribute Group was consumed,
311 but the Notification Recipient wishes to cancel the Subscription object. The Printer MUST
312 cancel the Subscription and MUST NOT attempt to send any further Event Notifications from
313 the associated Subscription object.

314 ### 9.2 Notification Protocol URI Scheme

315 The INDP Notification Delivery Method uses the 'indp://' URI scheme in the "notify-recipients" attribute in
316 the Subscription object in order to indicate the notification Delivery Method defined in this document. The
317 remainder of the URI indicates the host and address of the Notification Recipient that is to receive the
318 Send-Notification operation.

319 # 10 Status Codes

320 This section lists status codes whose meaning have been extended and/or defined for returning in Event
321 Notification Attribute Groups as the value of the "notification-status-code" operation attribute. The code
322 values are allocated in the same space as the status codes in [ipp-mod].

323 ### 10.1 Additional Status Codes

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

328 #### 10.1.1 successful-ok-ignored-notifications (0x0004)

329 The Notification Recipient was able to consume some, but not all, of the Event Notifications Attributes
330 Groups sent by the Printer in the Send-Notifications request. See section 9.1.2 for further details.

331 ### 10.2 Status Codes returned in Event Notification Attributes Groups

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

335 1. was not consumed OR

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

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

10.2.1 client-error-not-found (0x0406)

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

The Notification Recipient was unable to consume this Event Notification Attributes Group because it was not expected. See section 9.1.2 for further details.

10.2.2 successful-ok-but-cancel-subscription (0x0006)

The Notification Recipient was able to consume this Event Notification Attributes Group that the Printer sent, but wants the corresponding Subscription object to be canceled none-the-less. See section 9.1.2 for further details.

11 Encoding and Transport

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

11.1 Encoding of the Operation Layer

The 'indp' Delivery Method uses the IPP operation layer encoding described in [ipp-pro] and the following Event Notification Attributes Group tag allocated by [ipp-ntfy]:

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

11.2 Encoding of Transport Layer

The 'indp' Notification Delivery Method uses the IPP transport layer encoding described in [ipp-pro].

It is REQUIRED that an 'indp' Notification Recipient implementation support HTTP over the IANA assigned Well Known Port assigned to the 'indp' Delivery Method as its default port by IANA (see section 12), though a Notification Recipient implementation MAY support HTTP over some other port as well.

12 IANA Considerations

The 'indp://' URL scheme for the 'indp' Delivery Method will be registered with IANA. IANA will assign a default port to use with the 'indp' Delivery Method.

13 Internationalization Considerations

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

14 Security Considerations

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

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

14.1 Security Conformance

Printers (client) MAY support Digest Authentication [rfc2617]. If Digest Authentication is supported, then MD5 and MD5-sess MUST be supported, but the Message Integrity feature NEED NOT be supported.

Notification Recipient (server) MAY support Digest Authentication [rfc2617]. If Digest Authentication is supported, then MD5 and MD5-sess MUST be supported, but the Message Integrity feature NEED NOT be supported.

Notification Recipients MAY support TLS for client authentication, server authentication and operation privacy. If a Notification Recipient supports TLS, it MUST support the TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA cipher suite as mandated by RFC 2246 [rfc2246]. All other cipher suites are OPTIONAL. Notification recipients MAY support Basic Authentication (described in HTTP/1.1 [rfc2616]) for client authentication if the channel is secure. TLS with the above mandated cipher suite can provide such a secure channel.

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