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Hugo Parra
Novell, Inc.
Tom Hastings
Xerox Corp.
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Internet Printing Protocol (IPP):

The 'indp' Notification Delivery Method and Protocol/1.0

Status of this Memo

Abstract

The IPP 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. 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 and Protocol. 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 this Delivery Method, when an Event occurs, the Printer immediately sends (pushes) an Event Notification via the Send-Notifications operation 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 returns a response to the Printer.

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: Model and Semantics” document describes a simplified model with abstract objects, their attributes, and their operations that are independent of encoding and transport. It introduces a Printer and a Job object. The Job object optionally supports multiple documents per Job. It also addresses security, internationalization, and directory issues.

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.

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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. 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.

~~1~~2 Terminology

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

Terms such as attributes, keywords, and support. These terms have special meaning and are defined in the model terminology [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 as specified in RFC 2119 [RFC2119] and [ipp-mod] section 12.1. These terms refer to conformance to this document, if this document is implemented.

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.

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 10.2 for more details.

4 General Information

If a 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	A Printer implementation MAY combine several Event Notifications into a single Event

Document Method conformance requirement	'indp' realization
Notification?	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 [ipp-mod]).
9. What are the security aspects of the transport and delivery protocol, e.g., how it is handled in firewalls?	See section 14
10. What are the content length restrictions?	They are the same as for IPP/1.0 and IPP/1.1 itself (see [ipp-mod]).
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)
12. What are the additional Subscription	None

Document Method conformance requirement	'indp' realization
Template and/or Subscription Description attributes and the conformance requirements thereof?	
13. What are the additional Printer Description attributes and the conformance requirements thereof?	None

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

5 Subscription object attributes

This section defines the Subscription object conformance requirements for Printers.

~~1.1~~5.1 Subscription Template Attribute Conformance

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

5.2 Additional Information about Subscription Template Attributes

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

5.2.1 notify-recipient-uri (uri)

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

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

The 'indp://' URI scheme. The remainder of the URI indicates the host and address of the Notification Recipient that is to receive the Send-Notification operation.

5.3 Subscription Description Attribute Conformance

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

6 Printer Description Attributes

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

6.1 Printer Description Attribute Conformance

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

6.2 New Values for Existing Printer Description Attributes

This section defines additional values for existing Printer Description attributes.

~~1.1.1~~6.2.1 notify-schemes-supported (1setOf uriScheme)

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

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

~~1.1.2~~6.2.2 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

7 Attributes Only in Event Notifications

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

8 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 6.2.2 assigns of the “operation-id” for the Send-Notifications operation and the following section defined the operation.

~~1.1~~8.1 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: Notification Recipient MAY enforce access rights. If the Printer receives a rejection with these status codes: 'client-error-forbidden’, ‘client-error-not-authenticated’, or ‘client-error-not-authorized’ status code , the Printer SHOULD cancel the subscription.

8.1.1 Send-Notifications Request

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

- a "version-number" ‘1.0’ – the version of the ‘indp’ protocol is ‘1.0’.
- 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 5.2.1).

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

Source Value	Sends	Source Object
attributes from the “notify-attributes” attribute ***	MUST	Subscription

* 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

8.1.2 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 9.1 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:

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

'client-error-not-found' - this Event Notification Attribute Group was not able to be consumed. The Printer MUST cancel the Subscription and MUST NOT attempt to send any further Event Notifications from the associated Subscription object.

'successful-ok-but-cancel-subscription' - the Event Notification Attribute Group was consumed, but the Notification Recipient wishes to cancel the Subscription object. The Printer MUST cancel the Subscription and MUST NOT attempt to send any further Event Notifications from the associated Subscription object.

9 Status Codes

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

~~1.1~~9.1 Additional Status Codes

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

~~1.1.1~~9.1.1 successful-ok-ignored-notifications (0x0004)

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

~~1.2~~9.2 Status Codes returned in Event Notification Attributes Groups

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

1. was not consumed OR
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.

~~1.1.1~~9.2.1 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 8.1.2 for further details.

~~1.1.2~~9.2.2 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 8.1.2 for further details.

10 Encoding and Transport

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

~~1.1~~10.1 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”

~~1.2~~10.2 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.

11 Conformance Requirements

This section defines conformance requirements for Printers and Notification Recipients.

11.1 Printer Conformance Requirements

The ‘indp’ Delivery Method is RECOMMENDED for a Printer to support.

If the Printer supports the ‘indp’ Delivery Method, the Printer MUST:

1. meet the conformance requirements defined in [ipp-ntfy].
2. support the conformance requirements for Subscription object attributes defined in section 5, including the syntax for the “notify-recipient-uri” Subscription Object attribute defined in section 5.2.1.
3. support the conformance requirements for Printer Description object attributes defined in section 6.
4. support the ‘indp’ protocol by sending Event Notifications using the Send-Notifications operation defined in section 8.1.
5. support sending Event Notification via email with the content specified in section 8.1.1.

11.2 Notification Recipient Requirements

A Notification Recipient MUST accept Send-Notifications requests and return Send-Notifications responses as defined in sections 8 and 9.

~~1~~12 IANA Considerations

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

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.

~~1.1~~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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16 Author's Addresses

Hugo Parra
Novell, Inc.
1800 South Novell Place
Provo, UT 84606

Phone: 801-861-3307
Fax: 801-861-2517
e-mail: hparra@novell.com

Tom Hastings
Xerox Corporation
737 Hawaii St. ESAE 231
El Segundo, CA 90245

Phone: 310-333-6413
Fax: 310-333-5514
e-mail: hastings@cp10.es.xerox.com

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