2   From: Tom Hastings
3   Date: 8/02/99
4   File: ipp-notification-model-990802.doc

5   <mark>There are 4 issues highlighted like this that need to be resolved.</mark>

6   This paper uses object modeling techniques to describe the current IPP Notification Specification object
7   model (July 22, 1999):

8   ftp://ftp.pwg.org/pub/pwg/ipp/new_NOT/ipp-notification-990722.pdf

9   and the proposed new object model that introduces the Subscription object as an OPTIONAL object when
10   implementing notification. In other words, notification can be implemented with or without the
11   Subscription object. Review of this object model before writing the complete spec will help speed up the
12   production of the spec and will also help with the understanding of the semantics. I suggest that this
13   modeling be kept in the final spec in some form similar to this paper.

14   *NOTE - In this model document, the notation [ ] indicates that the sender (client in a request, IPP*
15   *object in a response, notification sender in a notification) MAY omit the attribute inside the square*
16   *brackets. For simplicity, the conformance requirements for attribute support are not indicated in this*
17   *document.*

1   Current IPP Notification Operations

18

19   The current IPP Notification object model (July 22, 1999) consists of the Printer object and the Job object.
20   The following operations are defined for each of the object targets:

1.1   Printer object - current

21

22   Printer object target: salient inputs beside printer-uri:
23   job creation operations   recipients, [events,] [user-data]
24   Subscribe-Printer   recipients, [events,] [lease time]
25   Get-Printer-Attributes   [requested-attributes]
26   Renew-Printer-Subscription   [lease time]
27   Get-Printer-Subscriptions   [my-subscriptions]
28   Unsubscribe-Printer   subscription-id

1.2   Job object

29

30   Job object target: salient inputs besides job-id:
31   Subscribe-Job   recipients, [events]
32   Get-Job-Attributes   [requested-attributes]
33   Unsubscribe-Job   subscription-id

2   New IPP Notification Operations

34

35   The Printer, Job, and (new) Subscription object targets have the following operations defined for use with
36   notification:

53 3   Notification attributes defined for each object

54 The following notification attributes are defined for each of the Printer, Job, and (new) Subscription
55 objects. Attributes and objects not in the current, July 22, spec are labeled as "new":

56 3.1.1 Printer object notification attributes

57   Printer object attributes: set by:
58
59   printer-trigger-event (type2 keyword)   System - event occurring
60   printer-trigger-message (text(255))   System - event occurring
61   printer-trigger-time (integer(MIN:MAX))   System - event occurring
62   printer-trigger-date-time (dateTime)   System - event occurring
63   previous-printer-state (type1 enum)   System - event occurring
64   printer-state-reasons-added (1setOf type2 keyword) System - event occurring
65   printer-state-reasons-deleted (1setOf type2 keyword) System - event occurring
66
67   notify-recipients-schemes-supported (1setOf uriScheme) Administrator
68   notify-events-default (1setOf type2 keyword)   Administrator
69   notify-events-supported (1setOf type2 keyword)   Administrator
70   notify-lease-time-supported (rangeOfInteger(0:MAX)) Administrator
71   notify-lease-time-default (integer(0:MAX))   Administrator
72   max-number-of-subscriptions-supported (integer(1:MAX)) Administrator

3.1.2 Job object notification attributes

Job object attributes:	set by:
notify-recipients (1setOf uri)	job creation operation
notify-events (1setOf type2 keyword)	job creation operation
notify-user-data (octetString(255))	job creation operation
new: job-subscription-ids (1setOf integer(0:MAX))	job creation operation and/or
	subsequent Create-Subscription
	0 indicates no Subscription objects
job-trigger-event (type2 keyword)	System - event occurring
job-trigger-message (text(255))	System - event occurring
job-trigger-time (integer(MIN:MAX))	System - event occurring
job-trigger-date-time (dateTime)	System - event occurring
previous-job-state (type1 enum)	System - event occurring
job-state-reasons-added (1setOf type2 keyword)	System - event occurring
job-state-reasons-deleted (1setOf type2 keyword)	System - event occurring

3.1.3 Subscription object attributes (new)

Subscription object attributes:	set by:
notify-recipients (1setOf uri)	client - Create-Subscription
notify-events (1setOf type2 keyword)	client - Create-Subscription
notify-user-data (octetString(255))	client - Create-Subscription
notify-lease-time (integer(0:MAX))	client - Create-Subscription
notify-lease-time-remaining (integer(0:MAX))	system - Create-Subscription
	0 means infinite (for jobs only)
most-recent-sequence-number (integer(0:MAX))	system - event occurring
delivery-failure-count (integer(0:MAX))	system - event occurring

Note: The "notify-least-time" attribute is the number of seconds granted for the subscription. It is used to restore the subscription on the Restart-Job and Reprocess-Job operations.

The "notify-lease-time-remaining" attribute is the number of seconds remaining in the lease. Internally, the implementation may have a more absolute representation of when the least expires, but this relative value is returned to help the client know how much more time is remaining in the lease. A value of 0 is used for Subscriptions associated with Jobs, since they don't have a lease, but depend on the life time of the documents of the Job.

The "most-recent-sequence-number" attribute maintains the sequence number that was delivered in the most recent notification for the subscription.

The "delivery-failure-count" attribute is the number of transport delivery failures in delivering a notification to any of the "notify-recipients" using the transport indicated. Notification Recipients do not respond to the Notification Source.

4   Notification Content

The notification content is the same for the current and new specs:

4.1   Basic Job Event Notification content

```
version-number
status-code (with the value: basic-job-event(600))
request-id (used as notification delivery sequence number)
job-printer-uri (uri)
job-id (integer(1:MAX))
job-trigger-event (type2 keyword)
[job-trigger-message* (text(255))]
job-trigger-time (integer(1:MAX))
[job-trigger-date-time (dateTime)]
job-state (type1 enum)
previous-job-state (type1 enum)
job-state-reasons (1setOf type2 keyword)
job-state-reasons-added (1setOf type2 keyword)
job-state-reasons-deleted (1setOf type2 keyword)
[subscription-id** (integer(1:MAX))]
```

** If the Subscription object is implemented, the "subscription-id" MUST be supplied in the notification content.

4.2   Basic Printer Event Notification content:

```
version-number
status-code (with the value: basic-printer-event(601))
request-id (used as sequence number
printer-uri-supported (uri)
printer-trigger-event (type2 keyword)
[printer-trigger-message* (text(255))]
printer-trigger-time (integer(1:MAX))
[printer-trigger-date-time (dateTime)]
printer-state (type1 enum)
previous-printer-state (type1 enum)
printer-state-reasons (1setOf type2 keyword)
printer-state-reasons-added (1setOf type2 keyword)
printer-state-reasons-deleted (1setOf type2 keyword)
[subscription-id** (integer(1:MAX))]
```

** If the Subscription object is implemented, the "subscription-id" MUST be supplied in the notification content.

5 REQUIRED Job Submission Subscription

As in the current notification spec (July 22, 1999), the usual method for a client to associate one subscription with a Job is to specify the subscription when the job is created. For a Job Submission Subscription, the client supplies the following notification operation attributes:

notify-recipients (1setOf uri)	REQUIRED to support
[notify-events (1setOf type2 keyword)]	REQUIRED to support
[notify-user-data (octetString(255))]	OPTIONAL to support

5.1   REQUIRED operation requests and responses related to notification

This section lists the REQUIRED operation requests and response that have some relation to notification. The section 6 lists the OPTIONAL operation requests and responses associated with the OPTIONAL Subscription object.

5.1.1   Job Creation Operations (Create-Job, Print-Job, Print-URI, and Validate-Job)

The following IPP/1.1 extension operation attributes are defined for use with any of the job creation operations, including Validate-Job (which doesn't create a job or subscription):

```
Request:
    Group 1: Operation Attributes
        ["notify-recipients" (1setOf uri)
        ["notify-events" (1setOf type2 keyword)]
        ["notify-user-data" (octetString(255))]]
Response:
    Group 1: Operation Attributes
```

5.1.2   Get-Printer-Attributes

The Get-Printer-Attributes can be used to request the additional Printer Description attributes that indicate the notification supported. See section 3.1.1.

5.1.3   Get-Printer-Subscriptions

The Get-Printer-Subscriptions operations returns Printer subscription objects, i.e., ones associated with the Printer object or ones that have not been associated with either a Printer or Job object. Subscription objects that are associated with a Job object are not returned, since there could be a large number of them associated with a large number of jobs and the Job Subscription can be easily queried using the Get-Job-Attributes or Get-Jobs operations to request the "subscription-ids" attribute and then performing Get-Subscriptions operations.

ISSUE 1: Agreed that we don't want this operation to return the Subscription objects associated with Jobs, correct?

5

```
183         Request:
184             Group 1: Operation Attributes
185                 "attributes-charset"
186                 "attributes-natural-language"
187                 "printer-uri" (uri)
188                 ["requesting-user-name" (name(MAX))]
189                 ["limit" (integer(1:MAX))]
190                 ["requested-attributes" (1setOf type2 keyword)]
```
191 ISSUE 2: or is it was simpler just to always return all of the attributes of the
192 Subscription object and not have "requested-attributes"?
```
193                 ["my-subscriptions" (boolean)]
194         Response:
195             Group 1: Operation Attributes
196                 "status-code" (type2 enum)
197                 "attributes-charset"
198                 "attributes-natural-language"
199                 ["status-message" (text)]
200                 ["detailed-status-message" (text(MAX))]
201                 ["subscription-ids" (1setOf integer(1:MAX))]
202             Group 2: Unsupported Attributes
203             Group 3 to N:
204                 <the requested Subscription Attributes for each Subscription object
205                 in a separate group>
```
206 ISSUE 3: We don't really need a parallel Get-Job-Subscriptions operation, since a client can use either
207 Get-Job-Attributes or Get-Jobs to request the Job's "subscription-ids" attribute and then do a Get-
208 Subscription-Attributes for each, ok?

5.1.4 Get-Job-Attributes

The Get-Job-Attributes can be used to request the additional Job Description attributes that relate to
notification. See section 3.1.2.

6   OPTIONAL Explicit Subscriptions and the Subscription object

This section describes the new notification object model that adds a Subscription object which together
with the Job and Printer object provide the notification semantics. The Subscription object is OPTIONAL.
Without the Subscription object, the Job Submission Subscription semantics are supported with only a
single subscription per job and no explicit Subscriptions for the Job or Printer object as described in section
5.

6.1   Object Relationships

When the Subscription object is supported, it is created and associated with one Printer object, one
previously created Job object, or neither (so that a subsequent job creation operation can perform the
association of the Job object with the Subscription object and possibly other previously created
Subscription objects).

223 The object relationships can be stated as follows:
224   The Printer object contains zero or more Subscription objects
225   A Subscription object is contained in one Printer object
226   A Subscription object is exactly one of:
227   associated with one Printer object (s1-s3)
228   associated with one previously created Job object (s5 and s6 are associated with job j1
229   s7 is associated with job j2)
230   not associated with either a Printer object or a Job object (s4)
231
232   A Printer object is associated with zero or more Subscription objects (p1 is associated with s1-s3)
233
234   A Job object is associated with zero or more previously created Subscription objects (j1 is
235   associated with s5 and s6;
236   j2 is associated with s7
237   j3 is not associated with any s objects)
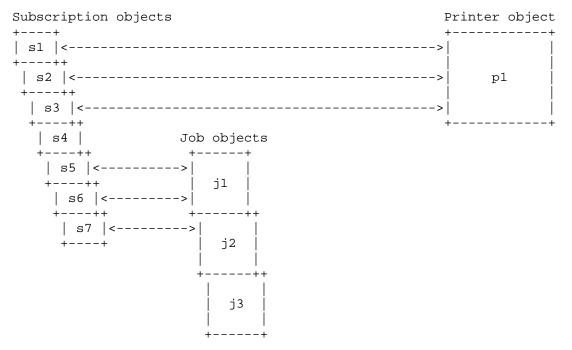238
239   A Subscription object cannot be contained in or associated with more than one Printer object
240   A Subscription object cannot be associated with more than one Job object
241   A Subscription object cannot be associated with both a Printer object and a Job object
242   A Subscription object MUST be associated ONLY with jobs that are contained in its Printer object
243
244 The object association relationships can be seen pictorially as (object containment not shown):
245

```
246  Subscription objects                                      Printer object
247  +----+                                                    +------------+
248  | s1 |<-------------------------------------------------->|            |
249  +----++                                                   |            |
250   | s2 |<------------------------------------------------->|     p1     |
251   +----++                                                  |            |
252    | s3 |<------------------------------------------------>|            |
253    +----++                                                 +------------+
254     | s4 |            Job objects
255     +----++          +------+
256      | s5 |<--------->|      |
257      +----++         |  j1  |
258       | s6 |<--------->|      |
259       +----++          +------++
260       | s7 |<--------->|      |
261       +----+          |  j2  |
262                       |      |
263                       +------++
264                         |      |
265                         |  j3  |
266                         |      |
267                         +------+
```

6.2 Extensions to Job Submission Subscriptions for Subscription object

Even when the Subscription object is supported, the usual method for a client to associate one subscription with a Job is to specify the subscription when the job is created. For a Job Submission Subscription, the client supplies the following notification operation attributes:

notify-recipients (1setOf uri)	REQUIRED to support
[notify-events (1setOf type2 keyword)]	REQUIRED to support
[notify-user-data (octetString(255))]	OPTIONAL to support

If the implementation supports the Subscription operation, then the Printer MUST create a Subscription object, duplicate these notification operation attributes on it, and return subscription id of the Subscription object in the job creation response. Otherwise, the subscription couldn't be canceled for the job. If the implementation does not support the Subscription object, then the notification operation attributes remain only on the Job object.

If the client only supplies a "subscription-ids" attribute and does not supply these explicit "notify-xxx" attributes, the Printer MUST copy these three attributes from the first Subscription object identified in the "subscription-ids" operation attribute. Then all clients will see the subscription attributes of the first subscription on the Job object, thereby simplifying client query of job-related notification subscription information. When the client does not supply any "xxx-notify" operation attributes in the job creation operation, the Printer does not create any new Subscription objects.

6.3 Operation requests and responses related to the Subscription object

This section lists the operation requests and responses the MUST be supported if the OPTIONAL Subscription object is supported and vice versa.

6.3.1 Job Creation Operations (Create-Job, Print-Job, Print-URI, and Validate-Job)

The following IPP/1.1 extension operation attributes are defined for use with any of the job creation operations, including Validate-Job (which doesn't create a job or subscription):

```
Request:
    Group 1: Operation Attributes
        ["subscription-ids"  (1setOf integer(1:MAX))]
        ["notify-recipients" (1setOf uri)
        ["notify-events" (1setOf type2 keyword)]
        ["notify-user-data" (octetString(255))]]
Response:
    Group 1: Operation Attributes
        [subscription-ids (1setOf integer(1:MAX))]
```

Notes: The client MAY supply one or both of:

1. one or more subscription ids for previously created (but unassociated) Subscription objects
2. explicit "notify-xxx" attributes

If the implementation supports the Subscription object and the client supplies "notify-xxx" operation attributes, the Printer MUST create a new Subscription object initialized with these "notify-xxx" operation attributes and return the "subscription-ids" operation attribute with the new subscription-id as the first value.

308 No lease time is requested or returned, since Subscription objects associated with Jobs have no real lease.
309 Instead the Subscription object is maintained until the job completes and the document data is deleted.

310 ### 6.3.2 Create-Subscription Operation

```
311     Request:
312         Group 1: Operation Attributes
313             "attributes-charset" (charset)
314             "attributes-natural-language" (naturalLanguage)
315             "printer-uri" (uri)
316             ["requesting-user-name" (name(MAX))]
317             "notify-recipients" (1setOf uri)
318             ["notify-events" (1setOf type2 keyword)]
319             ["notify-user-data" (octetString(255))]
320             ["notify-lease-time" (integer(0:MAX))]
321             ["associated-job-id" (integer(1:MAX)) OR
322             "associated-printer" (boolean)]
323     Response:
324         Group 1: Operation Attributes
325             "status-code" (type2 enum)
326             "attributes-charset" (charset)
327             "attributes-natural-language" (naturalLanguage
328             ["status-message" (text(255))]
329             ["detailed-status-message" (text(MAX))
330             "subscription-id"  (integer(1:MAX))
331             "notify-lease-time" (integer(0:MAX))
332             "notify-lease-time-remaining" (integer(0:MAX))
333         Group 2: Unsupported Attributes
```

334 Notes: A "notify-lease-time" and "notify-lease-time-remaining" of 0 means infinite for use with
335 Subscriptions associated with Job objects, since the life of the subscription is the same as for the documents
336 in the job.

337 The client MUST supply either "associated-job-id" or "associated-printer" or neither one, but MUST NOT
338 specify both, since a Subscription object can be associated with at most one (Job or Printer) object.

339 The Printer object MUST return the "notify-lease-time" actually granted which may be less than the
340 requester requested if it was greater than the MAX supported or more than the requester requested if it was
341 less than the MIN supported, as indicated in the Printer's "lease-time-supported" (rangeOfInteger(0:MAX))
342 attribute.

343 The Printer object MUST return the "notify-lease-time-remaining" which is the number of seconds
344 remaining in the lease.

345 ### 6.3.3 Get-Subscription-Attributes

346 The Get-Subscription-Attributes can be used to request the Subscription object attributes. See section
347 3.1.3.

9

```
348           Request:
349               Group 1: Operation Attributes
350                    "attributes-charset"
351                    "attributes-natural-language"
352                    "printer-uri" (uri)
353                   ["job-id" (integer(1:MAX))]
354                   ["requesting-user-name" (name(MAX))]
355                    "subscription-id"  (integer(1:MAX))
356                   ["requested-attributes" (1setOf type2 keyword)]
357  ISSUE 4: or is it simpler just to always return all of the attributes of the
358  Subscription object, since there are not too many?
359           Response:
360               Group 1: Operation Attributes
361                    "status-code" (type2 enum)
362                    "status-message" (text)
363                    "attributes-charset"
364                    "attributes-natural-language"
365           Group 2: Unsupported Attributes
366           Group 3: <the requested Subscription object attributes>
```

367 Notes: A client MUST supply the "job-id" operation attribute, if the Subscription object is associated with
368 a Job. If the "job-id" operation attribute is omitted, the "subscription-id" is assumed to apply to a
369 Subscription object associated with the Printer object or not associated yet with either the Printer object or a
370 Job object.

371 6.3.4 Renew-Subscription

```
372               Group 1: Operation Attributes
373                    "attributes-charset"
374                    "attributes-natural-language"
375                    "printer-uri" (uri)
376                    "requesting-user-name" (name(MAX))
377                    "subscription-id"  (integer(1:MAX))
378                    "notify-lease-time" (integer(0:MAX))
379           Response:
380               Group 1: Operation Attributes
381                    "status-code" (type2 enum)
382                    "attributes-charset"
383                    "attributes-natural-language"
384                   ["status-message" (text(255))]
385                   ["detailed-status-message" (text(MAX))]
386                    "notify-lease-time" (integer(0:MAX))
387                    "notify-lease-time-remaining" (integer(0:MAX))
388           Group 2: Unsupported Attributes
```

389 Notes: The Printer object MUST return the "notify-lease-time" actually granted which may be less than the
390 requester requested if it was greater than the MAX supported or more than the requester requested if it was
391 less than the MIN supported, as indicated in the Printer's "lease-time-supported" (rangeOfInteger(0:MAX))
392 attribute.

393 The Printer object MUST return the "notify-lease-time-remaining" which is the number of seconds
394 remaining in the lease.

395 6.3.5 Cancel-Subscription
```
396         Request:
397            Group 1: Operation Attributes
398                  "attributes-charset"
399                  "attributes-natural-language"
400                  "printer-uri" (uri)
401                  ["job-id" (integer(1:MAX))]
402                  ["requesting-user-name" (name(MAX))]
403                  "subscription-id" (integer(1:MAX))
404         Response:
405            Group 1: Operation Attributes
406                  "status-code" (type2 enum)
407                  "attributes-charset"
408                  "attributes-natural-language"
409                  ["status-message" (text(255))]
410                  ["detailed-status-message" (text(MAX))]
411            Group 2: Unsupported Attributes
```
412 Notes: A client MUST supply the "job-id" operation attribute, if the Subscription object is associated with
413 a Job. If the "job-id" operation attribute is omitted, the "subscription-id" is assumed to apply to a
414 Subscription object associated with the Printer object or not associated yet with either the Printer object or a
415 Job object.

416 **6.4   Subscription object lease time**

417 A Subscription object that is associated with a Printer object or is not associated with any object has a lease
418 time. When the lease time expires, the Printer object MUST delete the Subscription object. A subscriber is
419 expected to renew such Subscriptions before the lease expires. A Subscription object that is associated
420 with a Job object has no lease; instead the Printer object deletes Subscription object when it deletes
421 document data for the job. Thus if the job is in one of the Retained states ('completed', 'canceled', or
422 'aborted') and a client issues the Restart-Job or Reprocess-Job operation, the Printer initializes the
423 associated Subscription objects with new lease times.

424 A Subscription object that is associated with a Job does not have a lease. Instead the life of the job is used
425 instead. When the Job completes (or is aborted or canceled), the documents may be retained for a period of
426 time so that a client can use the Restart-Job or Reprocess-Job operation to perform the job again. In these
427 cases, the subscription(s) associated with the Job are automatically renewed. When the Printer object
428 deletes the Documents for a completed (aborted or canceled) Job, then it MUST also delete any
429 Subscription objects associated with the Job.

430 **6.5   Sequencing of Subscription object association with the Printer or a Job object**

431 Subscription object may be created before Job objects and vice versa. All associations between
432 Subscription objects and a Printer or a Job object occurs when the second object instance is created by
433 specifying the first object instance that is to form the association. Therefore, one and only one of the
434 following rules for the timing and sequencing of associating objects applies to each association:

435   1. A Subscription object is associated with its Printer object when the Subscription object is created

436   2. A Subscription object is associated with a previously created Job object when the Subscription
437   object is created

438   3. A Subscription object is created without any association and a subsequent Job object creation
439   associates the Job object with (one or more previously created, but unassociated) Subscription
440   object(s)

441 ## *6.6   Not implementing the Subscription object*

442 As an implementer option, only Job Submission Subscription need be supported. In this case, the
443 Subscription object and the Create-Subscription, Cancel-Subscription, Renew-Subscription, and Get-
444 Printer-Subscriptions operations are not implemented. Thus no Explicit subscriptions are provided.
445 However, a Job Submission Subscription can still specify Job events and/or Printer events, just as when the
446 Subscription object and the other operations are implemented.