

1 Internet Printing Protocol WG  
2 INTERNET-DRAFT  
3 <draft-ietf-ipp-collection-05.txt>  
4 Updates: RFC 2910 and RFC 2911  
5 [Target category: standards track]  
6 Expires: January 17, 2002  
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July 17, 2001

13 **Internet Printing Protocol (IPP):**  
14 **The 'collection' attribute syntax**

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27 **Abstract**

28 This document specifies an OPTIONAL attribute syntax called 'collection' for use with the Internet  
29 Printing Protocol/1.0 (IPP) [RFC2565, RFC2566], IPP/1.1 [RFC2911, RFC2910]. A 'collection'  
30 is a container holding one or more named values, which are called "member" attributes. A  
31 collection allows data to be grouped like a PostScript dictionary or a Java Map. This document  
32 also specifies the conformance requirements for a definition document that defines a collection  
33 attribute. Finally, this document gives some illustrative example collection attribute definitions that  
34 are not intended as actual attribute specifications.  
35  
36

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85

## 86 **1 Introduction**

87 This document is an OPTIONAL extension to IPP/1.0 [RFC2565, RFC2566] and IPP/1.1 [RFC2911,  
88 RFC2910]. For a description of the base IPP documents see section 17.

### 89 **1.1 Problem Statement**

90 The IPP Model and Semantics [RFC2911] supports most of the common data structures that are  
91 available in programming languages. It lacks a mechanism for grouping several attributes of different  
92 types. The Java language uses the Map to solve this problem and PostScript has a dictionary. The new  
93 mechanism for grouping attributes together (called 'collection' mechanism) must allow for optional  
94 members and subsequent addition of new members.

95 The 'collection' mechanism must be encoded in a manner consistent with existing 1.0 and 1.1 parsing  
96 rules (see [RFC2910]). Current 1.0 and 1.1 parsers that don't support the 'collection' mechanism must  
97 not confuse collections or parts of collection they receive with other attributes.

### 98 **1.2 Solution**

99 The new mechanism is a new IPP attribute syntax called a 'collection'. As such, each collection value is  
.00 a value of an attribute whose attribute syntax type is defined to be a 'collection'. Such an attribute is  
.01 called a collection attribute. The name of the collection attribute serves to identify the collection value  
.02 in an operation request or response, as with any attribute value.

.03 The 'collection' attribute syntax is a container holding one or more named values (i.e., attributes), which  
.04 are called member attributes. Each collection attribute definition document lists the mandatory and  
.05 optional member attributes of each collection value. A collection value is similar to an IPP attribute  
.06 group in a request or a response, such as the operation attributes group. They both consist of a set of  
.07 attributes.

.08 As with any attribute syntax, the document that defines a collection attribute specifies whether the  
.09 attribute is single-value (collection) or multi-valued (1setOf collection). If the attribute is multi-valued  
.10 (1setOf collection) each collection value MUST be a separate instance of a single definition of a  
.11 collection, i.e. it MUST have the same member attributes except for OPTIONAL member attributes. If  
.12 we view each collection definition as a separate syntax type, this rule continues the IPP/1.1 notion that  
.13 each attribute has a single type or pattern (e.g. "keyword | name" is a pattern). Without this rule, the  
.14 supported values would be more difficult to describe and the mechanism defined in item 4 of section 3.1  
.15 would not be sufficient.

.16 The name of each member attribute MUST be unique for a collection attribute, but MAY be the same  
.17 as the name of a member attribute in another collection attribute and/or MAY be the same as the name

.18 of an attribute that is not a member of a collection. The rules for naming member attributes are given in  
.19 section 3.1.

.20 Each member attribute can have any attribute syntax type, including 'collection', and can be either  
.21 single-valued or multi-valued. The length of a collection value is not limited. However, the length of  
.22 each member attribute **MUST NOT** exceed the limit of its attribute syntax.

.23 The member attributes in a collection **MAY** be in any order in a request or response. When a client  
.24 sends a collection attribute to the Printer, the order that the Printer stores the member attributes of the  
.25 collection value and the order returned in a response **MAY** be different from the order sent by the client.

.26 A collection value **MUST NOT** contain two or more member attributes with the same attribute name.  
.27 Such a collection is mal-formed. Clients **MUST NOT** submit such malformed requests and Printers  
.28 **MUST NOT** return such malformed responses. If such a malformed request is submitted to a Printer,  
.29 the Printer **MUST** (depending on implementation) either (1) reject the request with the 'client-error-bad-  
.30 request' status code (see section 13.1.4.1), or (2) accept the request and use only one of each duplicate  
.31 member attribute.

## .32 **2 Terminology**

.33 This section defines terminology used throughout this document.

### .34 **2.1 Conformance Terminology**

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

### .40 **2.2 Other terminology**

.41 This document uses terms such as Job object (or Job), IPP Printer object (or Printer), "operation",  
.42 "request", response, "attributes", "keywords", and "support". These terms have special meaning and  
.43 are defined in the model terminology [RFC2911] section 12.2. The following additional terms are  
.44 introduced in this document:

.45 collection: an attribute syntax in which each attribute value is a set of attributes, called *member*  
.46 *attributes*.

.47 member attribute: an attribute that is defined to be used as one of the attributes in a *collection*.

.48 collection attribute: an attribute whose definition specifies the 'collection' attribute syntax and each  
.49 of the member attributes that MAY occur in a collection attribute value.

## .50 **3 Definition of a Collection Attribute**

.51 This section describes the requirements for any collection attribute definition.

### .52 **3.1 Information to Include**

.53 When a specification document defines an "xxx" collection attribute, i.e., an attribute whose attribute  
.54 syntax type is 'collection' or '1setOf collection'; the definition document MUST include the following  
.55 aspects of the attribute semantics. Suppose the "xxx" collection attribute contains N member attributes  
.56 named "aaa1", "aaa2", ..., "aaaN" ("aaaI" represents any one of these N member attributes).

.57 1. The name of the collection attribute MUST be specified (e.g. "xxx"). The selection of the name  
.58 "xxx" MUST follow the same rules for uniqueness as for attributes of any other syntax type (as  
.59 defined by IPP/1.1) unless "xxx" is a member attribute of another collection. Then the selection of  
.60 the name "xxx" MUST follow the rules for uniqueness defined in item 5a) of this list.

.61 2. The collection attribute syntax MUST be of type 'collection' or '1setOf collection'.

.62 3. The context of the collection attribute MUST be specified, i.e., whether the attribute is an  
.63 operation attribute, a Job Template attribute, a Job Description attribute, a Printer Description  
.64 attribute, a member attribute of a particular collection attribute, etc.

.65 4. An "xxx-supported" attribute MUST be specified and it has one of the following two forms:

.66 a) "xxx-supported" is a "1setOf collection" which enumerates all of the supported collection  
.67 values of "xxx". If a collection of this form contains a nested collection, it MUST be of the  
.68 same form.

.69  
.70 For example, "media-size-supported" might have the values {{x-dimension:210, y-  
.71 dimension:297},{x-dimension:297, y-dimension:420}} to show that it supports two values of  
.72 "media size": A4 (210x297) and A3 (297x420). It does not support other combinations of "x-  
.73 dimension" and "y-dimension" member attributes, such as 210x420 or 297x297 and it does not  
.74 supported non-enumerated values, such as 420x595.

.75 b) "xxx-supported" is a "1setOf type2 keyword" which enumerates the names of all of the  
.76 member attributes of "xxx": "aaa1", "aaa2", ..., "aaaN". If a collection of this form contains a  
.77 nested collection, it MAY be of either form. See item 5f) below for details on supported values  
.78 of member attributes.

.80 For example, "media-col-supported" might have the keyword values: "media-size" and "media-  
.81 color".

- .82 5. The member attributes MUST be defined. For each member attribute the definition document  
.83 MUST provide the following information:
- .84 a) The member attribute's name (e.g., "aaa") MUST be unique within the collection being defined  
.85 and MUST either
- .86 i) reuse the attribute name of another attribute (that is unique across the entire IPP attribute  
.87 name space) and have the same syntax and semantics as the reused attribute (if the  
.88 condition of item 4b) above is met). For example, a member attribute definition could  
.89 reuse the IPP/1.1 "media" attribute.
- .90 ii) potentially occur elsewhere in the entire IPP attribute name space. (if the condition of item  
.91 4a) above is met). For example, a member attribute could be "x-dimension" which could  
.92 potentially occur in another collection or as an attribute outside of a collection.
- .93 iii) be unique across the entire IPP attribute name space (if the condition of item 4b) above is  
.94 met). For example, a member attribute could be "media-color" which must unique be  
.95 across the entire IPP attribute name space.
- .96 b) Whether the member attribute is REQUIRED or OPTIONAL for the Printer to support
- .97 c) Whether the member attribute is REQUIRED or OPTIONAL for the client to supply in a  
.98 request
- .99 d) The member attribute's syntax type, which can be any attribute syntax, including '1setOf X',  
:00 'collection', and '1setOf collection'. If this attribute name reuses the name of another attribute  
:01 (case of item a1 above), it MUST have the same attribute syntax, including cardinality  
:02 (whether or not 1setOf).
- :03 e) The semantics of the "aaa" member attribute. The semantic definition MUST include a  
:04 description of any constraint or boundary conditions the member attribute places on the  
:05 associated attribute, especially if the attribute reuses the name of another attribute (case of item  
:06 a1 above)
- :07 f) The supported values for the each "aaaI" member attribute (of the member attributes "aaa1",  
:08 "aaa2", ..., "aaaN") is specified by one of two mechanisms.
- :09 i) If "xxx-supported" is a "1setOf collection" (see item 4a) above), the value for each "aaaI"  
:10 is specified in each collection value of "xxx-supported" in the context of other member  
:11 attributes. That is, "xxx-supported" enumerates all supported values of "xxx".  
:12
- :13 ii) If the value of "xxx-supported" is a "1setOf type2 keyword" (see item 4b) above), the  
:14 supported values of "aaaI" are the values specified by either i) the "aaaI-supported"  
:15 attribute or ii) the definition of the member attribute "aaaI" within the document defining  
:16 the "xxx" attribute. The values of each member attribute "aaaI" are specified independently  
:17 of other member attributes though a Printer is not required to support all combinations of

supported values.

For example, "media-col-supported" might have the keyword values: "media-size" and "media-color". Using the first method for defining supported values (an "aaaI-supported" attribute), the collection values of "media-col" are combinations of values of "media-size-supported" and "media-color-supported". If "media-size-supported" has the values of '210x297' and '297x420' and "media-color-supported" has the values of 'white' and 'pink', the Printer might support only the combinations 'white-210x297', 'pink-210x297' and 'white-297x420', and not 'pink-297x420'.

If a collection contains a member "aaaI" whose syntax type is "text", the supported values would probably be defined by the definition of "xxx" rather than by the attribute "aaaI-supported".

- g) the default value of each "aaaI" member attribute if it is OPTIONAL for a client to supply the "aaa" member attribute in a request. The default value is specified by in the attribute's definition within a document and MUST be one of the following:
- i) a fixed default
  - ii) a mechanism by which the Printer determines default
  - iii) an indefinite default that is left to the implementation.
  - iv) an attribute that the Printer uses to determine the default
6. The default value of "xxx" if a client does not supply it. The default value is specified by in the attribute's definition within a document and MUST be one of the following:
- a) a fixed default
  - b) a mechanism by which the Printer determines default
  - c) an indefinite default that is left to the implementation
  - d) a Printer attribute "xxx-default" which is a collection with the same member attributes as "xxx". Though optional member attributes may be absent in which case the Printer uses the defaulting rules of item 5g) above.
7. The "xxx-ready (1setOf collection)" attribute if human intervention is required to make many of the supported values available. For example, "media-col" is an attribute which has a "ready" attribute. Most attributes do not have a "ready" attribute.

## !49 **3.2 Nested Collections**

!50 A member attribute may have a syntax type of 'collection' or '1setOf collection', in which case it is called  
!51 a nested collection attribute. The rules for a nested collection attribute are the same as for a collection  
!52 attribute as specified in section 3.1.

# !53 **4 Collection Attributes as Attributes in Operations**

## !54 **4.1 General Rules**

!55 A collection value is like any other IPP/1.1 value, except that it is structured. The rules for attributes  
!56 with collection values are the same as for attributes of any other syntax type (see IPP/1.1), be they in  
!57 any group of a request of a response.

## !58 **4.2 Unsupported Values**

!59 The rules for returning an unsupported collection attribute are an extension to the current rules:

- !60 1. If the entire collection attribute is unsupported, then the Printer returns just the collection  
!61 attribute name with the 'unsupported' out-of-band value (see the beginning of [RFC2911] section  
!62 4.1) in the Unsupported Attributes Group.
- !63 2. If a collection contains unrecognized, unsupported member attributes and/or conflicting values,  
!64 the attribute returned in the Unsupported Group is a collection containing the unrecognized,  
!65 unsupported member attributes, and/or conflicting values. The unrecognized member attributes  
!66 have an out-of-band value of 'unsupported' (see the beginning of [RFC2911] section 4.1). The  
!67 unsupported member attributes and conflicting values have their unsupported or conflicting  
!68 values.

# !69 **5 Example definition of a collection attribute**

!70 In some printing environments, it is desirable to allow the client to select the media by its properties,  
!71 e.g., weight, color, size, etc., instead of by name. In IPP/1.1 (see [RFC2911]), the "media (type3  
!72 keyword | name) Job Template attribute allows selection by name. It is tempting to extend the "media"  
!73 attribute syntax to include "collection", but then existing clients could not understand default or  
!74 supported media values that use the collection value. To preserve interoperability, a new attribute  
!75 MUST BE added, e.g., "media-col (collection)". The following subsections contain a sample definition  
!76 of a simplified "media-col" attribute. The definition follows the rules in section 3.

!77 All of the example attribute definitions in this document are illustrative examples, rather than actual  
!78 definitions. These examples are intended to illustrate how to define collection attributes. Other

documents MUST define collection attributes for use in actual interchange. Such definitions may be very similar to the examples in this document, since we attempted to pick useful examples.

Note: we picked the name "media-col" because the name "media" is already in use. Ordinarily the collection attribute would have a name like any other attribute and would not end in "col".

The member attributes of "media-col" attribute ("media-color (type 3 keyword)" and "media-size (collection)") both follow the naming rules of item 4a3 of section 3, i.e. the names are unique across the entire IPP attribute name space. The member attributes of the "media-size (collection)" member attribute ("x-dimension (integer(0:MAX))" and "y-dimension (integer(0:MAX))") both follow the naming rules of item 4a2 of section 3, i.e. they potentially occur elsewhere in the IPP attribute name space.

## 5.1 media-col (collection)

The "media-col" (collection) attribute augments the IPP/1.1 [RFC2911] "media" attribute. This collection attribute enables a client end user to submit a list of media characteristics to the Printer. When the client specifies media using the "media-col" collection attribute, the Printer object MUST match the requested media exactly. The 'collection' consists of the following member attributes:

**Table 1 - "media-col" member attributes**

Attribute name	attribute syntax	request	Printer Support
media-color	type3 keyword   name (MAX)	MAY	MUST
media-size	collection	MUST	MUST

The definitions for the member attributes is given in the following sub-sections:

### 5.1.1 media-color (type3 keyword | name(MAX))

This member attribute identifies the color of the media. Valid values are 'red', 'white' and 'blue'

The "media-color-supported" (1setOf (type3 keyword | name(MAX))) Printer attribute identifies the values of this "media-color" member attribute that the Printer supports, i.e., the colors supported.

If the client omits this member attribute, the Printer determines the value in an implementation dependent manner.

### 5.1.2 media-size (collection)

This member attribute identifies the size of the media. The 'collection' consists of the member attributes shown in Table 2:

306

**Table 2 - "media-size" collection member attributes**

Attribute name	attribute syntax	request	Printer Support
x-dimension	integer (0:MAX)	MUST	MUST
y-dimension	integer (0:MAX)	MUST	MUST

307

308

The definitions for the member attributes is given in the following sub-sections:

309

**5.1.2.1 x-dimension (integer(0:MAX))**

310

This attribute identifies the width of the media in inch units along the X axis.

311

**5.1.2.2 y-dimension (integer(0:MAX))**

312

This attribute identifies the height of the media in inch units along the Y axis.

313

314

315

316

317

The "media-size-supported" (1setOf collection) Printer attribute identifies the values of this "media-size" member attribute that the Printer supports, i.e., the size combinations supported. The names of the member attributes are the same as the member attributes of the "media-size" collection attribute, namely "x-dimension", and "y-dimension", since they have the same attribute syntax and the same semantics.

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**5.2 media-col-default (collection)**

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The "media-col-default" Printer attribute specifies the media that the Printer uses, if any, if the client omits the "media-col" and "media". Job Template attribute in the Job Creation operation (and the PDL doesn't include a media specification). The member attributes are defined in Table 1. A Printer MUST support the same member attributes for this default collection attribute as it supports for the corresponding "media-col" Job Template attribute.

324

**5.3 media-col-ready (1setOf collection)**

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327

The "media-col-ready" Printer attribute identifies the media that are available for use without human intervention, i.e., the media that are ready to be used without human intervention. The collection value MUST have all of the member attributes that are supported in Table 1.

328

**5.4 media-col-supported (1setOf type2 keyword)**

329

330

331

The "media-col-supported" Printer attribute identifies the keyword names of the member attributes supported in the "media-col" collection Job Template attribute, i.e., the keyword names of the member attributes in Table 1 that the Printer supports.

## 332 **6 A Second Example Definition Of A Collection Attribute**

333 All of the example attribute definitions in this document are illustrative examples, rather than actual  
334 definitions. These examples are intended to illustrate how to define collection attributes. Other  
335 documents **MUST** define collection attributes for use in actual interchange. Such definitions may be  
336 very similar to the examples in this document, since we attempted to pick useful examples.

337 In some printing environments, it is desirable to allow the client to select the media for the job start  
338 sheet. The reason for not adding the 'collection' attribute syntax to the existing "job-sheets" Job  
339 Template attribute is the same as for "media". Instead, a new Job Template attribute is introduced, e.g.  
340 "job-sheet-col (collection)".

341 The member attributes of "job-sheet-col" attribute ("job-sheets (type 3 keyword)" and "media (type3  
342 keyword | name)") both follow the naming rules of item 4a1 of section 3, i.e., they reuse existing IPP  
343 attributes. According to the rules, their supported values come from the existing IPP attributes: "job-  
344 sheets-supported" and "media-supported". However, their default values do not come from "job-sheets-  
345 default" and "media-default", respectively. Rather the definition of "job-sheet-col" says that "job-sheets  
346 (type 3 keyword)" is required and if "media (type3 keyword | name)" is absent, the Printer uses the same  
347 media as the rest of the job uses.

348 If "job-sheet-col" attribute were defined to contain the member attribute "job-sheet-media (type3  
349 keyword | name)" instead of "media (type3 keyword | name)", then the definition would also have to  
350 specify a "job-sheet-media-supported (1setOf (type3 keyword | name))" whose values would be  
351 independent of "media-supported (1setOf (type3 keyword | name))" and would be set separately by a  
352 System Administrator.

353 The actual text for the definition of the attribute is left as an exercise for the reader.

## 354 **7 Encoding**

355 This section defines the additional encoding tags used according to [RFC2910] and gives an example of  
356 their use. The encoding tags define in this document **MUST** be used by all collection attributes defined  
357 in other documents. However, the example of their use is illustrative only.

### 358 **7.1 Additional tags defined for representing a collection attribute value**

359 The 'collection' attribute syntax uses the tags defined in Table 3.

**Table 3 - Tags defined for encoding the 'collection' attribute syntax**

Tag name	Tag value	Meaning
begCollection	0x34	Begin the collection attribute value.
endCollection	0x37	End the collection attribute value.
memberAttrName	0x4A	The value is the name of the collection member attribute

When encoding a collection attribute "xxx" that contains an attribute "aaa" and is not inside another collection, the encoding follows these rules:

1. The beginning of the collection is indicated with a value tag that **MUST** be syntax type 'begCollection' (0x34) with a name length and Name field that represent the name of the collection attribute ("xxx") as with any attribute, followed by a value. The Printer **MAY** ignore the value and its length of **MAY** be 0. In the future, however, this field **MAY** contain useful information, such as the collection name (cf. the name of a C struct).
2. Each member attribute is encoded as a sequence of two or more values that appear to be part of a single multi-valued attribute, i.e. 1setOf. The first value after the 'begCollection' value has the attribute syntax 'memberAttrName' (0x4A) and its value holds the name of the first member attribute (e.g. "aaa"). The second value holds the first member's attribute value, which can be of any attribute syntax, except 'memberAttrName' or 'endCollection'. If the first member's attribute value is multi-valued, the third value holds the second value of the first member's value. Otherwise, the third value holds the name of second member attribute (e.g. "bbb") and its attribute syntax is 'memberAttrName'. In this case, the fourth member's value is the value of "bbb".  
  
Note that the technique of encoding a 'collection' as a '1setOf' makes it easy for a Printer that doesn't support a particular collection attribute (or the collection attribute syntax at all) to simply skip over the entire collection value.
3. The end of the collection is indicated with a value tag that **MUST** be syntax type 'endCollection' (e.g. 0x37) and **MAY** have a zero name length and a zero value length. In the future, this field **MAY** contain useful information, such as the collection name that matches the one in the 'begCollection' .
4. It is valid to have a member attribute that is, itself, a collection attribute, i.e., collections can be nested within collections. This is represented by the occurrence of a member attribute that is of attribute syntax type 'begCollection'. Such a collection is terminated by a matching 'endCollection'. The name of such a member attribute is in the immediately preceding value whose syntax type is 'memberAttrName'.
5. It is valid for a collection attribute to be multi-valued, i.e., have more than one collection value. If the next attribute immediately following the 'endCollection' has a zero name length and a tag of 'begCollection', then the collection attribute is a multi-valued collection, as with any attribute. This statement applies to collections within collections and collections that are not in collections.

394 **7.2 Example encoding: "media-col" (collection)**

395 The collection specified in section 5 is used for the encoding example shown in Table 5. The example  
 396 also shows nested collections, since the "media-size" member attribute is a 'collection'. The encoding  
 397 example represents a blue 4x6-index cards and takes 216 octets. The Appendices contains more  
 398 complex examples.

399 Additional examples have been included in the appendices.

400 The overall structure of the two collection values can be pictorially represented as:

```
401 "media-col" =
402   { "media-color" = 'blue';
403     "media-size" =
404       { "x-dimension" = 6;
405         "y-dimension" = 4
406       }
407   },
```

408  
 409 The full encoding is in table 4. A simplified view of the encoding looks like this:

410 **Table 4 - Overview Encoding of "media-col" collection**

Tag Value	Name	Value
begCollection	media-col	""
memberAttrName	""	media-color
keyword	""	blue
memberAttrName	""	media-size
begCollection	""	""
memberAttrName	""	x-dimension
integer	""	6
memberAttrName	""	y-dimension
integer	""	4
endCollection	""	""
endCollection	""	""

411

412

H13

**Table 5 - Example Encoding of "media-col" collection**

Octets	Symbolic Value	Protocol field	comments
0x34	begCollection	value-tag	beginning of the "media-col" collection attribute
0x0009		name-length	length of (collection) attribute name
media-col	media-col	name	name of (collection) attribute
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)
0x4A	memberAttrName	value-tag	starts a new member attribute: "media-color"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x000B		value-length	length of "media-color" keyword
media-color	media-color	value	value is name of 1st member attribute
0x44	keyword type	value-tag	keyword type
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0004		value-length	
blue	blue	value	value of 1st member attribute
0x4A	memberAttrName	value-tag	starts a new member attribute: "media-size"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x000A		value-length	length of "media-size" keyword
media-size	media-size	value	Name of 2nd member attribute
0x34	begCollection	value-tag	Beginning of the "media-size" collection attribute which is a sub-collection
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0000		value-length	collection attribute names have no value
			no value (since value-length was 0)
0x4A	memberAttrName	value-tag	starts a new member attribute: "x-dimension"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)

Octets	Symbolic Value	Protocol field	comments
0x000B		value-length	length of "x-dimension" keyword
x-dimension	x-dimension	value	name of 1st sub-collection member attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0006		value	value of 1st sub-collection member attribute
0x4A	memberAttrName	value-tag	starts a new member attribute: "y-dimension"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x000B		value-length	length of the "y-dimension" keyword
y-dimension	y-dimension	value	name of 2nd sub-collection member attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0004		value	value of 2nd sub-collection member attribute
0x37	endCollection	value-tag	end of the sub-collection
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)
0x37	endCollection	value-tag	end of the 1st collection value in 1setOf
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)

## l14 8 Legacy issues

l15 IPP 1.x Printers and Clients will gracefully ignore collections and its member attributes if it does not  
 l16 understand the collection. The begCollection and endCollection elements each look like an attribute  
 l17 with an attribute syntax that the recipient doesn't support and so should ignore the entire attribute. The  
 l18 individual member attributes and their values will look like a 1setOf values of the collection attribute, so  
 l19 that the Printer simply ignores the entire attribute and all of its values. Returning unsupported attributes  
 l20 is also simple, since only the name of the collection attribute is returned with the 'unsupported' out-of-  
 l21 band value (see section 4.2).

## l22 9 IANA Considerations

l23 The following table provides registration for the 'collection' attribute syntax defined in this document.  
 l24 This is to be registered according to the procedures in RFC 2911 [RFC2911] section 6.3.

l25 *Note to RFC Editors: Replace RFC NNNN below with the RFC number for this document, so that it*  
 l26 *accurately reflects the content of the information for the IANA Registry.*

l27 Attribute Syntaxes:	Tag value:	Ref.	Section:
l28 collection		RFC NNNN	3
l29 begCollection	0x34	RFC NNNN	7.1
l30 endCollection	0x37	RFC NNNN	7.1
l31 memberAttrName	0x4A	RFC NNNN	7.1

l32  
 l33 The resulting attribute syntax registration will be published in the  
 l34 <ftp://ftp.iana.org/in-notes/iana/assignments/ipp/attribute-syntaxes/>  
 l35 area.  
 l36

## l37 10 Internationalization Considerations

l38 This attribute syntax by itself has no impact on internationalization. However, the member attributes  
 l39 that are subsequently defined for use in a collection may have internationalization considerations, as may  
 l40 any attribute, according to [RFC2911].

## l41 11 Security Considerations

l42 This attribute syntax causes no more security concerns than any other attribute syntax. It is only the  
 l43 attributes that are subsequently defined to use this or any other attribute syntax that may have security  
 l44 concerns, depending on the semantics of the attribute, according to [RFC2911].

## 12 References

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l09 IPP Mailing List: [ipp@pwg.org](mailto:ipp@pwg.org)

l10  
l11 To subscribe to the ipp mailing list, send the following email:  
l12 1) send it to [majordomo@pwg.org](mailto:majordomo@pwg.org)  
l13 2) leave the subject line blank  
l14 3) put the following two lines in the message body:  
l15 subscribe ipp  
l16 end  
l17

l18 Implementers of this specification document are encouraged to join the IPP Mailing List in order to  
l19 participate in any discussions of clarification issues and review of registration proposals for additional

i20 attributes and values. In order to reduce spam the mailing list rejects mail from non-subscribers, so you  
 i21 must subscribe to the mailing list in order to send a question or comment to the mailing list.

## i22 **14 Appendix A: Encoding Example of a Simple Collection**

i23 The overall structure of the collection value can be pictorially represented as:

```
i24     "media-size" =
i25     {   "x-dimension" = 6;
i26         "y-dimension" = 4
i27     }
```

i28  
 i29 A simplified view of the encoding would look like this:

i30 **Table 6 - Overview Encoding of simple collection**

Tag Value	Name	Value
begCollection	media-size	""
memberAttrName	""	x-dimension
integer	""	6
memberAttrName	""	y-dimension
integer	""	4
endCollection	""	""

i31  
 i32 Note: "" represents a name or value whose length is 0.  
 i33

**Table 7 - Example Encoding of simple collection**

Octets	Symbolic Value	Protocol field	comments
0x34	begCollection	value-tag	beginning of the "media-size" collection attribute
0x000A		name-length	length of (collection) attribute name
media-size	media-size	name	name of (collection) attribute
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)
0x4A	memberAttrName	value-tag	starts member attribute: "x-dimension"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x000B		value-length	length of "x-dimension" keyword
x-dimension	x-dimension	value	name of 1 <sup>st</sup> collection member attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0006		value	value of 1 <sup>st</sup> collection member attribute
0x4A	memberAttrName	value-tag	starts a new member attribute: "y-dimension"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x000B		value-length	length of the "y-dimension" keyword
y-dimension	y-dimension	value	name of 2 <sup>nd</sup> collection member attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf for media-size
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0004		value	value of 2 <sup>nd</sup> collection member attribute
0x37	endCollection	value-tag	end of the collection
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)

Octets	Symbolic Value	Protocol field	comments
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)

i35

## i36 15 Appendix B: Encoding Example of 1setOf Collection

i37 The overall structure of the collection value can be pictorially represented as:

```

i38     "media-size-supported" =
i39     {   "x-dimension" = 6;
i40         "y-dimension" = 4
i41     },
i42     {   "x-dimension" = 3;
i43         "y-dimension" = 5
i44     };
i45
i46

```

A simplified view of the encoding would look like this:

i47

**Table 8 - Overview Encoding of 1setOf collection**

Tag Value	Name	Value
begCollection	media-size-supported	""
memberAttrName	""	x-dimension
integer	""	6
memberAttrName	""	y-dimension
integer	""	4
endCollection	""	""
begCollection	""	""
memberAttrName	""	x-dimension
integer	""	3
memberAttrName	""	y-dimension
integer	""	5
endCollection	""	""

i48

**Table 9 - Example Encoding of 1setOf collection**

Octets	Symbolic Value	Protocol field	comments
0x34	begCollection	value-tag	beginning of the "media-size-supported (1setOf collection" attribute
0x00014		name-length	length of (collection) attribute name
media-size-supported	media-size-supported	name	name of (collection) attribute
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)
0x4A	memberAttrName	value-tag	starts member attribute: "x-dimension"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x000B		value-length	length of "x-dimension" keyword
x-dimension	x-dimension	value	name of 1 <sup>st</sup> collection member attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0006		value	value of 1 <sup>st</sup> collection member attribute
0x4A	memberAttrName	value-tag	starts member attribute: "y-dimension"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x000B		value-length	length of the "y-dimension" keyword
y-dimension	y-dimension	value	name of 2 <sup>nd</sup> collection member attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0004		value	value of 2 <sup>nd</sup> collection member attribute
0x37	endCollection	value-tag	end of the collection
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)

Octets	Symbolic Value	Protocol field	comments
0x34	begCollection	value-tag	beginning of the 2 <sup>nd</sup> member of the 1setOf "sizes-avail " collection attribute
0x0000		name-length	Zero length name indicates this is member of previous attribute
		name	no name (since name-length was 0)
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)
0x4A	memberAttrName	value-tag	starts member attribute: "x-dimension"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x000B		value-length	length of "x-dimension" keyword
x-dimension	x-dimension	value	name of 1 <sup>st</sup> collection member attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0003		value	value of 1 <sup>st</sup> collection member attribute
0x4A	memberAttrName	value-tag	starts member attribute: "y-dimension"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x000B		value-length	length of the "y-dimension" keyword
y-dimension	y-dimension	value	name of 2 <sup>nd</sup> collection member attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0005		value	value of 2 <sup>nd</sup> collection member attribute
0x37	endCollection	value-tag	end of the 1setOf collection value
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)

551 **16 Appendix C: Encoding Example of Collection containing 1setOf XXX**  
 552 **attribute**

553 The overall structure of the collection value can be pictorially represented as:

```
554 "wagons" =
555     { "colors" = red, blue;
556       "sizes" = 4, 6, 8
557     }
```

558  
 559 A simplified view of the encoding would look like this:

560 **Table 10 - Overview Encoding of collection with 1setOf value**

Tag Value	Name	Value
begCollection	wagons	""
memberAttrName	""	colors
keyword	""	red
keyword	""	blue
memberAttrName	""	sizes
integer	""	4
integer	""	6
integer	""	8
endCollection	""	""

561

**Table 11 - Example Encoding of collection with 1setOf value**

Octets	Symbolic Value	Protocol field	comments
0x34	begCollection	value-tag	beginning of the "wagons" collection attribute
0x0005		name-length	length of (collection) attribute name
wagons	wagons	name	name of (collection) attribute
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)
0x4A	memberAttrName	value-tag	starts a new member attribute: "colors"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x0006		value-length	length of "colors" keyword
colors	colors	value	value is name of 1 <sup>st</sup> member attribute
0x44	keyword type	value-tag	keyword type
0x0000		name-length	0 indicates 1setOf wagons
			no name (since name-length was 0)
0x0004		value-length	
blue	blue	value	value of 1 <sup>st</sup> member attribute
0x44	keyword type	value-tag	keyword type
0x0000		name-length	0 indicates 1setOf wagons
			no name (since name-length was 0)
0x0003		value-length	
red	red	value	value of 1 <sup>st</sup> member attribute
0x4A	memberAttrName	value-tag	starts a new member attribute: "sizes"
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x0005		value-length	length of "length-avail" keyword
sizes	sizes	value	Name of 2 <sup>nd</sup> member attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf wagons
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0004		value	1 <sup>st</sup> value for 1setOf integer attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0006		value	2 <sup>nd</sup> value for 1setOf integer attribute
0x21	integer type	value-tag	attribute type
0x0000		name-length	0 indicates 1setOf

Octets	Symbolic Value	Protocol field	comments
			no name (since name-length was 0)
0x0004		value-length	length of an integer = 4
0x0008		value	3 <sup>rd</sup> value for 1setOf integer attribute
0x37	endCollection	value-tag	end of the collection
0x0000		name-length	defined to be 0 for this type, so part of 1setOf
			no name (since name-length was 0)
0x0000		value-length	defined to be 0 for this type
			no value (since value-length was 0)

563

## 564 17 Appendix D: Description of the Base IPP Documents

565 The base set of IPP documents includes:

- 566 Design Goals for an Internet Printing Protocol [RFC2567]
- 567 Rationale for the Structure and Model and Protocol for the Internet Printing Protocol [RFC2568]
- 568 Internet Printing Protocol/1.1: Model and Semantics [RFC2911]
- 569 Internet Printing Protocol/1.1: Encoding and Transport [RFC2910]
- 570 Internet Printing Protocol/1.1: Implementer's Guide [IPP-IIG]
- 571 Mapping between LPD and IPP Protocols [RFC2569]

572

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

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

583 The "Internet Printing Protocol/1.1: Model and Semantics" document describes a simplified model with  
 584 abstract objects, their attributes, and their operations. The model introduces a Printer and a Job. The  
 585 Job supports multiple documents per Job. The model document also addresses how security,  
 586 internationalization, and directory issues are addressed.

587 The "Internet Printing Protocol/1.1: Encoding and Transport" document is a formal mapping of the  
 588 abstract operations and attributes defined in the model document onto HTTP/1.1 [RFC2616]. It also  
 589 defines the encoding rules for a new Internet MIME media type called "application/ipp". This document

590 also defines the rules for transporting over HTTP a message body whose Content-Type is  
591 "application/ipp". This document defines the 'ipp' scheme for identifying IPP printers and jobs.

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

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

## 599 **18 Appendix E: Full Copyright Statement**

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518  
519 Funding for the RFC Editor function is currently provided by the Internet Society.