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Lightweight Directory Access Protocol (LDAP): Schema for Printer Services

Abstract

This document defines a schema, object classes, and attributes, for Printers and print services, for use with directories that support the Lightweight Directory Access Protocol (RFC 4510). This document is based on the Printer attributes listed in Appendix E of "Internet Printing Protocol/1.1: Model and Semantics" (RFC 2911). Additional Printer attributes are based on definitions in "Printer MIB v2" (RFC 3805), "PWG Command Set Format for IEEE 1284 Device ID v1.0" (PWG 5107.2), "IPP Job and Printer Extensions - Set 3 (JPS3)" (PWG 5100.13), and "IPP Everywhere" (PWG 5100.14).

This memo is an Independent Submission to the RFC Editor by the Internet Printing Protocol (IPP) Working Group of the IEEE-ISTO Printer Working Group (PWG), as part of their PWG "IPP Everywhere" (PWG 5100.14) project for secure mobile printing with vendor-neutral Client software.

This document obsoletes RFC 3712.

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1. Introduction

This document defines several object classes to provide Lightweight Directory Access Protocol (LDAP) [RFC4510] applications with flexible options in defining Printer information using an LDAP schema. Classes are provided for defining directory entries with common Printer information as well as for extending existing directory entries with Service Location Protocol Version 2 (SLPv2) [RFC2608], Internet Printing Protocol/1.1 (IPP/1.1) [RFC2911], and lineprinter (LPR) [RFC1179] protocol-specific information.

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1.1. Relationship to SLP Printer Service

The schema defined in this document is technically aligned with the stable IANA-registered 'service:printer:' v2.0 template [SLPPRT20], for compatibility with already-deployed SLPv2 [RFC2608] service advertising and discovery infrastructure. The attribute syntaxes are technically aligned with the 'service:printer:' v2.0 template; therefore, simpler types are sometimes used (for example, 'DirectoryString' [RFC4517] rather than 'labeledURI' [RFC2079] for the 'printer-uri' attribute).

1.2. Source of LDAP Printer Attributes

The schema defined in this document is based on:

- all of the Printer attributes listed in Appendix E ("Generic Directory Schema") of "Internet Printing Protocol/1.1: Model and Semantics" [RFC2911] that are defined in Section 4.4 ("Printer Description Attributes") of [RFC2911]

- selected Printer attributes defined in "Printer MIB v2" [RFC3805], "PWG Command Set for IEEE 1284 Device ID v1.0" [PWG5107.2], "IPP Job and Printer Extensions - Set 3 (JPS3)" [PWG5100.13], and "IPP Everywhere" [PWG5100.14]

See the table of Printer attributes and source documents in Section 4 ("Definition of Attribute Types") of this document.

1.3. Source of LDAP Printer Schema OIDs

1.3.1. IBM Assignments for RFC 3712

In March 2000, IBM permanently assigned ASN.1 OIDs to all of the object classes and attribute types that were defined in the original LDAP Printer Schema [RFC3712] (see Section 7.2).

1.3.2. IEEE-ISTO PWG Assignments

In October 2011, IBM permanently delegated the base ASN.1 OID "1.3.18.0.2.24.46" to the IEEE-ISTO PWG for use in any PWG project. In October 2011, the IEEE-ISTO PWG permanently assigned subordinate ASN.1 OIDs for all of the new attribute types defined in this updated LDAP Printer Schema (see Section 7.1).

1.4. Rationale for Design Choices

1.4.1. Rationale for Using DirectoryString Syntax

The attribute syntax 'DirectoryString' (UTF-8 [STD63]) defined in [RFC4517] is specified for several groups of string attributes that are defined in this document:

1) URI

- printer-uri, printer-xri-supported, printer-more-info, printer-charge-info-uri, printer-uuid

  The UTF-8 encoding is compatible with deployment of (UTF-8 based) Internationalized Resource Identifiers (IRIs) [RFC3987].

2) Description

- printer-name, printer-location, printer-info, printer-make-and-model

  The UTF-8 encoding supports descriptions in any language, conformant with the IETF Policy on Character Sets and Languages [BCP18].

  Note: The printer-natural-language-configured attribute contains a language tag [BCP47] for these description attributes (for example, to support text-to-speech conversions).

3) Keyword

- printer-compression-supported, printer-finishings-supported, printer-media-supported, printer-media-local-supported, printer-print-quality-supported

  The UTF-8 encoding is compatible with the current IPP/1.1 [RFC2911] definition of the equivalent attributes, most of which have the IPP/1.1 union syntax 'keyword' or 'name'. The keyword attributes defined in this document are extensible by site-specific or vendor-specific 'names' that behave like new 'keywords'.

  Note: In IPP/1.1, each value is strongly typed over-the-wire as either 'keyword' or 'name'. This union selector is not preserved in the definitions of these equivalent LDAP attributes.

1.4.2. Rationale for Using caseIgnoreMatch

The EQUALITY matching rule 'caseIgnoreMatch' defined in [RFC4517] is specified for several groups of string attributes that are defined in this document:

1) URI

These URI attributes specify EQUALITY matching with 'caseIgnoreMatch' (rather than with 'caseExactMatch') in order to conform to the spirit of [STD66], which requires case-insensitive matching on the host part of a URI versus case-sensitive matching on the remainder of a URI.

These URI attributes follow existing practice of supporting case-insensitive equality matching for host names in the associatedDomain attribute defined in [RFC4524].

Either equality matching rule choice would be a compromise:

a) case-sensitive whole URI matching can lead to false negative matches and has been shown to be fragile (given deployed client applications that 'pretty up' host names displayed and transferred in URI);

b) case-insensitive whole URI matching can lead to false positive matches, although it is a dangerous practice to publish URI that differ only by case (for example, in the path elements).

2) Description

Case-insensitive equality matching is more user-friendly for description attributes.

3) Keyword

Case-insensitive equality matching is more user-friendly for keyword attributes.

4) IEEE 1284 Device ID

Case-insensitive equality matching is mandatory for IEEE 1284 Device ID attributes.

1.4.3. Rationale for Using caseIgnoreSubstringsMatch

The SUBSTR matching rule 'caseIgnoreSubstringsMatch' defined in [RFC4517] is specified for several groups of string attributes that are defined in this document:

1) URI

These URI attributes follow existing practice of supporting case-insensitive equality matching for host names in the associatedDomain attribute defined in [RFC4524].

2) Description

Support for case-insensitive substring matching is more user-friendly for description attributes.

3) Keyword

Support for case-insensitive substring matching is more user-friendly for keyword attributes.

4) IEEE 1284 Device ID

Support for case-insensitive substring matching is mandatory for IEEE 1284 Device ID attributes.

2. Conventions Used in This Document

2.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

2.2. LDAP Schema Descriptions

Schema definitions are provided using LDAP [RFC4510] description formats. Definitions provided here are formatted (line wrapped) for readability.

2.3. Abbreviations

This document makes use of the following abbreviations (given with their expanded forms and references for further reading):

IANA - Internet Assigned Numbers Authority
<http://www.iana.org>

IEEE - Institute of Electrical and Electronics Engineers
<http://www.ieee.org>

IPP - Internet Printing Protocol [RFC2911] [PWG5100.12]
<http://www.pwg.org/ipp/>

ISTO - IEEE Industry Standards and Technology Organization
<http://www.ieee-isto.org/>

PWG - IEEE-ISTO Printer Working Group
<http://www.pwg.org>

RFC - Request for Comments
<http://www.rfc-editor.org>

TLS - Transport Layer Security [RFC5246]

URI - Uniform Resource Identifier [STD66]

URL - Uniform Resource Locator [STD66]

UTF-8 - Unicode Transformation Format - 8-bit [STD63]

3. Definition of Object Classes

We define the following LDAP object classes for use with both generic Printer-related information and services specific to SLPv2 [RFC2608], IPP/1.1 [RFC2911], and LPR [RFC1179].

slpServicePrinter - auxiliary class for SLP-registered Printers
printerAbstract - abstract class for all Printer classes
printerService - structural class for Printers
printerServiceAuxClass - auxiliary class for Printers
printerIPP - auxiliary class for IPP Printers
printerLPR - auxiliary class for LPR Printers

The following are some examples of how applications could choose to use these classes when creating directory entries:

1) Use printerService for directory entries containing common Printer information.

2) Use both printerService and slpServicePrinter for directory entries containing common Printer information for SLP-registered Printers.

3) Use printerService, printerLPR, and printerIPP for directory entries containing common Printer information for Printers that support both LPR and IPP.

4) Use printerServiceAuxClass and object classes not defined by this document for directory entries containing common Printer information. In this example, printerServiceAuxClass is used for extending other structural classes defining Printer information with common Printer information defined in this document.

Refer to Section 4 for the definition of attribute types referenced by these object classes. We use attribute names instead of OIDs in object class definitions for clarity. Some attribute names described in [RFC2911] have been prefixed with 'printer-' as recommended in [RFC2926] and [SLPPRT20].

3.1. slpServicePrinter

```
( 1.3.18.0.2.6.254
NAME  'slpServicePrinter'
DESC  'Service Location Protocol (SLP) information.'
AUXILIARY
SUP   slpService
)
```

This auxiliary class defines information specific to the Service Location Protocol (SLPv2) [RFC2608]. It MAY be used to create new, or extend existing, directory entries with SLP 'service:printer' abstract service type information as defined in [SLPPRT20]. This object class is derived from 'slpService', the parent class for all SLP services, defined in [RFC2926].

3.2. printerAbstract

```
( 1.3.18.0.2.6.258
NAME  'printerAbstract'
DESC  'Printer-related information.'
ABSTRACT
SUP   top
MAY   ( printer-name $
        printer-natural-language-configured $
        printer-location $
        printer-info $
        printer-more-info $
        printer-make-and-model $
        printer-multiple-document-jobs-supported $
        printer-charset-configured $
        printer-charset-supported $
        printer-generated-natural-language-supported $
        printer-document-format-supported $
        printer-color-supported $
        printer-compression-supported $
        printer-pages-per-minute $
        printer-pages-per-minute-color $
        printer-finishings-supported $
        printer-number-up-supported $
        printer-sides-supported $
        printer-media-supported $
        printer-media-local-supported $
        printer-resolution-supported $
        printer-print-quality-supported $
        printer-job-priority-supported $
        printer-copies-supported $
        printer-job-k-octets-supported $
```

```
          printer-current-operator $
          printer-service-person $
          printer-delivery-orientation-supported $
          printer-stacking-order-supported $
          printer-output-features-supported $
          printer-device-id $
          printer-device-service-count $
          printer-uuid $
          printer-charge-info $
          printer-charge-info-uri $
          printer-geo-location )
)
```

This abstract class defines Printer information. It is a base class for deriving other Printer-related classes, such as, but not limited to, classes defined in this document. It defines a common set of Printer attributes that are not specific to any one type of service, protocol, or operating system.

3.3. printerService

```
( 1.3.18.0.2.6.255
NAME  'printerService'
DESC  'Printer information.'
STRUCTURAL
SUP   printerAbstract
MAY   ( printer-uri $
        printer-xri-supported )
)
```

This structural class defines Printer information. It is derived from class printerAbstract and thus inherits common Printer attributes. This class can be used with or without auxiliary classes to define Printer information. Auxiliary classes can be used to extend the common Printer information with information specific to the protocol, service, or operating system.

Note: When extending other structural classes with auxiliary classes, printerService SHOULD NOT be used.

3.4. printerServiceAuxClass

```
( 1.3.18.0.2.6.257
NAME  'printerServiceAuxClass'
DESC  'Printer information.'
AUXILIARY
SUP   printerAbstract
MAY   ( printer-uri $
        printer-xri-supported )
)
```

This auxiliary class defines Printer information. It is derived from class printerAbstract and thus inherits common Printer attributes.

3.5. printerIPP

```
( 1.3.18.0.2.6.256
NAME  'printerIPP'
DESC  'Internet Printing Protocol (IPP) information.'
AUXILIARY
SUP   top
MAY   ( printer-ipp-versions-supported $
        printer-ipp-features-supported $
        printer-multiple-document-jobs-supported )
)
```

This auxiliary class defines Internet Printing Protocol (IPP/1.1) [RFC2911] information. It is used to extend structural classes with IPP-specific Printer information.

Note: See "Internet Printing Protocol/1.1: IPP URL Scheme" [RFC3510] and "Internet Printing Protocol (IPP) over HTTPS Transport Binding and the 'ipps' URI Scheme" [RFC7472] for conforming URI for IPP Printers.

3.6. printerLPR

```
( 1.3.18.0.2.6.253
NAME  'printerLPR'
DESC  'LPR information.'
AUXILIARY
SUP   top
MUST  ( printer-name )
MAY   ( printer-aliases )
)
```

This auxiliary class defines LPR [RFC1179] information. It is used to identify directory entries that support LPR.

4. Definition of Attribute Types

The following attribute types are referenced by the object classes defined in Section 3.

The following attribute types reference syntax OIDs defined in Section 3 of [RFC4517] (see Section 5 ("Definition of Syntaxes") below).

The following attribute types reference matching rule names (instead of OIDs) for clarity (see Section 6 below). For optional attributes, if the Printer information is not known, the attribute value SHOULD NOT be set. In the following definitions, referenced matching rules are defined in Section 4 of [RFC4517] and discussed in Section 6 ("Definition of Matching Rules") later in this document.

Note: For compatibility with existing implementations of [RFC3712] and underlying string length limits in [RFC2707], [RFC2911], [RFC3805], [PWG5107.2], [PWG5100.13], and [PWG5100.14], implementations of the attributes defined in this document SHOULD NOT exceed those underlying string length limits (to avoid truncation and false matches).

Note: For interoperability and consistent text display, values of attributes defined in this document (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; (b) SHOULD NOT contain DEL or any C0 or C1 control characters except for HT, CR, and LF; (c) SHOULD only contain CR and LF characters together (not as singletons); and (d) SHOULD NOT contain HT, CR, or LF characters in names, e.g., printer-name and printer-aliases.

Note: Some of the following attributes are described as 'List of xxx' (using a comma as the member delimiter). Some other attributes are described as 'One of xxx' (single-valued). In all cases, any attribute can have multiple values represented as multiple instances, except where explicitly restricted in syntax to be single-valued.

Note: Values of the string attributes printer-xri-supported and printer-resolution-supported use different field delimiters ('<' and '>', respectively). These two field delimiters are different for compatibility with the corresponding attributes in the IANA-registered SLP 'service:printer:' v2.0 template [SLPPRT20], which was defined before the original LDAP Printer Schema [RFC3712] was written.

The following table is a summary of the attribute names defined by this document and their corresponding source document names as defined in [RFC2911], [RFC3805], [PWG5107.2], or [PWG5100.13]. Some source attribute names have been prefixed with 'printer-' as recommended in [RFC2926], to address the flat namespace for LDAP identifiers.

LDAP and SLP Printer Schema	Source Document and Attribute Name
***	IPP/1.1 and Semantics Model [RFC2911]
printer-uri	
printer-xri-supported	
	[printer-uri-supported]
	[uri-authentication-supported]
	[uri-security-supported]
printer-name	printer-name
printer-natural-language-configured	
	natural-language-configured
printer-location	printer-location
printer-info	printer-info
printer-more-info	printer-more-info
printer-make-and-model	printer-make-and-model
printer-ipp-versions-supported	ipp-versions-supported
printer-multiple-document-jobs-supported	
	multiple-document-jobs-supported
printer-charset-configured	charset-configured
printer-charset-supported	charset-supported
printer-generated-natural-language-supported	
	generated-natural-language-supported
printer-document-format-supported	
	document-format-supported
printer-color-supported	color-supported
printer-compression-supported	compression-supported
printer-pages-per-minute	pages-per-minute
printer-pages-per-minute-color	pages-per-minute-color
printer-finishings-supported	finishings-supported
printer-number-up-supported	number-up-supported
printer-sides-supported	sides-supported
printer-media-supported	media-supported
printer-media-local-supported	[site names from IPP media-supported]
printer-resolution-supported	printer-resolution-supported
printer-print-quality-supported	print-quality-supported
printer-job-priority-supported	job-priority-supported
printer-copies-supported	copies-supported
printer-job-k-octets-supported	job-k-octets-supported

***	Printer MIB v2 [RFC3805]
printer-current-operator	prtGeneralCurrentOperator
printer-service-person	prtGeneralServicePerson
printer-delivery-orientation-supported	prtOutputPageDeliveryOrientation
printer-stacking-order-supported	prtOutputStackingOrder
printer-output-features-supported	[prtOutputBursting] [prtOutputDecollating] [prtOutputPageCollated] [prtOutputOffsetStacking]
printer-aliases	prtGeneralPrinterName
***	Cmd Set 1284 Device ID [PWG5107.2]
printer-device-id	printer-device-id
***	IPP Job/Printer Ext Set3 [PWG5100.13]
printer-device-service-count	device-service-count
printer-uuid	printer-uuid
printer-charge-info	printer-charge-info
printer-charge-info-uri	printer-charge-info-uri
printer-geo-location	printer-geo-location
printer-ipp-features-supported	ipp-features-supported

4.1. printer-uri

```
( 1.3.18.0.2.4.1140
NAME 'printer-uri'
DESC 'A URI supported by this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

If the printer-xri-supported LDAP attribute is implemented, then this printer-uri value MUST be listed in printer-xri-supported.

See [STD66] for details of URI syntax.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 1023 octets in length.

Note: LDAP application clients SHOULD NOT attempt to use malformed URI values read from this attribute. LDAP administrative clients SHOULD NOT write malformed URI values into this attribute.

Note: See "Internet Printing Protocol/1.1: IPP URL Scheme" [RFC3510] and "Internet Printing Protocol (IPP) over HTTPS Transport Binding and the 'ipps' URI Scheme" [RFC7472] for conforming URI for IPP Printers.

Note: For SLP-registered Printers, the LDAP printer-uri attribute SHOULD be set to the value of the SLP-registered URL of the Printer, for interworking with SLPv2 [RFC2608] service discovery.

Note: See Sections 1.4.1, 1.4.2, and 1.4.3 for rationale for design choices.

4.2. printer-xri-supported

```
( 1.3.18.0.2.4.1107
NAME 'printer-xri-supported'
DESC 'An XRI (extended resource identifier) supported by
      this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

Each value of this attribute MUST consist of a URI (uniform resource identifier) followed by (optional) authentication and security fields.

Each XRI field MUST be delimited by '<', with optional trailing whitespace. For example:

```
'uri=ipp://example.com/ipp< auth=digest< sec=tls<'
'uri=ipps://example.com/ipp< auth=digest< sec=tls<'
'uri=lpr://example.com/lpr< auth=none< sec=none<'
'uri=mailto:printer@example.com< auth=none< sec=none<'
```

Note: See the note in Section 4 about the different field delimiters used in the printer-xri-supported and printer-resolution-supported attributes ('<' and '>', respectively), chosen for compatibility with the IANA-registered SLP 'service:printer:' v2.0 template [SLPPRT20].

Note: Multiple values for this attribute are represented as multiple instances of this attribute.

See [STD66] for details of URI syntax.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 1023 octets in length.

Note: LDAP application clients SHOULD NOT attempt to use malformed URI values read from this attribute. LDAP administrative clients SHOULD NOT write malformed URI values into this attribute.

Note: This attribute is based on the IPP/1.1 [RFC2911] attributes 'printer-uri-supported', 'uri-authentication-supported', and 'uri-security-supported' (called the 'Three Musketeers' because they are parallel, ordered attributes). This attribute unfolds those IPP/1.1 attributes and thus avoids the ordering (and same number of values) constraints of the IPP/1.1 separate attributes.

Defined keywords for fields include:

'uri' (IPP 'printer-uri-supported')
'auth' (IPP 'uri-authentication-supported')
'sec' (IPP 'uri-security-supported')

A missing 'auth' field SHOULD be interpreted to mean 'none'. Per IPP/1.1 [RFC2911], "IPP Job and Printer Extensions - Set 3 (JPS3)" [PWG5100.13], and the IANA IPP registry [IANAIPP], defined values of the 'auth' field include:

'none' (no authentication for this URI)
'requesting-user-name' (from operation request)
'basic' (HTTP/1.1 Basic [RFC2617] and [RFC7235])
'digest' (HTTP/1.1 Digest [RFC2617] and [RFC7235])
'certificate' (X.509 Certificate [RFC5280] and [RFC6818])
'negotiate' (HTTP/1.1 Negotiate [RFC4559])

The 'certificate' value refers to the IPP Client certificate extracted from the TLS session.

A missing 'sec' field SHOULD be interpreted to mean 'none'. Per IPP/1.1 [RFC2911] and the IANA IPP registry [IANAIPP], defined values of the 'sec' field include:

'none' (no security for this URI)
'ssl3' (Netscape's Secure Socket Layer protocol (SSL3))
'tls' (IETF TLS, [RFC5246])

Note: The syntax and delimiter for this attribute are aligned with the equivalent attribute in the 'service:printer:' v2.0 template [SLPPRT20]. Whitespace is permitted after (but not before) the delimiter '<'.

Note: See "Internet Printing Protocol/1.1: IPP URL Scheme" [RFC3510] and "Internet Printing Protocol (IPP) over HTTPS Transport Binding and the 'ipps' URI Scheme" [RFC7472] for conforming URI for IPP Printers.

Note: See Sections 1.4.1, 1.4.2, and 1.4.3 for rationale for design choices.

4.3. printer-name

```
( 1.3.18.0.2.4.1135
NAME 'printer-name'
DESC 'The site-specific administrative name of this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

Values of this attribute SHOULD be specified in the language specified in printer-natural-language-configured (for example, to support text-to-speech conversions), although the Printer's name MAY be specified in any language.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 255 octets in length.

Note: This name can be the last part of the Printer's URI, or it can be completely unrelated. This name can contain characters that are not allowed in a conventional URI (see [STD66]).

Note: For interoperability, values of this attribute (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; and (b) SHOULD NOT contain DEL or any C0 or C1 control characters.

4.4. printer-natural-language-configured

```
( 1.3.18.0.2.4.1119
NAME 'printer-natural-language-configured'
DESC 'The configured natural language for LDAP attributes of
      syntax DirectoryString (UTF-8) in this directory entry.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

Also, a possible natural language for IPP protocol string attributes set by operator, system administrator, or manufacturer. Also, the (declared) natural language of the printer-name, printer-location, printer-info, and printer-make-and-model attributes of this Printer.

Values of language tags MUST conform to "Tags for Identifying Languages" [BCP47]. For example:

'en-us' (English as spoken in the US)
'fr-fr' (French as spoken in France)

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 63 octets in length.

Note: For compatibility with IPP/1.1 [RFC2911], language tags in this attribute SHOULD be lowercase normalized.

4.5. printer-location

```
( 1.3.18.0.2.4.1136
NAME 'printer-location'
DESC 'The physical location of this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

For example:

'Room 123A'
'Second floor of building XYZ'

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 127 octets in length.

Note: For interoperability and consistent text display, values of this attribute (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; (b) SHOULD NOT contain DEL or any C0 or C1 control characters except for HT, CR, and LF; and (c) SHOULD only contain CR and LF characters together (not as singletons).

4.6. printer-info

```
( 1.3.18.0.2.4.1139
NAME 'printer-info'
DESC 'Descriptive information about this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

For example:

'This Printer can be used for printing color transparencies for HR presentations'

'Out of courtesy for others, please print only small (1-5 page) jobs at this Printer'

'This Printer is going away on July 1, 1997; please find a new Printer'

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 127 octets in length.

Note: For interoperability and consistent text display, values of this attribute (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; (b) SHOULD NOT contain DEL or any C0 or C1 control characters except for HT, CR, and LF; and (c) SHOULD only contain CR and LF characters together (not as singletons).

4.7. printer-more-info

```
( 1.3.18.0.2.4.1134
NAME 'printer-more-info'
DESC 'A URI for more information about this specific Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

For example, this could be an HTTP URI referencing an HTML page accessible to a Web Browser. The information obtained from this URI is intended for end user consumption.

See [STD66] for details of URI syntax.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 1023 octets in length.

Note: LDAP application clients SHOULD NOT attempt to use malformed URI values read from this attribute. LDAP administrative clients SHOULD NOT write malformed URI values into this attribute.

Note: See Sections 1.4.1, 1.4.2, and 1.4.3 for rationale for design choices.

4.8. printer-make-and-model

```
( 1.3.18.0.2.4.1138
NAME 'printer-make-and-model'
DESC 'Make and model of this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 127 octets in length.

Note: The Printer manufacturer MAY initially populate this attribute.

Note: For interoperability and consistent text display, values of this attribute (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; (b) SHOULD NOT contain DEL or any C0 or C1 control characters except for HT, CR, and LF; and (c) SHOULD only contain CR and LF characters together (not as singletons).

4.9. printer-ipp-versions-supported

```
( 1.3.18.0.2.4.1133
NAME 'printer-ipp-versions-supported'
DESC 'Comma-delimited list of IPP versions supported by
      this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

```
'1.1,2.0'
```

Note: Length overflow in values of this attribute MUST be handled by multiple instances of this attribute, i.e., individual comma-delimited list members MUST NOT be truncated.

The IPP protocol version(s) MUST include major and minor versions, i.e., the exact version numbers for which this Printer implementation meets the IPP version-specific conformance requirements as registered in the IANA IPP registry [IANAIPP].

IANA-registered versions of IPP currently are:

'1.0' (IPP/1.0 [RFC2566], OBSOLETE)
'1.1' (IPP/1.1 [RFC2911])
'2.0' (IPP/2.0 [PWG5100.12])
'2.1' (IPP/2.1 [PWG5100.12])
'2.2' (IPP/2.2 [PWG5100.12])

4.10. printer-multiple-document-jobs-supported

```
( 1.3.18.0.2.4.1132
NAME 'printer-multiple-document-jobs-supported'
DESC 'Indicates whether or not this Printer supports more than one
      document per job.'
EQUALITY booleanMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.7
SINGLE-VALUE
)
```

4.11. printer-charset-configured

```
( 1.3.18.0.2.4.1109
NAME 'printer-charset-configured'
DESC 'The configured charset for IPP protocol values of error
      and status messages generated by this Printer.'
EQUALITY caseIgnoreMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

Also, a possible charset for IPP protocol string attributes set by operator, system administrator, or manufacturer. For example:

'utf-8' (ISO 10646/Unicode in UTF-8 transform [STD63])
'iso-8859-1' (ISO Latin1)

Values of charset tags SHOULD be defined in the IANA registry of Character Sets [IANACHAR] (see also [BCP19]), and the '(preferred MIME name)' SHOULD be used as the charset tag in this attribute.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 63 octets in length.

Note: For compatibility with IPP/1.1 [RFC2911], charset tags in this attribute SHOULD be lowercase normalized.

4.12. printer-charset-supported

```
( 1.3.18.0.2.4.1131
NAME 'printer-charset-supported'
DESC 'One of the charsets supported for IPP protocol values of
      IPP string attributes that correspond to attributes of
      syntax DirectoryString (UTF-8) for this directory entry.'
EQUALITY caseIgnoreMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

'utf-8' (ISO 10646/Unicode in UTF-8 transform [STD63])
'iso-8859-1' (ISO Latin1)

Note: Multiple values for this attribute are represented as multiple instances of this attribute.

Values of charset tags SHOULD be defined in the IANA registry of Character Sets [IANACHAR] (see also [BCP19]), and the '(preferred MIME name)' SHOULD be used as the charset tag in this attribute.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 63 octets in length.

Note: For compatibility with IPP/1.1 [RFC2911], charset tags in this attribute SHOULD be lowercase normalized.

4.13. printer-generated-natural-language-supported

```
( 1.3.18.0.2.4.1137
NAME 'printer-generated-natural-language-supported'
DESC 'One of the natural languages supported for LDAP attributes of
      syntax DirectoryString (UTF-8) in this directory entry.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

Values of language tags SHOULD conform to "Tags for Identifying Languages" [BCP47]. For example:

'en-us' (English as spoken in the US)
'fr-ca' (French as spoken in Canada)

Note: Multiple values for this attribute are represented as multiple instances of this attribute.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 63 octets in length.

Note: For compatibility with IPP/1.1 [RFC2911], language tags in this attribute SHOULD be lowercase normalized.

4.14. printer-document-format-supported

```
( 1.3.18.0.2.4.1130
NAME 'printer-document-format-supported'
DESC 'One of the source document formats that can be interpreted
      and printed by this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

Values of document formats SHOULD be MIME media types defined in the IANA registry of MIME Media Types [IANAMIME] (see also [BCP13]).

For example:

'application/postscript' (Adobe PostScript)
'text/plain' (plain text)

Note: Multiple values for this attribute are represented as multiple instances of this attribute.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 255 octets in length.

4.15. printer-color-supported

```
( 1.3.18.0.2.4.1129
NAME 'printer-color-supported'
DESC 'Indicates whether or not this Printer is capable of any type of
      color printing at all, including highlight color.'
EQUALITY booleanMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.7
SINGLE-VALUE
)
```

4.16. printer-compression-supported

```
( 1.3.18.0.2.4.1128
NAME 'printer-compression-supported'
DESC 'Comma-delimited list of compression algorithms supported by
      this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

```
'none'
'deflate,gzip'
```

Note: Length overflow in values of this attribute MUST be handled by multiple instances of this attribute, i.e., individual comma-delimited list members MUST NOT be truncated.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 255 octets in length.

Values defined in IPP/1.1 [RFC2911] and recorded in the IANA IPP registry [IANAIPP] include:

'none' (no compression is used)
'deflate' (public domain ZIP described in [RFC1951])
'gzip' (GNU ZIP described in [RFC1952])
'compress' (UNIX compression described in [RFC1977])

4.17. printer-pages-per-minute

```
( 1.3.18.0.2.4.1127
NAME 'printer-pages-per-minute'
DESC 'The nominal number of pages per minute that can be output by
      this Printer.'
EQUALITY integerMatch
ORDERING integerOrderingMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.27
SINGLE-VALUE
)
```

This attribute is informative, not a service guarantee. Typically, it is the value used in marketing literature to describe this Printer -- for example, the value for a simplex or black-and-white print mode.

4.18. printer-pages-per-minute-color

```
( 1.3.18.0.2.4.1126
NAME 'printer-pages-per-minute-color'
DESC 'The nominal number of color pages per minute that can be
      output by this Printer.'
EQUALITY integerMatch
ORDERING integerOrderingMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.27
SINGLE-VALUE
)
```

This attribute is informative, not a service guarantee. Typically, it is the value used in marketing literature to describe this Printer.

4.19. printer-finishings-supported

```
( 1.3.18.0.2.4.1125
NAME 'printer-finishings-supported'
DESC 'Comma-delimited list of finishing operations supported by
      this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

```
'staple'
'staple,punch,bind'
```

Note: Length overflow in values of this attribute MUST be handled by multiple instances of this attribute, i.e., individual comma-delimited list members MUST NOT be truncated.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 255 octets in length.

Values defined in IPP/1.1 [RFC2911] and recorded in the IANA IPP registry [IANAIPP] include:

'none', 'staple', 'punch', 'cover', 'bind', 'saddle-stitch', 'edge-stitch', 'staple-top-left', 'staple-bottom-left', 'staple-top-right', 'staple-bottom-right', 'edge-stitch-left', 'edge-stitch-top', 'edge-stitch-right', 'edge-stitch-bottom', 'staple-dual-left', 'staple-dual-top', 'staple-dual-right', 'staple-dual-bottom'.

Note: Implementations MAY support other values.

4.20. printer-number-up-supported

```
( 1.3.18.0.2.4.1124
NAME 'printer-number-up-supported'
DESC 'Maximum number of print-stream pages that can be imposed upon
      a single side of an instance of a selected medium by this
      Printer.'
EQUALITY integerMatch
ORDERING integerOrderingMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.27
SINGLE-VALUE
)
```

For example:

```
'1'
'4'
```

Note: Values of this attribute differ from the corresponding IPP attribute, in that only the maximum number-up is mapped from the corresponding IPP attribute 'number-up-supported' defined in [RFC2911].

4.21. printer-sides-supported

```
( 1.3.18.0.2.4.1123
NAME 'printer-sides-supported'
DESC 'Comma-delimited list of impression sides (one or two) and the
      two-sided impression rotations supported by this Printer.'
EQUALITY caseIgnoreMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

```
'one-sided'
'one-sided,two-sided-short-edge'
```

Note: Length overflow in values of this attribute MUST be handled by multiple instances of this attribute, i.e., individual comma-delimited list members MUST NOT be truncated.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 255 octets in length.

Values defined in IPP/1.1 [RFC2911] and recorded in the IANA IPP registry [IANAIPP] are:

'one-sided'
'two-sided-long-edge'
'two-sided-short-edge'

4.22. printer-media-supported

```
( 1.3.18.0.2.4.1122
NAME 'printer-media-supported'
DESC 'One of the names/sizes/types/colors of the media supported by
      this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

Values SHOULD conform to "PWG Media Standardized Names 2.0 (MSN2)" [PWG5101.1].

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 255 octets in length.

Values of standardized media size names defined in [PWG5101.1] and recorded in the IANA IPP registry [IANAIPP] include:

'na_letter_8.5x11in'
'iso_a4_210x297mm'

Values of standardized media types defined in [PWG5101.1] and recorded in the IANA IPP registry [IANAIPP] include:

'envelope'
'stationery'

Values of standardized media colors defined in [PWG5101.1] and recorded in the IANA IPP registry [IANAIPP] include:

'white'
'blue'

Note: Multiple values for this attribute are represented as multiple instances of this attribute.

4.23. printer-media-local-supported

```
( 1.3.18.0.2.4.1117
NAME 'printer-media-local-supported'
DESC 'One of the site-specific media supported by this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

Values SHOULD conform to "PWG Media Standardized Names 2.0 (MSN2)" [PWG5101.1].

For example:

'custom_purchasing-form_8.5x11in' (site-specific name)

Note: Multiple values for this attribute are represented as multiple instances of this attribute.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 255 octets in length.

4.24. printer-resolution-supported

```
( 1.3.18.0.2.4.1121
NAME 'printer-resolution-supported'
DESC 'One of the resolutions supported for printing documents by
      this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

Each resolution value MUST be a string containing three fields:

1) Cross-feed direction resolution (positive integer);

2) Feed direction resolution (positive integer);

3) Unit -- 'dpi' (dots per inch) or 'dpcm' (dots per centimeter).

Each resolution field MUST be delimited by '>', with optional trailing whitespace. For example:

'300> 300> dpi>'
'600> 600> dpi>'

Note: See the note in Section 4 about the different field delimiters used in the printer-xri-supported and printer-resolution-supported attributes ('<' and '>', respectively), chosen for compatibility with the IANA-registered SLP 'service:printer:' v2.0 template [SLPPRT20].

Note: Multiple values for this attribute are represented as multiple instances of this attribute.

Note: This attribute is based on 'printer-resolution-supported' defined in IPP/1.1 [RFC2911] with a complex encoding derived from 'prtMarkerAddressabilityFeedDir', 'prtMarkerAddressabilityXFeedDir', and 'prtMarkerAddressabilityUnit' defined in "Printer MIB v2" [RFC3805] (which have integer encodings).

Note: The syntax and delimiter for this attribute are aligned with the equivalent attribute in the 'service:printer:' v2.0 template [SLPPRT20]. Whitespace is permitted after (but not before) the delimiter '>'.

4.25. printer-print-quality-supported

```
( 1.3.18.0.2.4.1120
NAME 'printer-print-quality-supported'
DESC 'Comma-delimited list of print qualities supported
      for printing documents on this Printer.'
EQUALITY caseIgnoreMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

```
'unknown'
'draft,normal,high'
```

Note: Length overflow in values of this attribute MUST be handled by multiple instances of this attribute, i.e., individual comma-delimited list members MUST NOT be truncated.

Values defined in IPP/1.1 [RFC2911] and recorded in the IANA IPP registry [IANAIPP] include:

```
'draft'
'normal'
'high'
```

Note: The value 'unknown' MUST only be reported if the corresponding IPP attribute is not present, i.e., the value 'unknown' is an artifact of this LDAP mapping.

4.26. printer-job-priority-supported

```
( 1.3.18.0.2.4.1110
NAME 'printer-job-priority-supported'
DESC 'Indicates the number of job priority levels supported by
      this Printer.'
EQUALITY integerMatch
ORDERING integerOrderingMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.27
SINGLE-VALUE
)
```

An IPP/1.1 [RFC2911] conformant Printer, which supports job priority, always supports a full range of priorities from '1' to '100' (to ensure consistent behavior); therefore, this attribute describes the 'granularity' of priority supported. Values of this attribute are from '1' to '100'.

4.27. printer-copies-supported

```
( 1.3.18.0.2.4.1118
NAME 'printer-copies-supported'
DESC 'The maximum number of copies of a document that can be printed
      as a single job on this Printer.'
EQUALITY integerMatch
ORDERING integerOrderingMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.27
SINGLE-VALUE
)
```

A positive value indicates the maximum supported copies. A value of '0' indicates no maximum limit. A value of '-1' indicates 'unknown'.

Note: The syntax and values for this attribute are aligned with the equivalent attribute in the 'service:printer:' v2.0 template [SLPPRT20].

4.28. printer-job-k-octets-supported

```
( 1.3.18.0.2.4.1111
NAME 'printer-job-k-octets-supported'
DESC 'The maximum size of an incoming print job that this Printer
      will accept, in kilobytes (1,024 octets).'
EQUALITY integerMatch
ORDERING integerOrderingMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.27
SINGLE-VALUE
)
```

A positive value indicates the maximum supported job size. A value of '0' indicates no maximum limit. A value of '-1' indicates 'unknown'.

Note: The syntax and values for this attribute are aligned with the equivalent attribute in the 'service:printer:' v2.0 template [SLPPRT20].

4.29. printer-current-operator

```
( 1.3.18.0.2.4.1112
NAME 'printer-current-operator'
DESC 'The identity of the current human operator responsible for
      operating this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

The value of this attribute SHOULD include information that would enable other humans to reach the operator, such as a telephone number.

Note: For interoperability and consistent text display, values of this attribute (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; (b) SHOULD NOT contain DEL or any C0 or C1 control characters except for HT, CR, and LF; and (c) SHOULD only contain CR and LF characters together (not as singletons).

4.30. printer-service-person

```
( 1.3.18.0.2.4.1113
NAME 'printer-service-person'
DESC 'The identity of the current human service person responsible
      for servicing this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

The value of this attribute SHOULD include information that would enable other humans to reach the service person, such as a telephone number.

Note: For interoperability and consistent text display, values of this attribute (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; (b) SHOULD NOT contain DEL or any C0 or C1 control characters except for HT, CR, and LF; and (c) SHOULD only contain CR and LF characters together (not as singletons).

4.31. printer-delivery-orientation-supported

```
( 1.3.18.0.2.4.1114
NAME 'printer-delivery-orientation-supported'
DESC 'Comma-delimited list of delivery orientations of pages as they
      are printed and ejected supported by this Printer.'
EQUALITY caseIgnoreMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

```
'unknown'
'face-up,face-down'
```

Values defined in "Printer MIB v2" [RFC3805] for prtOutputPageDeliveryOrientation are:

```
'face-up'
'face-down'
```

Note: The value 'unknown' MUST only be reported if the corresponding Printer MIB attribute is not present, i.e., the value 'unknown' is an artifact of this LDAP mapping.

Note: The syntax and values for this attribute are aligned with the equivalent attribute in the 'service:printer:' v2.0 template [SLPPRT20].

4.32. printer-stacking-order-supported

```
( 1.3.18.0.2.4.1115
NAME 'printer-stacking-order-supported'
DESC 'Comma-delimited list of stacking orders of pages as they are
      printed and ejected supported by this Printer.'
EQUALITY caseIgnoreMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

```
'unknown'
'first-to-last'
'first-to-last,last-to-first'
```

Values defined in "Printer MIB v2" [RFC3805] for prtOutputStackingOrder are:

```
'first-to-last'
'last-to-first'
```

Note: The value 'unknown' MUST only be reported if the corresponding Printer MIB attribute is not present, i.e., the value 'unknown' is an artifact of this LDAP mapping.

Note: The syntax and values for this attribute are aligned with the equivalent attribute in the 'service:printer:' v2.0 template [SLPPRT20].

4.33. printer-output-features-supported

```
( 1.3.18.0.2.4.1116
NAME 'printer-output-features-supported'
DESC 'Comma-delimited list of output features supported by
      this Printer.'
EQUALITY caseIgnoreMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

```
'unknown'
'bursting,decollating'
'offset-stacking'
```

Note: Length overflow in values of this attribute MUST be handled by multiple instances of this attribute, i.e., individual comma-delimited list members MUST NOT be truncated.

Values defined in "Printer MIB v2" [RFC3805] for prtOutputBursting, prtOutputDecollating, prtOutputPageCollated, and prtOutputOffsetStacking are:

```
'bursting'
'decollating'
'page-collating'
'offset-stacking'
```

Note: The value 'unknown' MUST only be reported if the corresponding Printer MIB attributes are not present, i.e., the value 'unknown' is an artifact of this LDAP mapping.

Note: The syntax and values for this attribute are aligned with the equivalent attribute in the 'service:printer:' v2.0 template [SLPPRT20].

Note: Implementations MAY support other values.

4.34. printer-aliases

```
( 1.3.18.0.2.4.1108
NAME 'printer-aliases'
DESC 'One of the site-specific administrative names of this Printer
      in addition to the value specified for printer-name.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

Values of this attribute SHOULD be specified in the language specified in printer-natural-language-configured (for example, to support text-to-speech conversions), although the Printer's alias MAY be specified in any language.

Note: Multiple values for this attribute are represented as multiple instances of this attribute.

Note: For compatibility with IPP/1.1 [RFC2911], values of this attribute SHOULD NOT exceed 255 octets in length.

Note: For interoperability, values of this attribute (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; and (b) SHOULD NOT contain DEL or any C0 or C1 control characters.

4.35. printer-device-id

```
( 1.3.18.0.2.24.46.1.101
NAME 'printer-device-id'
DESC 'The IEEE 1284 Device ID for this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

Values of this attribute SHOULD conform to "PWG Command Set Format for IEEE 1284 Device ID v1.0" [PWG5107.2].

Note: For compatibility with [PWG5100.14] and [PWG5107.2], values of this attribute SHOULD NOT exceed 1023 octets in length.

4.36. printer-device-service-count

```
( 1.3.18.0.2.24.46.1.102
NAME 'printer-device-service-count'
DESC 'The number of Printer (print service) instances configured on
      this Imaging Device (host system).'
EQUALITY integerMatch
ORDERING integerOrderingMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.27
SINGLE-VALUE
)
```

A positive value indicates the number of Printer (print service) instances. A value of '-1' indicates 'unknown'. A value of '0' is not meaningful (because this attribute must be reported by some Printer instance).

Note: The syntax and values for this attribute are aligned with the equivalent 'device-service-count' attribute defined in [PWG5100.13].

4.37. printer-uuid

```
( 1.3.18.0.2.24.46.1.104
NAME 'printer-uuid'
DESC 'A URN specifying the UUID of this Printer (print service)
      instance on this Imaging Device (host system).'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

For example:

```
'urn:uuid:f81d4fae-7dec-11d0-a765-00a0c91e6bf6'
```

Values of this attribute MUST conform to the Universally Unique Identifier (UUID) URN namespace [RFC4122].

Note: For compatibility with [PWG5100.13] and [RFC4122], values of this attribute SHOULD NOT exceed 45 octets in length.

Note: LDAP application clients SHOULD NOT attempt to use malformed URN values read from this attribute. LDAP administrative clients SHOULD NOT write malformed URN values into this attribute.

Note: The syntax and values for this attribute are aligned with the equivalent 'printer-uuid' attribute defined in [PWG5100.13].

4.38. printer-charge-info

```
( 1.3.18.0.2.24.46.1.105
NAME 'printer-charge-info'
DESC 'Descriptive information about paid printing services for this
      Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

For example:

'This Printer can be used for paid printing at 2 cents/page.'

Note: For compatibility with [PWG5100.13], values of this attribute SHOULD NOT exceed 1023 octets in length.

Note: For interoperability and consistent text display, values of this attribute (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; (b) SHOULD NOT contain any C0 or C1 control characters except for HT, CR, and LF; and (c) SHOULD only contain CR and LF characters together (not as singletons).

Note: The syntax and values for this attribute are aligned with the equivalent 'printer-charge-info' attribute defined in [PWG5100.13].

4.39. printer-charge-info-uri

```
( 1.3.18.0.2.24.46.1.106
NAME 'printer-charge-info-uri'
DESC 'A URI for a human-readable Web page for paid printing services
      for this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

For example:

'http://example.com/charges'

See [STD66] for details of URI syntax.

Note: For compatibility with IPP/1.1 [RFC2911] and [PWG5100.13], values of this attribute SHOULD NOT exceed 1023 octets in length.

Note: LDAP application clients SHOULD NOT attempt to use malformed URI values read from this attribute. LDAP administrative clients SHOULD NOT write malformed URI values into this attribute.

Note: The syntax and values for this attribute are aligned with the equivalent 'printer-charge-info-uri' attribute defined in [PWG5100.13].

4.40. printer-geo-location

```
( 1.3.18.0.2.24.46.1.107
NAME 'printer-geo-location'
DESC 'A geo: URI specifying the geographic location of this Printer.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
SINGLE-VALUE
)
```

For example:

'geo:13.4125,103.8667'

Values of this attribute MUST conform to the 'geo' URI scheme [RFC5870].

Note: For compatibility with IPP/1.1 [RFC2911] and [PWG5100.13], values of this attribute SHOULD NOT exceed 1023 octets in length.

Note: LDAP application clients SHOULD NOT attempt to use malformed URI values read from this attribute. LDAP administrative clients SHOULD NOT write malformed URI values into this attribute.

Note: The syntax and values for this attribute are aligned with the equivalent 'printer-geo-location' attribute defined in [PWG5100.13].

4.41. printer-ipp-features-supported

```
( 1.3.18.0.2.24.46.1.108
NAME 'printer-ipp-features-supported'
DESC 'Comma-delimited list of IPP protocol features that
      this Printer supports.'
EQUALITY caseIgnoreMatch
SUBSTR caseIgnoreSubstringsMatch
SYNTAX  1.3.6.1.4.1.1466.115.121.1.15
)
```

For example:

```
'none'
'unknown'
'proof-print'
'ipp-everywhere,proof-print,job-save'
```

Note: Length overflow in values of this attribute MUST be handled by multiple instances of this attribute, i.e., individual comma-delimited list members MUST NOT be truncated.

Values of this attribute SHOULD specify only IANA-registered keywords for the 'ipp-features-supported' attribute defined in [PWG5100.13] or other Standards Track IETF or IEEE-ISTO PWG specifications if this Printer implementation meets all of the IPP feature-specific conformance requirements.

IANA-registered values include:

'none' (No extension features are supported)
'document-object' (Document object defined in [PWG5100.5])
'job-save' (Job save defined in [PWG5100.11])
'ipp-everywhere' ("IPP Everywhere" defined in [PWG5100.14])
'page-overrides' (Page overrides defined in [PWG5100.6])
'proof-print' (Proof print defined in [PWG5100.11])
'subscription-object' (Subscription object defined in [RFC3995])

Note: The value 'unknown' MUST only be reported if the corresponding IPP Printer attribute is not present, i.e., the value 'unknown' is an artifact of this LDAP mapping.

Note: The syntax and values for this attribute are aligned with the equivalent 'ipp-features-supported' attribute defined in [PWG5100.13].

5. Definition of Syntaxes

No new attribute syntaxes are defined by this document.

The attribute types defined in Section 4 of this document reference syntax OIDs defined in Section 3 of [RFC4517], which are summarized below:

Syntax OID	Syntax Description
1.3.6.1.4.1.1466.115.121.1.7	Boolean
1.3.6.1.4.1.1466.115.121.1.15	DirectoryString (UTF-8 [STD63])
1.3.6.1.4.1.1466.115.121.1.27	Integer

6. Definition of Matching Rules

No new matching rules are defined by this document.

The attribute types defined in Section 4 of this document reference matching rules defined in Section 4 of [RFC4517], which are summarized below:

Matching Rule OID	Matching Rule Name	Usage
2.5.13.13	booleanMatch	EQUALITY
2.5.13.2	caseIgnoreMatch	EQUALITY
2.5.13.14	integerMatch	EQUALITY
2.5.13.15	integerOrderingMatch	ORDERING
2.5.13.4	caseIgnoreSubstringsMatch	SUBSTR

7. IANA Considerations

This document does not define any new syntaxes or matching rules.

This document defines a few new attribute types that have been registered by IANA per this document (see Section 7.1 below).

All of the object classes and most of the attribute types described in this document were registered by IANA when RFC 3712 was published (see Section 7.2 below).

7.1. Registration of Attribute Types

The following Attribute Type OIDs have been assigned by the IEEE-ISTO PWG (see Section 1.3.2) and have been registered by IANA.

Subject: Request for Object Identifier Descriptor Registration

Descriptor (short name): see table below

Object Identifier: see table below

Person & email address to contact for further information: see below

Usage: attribute type

Specification: RFC 7612 (this document)

Author/Change Controller:

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High North Inc.
221 Ridge Ave.
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United States
Phone: +1 906-494-2434
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Comments:

Attribute Type	OID
printer-device-id	1.3.18.0.2.24.46.1.101
printer-device-service-count	1.3.18.0.2.24.46.1.102
printer-uuid	1.3.18.0.2.24.46.1.104
printer-charge-info	1.3.18.0.2.24.46.1.105
printer-charge-info-uri	1.3.18.0.2.24.46.1.106
printer-geo-location	1.3.18.0.2.24.46.1.107
printer-ipp-features-supported	1.3.18.0.2.24.46.1.108

7.2. Object Classes and Attribute Types from RFC 3712

This section is strictly informative. None of the LDAP OIDs listed in this section have been re-registered by IANA.

The following Object Class OIDs were assigned by IBM (see Section 1.3.1) and were already registered by IANA when RFC 3712 was published.

Object Class	OID
slpServicePrinter	1.3.18.0.2.6.254
printerAbstract	1.3.18.0.2.6.258
printerService	1.3.18.0.2.6.255
printerServiceAuxClass	1.3.18.0.2.6.257
printerIPP	1.3.18.0.2.6.256
printerLPR	1.3.18.0.2.6.253

The following Attribute Type OIDs were assigned by IBM (see Section 1.3.1) and were already registered by IANA when RFC 3712 was published.

Attribute Type	OID
printer-uri	1.3.18.0.2.4.1140
printer-xri-supported	1.3.18.0.2.4.1107
printer-name	1.3.18.0.2.4.1135
printer-natural-language-configured	1.3.18.0.2.4.1119
printer-location	1.3.18.0.2.4.1136
printer-info	1.3.18.0.2.4.1139
printer-more-info	1.3.18.0.2.4.1134
printer-make-and-model	1.3.18.0.2.4.1138
printer-ipp-versions-supported	1.3.18.0.2.4.1133
printer-multiple-document-jobs-supported	1.3.18.0.2.4.1132
printer-charset-configured	1.3.18.0.2.4.1109
printer-charset-supported	1.3.18.0.2.4.1131
printer-generated-natural-language-supported	1.3.18.0.2.4.1137
printer-document-format-supported	1.3.18.0.2.4.1130
printer-color-supported	1.3.18.0.2.4.1129
printer-compression-supported	1.3.18.0.2.4.1128
printer-pages-per-minute	1.3.18.0.2.4.1127
printer-pages-per-minute-color	1.3.18.0.2.4.1126
printer-finishings-supported	1.3.18.0.2.4.1125
printer-number-up-supported	1.3.18.0.2.4.1124
printer-sides-supported	1.3.18.0.2.4.1123
printer-media-supported	1.3.18.0.2.4.1122
printer-media-local-supported	1.3.18.0.2.4.1117
printer-resolution-supported	1.3.18.0.2.4.1121

printer-print-quality-supported	1.3.18.0.2.4.1120
printer-job-priority-supported	1.3.18.0.2.4.1110
printer-copies-supported	1.3.18.0.2.4.1118
printer-job-k-octets-supported	1.3.18.0.2.4.1111
printer-current-operator	1.3.18.0.2.4.1112
printer-service-person	1.3.18.0.2.4.1113
printer-delivery-orientation-supported	1.3.18.0.2.4.1114
printer-stacking-order-supported	1.3.18.0.2.4.1115
printer-output-features-supported	1.3.18.0.2.4.1116
printer-aliases	1.3.18.0.2.4.1108

8. Internationalization Considerations

All text string attributes defined in this document of syntax 'DirectoryString' [RFC4517] have values that are encoded in UTF-8 [STD63], as required by [RFC4517].

A language tag [BCP47] for all of the text string attributes defined in this document is contained in the printer-natural-language-configured attribute.

Therefore, all object classes defined in this document conform to the IETF Policy on Character Sets and Languages [BCP18].

Note: For interoperability and consistent text display, values of attributes defined in this document (a) SHOULD be normalized as recommended in "Unicode Format for Network Interchange" [RFC5198]; (b) SHOULD NOT contain DEL or any C0 or C1 control characters except for HT, CR, and LF; (c) SHOULD only contain CR and LF characters together (not as singletons); and (d) SHOULD NOT contain HT, CR, or LF characters in names, e.g., printer-name and printer-aliases.

9. Security Considerations

See [RFC4513] for detailed guidance on authentication methods for LDAP and the use of TLS/1.2 [RFC5246] to supply connection confidentiality and data integrity for LDAP sessions.

As with any LDAP schema, it is important to protect specific entries and attributes with the appropriate access control. It is particularly important that only administrators can modify entries defined in this LDAP Printer schema. Otherwise, an LDAP client might be fooled into diverting print service requests from the original Printer (or spooler) to a malicious intruder's host system, thus exposing the information in printed documents.

Note: Security vulnerabilities can arise if DEL or any C0 or C1 control characters are included in names, e.g., printer-name or printer-aliases.

For additional security considerations regarding deploying Printers in an IPP environment, see Section 8 of [RFC2911].

10. References

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Appendix A. Changes since RFC 3712

1) Added many editorial corrections and clarifications

   - corrected typos, missing words, and ambiguous sentences;

   - replaced lowercase 'printer' with titlecase 'Printer' for readability and consistency with IETF and IEEE-ISTO PWG IPP standards usage;

   - added implementation notes;

   - updated and added references.

2) Deleted length restrictions from formal definitions of DirectoryString syntax attributes

   - replaced with notes recommending length restrictions for compatibility with existing implementations of [RFC3712] and underlying string length limits in [RFC2707], [RFC2911], [RFC3805], [PWG5107.2], [PWG5100.13], and [PWG5100.14].

3) Added new Printer attributes defined in [PWG5107.2], [PWG5100.13], and [PWG5100.14] (see Section 7.1)

   - updated the table of Printer attributes and source documents in Section 4 ("Definition of Attribute Types");

   - added support for IEEE-ISTO PWG "IPP Everywhere" [PWG5100.14] project.

4) Added implementation note to Section 4 about string encodings

   - added discussion of 'List of xxx' and 'One of xxx' encodings;

   - stated that any of these attributes can be represented as multiple instances (i.e., to avoid length overflow).

5) Improved comma-delimited examples of string attributes

   - added both single-valued and multi-valued examples.

6) Clarified use of printer-xri-supported and printer-resolution-supported attributes, and their corresponding field delimiters

   - added note in Section 4 ("Definition of Attribute Types") to explain the origin of the different field delimiters;

   - added examples to show optional *trailing* whitespace after '<' delimiters in printer-xri-supported;

   - added examples to show optional *trailing* whitespace after '>' delimiters in printer-resolution-supported.

7) Clarified Section 8 ("Internationalization Considerations")

   - added note about Net-Unicode [RFC5198] and avoiding use of C0 and C1 control characters.

8) Clarified Section 9 ("Security Considerations")

   - added note about security vulnerabilities caused by use of DEL or any C0 or C1 control characters in names.

9) Clarified terms and abbreviations

   - renamed Section 2 ("Conventions Used in This Document");

   - added Section 2.1 ("Requirements Language");

   - added Section 2.2 ("LDAP Schema Descriptions");

   - added Section 2.3 ("Abbreviations").

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