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.

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

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.

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Source Document and Attribute Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>printer-uri</td>
<td>IPP/1.1 and Semantics Model [RFC2911]</td>
</tr>
<tr>
<td>printer-xri-supported</td>
<td>[printer-uri-supported]</td>
</tr>
<tr>
<td></td>
<td>[uri-authentication-supported]</td>
</tr>
<tr>
<td></td>
<td>[uri-security-supported]</td>
</tr>
<tr>
<td>printer-name</td>
<td>printer-name</td>
</tr>
<tr>
<td>printer-natural-language-configured</td>
<td>natural-language-configured</td>
</tr>
<tr>
<td>printer-location</td>
<td>printer-location</td>
</tr>
<tr>
<td>printer-info</td>
<td>printer-info</td>
</tr>
<tr>
<td>printer-more-info</td>
<td>printer-more-info</td>
</tr>
<tr>
<td>printer-make-and-model</td>
<td>printer-make-and-model</td>
</tr>
<tr>
<td>printer-ipp-versions-supported</td>
<td>ipp-versions-supported</td>
</tr>
<tr>
<td>printer-multiple-document-jobs-supported</td>
<td>multiple-document-jobs-supported</td>
</tr>
<tr>
<td>printer-charset-configured</td>
<td>charset-configured</td>
</tr>
<tr>
<td>printer-charset-supported</td>
<td>charset-supported</td>
</tr>
<tr>
<td>printer-generated-natural-language-supported</td>
<td>generated-natural-language-supported</td>
</tr>
<tr>
<td>printer-document-format-supported</td>
<td>document-format-supported</td>
</tr>
<tr>
<td>printer-color-supported</td>
<td>color-supported</td>
</tr>
<tr>
<td>printer-compression-supported</td>
<td>compression-supported</td>
</tr>
<tr>
<td>printer-pages-per-minute</td>
<td>pages-per-minute</td>
</tr>
<tr>
<td>printer-pages-per-minute-color</td>
<td>pages-per-minute-color</td>
</tr>
<tr>
<td>printer-finishings-supported</td>
<td>finishings-supported</td>
</tr>
<tr>
<td>printer-number-up-supported</td>
<td>number-up-supported</td>
</tr>
<tr>
<td>printer-sides-supported</td>
<td>sides-supported</td>
</tr>
<tr>
<td>printer-media-supported</td>
<td>media-supported</td>
</tr>
<tr>
<td>printer-media-local-supported</td>
<td>[site names from IPP media-supported]</td>
</tr>
<tr>
<td>printer-resolution-supported</td>
<td>printer-resolution-supported</td>
</tr>
<tr>
<td>printer-print-quality-supported</td>
<td>print-quality-supported</td>
</tr>
<tr>
<td>printer-job-priority-supported</td>
<td>job-priority-supported</td>
</tr>
<tr>
<td>printer-copies-supported</td>
<td>copies-supported</td>
</tr>
<tr>
<td>printer-job-k-octets-supported</td>
<td>job-k-octets-supported</td>
</tr>
</tbody>
</table>
*** Printer MIB v2 [RFC3805]
printer-current-operator prtGeneralCurrentOperator
printer-service-person prtGeneralServicePerson
printer-delivery-orientation-supported prtOutputPageDeliveryOrientation
printer-stacking-order-supportedprtOutputStackingOrder
printer-output-features-supported
  [prtOutputBursting]
  [prtOutputDecollating]
  [prtOutputPageCollated]
  [prtOutputOffsetStacking]
printer-aliasesprtGeneralPrinterName

*** 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 '<'.
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.
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-bottom', 'edge-stitch-right',
   '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
singleton).
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:

'busting'
'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:

<table>
<thead>
<tr>
<th>Syntax OID</th>
<th>Syntax Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3.6.1.4.1.1466.115.121.1.7</td>
<td>Boolean</td>
</tr>
<tr>
<td>1.3.6.1.4.1.1466.115.121.1.15</td>
<td>DirectoryString (UTF-8 [STD63])</td>
</tr>
<tr>
<td>1.3.6.1.4.1.1466.115.121.1.27</td>
<td>Integer</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Matching Rule OID</th>
<th>Matching Rule Name</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5.13.13</td>
<td>booleanMatch</td>
<td>EQUALITY</td>
</tr>
<tr>
<td>2.5.13.2</td>
<td>caseIgnoreMatch</td>
<td>EQUALITY</td>
</tr>
<tr>
<td>2.5.13.14</td>
<td>integerMatch</td>
<td>EQUALITY</td>
</tr>
<tr>
<td>2.5.13.15</td>
<td>integerOrderingMatch</td>
<td>ORDERING</td>
</tr>
<tr>
<td>2.5.13.4</td>
<td>caseIgnoreSubstringsMatch</td>
<td>SUBSTR</td>
</tr>
</tbody>
</table>

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:

Ira McDonald
High North Inc.
221 Ridge Ave.
Grand Marais, MI 49839
United States
Phone: +1 906-494-2434
Email: blueroofmusic@gmail.com

Comments:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>printer-device-id</td>
<td>1.3.18.0.2.24.46.1.101</td>
</tr>
<tr>
<td>printer-device-service-count</td>
<td>1.3.18.0.2.24.46.1.102</td>
</tr>
<tr>
<td>printer-uuid</td>
<td>1.3.18.0.2.24.46.1.104</td>
</tr>
<tr>
<td>printer-charge-info</td>
<td>1.3.18.0.2.24.46.1.105</td>
</tr>
<tr>
<td>printer-charge-info-uri</td>
<td>1.3.18.0.2.24.46.1.106</td>
</tr>
<tr>
<td>printer-geo-location</td>
<td>1.3.18.0.2.24.46.1.107</td>
</tr>
<tr>
<td>printer-ipp-features-supported</td>
<td>1.3.18.0.2.24.46.1.108</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Object Class</th>
<th>OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>slpServicePrinter</td>
<td>1.3.18.0.2.6.254</td>
</tr>
<tr>
<td>printerAbstract</td>
<td>1.3.18.0.2.6.258</td>
</tr>
<tr>
<td>printerService</td>
<td>1.3.18.0.2.6.255</td>
</tr>
<tr>
<td>printerServiceAuxClass</td>
<td>1.3.18.0.2.6.257</td>
</tr>
<tr>
<td>printerIPP</td>
<td>1.3.18.0.2.6.256</td>
</tr>
<tr>
<td>printerLPR</td>
<td>1.3.18.0.2.6.253</td>
</tr>
</tbody>
</table>

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.

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

10.1. Normative References


<http://www.rfc-editor.org/info/bcp47>


10.2. Informative References


<http://www.rfc-editor.org/info/bcp13>


Fleming & McDonald  Informational  [Page 50]
"Service Location Protocol, Version 2", RFC 2608,
DOI 10.17487/RFC2608, June 1999,

Access Protocol (LDAP): Schema for Printer Services",
RFC 3712, DOI 10.17487/RFC3712, February 2004,

Kerberos and NTLM HTTP Authentication in Microsoft
Windows", RFC 4559, DOI 10.17487/RFC4559, June 2006,

[SLPPRT20]  IANA, "Service Location Protocol, Version 2 (SLPv2)
Templates",
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").
Acknowledgments

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