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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   http://www.rfc-editor.org/info/rfc7612.

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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:

   o 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]

   o 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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      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

10.1. Normative 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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