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Internet Printing Protocol (IPP): **Printer Installation Extension**

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Abstract

Various client platforms require that some setting up take place at the workstation before the client can properly submit jobs to a specific printer. This setup process is sometimes referred to as printer installation. Most clients need some information about the printer being installed as well as support files to complete the printer installation. The nature of the support files varies depending on the specific client platform, from simple configuration files to highly sophisticated printer drivers. This document refers to these support files as "Client Print Support Files". Traditionally, the selection and installation of the correct Client Print Support Files has been error prone. The selection and installation process can be simplified and even automated if the workstation can learn some key information about the printer and which sets of Client Print Support Files are available. Such key information includes: operating system type, CPU type, document-format (PDL), natural language, compression mechanism, file type, client file name, policy for automatic loading, file size, file version, file date and time, file information description, and digital signature. This document describes the IPP extensions that enable workstations to obtain the information needed to perform a proper printer driver installation using IPP, including security for downloading executable code and data.

The full set of IPP documents includes:

- Design Goals for an Internet Printing Protocol [RFC2567]
- Rationale for the Structure and Model and Protocol for the Internet Printing Protocol [RFC2568]
- Internet Printing Protocol/1.1: Model and Semantics [RFC2911]
- Internet Printing Protocol/1.1: Encoding and Transport [RFC2910]
- Internet Printing Protocol/1.1: Implementer's Guide [ipp-iig]
- Mapping between LPD and IPP Protocols [RFC2569]

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

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

The "Internet Printing Protocol/1.1: Encoding and Transport" document is a formal mapping of the abstract operations and attributes defined in the model document onto HTTP/1.1 [RFC2616]. It defines the encoding rules for a new Internet MIME media type called "application/ipp". This document also defines the rules for transporting a message body over HTTP whose Content-Type is "application/ipp". This document defines a new scheme named 'ipp' for identifying IPP printers and jobs.

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

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

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1 Introduction

A common configuration for printing from a workstation requires that some Client Print Support Files (e.g., PPD, printer driver files) specific to the target printer be installed on that workstation. Selection and configuration of the appropriate Client Print Support Files can be simplified and even automated if the workstation can obtain some key information about the printer and which sets of Client Print Support Files are available. Such key information includes: operating system type, CPU type, document-format (PDL), natural language, compression mechanism, file type, client file name, policy for automatic loading, file size, file version, file date and time, file information description, and digital signature. With a few extensions, IPP provides a simple and reliable vehicle for printers to convey this information to interested workstations. The IPP extensions described in this document enable a flexible solution for installing Client Print Support Files on workstations running different operating systems and for printers of all makes and models. It allows Client Print Support Files to be downloaded from repositories of different sorts. A possible repository for the files is the printer itself. The extensions necessary for getting Client Print Support Files from the printer are included in this document, including security for downloading executable code and data.

2 Terminology

Client Print Support Files - a set of files, such as a printer driver, font metric file, printer configuration file (PPD, GPD, etc.) that support a client printing to a particular Printer. A Printer MAY have multiple sets of Client Print Support Files that work for different operating systems, document formats, natural languages, CPUs, etc.

This document uses terms such as “attributes”, “keywords”, and “support”. These terms have special meaning and are defined in the model terminology [RFC2911] section 12.2. This document also uses the terms “IPP Printer”, “Printer” and “Printer object” interchangeably as in [RFC2911] to mean the software entity that accepts IPP operation requests and returns IPP operation responses (see [RFC2911] section 2).

Capitalized terms, such as MUST, MUST NOT, REQUIRED, SHOULD, SHOULD NOT, MAY, NEED NOT, and OPTIONAL, have special meaning relating to conformance. These terms are defined in [RFC2911] section 12.1 on conformance terminology, most of which is taken from RFC 2119 [RFC2119].

This section defines the following additional terms that are used throughout this document:

REQUIRED: if an implementation supports the extensions described in this document, it MUST support a REQUIRED feature.

OPTIONAL: if an implementation supports the extensions described in this document, it MAY support an OPTIONAL feature.

3 Model Extensions

To assist workstations in the printer installation process, an IPP printer needs to provide the workstation with information about the Client Print Support Files, such as the their name and location/s. This information needs

to match the workstation's specific environment, such as its operating system, preferred natural language, and preferred document format.

The following extensions to the IPP model enable assisted or automated printer installation. This section describes each extension in detail.

- A new REQUIRED Printer Description attribute: "client-print-support-files-supported" (1setOf octetString(MAX)).
- A new REQUIRED Get-Printer-Attributes operation attribute: "client-print-support-files-filter" (octetString(MAX)).
- A new RECOMMENDED printer operation: Get-Client-Print-Support-Files.

3.1 client-print-support-files-supported (1setOf octetString(MAX))

An IPP Printer uses the REQUIRED Printer Description attribute "client-print-support-files-supported" to represent relevant information about all of the Client Print Support Files it supports. Each value is a composite UTF-8 string with well-defined fields (see Table 1). Each value string MUST be formatted as follows:

$$\text{"uri=val}_1\text{< field-name}_2\text{=val}_{21},\ldots,\text{val}_{2p}\text{< } \ldots \text{ < field-name}_n\text{=val}_{n1},\ldots,\text{val}_{nq}\text{<"}$$

The first field MUST be the "uri" field. The remaining fields MAY be in any order.

The string MUST NOT include any control characters (hex 00 to 1F), even the so-called white space control characters (TAB, CR, and LF) anywhere. Only zero or more UTF-8 SPACE characters (hex 20) can be included and they can be included only IMMEDIATELY AFTER the delimiter character: "<", but NOT anywhere else, including after "=" and ",". However, if the UTF-8 SPACE character is needed in a client-file-name value, then each occurrence is included directly, without escaping (see example). On the other hand, if the UTF-8 SPACE character is needed in a URL value, then each occurrence is escaped as: "%20" (URI conventions - see [RFC2396]).

Table 1 lists the REQUIRED fields that a Printer MUST support and the OPTIONAL fields that a Printer MAY support in the "client-print-support-files-supported" (1setOf octetString(MAX)) Printer Description attribute. A Printer implementation MAY support additional fields using the same syntax. Values are defined to be either CASE-SENSITIVE or ALL-LOWER-CASE according to the definitions for the attribute syntaxes from [RFC2911] (set off by single quotes in the table). The CASE-SENSITIVE values MAY have upper and lower case letters as for the corresponding attribute syntaxes in [RFC2911]. The LOWER-CASE values MUST have all lower case alphabetic letters. Additional characters, such as digits, hyphen-minus (-), period (.), and slash (/) are according to the corresponding attribute syntaxes in [RFC2911].

Clients SHOULD ignore fields they don't recognize in a given value. This allows for future extensions to the format of the string without breaking compatibility with earlier clients.

168 **Table 1 - "client-print-support-files-supported" attribute fields**

Field name	Field value
"uri"	One REQUIRED CASE-SENSITIVE 'uri' string identifying the uri where to obtain the support files for each OS platform, document format, and natural language the printer supports. This MUST be the first field in each value. Examples of uri schemes that MAY be found here are 'ftp', 'http', and 'ipp'. The 'ftp' and 'http' schemed URIs identify the archive file that contains all the necessary client support files. The 'ipp' schemed URIs identify the archive file that clients MAY obtain from the Printer using the Get-Client-Print-Support-Files operation (see section 3.3). The URI MUST be a valid URI to the same Printer object, i.e., one of the values of the Printer's "printer-uri-supported" attribute. The 'ipp' URI is used to distinguish between multiple Client Print Support Files in an implementation dependent manner using the URL query syntax (e.g., "?drv-id=xxx") [RFC2396]. The query part MUST NOT exceed 127 octets, not counting the "?" character that begins the query part. A Printer SHOULD support the 'ipp' scheme.
"os-type"	One or more REQUIRED comma-separated LOWER-CASE 'keyword' strings identifying the operating system types supported by this set of Client Print Support Files. Valid values are the operating system names defined in the IANA document [os-names] and the special keyword value: 'unknown'. Although the IANA registry requires that the names be all upper-case, the values MUST be all lower case in this field (plus hyphen-minus (-), period (.), and slash (/)). Examples: 'linux', 'linux-2.2', 'os/2', 'sun-os-4.0', 'unix', 'unix-bsd', 'win32', 'windows-95', 'windows-98', 'windows-ce', 'windows-nt', 'windows-nt-4', 'windows-nt-5', 'unknown'.
"cpu-type"	One or more REQUIRED comma-separated LOWER-CASE 'keyword' strings identifying the CPU types supported by this set of Client Print Support Files. The values indicate the CPU family independent of the CPU manufacturer. Valid keyword values are: 'x86-16', 'x86-32', 'x86-64', 'dec-vax', 'alpha', 'power-pc', 'm-68000, 'sparc', 'itantium', 'mips', 'arm' and will be used as the initial value for the "cpu-type" IANA registry. In addition, the special keyword value: 'unknown' is valid.
"document-format"	One or more REQUIRED comma-separated CASE-SENSITIVE 'mimeMediaType' strings identifying the document formats supported by this set of Client Print Support Files. Valid values are the string representation of the IPP mimeMediaType attribute syntax (see [RFC2911] section 4.1.9), for example 'application/postscript'. In addition, the special keyword value: 'unknown' is valid.
"natural-language"	One or more REQUIRED comma-separated LOWER-CASE 'naturalLanguage' strings identifying the natural language used by this set of Client Print Support Files. Valid values are the string representation of the IPP 'naturalLanguage' attribute syntax (see [RFC2911] section 4.1.8), for example 'en' and 'en-us'. In addition, the special keyword value:

Field name	**Field value**
	'unknown' is valid.
"compression"	One REQUIRED LOWER-CASE 'keyword' string identifying the mechanism used to compress this set of Client Print Support Files. All files needed for the installation of a printer driver MUST be compressed into a single file. Valid keyword values are the keywords defined by [RFC2911] or registered with IANA for use in the IPP "compression" and "compression-supported" attributes. See [RFC2911] section 4.4.32), for example 'gzip'. The 'none' value limits the uncompressed Client Print Support File to a single file. The values for the "compression" field that a Printer supports NEED NOT be the same values that the Printer is configured to support in Job Creation operations as indicated in the Printer's "compressions-supported" attribute.
"file-type"	One or more REQUIRED comma-separated LOWER-CASE 'keyword' strings identifying the type of the Client Print Support Files. Valid keyword values are: 'printer-driver', 'ppd', 'updf', 'gpd'.
"client-file-name"	One REQUIRED CASE-SENSITIVE string identifying the name by which the Client Print Support Files will be installed on the workstation. For Client Print Support Files of type 'printer-driver', this is also the name that identifies this printer driver in an .inf file.
"policy"	One OPTIONAL LOWER-CASE 'keyword' string indicating the policy for automatic loading. Valid keyword values are: 'manufacturer-recommended', 'administrator-recommended', 'manufacturer-experimental, 'administrator-experimental'. The experimental values are for beta test.
"file-size"	One OPTIONAL file size in octets represented as ASCII decimal digits.
"file-version"	One OPTIONAL LOWER-CASE version number. Recommended to be of the form "Major.minor[.revision]" where "Major" is the major version number, "minor" is the minor version number and "revision" is an optional revision number.
"file-date-time"	One OPTIONAL File CASE-SENSITIVE creation date and time according to ISO 8601 where all fields are fixed length with leading zeroes (see [RFC2518] Appendix 2). Examples: 2000-01-01T23:09:05Z and 2000-01-01T02:59:59-04.00
"file-info"	One OPTIONAL CASE-SENSITIVE human readable 'text' string describing this set of Client Print Support Files. The natural language for this value MUST be the natural language indicated by the Printer's "natural-language-configured" attribute. To avoid exceeding the maximum limit imposed on IPP attributes and to increase interoperability with other systems, the length of this field value MUST not exceed 127 characters.
"digital-signature"	One REQUIRED LOWER-CASE 'keyword' string identifying the mechanism used to ensure the integrity and authenticity of this set of Client Print Support Files. Valid values are: 'smime', 'pgp', 'dss', and 'xmldsig' which are defined in [RFC2634], [RFC1991], [dss], and [xmldsig], respectively. In addition, the special keyword value: 'none' is valid.

Each value MUST refer to one and only one set of Client Print Support Files, even if the files are downloadable from various repositories (i.e., even if they are associated with multiple URIs).

3.1.1 Use of Keyword Values in fields

A number of the fields in Table 1 use keyword strings as values. The syntax of these keywords is the same as in [RFC2911], including the use of private keywords. See [RFC2911] sections 4.1.3 and 6.1. Printer implementers are strongly RECOMMENDED to submit additional keyword values for registration with IANA according to the procedures for registering attributes. See section 7 and [RFC2911] section 6.1.

3.1.2 Use of the Special Keyword Value: 'unknown'

A number of REQUIRED 'keyword' value fields have a special keyword value: 'unknown' defined. This value is intended for use when the actual value is not known, such as by an administrator automatic software configuring the IPP Printer object. However, it is strongly RECOMMENDED that other more meaningful values be used, instead of the 'unknown' value whenever possible.

3.1.3 Examples of "client-print-support-files-supported" attribute values

The following illustrates what two valid values of the "client-print-support-files-supported" (1setOf octetString(MAX)) Printer Description attribute might look like:

```
uri=ipp://mycompany.com/myprinter?drv-id=ModelY.gz<
os-type=windows-95< cpu-type=x86-32<
document-format=application/postscript<
natural-language=en< compression=gzip<
file-type=printer-driver<
client-file-name=CompanyX-ModelY-driver.gz<
policy=manufacturer-recommended<

uri=ftp://mycompany.com/root/drivers/win95/CompanyX/ModelY.gz<
os-type=windows-95< cpu-type=x86-32<
document-format=application/postscript,application/vnd.hp-PCL<
natural-language=en,fr< compression=gzip<
file-type=printer-driver<
client-file-name=Company T Model Z driver.gz<
policy=manufacturer-recommended<
```

The above examples have been broken onto separate lines for readability in this document. However, there MUST NOT be any line breaks in the actual values.

The "client-print-support-files-supported" Printer Description attribute MAY be preset at manufacturing time or through administrative means outside the scope of this document.

3.2 Get-Printer-Attributes Operation Extension

The "client-print-support-files-supported" Printer Description attribute defined in section 3.1 contains information, such as operating system, natural language, and document format, about *all* of the sets of Client Print Support Files. This section defines an extension to the Get-Printer-Attributes operation that allows a workstation to filter out all but the Client Print Support Files of interest.

3.2.1 Get-Printer-Attributes Request

A Printer MAY contain information about multiple sets of Client Print Support Files to match the different operating systems, natural languages and document formats it supports. A workstation MAY query this information by including the 'client-print-support-files-supported' keyword as a value of the "requested-attributes" operation attribute of the Get-Printer-Attributes operation.

3.2.1.1 client-print-support-files-filter (octetString(MAX)) operation attribute

The client can request a subset of the values of the "client-print-support-files-supported" Printer attribute by supplying the "client-print-support-files-filter" (octetString(MAX)) operation attribute in the request as a filter. The filter value indicates in which Client Print Support Files the client is interested. The client MAY supply this attribute. The Printer MUST support this attribute.

The filter value of the "client-print-support-files-filter" attribute is a composite string with the same format as that of "client-print-support-files-supported" (see Table 1 - "client-print-support-files-supported" attribute fields in section 3.1) with the following exceptions:

Table 2 - "client-print-support-files-filter" attribute fields

Field Name	Field Value in the "client-print-support-files-filter" attribute
uri-scheme	One or more comma-separated LOWER-CASE 'uriScheme' string values identifying the uri scheme to be filtered on. Valid values are the string representation of the IPP 'uriScheme' attribute syntax (see [RFC2911] section 4.1.6). Example URI schemes are: 'ftp', 'http', and 'ipp'. The Printer SHOULD support the 'ipp' scheme. If supplied by the client, this field NEED NOT be first. If this field is omitted by the client, the Printer returns all schemes.
xxx	One or more comma-separated values for any of the fields defined in Table 1, with the single exception of the "uri" field which a client MUST NOT supply and a Printer MUST NOT support. The Printer MUST support any filter field having more than one value separated by a COMMA (,), including the fields that Table 1 indicates MUST BE single valued.

Printer implementations MUST support the "client-print-support-files-filter" operation attribute in a Get-Printer-Attributes request with the member fields listed Table 3. Printers MAY support any additional filter fields listed in Table 2.

Client implementations MAY supply any filter fields listed in Table 2 in the "client-print-support-files-filter" operation attribute of a Get-Printer-Attributes request.

Table 3 - REQUIRED "client-print-support-files-filter" fields

uri-scheme
os-type
cpu-type
document-format
natural-language

3.2.1.1.1 Filter matching rules

The Printer returns only the values of the "client-print-support-files-supported" Printer Description attribute that match the filter in the "client-print-support-files-filter" operation attribute. The following filter matching rules are defined:

1. A match occurs if at least one value of each field supplied by the client in the filter matches a Client Print Support File value. Printers MUST ignore a filter field supplied by a client that the Printer does

not support and return a match if all supported fields do match, no matter what value the client supplied for that unsupported field. Similarly, Printers MUST ignore a filter field supplied by a client that the Printer does support, but which the field has not been populated for a Client Print Support Files and return a match if all supported and populated fields do match, no matter what value the client supplied for that unpopulated field.

2. A match for a CASE-INSENSITIVE field occurs independent of the case of the letters supplied by the client and those stored by the Printer, while a match for a LOWER-CASE field is a strict character for character match.

3. A match for a 'keyword' Printer field that is populated with the 'unknown' special keyword value occurs for *any* value supplied by the client for that field.

4. If the "client-print-support-files-filter" operation attribute filter is not supplied by the client, the printer SHOULD behave as if the attribute had been provided with all fields left empty (i.e., return an unfiltered list).

The following are two examples of a "client-print-support-files-filter" filter value:

```
os-type=windows-95< cpu-type=x86-32<
document-format=application-postscript< natural-language=en,de<

uri-scheme=ipp< os-type=windows-95< cpu-type=x86-32<
document-format=application-postscript< natural-language=en,de<
```

See section 3.2.2 for example matching responses.

It is RECOMMENDED that workstations first use the Get-Printer-Attributes operation in combination with "client-print-support-files-filter" operation attribute filter to get a list of the potential Client Print Support Files that meet the workstation's requirements. The workstation can then choose from the returned list which Client Print Support Files to use and where to get them. If one of the URIs returned is an IPP uri, the workstation can retrieve the Client Print Support Files from an IPP printer via the Get-Client-Print-Support-Files operation (see section 3.3).

3.2.2 Get-Printer-Attributes Response

A Printer MUST return the "client-print-support-files-supported" (1setOf octetString(MAX)) attribute in the Printer Object Attributes group (group 3) when requested by a client. Each returned attribute value MUST satisfy the criteria specified by the client in the request.

For example, if the request contains the following "client-print-support-files-filter" filter:

```
os-type=windows-95< cpu-type=x86-32<
```

```
   document-format=application-postscript<
   natural-language=en,de<
```

A conforming response is the following two octet String values:

```
   uri=ipp://mycompany.com/myprinter?drv-id=ModelY.gz<
   os-type=windows-95< cpu-type=x86-32<
   document-format=application/postscript<
   natural-language=en< compression=gzip<
   file-type=printer-driver<
   client-file-name=CompanyX-ModelY-driver.gz<
   policy=manufacturer-recommended<
   digital-signature=smime<

   uri=ftp://mycompany.com/root/drivers/win95/CompanyX/ModelY.gz<
   os-type=windows-95< cpu-type=x86-32<
   document-format=application/postscript,application/vnd.hp-PCL<
   natural-language=en,fr< compression=gzip<
   file-type=printer-driver<
   client-file-name=CompanyX-ModelY-driver.gz<
   policy=manufacturer-recommended<
   digital-signature=smime<
```

These examples have been broken onto separate lines for readability in this document. However, there MUST NOT be any line breaks in the actual values.

As another example, if the above request had also contained the “uri-scheme” field in the following “client-print-support-files-filter” filter:

```
   uri-scheme=ipp< os-type=windows-95< cpu-type=x86-32<
   document-format=application-postscript<
   natural-language=en,de<
```

Then only the first value would have been returned as a single octetString value:

```
   uri=ipp://mycompany.com/myprinter?drv-id=ModelY.gz<
   os-type=windows-95< cpu-type=x86-32<
   document-format=application/postscript<
   natural-language=en< compression=gzip<
   file-type=printer-driver<
   client-file-name=CompanyX-ModelY-driver.gz<
   policy=manufacturer-recommended<
   digital-signature=smime<
```

3.3 Get-Client-Print-Support-Files

This RECOMMENDED operation allows a client to download Client Print Support Files from an IPP Printer.

3.3.1 Get-Client-Print-Support-Files Request

The following sets of attributes are part of the Get-Client-Print-Support-Files request:

Group 1: Operation Attributes

Natural Language and Character Set:
The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911], section 3.1.4.1.

Target:
The "printer-uri" (uri) operation attribute which is the target for this operation as described in [RFC2911], section 3.1.5. The client MUST use the URI value as the target of this operation that the Printer returns in the "uri" field (see Table 1) in the Get-Printer-Attributes response. Furthermore, the client MUST use the appropriate authorization and security regime for this URI as indicated by the Printer's "printer-uri-supported", "uri-authentication-supported" and "uri-security-supported" attributes (see [RFC2911] sections 4.4.1, 4.4.2, and 4.4.3). Only if the URI returned in the "uri" field matches the URI that the client used for the Get-Printer-Attributes request MAY the client use the same HTTP connection. The 'ipp' URL matching rules are defined in [ipp-url] and do not include the query part.

Requesting User Name:
The "requesting-user-name" (name(MAX)) attribute SHOULD be supplied by the client as described in [RFC2911], section 8.3.

"client-print-support-files-query" (text(127)):
The client MUST supply this attribute specifying the query part [RFC2396] of the ipp uri for the desired Client Print Support Files not including the "?" character that starts the query part, i.e., the value of the "uri" field following the "?" character returned by the Get-Printer-Attributes in one of the values of the "client-print-support-files-supported" (1setOf octetString(MAX)) Printer attribute (see Table 1) that had an 'ipp' scheme.

3.3.2 Get-Client-Print-Support-Files Response

The Printer object returns the following sets of attributes as part of the Get-Client-Print-Support-Files Response:

Group 1: Operation Attributes

Status Message:
In addition to the REQUIRED status code returned in every response, the response OPTIONALLY includes a "status-message" (text(255)) operation attribute as described in [RFC2911], sections 13 and 3.1.6.

Natural Language and Character Set:
The "attributes-charset" and "attributes-natural-language" attributes as described in [RFC2911], section 3.1.4.2.

Group 2: Unsupported Attributes
See [RFC2911], section 3.1.7 for details on returning Unsupported Attributes.

Group 3: Printer Object Attributes
"client-print-support-files-supported" (octetString(MAX)).
This attribute identifies the properties of the returned Client Print Support Files. The Printer object MUST return this attribute if the response includes Group 4 (i.e., if a set of Client Print Support Files identified by the supplied "client-print-support-files-query" operation attribute was found). The Printer MUST return all configured fields for the selected Client Print Support Files in the format shown in section 3.1.

Group 4: Client Print Support Files
The printer MUST supply the Client Print Support Files that match the client's criteria following the "end-of-attributes" tag. All necessary files MUST be compressed into a single transferred file.

4 Conformance

A Printer conforming to this specification:

1. MUST support the "client-print-support-files-supported" Printer Description attribute as defined in section 3.1, including all of the REQUIRED fields defined in Table 1 and MAY support the OPTIONAL fields defined in Table 1.

2. MUST support the "client-print-support-files-filter" operation attribute in the Get-Printer-Attributes request as defined in section 3.2, including all of the fields listed in Table 3 and ignoring any fields not recognized.

3. MUST support at least one of the following URI schemes that identify the support files: 'ftp', 'http', or 'ipp', of which the 'ipp' scheme is the RECOMMENDED one.

4. SHOULD support the Get-Client-Print-Support-Files operation as described in section 3.3. If this operation is supported, then one of the supported schemes MUST be 'ipp'.

5. SHOULD support TLS as described in section 9.

6. SHOULD support the downloading of Client Print Support Files that have been digitally signed as described in section 9.

A client conforming to this specification:

1. MUST ignore any fields returned by the Printer in the "client-print-support-files-supported" Printer Description attribute that the client does not recognize or support.

2. SHOULD be able to retrieve Client Print Support Files by either FTP Get or HTTP Get operations.

3. MUST be able to retrieve Client Print Support Files using the Get-Client-Print-Support-Files operation, i.e., support the 'ipp' scheme.

4. MUST supply the proper URI value for the "printer-uri" operation attribute as specified in section 3.3.1 under Target:.

5. MUST validate that files that are supposed to be digitally signed are done with the indicated mechanism as described in section 9.

6. SHOULD support TLS as described in section 9.

5 Encoding of the Operation Layer

This extension uses the operation layer encoding described in [RFC2910].

6 Encoding of Transport Layer

This specification uses the transport layer encoding described in [RFC2910] with the following extensions.

New Error codes:

0x0417 client-error-client-print-support-file-not-found

New Operation code

0x0021 Get-Client-Print-Support-Files

7 IANA Considerations

The IANA-registered operating system names that IANA has registered [os-names] are required by this spec for use in the “os-type” field (see Table 1).

Table 1 of this document defines possible ‘keyword’ values for the “cpu-type” field. However, the existing IANA machine registration [cpu-names] is inadequate for two reasons: a) it is really a machine model number, not a CPU type, and b) it doesn't express whether a CPU is 16-bit, 32-bit, or 64-bit which needs to be indicated in the keyword value. Therefore, the “os-type” field will be a new registration with initial values assigned.

The rest of this section contains the exact information for IANA to add to the IPP Registries according to the procedures defined in RFC 2911 [RFC2911] section 6.

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

7.1 Attribute Registrations

The attributes and fields defined in this document will be published by IANA according to the procedures in RFC 2911 [RFC2911] section 6.2 with the following path:

ftp.isi.edu/iana/assignments/ipp/attributes/

The registry entry will contain the following information:

```
Printer Description Attributes:                        Ref:  Section:
client-print-support-files-supported (1setOf octetString(MAX))
                                                       RFC NNNN   3.1

For purposes of IANA attribute registration, the following fields
of the “client-print-support-files-supported” and the “client-
print-support-files-filter” attributes are registered following
the procedures for IPP attribute registration:
                                                       Ref:  Section:
uri (uri)                                              RFC NNNN   3.1
os-type (type2 keyword)                                RFC NNNN   3.1
cpu-type (type2 keyword)                               RFC NNNN   3.1
document-format (mimeMediaType)                        RFC NNNN   3.1
natural-language (naturalLanguage)                     RFC NNNN   3.1
compression (type2 keyword)                            RFC NNNN   3.1
file-type (type2 keyword)                              RFC NNNN   3.1
client-file-name (name(MAX))                           RFC NNNN   3.1
policy (type2 keyword)                                 RFC NNNN   3.1
file-size (integer(0:MAX))                             RFC NNNN   3.1
file-version (name(MAX))                               RFC NNNN   3.1
```

```
   file-date-time (text(25))                                  RFC NNNN   3.1
   file-info (text(127))                                      RFC NNNN   3.1
   digital-signature (type2 keyword)                          RFC NNNN   3.1

   uri-scheme (uriScheme)                                     RFC NNNN   3.2

   Operation Attributes:                                      Ref:  Section:
   client-print-support-files-filter (octetString(MAX))RFC NNNN   3.2
```

7.2 Operation Registrations

The operations defined in this document will be published by IANA according to the procedures in RFC 2911 [RFC2911] section 6.4 with the following path:

ftp.isi.edu/iana/assignments/ipp/operations/

The registry entry will contain the following information:

```
   Operations:                                                Ref.  Section:
   Get-Client-Print-Support-Files                             RFC NNNN   3.3
```

8 Internationalization Considerations

All text representations introduced by this specification adhere to the internationalization-friendly representation supported by IPP. This work is also accommodates the use of Client Print Support Files of different languages.

9 Security Considerations

The IPP Model and Semantics document [RFC2911] discusses high-level security requirements (Client Authentication, Server Authentication and Operation Privacy). Client Authentication is the mechanism by which the client proves its identity to the server in a secure manner. Server Authentication is the mechanism by which the server proves its identity to the client in a secure manner. Operation Privacy is defined as a mechanism for protecting operations from eavesdropping.

Only operators of a printer SHOULD be allowed to set the “client-print-support-files-supported” attribute and only users of the printer SHOULD be allowed to query that information.

The IPP extension described in this document introduces the potential for a security threat previously not encountered by IPP. As Client Print Support Files might exist in the form of executable objects (as is the case with printer drivers, for example), additional provisions are needed to prevent the distribution of malicious code through this mechanism. Digital signatures provide the message level security commonly used to help

consumers of network resources verify the authenticity and integrity of those resources. Specifically, digital signatures help defend against security threats such as message insertion, message deletion, and message modification, and their combined use into man-in-the-middle attacks.

This document identifies some commonly used signing mechanisms (SMIME [RFC2634], PGP [RFC1991], DSS [dss], and XML Digital Signatures [xmldsig]), though any others MAY be used. Of course, it is assumed that once end-users know the identity of the provider of Client Print Support Files, they can make the correct determination as to whether it is safe to use those files.

Printers that support the Get-Client-Print-Support-Files operation SHOULD support the downloading of Client Print Support Files that have been digitally signed. Clients that invoke the Get-Client-Print-Support-Files operation MUST make sure that Client Print Support Files that are supposed to be signed (i.e., whose client-print-support-files-supported attribute value includes the "digital-signature" field) are indeed signed via the specified mechanism when downloaded from the printer.

Furthermore, printers that support the Get-Client-Print-Support-Files operation SHOULD implement TLS to provide application level channel security and enable users to reliably authenticate the source of the Client Print Support Files.

10 References

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12 Full Copyright Statement

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