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[Target Category: Standards Track]	13 February 2001	5

Internet Printing Protocol (IPP):
 IPP URL Scheme
 <draft-ietf-ipp-url-scheme-02.txt>

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Abstract 18

This document is a product of the Internet Printing Protocol Working 19
 Group of the Internet Engineering Task Force (IETF). Comments should 20
 be submitted to the ipp@pwg.org mailing list. 21

This document is intended for use in registering the "ipp" URL scheme 22
 with IANA and fully conforms to the requirements in [RFC-2717]. This 23
 document defines the "ipp" URL (Uniform Resource Locator) scheme for 24
 specifying the location of an IPP Printer, IPP Job, or other IPP 25
 object (defined in some future version of IPP) which implements the 26
 IPP/1.1 Model [RFC-2911] and the IPP/1.1 Protocol encoding over HTTP 27
 [RFC-2910] or any later version of IPP. The intended usage of the 28
 "ipp" URL scheme is COMMON. 29

The IPP URL scheme defined in this document is based on the ABNF for 30
 the HTTP URL scheme defined in HTTP/1.1 [RFC-2616], which is derived 31
 from the URI Generic Syntax [RFC-2396] and further updated by 32
 [RFC-2732] and [RFC-2373] (for IPv6 addresses in URLs). An IPP URL 33
 is transformed into an HTTP URL according to the rules specified in 34
 section 5 of the IPP/1.1 Protocol [RFC-2910]. 35

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1. Introduction

See section 1 'Introduction' in [RFC-2911] for a full description of the IPP document set and overview information about IPP.

The open issues in this document each begin 'ISSUE_n:'.

This document is a product of the Internet Printing Protocol Working Group of the Internet Engineering Task Force (IETF). Comments should be submitted to the ipp@pwg.org mailing list.

This document is intended for use in registering the "ipp" URL scheme with IANA and fully conforms to the requirements in [RFC-2717]. This document defines the "ipp" URL (Uniform Resource Locator) scheme for specifying the location of an IPP Printer, IPP Job, or other IPP object (defined in some future version of IPP) which implements the IPP/1.1 Model [RFC-2911] and the IPP/1.1 Protocol encoding over HTTP [RFC-2910] or any later version of IPP. The intended usage of the "ipp" URL scheme is COMMON.

This document defines:

- IPP URL scheme applicability and intended usage;
- IPP URL scheme associated port (i.e., well-known port 631);
- IPP URL scheme associated MIME type (i.e., "application/ipp");
- IPP URL scheme syntax in ABNF [RFC-2234];
- IPP URL scheme character encoding;
- IPP URL scheme IANA, internationalization, and security considerations.

This document is laid out as follows:

- Section 2 is the terminology used throughout the document.
- Section 3 provides references to the IPP Printer and IPP Job object model.
- Section 4 specifies IPP URL scheme.
- Section 5 specifies the conformance requirements for IPP Clients and IPP Printers that claim conformance to this document.
- Section 6, 7, and 8 specify IANA, internationalization, and security considerations.
- Sections 9, 10, 11, 12, and 13 list references, acknowledgements, authors' addresses, change history, and full IETF copyright statement.

2. Terminology

This specification document uses the terminology defined in this section. 94
95

2.1. Conformance Terminology

The uppercase terms "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC-2119]. 96
97
98
These terms are used to specify conformance requirements for all 99
implementations of this specification. 100

2.2. Model Terminology

See section 12.2 'Model Terminology' in [RFC-2911]. 101

3. IPP Model for Printers and Jobs

See section 2 'IPP Objects', section 2.1 'Printer Object', and 102
section 2.2 'Job Object' in [RFC-2911] for a full description of the 103
IPP object model and terminology. 104

In this document, "IPP Client" means the software (on some hardware 105
platform) that submits, monitors, and/or manages print jobs via 106
IPP/1.1 [RFC-2910] [RFC-2911], or any later version of IPP to a 107
spooler, gateway, or actual printing device. 108

In this document, "IPP Printer object" means the software (on some 109
hardware platform) that receives print jobs and/or printer/job 110
operations via IPP/1.1 [RFC-2910] [RFC-2911], or any later version of 111
IPP from an "IPP Client". 112

In this document, "IPP Printer" is a synonym for "IPP Printer 113
object". 114

In this document, "IPP Job object" means the set of attributes and 115
documents for one print job on an "IPP Printer". 116

In this document, "IPP Job" is a synonym for "IPP Job object". 117

In this document, "IPP URL" means a URL with the "ipp" scheme. 118

Note: In this document, "IPP URL" is a synonym for "ipp_URL" (in 119
section 4 'IPP URL Scheme' of this document) and "ipp-URL" (in 120

section 5 'IPP URL Scheme' of [RFC-2910])).

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4. IPP URL Scheme

4.1. IPP URL Scheme Applicability and Intended Usage

This document is intended for use in registering the "ipp" URL scheme with IANA and fully conforms to the requirements in [RFC-2717]. This document defines the "ipp" URL (Uniform Resource Locator) scheme for specifying the location of an IPP Printer, IPP Job, or other IPP object (defined in some future version of IPP) which implements the IPP/1.1 Model [RFC-2911] and the IPP/1.1 Protocol encoding over HTTP [RFC-2910] or any later version of IPP. The intended usage of the "ipp" URL scheme is COMMON.

4.2. IPP URL Scheme Associated IPP Port

All IPP URLs which do NOT explicitly specify a port MUST be used over IANA-assigned well-known port 631 for the IPP protocol described in [RFC-2910].

See: IANA Port Numbers Registry [IANA-PORTREG]. registration with IANA.

4.3. IPP URL Scheme Associated MIME Type

All IPP protocol operations (requests and responses) MUST be conveyed in an "application/ipp" MIME media type as registered in [IANA-MIMEREG]. IPP URLs MUST refer to IPP Printers which support this "application/ipp" MIME media type.

See: IANA MIME Media Types Registry [IANA-MIMEREG].

4.4. IPP URL Scheme Character Encoding

The IPP URL scheme defined in this document is based on the ABNF for the HTTP URL scheme defined in HTTP/1.1 [RFC-2616], which is derived from the URI Generic Syntax [RFC-2396] and further updated by [RFC-2732] and [RFC-2373] (for IPv6 addresses in URLs). The IPP URL scheme is case-insensitive in the host name or host address part; however the path part is case-sensitive, as in [RFC-2396]. Codepoints outside [US-ASCII] MUST be hex escaped by the mechanism specified in [RFC-2396].

4.5. IPP URL Scheme Syntax in ABNF

Note: In this document, "IPP URL" is a synonym for "ipp_URL" (in section 4 'IPP URL Scheme' of this document) and "ipp-URL" (in section 5 'IPP URL Scheme' of [RFC-2910]).

This document is intended for use in registering the "ipp" URL scheme with IANA and fully conforms to the requirements in [RFC-2717]. This document defines the "ipp" URL (Uniform Resource Locator) scheme for specifying the location of an IPP Printer, IPP Job, or other IPP object (defined in some future version of IPP) which implements the IPP/1.1 Model [RFC-2911] and the IPP/1.1 Protocol encoding over HTTP [RFC-2910] or any later version of IPP. The intended usage of the "ipp" URL scheme is COMMON.

The IPP protocol places a limit of 1023 octets (NOT characters) on the length of a URI (see section 4.1.5 'uri' in [RFC-2911]). An IPP Printer MUST return 'client-error-request-value-too-long' (see section 13.1.4.10 in [RFC-2911]) when a URI received in a request (e.g., in the "printer-uri" attribute) is too long.

Note: IPP Printers ought to be cautious about depending on URI lengths above 255 bytes, because some older client or proxy implementations might not properly support these lengths.

IPP URLs MUST be represented in absolute form. Absolute URLs always begin with a scheme name followed by a colon. For definitive information on URL syntax and semantics, see "Uniform Resource Identifiers (URI): Generic Syntax and Semantics" [RFC-2396]. This specification adopts the definitions of "URI-reference", "absoluteURI", "relativeURI", "port", "host", "abs_path", "rel_path", and "authority" from [RFC-2396], as updated by [RFC-2732] and [RFC-2373] (for IPv6 addresses in URLs).

The IPP URL scheme syntax in ABNF is as follows:

```
ipp_URL = "ipp:" "/" host [ ":" port ] [ abs_path [ "?" query ] ]
```

If the port is empty or not given, port 631 is assumed. The semantics are that the identified resource (see section 5.1.2 of [RFC-2616]) is located at the IPP Printer or IPP Job listening for HTTP connections on that port of that host, and the Request-URI for the identified resource is 'abs_path'.

Note: The use of IP addresses in URLs SHOULD be avoided whenever possible (see [RFC-1900]).

If the 'abs_path' is not present in the URL, it MUST be given as "/"

when used as a Request-URI for a resource (see section 5.1.2 of [RFC-2616]). If a proxy receives a host name which is not a fully qualified domain name, it MAY add its domain to the host name it received. If a proxy receives a fully qualified domain name, the proxy MUST NOT change the host name.

4.5.1. IPP URL Examples

The following are examples of valid IPP URLs for IPP Printers:

```
ipp://abc.com
ipp://abc.com/printer
ipp://abc.com/tiger
ipp://abc.com/printers/tiger
ipp://abc.com/printers/fox
ipp://abc.com/printers/tiger/bob
ipp://abc.com/printers/tiger/ira
ipp://printer.abc.com
ipp://printers.abc.com/tiger
ipp://printers.abc.com/tiger/bob
ipp://printers.abc.com/tiger/ira
```

Each of the above URLs are legitimate URLs for IPP Printers and each references a logically different IPP Printer, even though some of the IPP Printers may share the same hardware. The last part of the path 'bob' or 'ira' may represent two different hardware devices where 'tiger' represents some grouping of IPP Printers (e.g., a load-balancing spooler) or the two names may represent separate human recipients ('bob' and 'ira') on the same hardware device (e.g., a printer supporting two job queues). In either case both 'bob' and 'ira' behave as different IPP Printers.

The following are examples of IPP URLs with (optional) ports and paths:

```
ipp://abc.com
ipp://abc.com/~smith/printer
ipp://abc.com:631/~smith/printer
```

The first and second IPP URLs above MUST be resolved to port 631 (IANA assigned well-known port for IPP). The second and third IPP URLs above are equivalent (see section 4.5.2 below).

Note: The use of IP addresses in URLs SHOULD be avoided whenever possible (see [RFC-1900]).

The following literal IPv4 addresses:

192.9.5.5	; IPv4 address in IPv4 style	222
186.7.8.9	; IPv4 address in IPv4 style	223
are represented in the following example IPP URLs:		224
ipp://192.9.5.5/prt1		225
ipp://186.7.8.9/printers/tiger/bob		226
The following literal IPv6 addresses (conformant to [RFC-2373]):		227
::192.9.5.5	; IPv4 address in IPv6 style	228
::FFFF:129.144.52.38	; IPv4 address in IPv6 style	229
2010:836B:4179::836B:4179	; IPv6 address per RFC 2373	230
are represented in the following example IPP URLs:		231
ipp://[::192.9.5.5]/prt1		232
ipp://[::FFFF:129.144.52.38]:631/printers/tiger		233
ipp://[2010:836B:4179::836B:4179]/printers/tiger/bob		234

4.5.2. IPP URL Comparisons

When comparing two IPP URLs to decide if they match or not, an IPP Client SHOULD use a case-sensitive octet-by-octet comparison of the entire URLs, with these exceptions:

- A port that is empty or not given is equivalent to the well-known port for that IPP URL (port 631);
- Comparisons of host names MUST be case-insensitive;
- Comparisons of scheme names MUST be case-insensitive;
- An empty 'abs_path' is equivalent to an 'abs_path' of "/".

Characters other than those in the "reserved" and "unsafe" sets (see [RFC-2396] and [RFC-2732]) are equivalent to their "%" HEX HEX encoding.

For example, the following three URIs are equivalent:

ipp://abc.com:631/~smith/printer	247
ipp://ABC.com/%7Esmith/printer	248
ipp://ABC.com:/%7esmith/printer	249

5. Conformance Requirements

5.1. Conformance Requirements for IPP Clients

IPP Clients that conform to this specification:	250
a) MUST send IPP URLs (e.g., in the "printer-uri" operation attribute in 'Print-Job') that conform to the ABNF specified in section 4.5 of this document;	251 252 253
b) MUST send IPP operations via the port specified in the IPP URL (if present) or otherwise via IANA assigned well-known port 631;	254 255
c) MUST convert IPP URLs to their corresponding HTTP URL forms according to the rules in section 5 'IPP URL Scheme' in [RFC-2910];	256 257 258
d) SHOULD interoperate with IPP/1.0 Printers according to the rules in section 9 'Interoperability with IPP/1.0 Implementations' and section 9.2 'Security and URL Schemes' in [RFC-2910].	259 260 261

5.2. Conformance Requirements for IPP Printers

IPP Printers that conform to this specification:	262
a) SHOULD reject received IPP URLs in "application/ipp" request bodies (e.g., in the "printer-uri" attribute in a 'Print-Job' request) that do not conform to the ABNF for IPP URLs specified in section 4.5 of this document;	263 264 265 266
b) SHOULD return IPP URLs in "application/ipp" response bodies (e.g., in the "job-uri" attribute in a 'Print-Job' response) that do conform to the ABNF for IPP URLs specified in section 4.5 of this document;	267 268 269 270
c) MUST listen for IPP operations on IANA-assigned well-known port 631, unless explicitly configured by system administrators or site policies;	271 272 273
d) SHOULD NOT listen for IPP operations on any other port, unless explicitly configured by system administrators or site policies;	274 275
e) SHOULD interoperate with IPP/1.0 Clients according to the rules in section 9 'Interoperability with IPP/1.0 Implementations' and section 9.2 'Security and URL Schemes' in [RFC-2910].	276 277 278

6. IANA Considerations

This document is intended for use in registering the "ipp" URL scheme with IANA and fully conforms to the requirements in [RFC-2717]. This document defines the "ipp" URL (Uniform Resource Locator) scheme for specifying the location of an IPP Printer, IPP Job, or other IPP object (defined in some future version of IPP) which implements the IPP/1.1 Model [RFC-2911] and the IPP/1.1 Protocol encoding over HTTP [RFC-2910] or any later version of IPP. The intended usage of the "ipp" URL scheme is COMMON.

This IPP URL Scheme specification does not introduce any additional IANA considerations, beyond those described in [RFC-2910] and [RFC-2911].

See: Section 6 'IANA Considerations' in [RFC-2910]
See: Section 6 'IANA Considerations' in [RFC-2911].

7. Internationalization Considerations

This IPP URL Scheme specification does not introduce any additional internationalization considerations, beyond those described in [RFC-2910] and [RFC-2911].

See: Section 7 'Internationalization Considerations' in [RFC-2910].
See: Section 7 'Internationalization Considerations' in [RFC-2911].

8. Security Considerations

This IPP URL Scheme specification does not introduce any additional security considerations, beyond those described in [RFC-2910] and [RFC-2911].

See: Section 8 'Security Considerations' in [RFC-2910].
See: Section 8 'Security Considerations' in [RFC-2911].

9. References

See: Section 10 'References' in [RFC-2910].	302
See: Section 9 'References' in [RFC-2911].	303
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10. Acknowledgments

This document is a product of the Internet Printing Protocol Working 360
Group of the Internet Engineering Task Force (IETF). Comments should 361
be submitted to the ipp@pwg.org mailing list. 362

Thanks to Pat Fleming (IBM), Tom Hastings (Xerox), Harry Lewis (IBM), 363
and Hugo Parra (Novell). 364

Section 5 'IPP URL Scheme' in IPP/1.1 Encoding and Transport 365

[RFC-2910] was the primary input to this IPP URL Scheme specification. 366
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12. Appendix X - Change History

[To be deleted before RFC publication] 382

13 February 2001 - draft-ietf-ipp-url-scheme-02.txt 383
- revised section 3 'IPP Model for Printers and Jobs' and section 4.5 384
'IPP URL Scheme Syntax in ABNF' to add notes stating that "IPP URL" 385
(in this document) is a synonym for "ipp-URL" in [RFC-2910], per 386
request of Bob Herriot; 387
- revised section 4.5 'IPP URL Scheme Syntax in ABNF' to correct typo 388
that showed "http:" rather than "ipp:" in the one-line ABNF, per 389
request of Tom Hastings; 390
- revised section 4.5.1 'IPP URL Examples' to add a note discouraging 391
the use of literal IP addresses in URLs, per [RFC-2616] and 392
[RFC-1900]; 393

5 February 2001 - draft-ietf-ipp-url-scheme-01.txt 394
- revised section 4.1 'IPP URL Applicability and Intended Usage' to 395
clarify that a given IPP URL MAY identify an IPP Printer object or 396
an IPP Job object, per request of Tom Hastings; 397
- revised section 4.5 'IPP URL Scheme Syntax in ABNF' to define IPP 398
URLs consistently with section 3.2.2 'http URL' of HTTP/1.1 399
[RFC-2616], per request of Tom Hastings; 400

- revised section 4.5 'IPP URL Scheme Syntax in ABNF' to clarify that IPP URLs may reference IPP Printer objects, IPP Job objects, or (possibly other future) IPP objects, per request of Bob Herriot;
 - added section 4.5.1 'IPP URL Examples' to supply meaningful examples of IPP URLs with host names, IPv4 addresses, and IPv6 addresses, per request of Tom Hastings;
 - added section 4.5.2 'IPP URL Comparisons' to define IPP URL comparisons consistently with section 3.3 'URI Comparison' of HTTP/1.1 [RFC-2616], per request of Tom Hastings;
 - revised section 5.1 'Conformance Requirements for IPP Clients' to clarify that an IPP Client MUST convert IPP URLs to their corresponding HTTP URL forms according to section 5 'IPP URL Scheme' in [RFC-2910], per request of Tom Hastings and Bob Herriot;
 - revised section 5.1 'Conformance Requirements for IPP Clients' and section 5.2 'Conformance Requirements for IPP Printers' to clarify that IPP Clients and IPP Printers SHOULD interoperate with IPP/1.0 systems according to section 9 'Interoperability with IPP/1.0 Implementations' in [RFC-2910], per request of Carl Kugler;
 - revised section 5.2 'Conformance Requirements for IPP Printers' to clarify that an IPP Printer MUST listen on (IANA assigned well-known) port 631, unless explicitly configured, per request of Michael Sweet;
 - revised section 5.2 'Conformance Requirements for IPP Printers' to clarify that an IPP Printer SHOULD NOT listen on ports other than (IANA assigned well-known) port 631, unless explicitly configured, per request of Don Wright;
 - revised section 6 'IANA Considerations' to clarify that the sole purpose of the entire document is IANA registration of the "ipp" URL scheme;
 - deleted Appendix A 'Registration of IPP Port' as unnecessary (port is already registered);
 - deleted Appendix B 'Registration of MIME "application/ipp" as unnecessary (MIME registry has recently caught up to RFC 2910);
- 11 January 2001 - draft-ietf-ipp-url-scheme-00.txt
- initial version - simple "ipp" URL scheme without parameters or query part (consistent with existing and IPP/1.1 implementations);
 - added Appendix A 'Registration of IPP Port' (placeholder) for updated IANA registration of port 631 with references to IPP/1.1;
 - added Appendix B 'Registration of MIME "application/ipp"' with updated IANA registration for IPP MIME type with references to both IPP/1.0 and IPP/1.1;

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