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[Target Category: Standards Track]	5 February 2001	5

Internet Printing Protocol (IPP):
 IPP URL Scheme
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Status of this Memo 6

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Abstract 18

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. 19-21

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. 22-29

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). An IPP URL is transformed into an HTTP URL according to the rules specified in section 5 of the IPP/1.1 Protocol [RFC-2910]. 30-35

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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. 60
61

The open issues in this document each begin 'ISSUE_n:'. 62

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. 63
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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. 66
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This document defines: 74

- IPP URL scheme applicability and intended usage; 75
- IPP URL scheme associated port (i.e., well-known port 631); 76
- IPP URL scheme associated MIME type (i.e., "application/ipp"); 77
- IPP URL scheme syntax in ABNF [RFC-2234]; 78
- IPP URL scheme character encoding; 79
- IPP URL scheme IANA, internationalization, and security considerations. 80
81

This document is laid out as follows: 82

- Section 2 is the terminology used throughout the document. 83
- Section 3 provides references to the IPP Printer and IPP Job object model. 84
85
- Section 4 specifies IPP URL scheme. 86
- Section 5 specifies the conformance requirements for IPP Clients and IPP Printers that claim conformance to this document. 87
88
- Section 6, 7, and 8 specify IANA, internationalization, and security considerations. 89
90
- Sections 9, 10, 11, 12, and 13 list references, acknowledgements, authors' addresses, change history, and full IETF copyright statement. 91
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2. Terminology

This specification document uses the terminology defined in this section. 94
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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
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These terms are used to specify conformance requirements for all implementations of this specification. 99
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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 section 2.2 'Job Object' in [RFC-2911] for a full description of the IPP object model and terminology. 102
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In this document, "IPP Client" means the software (on some hardware platform) that submits, monitors, and/or manages print jobs via IPP/1.1 [RFC-2910] [RFC-2911], or any later version of IPP to a spooler, gateway, or actual printing device. 105
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In this document, "IPP Printer object" means the software (on some hardware platform) that receives print jobs and/or printer/job operations via IPP/1.1 [RFC-2910] [RFC-2911], or any later version of IPP from an "IPP Client". 109
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In this document, "IPP Printer" is a synonym for "IPP Printer object". 113
114

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

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

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

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 1023 octets (NOT characters) on the length of a URI in section 4.1.5 'uri' in [RFC-2911]. An IPP Printer implementation MUST be able to handle the URI of any resource that it supports. 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 = "http:" "://" 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'. 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. 183

4.5.1. IPP URL Examples

The following are examples of valid IPP URLs for IPP Printers: 184

```
ipp://abc.com 185
ipp://abc.com/printer 186
ipp://abc.com/tiger 187
ipp://abc.com/printers/tiger 188
ipp://abc.com/printers/fox 189
ipp://abc.com/printers/tiger/bob 190
ipp://abc.com/printers/tiger/ira 191
ipp://printer.abc.com 192
ipp://printers.abc.com/tiger 193
ipp://printers.abc.com/tiger/bob 194
ipp://printers.abc.com/tiger/ira 195
```

Each of the above URLs are legitimate URLs for IPP Printers and each 196
 references a logically different IPP Printer, even though some of the 197
 IPP Printers may share the same hardware. The last part of the path 198
 'bob' or 'ira' may represent two different hardware devices where 199
 'tiger' represents some grouping of IPP Printers (e.g., a 200
 load-balancing spooler) or the two names may represent separate human 201
 recipients ('bob' and 'ira') on the same hardware device (e.g., a 202
 printer supporting two job queues). In either case both 'bob' and 203
 'ira' behave as different IPP Printers. 204

The following are examples of IPP URLs with (optional) ports and 205
 paths: 206

```
ipp://abc.com 207
ipp://abc.com/~smith/printer 208
ipp://abc.com:631/~smith/printer 209
```

The first and second IPP URLs above MUST be resolved to port 631 210
 (IANA assigned well-known port for IPP). The second and third IPP 211
 URLs above are equivalent (see section 4.5.2 below). 212

The following literal IPv6 addresses (conformant to [RFC-2373]): 213

```
::192.9.5.5 ; IPv4 address in IPv6 style 214
::FFFF:129.144.52.38 ; IPv4 address in IPv6 style 215
2010:836B:4179::836B:4179 ; IPv6 address per RFC 2373 216
```

are represented in the following example IPP URLs: 217

```
ipp://[::192.9.5.5]/prt1 218
ipp://[::FFFF:129.144.52.38]:631/printers/tiger 219
```

ipp://[2010:836B:4179::836B:4179]/printers/tiger/bob 220

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: 221
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- A port that is empty or not given is equivalent to the well-known port for that IPP URL (port 631); 224
225
- Comparisons of host names MUST be case-insensitive; 226
- Comparisons of scheme names MUST be case-insensitive; 227
- An empty 'abs_path' is equivalent to an 'abs_path' of "/". 228

Characters other than those in the "reserved" and "unsafe" sets (see [RFC-2396] and [RFC-2732]) are equivalent to their "%" HEX HEX encoding. 229
230
231

For example, the following three URIs are equivalent: 232

ipp://abc.com:631/~smith/printer 233
ipp://ABC.com/%7Esmith/printer 234
ipp://ABC.com:/%7esmith/printer 235

5. Conformance Requirements

5.1. Conformance Requirements for IPP Clients

IPP Clients that conform to this specification:	236
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;	237 238 239
b) MUST send IPP operations via the port specified in the IPP URL (if present) or otherwise via IANA assigned well-known port 631;	240 241
c) MUST convert IPP URLs to their corresponding HTTP URL forms according to the rules in section 5 'IPP URL Scheme' in [RFC-2910];	242 243 244
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].	245 246 247

5.2. Conformance Requirements for IPP Printers

IPP Printers that conform to this specification:	248
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;	249 250 251 252
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;	253 254 255 256
c) MUST listen for IPP operations on IANA-assigned well-known port 631, unless explicitly configured by system administrators or site policies;	257 258 259
d) SHOULD NOT listen for IPP operations on any other port, unless explicitly configured by system administrators or site policies;	260 261
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].	262 263 264

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] 276

See: Section 6 'IANA Considerations' in [RFC-2911]. 277

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]. 281

See: Section 7 'Internationalization Considerations' in [RFC-2911]. 282

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]. 286

See: Section 8 'Security Considerations' in [RFC-2911]. 287

9. References

See: Section 10 'References' in [RFC-2910].	288
See: Section 9 'References' in [RFC-2911].	289
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[IANA-MIMEREG] IANA MIME Media Types Registry.	292
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[IANA-PORTREG] IANA Port Numbers Registry.	294
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[RFC-2910] R. Herriot, S. Butler, P. Moore, R. Turner, J. Wenn. IPP/1.1 Encoding and Transport, RFC 2910, September 2000.	336 337
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[RFC-3066] H. Alvestrand. Tags for the Identification of Languages, RFC 3066, January 2001.	342 343
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and Hugo Parra (Novell).

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

[RFC-2910] was the primary input to this IPP URL Scheme specification. 352
353

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12. Appendix X - Change History

[To be deleted before RFC publication] 368

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- revised section 4.1 'IPP URL Applicability and Intended Usage' to 370
clarify that a given IPP URL MAY identify an IPP Printer object or 371
an IPP Job object, per request of Tom Hastings; 372
- revised section 4.5 'IPP URL Scheme Syntax in ABNF' to define IPP 373
URLs consistently with section 3.2.2 'http URL' of HTTP/1.1 374
[RFC-2616], per request of Tom Hastings; 375
- revised section 4.5 'IPP URL Scheme Syntax in ABNF' to clarify that 376
IPP URLs may reference IPP Printer objects, IPP Job objects, or 377
(possibly other future) IPP objects, per request of Bob Herriot; 378
- added section 4.5.1 'IPP URL Examples' to supply meaningful 379
examples of IPP URLs with host names, IPv4 addresses, and IPv6 380
addresses, per request of Tom Hastings; 381
- added section 4.5.2 'IPP URL Comparisons' to define IPP URL 382
comparisons consistently with section 3.3 'URI Comparison' of 383
HTTP/1.1 [RFC-2616], per request of Tom Hastings; 384
- revised section 5.1 'Conformance Requirements for IPP Clients' to 385
clarify that an IPP Client MUST convert IPP URLs to their 386
corresponding HTTP URL forms according to section 5 'IPP URL 387

Scheme' in [RFC-2910], per request of Tom Hastings and Bob Herriot;	388
- revised section 5.1 'Conformance Requirements for IPP Clients' and	389
section 5.2 'Conformance Requirements for IPP Printers' to clarify	390
that IPP Clients and IPP Printers SHOULD interoperate with IPP/1.0	391
systems according to section 9 'Interoperability with IPP/1.0	392
Implementations' in [RFC-2910], per request of Carl Kugler;	393
- revised section 5.2 'Conformance Requirements for IPP Printers' to	394
clarify that an IPP Printer MUST listen on (IANA assigned	395
well-known) port 631, unless explicitly configured, per request of	396
Michael Sweet;	397
- revised section 5.2 'Conformance Requirements for IPP Printers' to	398
clarify that an IPP Printer SHOULD NOT listen on ports other than	399
(IANA assigned well-known) port 631, unless explicitly configured,	400
per request of Don Wright;	401
- revised section 6 'IANA Considerations' to clarify that the sole	402
purpose of the entire document is IANA registration of the "ipp"	403
URL scheme;	404
- deleted Appendix A 'Registration of IPP Port' as unnecessary (port	405
is already registered);	406
- deleted Appendix B 'Registration of MIME "application/ipp" as	407
unnecessary (MIME registry has recently caught up to RFC 2910);	408
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- initial version - simple 'ipp:' URL scheme without parameters or	410
query part (consistent with existing and IPP/1.1 implementations);	411
- added Appendix A 'Registration of IPP Port' (placeholder) for	412
updated IANA registration of port 631 with references to IPP/1.1;	413
- added Appendix B 'Registration of MIME "application/ipp"' with	414
updated IANA registration for IPP MIME type with references to both	415
IPP/1.0 and IPP/1.1;	416

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