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[Target Category: Standards Track]

Internet Printing Protocol (IPP):
 IPP URL Scheme
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Abstract 18

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 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]. 19
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Table of Contents

1. Introduction	3	33
2. Terminology	4	34
2.1. Conformance Terminology	4	35
2.2. Model Terminology	4	36
3. IPP Model for Printers and Jobs	5	37
4. IPP URL Scheme	6	38
4.1. IPP URL Scheme Applicability and Intended Usage	6	39
4.2. IPP URL Scheme Associated IPP Port	6	40
4.3. IPP URL Scheme Associated MIME Type	6	41
4.4. IPP URL Scheme Character Encoding	6	42
4.5. IPP URL Scheme Syntax in ABNF	7	43
4.5.1. IPP URL Examples	8	44
4.5.2. IPP URL Comparisons	9	45
5. Conformance Requirements	10	46
5.1. Conformance Requirements for IPP Clients	10	47
5.2. Conformance Requirements for IPP Printers	10	48
6. IANA Considerations	11	49
7. Internationalization Considerations	11	50
8. Security Considerations	11	51
9. References	12	52
10. Acknowledgments	12	53
11. Authors' Addresses	13	54
12. Appendix X - Change History	13	55
13. Full Copyright Statement	15	56

1. Introduction

See section 1 'Introduction' in [RFC-2911] for a full description of the IPP document set and overview information about IPP. 57
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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. 59
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This document defines: 67

- IPP URL scheme applicability and intended usage; 68
- IPP URL scheme associated port (i.e., well-known port 631); 69
- IPP URL scheme associated MIME type (i.e., "application/ipp"); 70
- IPP URL scheme syntax in ABNF [RFC-2234]; 71
- IPP URL scheme character encoding; 72
- IPP URL scheme IANA, internationalization, and security considerations. 73
74

This document is laid out as follows: 75

- Section 2 is the terminology used throughout the document. 76
- Section 3 provides references to the IPP Printer and IPP Job object model. 77
78
- Section 4 specifies IPP URL scheme. 79
- Section 5 specifies the conformance requirements for IPP Clients and IPP Printers that claim conformance to this document. 80
81
- Section 6, 7, and 8 specify IANA, internationalization, and security considerations. 82
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- Sections 9, 10, 11, 12, and 13 list references, acknowledgements, authors' addresses, change history, and full IETF copyright statement. 84
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2. Terminology

This specification document uses the terminology defined in this section. 87
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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]. 89
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91
These terms are used to specify conformance requirements for all 92
implementations of this specification. 93

2.2. Model Terminology

See section 12.2 'Model Terminology' in [RFC-2911]. 94

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.	95 96 97
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.	98 99 100 101
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".	102 103 104 105
In this document, "IPP Printer" is a synonym for "IPP Printer object".	106 107
In this document, "IPP Job object" means the set of attributes and documents for one print job on an "IPP Printer".	108 109
In this document, "IPP Job" is a synonym for "IPP Job object".	110
In this document, "IPP URL" means a URL with the "ipp" scheme.	111
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]).	112 113 114

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 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'.

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]).

4.5.1. IPP URL Examples

The following are examples of valid IPP URLs for IPP Printers: 178

```
ipp://abc.com 179
ipp://abc.com/printer 180
ipp://abc.com/tiger 181
ipp://abc.com/printers/tiger 182
ipp://abc.com/printers/fox 183
ipp://abc.com/printers/tiger/bob 184
ipp://abc.com/printers/tiger/ira 185
ipp://printer.abc.com 186
ipp://printers.abc.com/tiger 187
ipp://printers.abc.com/tiger/bob 188
ipp://printers.abc.com/tiger/ira 189
```

Each of the above URLs are legitimate URLs for IPP Printers and each 190
 references a logically different IPP Printer, even though some of the 191
 IPP Printers may share the same hardware. The last part of the path 192
 'bob' or 'ira' may represent two different hardware devices where 193
 'tiger' represents some grouping of IPP Printers (e.g., a 194
 load-balancing spooler) or the two names may represent separate human 195
 recipients ('bob' and 'ira') on the same hardware device (e.g., a 196
 printer supporting two job queues). In either case both 'bob' and 197
 'ira' behave as different IPP Printers. 198

The following are examples of IPP URLs with (optional) ports and 199
 paths: 200

```
ipp://abc.com 201
ipp://abc.com/~smith/printer 202
ipp://abc.com:631/~smith/printer 203
```

The first and second IPP URLs above MUST be resolved to port 631 204
 (IANA assigned well-known port for IPP). The second and third IPP 205
 URLs above are equivalent (see section 4.5.2 below). 206

The following literal IPv4 addresses: 207

```
192.9.5.5 ; IPv4 address in IPv4 style 208
186.7.8.9 ; IPv4 address in IPv4 style 209
```

are represented in the following example IPP URLs: 210

```
ipp://192.9.5.5/prt1 211
ipp://186.7.8.9/printers/tiger/bob 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 MUST use the same rules as those defined for HTTP URI comparisons in [RFC-2616], with the sole following exception: 221
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- A port that is empty or not given MUST be treated as equivalent to the well-known port for that IPP URL (port 631); 224
225

See: Section 3.2.3 'URI Comparison' in [RFC-2616]. 226

5. Conformance Requirements

5.1. Conformance Requirements for IPP Clients

IPP Clients that conform to this specification:	227
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;	228 229 230
b) MUST send IPP operations via the port specified in the IPP URL (if present) or otherwise via IANA assigned well-known port 631;	231 232
c) MUST convert IPP URLs to their corresponding HTTP URL forms according to the rules in section 5 'IPP URL Scheme' in [RFC-2910];	233 234 235
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].	236 237 238

5.2. Conformance Requirements for IPP Printers

IPP Printers that conform to this specification:	239
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;	240 241 242 243
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;	244 245 246 247
c) MUST listen for IPP operations on IANA-assigned well-known port 631, unless explicitly configured by system administrators or site policies;	248 249 250
d) SHOULD NOT listen for IPP operations on any other port, unless explicitly configured by system administrators or site policies;	251 252
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].	253 254 255

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] 267

See: Section 6 'IANA Considerations' in [RFC-2911]. 268

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]. 272

See: Section 7 'Internationalization Considerations' in [RFC-2911]. 273

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]. 277

See: Section 8 'Security Considerations' in [RFC-2911]. 278

9. References

See: Section 10 'References' in [RFC-2910].	279
[IANA-MIMEREG] IANA MIME Media Types Registry.	280
ftp://ftp.isi.edu/in-notes/iana/assignments/media-types/...	281
[IANA-PORTREG] IANA Port Numbers Registry.	282
ftp://ftp.isi.edu/in-notes/iana/assignments/port-numbers	283
[RFC-2234] D. Crocker, P. Overell. Augmented BNF for Syntax Specifications: ABNF, RFC 2234, November 1997.	284 285
[RFC-2373] R. Hinden, S. Deering. IP Version 6 Addressing Architecture, RFC 2373, July 1998.	286 287
[RFC-2396] T. Berners-Lee, R. Fielding, L. Masinter. Uniform Resource Identifiers (URI): Generic Syntax, RFC 2396, August 1998.	288 289
[RFC-2616] R. Fielding, J. Gettys, J. Mogul, H. Frystyk, L. Masinter, P. Leach, T. Berners-Lee. Hypertext Transfer Protocol -- HTTP/1.1, RFC 2616, June 1999.	290 291 292
[RFC-2717] R. Petke, I. King. Registration Procedures for URL Scheme Names, RFC 2717, November 1999.	293 294
[RFC-2732] R. Hinden, B. Carpenter, L. Masinter. Format for Literal IPv6 Addresses in URL's, RFC 2732, December 1999.	295 296
[RFC-2910] R. Herriot, S. Butler, P. Moore, R. Turner, J. Wenn. IPP/1.1 Encoding and Transport, RFC 2910, September 2000.	297 298
[RFC-2911] T. Hastings, R. Herriot, R. deBry, S. Isaacson, P. Powell. IPP/1.1 Model and Semantics, RFC 2911, September 2000.	299 300
[US-ASCII] Coded Character Set -- 7-bit American Standard Code for Information Interchange, ANSI X3.4-1986.	301 302

10. Acknowledgments

This document is a product of the Internet Printing Protocol Working Group of the Internet Engineering Task Force (IETF).	303 304
Thanks to Pat Fleming (IBM), Tom Hastings (Xerox), Harry Lewis (IBM), Hugo Parra (Novell), Don Wright (Lexmark), and all the members of the IETF IPP WG.	305 306 307

Section 5 'IPP URL Scheme' in IPP/1.1 Encoding and Transport 308
 [RFC-2910] was the primary input to this IPP URL Scheme 309
 specification. 310

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Usage questions and comments on this IPP URL Scheme should be sent to 325
 the IETF IPP WG mailing list at 'ipp@pwg.org'. 326

12. Appendix X - Change History

[To be deleted before RFC publication] 327

2 April 2001 - draft-ietf-ipp-url-scheme-03.txt 328
 - final edits after IETF IPP WG 'last call' comments; 329
 - revised 'Abstract' and section 1 'Introduction' to remove 330
 references to ISSUE's and request for comments to the 'ipp@pwg.org' 331
 mailing list, in preparation for publication as an RFC; 332
 - revised section 4.5 'IPP URL Scheme Syntax in ABNF' to delete all 333
 references to HTTP proxy behavior (which IPP does NOT specify), per 334
 request of Don Wright; 335
 - revised section 4.5.1 'IPP URL Examples' to remove note 336
 discouraging the use of literal IP addresses in URLs, to remove 337
 dependency on Informational [RFC-1900]; 338
 - revised section 4.5.2 'IPP URL Comparisons' to specify the use of 339
 rules defined in section 3.2.3 'URI Comparison' in [RFC-2616], with 340
 the sole exception that an empty port MUST be treated as equivalent 341

to the IPP well-known port 631, per request of Don Wright;	342
- revised section 9 'References' to delete all unused references;	343
- revised section 11 'Authors' Addresses' to add the address of the IPP WG mailing list for usage questions and comments;	344 345
13 February 2001 - draft-ietf-ipp-url-scheme-02.txt	346
- revised section 3 'IPP Model for Printers and Jobs' and section 4.5 'IPP URL Scheme Syntax in ABNF' to add notes stating that "IPP URL" (in this document) is a synonym for "ipp-URL" in [RFC-2910], per request of Bob Herriot;	347 348 349 350
- revised section 4.5 'IPP URL Scheme Syntax in ABNF' to correct typo that showed "http:" rather than "ipp:" in the one-line ABNF, per request of Tom Hastings;	351 352 353
- revised section 4.5.1 'IPP URL Examples' to add a note discouraging the use of literal IP addresses in URLs, per [RFC-2616] and [RFC-1900];	354 355 356
5 February 2001 - draft-ietf-ipp-url-scheme-01.txt	357
- revised section 4.1 'IPP URL Applicability and Intended Usage' to clarify that a given IPP URL MAY identify an IPP Printer object or an IPP Job object, per request of Tom Hastings;	358 359 360
- revised section 4.5 'IPP URL Scheme Syntax in ABNF' to define IPP URLs consistently with section 3.2.2 'http URL' of HTTP/1.1 [RFC-2616], per request of Tom Hastings;	361 362 363
- 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;	364 365 366
- 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;	367 368 369
- 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;	370 371 372
- 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;	373 374 375 376
- 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;	377 378 379 380 381
- 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;	382 383 384 385
- 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;	386 387 388 389

- revised section 6 'IANA Considerations' to clarify that the sole purpose of the entire document is IANA registration of the "ipp" URL scheme; 390-392
 - deleted Appendix A 'Registration of IPP Port' as unnecessary (port is already registered); 393-394
 - deleted Appendix B 'Registration of MIME "application/ipp" as unnecessary (MIME registry has recently caught up to RFC 2910); 395-396
- 11 January 2001 - draft-ietf-ipp-url-scheme-00.txt 397
- initial version - simple "ipp" URL scheme without parameters or query part (consistent with existing and IPP/1.1 implementations); 398-399
 - added Appendix A 'Registration of IPP Port' (placeholder) for updated IANA registration of port 631 with references to IPP/1.1; 400-401
 - 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; 402-404

13. Full Copyright Statement

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