DHC	T. Huth	
Internet-Draft	J. Freimann	
Intended status: Standards Track	IBM Germany Research &	
Expires: January 27, 2011	Development GmbH	
	V. Zimmer	
	Intel	
	D. Thaler	
	Microsoft	
	July 26, 2010	

TOC

DHCPv6 options for network boot
draft-ietf-dhc-dhcpv6-opt-netboot-10

Abstract

The Dynamic Host Configuration Protocol for IPv6 (DHCPv6) provides a framework for passing configuration information to nodes on a network. This document describes new options for DHCPv6 which SHOULD be used for booting a node from the network.

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.
Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.
Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as “work in progress.”
This Internet-Draft will expire on January 27, 2011.

Copyright Notice

Table of Contents

---

1. Introduction

TOC

This draft describes DHCPv6 options that SHOULD be used to provide configuration information for a node that must be booted using the network, rather than from local storage.
Network booting is used, for example, in some environments where administrators have to maintain a large number of nodes. By serving all boot and configuration files from a central server, the effort required to maintain these nodes is greatly reduced.
A typical boot file would be, for example, an operating system kernel or a boot loader program. To be able to execute such a file, the firmware running on the client node must perform the following two steps (see Figure 1 (Network Boot Sequence)): First get all information which is required for downloading and executing the boot file. Second, download the boot file and execute it.

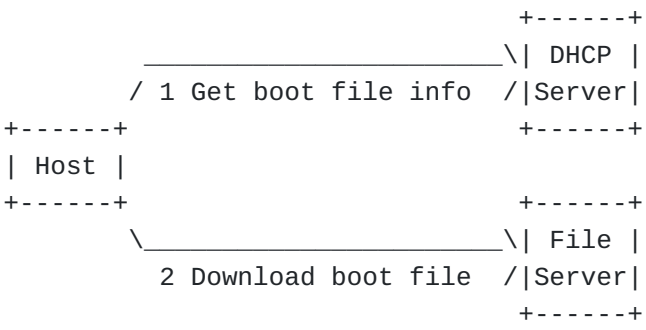


Figure 1: Network Boot Sequence

The information which is required for booting over the network MUST include at least the details about the server on which the boot files can be found, the protocol to be used for the download (for example HTTP (Fielding, R., Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and T. Berners-Lee, "Hypertext Transfer Protocol -- HTTP/1.1," June 1999.) [RFC2616] or TFTP (Sollins, K., "The TFTP Protocol (Revision 2)," July 1992.) [RFC1350]) and the path and name of the boot file on the server. Additionally, the server and client MAY exchange information about the parameters which should be passed to the OS kernel or boot loader program respectively, or information about the supported boot environment.
DHCPv6 allows client nodes to ask a DHCPv6 server for configuration parameters. This document provides new options which a client can request from the DHCPv6 server to satisfy its requirements for booting. It also introduces a new IANA registry for processor architecture types which are used by the OPTION_CLIENT_ARCH_TYPE option (see Section 3.3 (Client System Architecture Type Option)).

---

2. Conventions

TOC

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 (Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," March 1997.) [RFC2119].
Terminology specific to IPv6 and DHCPv6 are used in the same way as defined in the "Terminology" sections of [RFC3315] (Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)," July 2003.).

---

3. Options

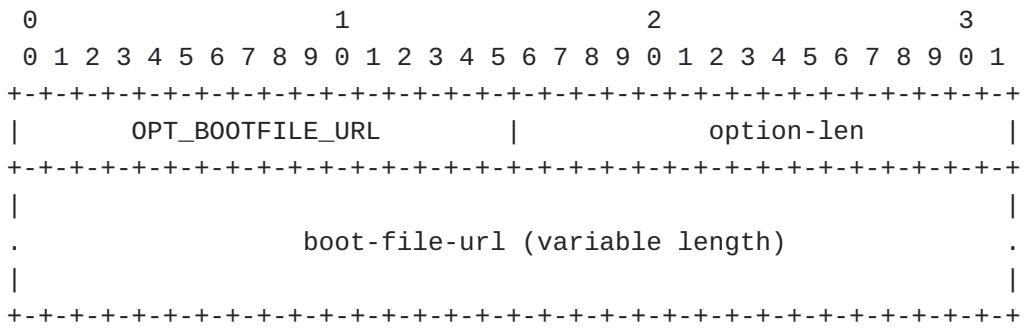
TOC

Option formats comply with DHCPv6 options per [RFC3315] (Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)," July 2003.) (section 6). The boot-file-url option (see Section 3.1 (Boot File Uniform Resource Locator (URL) Option)) is mandatory for booting, all other options are optional.

3.1. Boot File Uniform Resource Locator (URL) Option

TOC

The server sends this option to inform the client about an URL to a boot file.



Format description:

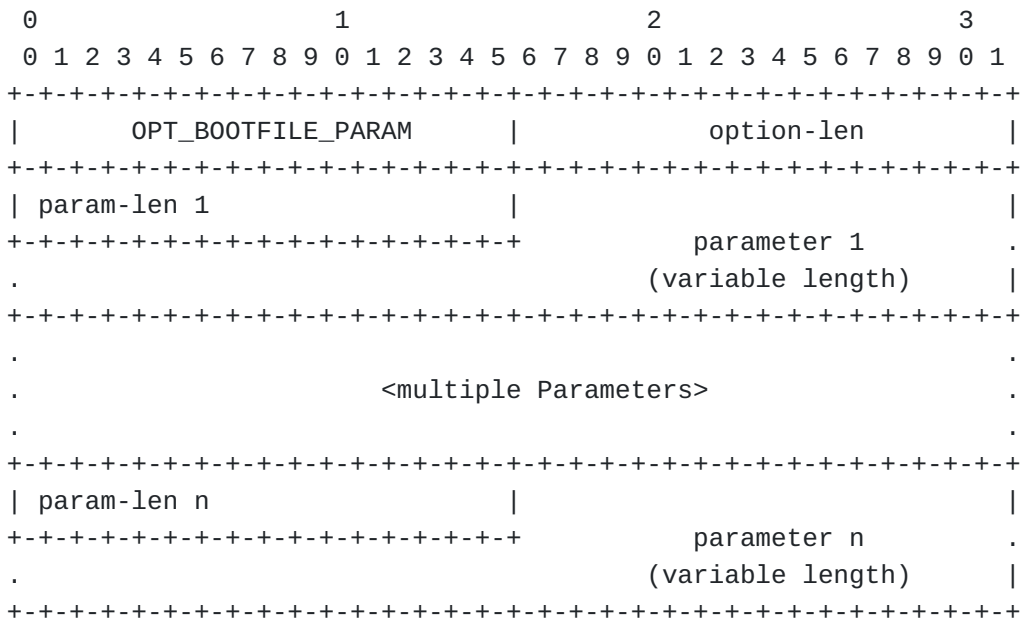
> **option-code** OPT_BOOTFILE_URL (TBD1).
>
> **option-len** Length of the boot-file-url in octets.
>
> **boot-file-url** This string is the URL for the boot file. It MUST comply with STD 66 [RFC3986] (Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifier (URI): Generic Syntax," January 2005.). The string is not NUL-terminated.

If the host in the URL is expressed using an IPv6 address rather than a domain name, the address in the URL then MUST be enclosed in "[" and "]" characters, conforming to [RFC3986] (Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifier (URI): Generic Syntax," January 2005.). Clients that have DNS implementations SHOULD support the use of domain names in the URL.

TOC

3.2. Boot File Parameters Option

This option is sent by the server to the client. It consists of multiple UTF-8 ([RFC3629] (Yergeau, F., "UTF-8, a transformation format of ISO 10646," November 2003.)) strings. They are used to specify parameters for the boot file (similar to the command line arguments in most modern operating systems). For example, these parameters could be used to specify the root file system of the OS kernel, or where a second stage boot loader can download its configuration file from.



Format description:

option-code OPT_BOOTFILE_PARAM (TBD2).

option-len Length of the Boot File Parameters option in octets (not including the size of the option-code and option-len fields).

param-len 1...n This is a 16-bit integer which specifies the length of the following parameter in octets (not including the parameter-length field).

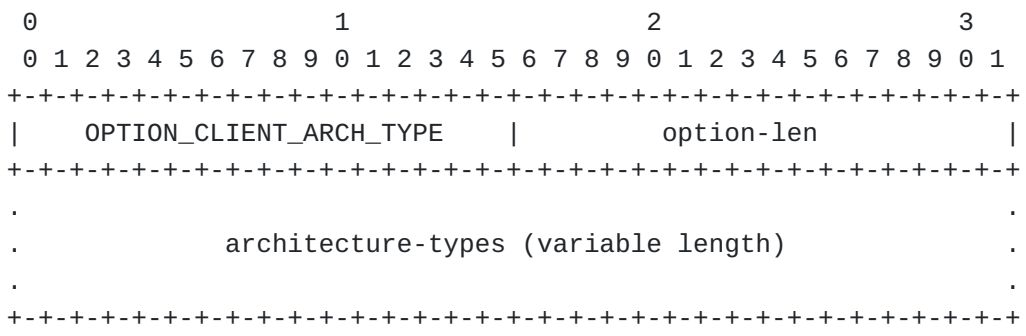
parameter 1...n These UTF-8 strings are parameters needed for booting, e.g. kernel parameters. The strings are not NUL-terminated.

When the boot firmware executes the boot file which has been specified in the OPT_BOOTFILE_URL option, it MUST pass these parameters, if present, in the order that they appear in the OPT_BOOTFILE_PARAM option.

3.3. Client System Architecture Type Option

TOC

This option provides parity with the Client System Architecture Type Option defined for DHCPv4 in section 2.1 of [RFC4578] (Johnston, M. and S. Venaas, "Dynamic Host Configuration Protocol (DHCP) Options for the Intel Preboot eXecution Environment (PXE)," November 2006.).
The format of the option is:



option-code OPTION_CLIENT_ARCH_TYPE (TBD3).

option-len Length of the "architecture-types" field in octets. It MUST be an even number greater than zero. See section 2.1 of [RFC4578] (Johnston, M. and S. Venaas, "Dynamic Host Configuration Protocol (DHCP) Options for the Intel Preboot eXecution Environment (PXE)," November 2006.) for details.

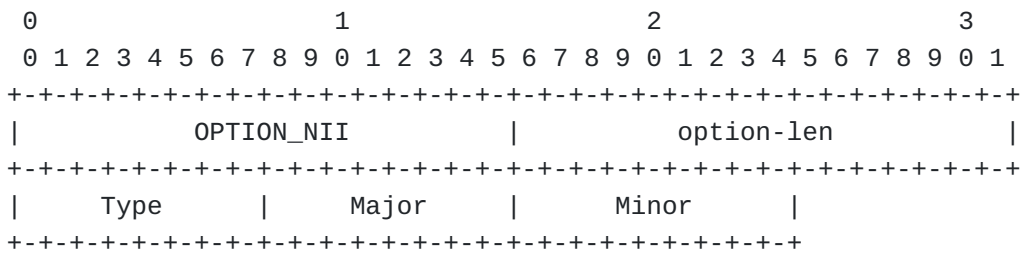
architecture-types A list of one or more architecture types, as specified in section 2.1 of [RFC4578] (Johnston, M. and S. Venaas, "Dynamic Host Configuration Protocol (DHCP) Options for the Intel Preboot eXecution Environment (PXE)," November 2006.). Each architecture type identifier in this list is a 16-bit value which describes the pre-boot runtime environment of the client machine. A list of valid values is maintained by the IANA (see Section 6 (IANA considerations)).

The client MAY use this option to send a list of supported architecture types to the server, so the server can decide which boot file should be provided to the client. If a client supports more than one pre-boot environment (for example both, 32-bit and 64-bit executables), the most preferred architecture type MUST be listed as first item, followed by the others with descending priority.
If the client used this option in the request, the server SHOULD include this option to inform the client about the pre-boot environments which are supported by the boot file. The list MUST only contain architecture types which have initially been queried by the client. The items MUST also be listed in order of descending priority.

3.4. Client Network Interface Identifier Option

TOC

If the client supports the Universal Network Device Interface (UNDI) (see [PXE21] (Johnston, M., "Preboot Execution Environment (PXE) Specification," September 1999.) and [UEFI23] (UEFI Forum, "Unified Extensible Firmware Interface Specification, Version 2.3," May 2009.)), it may send the Client Network Interface Identifier option to a DHCP server to provide information about its level of UNDI support.
This option provides parity with the Client Network Interface Identifier Option defined for DHCPv4 in section 2.2 of [RFC4578] (Johnston, M. and S. Venaas, "Dynamic Host Configuration Protocol (DHCP) Options for the Intel Preboot eXecution Environment (PXE)," November 2006.).
The format of the option is:



option-code OPTION_NII (TBD4).

option-len 3

Type As specified in section 2.2 of [RFC4578] (Johnston, M. and S. Venaas, "Dynamic Host Configuration Protocol (DHCP) Options for the Intel Preboot eXecution Environment (PXE)," November 2006.).

Major As specified in section 2.2 of [RFC4578] (Johnston, M. and S. Venaas, "Dynamic Host Configuration Protocol (DHCP) Options for the Intel Preboot eXecution Environment (PXE)," November 2006.).

Minor As specified in section 2.2 of [RFC4578] (Johnston, M. and S. Venaas, "Dynamic Host Configuration Protocol (DHCP) Options for the Intel Preboot eXecution Environment (PXE)," November 2006.).

The list of valid Type, Major and Minor values is maintained in the Unified Extensible Firmware Interface specification [UEFI23] (UEFI Forum, "Unified Extensible Firmware Interface Specification, Version 2.3," May 2009.).

TOC

4. Appearance of the options

These options MUST NOT appear in DHCPv6 messages other than the types Solicit, Advertise, Request, Renew, Rebind, Information-Request and Reply.
The option-codes of these options MAY appear in the Option Request Option in the DHCPv6 message types Solicit, Request, Renew, Rebind, Information-Request and Reconfigure.

---

5. Download protocol considerations

TOC

The Boot File URL option does not place any constraints on the protocol used for downloading the boot file, other than that it MUST be possible to specify it in a URL. For the sake of administrative simplicity, we strongly recommend that, at a mininum, implementors of network boot loaders implement the well-known and established hypertext transfer protocol [RFC2616] (Fielding, R., Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and T. Berners-Lee, "Hypertext Transfer Protocol -- HTTP/1.1," June 1999.) for downloading. Please note that for IPv6, this supersedes [RFC906] (Finlayson, R., "Bootstrap Loading using TFTP," June 1984.) which recommended to use TFTP for downloading (see [RFC3617] (Lear, E., "Uniform Resource Identifier (URI) Scheme and Applicability Statement for the Trivial File Transfer Protocol (TFTP)," October 2003.) for the 'tftp' URL definition).
When using iSCSI for booting, the 'iscsi' URI is formed as defined in [RFC4173] (Sarkar, P., Missimer, D., and C. Sapuntzakis, "Bootstrapping Clients using the Internet Small Computer System Interface (iSCSI) Protocol," September 2005.). The functionality attributed in RFC4173 to a root path option is provided for IPv6 by the Boot File URL option instead.

---

6. IANA considerations

TOC

The following options need to be assigned by the IANA from the option number space defined in the chapter 24 of the DHCPv6 RFC (Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)," July 2003.) [RFC3315].

Option name	Value	Specified in
OPT_BOOTFILE_URL	TBD1	Section 3.1 (Boot File Uniform Resource Locator (URL) Option)
OPT_BOOTFILE_PARAM	TBD2	Section 3.2 (Boot File Parameters Option)
OPTION_CLIENT_ARCH_TYPE	TBD3	

		Section 3.3 (Client System Architecture Type Option)
OPTION_NII	TBD4	Section 3.4 (Client Network Interface Identifier Option)

This document also introduces a new IANA registry for processor architecture types. The name of this registry shall be "Processor Architecture Type". Registry entries consist of a 16-bit integer recorded in decimal format, and a descriptive name. The initial values of this registry can be found in [RFC4578] (Johnston, M. and S. Venaas, "Dynamic Host Configuration Protocol (DHCP) Options for the Intel Preboot eXecution Environment (PXE)," November 2006.) section 2.1. The assignment policy for values shall be Expert Review (see [RFC5226] (Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs," May 2008.)), and any requests for values must supply the descriptive name for the processor architecture type.

---

7. Security considerations

TOC

In untrusted networks, a rogue DHCPv6 server could send the new DHCPv6 options described in this document. The booting clients could then be provided with a wrong URL so that either the boot fails, or even worse, the client boots the wrong operating system which has been provided by a malicious file server. To prevent this kind of attack, clients SHOULD use authentication of DHCPv6 messages (see chapter 21. in [RFC3315] (Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)," July 2003.)). Note also that DHCPv6 messages are sent unencrypted by default. So the boot file URL options are sent unencrypted over the network, too. This can become a security risk since the URLs can contain sensitive information like user names and passwords (for example a URL like "ftp://username:password@servername/path/file"). At the current point in time, there is no possibility to send encrypted DHCPv6 messages, so it is strongly RECOMMENDED not to use sensitive information in the URLs in untrusted networks (using passwords in URLs is deprecated anyway according to [RFC3986] (Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifier (URI): Generic Syntax," January 2005.)). Even if the DHCPv6 transaction is secured, this does not protect against attacks on the boot file download channel. Consequently, we recommend that either protocols like HTTPS [RFC2818] (Rescorla, E., "HTTP Over TLS," May 2000.) or TLS within HTTP [RFC2817] (Khare, R. and S. Lawrence, "Upgrading to TLS Within HTTP/1.1," May 2000.) are used to prevent spoofing, or that the boot loader software implements a mechanism for signing boot images and a configurable signing key in

memory, so that if a malicious image is provided, it can be detected and rejected.

8. Acknowledgements

TOC

The authors would like to thank Ruth Li, Dong Wei, Kathryn Hampton, Phil Dorah, Richard Chan, and Fiona Jensen for discussions that led to this document.
The authors would also like to thank Ketan P. Pancholi, Alfred Hoenes, Gabriel Montenegro and Ted Lemon for corrections and suggestions.

9. References

TOC

9.1. Normative References

TOC

[PXE21]	Johnston, M., “Preboot Execution Environment (PXE) Specification,” September 1999.
[RFC2119]	Bradner, S., “Key words for use in RFCs to Indicate Requirement Levels,” BCP 14, RFC 2119, March 1997 (TXT, HTML, XML).
[RFC3315]	Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, “Dynamic Host Configuration Protocol for IPv6 (DHCPv6),” RFC 3315, July 2003 (TXT).
[RFC3629]	Yergeau, F., “UTF-8, a transformation format of ISO 10646,” STD 63, RFC 3629, November 2003 (TXT).
[RFC3986]	Berners-Lee, T., Fielding, R., and L. Masinter, “Uniform Resource Identifier (URI): Generic Syntax,” STD 66, RFC 3986, January 2005 (TXT, HTML, XML).
[RFC4173]	Sarkar, P., Missimer, D., and C. Sapuntzakis, “Bootstrapping Clients using the Internet Small Computer System Interface (iSCSI) Protocol,” RFC 4173, September 2005 (TXT).
[RFC4578]	Johnston, M. and S. Venaas, “Dynamic Host Configuration Protocol (DHCP) Options for the Intel Preboot eXecution Environment (PXE),” RFC 4578, November 2006 (TXT).
[RFC5226]	Narten, T. and H. Alvestrand, “Guidelines for Writing an IANA Considerations Section in RFCs,” BCP 26, RFC 5226, May 2008 (TXT).
[UEFI23]	UEFI Forum, “Unified Extensible Firmware Interface Specification, Version 2.3,” May 2009.

9.2. Informative References

TOC

[RFC1350]	Sollins, K., "The TFTP Protocol (Revision 2)," STD 33, RFC 1350, July 1992 (TXT).
[RFC2616]	Fielding, R., Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and T. Berners-Lee, "Hypertext Transfer Protocol -- HTTP/1.1," RFC 2616, June 1999 (TXT, PS, PDF, HTML, XML).
[RFC2817]	Khare, R. and S. Lawrence, "Upgrading to TLS Within HTTP/1.1," RFC 2817, May 2000 (TXT).
[RFC2818]	Rescorla, E., "HTTP Over TLS," RFC 2818, May 2000 (TXT).
[RFC3617]	Lear, E., "Uniform Resource Identifier (URI) Scheme and Applicability Statement for the Trivial File Transfer Protocol (TFTP)," RFC 3617, October 2003 (TXT).
[RFC906]	Finlayson, R., "Bootstrap Loading using TFTP," RFC 906, June 1984.

Authors' Addresses

TOC

	Thomas H. Huth
	IBM Germany Research & Development GmbH
	Schoenaicher Strasse 220
	Boeblingen 71032
	Germany
Phone:	+49-7031-16-2183
Email:	thuth@de.ibm.com
	Jens T. Freimann
	IBM Germany Research & Development GmbH
	Schoenaicher Strasse 220
	Boeblingen 71032
	Germany
Phone:	+49-7031-16-1122
Email:	jfrei@de.ibm.com
	Vincent Zimmer
	Intel
	2800 Center Drive
	DuPont WA 98327
	USA
Phone:	+1 253 371 5667
Email:	vincent.zimmer@intel.com
	Dave Thaler
	Microsoft

	One Microsoft Way
	Redmond WA 98052
	USA
Phone:	+1 425 703-8835
Email:	dthaler@microsoft.com