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DHCPv6 option for network boot
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Abstract

The Dynamic Host Configuration Protocol for IPv6 (DHCPv6) provides a framework for passing configuration information to nodes on a network. This document describes a new option for DHCPv6 to convey information, required for network booting, to the nodes.

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1. Introduction

Network booting means that a node which should be booted fetches the files required for booting via its network device from a server. Network booting is, for example, very useful in environments where the administrators have to maintain a large number of nodes. Since all boot and configuration files are stored on a central server, the maintenance of all nodes can be kept simple this way.

A typical boot file would be, for example, an operating system kernel or a boot loader program. To be able to download such a file, the firmware (BIOS) running on the client node must be provided with information such as: the server on which the boot files can be found, the protocol to be used for the download (for example TFTP [RFC1350]) and the name of the boot file. Since some kernels or boot loaders need to be provided with additional parameters, there should also be the possibility to pass additional parameters along with the server address, the protocol and the file name.

DHCPv6 allows client nodes to ask a DHCPv6 server for configuration parameters. Contrary to its IPv4 predecessor, DHCPv6 does not define a way to query network boot options such as the IPv6 address of a boot file server and boot file names. Therefore this document defines a new DHCPv6 option which is required for network booting clients.

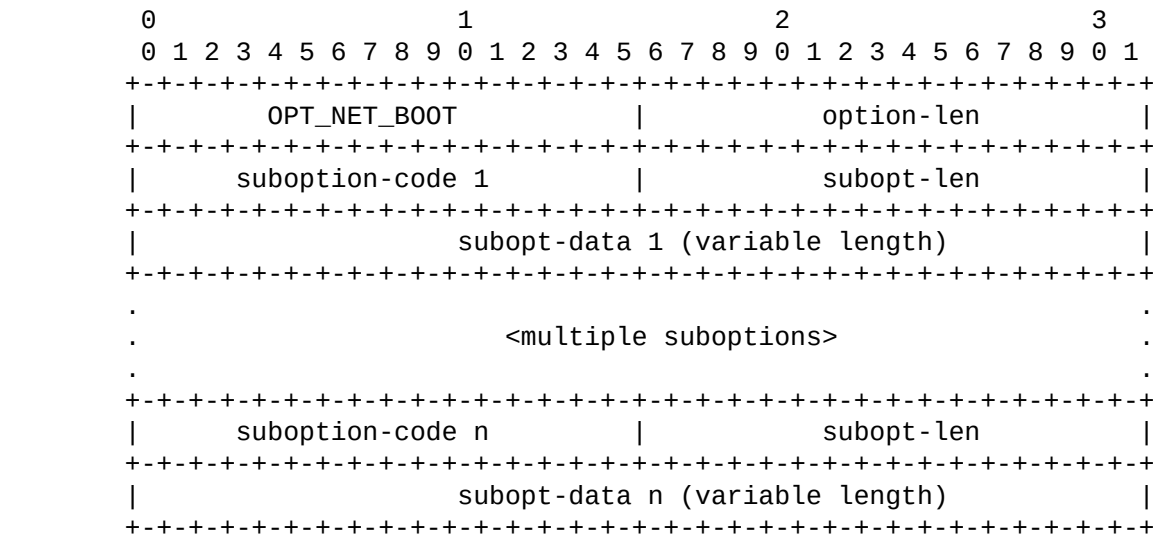
2. Conventions

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 [RFC2119].

Terminology specific to IPv6 and DHCPv6 are used in the same way as defined in the "Terminology" sections of RFC 3315 [RFC3315].

3. Netboot option format

The netboot option is used as an encapsulation for suboptions which carry the actual information needed to boot a client. This option will be used by clients to request boot information from a server.



option-code OPT_NET_BOOT (tbd).

option-len Length of the netboot option in octets.

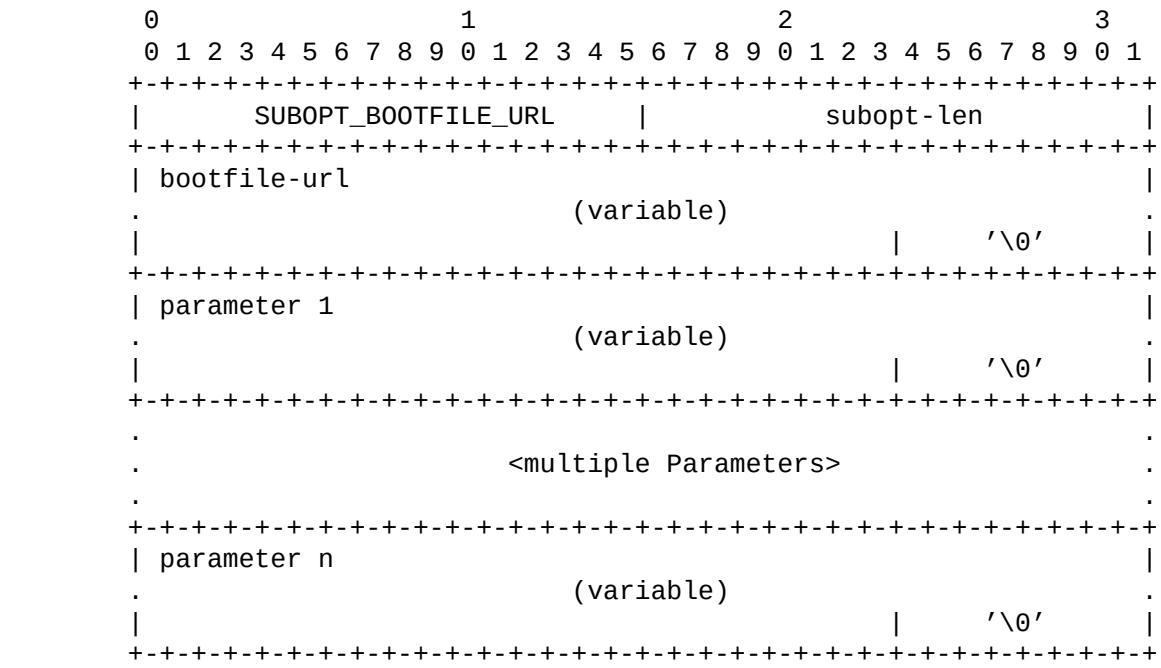
Multiple occurences of each suboption-type can occur within a netboot option (for example when more than one boot server is available). Clients MUST process the suboptions in the order in which they appear in the message sent by the server.

So far, only one suboption has been defined, SUBOPT_BOOTFILE_URL, which is described in Section 4. Other suboptions might be defined in future RFCs.

4. Suboption: boot file Uniform Resource Locator (URL)

This suboption consists of multiple null-terminated strings. It is used to convey an URL to a boot file together with additional parameters for the boot file (e.g. parameters for the kernel or boot loader program).

Since multiple occurrences of SUBOPT_BOOTFILE_URL can be present in a single OPT_NETBOOT message, clients MUST process them in the order in which they appear within the message. For example in the case of a boot file URL the first file should be downloaded and executed. In case of a failure the process should continue with the second one and so on.



Format description:

suboption-code SUBOPT_BOOTFILE_URL (tbd).

suboption-len Length of the bootfile suboption in octets.

bootfile-url This NULL-terminated ASCII string is the URL (conforming to [RFC2396]) to a boot file. This string starts with the protocol which is used for downloading. Separated by '://', the hostname or IPv6 address of the server hosting the boot file (see also the note below), the path, file name and query parts of the URL follow.

parameters 1...n These NULL-terminated ASCII strings are parameters needed for booting, e.g. kernel parameters. In cases where no parameters are needed, everything but the boot file URL can be omitted. Parameters following the boot file name should be directly related to the boot file (kernel) itself.

Note about the bootfile-url: This string can either contain a hostname or an IPv6 address to specify the server where the boot file should be downloaded from. All clients which implement support for the SUBOPT_BOOTFILE_URL suboption MUST be able to handle IPv6 addresses here. The IPv6 address in the URL then MUST be enclosed in

"[" and "]" characters, conforming to [RFC2732]. Clients SHOULD also be able to handle hostnames in the URLs. However, in this case the firmware implementation on the client machine must support DNS, too. Due to size limitations, this might not be possible in all firmware implementations, so support for hostnames in the URLs is only optional.

5. Appearance of these options

The netboot option MUST NOT appear in DHCPv6 messages other than the types Solicit, Advertise, Request, Renew, Rebind, Information-Request and Reply.

The number of the netboot option MAY appear in the Option Request Option in the DHCPv6 message types Solicit, Request, Renew, Rebind, Information-Request and Reconfigure.

The bootfile suboption MUST appear only in the netboot option.

6. Boot protocol considerations

RFC 906 [RFC906] suggests to use TFTP for bootstrap loading. Because it is easy to implement this protocol in firmware (where one has to deal with size and complexity constraints), this is still the recommended protocol for network booting, so every firmware implementation SHOULD at least support this protocol. The boot file URLs then must be specified according to RFC 3617 [RFC3617].

In some cases however, it might also be useful to use other protocols like FTP or HTTP for network booting, so a firmware implementation can support these protocols, too. Then it is up to the network administrator to choose the appropriate boot protocol for the network, and to specify the right boot file URLs in the DHCPv6 configuration file.

7. IANA considerations

The following options need to be assigned by the IANA from the option number space defined in the chapter 22 of the DHCPv6 RFC [RFC3315].

Option name	Value	Specified in
OPT_NET_BOOT	tbd	Section 3

| SUBOPT_BOOTFILE_URL | tbd | Section 4 |
+---------------------+-------+--------------+

8. Security considerations

The new DHCPv6 option described in this document could be sent in untrusted networks by malicious people with a fake DHCPv6 server to confuse the booting clients. The clients could be provided with a wrong URL so that the boot either 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 RFC 3315 [RFC3315]).

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.

9. Acknowledgements

The authors would like to thank Ketan P. Pancholi for corrections and suggestions.

Vijayabhaskar Kalusivalingam and Senthil Balasubramanian published a similar draft for IPv6 network booting some years ago (available at http://tools.ietf.org/html/draft-ietf-dhc-dhcpv6-opt-rboot-00), which however was abandoned for unknown reasons.

10. References

10.1. Normative References

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[RFC2396] Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifiers (URI): Generic Syntax", RFC 2396, August 1998.

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[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.

[RFC3617] Lear, E., "Uniform Resource Identifier (URI) Scheme and Applicability Statement for the Trivial File Transfer Protocol (TFTP)", RFC 3617, October 2003.

10.2. Informative References

[RFC1350] Sollins, K., "The TFTP Protocol (Revision 2)", STD 33, RFC 1350, July 1992.

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