             Dynamic Host Configuration Protocol (DHCP) Options for the
                  Intel Preboot eXecution Environment (PXE)

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Abstract

   We define Dynamic Host Configuration Protocol (DHCP) options being
   used by Preboot eXecution Environment (PXE) and Extensible Firmware
   Interface (EFI) clients to uniquely identify booting client machines
   and their pre-OS runtime environment so that the DHCP and/or PXE boot
   server can return the correct OS bootstrap image (or pre-boot
   application) name and server to the client.

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1. Introduction

   These DHCP [2] options are being widely used by PXE-compliant clients
   to uniquely identify booting client machines themselves and their
   pre-OS runtime environment so that the DHCP and/or PXE boot server
   can return the correct OS bootstrap image (or pre-boot application)
   name and server to the client. In the past, this work was done by
   examining the network Media Access Code (MAC) address in the "chaddr"
   field in the BOOTP/ DHCP header and keeping a database of MAC
   addresses on the BOOTP/DHCP server. This was deemed insufficient for
   large and complex networks for two main reasons. 1) Multiple laptops
   could end up with the same MAC address if the network interface was
   in a shared docking station. 2) Multiple network devices and MAC
   addresses could be used by one machine for redundancy or because of
   repairs. Another issue that came up was the machine that could
   change its pre-OS runtime environment. This issue caused the
   creation of another new option to identify the runtime environment so
   that the correct binary image could be matched up with the booting
   machine. These options are defined by Intel in the PXE [3] and EFI
   [4] specifications and are being documented in this draft for
   completeness within the IETF.

1.1. Requirements Language

   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 [1].

2. Option Definitions

   There are three DHCP options [5] defined for use by PXE clients.

2.1. Client System Architecture Type Option Definition

   The format of the option is:

                Code Len 16-bit Type
               +----+-----+-----+-----+
               | 93 | n | n1 | n2 |
               +----+-----+-----+-----+

Octet "n" gives the number of octets containing "architecture types"
(not including the code and len fields). It MUST be an even number
greater than zero. Clients that support more than one architecture
type MAY include a list of these types in their initial DHCP and PXE
boot server packets. The list of supported architecture types MAY be
reduced in any packet exchange between the client and server(s).
Octets "n1" and "n2" encode a 16-bit architecture type identifier
that describes the pre-boot runtime environment(s) of the client
machine.

As of the writing of this document, the following pre-boot
architecture types have been requested.

```
        Type    Architecture Name
        ----    -----------------
         0      Intel x86PC
         1      NEC/PC98
         2      EFI Itanium
         3      DEC Alpha
         4      Arc x86
         5      Intel Lean Client
         6      EFI IA32
         7      EFI BC
         8      EFI Xscale
         9      EFI x86-64
```

This option MUST be present in all DHCP and PXE packets sent by PXE-
compliant clients and servers.

2.2. Client Network Interface Identifier Option Definition

The format of the option is:

```
          Code  Len  Type Major Minor
         +----+-----+----+-----+-----+
         | 94 |  3  | t  |  M  |  m  |
         +----+-----+----+-----+-----+
```

Octet "t" encodes a network interface type. For now the only
supported value is 1 for Universal Network Device Interface (UNDI).
Octets "M" and "m" describe the interface revision. To encode the
UNDI revision of 2.11, "M" would be set to 2, and "m" would be set to
11 (0x0B).

```
        Revision  Description
        --------  -----------
        < 2.00    LANDesk service agent boot ROMs.  No PXE APIs.

          2.00    First generation PXE boot ROMs.  (PXENV+) [3]

          2.01    Second generation PXE boot ROMs.  (!PXE)  [3]

          3.00    32/64-bit UNDI specification.    (Alpha)  [4]
                  EFI boot services driver only.
                  No EFI runtime support.

          3.10    32/64-bit UNDI specification.     (Beta)  [4]
                  First generation EFI runtime driver support.

          3.20    32/64-bit UNDI specification.  (Release)  [4]
                  Second generation EFI runtime driver support.
```

   This option MUST be present in all DHCP and PXE packets sent by PXE-
   compliant clients and servers.

2.3. Client Machine Identifier Option Definition

   The format of the option is:

```
              Code  Len  Type  Machine Identifier
             +----+-----+----+-----+ . . . +-----+
             | 97 |  n  | t  |     | . . . |     |
             +----+-----+----+-----+ . . . +-----+
```

   Octet "t" describes the type of the machine identifier in the
   remaining octets in this option. 0 (zero) is the only value defined
   for this octet at the present time, and it describes the remaining
   octets as a 16-octet Globally Unique Identifier (GUID). Octet "n" is
   17 for type 0. (One definition of GUID can be found in Appendix A of
   the EFI specification [4].)

   This option MUST be present in all DHCP and PXE packets sent by PXE-
   compliant clients and servers.

2.4. Options Requested by PXE Clients

   All compliant PXE clients MUST include a request for DHCP options 128
   through 135 in all DHCP and PXE packets. The format and contents of
   these options are NOT defined by the PXE specification. These
   options MAY be present in the DHCP and PXE boot server replies and
   are meant for use by the downloaded network bootstrap programs.
   These options are NOT used by the PXE boot ROMs.

As options 128-135 are not officially assigned for PXE use (before
November 2004 they were considered site-specific options, [6]), use
of these option values for PXE may conflict with other uses of the
same options on the same networks.

3. Acknowledgements

The authors thank Bernie Volz for valuable input.

4. IANA Considerations

IANA has updated the numbering space defined for public DHCP options
in [7] with references to this document for options 93, 94, and 97
(previously, there were references to [8]). Also, IANA marked
options 128-135 as being used by PXE and referenced this document.

5. Security Considerations

By specifying incorrect values for some of these options, a client
may get access to, and possibly attempt to execute, code intended for
another platform or client. This may have security ramifications.
Also note that these options contain information about a client's
system architecture and pre-OS runtime environment that is revealed
to anyone who is able to listen in on DHCP messages sent by the
client. This information may be of use to potential attackers.

6. Normative References

   [1]   Bradner, S., "Key words for use in RFCs to Indicate Requirement
         Levels", BCP 14, RFC 2119, March 1997.

   [2]   Droms, R., "Dynamic Host Configuration Protocol", RFC 2131,
         March 1997.

   [3]   Henry, M. and M. Johnston, "Preboot Execution Environment (PXE)
         Specification", September 1999,
         <http://www.pix.net/software/pxeboot/archive/pxespec.pdf>.

   [4]   Intel Corp., "Extensible Firmware Interface Specification",
         December 2002, <http://developer.intel.com/technology/efi/
         main_specification.htm>.

   [5]   Alexander, S. and R. Droms, "DHCP Options and BOOTP Vendor
         Extensions", RFC 2132, March 1997.

   [6]   Volz, B., "Reclassifying Dynamic Host Configuration Protocol
         version 4 (DHCPv4) Options", RFC 3942, November 2004.

   [7] Droms, R., "Procedures and IANA Guidelines for Definition of New
        DHCP Options and Message Types", BCP 43, RFC 2939, September
        2000.

   [8] Droms, R., "Unused Dynamic Host Configuration Protocol (DHCP)
        Option Codes", RFC 3679, January 2004.

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