UEFI HTTPBoot Server Setup

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1. Introduction

HTTPBoot has been added since UEFI SPEC 2.5, aiming to replace PXE and provide more features. In fact, the concept of HTTPBoot is similar to PXE. HTTP Boot combines DHCP, DNS, and HTTP. It starts from the HTTP URL of the DHCP server and uses the HTTP protocol to obtain data. In addition, HTTPBoot also supports DNS. Using DNS can quickly transfer large files such as the Linux kernel and root file system from a server outside the local network, while tftp (PXE) is only applicable to the local network. This chapter describes how to configure UEFI HTTPBoot and HTTPsBoot servers.

2. Preparation

- Server
  HTTPBoot The server must have at least the following packages installed: dhcp-server, httpd, and dnsmasq.


```
注意：本文使用centos7.6 作为server端OS，httpboot 引导使用的suse15p1 iso中shim (bootx64.efi)
IP 子网 192.168.0.0/26 (v4) 和 2001:db8:f00f:cafe::/64 (v6) 并假设服务器 IP 地址为 192.168.0.5(v4) 和 2001:db8:f00f:cafe::1/64 (v6)。如有冲突，请调整相关设置。
```

- Client
  enables HTTPBoot in the Client BIOS firmware. Please refer to the motherboard or machine manual to enable httpboot.

3. HTTPBOOT server configuration

3.1 DNS Configuration (Optional)

DNS is optional, but it is a good idea to give your server a well-known name. To set up a DNS server, add the following line to /etc/dnsmasq.conf


```sh
interface=eth0
addn-hosts=/etc/hosts.conf
```

Create a domain name mapping for IP addresses in /etc/hosts.conf


```sh
192.168.0.5 www.httpboot.local
2001:db8:f00f:cafe::1 www.httpboot.local
```

Start DNS server

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```
systemctl start dnsmasq
```

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```
NOTE: 由于 UEFI 2.7 中的更改，我们建议使用 suse15 或更高版本的 shim 引导加载程序，以避免额外的 DNS 节点导致的潜在错误。
```

3.2 DHCPv4 Service Configuration

3.2.1 Specifying the DHCP Service Network Interface

Specify the DHCP network interface in /etc/sysconfig/dhcpd and add the following content. This way, the DHCP server only provides services on the eth0 interface.

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```
DHCPD_INTERFACE="eth0"
DHCPD6_INTERFACE="eth0"
```

3.2.2 Modifying the DHCPv4 Configuration File

To set up a DHCPv4 server for PXE boot and HTTP boot, add the following configuration to the /etc/dhcp/dhcpd.conf file:

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```
option arch code 93 = unsigned integer 16;
option domain-name-servers 192.168.0.5;
default-lease-time 14400;
ddns-update-style none;

subnet 192.168.0.0 netmask 255.255.255.192 {
        range 192.168.0.40 192.168.0.60;
        option routers 192.168.0.39;
        next-server 192.168.0.5;
        default-lease-time 14400;
        max-lease-time 172800;

  class "pxeclients" {
    match if substring (option vendor-class-identifier, 0, 9) = "PXEClient";
    option vendor-class-identifier "PXEClient";
    next-server 192.168.0.5;
    if option arch = 00:07 or option arch = 00:09 {
            filename "/uefi/shim.efi";
            #filename "BOOTX64.efi";
    } else {
            filename "pxelinux.0";
    }
  }
  class "httpclients" {
    match if substring (option vendor-class-identifier, 0, 10) = "HTTPClient";
    option vendor-class-identifier "HTTPClient";
    filename "http://www.httpboot.local/httpboot/bootx64.efi";
    # filename "https://www.httpboot.local/httpboot/bootx64.efi";
    #if option arch = 00:10 {
    #       option vendor-class-identifier "HTTPClient";

```

```
    #       filename "http://www.httpboot.local/httpboot/bootx64.efi";
    #}

  }
}
```

收起 ^

NOTE: A DHCPv4 server MUST use the HTTPClient parameter as the vendor class ID because the client uses this parameter to identify the HTTP bootstrap service.

3.2.3 Start DHCPv4 Service

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```sh
systemctl start dhcpd
```

3.3 DHCPv6 Service Configuration

3.3.1 Modifying the DHCPv6 Configuration File

Please add the following configuration to /etc/dhcp/dhcpd6.conf:

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```
option dhcp6.bootfile-url code 59 = string;
option dhcp6.vendor-class code 16 = {integer 32, integer 16, string};
subnet6 2001:db8:f00f:cafe::/64 {
        range6 2001:db8:f00f:cafe::42:10 2001:db8:f00f:cafe::42:99;
        option dhcp6.bootfile-url "http://www.httpboot.local/httpboot/bootx64.efi";
        option dhcp6.name-servers 2001:db8:f00f:cafe::1;
        option dhcp6.vendor-class 0 10 "HTTPClient";
}
```

This configuration defines the type of boot URL, vendor class, and other required options. Similar to the DHCPv4 setup, a boot URL needs to be provided, which must have an IPv6 address. The vendor class option also needs to be specified. In DHCPv6, it consists of an enterprise number and vendor class data (length and content). Since the HTTP Boot driver ignores the enterprise number, it can be set to 0. The content of the vendor class data must be HTTPClient; otherwise, the client will ignore the proposal.

Older HTTP Boot implementations do not follow RFC 3315 and require different configuration:

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```
option dhcp6.bootfile-url code 59 = string;
option dhcp6.vendor-class code 16 = string;
        subnet6 2001:db8:f00f:cafe::/64 {
        range6 2001:db8:f00f:cafe::42:10 2001:db8:f00f:cafe::42:99;
        option dhcp6.bootfile-url "http://www.httpboot.local/httpboot/bootx64.efi";
        option dhcp6.name-servers 2001:db8:f00f:cafe::1;
        option dhcp6.vendor-class "HTTPClient";
}
```

3.3.2 Supporting both PXE boot and HTTP boot configuration

Using the following configuration, you can configure a DHCPv6 server for PXE boot and HTTP boot.

- Method 1

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```
# /etc/dhcp/dhcp6.conf
allow booting;
allow bootp;
option dhcp6.bootfile-url code 59 = string;
option dhcp6.client-arch-type code 61 = array of unsigned integer 16;
option dhcp6.vendor-class code 16 = {integer 32, integer 16, string};


subnet6 2001:db8:f00f:cafe::/64 {
        range6 2001:db8:f00f:cafe::42:10 2001:db8:f00f:cafe::42:99;
        option dhcp6.name-servers 2001:db8:f00f:cafe::1;
        option dhcp6.domain-search "httpboot.com";

  if option dhcp6.client-arch-type = 00:07 or option dhcp6.client-arch-type = 00:09 {
          option dhcp6.bootfile-url "tftp://[2001:db8:f00f:cafe::1]/uefi/shim.efi";
          #option dhcp6.bootfile-url "tftp://[2001:db8:f00f:cafe::1]/uefi/grubx64.efi";
  }
  else {
          option dhcp6.bootfile-url "tftp://[2001:db8:f00f:cafe::1]/pxelinux.0";
  }
  if option dhcp6.client-arch-type = 00:10 {
          option dhcp6.bootfile-url "http://www.httpboot.local/httpboot/bootx64.efi";
          #option dhcp6.bootfile-url "https://www.httpboot.local/httpboot/bootx64.efi";
          #option dhcp6.name-servers 2001:db8:f00f:cafe::1;
          option dhcp6.vendor-class 0 10 "HTTPClient";
  }
}
```

收起 ^

- Method 2

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```
# /etc/dhcp/dhcp6.conf
option dhcp6.bootfile-url code 59 = string;
option dhcp6.vendor-class code 16 = {integer 32, integer 16, string};

subnet6 2001:db8:f00f:cafe::/64 {
        range6 2001:db8:f00f:cafe::42:10 2001:db8:f00f:cafe::42:99;
        option dhcp6.name-servers 2001:db8:f00f:cafe::1;
        option dhcp6.domain-search "httpboot.com";

        class "PXEClient" {
            match substring (option dhcp6.vendor-class, 6, 9);
    }

        subclass "PXEClient" "PXEClient" {
            option dhcp6.bootfile-url "tftp://[2001:db8:f00f:cafe::1]/uefi/shim.efi";
            #option dhcp6.bootfile-url "tftp://[2001:db8:f00f:cafe::1]/uefi/grubx64.efi";
    }


```

```
    class "HTTPClient" {
            match substring (option dhcp6.vendor-class, 6, 10);
    }

    subclass "HTTPClient" "HTTPClient" {
            option dhcp6.bootfile-url "http://www.httpboot.local/httpboot/bootx64.efi";
            #option dhcp6.bootfile-url "https://www.httpboot.local/httpboot/bootx64.efi";
            #option dhcp6.name-servers 2001:db8:f00f:cafe::1;
            option dhcp6.vendor-class 0 10 "HTTPClient";
    }
}
```

收起 ^

It can also further match the vendor level of different architectures.

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```sh
class "HTTPClient" {
        match substring (option dhcp6.vendor-class, 6, 21);
    }

subclass "HTTPClient" "HTTPClient:Arch:00016" {
        option dhcp6.bootfile-url "http://www.httpboot.local/httpboot/bootx64.efi";
        #option dhcp6.bootfile-url "https://www.httpboot.local/httpboot/bootx64.efi";
        option dhcp6.name-servers 2001:db8:f00f:cafe::1;
        option dhcp6.vendor-class 0 10 "HTTPClient";
}
```

收起 ^

In the example, "HTTPClient:Arch:00016" refers to the x86_64 HTTPBoot client. This configuration allows the server to serve different architectures at the same time.
Reference: https://www.mail-archive.com/edk2-devel@lists.01.org/msg14683.html

3.3.3 Start the DHCPv6 service.

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```sh
systemctl start dhcpd6
```

3.4 Firewall Configuration

If DHCPv6 packets are dropped by the RP filter in the firewall, check its log. If it contains the rpfilter_DROP entry, disable the filter using the following configuration in /etc/firewalld/firewalld.conf:

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```sh
IPv6_rpfilter=no
```

3.5 TFTP service configuration (optional)

If you need to support PXE, you need a tftp server, and copy the BootLoader, pxeboot vmlinuz, and initrd required for booting to the tftp shared directory.

3.5.1 Installing the tftp package

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```sh
yum install tftp-server xinetd
```

3.5.2 Modify the tftp configuration file

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```sh
vim /etc/xinetd.d/tftp

# default: off
# description: The tftp server serves files using the trivial file transfer \
#       protocol.  The tftp protocol is often used to boot diskless \
#       workstations, download configuration files to network-aware printers, \
#       and to start the installation process for some operating systems.
service tftp
{
        socket_type             = dgram
        protocol                = udp
        wait                    = yes
        user                    = root
        server                  = /usr/sbin/in.tftpd
        server_args             = -s /var/lib/tftpboot # tftp 目录
        disable                 = no  # 开启tftp只需要改为no
        per_source              = 11
        cps                     = 100 2
        flags                   = IPv4
}
```

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TFTP is managed by the super daemon xinetd, so after setting up TFTP, xinetd should be started;

3.5.3 Start tftp service

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```sh
systemctl restart tftp
systemctl enable tftp
systemctl restart xinetd
systemctl enable xinetd
```

3.5.4 Service Verification

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```sh
netstat -untlp | grep :69
udp        0      0 0.0.0.0:69              0.0.0.0:*                           6857/xinetd
```

3.6 http service configuration

3.6.1 Installing http

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```
```sh
yum install httpd
```
```

```
```

3.6.2 Enable http service

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```sh
systemctl restart httpd
systemctl enable httpd
```

3.7 System Image Copy

Copy the entire contents of the system ISO image to the /var/www/html/pxeimg directory.

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```
[root@server ~]# mount -o loop CentOS-7.6-x86_64-DVD-1810.iso /mnt
mount: /dev/loop0 is write-protected, mounting read-only
[root@server ~]# cp -fr /mnt/* /var/www/html/pxeimg/centos/7.6/os/x86_64/
[root@server ~]# mount -o loop SLE-15-SP1-Full-x86_64-GM-Media1.iso /mnt
mount: /dev/loop0 is write-protected, mounting read-only
[root@server ~]# cp -fr /mnt/* /pxeimg/15sp1/
[root@server ~]# cd /var/www/html
[root@server html]# tree -L 2  pxeimg
pxeimg
├── 15sp1
│   ├── ARCHIVES.gz
│   ├── boot
│   ├── CD2
│   ├── ChangeLog
│   ├── CHECKSUMS
│   ├── CHECKSUMS.asc
│   ├── COPYRIGHT
│   ├── COPYRIGHT.de
│   ├── docu
│   ├── EFI
twen│   ├── gpg-pubkey-307e3d54-5aaa90a5.asc
twen│   ├── gpg-pubkey-39db7c82-5847eb1f.asc
twen│   ├── gpg-pubkey-50a3dd1c-50f35137.asc
twen│   ├── INDEX.gz
│   ├── ls-lR.gz
│   ├── media.1
│   ├── noarch
│   ├── README
│   ├── repodata
│   ├── suse_ptf_key.asc
│   └── x86_64
└── centos
    └── 7.6
```

收起 ^

3.8 BootLoader File Preparation

The httpboot BootLoader used in this article is extracted from the suse15p1 iso. Mount the suse15p1 iso and copy EFI/BOOT/* to the /var/www/html/httpboot/ directory.

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```
[root@server ~]# cp /var/www/html
[root@server html]# mkdir httpboot
[root@server html]# cp /var/www/html/pxeimg/15sp1/EFI/BOOT/* /var/www/html/httpboot/
[root@server html]# tree httpboot/
httpboot/
├── bootx64.efi
├── grub.cfg
├── grub.efi
├── locale
│   └── en.mo
└── MokManager.efi
```

收起 ^

3.9 Boot menu grub.cfg configuration

- grub.cfg file configuration

sh AI generated projects 登录复制

```
[root@server ~]# vim /var/www/html/htttboot/grub.cfg
timeout=60
default=1

################################## IPv4 ######################################################
menuentry 'Installation suse15p1 via httpboot[ipv4]' --class opensuse --class gnu-linux --class gnu --class os {
  set gfxpayload=keep
  echo 'Loading kernel ...'
  linuxefi /pxeimg/15sp1/boot/x86_64/loader/linux install=http://www.httpboot.local/pxeimg/15sp1
  echo 'Loading initial ramdisk ...'
  initrdefi /pxeimg/15sp1/boot/x86_64/loader/initrd
}

menuentry 'Installation centos7.6 via httpboot[ipv4]' --class opensuse --class gnu-linux --class gnu --class os {
  set gfxpayload=keep
  echo 'Loading kernel ...'
  linuxefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/vmlinuz repo=http://www.httpboot.local/pxeimg/centos/7.6/os/x86_64 ip=dhcp dhcptimeout=300
  echo 'Loading initial ramdisk ...'
  initrdefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/initrd.img
}
twen
twen  ################################## IPv6 ######################################################
twen  menuentry 'Installation suse15p1 via httpboot[ipv6]' --class opensuse --class gnu-linux --class gnu --class os {
twen    set gfxpayload=keep
  25    echo 'Loading kernel ...'
  26    linuxefi /pxeimg/15sp1/boot/x86_64/loader/linux install=http://www.httpboot.local/pxeimg/15sp1 ipv6only=1 ifcfg=*=dhcp6,DHCLIENT6_MODE=managed
  27    echo 'Loading initial ramdisk ...'
  28    initrdefi /pxeimg/15sp1/boot/x86_64/loader/initrd
  29  }
  30
  31  menuentry 'Installation centos7.6 via httpboot[ipv6]' --class opensuse --class gnu-linux --class gnu --class os {
  32    set gfxpayload=keep
  33    echo 'Loading kernel ...'
```

```
    linuxefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/vmlinuz repo=http://www.httpboot.local/pxeimg/centos/7.6/os/x86_64 ip=dhcp6
    echo 'Loading initial ramdisk ...'
    initrdefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/initrd.img
}
```

收起 ^

4. HTTPs service configuration (Optional)

The TLS protocol has been included since UEFISpec 2.5. This section provides information about setting up an environment deployment for UEFI HTTP over TLS (HTTPS) boot.

4.1 Install dependency packages

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```
# yum install mod_ssl openssl
```

4.2 Create a certificate

sh AI generated projects 登录复制

```
# openssl req -newkey rsa:4096 -nodes -keyout server.key -x509 -days 365 -out server.crt
Generating a 4096 bit RSA private key
.....................................++
.............................................++
writing new private key to 'server.key'
-----
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [XX]:CN
State or Province Name (full name) []:shanghai
Locality Name (eg, city) [Default City]:SH
Organization Name (eg, company) [Default Company Ltd]:IEC
Organizational Unit Name (eg, section) []:FAE
Common Name (eg, your name or your server's hostname) []:*.httpboot.local
Email Address []:
```

收起 ^

Since we choose " *.httpboot.local" as the domain name, use "* .httpboot.local" as the "Common Name".

Convert the certificate to DER format for the client:

sh AI generated projects 登录复制

```
openssl x509 -in server.crt -outform der -out server.der
```

4.3 Modify ssl.conf

sh AI generated projects 登录复制

```sh
# vim -n /etc/httpd/conf.d/ssl.conf
60 ServerName www.httpboot.local:443 #Edit ServerName
 ...
100 SSLCertificateFile /etc/pki/tls/certs/server.crt #change the private key
107 SSLCertificateKeyFile /etc/pki/tls/private/server.key #change the certificate
```

4.4 Copy the certificate to the directory corresponding to the path in the configuration file

sh AI generated projects 登录复制

```sh
# cp server.crt /etc/pki/tls/crets/
# cp server.key /etc/pki/tls/private/
```

4.5 Restart Apache service

sh AI generated projects 登录复制

```sh
# systemctl restart httpd
```

4.6 Modify the DHCP configuration file

Replace the "http://" prefix in dhcpd.conf/dhcpd6.conf with "https://", and then restart the dhcp server.

sh AI generated projects 登录复制

```sh
# sed -i "s/http/https/g" /etc/dhcp/dhcpd.conf
# sed -i "s/http/https/g" /etc/dhcp/dhcpd.conf
# systemctl restart dhcpd
# systemctl restart dhcpd6
```

4.7 Modify the grub.cfg configuration file

Replace the "http://" prefix in grub.conf with "https://" and restart the dhcp server.
Since we created a self-signed certificate for the HTTPS server, if we specify the HTTPS url in grub.cfg, the installation system may not be able to verify the certificate and refuse to download files from our HTTPS server.
You can try to solve this problem with the following solution:

1. Add ssl.certs=0 to disable certificate verification. For example:
   `linuxefi /pxeimg/15sp1/boot/x86_64/loader/linux install=http://www.httpboot.local/pxeimg/15sp1 ssl.certs=0`

sh AI generated projects 登录复制

```sh
# /var/www/html/httpboot/grub.cfg
  menuentry 'Installation suse15p1 via httpsboot[ipv4]' --class opensuse --class gnu-linux --class gnu --class os {
    set gfxpayload=keep
    echo 'Loading kernel ...'
    linuxefi /pxeimg/15sp1/boot/x86_64/loader/linux install=http://www.httpboot.local/pxeimg/15sp1  ssl.certs=0
    echo 'Loading initial ramdisk ...'
    initrdefi /pxeimg/15sp1/boot/x86_64/loader/initrd
  }

  menuentry 'Installation centos7.6 via httpsboot[ipv4]' --class opensuse --class gnu-linux --class gnu --class os {
    set gfxpayload=keep
    echo 'Loading kernel ...'
```

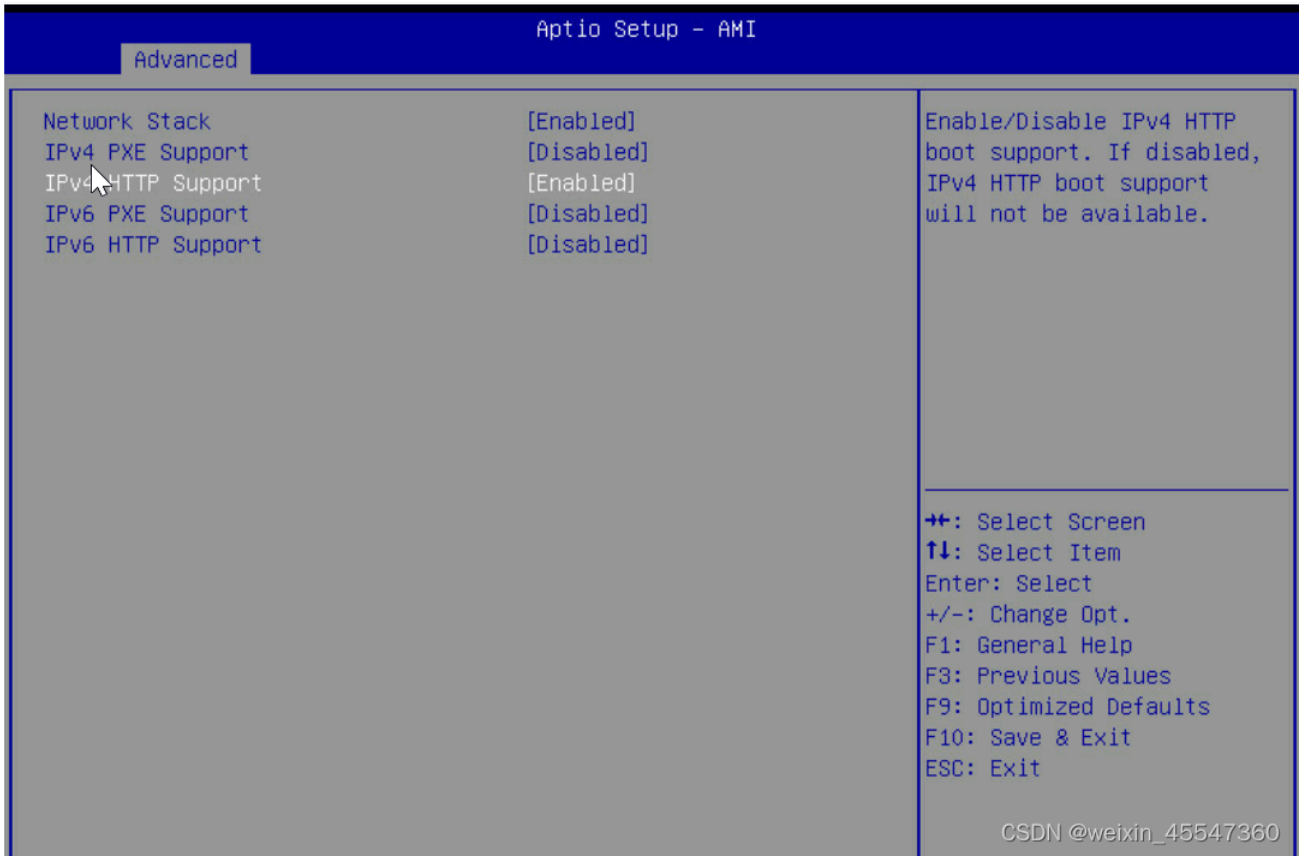
```
    linuxefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/vmlinuz repo=http://www.httpboot.local/pxeimg/centos/7.6/os/x86_64 ip=dhcp dhcptimeout=300  ssl.certs=0
    echo 'Loading initial ramdisk ...'
    initrdefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/initrd.img
}

menuentry 'Installation suse15p1 via httpsboot[ipv6]' --class opensuse --class gnu-linux --class gnu --class os {
    set gfxpayload=keep
    echo 'Loading kernel ...'
    linuxefi /pxeimg/15sp1/boot/x86_64/loader/linux install=http://www.httpboot.local/pxeimg/15sp1 ipv6only=1 ifcfg=*=dhcp6,DHCLIENT6_MODE=managed ssl.certs=0
    echo 'Loading initial ramdisk ...'
    initrdefi /pxeimg/15sp1/boot/x86_64/loader/initrd
}

menuentry 'Installation centos7.6 via httpsboot[ipv6]' --class opensuse --class gnu-linux --class gnu --class os {
    set gfxpayload=keep
    echo 'Loading kernel ...'
    linuxefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/vmlinuz repo=http://www.httpboot.local/pxeimg/centos/7.6/os/x86_64 ip=dhcp6 ssl.certs=0
    echo 'Loading initial ramdisk ...'
    initrdefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/initrd.img
}
```

收起 ^

4.7 Registering the server certificate to the client firmware

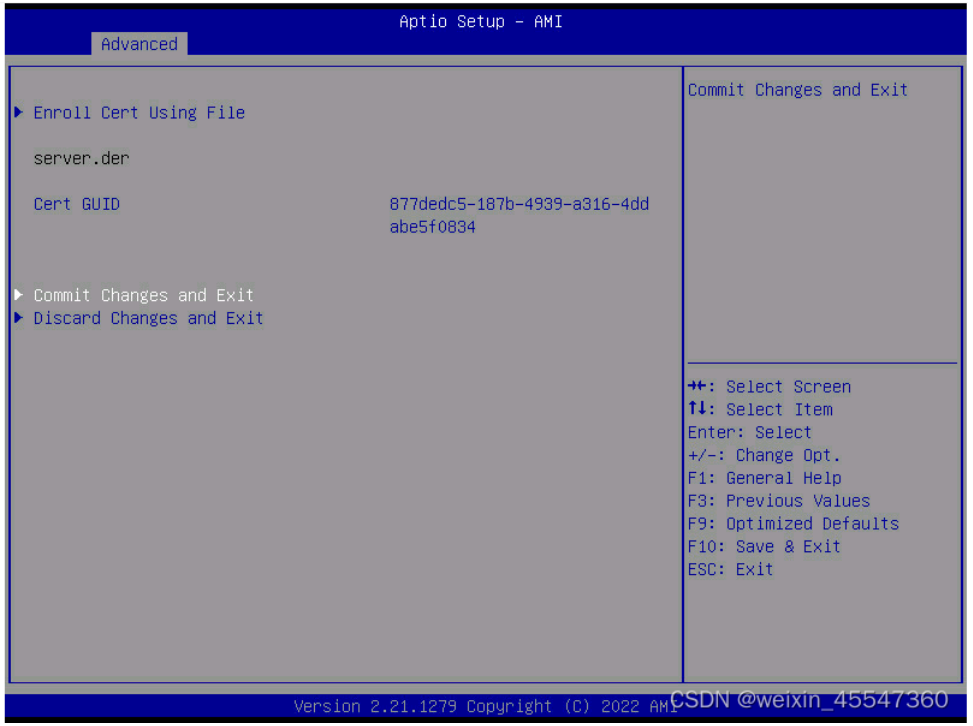
Before booting with HTTPS, you must register the server certificate (server.der) on the client, otherwise the client will not be able to connect to the server.
To register the server certificate to the physical machine, you can manually register it by inserting the USB drive containing the certificate file and then entering the BIOS Setup page. Some products can support remote registration of certificates via Redfish. For more information on registering certificates, refer to the documentation of the specific hardware. The following steps are for reference only.

1. Copy the server.crt certificate to a USB drive and connect the USB drive to the SUT
2. Enter BIOS Setup Enabled httpboot and save and reboot



3. After rebooting, enter BIOS Setup again to import the certificate:
   In BIOSsetup: Advanced ->TIs Auth Configuration -> Server CA Configuration, select Enroll Cert and Enrol Cert Using File

4. Enter the cert guid and select "Commit Changes and Exit"



Note: https://www.guidgenerator.com/online-guid-generator.aspx can be used to generate random guid.

6. Go to the “Save & Exit” page and select “Save Changes and Reset”.

7. After restarting, press F12 and select boot from networking.

5. KickStart automatic installation configuration

5.1 Kickstart file creation

Omitted, please refer to the Kickstart configuration section in the same series of articles " PXE Server Setup "

Copy the created kickstart file to the http server directory /var/www/html/kickstart and name it "osname-ver-ks.cfg", such as centos-7.6-ks.cfg

5.2 grub.cfg menu update

sh AI generated projects 登录复制

```sh
[root@server ~]# vim /var/www/html/htttboot/grub.cfg
timeout=60
default=1

################################## IPv4 ################################################
menuentry 'Installation suse15p1 via httpboot[ipv4]' --class opensuse --class gnu-linux --class gnu --class os {
  set gfxpayload=keep
  echo 'Loading kernel ...'
  linuxefi /pxeimg/15sp1/boot/x86_64/loader/linux install=http://192.168.0.5/pxeimg/15sp1
  echo 'Loading initial ramdisk ...'
```

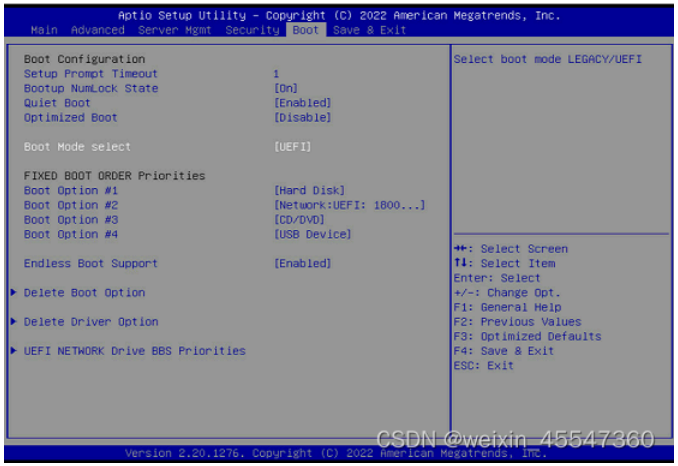
```
  initrdefi /pxeimg/15sp1/boot/x86_64/loader/initrd
}

menuentry 'Installation centos7.6 httpboot[ipv4]' --class opensuse --class gnu-linux --class gnu --class os {
  set gfxpayload=keep
  echo 'Loading kernel ...'
  linuxefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/vmlinuz ks=http://www.httpboot.local/kickstart/centos-7.6-ks.cfg ip=dhcp dhcptimeout=300
  echo 'Loading initial ramdisk ...'
  initrdefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/initrd.img
}

################################## IPv6 ##################################################
menuentry 'Installation suse15p1 via httpboot[ipv6]' --class opensuse --class gnu-linux --class gnu --class os {
  set gfxpayload=keep
  echo 'Loading kernel ...'
  linuxefi /pxeimg/15sp1/boot/x86_64/loader/linux install=http://[2001:db8:ffff:100::10]/pxeimg/15sp1 ipv6only=1 ifcfg=*=dhcp6,DHCLIENT6_MODE=managed
  echo 'Loading initial ramdisk ...'
  initrdefi /pxeimg/15sp1/boot/x86_64/loader/initrd
}

menuentry 'Installation centos7.6 via httpboot[ipv6]' --class opensuse --class gnu-linux --class gnu --class os {
  set gfxpayload=keep
  echo 'Loading kernel ...'
  linuxefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/vmlinuz ks=http://www.httpboot.local/kickstart/centos-7.6-ks.cfg  ip=dhcp6
  echo 'Loading initial ramdisk ...'
  initrdefi /pxeimg/centos/7.6/os/x86_64/images/pxeboot/initrd.img
}

```

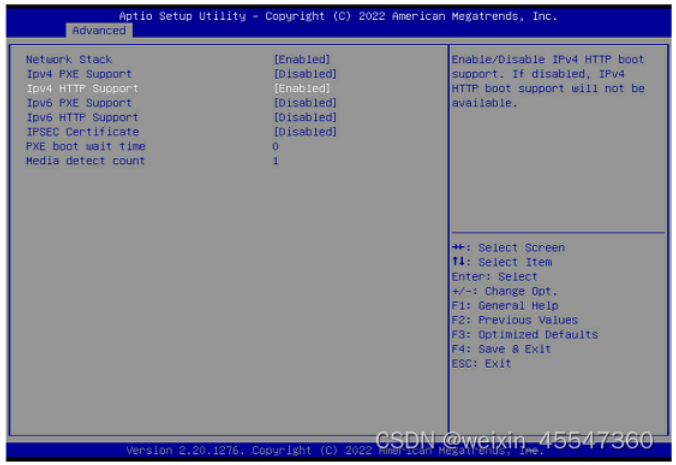
收起 ^

6. Testing

6.1 IPV4 httpboot test

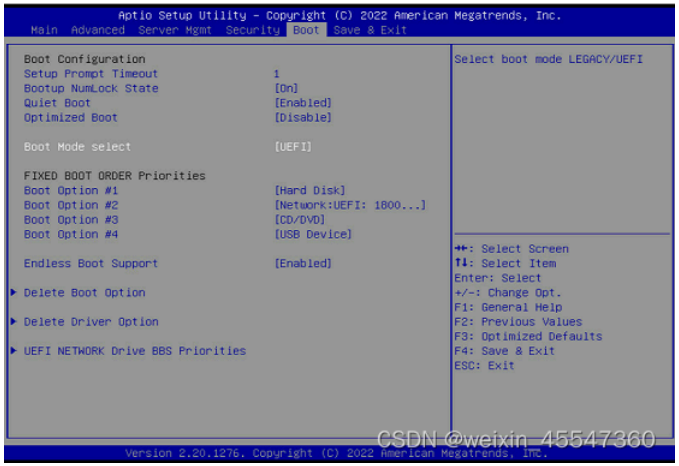
- UEFI httpboot

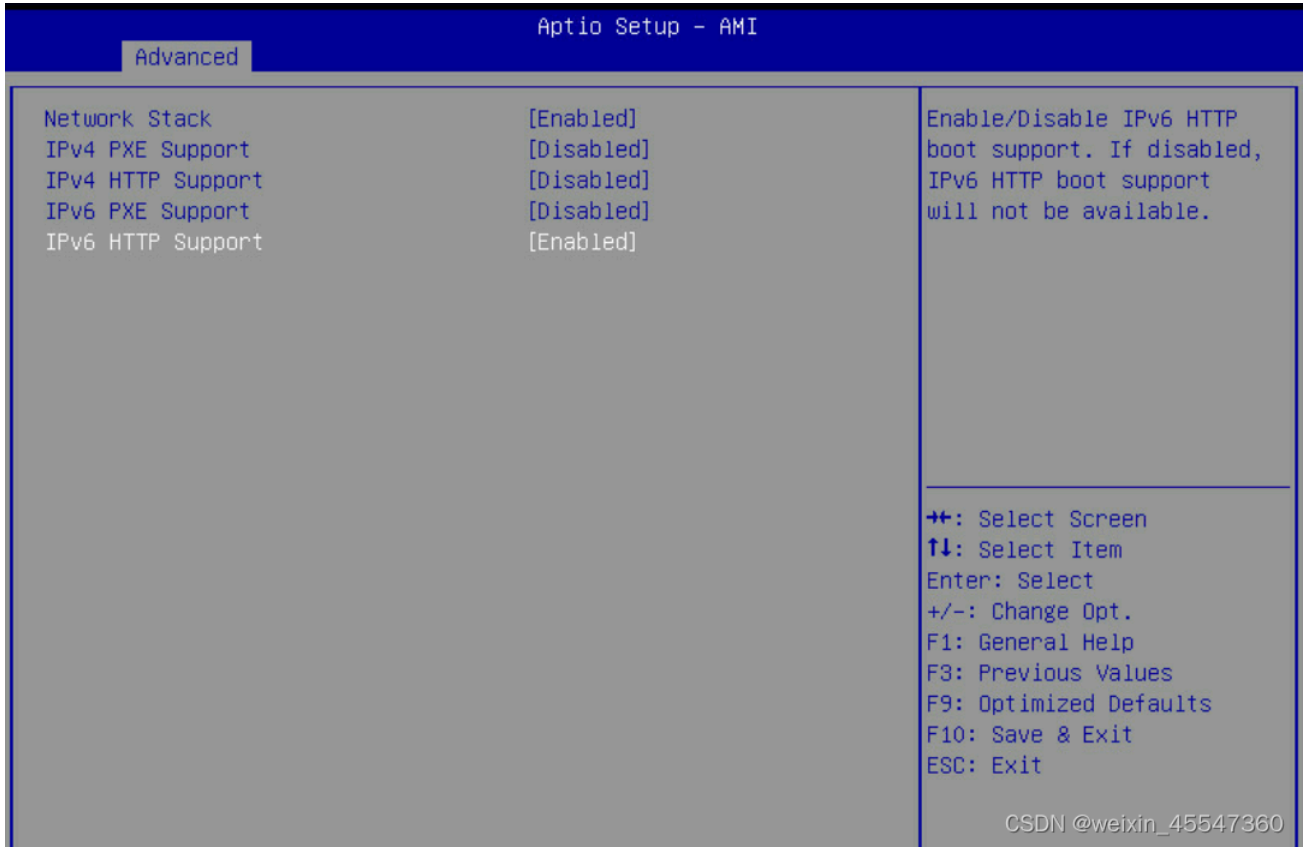




6.2 IPV6 httpboot test

- UEFI httpboot




Aptio Setup - AMI
Advanced
Network Stack [Enabled]
IPv4 PXE Support [Disabled]
IPv4 HTTP Support [Disabled]
IPv6 PXE Support [Disabled]
IPv6 HTTP Support [Enabled]
Enable/Disable IPv6 HTTP boot support. If disabled, IPv6 HTTP boot support will not be available.
→←: Select Screen
↑↓: Select Item
Enter: Select
+/-: Change Opt.
F1: General Help
F3: Previous Values
F9: Optimized Defaults
F10: Save & Exit
ESC: Exit
CSDN @weixin_45547360

7. References

https://en.opensuse.org/UEFI_HTTPBoot_Server_Setup
https://documentation.suse.com/sles/15-SP2/html/SLES-all/cha-deployment-prep-uefi-httpboot.html
https://lenovopress.lenovo.com/lp1584.pdf
https://lenovopress.lenovo.com/lp0736.dpf