

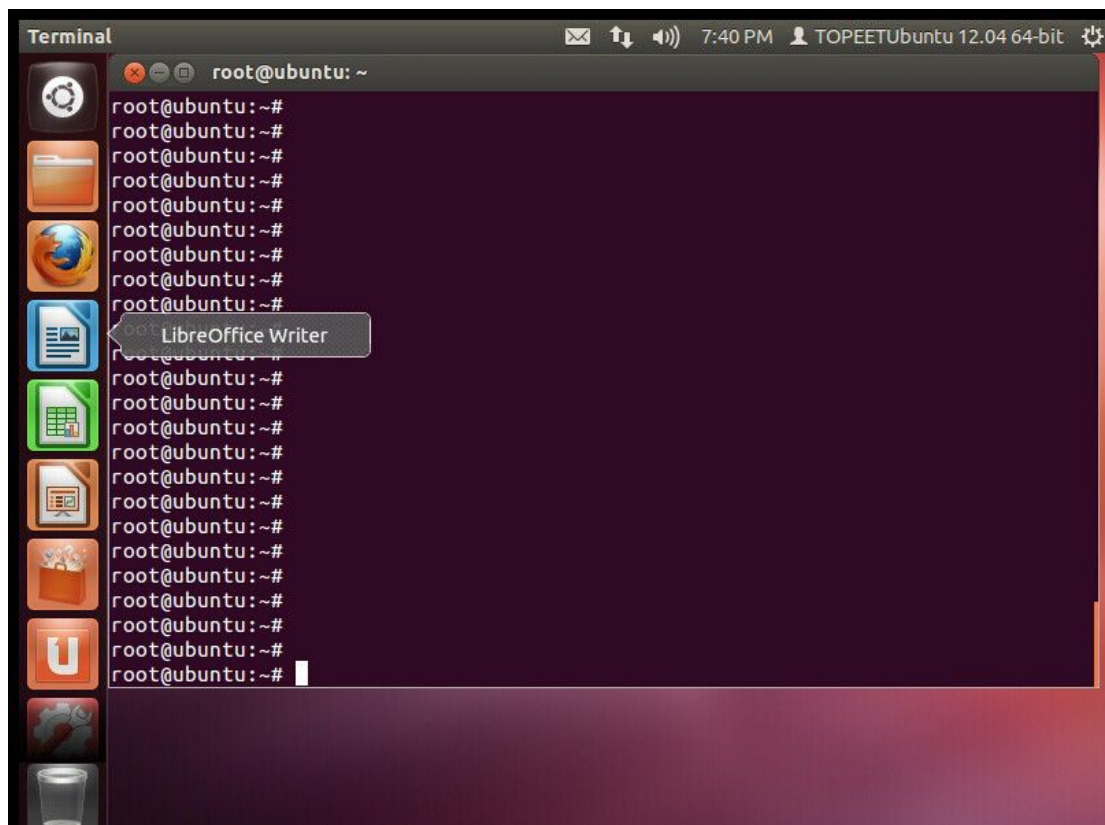
## iTOP-4412 实现 TFTP 文件传输

在前面的视频中我们讲了控制 led 的程序的实现，需要把编译好的 led 可执行文件拷贝到文件系统里面，然后用 `make_ext4fs` 命令重新制作 `system.img` 文件系统，然后再烧写到 iTOP-4412 开发板，然后再运行 led 可执行文件。这种方式的缺点是每次修改了应用程序，都需要重新制作文件系统，在重新烧写文件系统，效率很低。这一章我们讲解如何通过 TFTP 来实现在线调试应用程序。

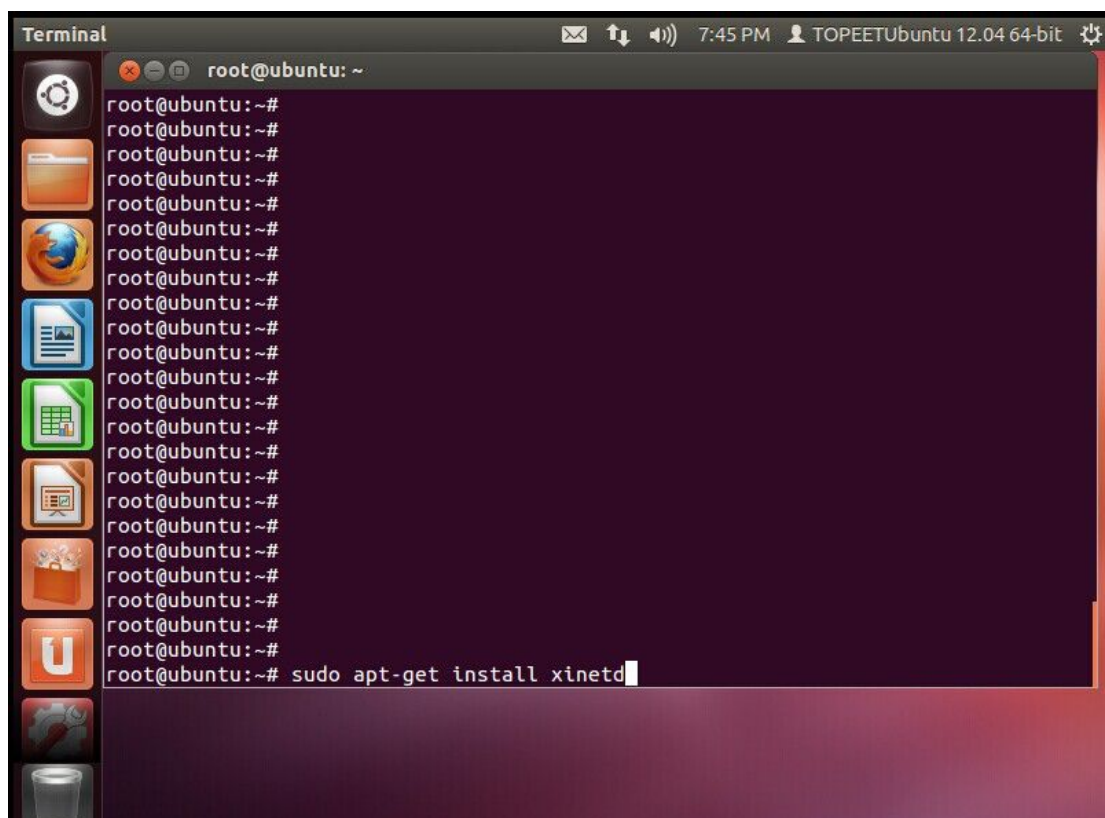
TFTP ( Trivial File Transfer Protocol，简单文件传输协议 )，是一个基于 UDP 协议实现的用于在客户机和服务器之间进行简单文件传输的协议，适合于开销不大、不复杂的应用场合。TFTP 协议专门为小文件传输而设计，只能从服务器上获取文件，或者向服务器写入文件，不能列出目录，也不能进行认证。

根据上面关于 TFTP 的介绍，实现 TFTP 我们需要搭建一个 TFTP 的服务器，iTOP-4412 开发板当做客户端。使用我们的虚拟机 Ubuntu 来当做服务器，下面我们先讲解一下服务器端的配置。

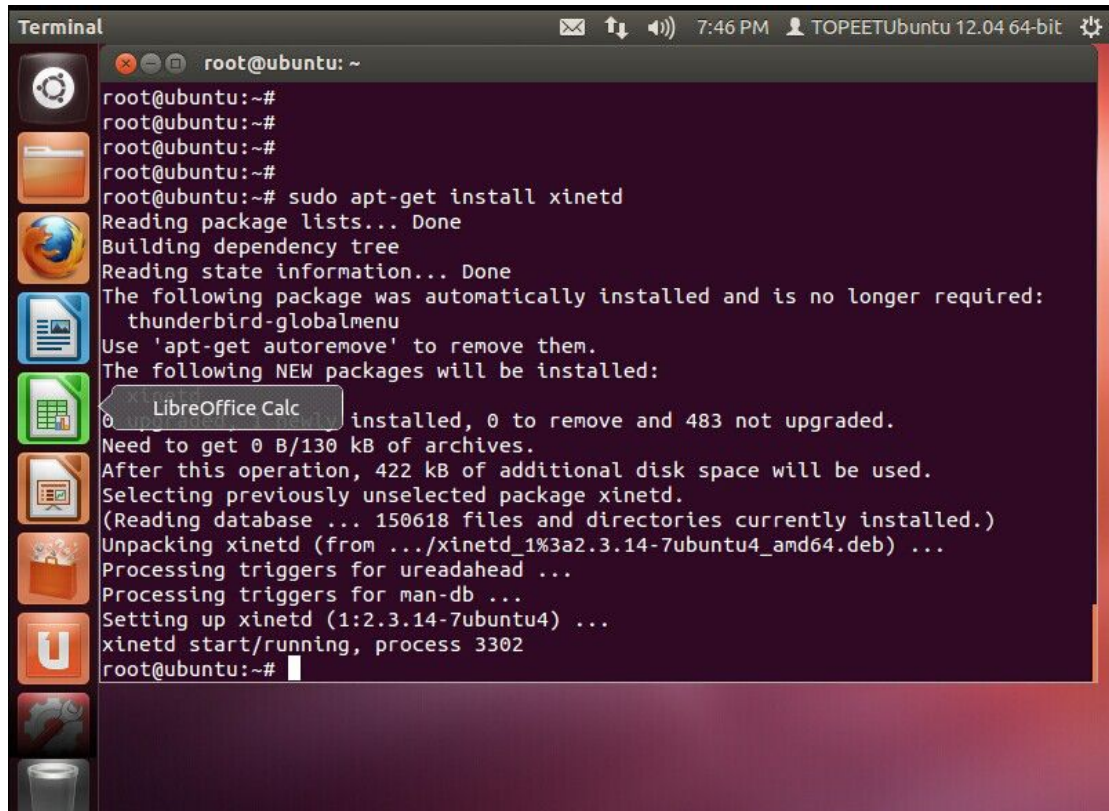
在我们的虚拟机 Ubuntu 上打开终端，如下图：



首先输入命令：sudo apt-get install xinetd，安装 xinetd，如下图：



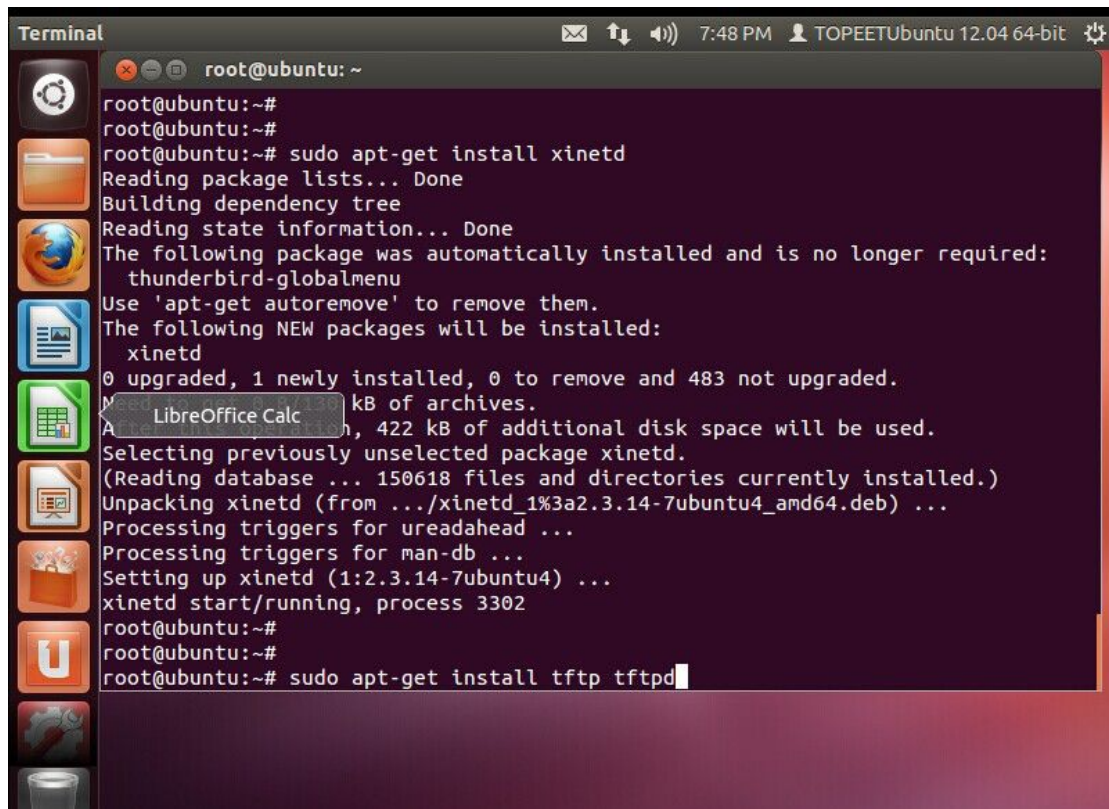
安装完 xinetd , 如下图 :



```
Terminal
root@ubuntu: ~
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# sudo apt-get install xinetd
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following package was automatically installed and is no longer required:
  thunderbird-globalmenu
Use 'apt-get autoremove' to remove them.
The following NEW packages will be installed:
  LibreOffice Calc
0 packages installed, 0 to remove and 483 not upgraded.
Need to get 0 B/130 kB of archives.
After this operation, 422 kB of additional disk space will be used.
Selecting previously unselected package xinetd.
(Reading database ... 150618 files and directories currently installed.)
Unpacking xinetd (from .../xinetd_1%3a2.3.14-7ubuntu4_amd64.deb) ...
Processing triggers for ureadahead ...
Processing triggers for man-db ...
Setting up xinetd (1:2.3.14-7ubuntu4) ...
xinetd start/running, process 3302
root@ubuntu:~#
```

接下来输入命令安装 tftp 和 tftpd : `sudo apt-get install tftp tftpd` , 如下图 :

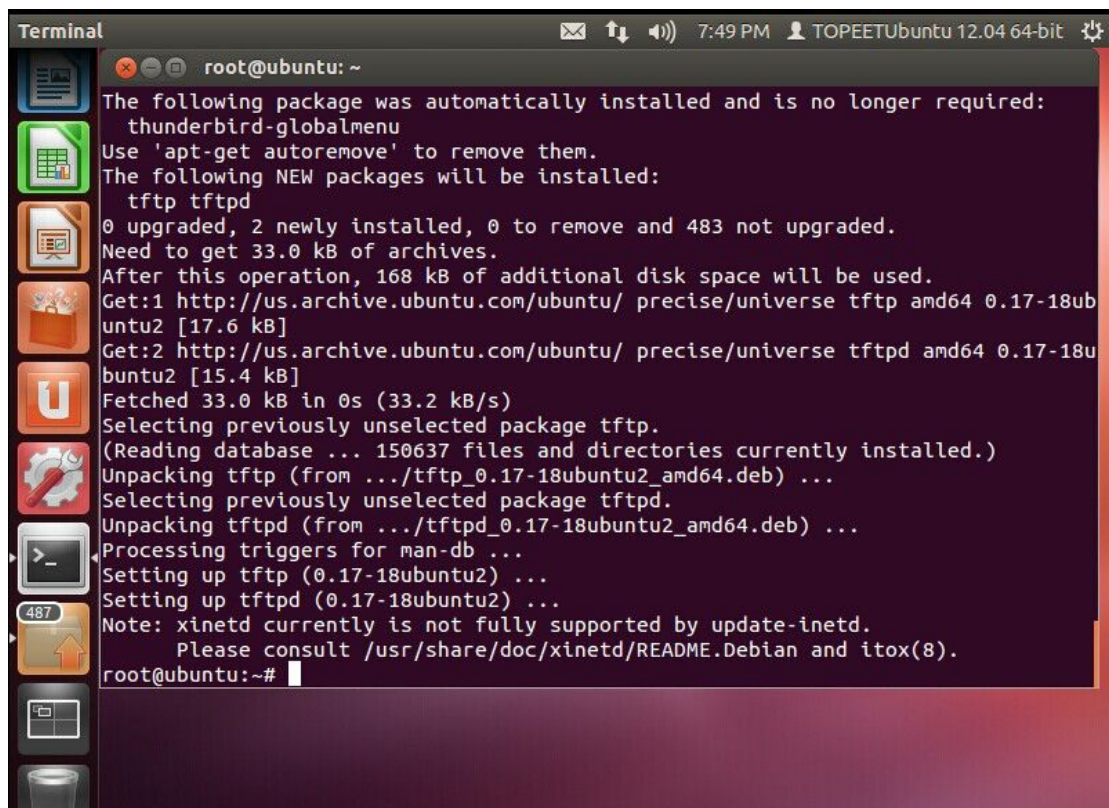




A terminal window titled "Terminal" showing the installation of xinetd. The user is root@ubuntu:~. The command "sudo apt-get install xinetd" is entered. The output shows that thunderbird-globalmenu was automatically installed and is no longer required. The following NEW packages will be installed: xinetd. 0 upgraded, 1 newly installed, 0 to remove and 483 not upgraded. 150618 files and directories currently installed. Unpacking xinetd (from ../xinetd\_1%3a2.3.14-7ubuntu4\_amd64.deb) ... xinetd start/running, process 3302. The user then enters "sudo apt-get install tftp tftpd".

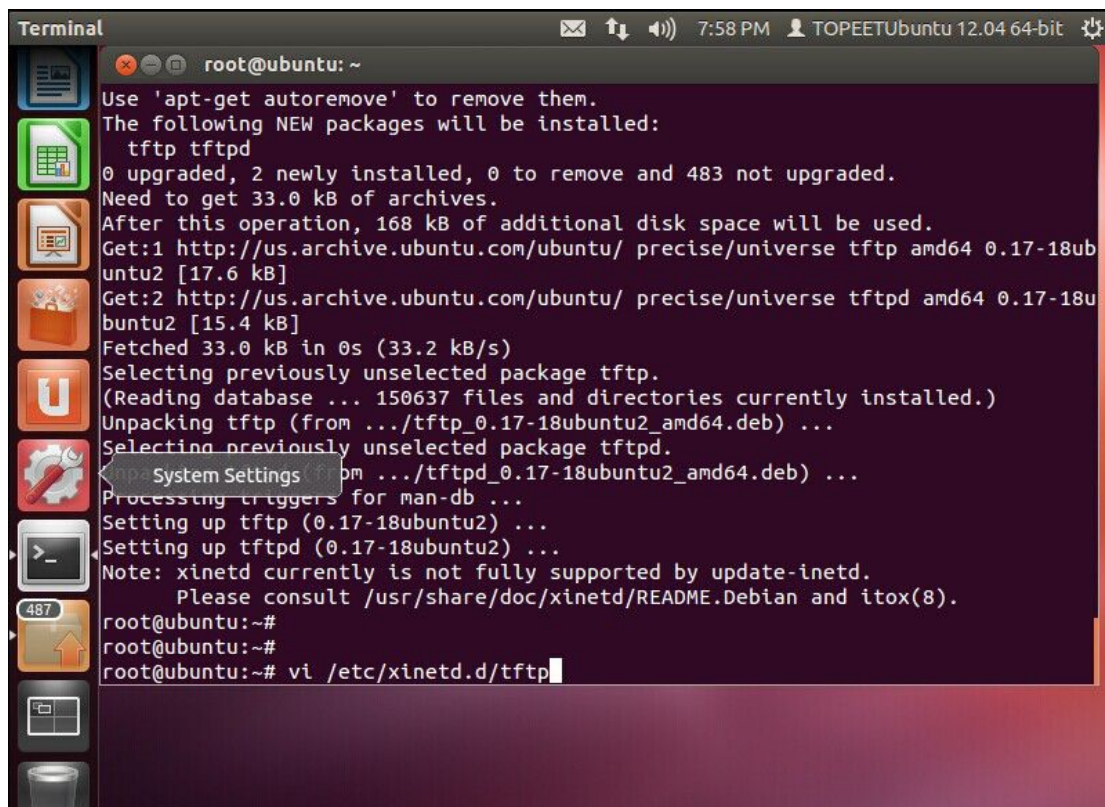
```
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# sudo apt-get install xinetd
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following package was automatically installed and is no longer required:
  thunderbird-globalmenu
Use 'apt-get autoremove' to remove them.
The following NEW packages will be installed:
  xinetd
0 upgraded, 1 newly installed, 0 to remove and 483 not upgraded.
150618 files and directories currently installed.
Unpacking xinetd (from ../xinetd_1%3a2.3.14-7ubuntu4_amd64.deb) ...
Processing triggers for ureadahead ...
Processing triggers for man-db ...
Setting up xinetd (1:2.3.14-7ubuntu4) ...
xinetd start/running, process 3302
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# sudo apt-get install tftp tftpd
```

安装完成后，如下图：



A terminal window titled "Terminal" showing the installation of tftp and tftpd. The user is root@ubuntu:~. The command "sudo apt-get install tftp tftpd" is entered. The output shows that thunderbird-globalmenu was automatically installed and is no longer required. The following NEW packages will be installed: tftp tftpd. 0 upgraded, 2 newly installed, 0 to remove and 483 not upgraded. Need to get 33.0 kB of archives. After this operation, 168 kB of additional disk space will be used. Get:1 http://us.archive.ubuntu.com/ubuntu/ precise/universe tftp amd64 0.17-18ubuntu2 [17.6 kB] Get:2 http://us.archive.ubuntu.com/ubuntu/ precise/universe tftpd amd64 0.17-18ubuntu2 [15.4 kB] Fetched 33.0 kB in 0s (33.2 kB/s) Selecting previously unselected package tftp. (Reading database ... 150637 files and directories currently installed.) Unpacking tftp (from ../tftp\_0.17-18ubuntu2\_amd64.deb) ... Selecting previously unselected package tftpd. Unpacking tftpd (from ../tftpd\_0.17-18ubuntu2\_amd64.deb) ... Processing triggers for man-db ... Setting up tftp (0.17-18ubuntu2) ... Setting up tftpd (0.17-18ubuntu2) ... Note: xinetd currently is not fully supported by update-inetd. Please consult /usr/share/doc/xinetd/README.Debian and itox(8). root@ubuntu:~#

然后建立 TFTP 的配置文件，使用命令：vi /etc/xinetd.d/tftp 建立文件，如下图：



```
Terminal
root@ubuntu: ~
Use 'apt-get autoremove' to remove them.
The following NEW packages will be installed:
  tftp tftpd
0 upgraded, 2 newly installed, 0 to remove and 483 not upgraded.
Need to get 33.0 kB of archives.
After this operation, 168 kB of additional disk space will be used.
Get:1 http://us.archive.ubuntu.com/ubuntu/ precise/universe tftp amd64 0.17-18ubuntu2 [17.6 kB]
Get:2 http://us.archive.ubuntu.com/ubuntu/ precise/universe tftpd amd64 0.17-18ubuntu2 [15.4 kB]
Fetched 33.0 kB in 0s (33.2 kB/s)
Selecting previously unselected package tftp.
(Reading database ... 150637 files and directories currently installed.)
Unpacking tftp (from .../tftp_0.17-18ubuntu2_amd64.deb) ...
Selecting previously unselected package tftpd.
Unpacking tftpd (from .../tftpd_0.17-18ubuntu2_amd64.deb) ...
Processing triggers for man-db ...
Setting up tftp (0.17-18ubuntu2) ...
Setting up tftpd (0.17-18ubuntu2) ...
Note: xinetd currently is not fully supported by update-inetd.
Please consult /usr/share/doc/xinetd/README.Debian and itox(8).
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# vi /etc/xinetd.d/tftp
```

写入下面的内容：

```
service tftp
```

```
{
```

```
    socket_type = dgram
```

```
    protocol    = udp
```

```
    wait        = yes
```

```
    user        = root
```

```
    server      = /usr/sbin/in.tftpd
```

```
    server_args = -s /var/tftpboot/
```

```
    disable     = no
```

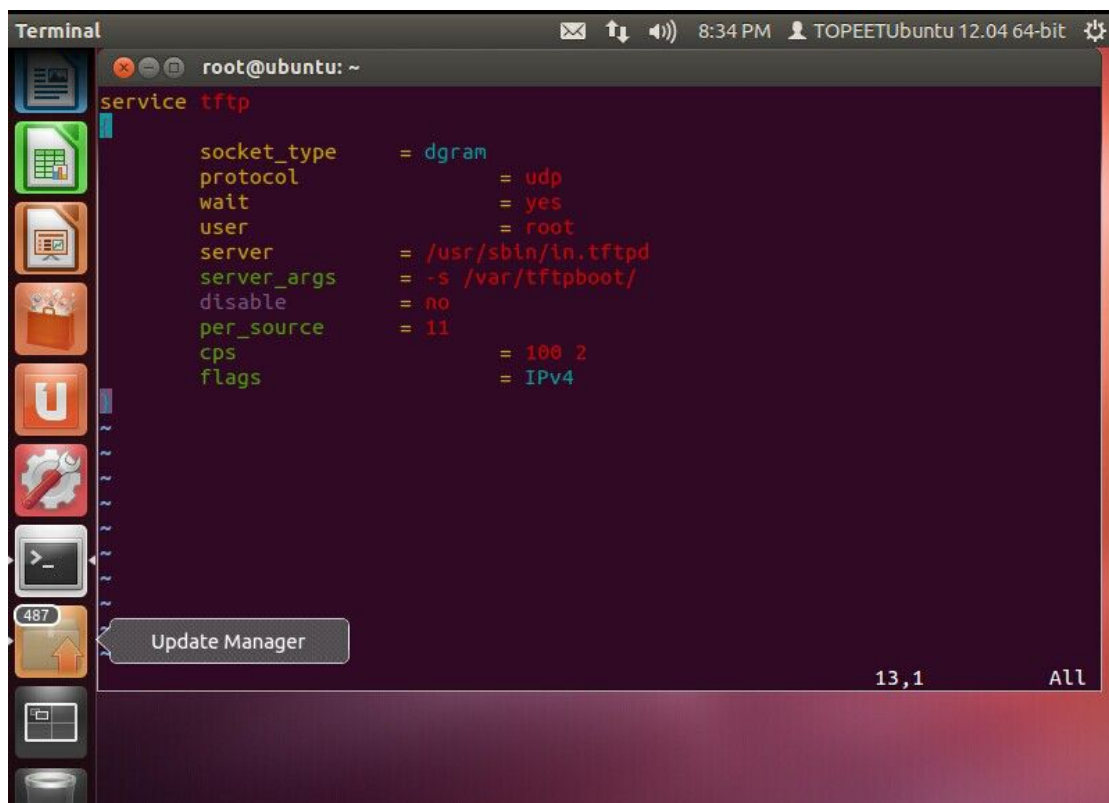
```
per_source = 11
```

```
cps = 100 2
```

```
flags = IPv4
```

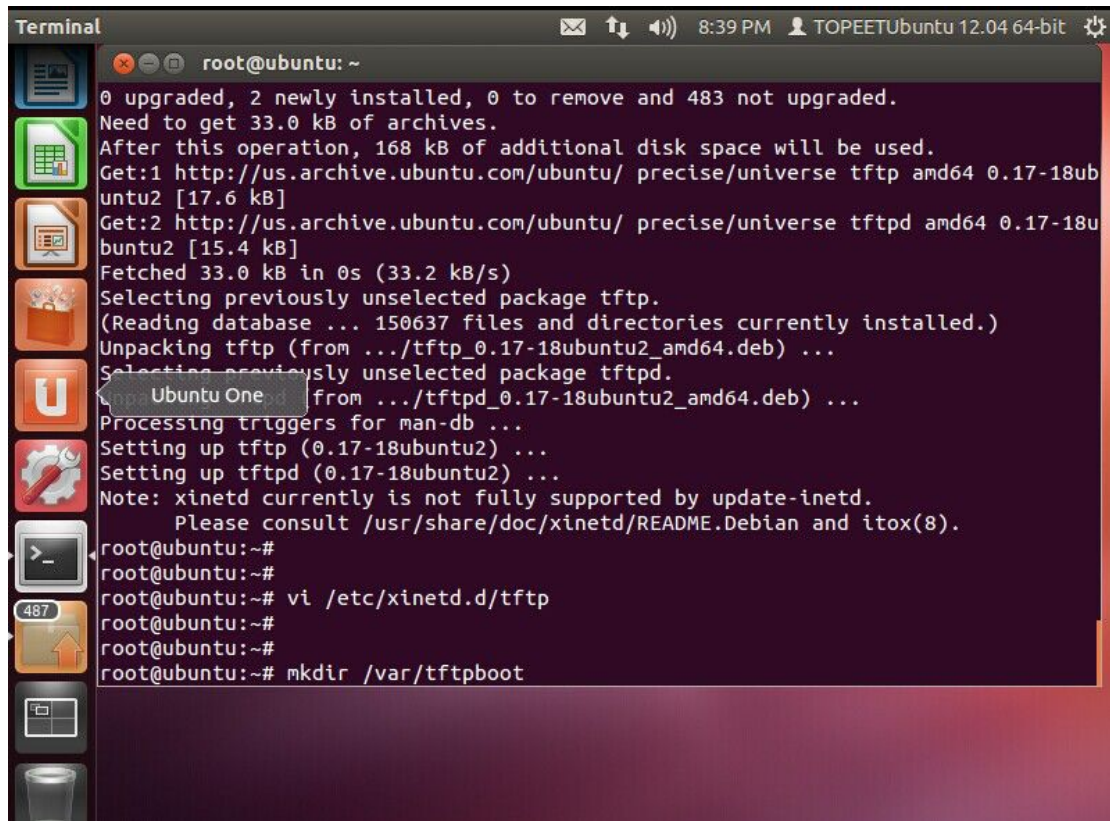
```
}
```

如下图：



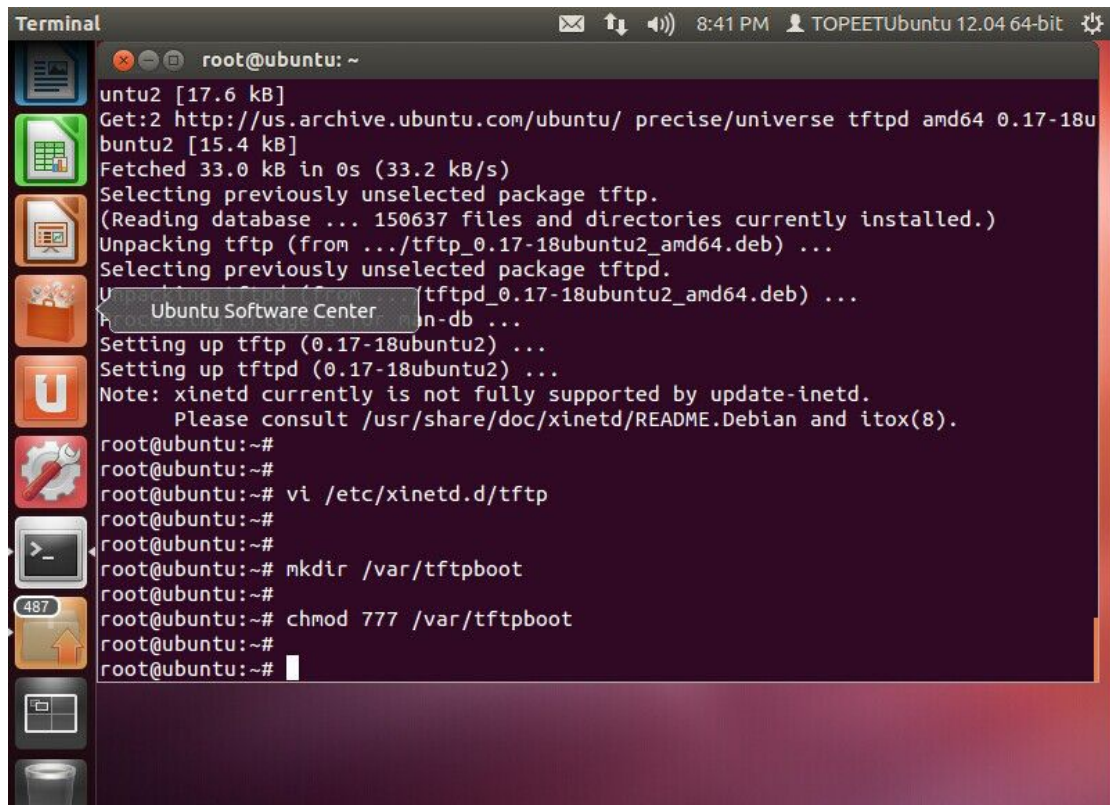
退出并保存。其中 server\_args 设置的 /var/tftpboot 目录是 tftp 服务器的目录，TFTP 客户端就是从这个目录里面获取服务器上的文件的。使用命令 `mkdir /var/tftpboot` 建立 tftp 服务器的目录，如下图：





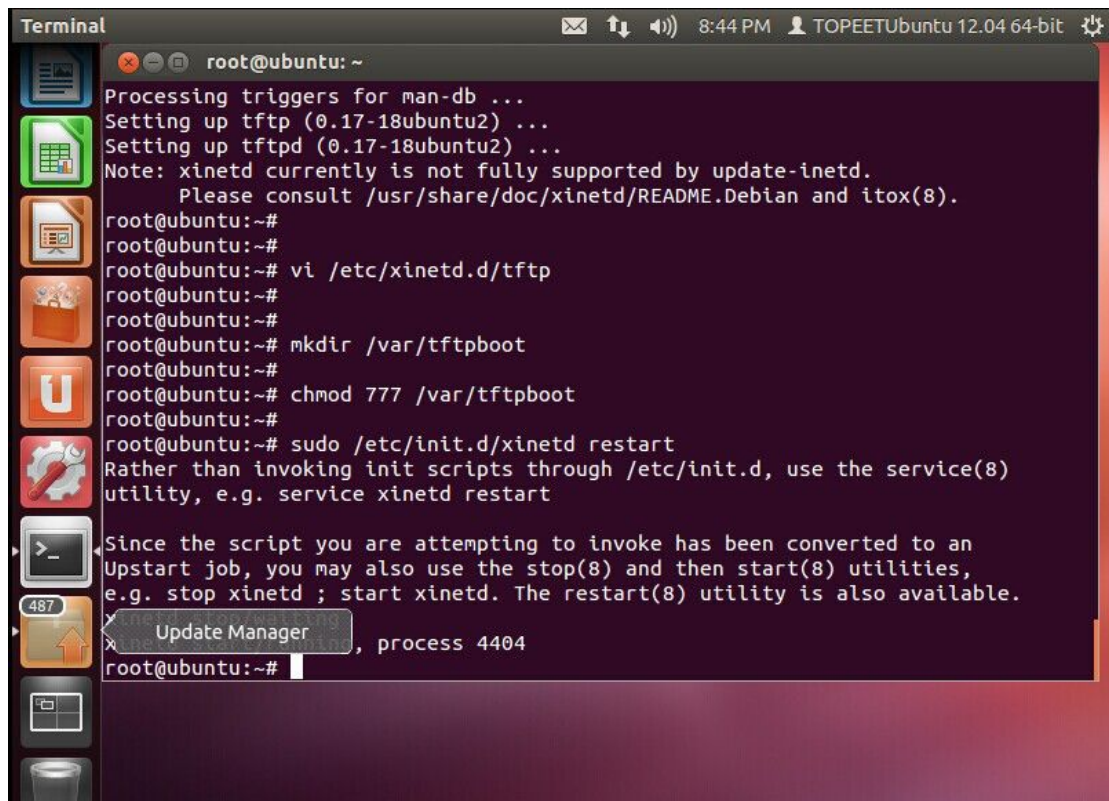
```
Terminal
root@ubuntu: ~
0 upgraded, 2 newly installed, 0 to remove and 483 not upgraded.
Need to get 33.0 kB of archives.
After this operation, 168 kB of additional disk space will be used.
Get:1 http://us.archive.ubuntu.com/ubuntu/ precise/universe tftp amd64 0.17-18ubuntu2 [17.6 kB]
Get:2 http://us.archive.ubuntu.com/ubuntu/ precise/universe tftpd amd64 0.17-18ubuntu2 [15.4 kB]
Fetched 33.0 kB in 0s (33.2 kB/s)
Selecting previously unselected package tftp.
(Reading database ... 150637 files and directories currently installed.)
Unpacking tftp (from .../tftp_0.17-18ubuntu2_amd64.deb) ...
Selecting previously unselected package tftpd.
Unpacking tftpd (from .../tftpd_0.17-18ubuntu2_amd64.deb) ...
Processing triggers for man-db ...
Setting up tftp (0.17-18ubuntu2) ...
Setting up tftpd (0.17-18ubuntu2) ...
Note: xinetd currently is not fully supported by update-inetd.
Please consult /usr/share/doc/xinetd/README.Debian and itox(8).
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# vi /etc/xinetd.d/tftp
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# mkdir /var/tftpboot
```

然后设置/var/tftpboot 的访问权限为 777，如下图：



```
Terminal
root@ubuntu: ~
untu2 [17.6 kB]
Get:2 http://us.archive.ubuntu.com/ubuntu/ precise/universe tftpd amd64 0.17-18ubuntu2 [15.4 kB]
Fetched 33.0 kB in 0s (33.2 kB/s)
Selecting previously unselected package tftp.
(Reading database ... 150637 files and directories currently installed.)
Unpacking tftp (from .../tftp_0.17-18ubuntu2_amd64.deb) ...
Selecting previously unselected package tftpd.
Unpacking tftpd (from .../tftpd_0.17-18ubuntu2_amd64.deb) ...
Processing triggers for man-db ...
Setting up tftp (0.17-18ubuntu2) ...
Setting up tftpd (0.17-18ubuntu2) ...
Note: xinetd currently is not fully supported by update-inetd.
Please consult /usr/share/doc/xinetd/README.Debian and itox(8).
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# vi /etc/xinetd.d/tftp
root@ubuntu:~#
root@ubuntu:~# mkdir /var/tftpboot
root@ubuntu:~#
root@ubuntu:~# chmod 777 /var/tftpboot
root@ubuntu:~#
root@ubuntu:~#
```

输入：sudo /etc/init.d/xinetd restart 命令重启 xinetd 服务，如下图：

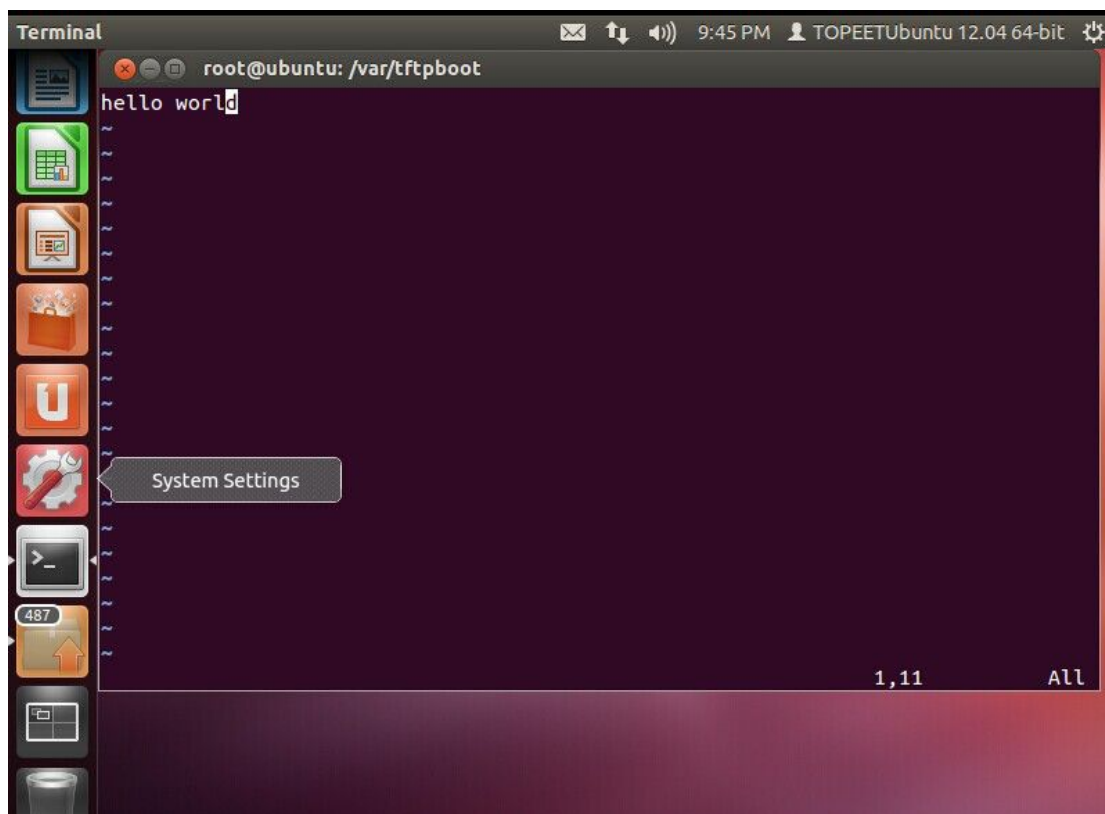
A terminal window titled 'Terminal' showing a root user on an Ubuntu system. The terminal output shows the process of setting up tftp and restarting the xinetd service. The user runs 'vi /etc/xinetd.d/tftp' to edit the configuration, then 'mkdir /var/tftpboot' to create the directory, and 'chmod 777 /var/tftpboot' to set permissions. Finally, the user runs 'sudo /etc/init.d/xinetd restart' to restart the service. The terminal also displays a message from the Update Manager about the conversion of init scripts to Upstart jobs.

```
Terminal
root@ubuntu: ~
Processing triggers for man-db ...
Setting up tftp (0.17-18ubuntu2) ...
Setting up tftpd (0.17-18ubuntu2) ...
Note: xinetd currently is not fully supported by update-inetd.
Please consult /usr/share/doc/xinetd/README.Debian and itox(8).
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# vi /etc/xinetd.d/tftp
root@ubuntu:~#
root@ubuntu:~# mkdir /var/tftpboot
root@ubuntu:~#
root@ubuntu:~# chmod 777 /var/tftpboot
root@ubuntu:~#
root@ubuntu:~# sudo /etc/init.d/xinetd restart
Rather than invoking init scripts through /etc/init.d, use the service(8)
utility, e.g. service xinetd restart

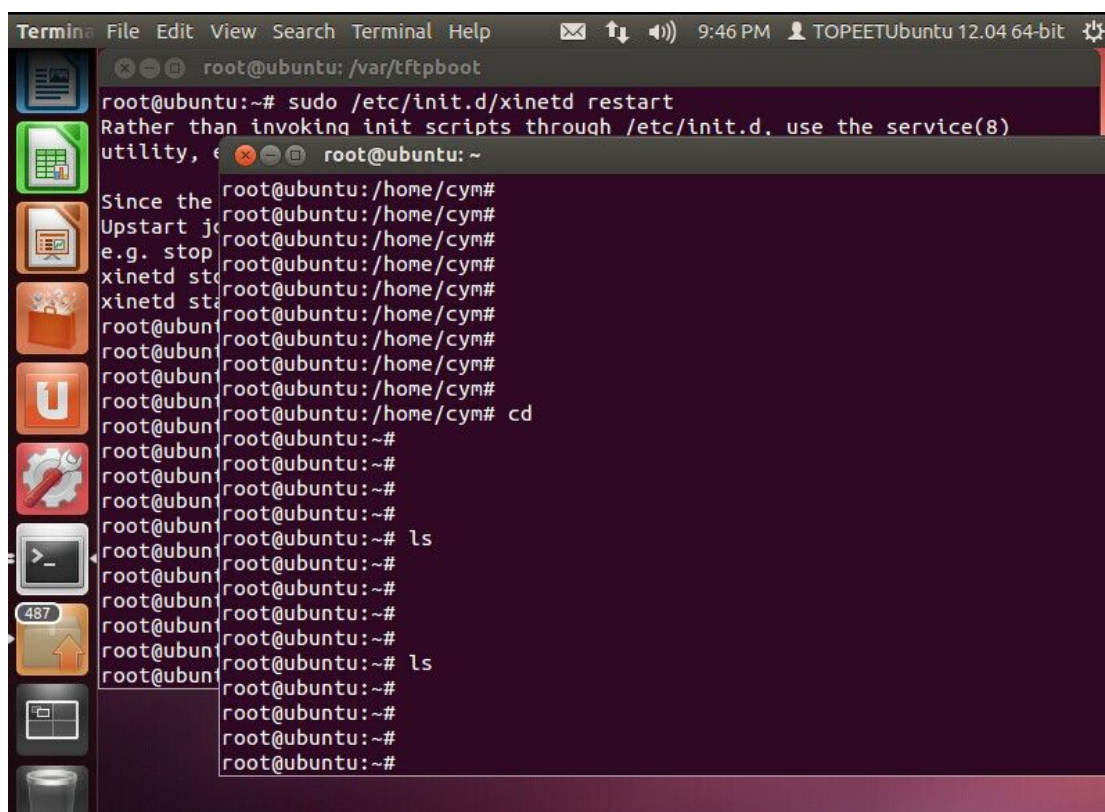
Since the script you are attempting to invoke has been converted to an
Upstart job, you may also use the stop(8) and then start(8) utilities,
e.g. stop xinetd ; start xinetd. The restart(8) utility is also available.
Update Manager
root@ubuntu:~#
```

本机测试：在/var/tftpboot 下面建立一个文件 test，在里面输入 hello world,然后保存该文件，如下图：

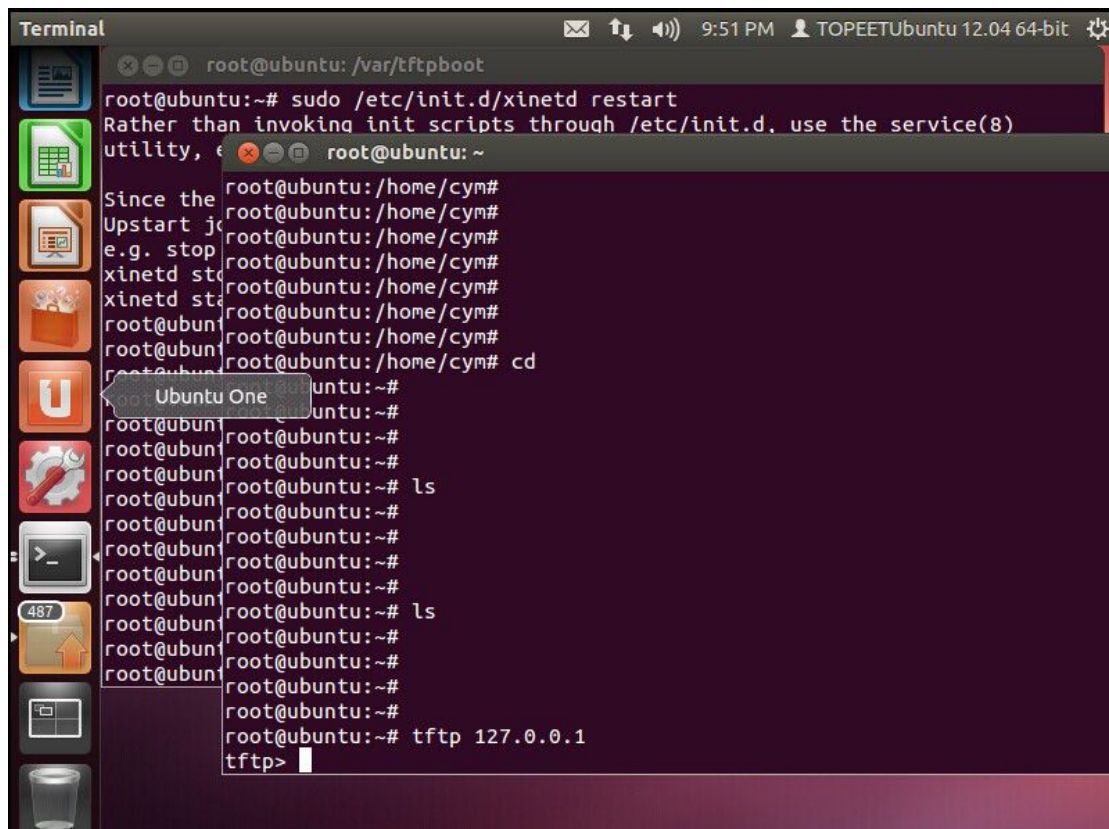




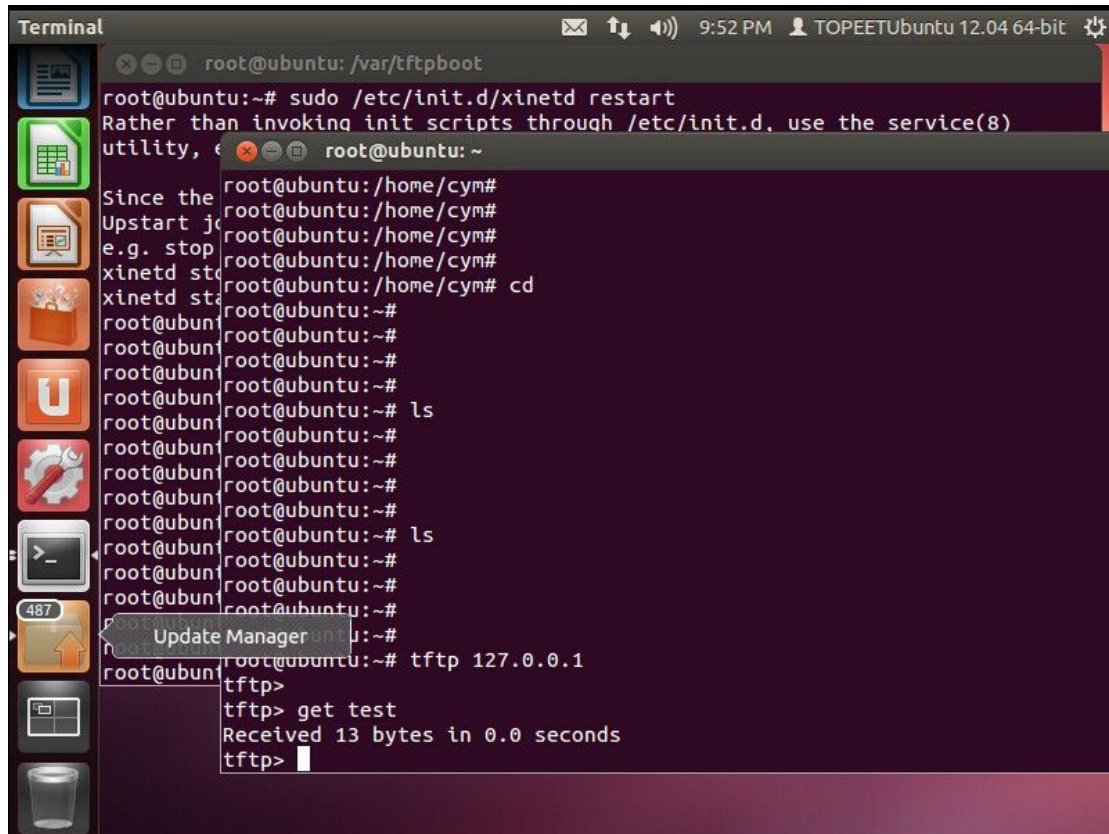
在启动另外一个终端，如下图：



然后输入：tftp 127.0.0.1，如下图：



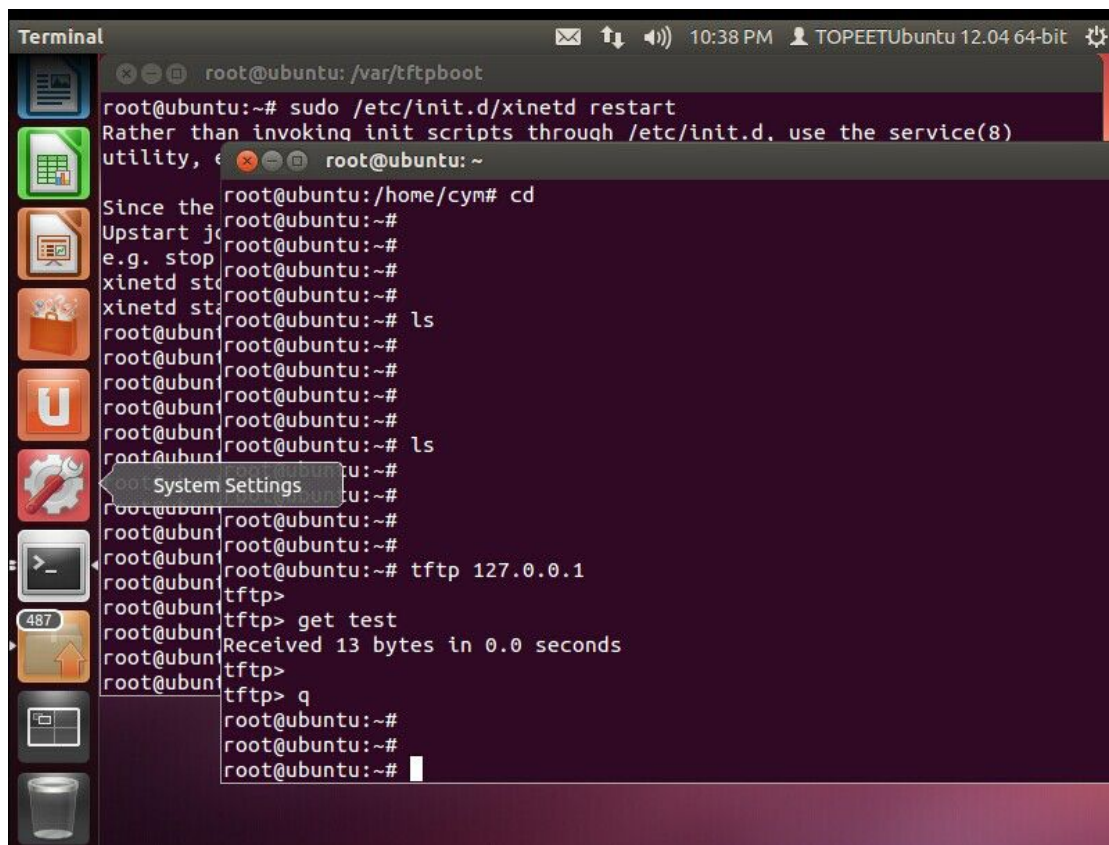
输入 get test 获取 test 文件，如下图：



A terminal window titled 'Terminal' with a top bar showing 'root@ubuntu: /var/tftpboot', system icons, and the time '9:52 PM' along with the user 'TOPEETubuntu 12.04 64-bit'. The terminal content shows a sequence of commands: 'sudo /etc/init.d/xinetd restart' with a warning about using 'service(8)', followed by several 'cd' and 'ls' commands in the '/home/cym' directory. It then shows the user switching to 'root' and running 'tftp 127.0.0.1', 'tftp>', 'tftp> get test', and receiving '13 bytes in 0.0 seconds'. A 'System Settings' window is partially visible in the background.

```
Terminal
root@ubuntu: /var/tftpboot
root@ubuntu:~# sudo /etc/init.d/xinetd restart
Rather than invoking init scripts through /etc/init.d, use the service(8)
utility, e.g. sudo service xinetd restart
root@ubuntu:~#
root@ubuntu:/home/cym#
root@ubuntu:/home/cym#
root@ubuntu:/home/cym#
root@ubuntu:/home/cym# cd
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# ls
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# ls
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# tftp 127.0.0.1
tftp>
tftp> get test
Received 13 bytes in 0.0 seconds
tftp>
```

在上图我们看到获取到 test 的信息 13 字节，然后输入 q 退出 tftp，如下图：

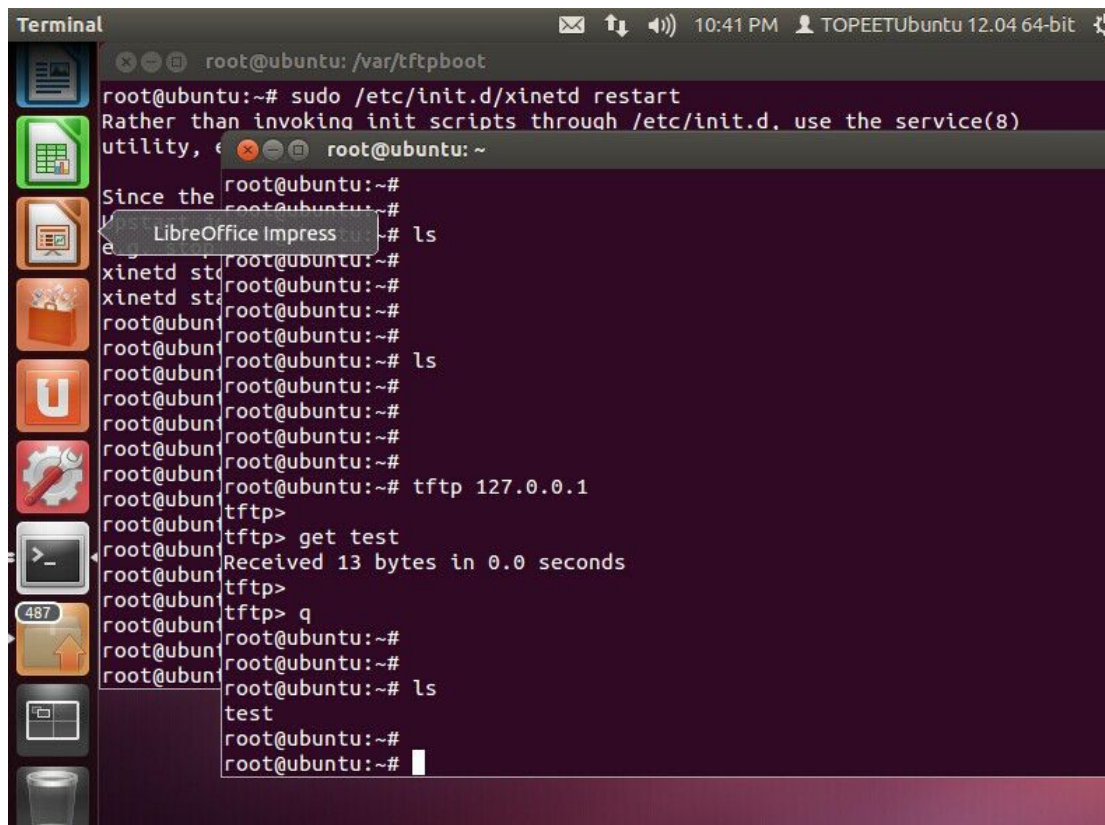


A terminal window titled 'Terminal' with a top bar showing 'root@ubuntu: /var/tftpboot', system icons, and the time '10:38 PM' along with the user 'TOPEETubuntu 12.04 64-bit'. The terminal content shows the continuation of the previous session: 'tftp>' followed by 'tftp> q', returning to the 'root@ubuntu:~#' prompt. A 'System Settings' window is partially visible in the background.

```
Terminal
root@ubuntu: /var/tftpboot
root@ubuntu:~# sudo /etc/init.d/xinetd restart
Rather than invoking init scripts through /etc/init.d, use the service(8)
utility, e.g. sudo service xinetd restart
root@ubuntu:~#
root@ubuntu:/home/cym# cd
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# ls
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# ls
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# tftp 127.0.0.1
tftp>
tftp> get test
Received 13 bytes in 0.0 seconds
tftp>
tftp> q
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
```

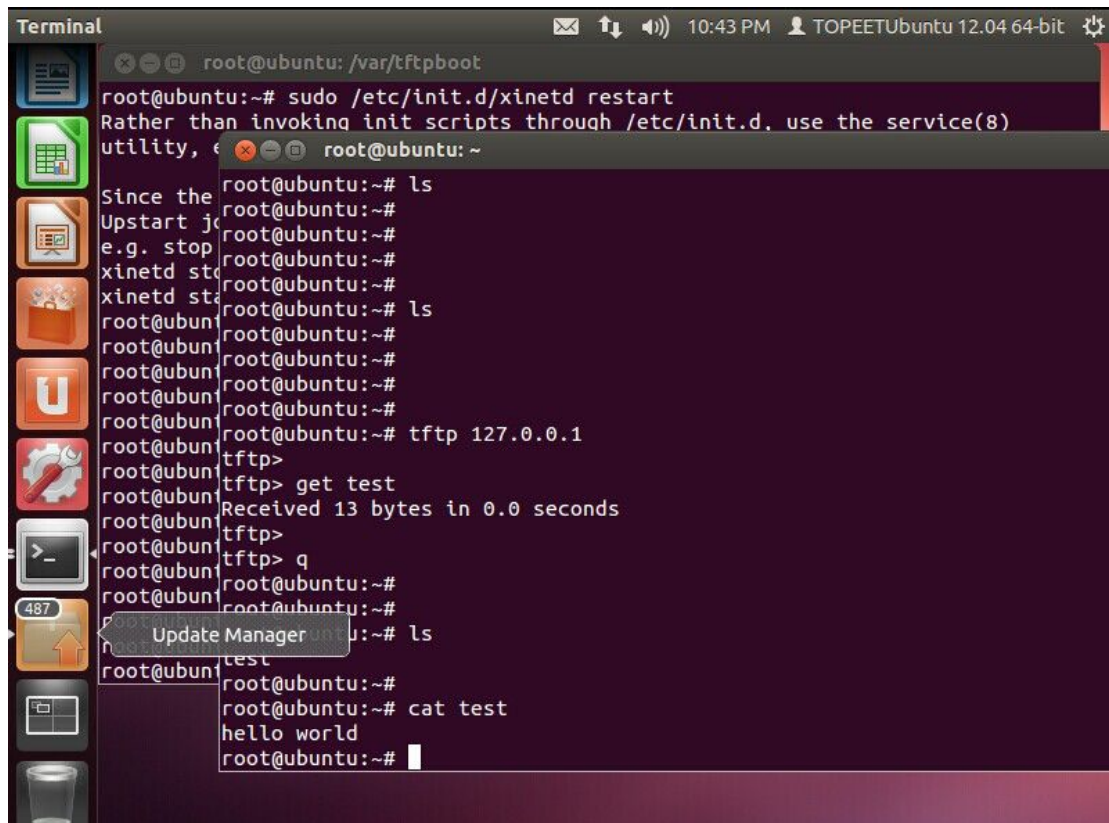


然后我们输入 ls 查看当前目录下是否有 test 文件了，通过查看，发现当前目录下应经有 test 文件了，这就是 /var/tftpboot 目录下的那个 test 文件，如下图：



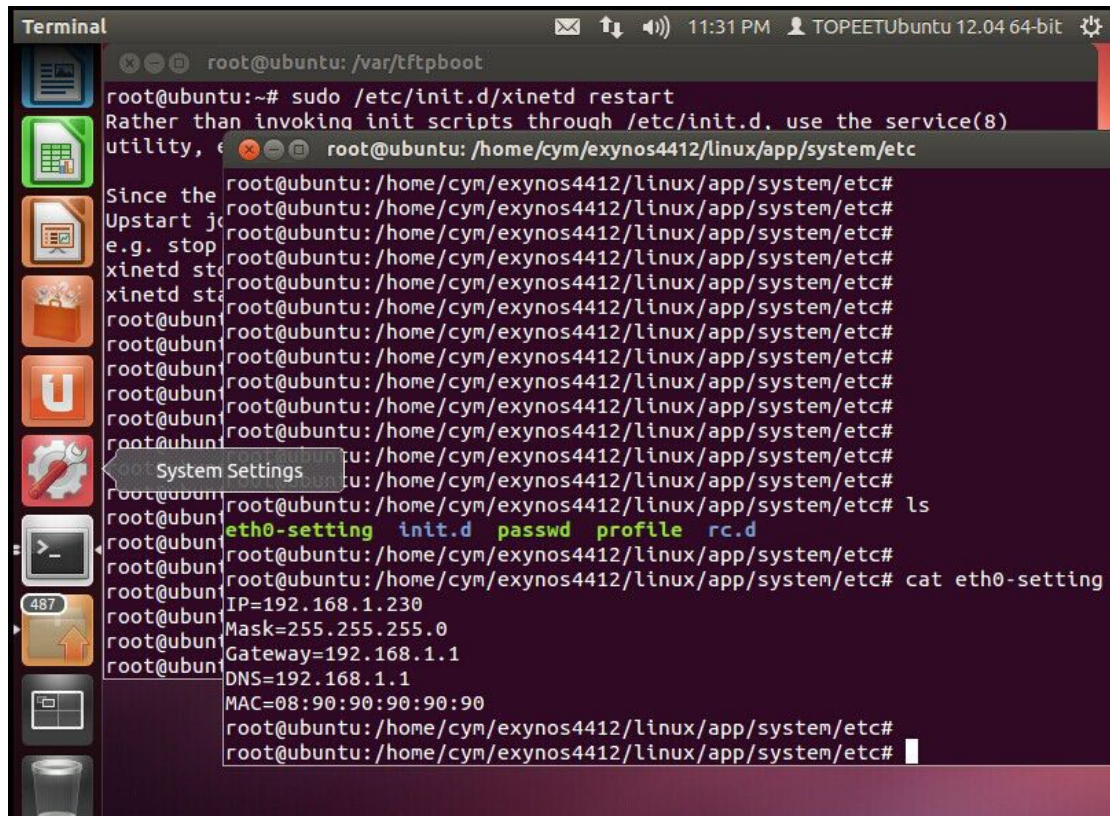
```
Terminal
root@ubuntu: /var/tftpboot
root@ubuntu:~# sudo /etc/init.d/xinetd restart
Rather than invoking init scripts through /etc/init.d, use the service(8)
utility, e.g.,
root@ubuntu:~#
root@ubuntu:~# ls
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# ls
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# tftp 127.0.0.1
tftp>
tftp> get test
Received 13 bytes in 0.0 seconds
tftp>
tftp> q
root@ubuntu:~#
root@ubuntu:~#
root@ubuntu:~# ls
test
root@ubuntu:~#
root@ubuntu:~#
```

我们使用 cat 命令查看一下 test 文件的内容，如下图：



通过上面的截图，我们看到 test 文件里面的内容是 hello world，与/var/tftpboot 目录的 test 是一样的，至此我们的 TFTP 服务器端的配置就完成了，下面我们来看下 iTOP-4412 开发板客户端的配置。

iTOP-4412 开发板我们制作的 linux 文件系统已经支持 TFTP 客户端命令了，编译 Busybox 时默认是支持该命令的，linux 文件系统在启动的时候我们通过脚本设置了以太网的 IP 地址是 192.168.1.230，这个脚本是在文件系统的 etc/eth0-setting 文件，我们打开这个文件，如下图：



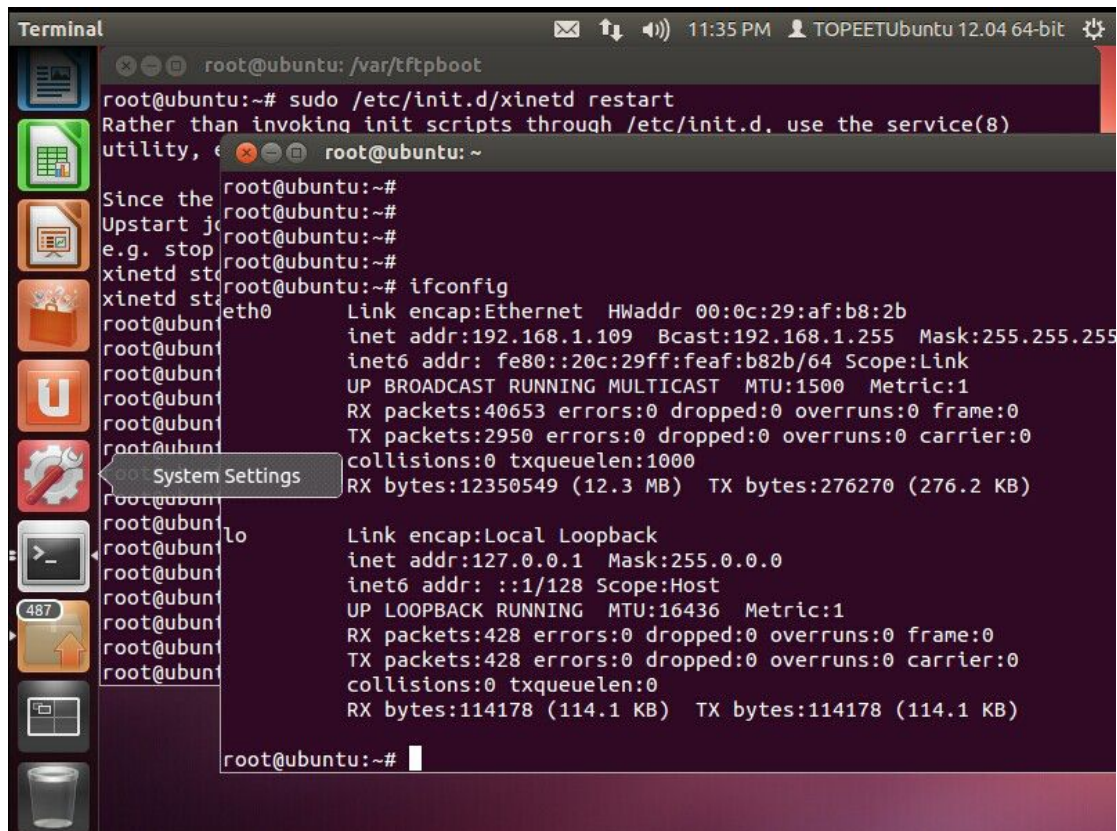
The image shows a terminal window on a Ubuntu system. The user is in the directory `/var/tftpboot` and has executed `sudo /etc/init.d/xinetd restart`. The terminal output shows the user navigating to `/home/cym/exynos4412/linux/app/system/etc` and listing files. The files listed are `eth0-setting`, `init.d`, `passwd`, `profile`, and `rc.d`. The user then cat's the `eth0-setting` file, which displays the following network configuration:

```
IP=192.168.1.230
Mask=255.255.255.0
Gateway=192.168.1.1
DNS=192.168.1.1
MAC=08:90:90:90:90:90
```

如果我们想修改默认的 IP，子网掩码，网关，DNS，MAC 就编辑这个文件对应的选项就可以了。

现在我们在 iTOP-4412 上获取 TFTP 服务器上的文件，首先我们先看一下 TFTP 服务器的 IP 地址，如下图：





```

Terminal
root@ubuntu: /var/tftpboot
root@ubuntu:~# sudo /etc/init.d/xinetd restart
Rather than invoking init scripts through /etc/init.d, use the service(8)
utility, e.g., sudo service xinetd restart
root@ubuntu:~#
root@ubuntu:~# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0c:29:af:b8:2b
          inet addr:192.168.1.109  Bcast:192.168.1.255  Mask:255.255.255
          inet6 addr: fe80::20c:29ff:feaf:b82b/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:40653 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2950 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:12350549 (12.3 MB)  TX bytes:276270 (276.2 KB)

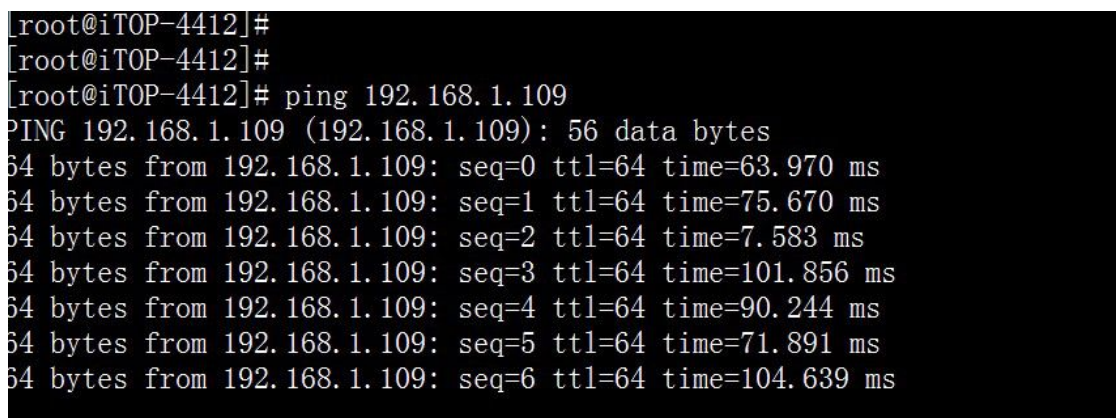
lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:428 errors:0 dropped:0 overruns:0 frame:0
          TX packets:428 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:114178 (114.1 KB)  TX bytes:114178 (114.1 KB)

root@ubuntu:~#

```

通过上面的截图我们可以知道 TFTP 虚拟机的 IP 地址是 192.168.1.109，我们的开发板的默认 IP 是 192.168.1.230，它们在同一个网段，如果不在同意个网段需要修改我们的开发板的 IP 地址，修改方法就是前面介绍的 etc 目录下的 ethsetting 文件。

连接开发板的网口到路由器上，然后输入 ping 命令确认开发板和 TFTP 服务器是连通的，如下图：



```

[root@iTOP-4412]#
[root@iTOP-4412]#
[root@iTOP-4412]# ping 192.168.1.109
PING 192.168.1.109 (192.168.1.109): 56 data bytes
64 bytes from 192.168.1.109: seq=0 ttl=64 time=63.970 ms
64 bytes from 192.168.1.109: seq=1 ttl=64 time=75.670 ms
64 bytes from 192.168.1.109: seq=2 ttl=64 time=7.583 ms
64 bytes from 192.168.1.109: seq=3 ttl=64 time=101.856 ms
64 bytes from 192.168.1.109: seq=4 ttl=64 time=90.244 ms
64 bytes from 192.168.1.109: seq=5 ttl=64 time=71.891 ms
64 bytes from 192.168.1.109: seq=6 ttl=64 time=104.639 ms

```

如果返回上面的信息就表示开发板和 TFTP 服务器是连通的，现在我们获取 TFTP 上的文件，在开发板的串口

输入：tftp -g -l test -r test 192.168.1.109，如下图：

```
[root@iTOP-4412]#  
[root@iTOP-4412]#  
[root@iTOP-4412]# tftp -g -l test -r test 192.168.1.109  
[root@iTOP-4412]#  
[root@iTOP-4412]#
```

执行完上面的命令,已经把 TFTP 上的 test 文件下载到开发板的当前目录下了,使用 ls 看到当前目录下有 test

文件,如下图:

```
[root@iTOP-4412]#  
[root@iTOP-4412]# tftp -g -l test -r test 192.168.1.109  
[root@iTOP-4412]#  
[root@iTOP-4412]# ls  
bin      etc      linuxrc  proc     sys      tmp      var  
dev      lib      mnt      sbin     test     usr  
[root@iTOP-4412]#  
[root@iTOP-4412]#  
[root@iTOP-4412]#
```

在开发板的串口输入 cat test 可以查看 test 的内容,如下图:

```
[root@iTOP-4412]#  
[root@iTOP-4412]# tftp -g -l test -r test 192.168.1.109  
[root@iTOP-4412]#  
[root@iTOP-4412]# ls  
bin      etc      linuxrc  proc     sys      tmp      var  
dev      lib      mnt      sbin     test     usr  
[root@iTOP-4412]#  
[root@iTOP-4412]#  
[root@iTOP-4412]# cat test  
hello world  
[root@iTOP-4412]#  
[root@iTOP-4412]#
```

通过上面的截图,我们可以看到文件的内容和 TFTP 上的文件内容是一样的,至此我们的 TFTP 搭建完成了,

大家以后再调试程序的时候可以用 TFTP,这样就避免了每次都要生成镜像,烧写景象了。

下面我给大家演示一下调试应用程序的方法,假设我在虚拟机的 Ubuntu 上编写了一个输出 hello world 的小

程序,然后我通过交叉编译器编译这个程序生成了可执行文件 hello,我通过 cp 命令把这个可执行程序 hello

拷贝到了/var/tftpboot 目录下面,接下来我要在开发板端把 hello 文件下载到开发板上,我需要在开发板的

串口上执行：tftp -g -l hello -r hello 192.168.1.109，如下图：

```
[root@iTOP-4412]# ls
bin      etc      linuxrc  proc     sys      tmp      var
dev      lib      mnt      sbin     test     usr
[root@iTOP-4412]#
[root@iTOP-4412]#
[root@iTOP-4412]# cat test
hello world
[root@iTOP-4412]#
[root@iTOP-4412]#
[root@iTOP-4412]# tftp -g -l hello -r hello 192.168.1.109
[root@iTOP-4412]#
[root@iTOP-4412]#
```

然后我们输入 ls 命令查看一下当前目录，可以看到已经有 hello 这个文件了，如下图：

```
[root@iTOP-4412]#
[root@iTOP-4412]# tftp -g -l hello -r hello 192.168.1.109
[root@iTOP-4412]#
[root@iTOP-4412]# ls
bin      etc      lib      mnt      sbin     test     usr
dev      hello    linuxrc  proc     sys      tmp      var
[root@iTOP-4412]#
```

因为 hello 这个文件现在没有执行权限，所以我们需要输入 chmod 777 hello 命令来修改下 hello 的权限，

如下图：

```
[root@iTOP-4412]#
[root@iTOP-4412]# ls
bin      etc      lib      mnt      sbin     test     usr
dev      hello    linuxrc  proc     sys      tmp      var
[root@iTOP-4412]#
[root@iTOP-4412]# chmod 777 hello
[root@iTOP-4412]#
[root@iTOP-4412]#
```

现在我们可以运行 hello 这个程序了，运行结果如下图：



```
[root@iTOP-4412]#  
[root@iTOP-4412]# ls  
bin      etc      lib      mnt      sbin     test     usr  
dev      hello    linuxrc  proc     sys      tmp      var  
[root@iTOP-4412]#  
[root@iTOP-4412]# chmod 777 hello  
[root@iTOP-4412]#  
[root@iTOP-4412]# ./hello  
hello world  
[root@iTOP-4412]#  
[root@iTOP-4412]#
```

我们可以看到程序输出：“hello world”了。通过 TFTP 这种方式可以提高我们调试程序的效率。