Lab 1

Embedded Linux Development Environment
Multiple OS in a PC

- VMware

VMware Workstation Player - VMware Products

Try VMware Workstation Player

VMware Workstation Player builds on the industry leading foundation of Workstation Pro, and delivers a streamlined user interface for creating and running operating systems and applications in a virtual machine.

The free version is available for non-commercial, personal and home use. We also encourage students and non-profit organizations to benefit from this offering.

Commercial organizations require paid licenses to use Workstation Player.

Need a more advanced virtualization solution? Check out Workstation Pro for Windows or Workstation Pro for Linux.

VMware Workstation 12.5 Player for Windows 64-bit

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VMware Workstation 12.5 Player for Linux 64-bit

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Multiple OS in a PC

- Oracle Virtual Box

VirtualBox

Download VirtualBox

Here, you will find links to VirtualBox binaries and its source code.

VirtualBox binaries

By downloading, you agree to the terms and conditions of the respective license.

- VirtualBox 5.1.12 platform packages. The binaries are released under the terms of the GPL version 2.
  - Windows hosts
  - OS X hosts
  - Linux distributions
  - Solaris hosts

- VirtualBox 5.1.12 Oracle VM VirtualBox Extension Pack (All supported platforms)
  Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe and PXE boot for Intel cards.
  The Extension Pack binaries are released under the VirtualBox Personal Use and Evaluation License (PUEL).
  Please install the extension pack with the same version as your installed version of VirtualBox.
  If you are using VirtualBox 5.0.30, please download the extension pack here.

- VirtualBox 5.1.12 Software Developer Kit (SDK) (All platforms)
- Debian
- Ubuntu
- Linux Mint
- Redhat
- CentOS
- Fedora
Development Environment

Host: Windows PC
- VMware player
- Linux Host

Target: Embedded Linux
- Application program
- Embedded Linux kernel
- Booting
- Flash Memory

Network:
- Ethernet
- Bridged

IP Addresses:
- 192.168.0.2
- 192.168.0.120
- 192.168.0.60
USB to Ethernet Adapter

이더넷 9
식별되지 않은 네트워크
ASIX AX88772 USB2.0 to F...
Properties

네트워킹

연결에 사용할 장치:
ASIX AX88772 USB2.0 to Fast Ethernet Adapter #4

이 연결에 다음 항목 사용(O):
- Microsoft Networks용 클라이언트
- VMware Bridge Protocol
- Microsoft 네트워크용 파일 및 프린터 공유
- QoS 패킷 스케줄러
- Reliable Multicast Protocol
- 인터넷 프로토콜 버전 4(TCP/IPV4)
- Microsoft 네트워크 어댑터 멀티플렉서 프로토콜

설정(N)...
제거(U)
속성(R)

설명
Transmission Control Protocol/인터넷 프로토콜입니다. 기본적인 억제 네트워크 프로토콜로, 다양한 연결된 네트워크에서 통신을 제공합니다.
네트워크가 IP 자동 설정 기능을 지원하면 IP 설정이 자동으로 할당되도록 할 수 있습니다. 지원하지 않으면, 네트워크 관리자에게 적절한 IP 설정값을 문의해야 합니다.

- 자동으로 IP 주소 받기 (O)
- 다음 IP 주소 사용 (S):
  - IP 주소 (I):
  - 서브넷 마스크 (U):
  - 기본 게이트웨이 (D):
- 자동으로 DNS 서버 주소 받기 (B)
- 다음 DNS 서버 주소 사용 (E):
  - 기본 설정 DNS 서버 (P):
  - 보조 DNS 서버 (A):

☐ 끝낼 때 설정 유효성 검사 (L)
VMware Player
VMware Player

- Select **Ubuntu1204_64** and play
- Or double click **Ubuntu1204_64.vmx** in the folder D:/Ubuntu1204_64
- ID: control  password: 
- ID: root  password: control 
- 마우스 포인터가 안 보일 경우에는 Ctrl-Alt
Open Terminal

- **pwd**: print working directory
- **ls**: list directory contents
New Terminal

- Right button click
Check IP address

- `ifconfig`
Open serial terminal

- Open **Windows SmarTTY**
Turn ON power switch
Power on and boot the target
Virtual Machine Network Setting

- Virtual machine settings
Network Adapter

Virtual Machine Settings

Hardware

Device | Summary
--- | ---
Memory | 1 GB
Processors | 1
Hard Disk (SCSI) | 30 GB
CD/DVD (SATA) | Auto detect
Network Adapter | Bridged (Automatic)
USB Controller | Present
Sound Card | Auto detect
Printer | Present
Display | Auto detect

Options

Device status
- [x] Connected
- [x] Connect at power on

Network connection
- Bridged: Connected directly to the physical network
  - [x] Replicate physical network connection state
- NAT: Used to share the host's IP address
- Host-only: A private network shared with the host
- Custom: Specific virtual network
  - VMnet0
- LAN segment:

[LAN Segments...]
[Advanced...]

[Add...]
[Remove]
Configure Adapters

Virtual Machine Settings

Automatic Bridging Settings

Select the host network adapter(s) you want to automatically bridge:

- [ ] ASIX AX88772 USB2.0 to Fast Ethernet Adapter #4
- [ ] Realtek PCIe GBE Family Controller
- [ ] Qualcomm Atheros QCA9377 Wireless Network Adapter
- [ ] Bluetooth Device (Personal Area Network)

Device status
- [ ] Connected
- [ ] Connect at power on

Network connection
- Bridged: Connected directly to the physical network
  - [ ] Replicate physical network connection state
- NAT: Used to share the host's IP address

[OK] [Cancel] [Help] [Configure Adapters]
Check if USB Ethernet adapter is connected to HOST!
System Settings
IP addresses

- Windows: 192.168.0.2
- Ubuntu1204: 192.168.0.120
- Target: 192.168.0.60
IP addresses

Hardware Address: 00:50:FC:BC:E6:74
IP Address: 192.168.0.120
Subnet Mask: 255.255.255.0
Default Route: 192.168.0.1
DNS: 8.8.8.8

Connection name: Wired connection 1
Connect automatically: checked
Method: Manual

Addresses:
- Address: 192.168.0.120, Netmask: 255.255.255.0, Gateway: 192.168.0.1
- DNS servers: 8.8.8.8
Check target IP address

SmarTTY - Raw Terminal
Connected to COM5 (115200 bps)

Interrupt: 142

eth0
Link encap: Ethernet  HWaddr B6:91:24:A8:14:72
inet addr: 192.168.0.60  Bcast: 0.0.0.0  Mask: 255.255.255.0
inet6 addr: fe80::b491:24ff:fea8:1472/64  Scope: Link
UP  BROADCAST  RUNNING  MULTICAST  MTU: 1500  Metric: 1
RX packets: 44  errors: 0  dropped: 0  overruns: 0  frame: 0
TX packets: 50  errors: 0  dropped: 0  overruns: 0  carrier: 0
collisions: 0  txqueuelen: 1000
RX bytes: 5176  (5.0 KiB)  TX bytes: 4872  (4.7 KiB)

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: 1  errors: 0  dropped: 0  overruns: 0  frame: 0
TX packets: 1  errors: 0  dropped: 0  overruns: 0  carrier: 0
collisions: 0  txqueuelen: 0
RX bytes: 88  (88.0 B)  TX bytes: 88  (88.0 B)

[root@ACHRO ~]# _
Check host-target connection

```
control@lab-pc2:~$ ping 192.168.0.60
PING 192.168.0.60 (192.168.0.60) 56(84) bytes of data.
64 bytes from 192.168.0.60: icmp_req=1 ttl=64 time=0.603 ms
64 bytes from 192.168.0.60: icmp_req=2 ttl=64 time=0.311 ms
64 bytes from 192.168.0.60: icmp_req=3 ttl=64 time=1.20 ms
^C
--- 192.168.0.60 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 1998ms
rtt min/avg/max/mdev = 0.311/0.706/1.205/0.372 ms
```

```
[root@ACHRO ~]# ping 192.168.0.120
PING 192.168.0.120 (192.168.0.120): 56 data bytes
64 bytes from 192.168.0.120: seq=0 ttl=64 time=0.607 ms
64 bytes from 192.168.0.120: seq=1 ttl=64 time=0.488 ms
64 bytes from 192.168.0.120: seq=2 ttl=64 time=0.434 ms
64 bytes from 192.168.0.120: seq=3 ttl=64 time=0.448 ms

--- 192.168.0.120 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0.434/0.494/0.607 ms
[root@ACHRO ~]# 
```
Make working directory

- `mkdir`: make directory
- `cd`: change directory
- `vi hello.c`
Press ‘a’ key to start to enter
- Start typing
To finish typing press ‘esc’ key
- To save and quit press `:wq` and Enter
Compile and run

- `gcc hello.c`
- `arm-none-linux-gnueabi-gcc hello.c`

```
control@lab-pc2:~/work/hello$ vi hello.c
control@lab-pc2:~/work/hello$ cat hello.c
#include <stdio.h>

void main(void)
{
    printf("Hello\n");
}
control@lab-pc2:~/work/hello$ gcc hello.c
control@lab-pc2:~/work/hello$ ls
a.out hello.c
control@lab-pc2:~/work/hello$ ./a.out
Hello
control@lab-pc2:~/work/hello$ arm-none-linux-gnueabi-gcc hello.c
control@lab-pc2:~/work/hello$ ./a.out
bash: ./a.out: cannot execute binary file
control@lab-pc2:~/work/hello$
```
Mount NFS (network file system)

- `mount -t nfs 192.168.0.120:/nfsroot /mnt/nfs -o rw,rsize=4096,nolock`
Connected to COM5 (115200 bps) Baud rate: 115200

```
[root@ACHRO ~]# cd /mnt/nfs
[root@ACHRO nfs]# ls
CanElevatorTest*
```

Run hello.c in target
Run `hello.c` in target

- Copy `a.out` to `/nfsroot`
Run hello.c in target

```
[root@ACHRO ~]# cd /mnt/nfs
[root@ACHRO nfs]# ls
CanElevatorTest  a.out
[root@ACHRO nfs]# ./a.out
Hello
[root@ACHRO nfs]#
```
all: app install

app:
  hello.c
  arm-none-linux-gnueabi-gcc  -o hello hello.c

install:
  cp hello /nfsroot
- ‘vi hello.c’ to start editing
- Move the cursor using arrow keys or ‘h,j,k,l’ keys
- Press ‘i’ to insert
- To finish typing press ‘esc’ key
- To save ‘:w’ and Enter
- To quit ‘:q’ and Enter
- To delete a character press ‘x’
- To append a character ‘a’
- To copy a line ‘yy’
- To paste a line ‘p’
- To delete and copy a line ‘dd’
- To delete and copy multiple lines ‘#dd’, for example ‘5dd’ to delete and copy 5 lines
- To insert a line ‘o’
- To cancel the last action ‘u’
- Line number ‘:set nu’
- Replace a pattern ‘:%s/old/new/’
- Quit without saving ‘:q!’
- To copy from line number #1 to line number #2 to the next line of #3 ‘:#1,#2co#3’
- To move from #1 to #2 to the next line of #3 ‘:#1,#2m#3’
- To delete from #1 to #2 ‘:#1,#2d’
Text Editor
```c
#include <stdio.h>

void main(void)
{
    printf("Hello World\n");
}
```
Basic Linux Commands

- cd: change directory
- mkdir: make a new directory
- rmdir: remove a directory, Directory including files or sub-directories cannot be deleted
- cp: copy one or more files to another location
- rm: remove files and directories
- ls: list files
Workspace Switcher
Shut Down

- Do not just close the VMware window
Exercise

- Hello World를 10번 프린트 하는 프로그램 을 vi 에디터를 사용하여 편집한 후, linux host와 target에서 각각 실행해 보십시오.
File Sharing with Windows

- Edit virtual machine settings
Virtual Machine Settings
Folder sharing
Folder sharing
Folder sharing
Folder sharing

Add Shared Folder Wizard

Name the Shared Folder
What would you like to call this shared folder?

Host path
D:"W

Name
D
Folder sharing

Specify Shared Folder Attributes
Specify the scope of this shared folder.

Additional attributes
- Enable this share
- Read-only
Folder sharing

Shared folders expose your files to programs in the virtual machine. This may put your computer and your data at risk. Only enable shared folders if you trust the virtual machine with your data.

- Disabled
- Always enabled
- Enabled until next power off or suspend

Folders

<table>
<thead>
<tr>
<th>Name</th>
<th>Host Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>D:WWW</td>
</tr>
<tr>
<td>E</td>
<td>E:WWW</td>
</tr>
</tbody>
</table>
Folder sharing
USB memory

A USB device is about to be unplugged from the host and connected to this virtual machine. It will first be stopped to enable safe removal. With some devices, the host may display the message "The device can now safely be removed."

- Do not show this message again

OK Cancel
USB memory

```
control@lab-pc2:/media$
control@lab-pc2:/media$
control@lab-pc2:/media$ cd
control@lab-pc2:~/media$ ls
7489-2D9C floppy floppy0
control@lab-pc2:/media$
```