CHAPTER 11

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Using Intel Hardware Accelerated Execution Manager on Windows, Mac OS, and Linux to Speed Up Android on x86 Emulation

I do not fear computers. I fear the lack of them.

—Isaac Asimov

Once the Android SDK is installed, the Android emulator is running, and your development environment is set up to your liking, there is still one frustration ahead: the Android emulator can be extremely slow. Especially when testing and debugging larger applications, the emulator's speed is a noticeable bottleneck in development. The best solution to this is the Intel Hardware Accelerated Execution Manager (Intel HAXM) with Intel Virtualization Technology (Intel VT). If your development system uses one of the supported Intel processors, this hardware-assisted virtualization engine, or hypervisor, will enable lightning-fast Android emulation.

Introduction

This software:

- Uses Intel VT, available on select Intel processors.

- Provides hardware-accelerated emulation of Intel x86 Android virtual devices.

- Integrates with the Android SDK.

- Intel HAXM requires the Android SDK to be installed (version 17 or higher). For best performance, using SDK version 2.0 or higher is recommended.

- Recent Windows or Mac OS X (32/64-bit).

As an important note, Intel HAXM cannot be used on systems without an Intel processor nor an Intel processor without the required hardware features. To determine the capabilities of your Intel processor, please visit http://ark.intel.com/. Additionally, Intel HAXM can only accelerate Android x86 system images for emulator x86. HAXM has been validated with x86 system images provided by Intel at http://www.intel.com/software/android.

Downloading Intel HAXM

Intel HAXM can be installed either through the Android SDK Manager (recommended), or manually, by downloading the installer from Intel's web site.


■ **Note** Intel HAXM does not automatically check for updates. To get the latest version, download the Intel HAXM package using the Android SDK Manager (recommended) or from the Intel Software Network Android developer site.

Downloading Through Android SDK Manager

1. Start the Android SDK Manager.

2. Under Extras, check the box next to Intel x86 Emulator Accelerator (HAXM), as seen in Figure 11-1.
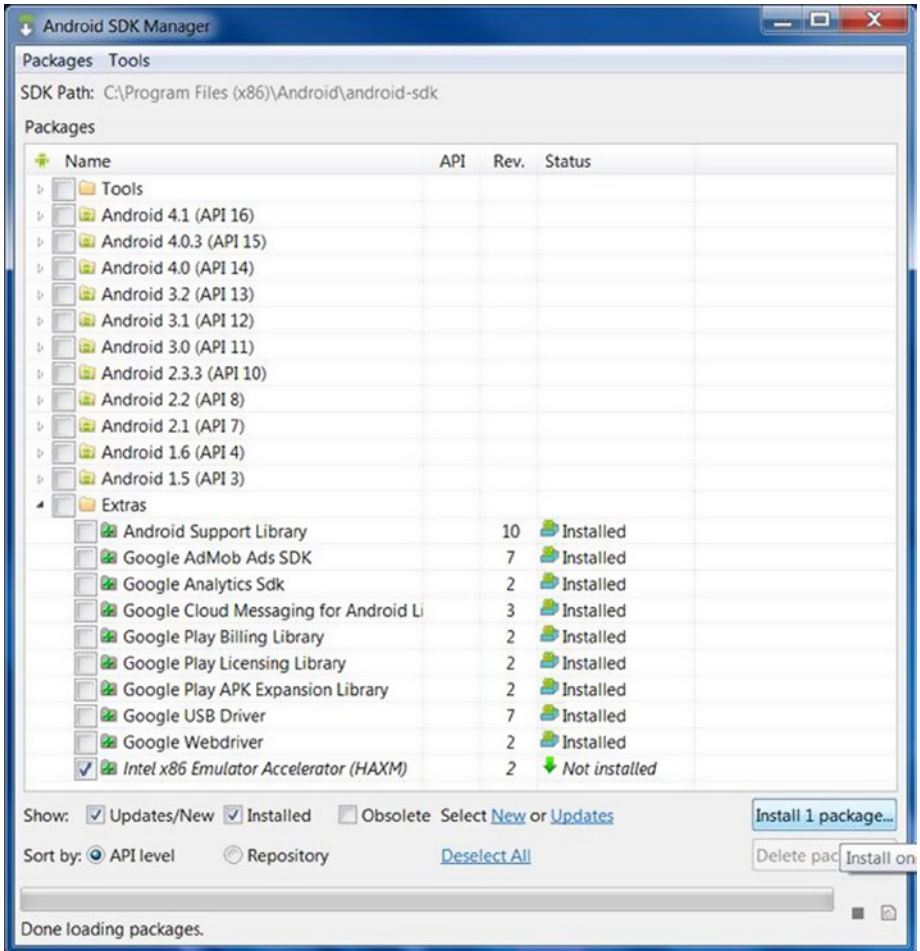
Figure 11-1. *Downloading the Intel x86 Emulator Accelerator (HAXM)*

3. Click the Install Package button.

4. Review the Intel Corporation license agreement. If you accept the terms, select Accept and click Install.

5. The SDK Manager will download the installer to the Tools directory, under the main SDK directory.

6. Extract the installer inside the Tools directory and follow the installation instructions for your platform.

Downloading Manually

1. Go to http://www.intel.com/software/android.

2. Choose the Intel HAXM installer package for your platform.

3. Extract the installer and follow the installation instructions for your platform.

Installing Intel HAXM on Windows

■ **Warning** Intel HAXM installation will fail if your system does not meet the system requirements, including support for Intel processor features, such as Intel Virtualization Technology (Intel VT).

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1. Download the installer package from http://www.intel.com/software/android or by using the SDK manager.

2. Run the installer (and accept the UAC prompt, if applicable).

3. If an older version Intel HAXM is installed, you will see something like Figure 11-2.

Figure 11-2. *Notification Dialog*

4. Click Yes to upgrade Intel HAXM, or click No to exit the installation and keep the currently installed version of Intel HAXM.

5. You will see a screen like Figure 11-3.

Figure 11-3. *HAXM Installation Screen*

■ **Note** You can access the documentation at any time by clicking Intel HAXM documentation.

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6. Click Next.

7. Read the Intel HAXM End-User License Agreement (EULA) and, if you agree, accept the EULA and continue installing Intel HAXM.

8. You will be prompted to adjust the amount of RAM allocated to Intel HAXM, as shown in Figure 11-4.
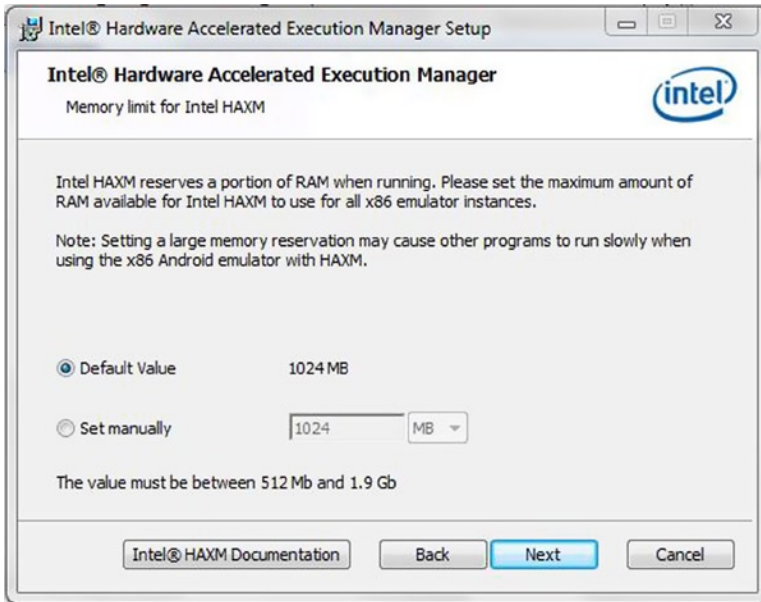
Figure 11-4. *HAXM RAM Adjustment Screen*

■ **Note**   The installer also functions as a configuration tool for Intel HAXM. To change your
memory settings, run the installer again.

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9. Figure 11-5 confirms your Intel HAXM memory allocation
    settings.

Figure 11-5. *Intel HAXM Ready to Install*

      10. When the Intel HAXM installation is finished, click Finish to exit the installer.

Intel HAXM is now installed and ready to use. To verify that Intel HAXM is running, open a command prompt window and execute the following command:

```
sc query
intelhaxm
```

     If Intel HAXM is working, the command will show a status message indicating that the state is **4 RUNNING**.

     To stop Intel HAXM, use these commands:

```
sc stop
intelhaxm
```

     To start Intel HAXM, use these commands:

```
sc start
intelhaxm
```

Adjusting Intel HAXM Memory Allocation

To change the amount of memory allocated to Intel HAXM, run the installer again.

■ **Note** Changes to Intel HAXM memory settings will take effect when Intel HAXM is restarted. Currently running emulators will continue to use the previous memory setting.

Intel Virtualization Technology (Intel VT-x) Capability

When installing Intel HAXM, you may encounter an error regarding Intel VT-x support. This error message can be triggered by the following conditions:

- Intel VT-x is not supported by your computer's processor.

- Intel VT-x is not enabled.

Intel VT-x Is Not Supported

Intel HAXM requires an Intel processor with Intel VT-x functionality and cannot be used on systems lacking this hardware feature. To determine the capabilities of your Intel processor, visit http://ark.intel.com/.

Intel VT-x Is Not Enabled

In some cases, Intel VT-x may be disabled in the system BIOS and must be enabled within the BIOS setup utility. To access the BIOS setup utility, you press a certain key during the computer's boot sequence. This key is dependent on which BIOS is used, but it is typically F2, Delete, or the Esc key. Within the BIOS setup utility, Intel VT may be identified by the terms "VT," "Virtualization Technology," or "VT-d." Make sure to enable all of the virtualization features. For specific information on entering BIOS setup and enabling Intel VT, contact your hardware manufacturer.

Tips and Tricks

The following list contains some recommendations to get the best experience out of the Android emulator using the Intel HAXM driver:

- Enable the GPU acceleration in the AVD Manager for your image. The HAXM driver executes most CPU instructions natively through Intel Virtualization Technology in the processor and the GPU acceleration offloads the OpenGL calls to the host GPU. As of SDK release 19, the GPU acceleration is considered "experimental" by Google.

- Launch the emulator from the command line to get more
  verbose output.

- Use the following command to launch the emulator:

```
emulator-x86 –avd <avd name> -partition-size 1024 –gpu on –verbose
```

- A partition size of 1024 allows 1GB of apps to be installed. This is
  different from the SDCard size option in the AVD manager, which
  specifies how much storage for storing media files is allotted
  inside of the emulator. Setting the GPU to **on** will provide better
  graphics performance.

- Make sure the **Path** environment variable to the GPU emulation
  libraries is set in Control Panel ➤ System ➤ Advanced System
  Settings ➤ Environment Variables. You can also set it manually
  each time a new command prompt is launched. Setting it
  manually is recommended if you are using multiple SDK installs.
  The following **<sdk install location>** typically refers to:

```
"c:\Users\<your username>\android-sdk" set PATH=%PATH%;<sdk install
location>\tools\lib
```

- When installing Intel HAXM, set the driver to use half of the
  available RAM in the system. For example, if your system has 6GB
  of installed memory, then use 3GB for the Intel HAXM driver.
  This allows for a good balance of memory for the HAXM driver as
  compared to the system memory.

- When creating the image, don't set the Device RAM Size option
  larger than the amount of RAM allocated to the Intel HAXM
  driver. In the previous example, the Device RAM Size should not
  be larger than 3GB since only 3GB were allocated to Intel HAXM.

- The maximum memory for the Intel HAXM driver that can be
  chosen for a 32-bit system is 1.6 GB. For a 64-bit system, the
  maximum is 8GB.

Sometimes, when booting an image for the first time, it will appear to be hung at the
boot screen. The boot process is completed, but the home screen doesn't appear. Click on
the Home button on the emulator to show the home screen.

Mac OS

1. Download the installer package from http://www.intel.com/software/
   android or by using the SDK Manager.

2. Open the DMG fil e, then run the installer contained inside.

3. If an older version Intel HAXM is installed, you will see a notification dialog. Click OK to dismiss the dialog. Then you can either exit the installer, to keep your current version of Intel HAXM, or continue with the installation and upgrade your version of Intel HAXM.

4. You will see a welcome screen, like Figure 11-6.
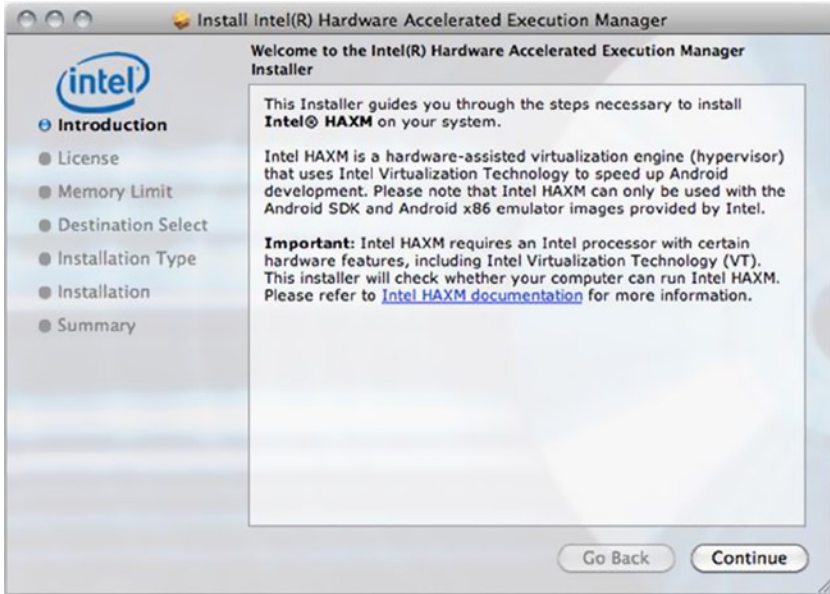
Figure 11-6. *Intel HAXM Welcome Screen on Mac OS*

5. Click Continue.

6. Read the Intel HAXM End-User License Agreement (EULA) and, if you agree, accept the EULA and continue installing Intel HAXM.

7. You will be prompted to adjust the amount of RAM that will be allocated to Intel HAXM, as shown in Figure 11-7.
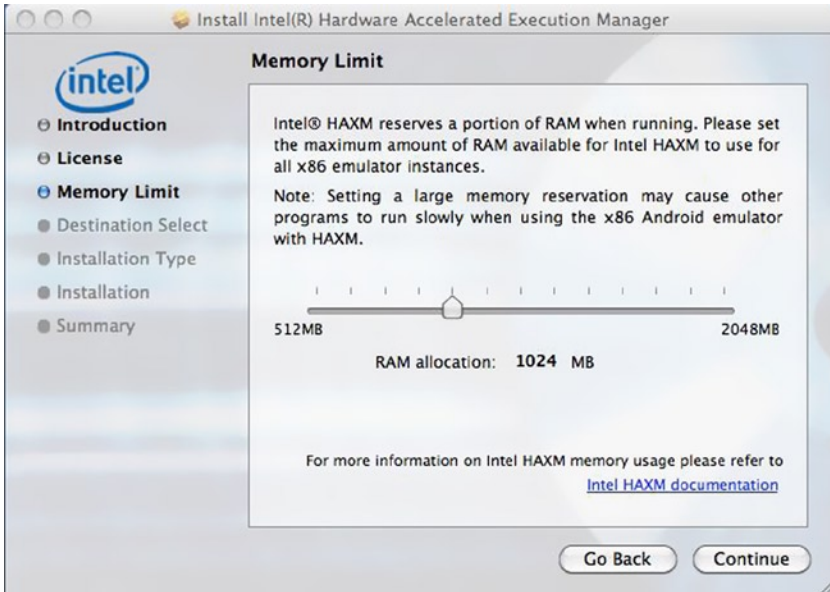
Figure 11-7. *Intel HAXM RAM Adjustment Screen on Mac OS*

8. Figure 11-8 confirms your Intel HAXM memory allocation settings.

Figure 11-8. *Intel HAXM Finish Screen on Mac OS*

9. Select the drive where Intel HAXM will be installed, then click Continue.

10. Once Intel HAXM is installed, click Close to exit the installer.

11. Intel H AXM is now installed and ready to use.

To verify that Intel HAXM is running, open a terminal window and execute the following command:

```
kextstat | grep
intel
```

If Intel HAXM is operating correctly, the command will show a status message indicating that the kernel extension named **com.intel.kext.intelhaxm** is loaded.

To stop Intel HAXM, use the following commands:

```
sudo kextunload -b
com.intel.kext.intelhaxm
```

To start Intel HAXM, use the following commands:

```
sudo kextload -b
com.intel.kext.intelhaxm
```

Adjusting Intel HAXM Memory Allocation

To change the amount of memory allocated to Intel HAXM, run the installer again.

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■ **Note** Changes to Intel HAXM memory settings will take effect when Intel HAXM is restarted. Currently running emulators will continue to use the previous memory setting.

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Removing Intel HAXM

To uninstall Intel HAXM, open a terminal window and execute this command:

```
sudo
/System/Library/Extensions/intelhaxm.kext/Contents/Resources/uninstall.sh
```

You will be prompted for your current user password. Follow the uninstaller prompts to remove Intel HAXM.

■ **Important** Removing Intel HAXM will disable acceleration of all Intel x86 Android emulators. Existing Android virtual devices will continue to function, but will no longer be accelerated. Installing Intel HAXM again will re-enable Android emulator acceleration.

Troubleshooting

Intel HAXM requires an Android x86 system image provided by Intel. You can download these images through the Android SDK manager or manually from the Intel Developer Zone web site.

Intel Execute Disable (XD) Bit Capability Error

When installing Intel HAXM, you may encounter an error regarding Intel XD support.
    This error message can be triggered by the following conditions:

- Intel XD is not supported by your computer's processor.
- Intel XD is not enabled.

Intel XD Is Not Supported

Intel HAXM requires an Intel processor with Execute Disable (XD) bit functionality and cannot be used on systems lacking this hardware feature. To determine the capabilities of your Intel processor, visit `http://ark.intel.com/`.

Intel XD Is Not Enabled

■ **Note** Apple computers have Intel XD permanently enabled if supported by the processor.

    If you receive an error message indicating that Intel XD is not enabled, your computer does not meet the minimum system requirements to use Intel HAXM. To determine the capabilities of your Intel processor, visit `http://ark.intel.com/`.

Intel Virtualization Technology (VT-x) Capability

When installing Intel HAXM, you may encounter an error regarding Intel VT-x support.

This error message can be triggered by the following conditions:

- Intel VT-x is not supported by your computer's processor.

- Intel VT-x is not enabled.

Intel VT-x Is Not Supported

Intel HAXM requires an Intel processor with Intel VT-x functionality and cannot be used on systems lacking this hardware feature. To determine the capabilities of your Intel processor, visit http://ark.intel.com/.

Intel VT-x Is Not Enabled

■ **Note** Apple computers have Intel VT-x permanently enabled if supported by the processor.

If you receive an error message indicating that Intel VT is not enabled, your computer does not meet the minimum system requirements to use Intel HAXM. To determine the capabilities of your Intel processor, visit http://ark.intel.com/.

Tips and Tricks

The following list contains recommendations to get the best experience out of the Android emulator using the Intel HAXM driver:

- Enable the GPU acceleration in the AVD manager for your image. The Intel HAXM driver executes most CPU instructions natively through the Intel Virtualization Technology in the processor and the GPU acceleration offloads the OpenGL calls to the host GPU.

- Use the following command in the terminal to launch the emulator:

```
./emulator-x86 –avd <avd name> -partition-size 1024 –gpu on
```

- A partition-size of 1024 allows 1GB of apps to be installed. This is different from the SDCard size option in the AVD manager, which specifies how much storage for storing media files is allotted inside of the emulator. Setting the GPU to **on** will provide better graphics performance.

- Make sure that the environment variables for the GL libraries are set correctly. Set the **LD_LIBRARY_PATH** variable by using the following command in the terminal. Modify the command to point to your SDK installation.

```
export LD_LIBRARY_PATH=<sdk install location>/tools/lib
```

- To automatically run this command whenever a new terminal is started, you can add this command to your **~/.bash_profile** script.

- When installing Intel HAXM, set the driver to use half of the available RAM in the system. For example, if your system has 6GB of installed memory, then use 3GB for the Intel HAXM driver. This allows a good balance of memory for the Intel HAXM driver as compared to the system memory.

- When creating the image, don't set the Device RAM Size option larger than the amount of RAM allocated to the Intel HAXM driver. In the previous example, the device RAM size should not be larger than 3GB since only 3GB were allocated to Intel HAXM.

- The maximum memory for the Intel HAXM driver on a 32-bit system is 1.6GB. For a 64-bit system, the maximum is 8GB.

- Sometimes, when booting an image for the first time, it will appear to be hung at the boot screen. The boot process is completed but the home screen doesn't appear. Click on the Home button on the emulator to show the home screen.

Linux

Since Google mainly supports Android builds on the Linux platform, and a lot of Android developers are using AVD on Eclipse hosted by a Linux system, it is critical that Android developers take advantage of Intel hardware-assisted KVM virtualization for Linux just like Intel HAXM for Windows and IOS. To enable KVM on the Ubuntu host platform and to begin using the Intel Android x86 emulator with Intel hardware-assisted virtualization (hypervisor), use the following steps.

KVM Installation

The first step is to install the required KVM by following the instructions from the Ubuntu community page (https://help.ubuntu.com/community/KVM/Installation). To check if your system's processor supports hardware virtualization, use this command:

```
$ egrep -c '(vmx|svm)' /proc/cpuinfo
```

If the output is **0**, it means that your CPU doesn't support hardware virtualization. The next step is to install the CPU checker:

```
$ sudo apt-get install cpu-checker
```

Now you can check if your CPU supports KVM by issuing the following command:

```
$kvm-ok
```

If you see this message:

```
"INFO: Your CPU supports KVM extensions
INFO: /dev/kvm exists
KVM acceleration can be used"
```

It means you can run your virtual machine faster with the KVM extensions.
However, if you see this:

```
"INFO: KVM is disabled by your BIOS
HINT: Enter your BIOS setup and enable Virtualization Technology (VT),
and then hard poweroff/poweron your system
KVM acceleration can NOT be used"
```

You need to go to the BIOS setup and enable Intel VT.

Install KVM

For Ubuntu Lucid (10.04) or later, use the following command:

```
$ sudo apt-get install qemu-kvm libvirt-bin ubuntu-vm-builder bridge-utils
```

Next, add your **‹username›** account to the **kvm** and **libvirtd** groups:

```
$ sudo adduser your_user_name kvm
$ sudo adduser your_user_name libvirtd
```

After the installation, you need to log in again so that your user account becomes an effective member of the **kvm** and **libvirtd** user groups. The members of these groups can run virtual machines. You can verify that your installation has been successful with the following command:

```
$ sudo virsh -c qemu:///system list
```

Your screen will paint the following if the installation was successful:

```
Id Name                          State
```

Start the AVD from Android SDK Directly from Terminal

Now start the Android for x86 Intel emulator, shown in Figure 11-9, using the following command:

```
$ <SDK directory>/tools/emulator-x86 -avd Your_AVD_Name -qemu -m 2047
-enable-kvm
```
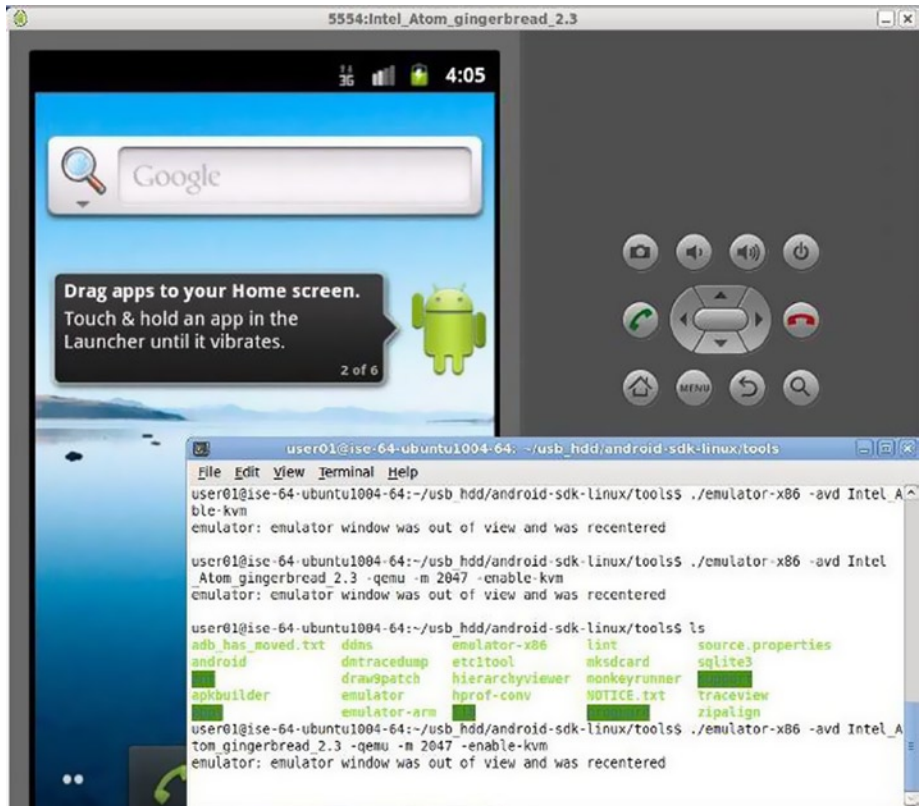

Figure 11-9. *Intel HAXM on Linux*

Only a 64-bit Ubuntu can allow you to run allocated memory of 2GB or more. My 64-bit Ubuntu has 6GB of memory, so I used one third of it for Android AVD. My AVD named **Intel_Atom_gingerbread_2.3. '-qemu'** provides the options to **qemu**, and the **-m** specifies the amount of memory for the emulated Android (that is, guest). If you use too small a value for that, it's possible that performance will suffer because of frequent swapping activities. Add **-show-kernel** to see the message from the kernel.

Start the AVD by AVD Manager in Eclipse

The following procedures are recommended by Google. If you are running the emulator from Eclipse, run your Android application with an x86-based AVD and include the KVM options:

1. In Eclipse, click your Android project folder and then select Run ➤ Run Configurations.

2. In the left panel of the Run Configurations dialog, select your Android project to run a configuration or to create a new configuration.

3. Click the Target tab.

4. Select the x86-based AVD you created previously.

5. In the Additional Emulator Command-Line Options field, enter:

```
-qemu -m 2047 -enable-kvm
```

6. Run your Android project using this run configuration.

Overview

This chapter covered the installation of the Intel Hardware Accelerated Execution Manager (Intel HAXM) with Intel Virtualization Technology (Intel VT). These tools provide you with the fastest and most efficient all-around experience as an Android x86 developer. This chapter included sections specific to each major operating system—Windows, Mac OS, and Linux. These sections highlighted not only the install process, but also tips and tricks for troubleshooting some common problems.