



Networking Level Laboratory

WSN Software Platform TinyOS: Installation and Configuration





Purpose/Objective:

Learn how to install and setup the programming environment for wireless sensor networks. Create Linux environment and install TinyOS that supports C compilation. First configure and install a virtual machine of Osian Linux within Virtual Box, then install TinyOS.

Introduction to Wireless Sensor Networks

Wireless sensor networks are made up of multiple nodes, which communicate with each other and to a base station via an onboard antenna controlled by onboard radio chip. The nodes can be fitted with a variety of sensors such as temperature, heat or pressure to monitor the local environment. The behavior of each node is controlled by a microcontroller, which can be configured according to the needs of the network operator.

WSN Applications:

All the sensing, communication and computation consumes little power, thus such nodes can be battery powered and can be deployed virtually anywhere for prolonged periods. Some modern uses of sensor networks include environment monitoring of large buildings through the use of pressure sensor equipped nodes or the structure integrity of bridges. Sensor networks have even been deployed for use in habitat monitoring where human presence would have a negative impact on the local wild life.

TinyOS Programming

TinyOS is an open source, BSD-licensed operating system designed for low-power wireless devices, such as those used in sensor networks, ubiquitous computing, personal area networks, smart buildings, and smart meters. Low power wireless devices make use of a programming language called NesC supported by TinyOS. While it is similar to the C language, it has some significant differences.

When creating a TinyOS application three files will be needed: the program file App.nc, the AppC.nc file and the Makefile. The program file contains the code that has implementation of functions dictating the operation of the device. The AppC file, or the configuration file, contains device names and “wirings” showing the relationship / interaction between the current application program and other application programs. In essence, the AppC file makes the device’s hardware available to the code written in the program file (APP file). The Makefile contains the rules that tell the compiler how to compile the code for use with TinyOS devices. In most cases the Makefile will remain the same, as the TinyOS software packages will have all the compiler configurations preinstalled.

Installing TinyOS and Environment Configuration

Download the following

Virtual Box - <https://www.virtualbox.org/wiki/Downloads>

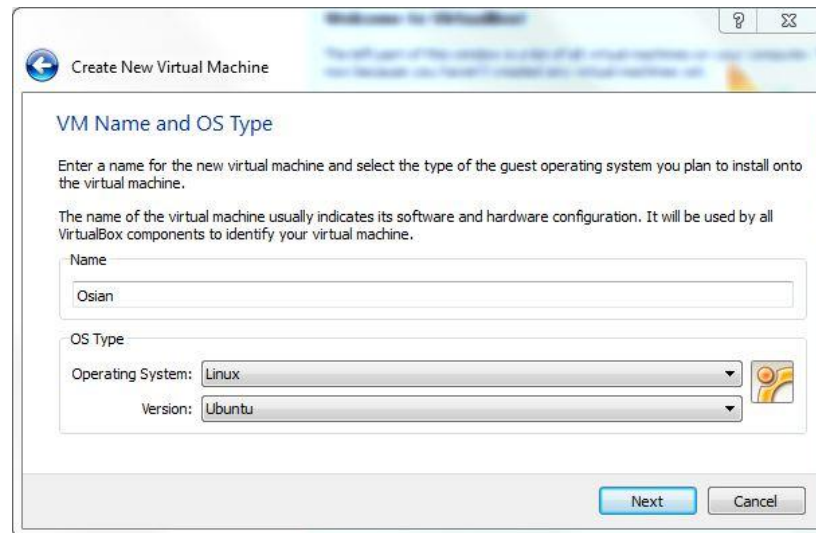
Osian Linux - www.tech.uh.edu/isgrin/resources/Osian_Linux.iso

Step 1. Create a new Virtual Machine

Install Virtual Box and make sure that there is a hard drive with at least 16GB available. Although Virtual Box is only around 100MB the image file which houses the Virtual Machine's hard drive will be at least 8GB.

1. Set this OS Type to **Ubuntu Linux**

! Setting the wrong OS Type can cause the installation of Guest Additions to fail later.

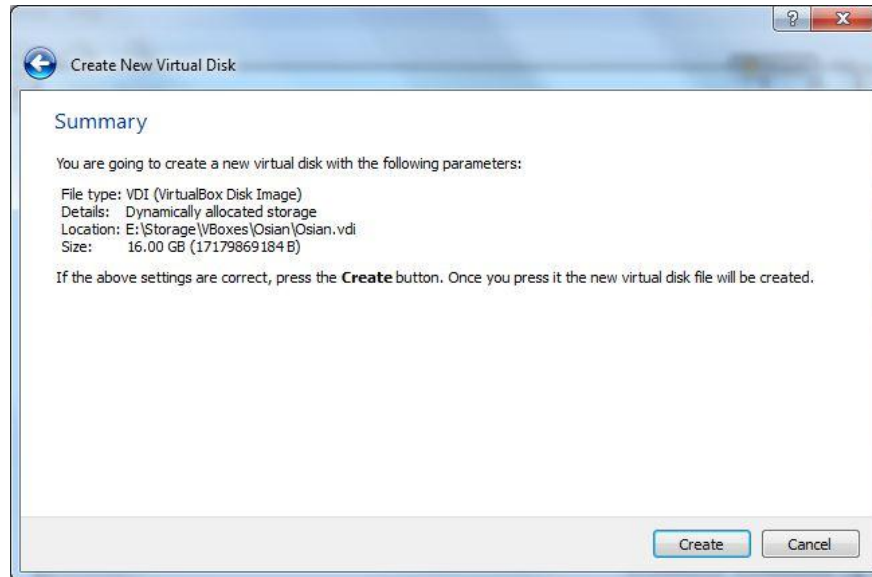


2. Allocate at least 512MB to the Virtual Machine
3. Create a new Virtual Disk

The Virtual Disk will act as the Virtual Machine's hard drive

4. Select VDI (Virtual Box Disk Image) for the file type: Dynamic Allocation and Fixed Size will both function. It does not matter which is selected.
5. Set the disk size to 16GB. 8GB will work but will leave storage space on the VM very limited.
6. After allocating the VM space, the Virtual Disk will be ready to be created.

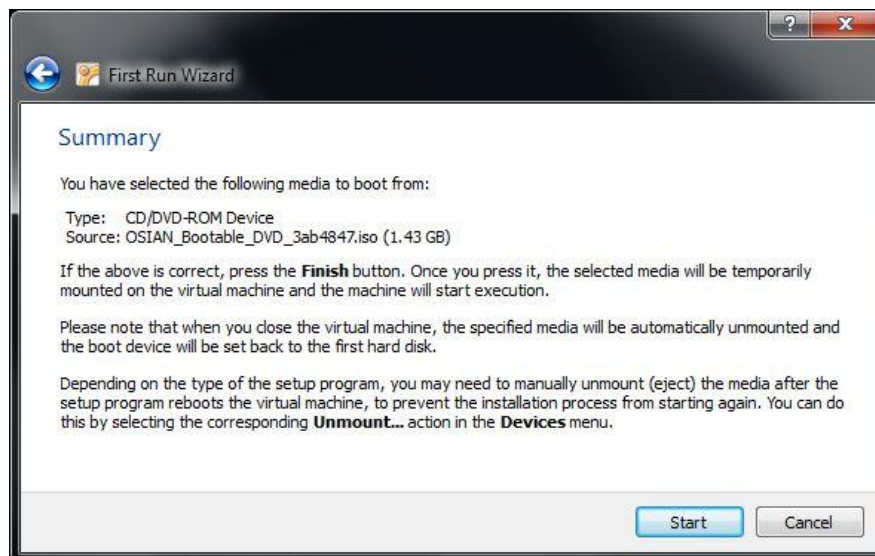
You should see something like the figure shown below.



Step 2. Virtual Machine First Run

Once the Virtual Machine has been created, it is ready to be launched. This section will cover the installation of the Osian operating system onto the currently blank Virtual Machine. The .iso file for Osian Linux will be needed before continuing.

1. When prompted, direct the First Run Wizard to the Osian Linux iso file
2. Once the .iso is selected the Virtual Machine will be able to boot



3. When the Virtual Machine finishes booting select the "Install Osian" option. The Virtual Machine will do some checks to ensure installation is possible.

Note: It is not necessary to download updates during installation. The .iso file has everything needed to configure TinyOS devices.

4. Allow the Virtual Machine to erase and use the entire disk

Only the Virtual Disk file will be affected by installation of Osian

During installation the Virtual Machine will ask for some basic configuration such as time zone and set up of a user account. The user created during the installation phase is also the root user for the virtual machine. **Do not forget the password, it will be needed to gain root privileges!**

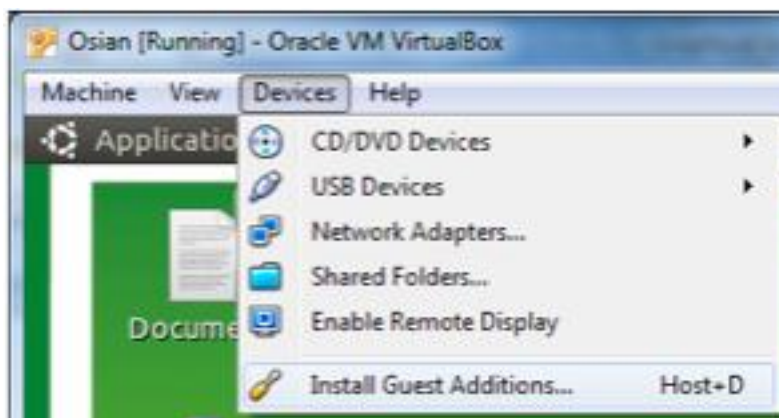
Now that Osian Linux is installed to the Virtual Disk, the .iso file is no longer needed.

Step 3. Installing Guest Additions

“Guest Additions” will be installed into the Virtual Machine in this step to allow better integration with the Host Operating system.

Note: If the VM asks to upgrade to Natty Narwhal, Decline

As shown in the figure below, under the “devices” menu of the VM’s window, select the Install Guest Addition’s option. Once Guest Additions are installed it will be possible to resize the VM’s window



Step 4. Testing installation: Loading a Program onto a Tmote node

With the virtual machine fully functional it is now possible to start working with TinyOS devices. To verify the TinyOS is installed properly and all its features of Osian are working, a wireless sensor node will be loaded with a basic program.

1. Plug the Tmote into an available USB port on your computer;
2. Give the Virtual Machine control of the mote;
3. Go to the devices menu on the VM’s window -> Under USB devices, the Tmote should show up, select the Tmote;



4. Launch a terminal
5. To verify that the Tmote shows up enter the command '**motelist**', this will list all Tmotes attached to the computer with their device addresses
6. Change the active directory to '**/opt/tinyos-2.x/apps/Blink**'
7. Use the command '**make telosb install, 1**' to load "Blink" program into the Tmote;
8. Once the program is finished downloading the mote should execute the program. That is, the 'Blink' program blinks the onboard LEDs.

Congratulations! You just verified that the Osian and the TinyOS components are installed correctly.