# **Software Requisites:**

In this section, the requirements to install emuEdge Server and Client on a system are mentioned. In addition to requirements, the steps for installing the Android SDK command line tool and creating AVDs are explained.

The following requirements should be provided to be able to install the emuEdge components.

* Java SE Development Kit 20 ([download](https://www.oracle.com/java/technologies/javase/jdk20-archive-downloads.html));

Please do not forget to set the JAVA\_HOME environment variable ([Link](https://www3.ntu.edu.sg/home/ehchua/programming/howto/Environment_Variables.html#zz-2.2) to how to set environment variable).

* Apache Tomcat Server v9 ([download](https://tomcat.apache.org/download-90.cgi)); \*
* Localhost network ports available for Termite2-Cli: 8081; \*
* Local network ports available for Termite2Server: 7000, (8085\*\* and 8095\*\*);
* Most up-to-date Android SDK command line tools ([download](https://developer.android.com/studio?gclid=CjwKCAjwrpOiBhBVEiwA_473dASLL9IAfVl1UZ6B83QVVutn3v8Lx_bUxo_j2M_458WC-X5MGXY_jhoCD1wQAvD_BwE&gclsrc=aw.ds)).

\* This is only needed if the user intends to use the emuEdge GUI (this is required to evaluate the reusability claim).

\*\* These ports can be user configured by accessing the file config/communicationports.txt on the Termite2Server folder (not recommended).

## **1.1 Installing Android SDK command line tools:**

Please go to the Android developers [link](https://developer.android.com/studio?gclid=CjwKCAjwrpOiBhBVEiwA_473dASLL9IAfVl1UZ6B83QVVutn3v8Lx_bUxo_j2M_458WC-X5MGXY_jhoCD1wQAvD_BwE&gclsrc=aw.ds) and scroll down to the “Command line tools only” section. Download the related package according to your OS.

* **Mac and Linux Operating Systems**

After downloading the package follow the steps below to install the package.

1. Please move the downloaded file to the home folder of your system. First, we need to create a directory to store the Android SDK, so open a terminal window and follow the steps:

~ $ mkdir android

~ $ cd android

1. Then we need to move and unzip the tools in the android directory we just created. Please note that the name of the file should be replaced according to your download file name. So, please replace “commandlinetools-mac-6858069\_latest.zip” with the correct name in the following commands.

~/android $ mv ~/commandlinetools-mac-6858069\_latest.zip ./

~/android $ unzip commandlinetools-mac-6858069\_latest.zip

~/android $ rm commandlinetools-mac-6858069\_latest.zip

1. After unzipping the content, you will get a directory named cmdline-tools. Please run the following steps in the android directory in the terminal:

$ cd cmdline-tools

$ mkdir tools

$ mv -i \* tools

The last command will probably give you a warning, but you don’t need the worry about that.

1. Now before we can add tools to path we have to add $ANDROID\_HOME to the path, to do that just open the .zshrc, .profile, or .bash\_profile (depending on your terminal) in your preferred terminal file editor (nano or vim) and add the following code at the end of the file:

export ANDROID\_HOME=$HOME/android

export PATH=$ANDROID\_HOME/cmdline-tools/tools/bin/:$PATH

export PATH=$ANDROID\_HOME/emulator/:$PATH

export PATH=$ANDROID\_HOME/platform-tools/:$PATH

1. After adding the code, please save the file, close the terminal window, and open a new terminal window. After you have opened a new terminal window just type the following command and hit return/enter.

$ sdkmanager --list

If the progress bar and then the list of packages are shown, your tools have been set up successfully.

1. The basic packages you need to install are as follows.

$ sdkmanager --install "platform-tools"

$ sdkmanager --install "platforms;android-30"

$ sdkmanager --install "build-tools;30.0.3"

$ sdkmanager --install "emulator"

$ sdkmanager --install "system-images;android-30;google\_apis;x86\_64"

If you got any error during running the above commands, please try to type the commands instead of copying them. Please note that if your CPU is not Intel, you need to install arm-based system images (in the last command, the system image should be replaced with an arm-based system image from the output of the “sdkmanager --list” command).

* **Windows Operating Systems**

Please follow the instructions on this [link](https://android.tutorials24x7.com/blog/how-to-install-android-sdk-tools-on-windows).

## **1.2. Create AVDs**

To be able to run the test scripts for networks with at most two nodes (small setup), we need to create two AVDs. To generate all the results shown in the figures in the paper, we need to create 10 AVDs. By repeating the following commands, we can create more AVDs.

* $ avdmanager create avd -n emu1 -k "system-images;android-30;google\_apis;x86\_64"
* $ avdmanager create avd -n emu2 -k "system-images;android-30;google\_apis;x86\_64"

Please note that “emu1” and “emu2” are the names of the AVDs that we are creating. You could replace these names with any arbitrary name. In order to check if the emulators work, please run the "emulator @emu1" command on the terminal\cmd. If the emulator starts successfully, shut it down and continue to the installing emuEdge Server section. Otherwise, please look up the error reported by Android.

# **Installing the emuEdge Server component**

1. Set the following environmental variables:

* TERMITE2\_SERVER\_PATH=“path to Termite2Server folder”
* ANDROID\_SDK\_PATH=“path to android sdk”

1. Please insert the IP address of the network interface connected to the internet (your local network IP address) to the localnetwork.txt file in the config folder in the Termite2Server folder (~/Termite2Server/config/ localnetwork.txt).

You could use this [link](https://www.avg.com/en/signal/find-ip-address) to find out how to check your IP address on Mac and Windows. Please use this [link](https://www.ionos.com/digitalguide/hosting/technical-matters/get-linux-ip-address/) to find your IP address on Linux.

1. Please open a command line window (cmd for Windows and terminal for Mac and Linux) and go to the Termite2Server directory/folder by using the cd command. Run the server by using the following command:

* In Linux or Mac OS - run the script termite2server.sh
* In Windows - run the batch file termite2server.bat

1. If everything goes well the following output is expected:

Termite2 Server ONLINE on network 192.168.1.X:

Working Directory = …/Termite2 Server

TERMITE2\_PLATFORM = mac

ANDROID\_SDK\_PATH = …/Library/Android/sdk

Type "help" or "h" for the full command list

Termite2Server is now up and ready; now let’s install Termite2-Cli.

# **Installing the emuEdge Client component**

1. Set the following environmental variables:

* TERMITE2\_CLI\_PATH=“path to Termite2-Cli folder”
* TOMCAT\_PATH=“…/apache-tomcat-9.0.34” (This variable is optional and is only needed if the user intends on using emuEdge GUI)

1. Set the Termite2Server(s) network(s):

For Termite2-Cli to connect with the Termite2Server(s) first we need to indicate to Termite2-Cli where each Termite2Server is running. To do this we need to provide the network IP of each machine running Termite2Server.

* Please open the text file at ~/Termite2-Cli/config/networks.txt

Here we could type each Termite2Server network and the client port we wish the Termite2-Cli to connect to (this IP address is the same IP address we obtained in the second step in installing the emuEdge Server), ex:

192.168.0.101:8085

1. Run the Termite2-Cli:

* In Linux or Mac OS - run the script termite2cli.sh
* In Windows - run the batch file termite2cli.bat

1. If everything goes well, UI options will be shown. Please, choose 1 to continue with the command line interface.

Please note that to use the second option (i.e., Google Map UI) you have to get Google Map API [Key](https://developers.google.com/maps/documentation/javascript/get-api-key). After getting the key, please add it to the apikey.txt file. This file is located in the "Termite2-Cli/ui/ Termite2UI/" directory. You can use this key for free for up to 90 days, for more usage there is a need for payment. The OpenStreetMap API (the third option) is free. However, you have to get a key for [OpenRoutService](https://openrouteservice.org/) API (which has a free version) and add it to the apikey\_OpenRouteService.txt file in "Termite2-Cli/ui/Termite2UI\_OpenStreetMap/" directory. We have already included this key.

Now, you are ready for the execution of the tool. To this end, please follow the steps explained in the Execution section of the ReadMe file. To make the process easier for you, the script files are also included in the Distribution.zip folder. As a result, you do not need to turn the emuEdgeClient VM on if you decide to install the emuEdge Client on your machine.