VoIP: Voice over Internet Protocol for Small Single-board Computers

Project Documentation of Term Project

Students:
Trupeshkumar R. Patel
trpatel2@crimson.ua.edu
David Coleman
dmcoleman1@crimson.ua.edu
Xiaoming Guo
xguo29@crimson.ua.edu

Supervisor:
Dr. Xiaoyan Hong
hxy@cs.ua.edu

VoIP: Voice over Internet Protocol for Small Single-board Computers

Trupesh R. Patel*, David Coleman*, Xiaoming Guo*
*Department of Computer Science
College of Engineering
University of Alabama
Tuscaloosa, AL 35487
$\{trpatel2,\ dmcoleman1,\ xguo29\}$@crimson.ua.edu

(Project Documentation)

I. SOFTWARE, HARDWARE & INTERNET REQUIREMENTS

To reproduce or memic the process of this process you will need to satifiy following requirements, and follow the installation steps mentioned in next sections.

A. Hardware Requirements

1) Raspberry Pi 4 from CanaKit (32 GB EVO+, 4GB RAM)
2) Cell Phone (iPhone/Android)
3) Desktop/Laptop (MacBook/Windows/Linux)

B. Software Requirements

1) Raspberry Pi OS with desktop:
   - System: 32-bit
   - Kernel version: 5.15
   - Debian version: 11 (bullseye)
2) Asterisk:
   - Version: 18.11.1
   - Releases: Long Term Support (LTS)
   - Build: From source http://downloads.asterisk.org/pub/telephony/asterisk/asterisk-18-current.tar.gz
3) ZoiPer
   - Version: 5
   - Use: non-commercial
   - For: Mac, Windows, Linux, iOS, Android
4) MicroSIP
   - Version: 3.20.7
   - Use: non-commercial
   - For: Windows
5) Telephone
   - Version: 1.5.2
   - Use: non-commercial
   - For: Mac
6) Wireshark
   - Version: 3.6.3
   - For: Mac, Windows, Linux

C. Internet Requirements

1) eduroam
   - Authority: The University of Alabama
   - Login: <crimson-ID> and <crimson-passphrase>
   - Script: "config_eduroam.sh"

II. Installation of Raspberry Pi OS

To install Raspberry Pi OS on "Raspberry Pi 4 from CanaKit", you will need to download **'Raspberry Pi Imager'** from the website here. The **'Raspberry Pi Imager'** is supported by all OS (Mac/Windows/Linux).
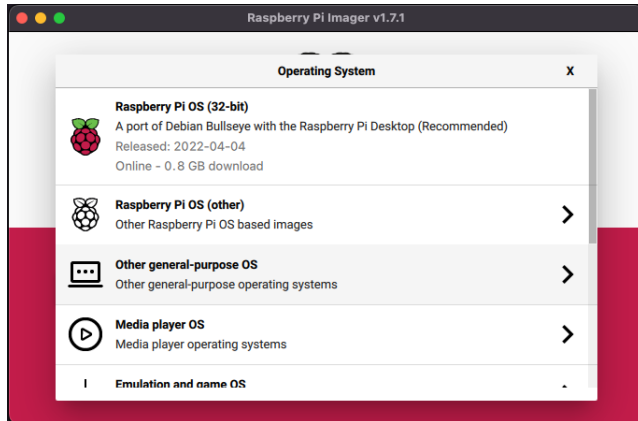
A. Installation of Raspberry Pi Imager on Mac

Step 1: Download Raspberry Pi Imager from here
Step 2: Open/Install "imager_x.x.x.dmg"
Step 3: Run application "Raspberry Pi Imager"

Step 4: Click on "CHOOSE OS" and Select **"Raspberry Pi OS (32-bit) Desktop"**

Step 5: Click on "CHOOSE STORAGE" (**NOTE:** Please make sure you select correct SD card with is in Raspberry Pi 4)
Step 6: Click on "WRITE"
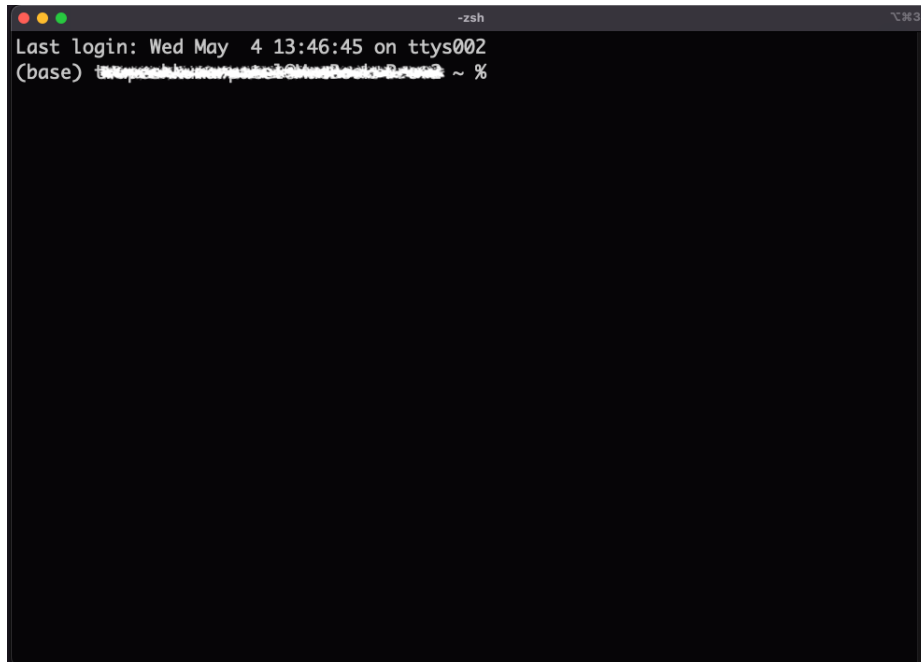**Step 7:** Wait untill writting is complete.

B. Login to Raspberry Pi OS

At the begining the user name of the OS is **"pi"** and password is **"raspberry"**. (**NOTE:** For this project we did **NOT** change any default user and password.)

1) Accessing Raspberry Pi: There are multiple ways you can access the **"pi"** user.
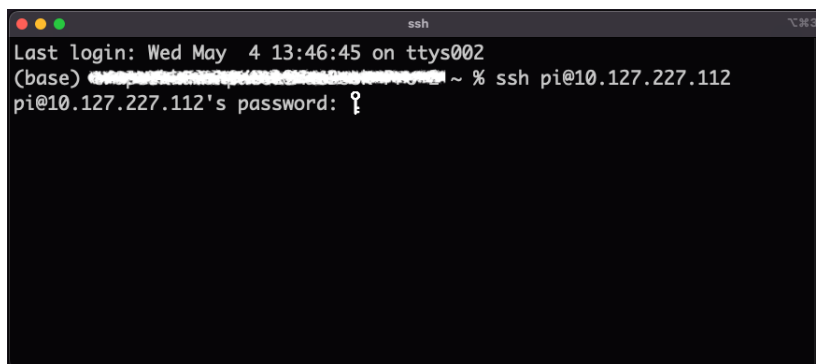
- Accessing through SSH
  To access **"pi"** user using SSH connection you need to make sure that your computer and Raspberry Pi are in same Internet connection. In this project it is "eduroam" connection. To setup "eduroam" connection into your newly install Raspberry Pi OS, please follow the instruction from Section III.
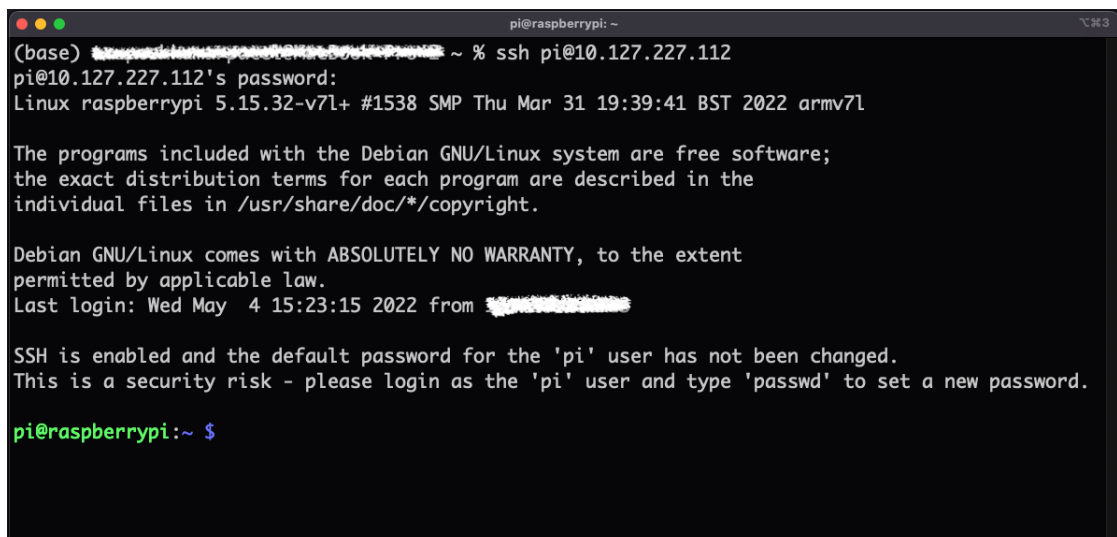
Step 1: Open Terminal in your local computer

Step 2: Type command "`ssh pi@10.127.227.112`" <– here '10.127.227.112' is IP address of Raspberry Pi, in your case might be different.

Step 3: Enter the password "`raspberry`". Please enter the password that you set if you have, else it is going to be same as the authors.
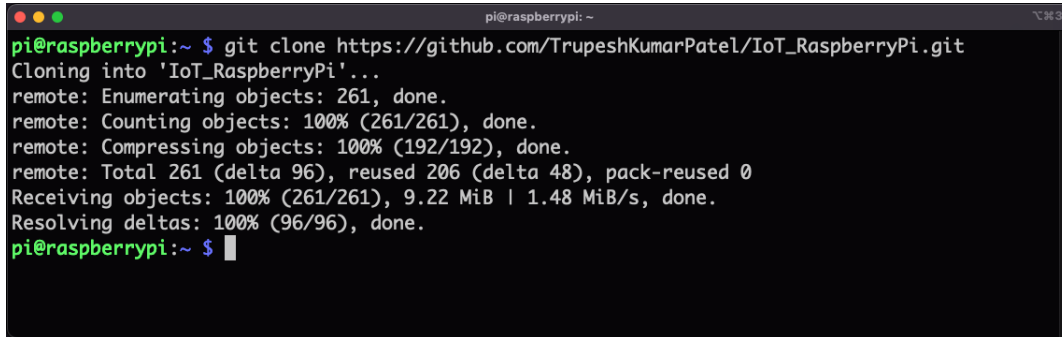
III. CONNECT TO EDUROAM

To re-run the project, you have to connect your Raspberry Pi with "eduroam" network at The Univeristy of Alabama. Now, if you have freshly install the Raspberry Pi OS, then you need to run the script called **"config_eduroam.sh"**, which can be found here.

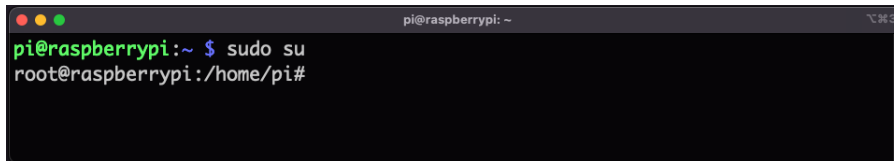### A. Configure Raspberry Pi for eduroam

Step 1: Login to the Raspberry Pi as user "pi"

Step 2: Type command "git clone https://github.com/TrupeshKumarPatel/IoT_RaspberryPi.git"

Step 3: Type command "sudo su" ⚠**NOTE** This command to get sudo access to Raspberry Pi ⚠

Step 4: Type command "chmod +x IoT_RaspberryPi/source_code/eduroam_config/config_eduroam.sh"

Step 4: Type command "./IoT_RaspberryPi/source_code/eduroam_config/config_eduroam.sh"

Step 5: Enter your crimson email address

Step 6: Enter your crimson password

Step 7: Now wait for your Raspberry Pi to restart

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IV. Installation of Asterisk

To install Asterisk same as this project authors, please follow below instructions: (**Note:** Here author installing Asterisk from source code. You can also follow the installation video from InnovationAsterisk)

A. Asterisk Installation from the Source Code

Step 1: Type command "`wget http://downloads.asterisk.org/pub/telephony/asterisk/asterisk-18-current.tar.gz`"

```
pi@raspberrypi:~ $ wget http://downloads.asterisk.org/pub/telephony/asterisk/asterisk-18-current.tar.gz
--2022-05-04 17:17:30--  http://downloads.asterisk.org/pub/telephony/asterisk/asterisk-18-current.tar.gz
Resolving downloads.asterisk.org (downloads.asterisk.org)... 170.249.154.172
Connecting to downloads.asterisk.org (downloads.asterisk.org)|170.249.154.172|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 28078155 (27M) [application/x-gzip]
Saving to: 'asterisk-18-current.tar.gz'

asterisk-18-current.tar.gz          100%[===================================================================>]
  26.78M  3.83MB/s    in 7.1s

2022-05-04 17:17:38 (3.77 MB/s) - 'asterisk-18-current.tar.gz' saved [28078155/28078155]

pi@raspberrypi:~ $
```

Step 2: Type command "`sudo apt-get update`"

Step 3: Type command "`sudo apt-get upgrade`"

Step 4: Type command "`sudo apt-get install ntp`"

Step 5: Type command "`sudo apt-get install speex speex* libspeex-dev libspeexdsp-dev`"

Step 6: Type command "`sudo apt-get install libspeex-dev libspeexdsp-dev speex speex-doc`"

Step 7: Type command "`sudo apt-get install xmlstarlet libopus-dev libopusfile-dev`" <– (**NOTE:** This optional if you don't want browser-base telephony, here author did not do this)

Step 8: Type command "`tar -xvf asterisk-18-current.tar.gz`" <– This command will extract all the source file into folder called "asterisk-18.x.x" (**Note:** here 'x' could be any number based of current relese/download)

Step 9: Type command "`cd asterisk-18.x.x`" <– (**Note:** here 'x' could be any number based of current relese/-download)

Step 10: Type command "`sudo contrib/scripts/install_prereq install`" <– This will check all the prerequisites of Asterisk. This command will ask few promps to set configurations

    1) Telephone code : Type "1" for US

Step 11: Type command "`sudo ./configure -libdir=/usr/lib -with-pjproject-bundled`"

Step 12: Type command "`sudo make menuselect`" <– Please watch this video) from InnovateAsterisk for more details.

Step 13: Type command "`sudo make`"

Step 14: Type command "`sudo make install`"

Step 15: Type command "`sudo make samples`" <– This will create all default Asterisk configuration files

⚠**NOTE: Step 16-17** is only required if you haven't downloaded "IoT_RaspberryPi" GitHub repository from here ⚠

Step 16⚠**:** Type command "`cd    `"

Step 17⚠**:** Type command "`git clone https://github.com/TrupeshKumarPatel/IoT_RaspberryPi.git`"
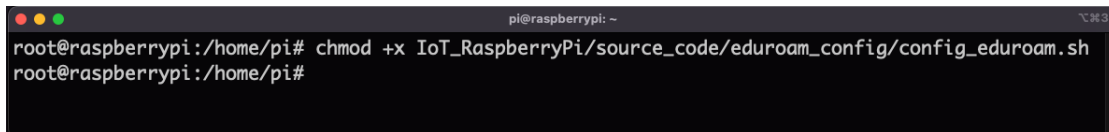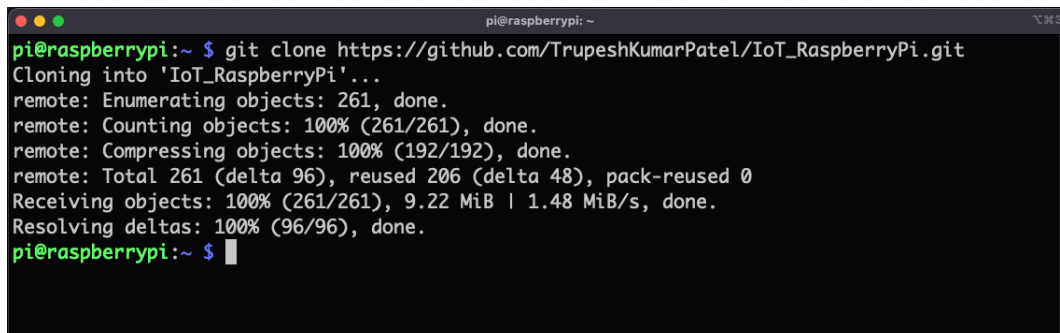
```
pi@raspberrypi:~ $ git clone https://github.com/TrupeshKumarPatel/IoT_RaspberryPi.git
Cloning into 'IoT_RaspberryPi'...
remote: Enumerating objects: 261, done.
remote: Counting objects: 100% (261/261), done.
remote: Compressing objects: 100% (192/192), done.
remote: Total 261 (delta 96), reused 206 (delta 48), pack-reused 0
Receiving objects: 100% (261/261), 9.22 MiB | 1.48 MiB/s, done.
Resolving deltas: 100% (96/96), done.
pi@raspberrypi:~ $
```

Step 18: Types command "`sudo cp -R  /IoT_RaspberryPi/source_code/asterisk_config/* /etc/asterisk/`"

V. COMMAND OF ASTERISK

Now, after following instruction from Section IV, you should be able to run asterisk commands.

- To check the status of Asterisk
  Type command "sudo service asterisk status"
- To start the Asterisk
  Type command "sudo service asterisk start"
- To restart the Asterisk
  Type command "sudo service asterisk restart"
- To stop the Asterisk
  Type command "sudo service asterisk stop"
- To access CLI of the Asterisk
  Type command "sudo asterisk -r"

```
pi@raspberrypi:~ $ sudo asterisk -r
Asterisk 18.11.1, Copyright (C) 1999 - 2021, Sangoma Technologies Corporation and others.
Created by Mark Spencer <markster@digium.com>
Asterisk comes with ABSOLUTELY NO WARRANTY; type 'core show warranty' for details.
This is free software, with components licensed under the GNU General Public
License version 2 and other licenses; you are welcome to redistribute it under
certain conditions. Type 'core show license' for details.
=================================================================
Connected to Asterisk 18.11.1 currently running on raspberrypi (pid = 642)
raspberrypi*CLI>
```

- To see all peers
  Type command "sip show peers"

```
raspberrypi*CLI> sip show peers
Name/username              Host                            Dyn Forcerport Comedia    ACL Port     Status        Description
1100/1100                  10.127.10.203                    D  Auto (No)  No             60415     Unmonitored
1200/1200                  (Unspecified)                    D  Auto (No)  No             0         Unmonitored
1300                       (Unspecified)                    D  Auto (No)  No             0         Unmonitored
5238434289GW1/5238434289   (Unspecified)                       Yes        No             0         UNKNOWN
5238434289GW2/5238434289   (Unspecified)                       Yes        No             0         UNKNOWN
5 sip peers [Monitored: 0 online, 2 offline Unmonitored: 1 online, 2 offline]
raspberrypi*CLI>
```

- To see all users
  Type command "sip show users"

```
raspberrypi*CLI> sip show users
Username              Secret           Accountcode     Def.Context     ACL  Forcerport
5238434289GW1        ey78bn2ufy8cvuj                  from-trunk      No   Yes
5238434289GW2        ey78bn2ufy8cvuj                  from-trunk      No   Yes
1300                 key1300                          from-trunk      No   No
1100                 key1100                          from-trunk      No   No
1200                 key1200                          from-trunk      No   No
raspberrypi*CLI>
```

There are many Asterisk commands are available in their document offical website here and external soure here, use it as you need.
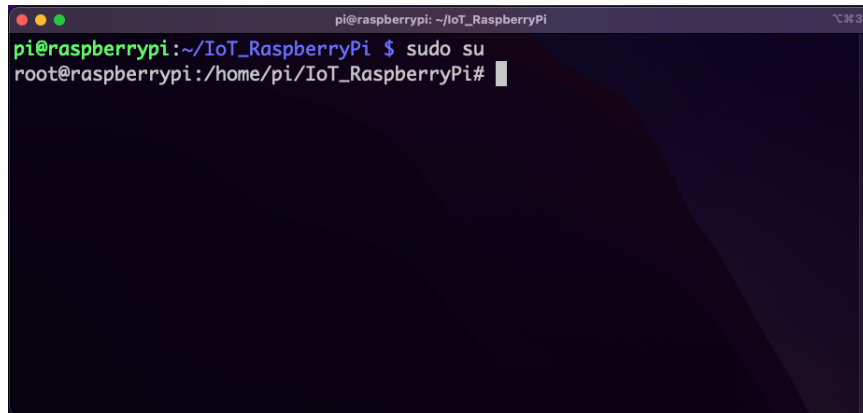
VI. HELPER FUNCTIONS OF ASTERISK

Author has created helper function to ease Asterisk configuration. Currently only one function is created, but in future their might be more.

- To add new user/peer use the bash script called "**add_user.sh**", this script can be found here.

    Step 1: Type command "cd IoT_RaspberryPi"

    Step 2: Type command "sudo su"
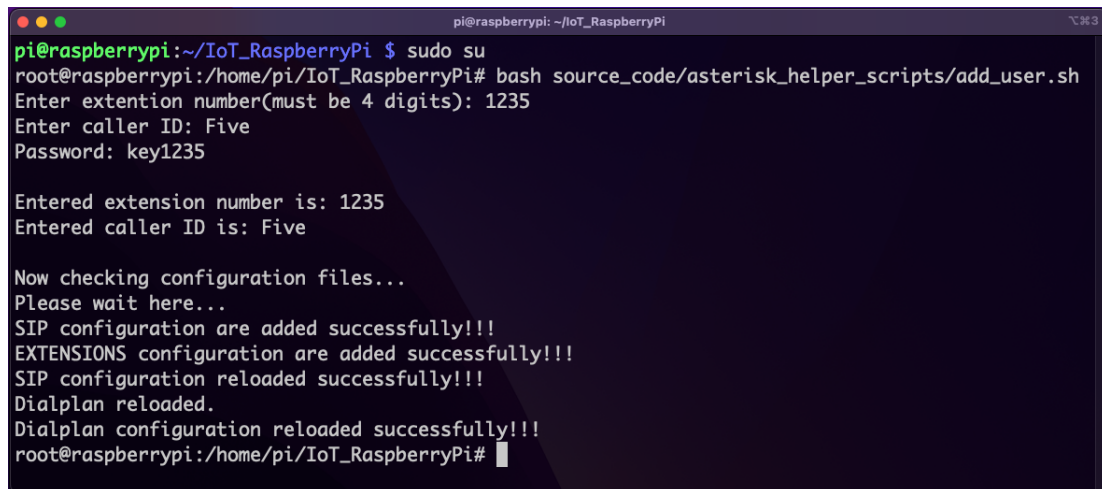

Step 3: Type command "bash source_code/asterisk_helper_scripts/add_user.sh"

Step 4: Enter extention number(must be 4 digits) <– for now it only accepts 4 digits, you can change the bash script if you want.

Step 5: Enter caller ID

Step 6: Enter Password