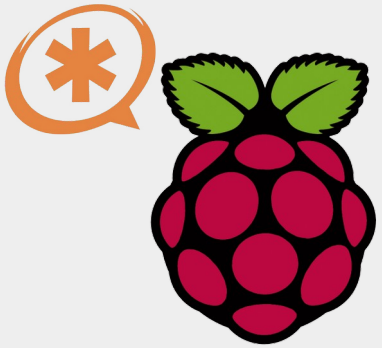
RasPBX or how to run your own phone network



Running your own phone network for fun (and profit).

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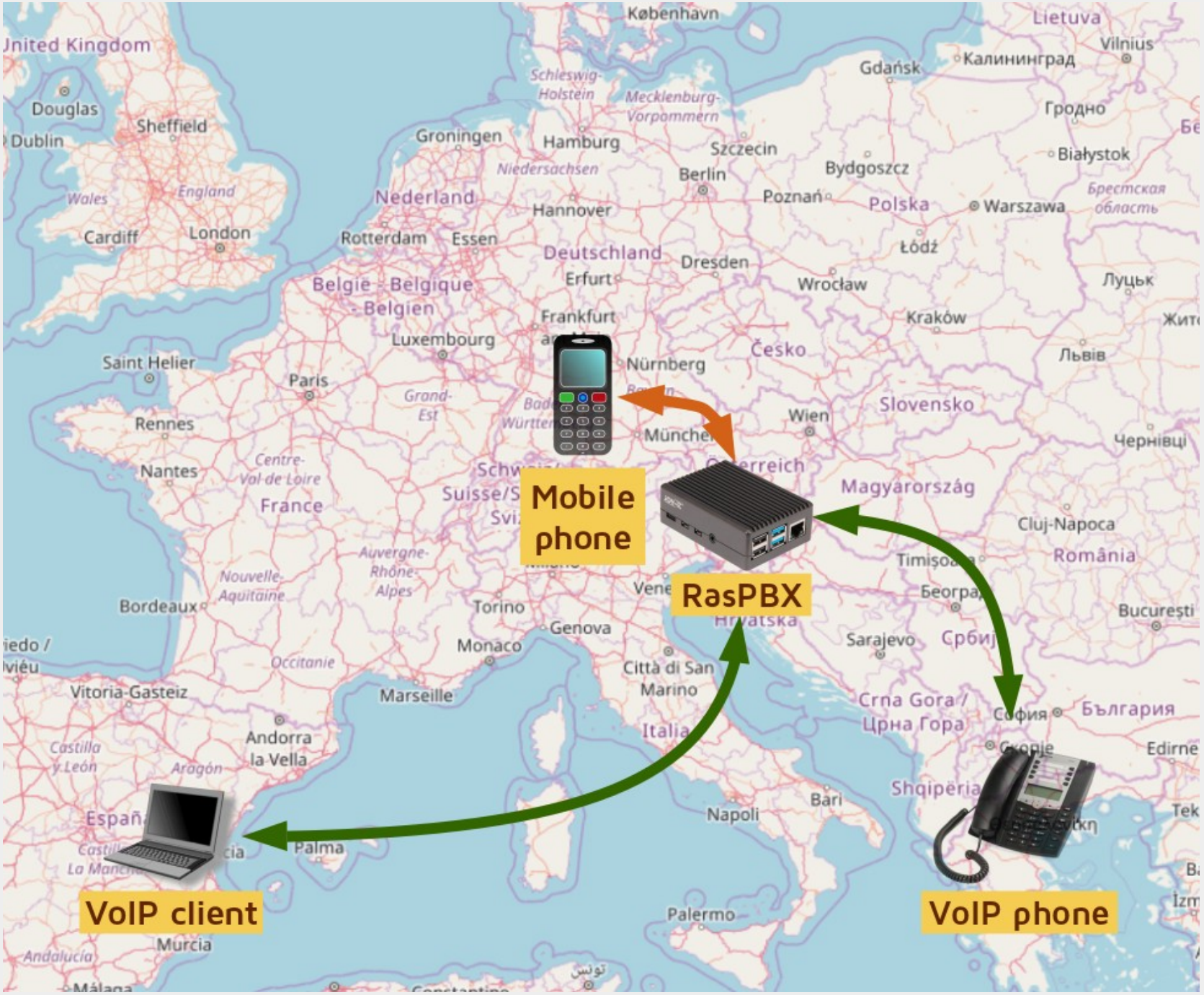
https://github.com/MatejKovacic/RasPBX-install


Mobile phone
RasPBX
VoIP client
VoIP phone

Why?

Why not?

- you like hacking and learning;
- it is really cool project;
- you have a small company and you would like to have your own PBX with the ability to call outside or automated voice system for customer support;
- you want to use Lenny* (to pwn telemarketers and scammers);
- get rid of high roaming costs;
- hide your location data;
- ...

* https://www.youtube.com/watch?v=RRhRImp6kKQ

Some basic concepts

RaspberryPi is a relatively cheap small computer based on ARM architecture. You will need a RaspberryPi 3 or a RaspberryPi 4 and a strong enough power supply (5V 3A).

RasPBX is an open source operating system for your RaspberryPi, based on a Debian Linux, which has integrated Asterisk and FreePBX software, so you don't need to install those two by yourself.

Asterisk is a software implementation of a private branch exchange (PBX). Basically, it is a voice over IP and telephony software used to establish and control telephone calls between telecommunication. It is open source software and used by many telecommunication companies around the world.

Some basic concepts

FreePBX is web-based open-source graphical user interface (GUI) that manages Asterisk. Any yes, it is also opensource and free.

USB dongle in RasPBX is a special USB device, actually a USB modem, in which you can insert a SIM card and then connect this modem to a computer (in our case a RaspberryPi) through a USB port.

An **endpoint** is basically your internal phone number (in your PBX), which is used by softphones (VoIP clients) and physical (VoIP) phones.

In telecom, **trunking** is used to connect two systems together. To put it simply, a **trunk** is a connection from your system (PBX) to another telephone system. From that trunk you can route outgoing and incoming calls.

What do you need

- RaspberryPi 3 or (preferably) RaspberryPi 4 with 4 or 8 GB RAM. (RPi4 can handle up to 200 concurrent phone calls!).
- Power supply for the RaspberryPi (3A 5V or more).
- Case (preferably aluminium) for RaspberryPi.
- SD card (8 GB is minimum, but I suggest buying 32 GB and a little bit higher quality).
- Compatible USB dongle (I am using the Huawei E1752C) – **should be unlocked**!.
- RasPBX version 10-10-2020 (you can freely download it from the official project's website).
- Internet connection.
- Optionally: VPN and VoIP phone.

What do you need

How to start

- Download RasPBX image and write it to SD card.
- Boot RaspberryPi with that SD card.
- SSH to the device (the initial username and password is root/raspberry).
- Change password, set up time zone, update the system, set up NTP, VPN, harden SSH settings, set up firewall and intrusion prevention,...
- Set up the e-mail system.
- Install USB dongle support.
- Configure (internal) website for sending SMS.

Configure USB dongle

```
-------------- Status -------------
  Device                  : dongle0
  State                   : Free
  Audio                   : /dev/ttyUSB1
  Data                    : /dev/ttyUSB2
  Voice                   : Yes
  SMS                     : Yes
  Manufacturer            : huawei
  Model                   : E1752
  Firmware                : 11.126.03.01.314
  IMEI                    : xxxxxxxxxxxxxxx
  IMSI                    : 2934xxxxxxxxxx
  GSM Registration Status : Registered, home network
  RSSI                    : 21, -71 dBm
  Mode                    : GSM/GPRS
  Submode                 : EDGE
  Provider Name           : BOB
  Location area code      : xxx
  Cell ID                 : xxx
  Subscriber Number       : Unknown
  SMS Service Center      : +38640441000
  Use UCS-2 encoding      : Yes
  USSD use 7 bit encoding : Yes
  USSD use UCS-2 decoding : No
  Tasks in queue          : 0
  Commands in queue       : 0
  Call Waiting            : Disabled
  Current device state    : start
  Desired device state    : start
  When change state       : now
  Calls/Channels          : 0
    Active                : 0
    Held                  : 0
    Dialing               : 0
    Alerting              : 0
    Incoming              : 0
    Waiting               : 0
    Releasing             : 0
    Initializing          : 0
```

Freedom is calling...

Sending SMS (geek way):

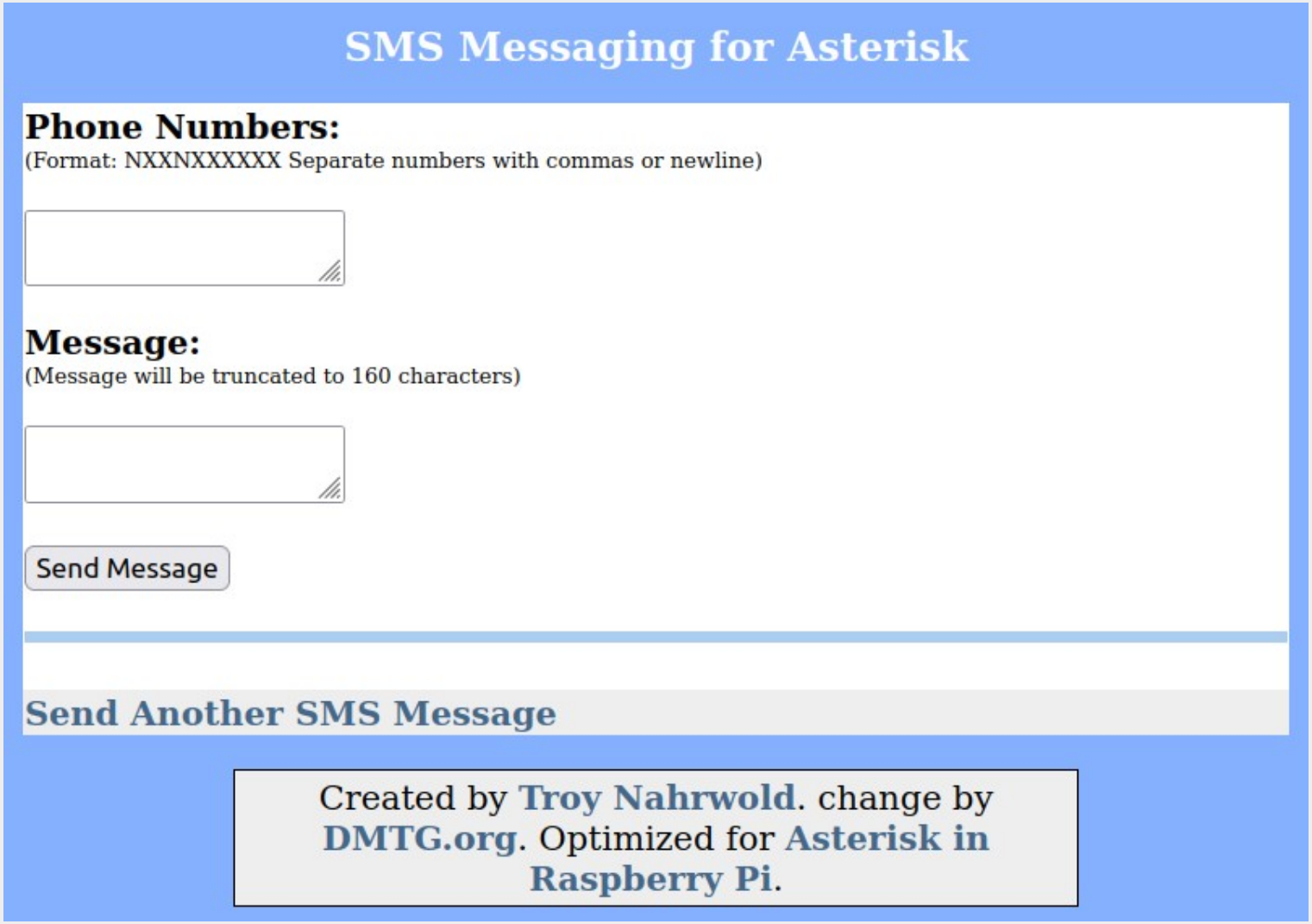
- `dongle sms dongle0 +3864 0XXXXXX Test!`

Calling (geek way):

- `channel originate dongle/dongle0/+3864 0XXXXXX application MusicOnHold`

```
-- Called dongle0/+3864 0XXXXXX
-- Dongle/dongle0-0100000000 is making progress
-- Dongle/dongle0-0100000000 answered
-- Started music on hold, class 'default', on
channel 'Dongle/dongle0-0100000000'
-- Stopped music on hold on Dongle/dongle0-
0100000000
```

Sending SMS (non-geek way)



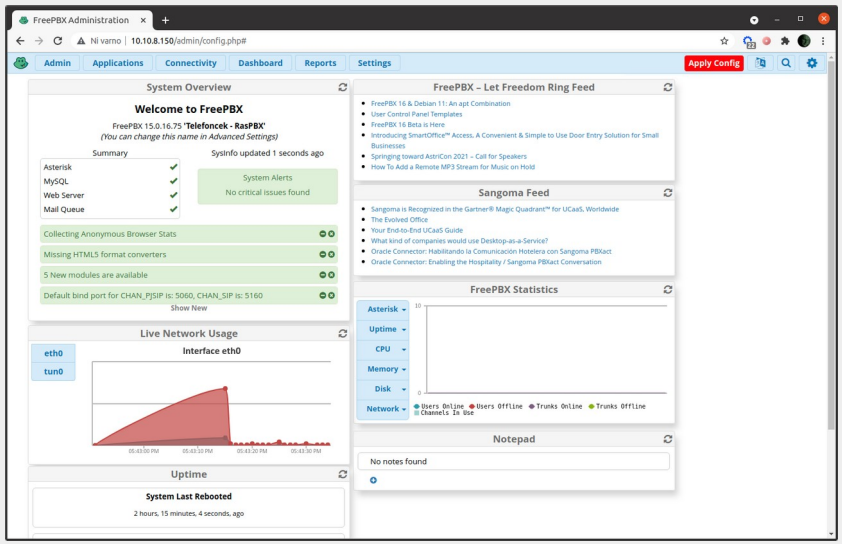
Calling (non-geek way)

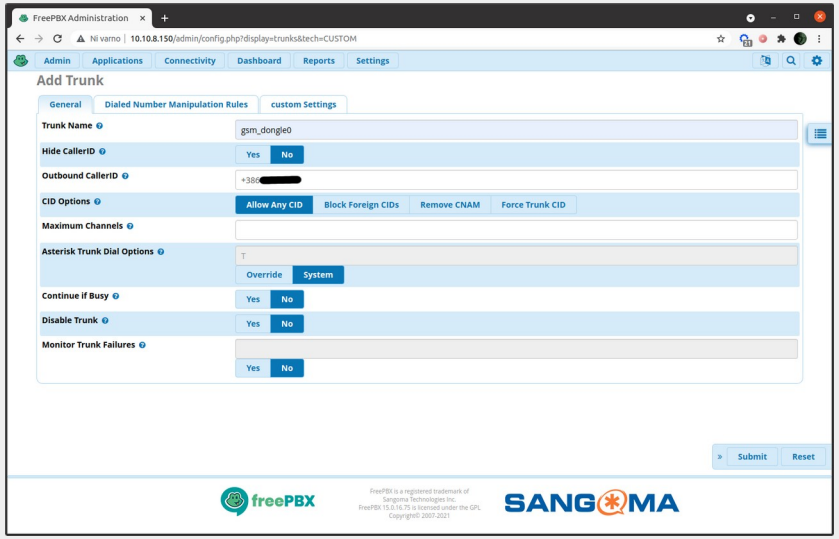
Well… hold your horses!

FreePBX

- Login to FreePBX and perform initial setup...
- Set up the trunk.
- Set up outbound routes.
- Set up extensions (and voicemail system).
- Set up inbound routes.
- SIP security and good practices...
- Enable TCP instead of UDP.*

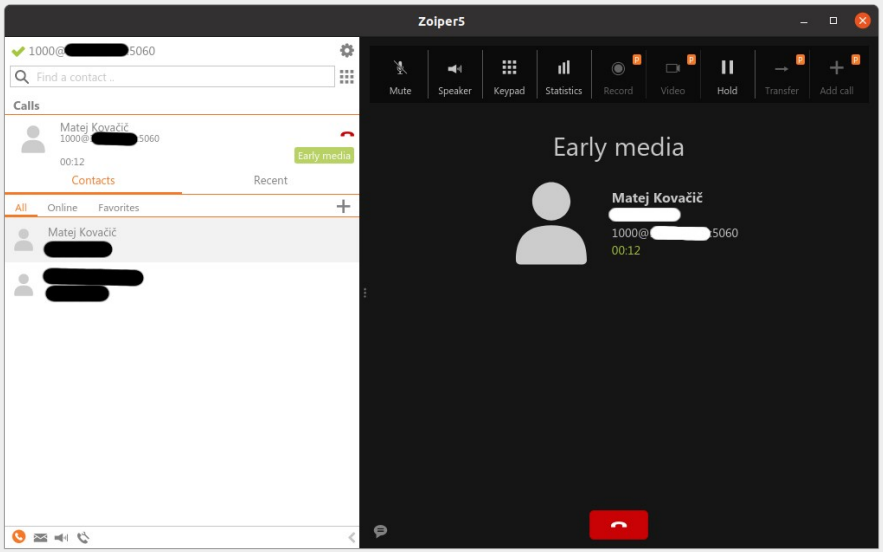
* Because of stupid SIP ALG which is "optimizing" SIP traffic going through NATs.

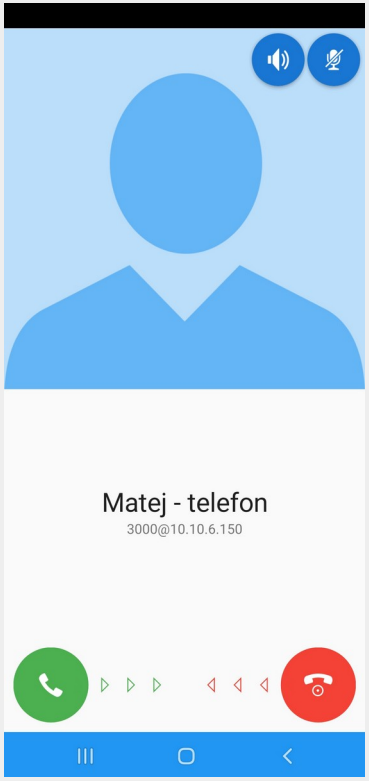




...and that is it!

Set up VoIP clients





Connecting physical phone

Make everything work via VPN

VoIP phone
192.168.100.51

eth1:
192.168.100.50-
192.168.100.240

tun0:
10.10.8.127

eth0:
192.168.1.150

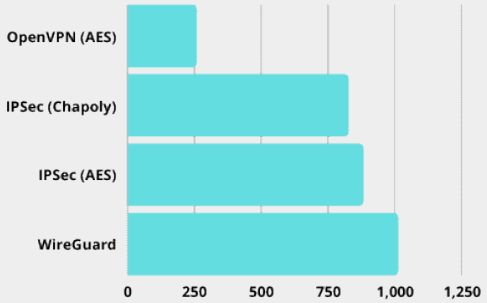
internet

VPN

RasPBX:
10.10.8.150

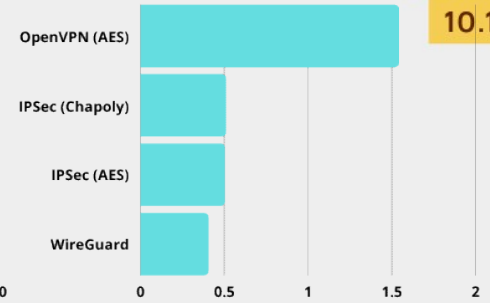
OpenVPN vs. Wireguard

Bandwidth



Megabits per Second

Ping Time

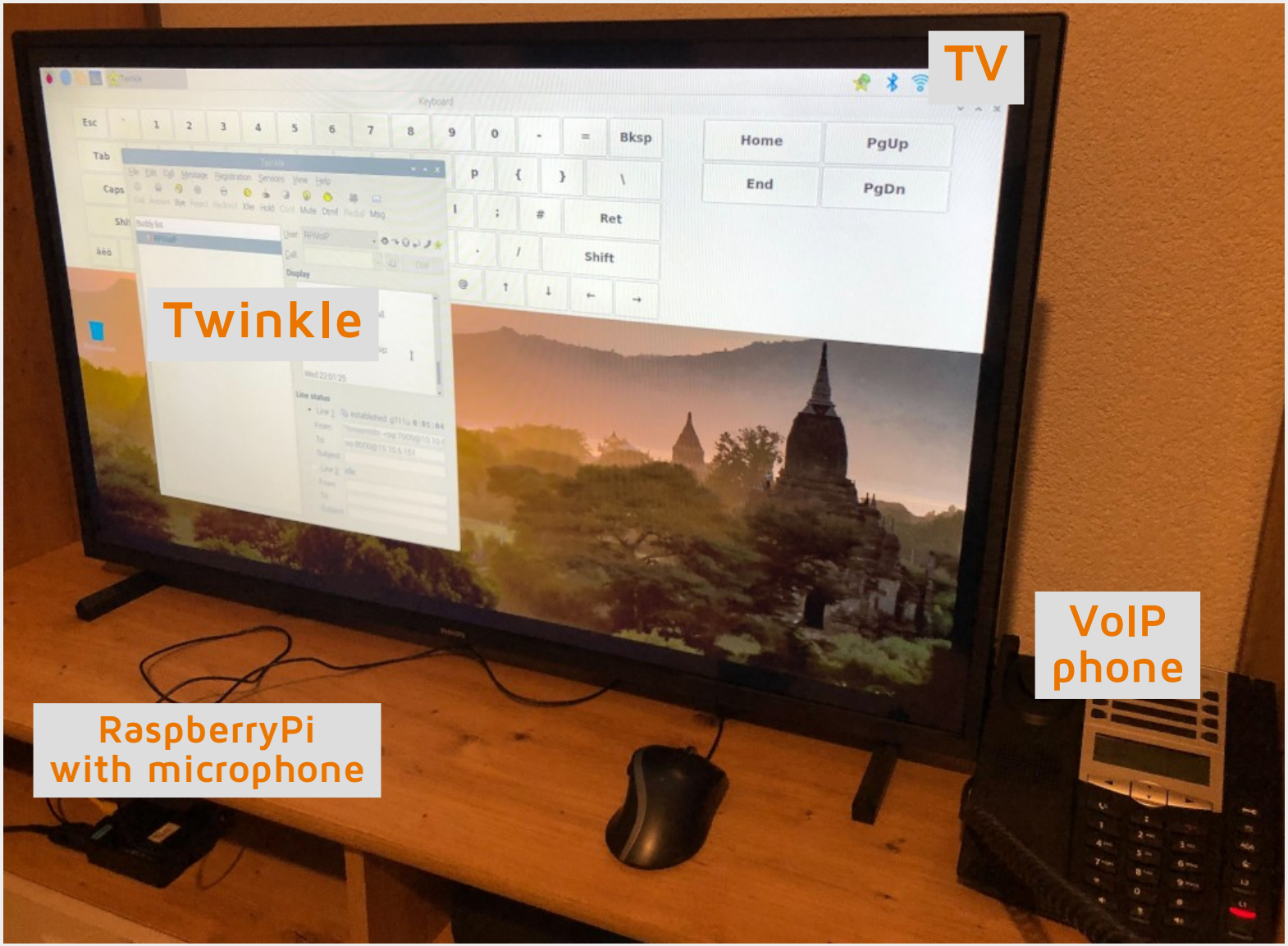


Milliseconds

Some other things to do...

- Block (specific) extension to call outside.
- Restrict extension to calling a specific number only.
- Updating the system.
- Backups.
- Ring groups.
- Chan-dongle-extended (https://github.com/garronej/chan-dongle-extended)
- Set up multiple trunks.
- ZRTP encryption protocol.
- Lenny!

You can even call your TV! :)



Demo and questions

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