Asterisk on Raspberry Pi

Scott Murphy

The relevant parts anyway

MY BACKGROUND

PBX Exposure

- I worked as a SysAdmin for the Norstar Product Group in Nortel back in 1995

- I was asked to be part of a tech trial for a smaller Norstar product they eventually called a CICS (Compact Integrated Communication System)

- I had my house wired for individual sets to the basement and never looked back

VoIP Exposure

- I ran across this thing called asterisk back in the early 2000s

- It did not work as well as my existing system, however it had a lot of interesting things to recommend it

- I kept playing with on and off it until 2007 when I bought a bulk DID and an account with a VoIP provider

Moving to VoIP

- I used that as a business number on a dedicated PC for a while and then started looking at VoIP appliances (embedded Linux boxes)

- I have deployed a few to clients and use one at home* to replace the old Norstar system
  - It is a mix of IP phones and an analog base station with wireless handsets using a VoIP ATA

Cutting the Landline

- Last year I finally cut my ties with the big telecom and transferred my phone number over to a VoIP service (a different one)
  - The first couple of weeks were rocky as the "ported number" would mostly go to a "Not in Service" message – this was not the fault of the VoIP provider, as outbound calls worked flawlessly

Current State

- I have an embedded box running a commercially branded version of asterisk, mostly so I could directly connect the old analog line

- I have used three different embedded systems to date and am not 100% happy with the offerings

- I was considering going back to a PC when I saw an ad for a new mini PBX from the same people who built one of the units. It was smaller and looked familiar

Looks like a RPi to Me
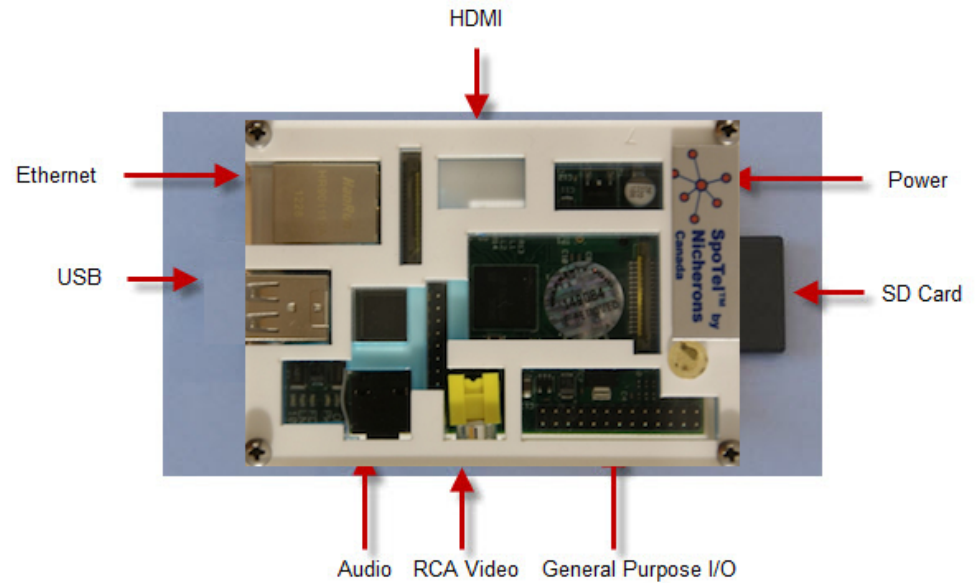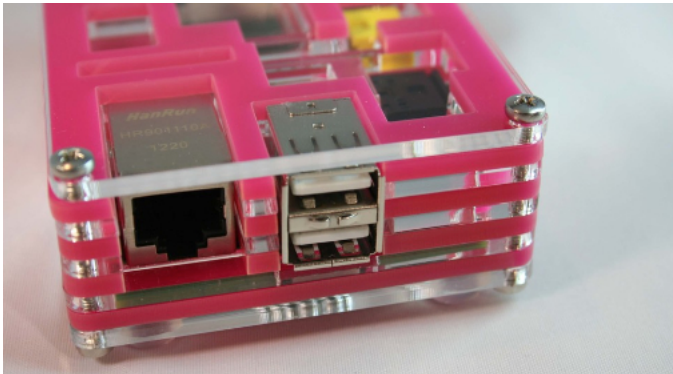
Well, check for RPi distros…

- There are more than I thought
- I thought I'd go with as basic a system as I could
- Raspbian with Asterisk and FreePBX installed seemed like a good match to me
  - Raspbx is the distro I picked

Evaluation is in progress

- This came about due to the management restrictions for the embedded unit

- I have not tried hacking it until I configure something to replace it

  - It is a variant of the rowtel blackfin hardware running astfin, so a uClinux distro is used

- Once I am happy with my config, it goes into production

You might like it…

WHY RUN A PBX AT HOME?

Do you have a landline?

- You can take control over those annoying calls
  - Robocalls
  - Solicitation
  - Hangups
  - Etc.
- There are blacklists to add these numbers to so over time you get less annoying calls making it through

Individual Voicemail

- Every person can have their own voicemail
  - You will need to set up a CCR tree for that
- Voicemail can be emailed to you as an attachment, no need to check for it

Time of Day Rules

- You can restrict when the phones ring
- Calls outside of that window go straight to voice mail
- Alternatively, you can provide a code that lets friends/family call through regardless of the rules

And much, much more. This could go on all night

Features

Call Features
- ADSI On-Screen Menu System
- Alarm Receiver
- Append Message
- Authentication
- Automated Attendant
- Blacklists
- Blind Transfer
- Call Detail Records
- Call Forward on Busy
- Call Forward on No Answer
- Call Forward Variable
- Call Monitoring
- Call Parking
- Call Queuing
- Call Recording
- Call Retrieval
- Call Routing (DID & ANI)
- Call Snooping
- Call Transfer
- Call Waiting
- Caller ID
- Caller ID Blocking
- Caller ID on Call Waiting
- Calling Cards

- Conference Bridging
- Database Store / Retrieve
- Database Integration
- Dial by Name
- Direct Inward System Access
- Distinctive Ring
- Distributed Universal Number Discovery (DUNDi™)
- Do Not Disturb
- E911
- ENUM
- Fax Transmit and Receive
- Flexible Extension Logic
- Interactive Directory Listing
- Interactive Voice Response (IVR)
- Local and Remote Call Agents
- Macros
- Music On Hold
- Music On Transfer:
- Flexible Mp3-based System
- Random or Linear Play
- Volume Control
- Predictive Dialer
- Privacy

- Open Settlement Protocol (OSP)
- Overhead Paging
- Protocol Conversion
- Remote Call Pickup
- Remote Office Support
- Roaming Extensions
- Route by Caller ID
- SMS Messaging
- Spell / Say
- Streaming Media Access
- Supervised Transfer
- Talk Detection
- Text-to-Speech (via Festival)
- Three-way Calling
- Time and Date
- Transcoding
- Trunking
- VoIP Gateways
- Voicemail:
  - Visual Indicator for Message Waiting
  - Stutter Dialtone for Message Waiting
  - Voicemail to email
  - Voicemail Groups
  - Web Voicemail Interface
- Zapateller

More Features

Computer-Telephony Integration

- AGI (Asterisk Gateway Interface)
- Graphical Call Manager
- Outbound Call Spooling
- Predictive Dialer
- TCP/IP Management Interface

Scalability

- TDMoE (Time Division Multiplex over Ethernet)
- Allows direct connection of Asterisk PBX
- Zero latency
- Uses commodity Ethernet hardware
- Voice-over IP
- Allows for integration of physically separate installations
- Uses commonly deployed data connections
- Allows a unified dialplan across multiple offices

Speech

- Cepstral TTS
- Lumenvox ASR

Codecs

- ADPCM
- CELT (pass through)
- G.711 (A-Law & μ-Law)
- G.719 (pass through)
- G.722
- G.722.1 licensed from Polycom®
- G.722.1 Annex C licensed from Polycom®
- G.723.1 (pass through)
- G.726
- G.729a
- GSM
- iLBC
- Linear
- LPC-10
- Speex
- SILK

VoIP Protocols

- Google Talk
- H.323
- IAX™ (Inter-Asterisk eXchange)
- Jingle/XMPP
- MGCP (Media Gateway Control Protocol
- SCCP (Cisco® Skinny®)
- SIP (Session Initiation Protocol)
- UNIStim

Traditional Telephony Protocols

- E&M
- E&M Wink
- Feature Group D
- FXS
- FXO
- GR-303
- Loopstart
- Groundstart
- Kewlstart
- MF and DTMF support
- Robbed-bit Signaling (RBS) Types

A quick overview of getting up and running

GETTING STARTED

Requirements

- Raspberry Pi type B (I prefer wired networks for services)

- Raspbx image (or one of the other offerings)

- 4 GB minimum class 10 SD card (bigger is fine)

- Phone Service
  - VoIP provider
  - Existing analog line (extra device required)

Get the Distribution Image

- Visit the project website
  - http://www.raspberry-asterisk.org/downloads/
- Select the latest full version and wait for it to download
- You will get updates after logging in

Put the image onto the SD Card

- General instructions can be found here for most operating systems:
  - http://elinux.org/RPi_Easy_SD_Card_Setup
- In my particular case:
  - *$ sudo dd if=raspbx-12-08-2013.img \ of=/dev/rdisk5 bs=4m*
  - This takes about 5 minutes on my laptop

Default Passwords

- Configuration details set during install:
  - Mysql root password: *raspberry*
  - SSH login:
    - user: *root*
    - password: *raspberry*
  - Default FreePBX login:
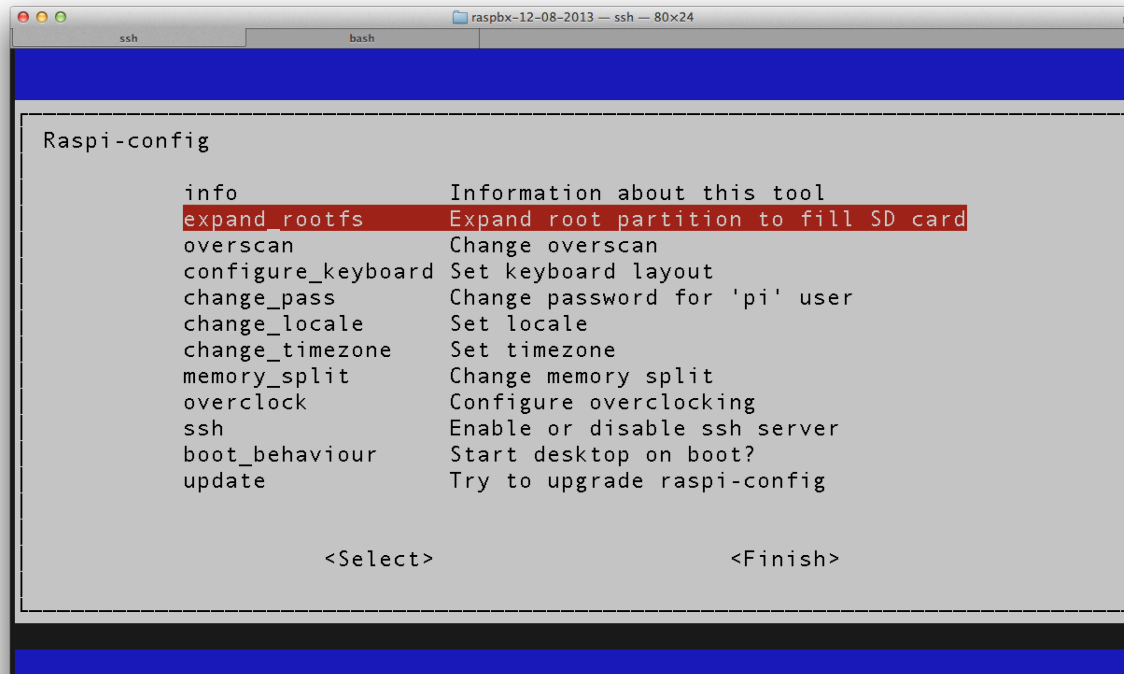   - user: *admin*
    - password: *admin*

> Note: These should be changed after installation, as they are public knowledge

Booting the RPi

- Now that you have the image on the SD card, insert it into the RPi

- Add a network cable and power

- After a few seconds (about 30), you should be able to log in to the RPi

  – Windows machines, ssh to raspbx

  – Mac boxes, ssh to raspbx.local

  – Other *nix, you need to determine the assigned ip address or log onto the console

First Item

- Expand the file system to fill the SD card
  - Run the raspi-config utility and select the expand_rootfs item. You will need to reboot.

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Updates/Upgrades

- Now that you are at logged in, you were given a list of commands:

```
List of RasPBX specific commands:
------------------------------------------------------------------------------
raspbx-upgrade          Keep your system up to date with the latest add-ons and
                        security fixes
configure-timezone      Set timezone for both system and PHP
install-fax             Install HylaFAX
add-fax-extension       Add additional fax extension for use with HylaFAX
install-fail2ban        Install Fail2Ban for additional security
install-dongle          Install GSM/3G calling capability with chan_dongle
raspbx-backup           Backup your complete system to an image file
```

- Run the raspbx-upgrade command
  - This will take a little while to run, move around

Set the timezone

- Run the configure-timezone script
  - Drill down until you get what you are looking for.
    - America
      - Montreal (Toronto gets too much attention, Ottawa is not listed)

Configure the Locale & Keyboard

- If you use UTF-8, you do not need to configure the locale

- If you will only access via ssh (no console), you can skip the keyboard reconfig

- This time using dpkg-reconfigure
  - dpkg-reconfigure locales
  - dpkg-reconfigure keyboard-configuration

Install an Editor

- Well, install something you like
- Nano is installed by default and I happen to prefer vim

  apt-get install vim

- At some point, you will need to edit a config file, thus the need for an editor you like

Email

- Assuming you want to send voicemail attachments via email, you need to set this up.

- While the RPi can send email directly to a target MX host, chances are it will be rejected. You need a smarthost

  – If you run your own mail server, you are golden, use it

  – If not, use a third party mail service and use that instead (I'm using gmail for this demo)

Configuring Email

- Run the following command to configure exim4:
  - dpkg-reconfigure exim4-config
- Set the following:
  - General type of mail configuration: **mail sent by smarthost; no local mail**
  - System mail name: **(default)**
  - IP-addresses to listen on for incoming SMTP connections: **127.0.0.1**
  - Other destinations for which mail is accepted: **(default)**
  - Visible domain name for local users: **yourdomain.com**
  - IP address or host name of the outgoing smarthost: **smtp.gmail.com:: 587**
  - Keep number of DNS-queries minimal (Dial-on-Demand)? **No**
  - Split configuration into small files? **No**

Authentication

- Edit the text file called /etc/exim4/passwd.client

- Update the file to read:

```
# password file used when the local exim is authenticating to a remote
# host as a client.
#
# see exim4_passwd_client(5) for more documentation
#
# Example:
### target.mail.server.example:login:password
gmail-smtp.l.google.com:you@gmail.com:password
*.google.com:you@gmail.com:password
smtp.gmail.com:you@gmail.com:password
```

- Of course, change you@gmail.com to the correct email address

/etc/mail-aliases

- The system may want to send emails, so you will need to address that:
  - Edit /etc/mail.aliases
  - Make sure you have the following:
    root: your_email@someisp.com
    asterisk: your_email@someisp.com

Activate the Changes

- Issue the command:

  service exim4 reload

- Test

  send_test_email your_email@someisp.com

That was just the beginning...

- Now you need to configure asterisk
- There is exhaustive documentation on the freepbx site: http://www.freepbx.org/support/documentation/installation/first-steps-after-installation
- Point your browser to http://raspbx.local

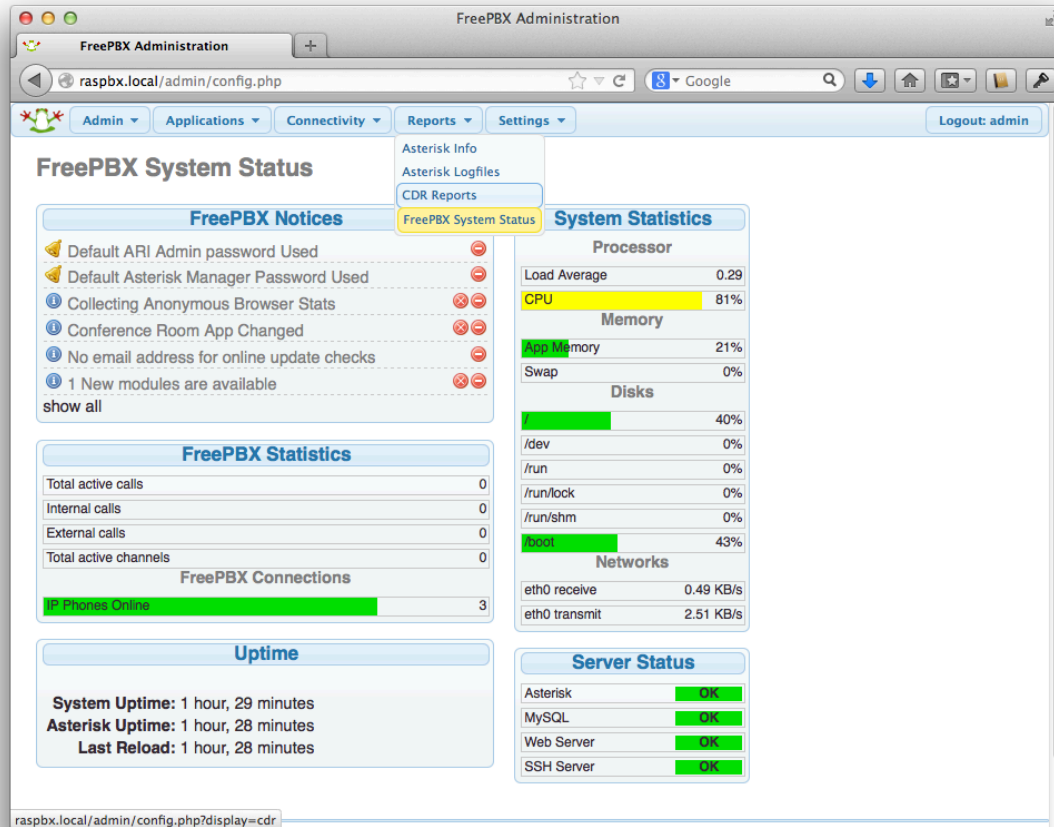# Asterisk Administration

Start Administrating

- Click on "FreePBX Administration"
- Log in with the default username and password
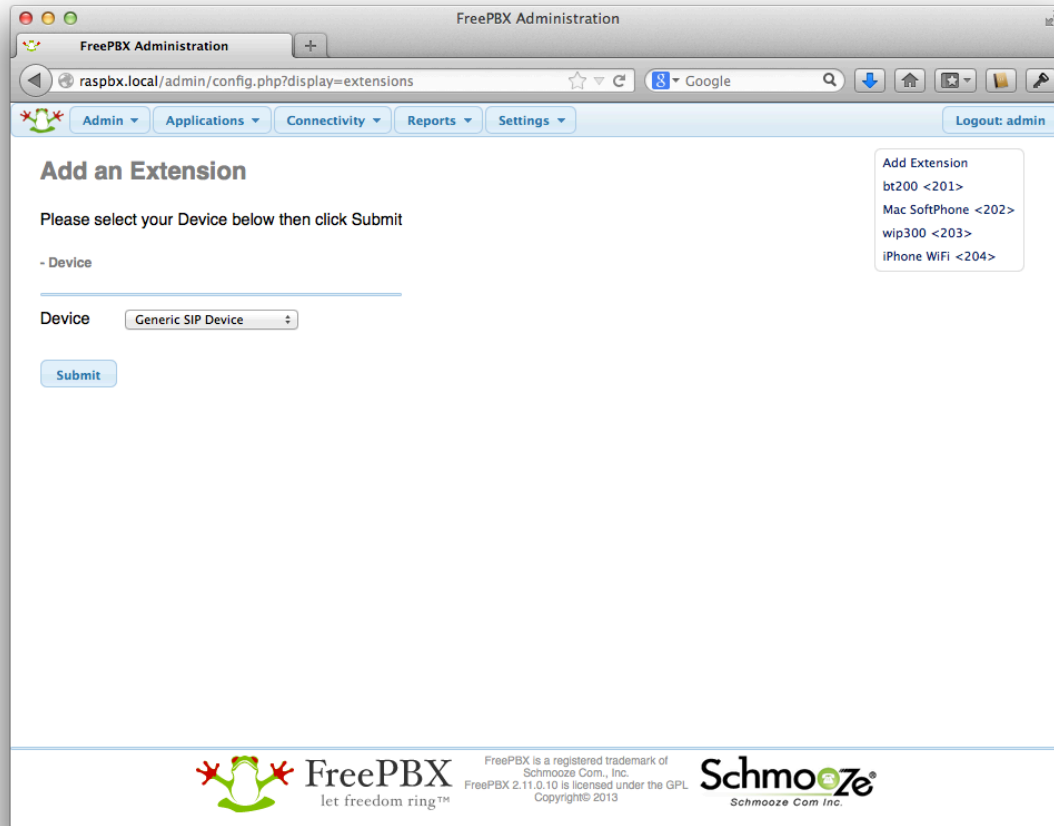- You will get a status page

FreePBX Status Page

Add an Extenion

- At the top, click on the "Applications" Dropdown menu
- Select "Extensions"

Extensions Page

Typical Extension

- Usually, you will be adding a Generic SIP device

- Click the "Submit" button

- You will get a "Add SIP Extension" page to fill out

Add SIP Extension Page

Filling out the form

- We will do a new extension in the demo and enable voice mail so that we can call it and have the system go to voicemail

- We should be able to play it back from the web client

More Configuration

- This is barely the beginning
- You still need to add a Trunk for inbound and outbound calls
  - This can be analog or VoIP, depending
- You need to set up:
  - Call Routing
  - Ring Groups
  - Etc.

http://www.freepbx.org/support/documentation/installation/first-steps-after-installation

Some pictures of the components then the live demonstration of the system
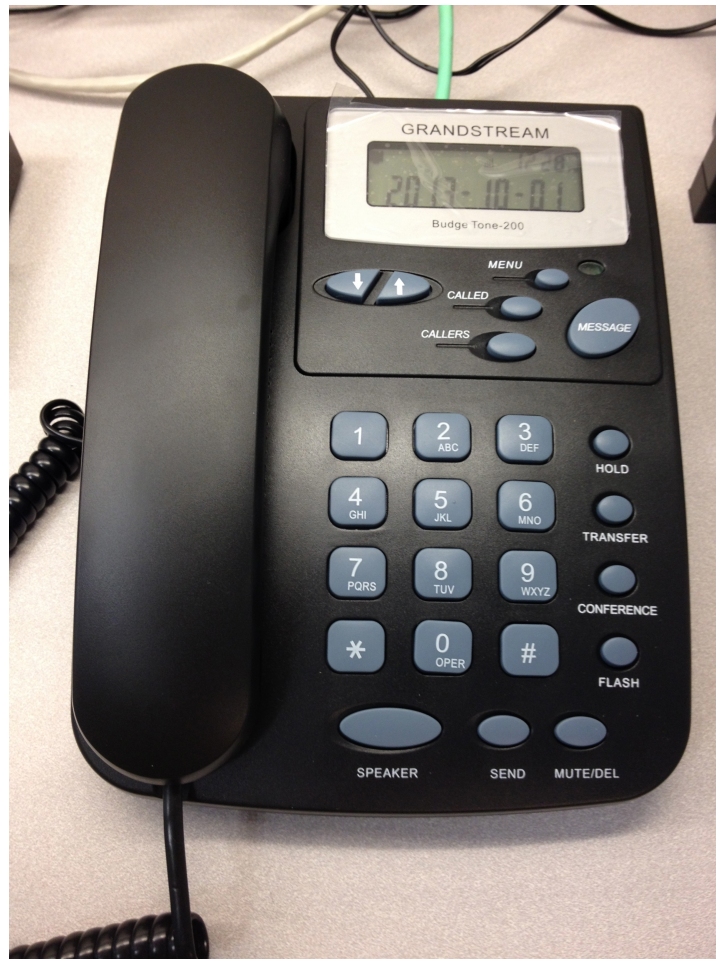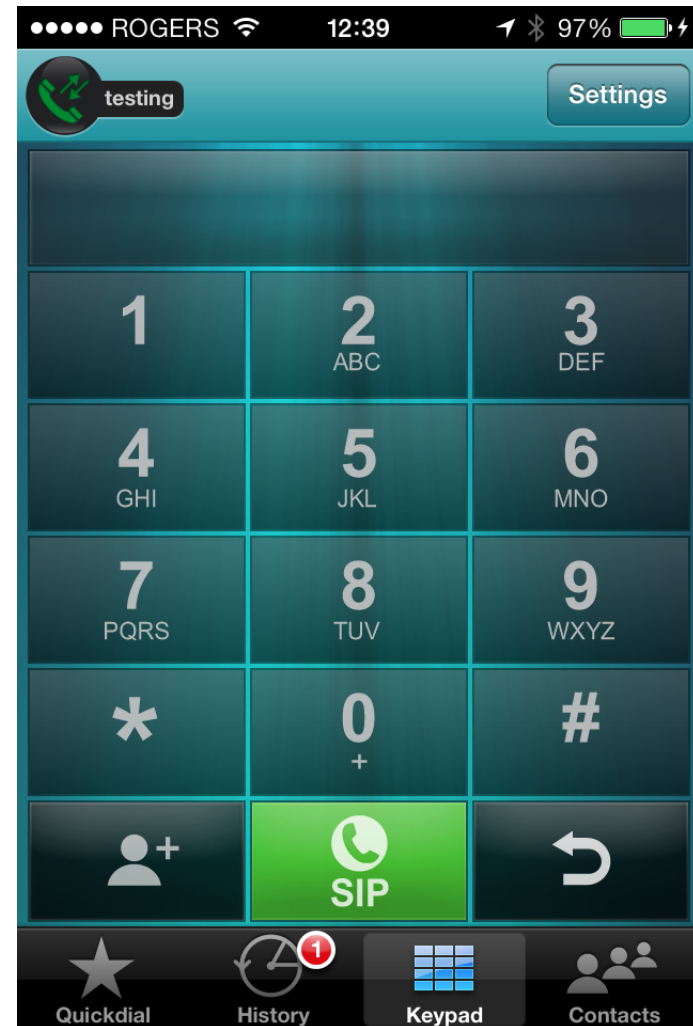
DEMO

Full Picture

The RPi

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Grandstream BT-200 ip Phone

iPhone running a softphone

Linksys WIP300

Linksys WRT54G

Demo Time

- The Linksys WIP300 sometimes has issues registering
  - Supposedly new firmware will fix the issue
  - The access point is not secured for this demo, as the WIP300 had problems with that as well.
- The WRT54G is running OpenWRT and is acting as the DNS/DHCP server for the subnet

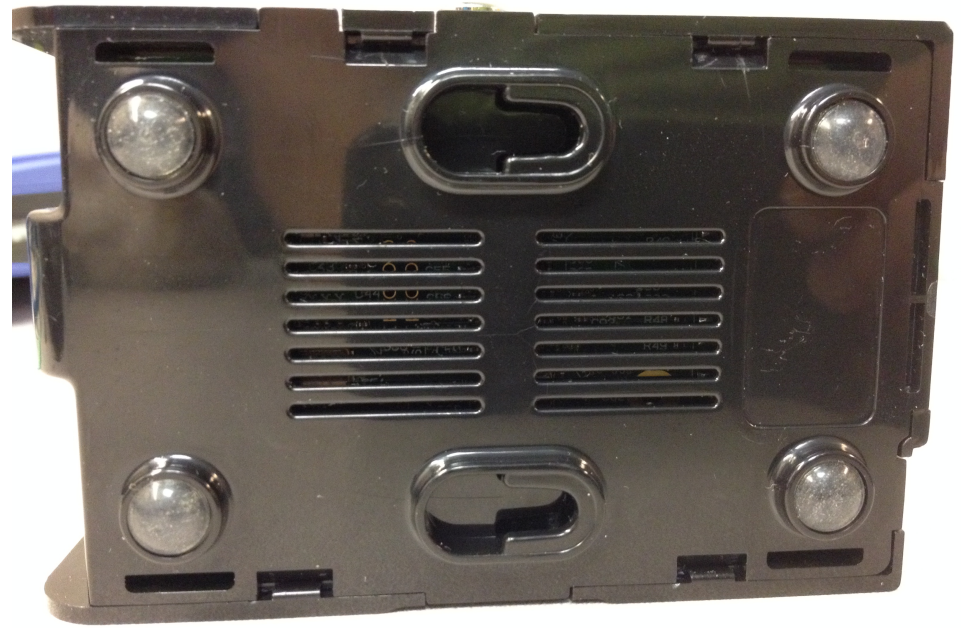A few things to make this a more professional looking box

ENHANCEMENTS

Case for RPi

- You will want a case. I bought a few different ones and this one is inexpensive and nice.

More Case Views

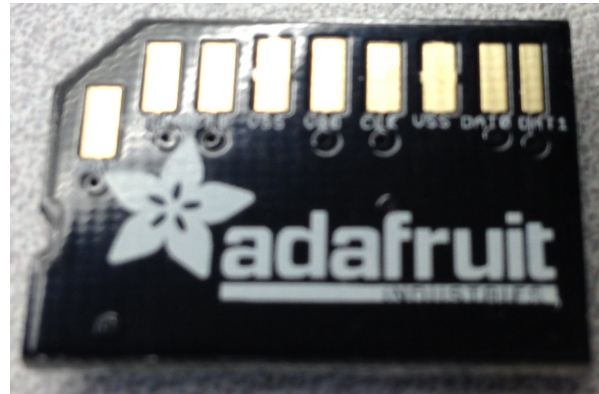# Modifying the Case

- You can adjust the size of the SD card slot to accommodate a microSD to SD adapter.
  - A little judicious grinding will allow you to insert a "better" adapter

microSD adapter

- This is not the standard adapter, but one designed to reduce the exposure of the SD card
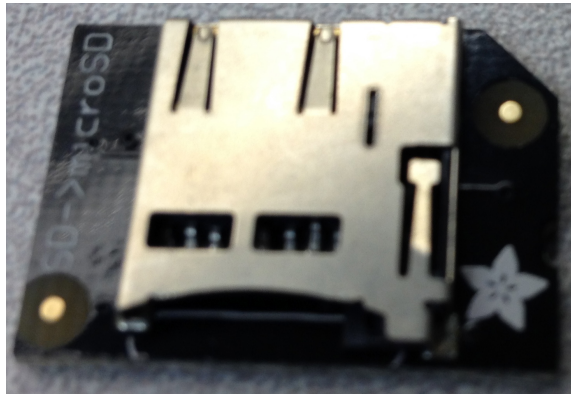
Using the microSD adapter

As you can see, the adapter keeps the card protected rather than hanging out

Dedicated Power

- While you can power it from your USB port, a dedicated and reliable power supply is recommended

I picked this one up from newark.com

References, configuration notes, observations, etc.

NOTES

Gotchas

- Gotchas from the past year or so of other peoples Raspberry Pi usage
    - Badly regulated power supplies have been a frequent cause of crashes or data corruption on the Rapsberry Pi's SD cards. Having a well regulated power supply with enough available current is key to reliability on the RPi.
    - The RPi has to boot from the external SD card, making it vulnerable to issues with low-cost cards.
    - Whenever users experience data corruption with their RPis, in almost all cases it originated from either the power supply or the SD card itself.

Gotchas from the Demo

- If you do not have an internet connection, there is a good chance that the system will not start up properly, at least the asterisk component

- There is a dependency on setting the correct date and time before it will start

- It uses ntp to manage the time configuration, so if you are trying to talk to an outside time source, it will fail.

- Use the date command to bypass this:
  date 100314552013

Analog Ports

- We didn't cover this, but if you want to use them, you need to know the following:
  - **FXS** and **FXO** are the name of ports used by Analog phone lines (also known as **POTS** – Plain Old Telephone Service) or phones.
  - **FXS** – **F**oreign e**X**change **S**ubscriber interface is the port that actually delivers the analog line to the subscriber. In other words it is the 'plug on the wall' that delivers a dial tone, battery current and ring voltage.
  - **FXO** – **F**oreign e**X**change **O**ffice interface is the port that receives the analog line. It is the plug on the phone or fax machine, or the plug(s) on your analog phone system. It delivers an on-hook/off-hook indication (loop closure). Since the FXO port is attached to a device, such as a fax or phone, the device is often called the 'FXO device'.

Analog Ports (continued)

- FXO and FXS are always paired, i.e similar to a male / female plug.

- Without a [PBX](#), a phone is connected directly to the FXS port provided by a telephone company.
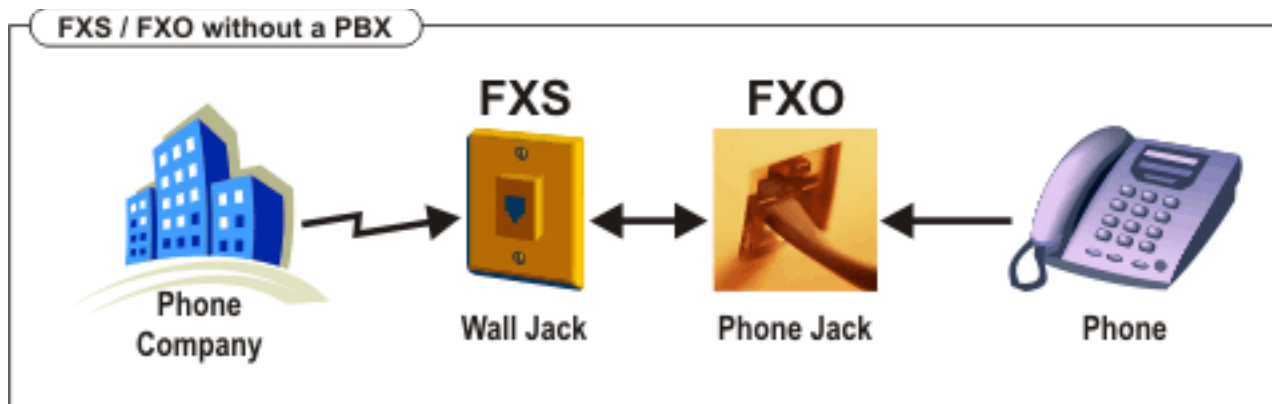
Analog Ports (continued)

- If you have a PBX, then you connect the lines provided by the telephone company to the PBX and then the phones to the PBX. Therefore, the PBX must have both FXO ports (to connect to the FXS ports provided by the telephone company) and FXS ports (to connect the phone or fax devices to).

FXS / FXO with a PBX
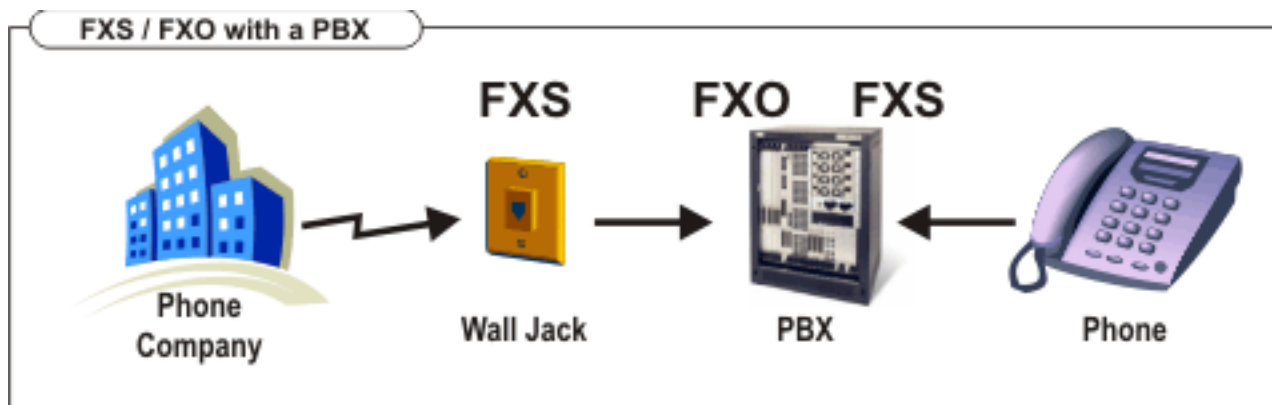
Using an Analog Line

- You can't directly interface an analog line to your RPi, so you will need a translation device to create a SIP trunk to use:
  - http://www.obihai.com/obi110pr.html
  - http://www.cisco.com/en/US/products/ps10027/index.html
- Configuring these is a topic for another day

Extra Parts Links

- Power Supply
  - http://canada.newark.com/raspberry-pi/rpi-psu-us-mk1/ac-dc-conv-external-plug-in-micro/dp/53W846
- Case
  - http://canada.newark.com/multicomp/mc-rp001-blk/enclosure-raspberry-pi-black/dp/07W8934
- SD Adapter
  - http://www.adafruit.com/products/966

Other Embedded Platforms

- Asterisk software will also run on:
  - the Beagle Bone Black
    - http://www.beaglebone-asterisk.org/

  - PC Engines ALIX boards
    - http://www.osnet.eu/en/content/asterisk-and-alix-revolution
    - http://www.smallnetbuilder.com/multimedia-voip/multimedia-voip-features/31208-how-to-build-asterisk-appliances-on-the-cheap?start=3

Reference Links

- http://asterisk.org
- http://www.raspberry-asterisk.org
- http://www.freepbx.org/
- https://www.wrbishop.com/telecom/end-robocaller-solicitation-and-hangup-calls-with-asterisk/
- http://www.rowetel.com/blog/?page_id=440
- http://blog.astfin.org/
- http://uCpbx.com/
- http://blackfin.uclinux.org/
- http://www.uclinux.org/
- http://www.adafruit.com/category/105
- http://canada.newark.com/raspberry-pi-accessories?ICID=HP-TP-raspberry-pi-accessories
- http://parlar.ca/blog/2011/8/8/my-voip-setup-with-voipms.html
- http://www.3cx.com (software PBX for windows)

Most of the images used in this presentation were taken by the presenter, but a few were grabbed from websites or mashed up from other images. The FXO/FXS text and images were taken from the 3cx website

Contact Info

Scott Murphy

scott.murphy@arrow-eye.com

GPG Key:

4B7DA0B2

GPG Fingerprint:

ED82 B038 8C5C 4A9B 123E CF3D 6D59 7F18 4B7D A0B2