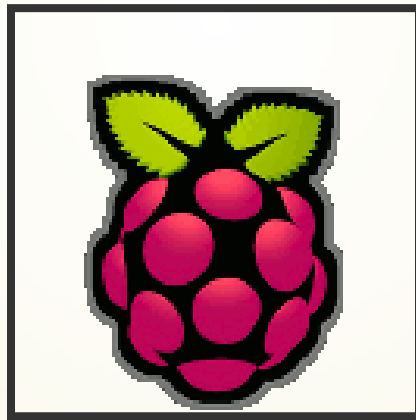


RASPBERRY PI

AN INTRODUCTION TO THE CREDIT-CARD SIZED COMPUTER



Jeffrey Kopcak - K8JTK
Ohio Section Technical Coordinator

TECHNICAL COORDINATOR

The ARRL Technical Coordinator (TC) is a section-level official appointed by the Section Manager to coordinate all technical activities within the section.

- Supervise and coordinate the work of the section's Technical Specialists (TS).
- Refer amateurs in the section who need technical advice to local TS.
- Encourage amateurs in the section to share their technical achievements with others through the pages of QST, at club meetings, hamfests, and conventions.

TECHNICAL COORDINATOR

- Be available to assist local technical program committees in arranging suitable programs for local club meetings, ARRL hamfests, and conventions.
- Promote technical advances and experimentation at VHF/UHF and with specialized modes, and work closely with enthusiasts in these fields within the section.

TECHNICAL SPECIALIST

For a section team to be effective in one of the most important arenas in Amateur Radio, technology, there must be a cadre of qualified, competent Technical Specialists (TS).

"Advancement of the radio art" is a profound obligation we incur under the rules of the FCC.

TSes help meet this obligation.

TECHNICAL SPECIALIST

TS supports the TC in two main areas of responsibility:
Radio Frequency Interference and Technical Information.

Technical Specialist can specialize in certain specific technical areas, or can be generalists.

<http://www.arrl.org/technical-specialist>

VIEW THE PRESENTATION!

Follow along with the presentation on your personal device!

- Connect to access point: **Pi WiFi**
- No password. Click through any 'unsecure' messages, ignore 'no internet' messages.
- Open web browser.
- Go to: **<http://slides.rpi.local>**
-or- **192.168.76.1**

SLIDE NAVIGATION

Tablets, Smartphones, Touchscreens:

- **Swipe** up/down, left/right
- or use the **navigation arrows** on screen in the lower right.

Laptops, Keyboard:

- Advance to the next slide: press [**SPACEBAR**].
- Go back to the previous slide: press and hold the [**SHIFT**] key while pressing the [**SPACEBAR**].
- Display presentation overview: [**ESC**] then use the **arrow keys** or **mouse** to select a slide. [**ESC**] again will exit overview mode.

OUTLINE

- About the Pi & creator
- Hardware & connectors
- Operating systems
- Raspberry Pi vs. Arduino
- Getting started
- Apps, programming, and projects
- Finding out more

QUÉ ES?

*The Raspberry Pi is a **low cost, credit-card sized computer** that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to **explore computing, and to learn how to program in languages like Scratch and Python...***

QUÉ ES?

...It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games. What's more, the Raspberry Pi has the ability to interact with the outside world, and has been used in a wide array of digital maker projects.


from: [What Is A Raspberry Pi?](#)

A man with a shaved head, wearing a dark suit jacket over a white shirt, stands in the center of the frame. He is looking directly at the camera with a neutral expression. The background is a blurred outdoor setting with green foliage and some yellow lights. In the bottom right corner, there are some blue and yellow geometric shapes, possibly toys or props.

Eben Upton, designer of the Raspberry Pi noticed the slide in skill levels while working at Cambridge University's Computer Laboratory in 2006.

Students applying to study computer science had far less experience than previous students.

from: Raspberry Pi for Dummies. img: [IBTimes](#)

A man with a shaved head and a grey sweater over a red shirt is holding a Raspberry Pi circuit board in his right hand. He is standing in front of a large rack of electronic components. The text is overlaid on the image.

Eben and his colleagues came up with the idea of creating a computer, that came with necessary tools, sold for \$25, was robust enough to survive a children's book bag, that did interesting things, and drew people to use it.

from: Raspberry Pi for Dummies. img: Cambridge Judge Business School

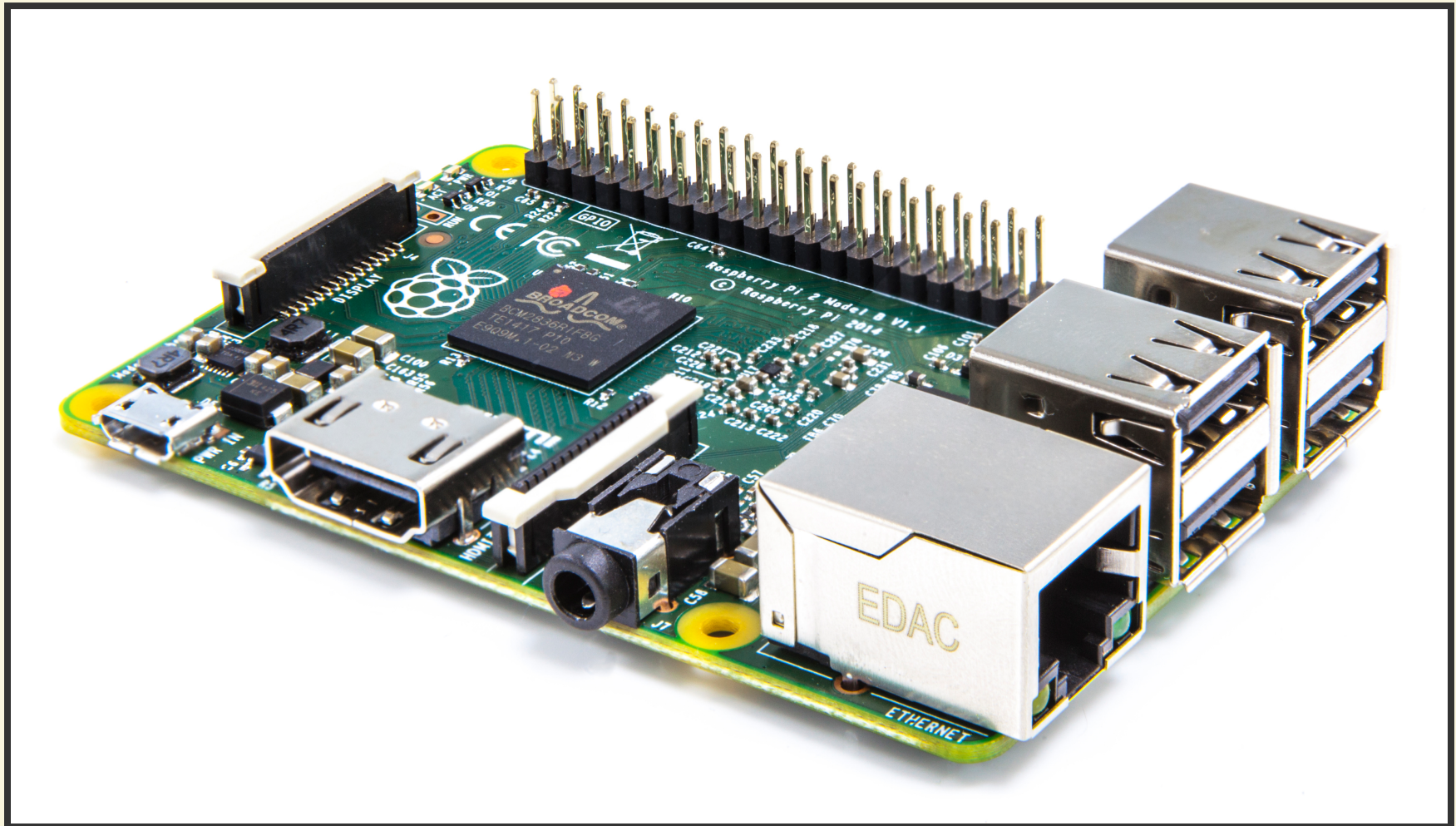
UNINTENDED CONSEQUENCES

The Raspberry Pi was designed to inspire children to take-up programming, but the vast majority of the £25 computers have been bought by adults.

"The reason we've sold so many of these (over a million) is largely is that they've sold to technology capable adults more than they've sold to kids," Upton said. "We think only 10-20%, maybe 30% of the ones we sold have ended up in the hands of kids."

from: [PC Pro](#)

HARDWARE



img: Raspberry Pi Foundation

WHICH OF THE FOLLOWING IS TRUE ABOUT THE RASPBERRY PI?

- a. has no video output.
- b. has no real-time clock.**
- c. has a small spinning hard drive.
- d. randomly blinks Morse Code.

HARDWARE

- Currently 7 models of Raspberry Pi: A, A+, B, B+, 2, Zero, 3.
- CPU equivalent to the chip used in older smartphones or a Pentium II processor (late '90s).
- Graphics equivalent to the Xbox game console (2001).
- **ARM SoC** (system on a chip) architecture (tablets & smartphones) which includes: CPU, GPU (graphics), and RAM (256 MB - 1 GB).
- **Overclocking** (forcing a component to operate faster than the manufactured clock frequency) is built into the operating system and does not void the warranty.

from: Raspberry Pi for Dummies and [Wikipedia](#)

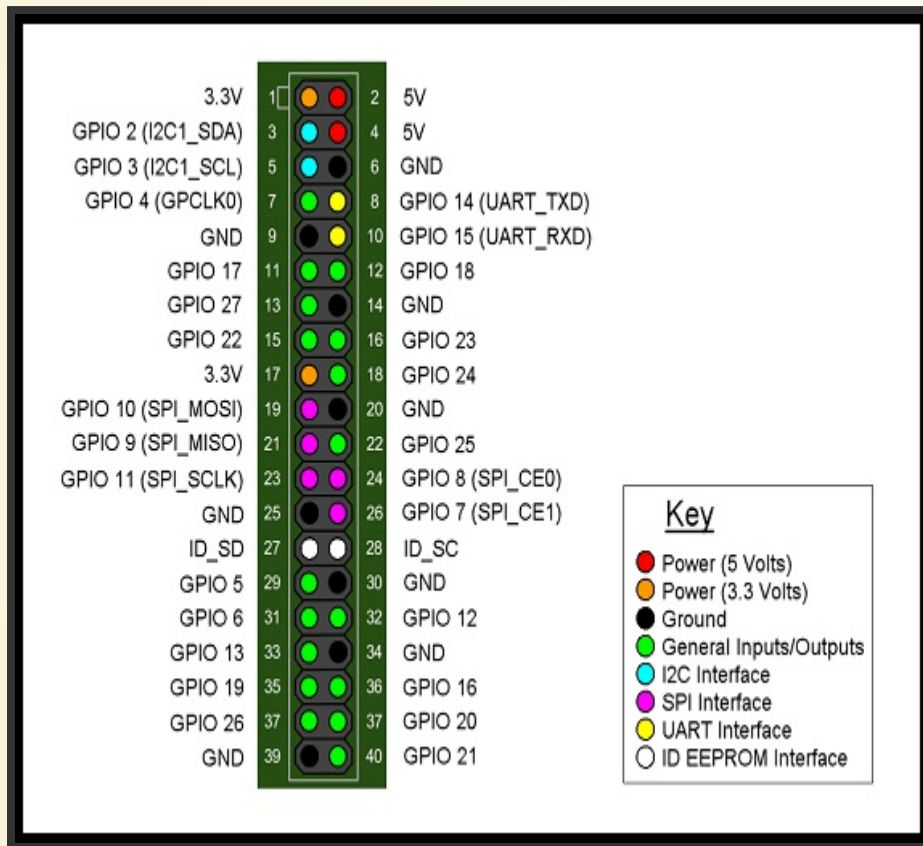
TYPICAL CONNECTORS

- MicroUSB power.
- 1 - 4 USB connectors.
- Video camera input.
- HDMI, RCA or TRRS (tip, ring, ring, sleeve) on audio port for video out.
- 1/8" audio out.
- SD (Secure Digital) or MicroSD card for storage.
- Ethernet networking port (not "A" boards).
- GPIO (General-purpose input/output).
- Full list of specifications for each model available on [Wikipedia](#).

from: [Wikipedia](#)

GPIO

Interface the Pi with your own circuits!



- Headers come in 26 or 40-pin GPIO depending on model.
- First 26 pins are the same.
- General purpose input and output via Broadcom BCM2836.
- **I2C** is a standard that can talk to other I2C chips (also used in the ID EEPROM).
- **SPI** is the Serial Peripheral Interface (sensors, LCD).
- **UART** is Universal asynchronous receiver/transmitter (Serial port).

img: DesignSpark

from: Wikipedia

OPERATING SYSTEMS



- Primary operating system is Linux.
- There are many Linux variants (called distributions) available for the Pi.
Distributions have various programs, software / hardware libraries, and / or package management system installed along with the Linux Kernel.
- Raspbian is the recommended RPi distribution.

WHAT ABOUT WINDOWS??

Yep. Wait, what? Yeah, Windows!

"We've had people queuing up and saying they want Windows. I think there's a sense that 'you're a real PC' if you run Windows." -Upton

Not the desktop version of Windows. "Internet of Things" version of Windows 10 allowing access to Azure (cloud computing platform) services, along with other APIs.

Windows 10 IoT (Internet of Things) version completely free!

from: [Connectedly](#)

RASPBERRY PI VS. ARDUINO

- Arduino boards are micro-controllers, not full computers. They don't run a full operating system, but simply execute written code as their firmware interprets it.
- You lose access to the basic tools an operating system provides, but on the other hand, directly executing simple code is easier, and is accomplished with no operating system overhead.
- The main purpose of the Arduino board is to interface with sensors and devices, so it's great for hardware projects in which you simply want things to respond to various sensor readings and manual input.

DIVE IN, RIGHT?

Not so fast.

The quickest way to get discouraged about something is to have no idea what you are going to do with it... AKA the "now what?" phenomenon.

Figure out a problem you want to solve **FIRST** before anything else.

GETTING STARTED: REQUIRED PERIPHERALS (AND CABLES)

Required to get started using the Pi.

- Monitor or TV: HDMI or RCA.
- USB keyboard and mouse.
- SD card.
- PC SD card writer.
- MicroUSB power supply or cable.

GETTING STARTED: RECOMMENDED PERIPHERALS (AND CABLES)

Useful when using the Pi.

- USB key or external HDD.
- Speakers.
- Case.
- Network cable or WiFi adapter.



VERIFIED PERIPHERALS

Two places for peripherals verified to work with the Raspberry Pi:

- RPi Verified Peripherals
- AdaFruit

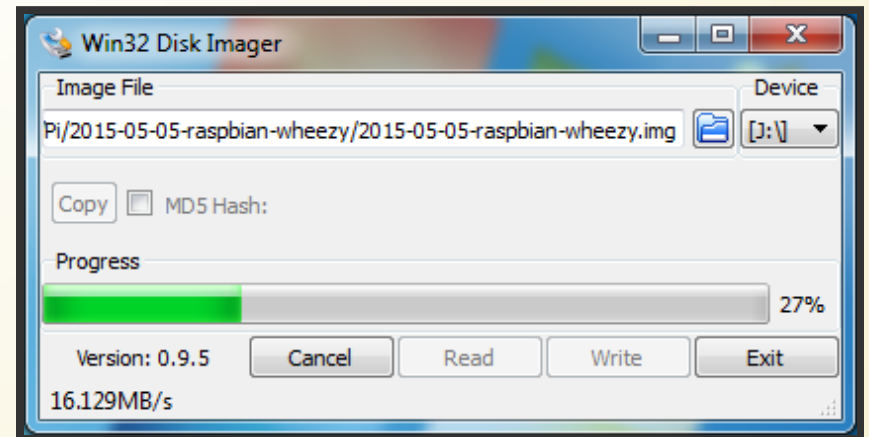
Of course, try any peripherals you can dig up first!

GETTING STARTED: PREP

- Download a Linux distribution (like Raspbian).

They say beginners should start with NOOBS. Truth is, NOOBS contains the Raspbian distribution with the option to download some other Linux distributions. I say skip it and download Raspbian.

- Download may come as a compressed archive, unzip it. An a ".IMG" is the file type containing the disk image.
- Write the image to the SD card.



GETTING STARTED: BOOTING THE PI

- Insert SD card, connect peripherals (monitor, keyboard, mouse, Ethernet) first.
- Then connect power.
- **Raspi-config** will assist in setting up your Pi: expanding to use the full SD card size, change password, change locale and time zone, assign memory split between system and GPU, overclock, Secure-Shell Server (SSH), boot to desktop, update.

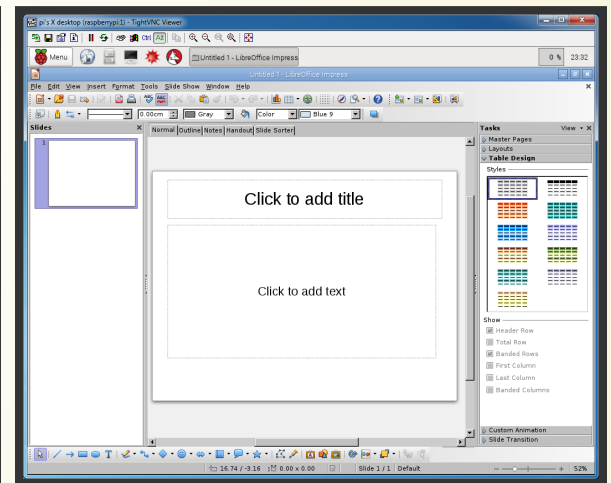
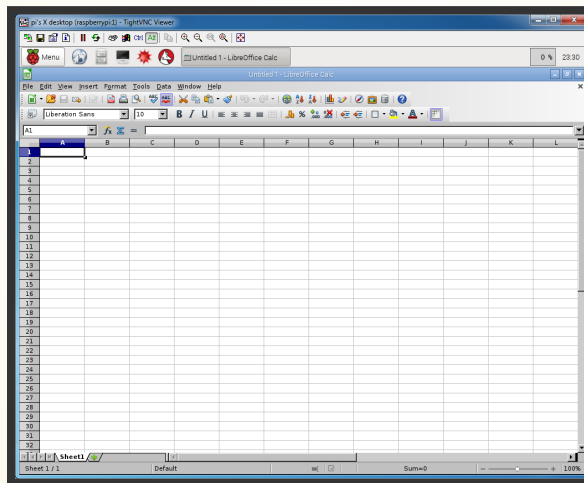
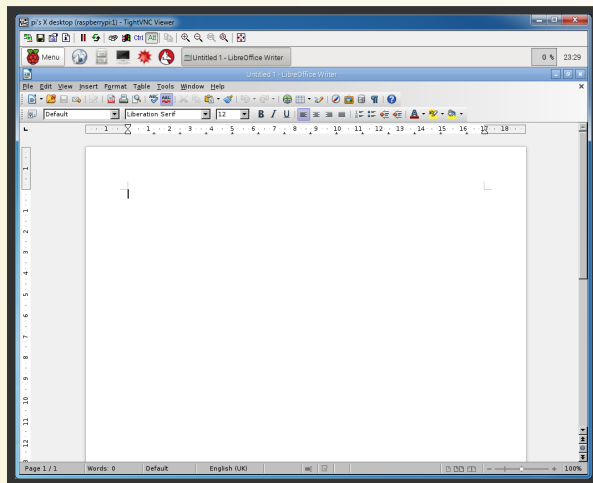
APPS, PROGRAMMING, AND PROJECTS

It's all about experimentation!

img: Eric Erfanian

DESKTOP APPS - OFFICE SUITE

```
sudo apt-get -y install libreoffice
```



DESKTOP APPS - WEB BROWSER

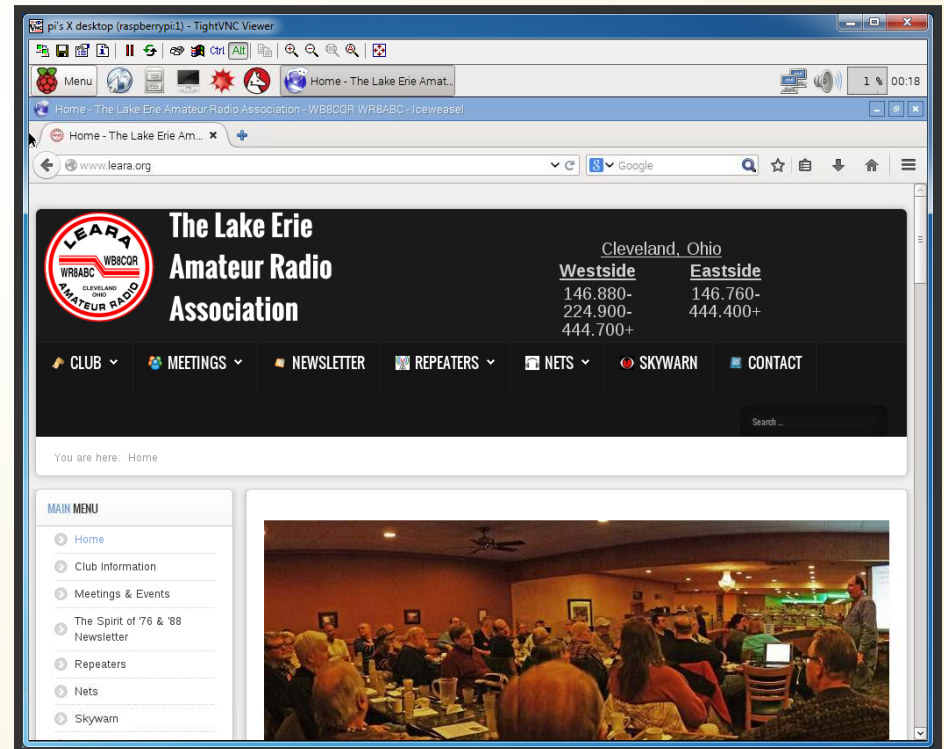
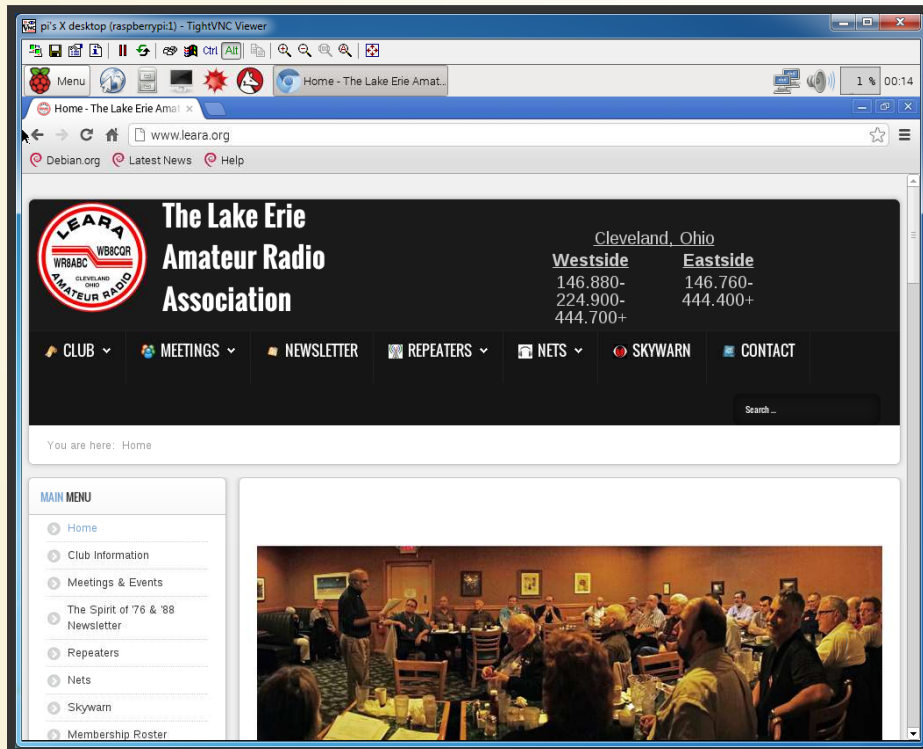
Preloaded with Web (Epiphany). Alternatives:

Chrome:

```
sudo apt-get -y install chromium
```

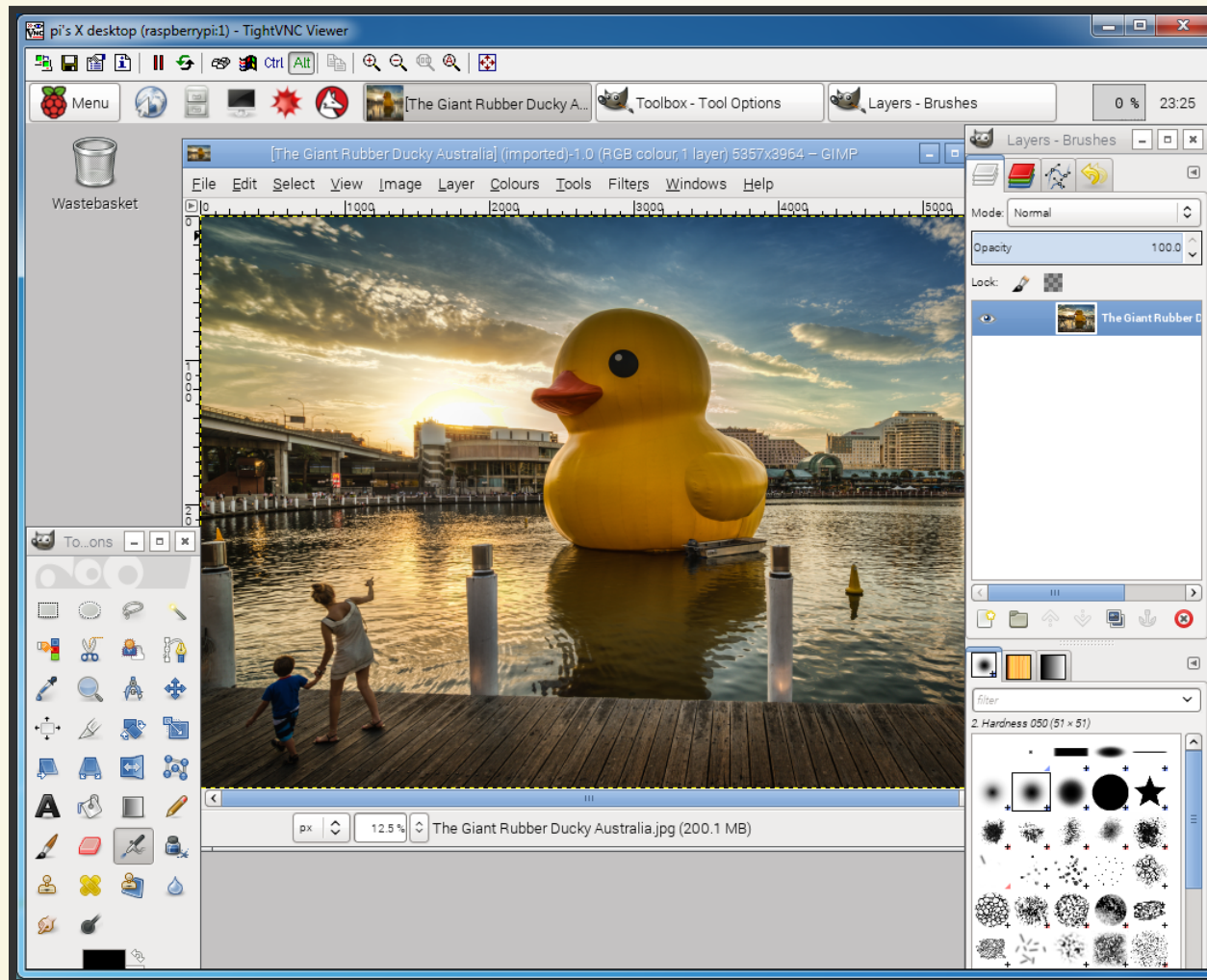
Firefox:

```
sudo apt-get -y install iceweasel
```



DESKTOP APPS - IMAGE EDITING: GIMP

```
sudo apt-get -y install gimp
```



PROGRAMMING

- Python
- Scratch (kids)

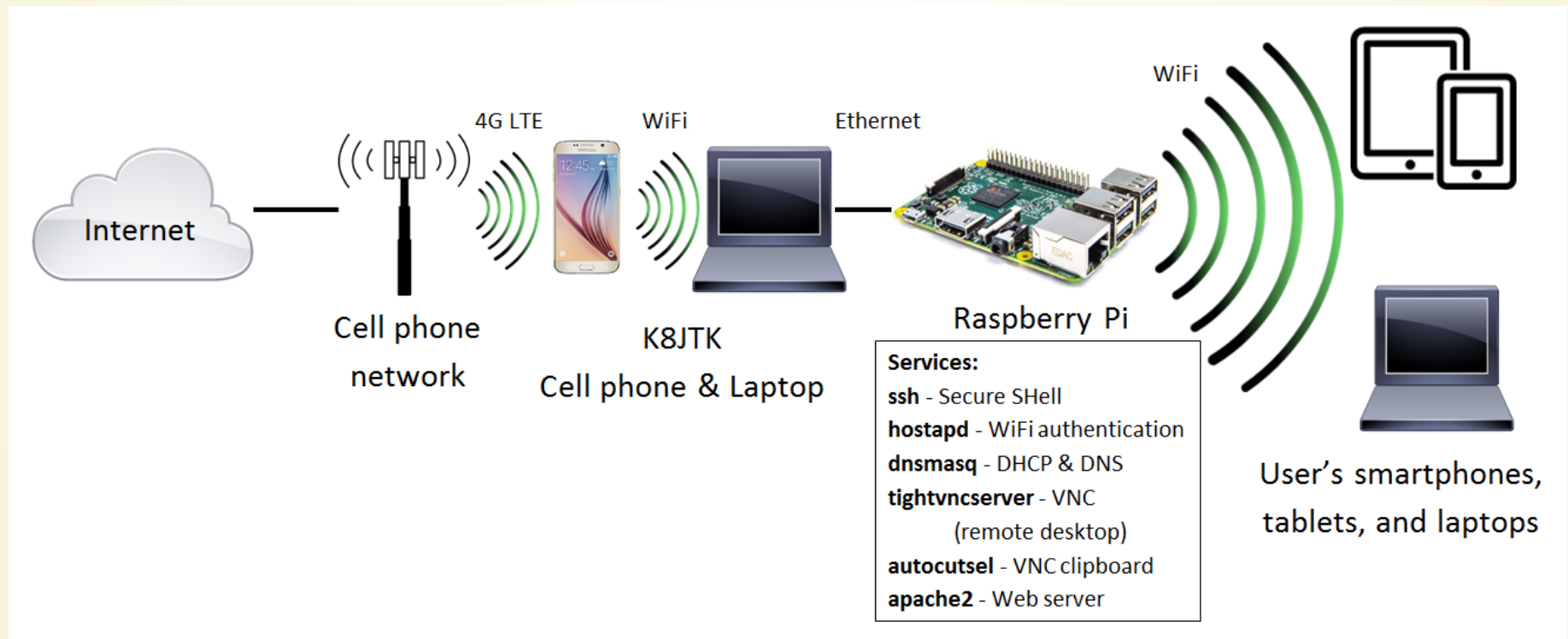
Others?

- Any language which complies on an ARM chip.
- Bash shell scripting
- C/C++
- Java
- Ruby
- Wolfram
- Graphics
- Bare metal

PROJECTS - USUAL LINUX STUFF

- RasPlex (Media Center)
- WiFi access point
- Network Attached Storage
- Web server
- VPN server
- NTP with GPS

The Pi WiFi demo network:



PROJECTS - GPIO CHRISTMAS TREE

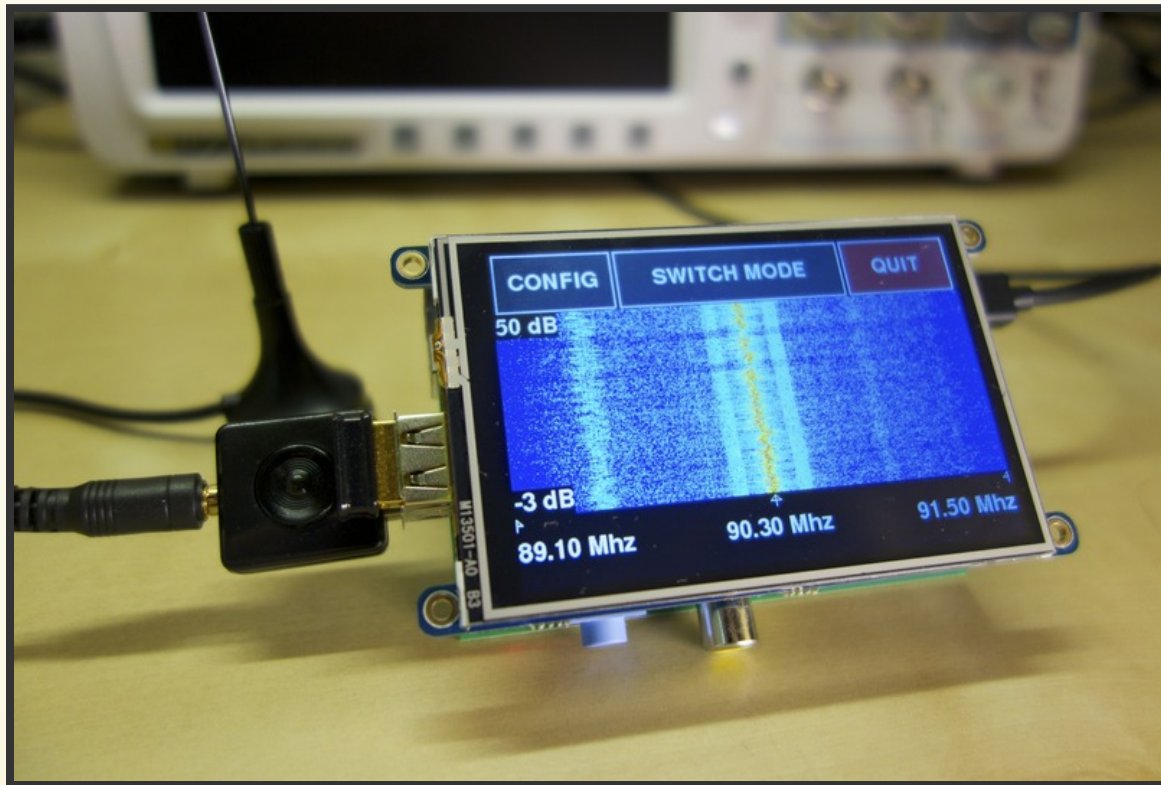
Great for kids!



from: [pocketmoneytronics](#)

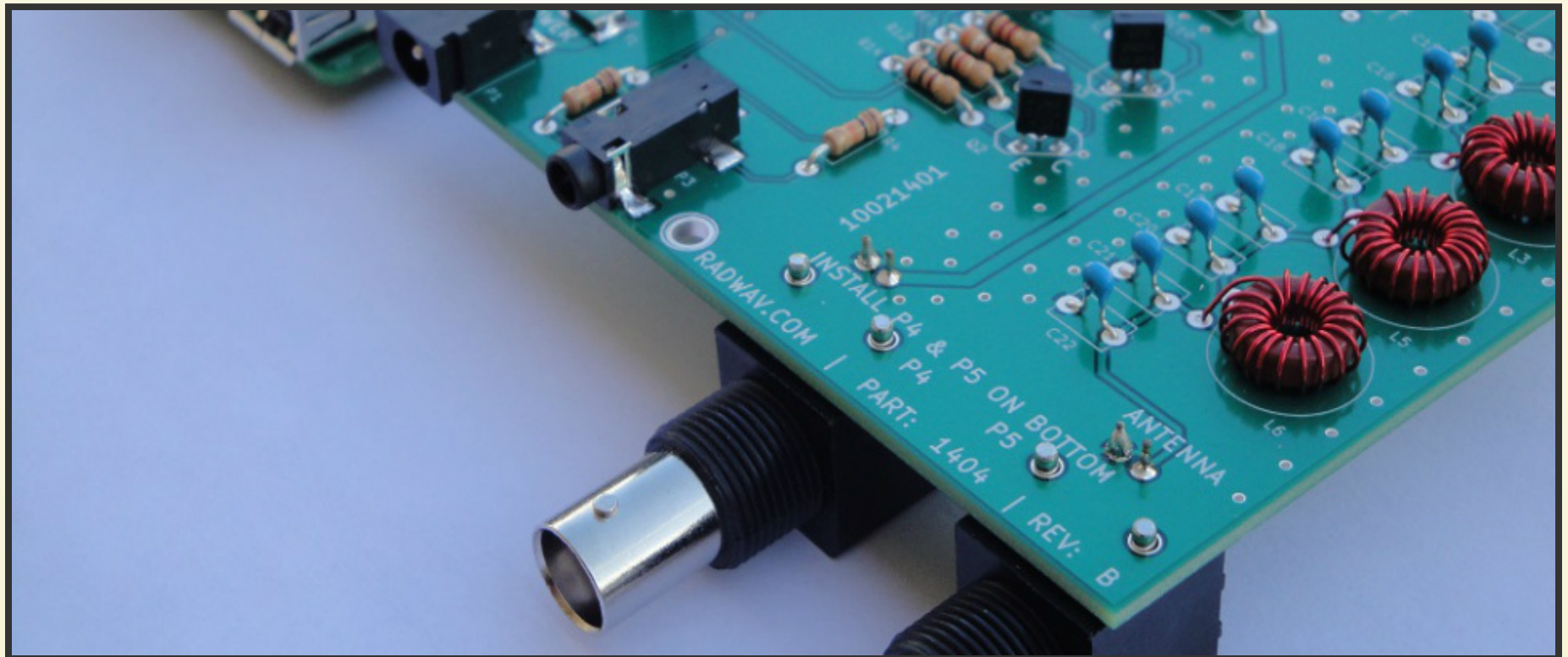
PROJECTS: SDR

- Freq Show (RTL-SDR Scanner)
- FM Transmitter
- PiAware (ADS-B Receiver)



HAM RADIO PROJECTS: TRANSMITTERS

- SkyPi-40
- WSPR Transmitter

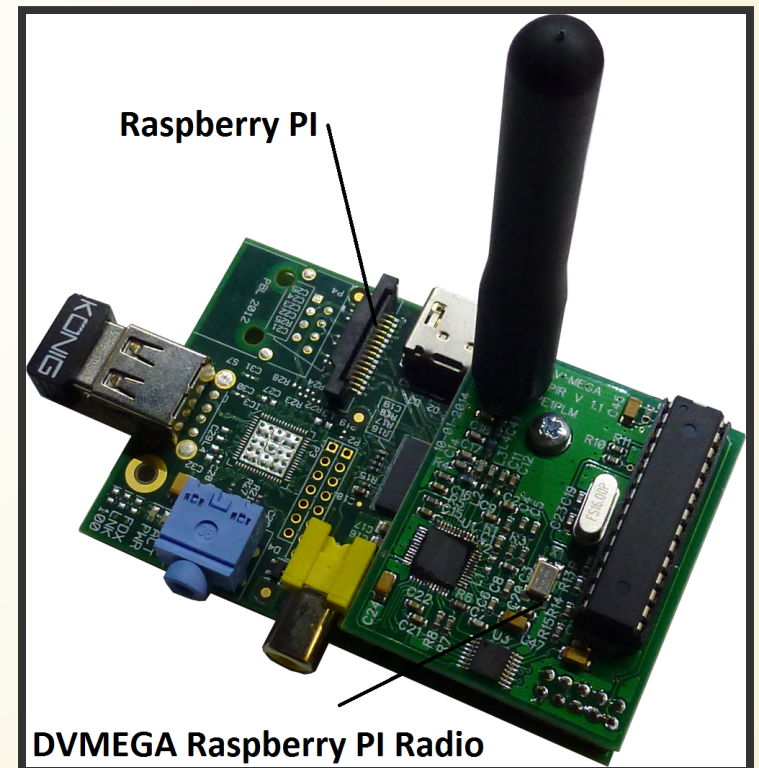


HAM RADIO PROJECTS: VOIP

D-STAR

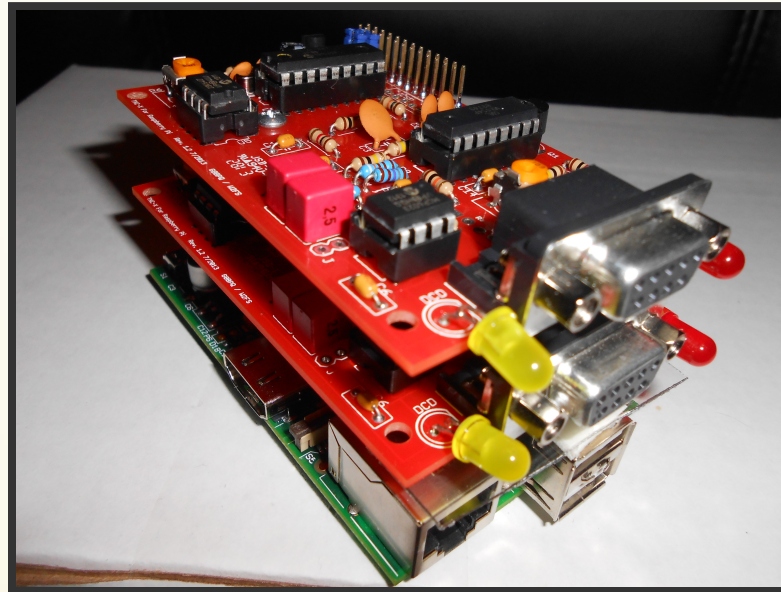
- K8JTK DVAP Pi Hotspot
- ThumbDV/PiDV
- DVMega (hotspots, shields)
- Alternative distributions:
Western D-STAR
Maryland D-STAR
D-STAR Commander

- PiRLP
- Svxlink (EchoLink & Repeater controller)
- Asterisk Allstar



HAM RADIO PROJECTS: APPS & NETWORKING

- SSTV Camera
- SSTV Beacon
- K8JTK FLDIGI
- K8JTK APRS RX IGate
- OpenRepeater (controller)
- TNC-Pi (APRS)
- HSMM-Pi
- RemoteQTH



img: AG6QO

FINDING OUT MORE

- **Dongle Bits** articles I wrote for Lake Erie ARA and Wood County ARC.
- **Books:** on the Raspberry Pi itself. Programming language books, ones for the Raspberry Pi would be more specific to using the Pi hardware and interfaces.
- **Magazines:** hobby magazines. Articles in **QST** for example.
- **Podcasts:** how tos. **AmateurLogic.TV**, **Hak5**, **Ham Nation**.
- **Internet sites, blogs, YouTube:** **Raspberry Pi forums**, **Slashdot**, **Lifehacker**, **Reddit**, **YouTube**.
- **Search for an interest or project idea.** Example:

APRS Raspberry Pi

THE END

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- K8JTK@arrl.net
- This presentation is available on my website: K8JTK.org
- Ohio Section

SSH AND VNC, PASSWORDS

SSH:

Hostname or IP:

ssh.rpi.local:22

Username: **pi**

Password: **demopi**

VNC:

Remote host: **vnc.rpi.local:*n***

Password: **demopi**

Where ***n*** is a (desktop) number
1-5.

VNC desktops are shared and
can be viewed by other users.

Superuser (sudo) password: **demopi**

Once it's broken, show's over!