

# Time From Space!



An NTP Time Server  
Using  
GPS as a Time Reference

# What's a Raspberry Pi?



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- Credit-card sized computer
- Introduced in 2012
- Currently 1.2 GHz quad-core CPU
- 1 GB Ram
- No onboard disk, runs from *u*SD or USB
- USB, Ethernet, Wifi, Bluetooth
- Integrated digital I/O
- Linux OS

# A Word About The Grid

- Why I love it and hate it

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- Keeps devices synchronized to a common source, typically WWV
- First demonstrated in 1979
- Formalized in 1981
- Includes a mechanism to include data travel time

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Because it's cool

# How

- Isn't GPS for location?

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- Yes, but it needs precise timing
- GPS data includes a precise timestamp



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- PPS Output (at the tone the time will be...)
- Keeps my pc sync'd to <1 sec of wvv

# Cost

- Raspberry Pi 3 B: \$35.00
- Adafruit Ultimate GPS Hat: \$44.95
- Hi gain GPS antenna: \$14.95
- 16 GB microSD card: ~ \$15.00
- Battery for GPS module: \$0.95
- Total: \$110.85

# Assembly

- Solder header to GPS board: 10 minutes

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- Follow procedure, get lost in Linux, look up a bunch of stuff: a couple of hours

# Configuration

- Didn't use NOOBS, started with Raspian

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- Followed procedure

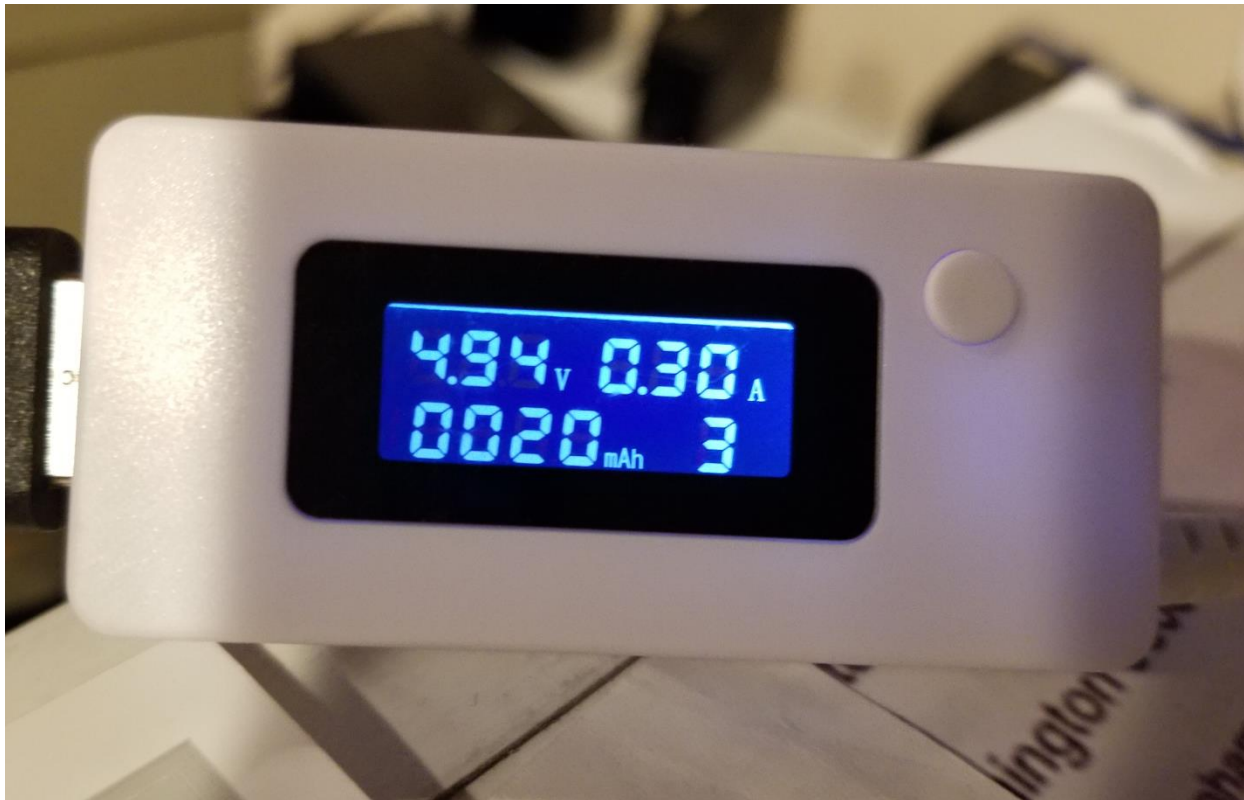


# Configuration

- Didn't use NOOBS, started with Raspian
- Followed procedure
- OS didn't have NTP, had to use APT GET

# Power Requirements

- About 300 mA...



# Uses

- Like any other NTP server, keeps time set on any NTP client

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- Like any other NTP server, keeps time set on any NTP client
- PC, Routers, pretty much anything

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- For digital modes (FT8, WSPR), yes
- PC clocks can be very inaccurate
- Need some kind of external influence, typically from an internet source
- What if there is no internet available?

# No Internet Available

- SOTA

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- SOTA
- Field Day

# No Internet Available

- SOTA
- Field Day
- Emergencies

# Other Options

- Highly accurate offline clock

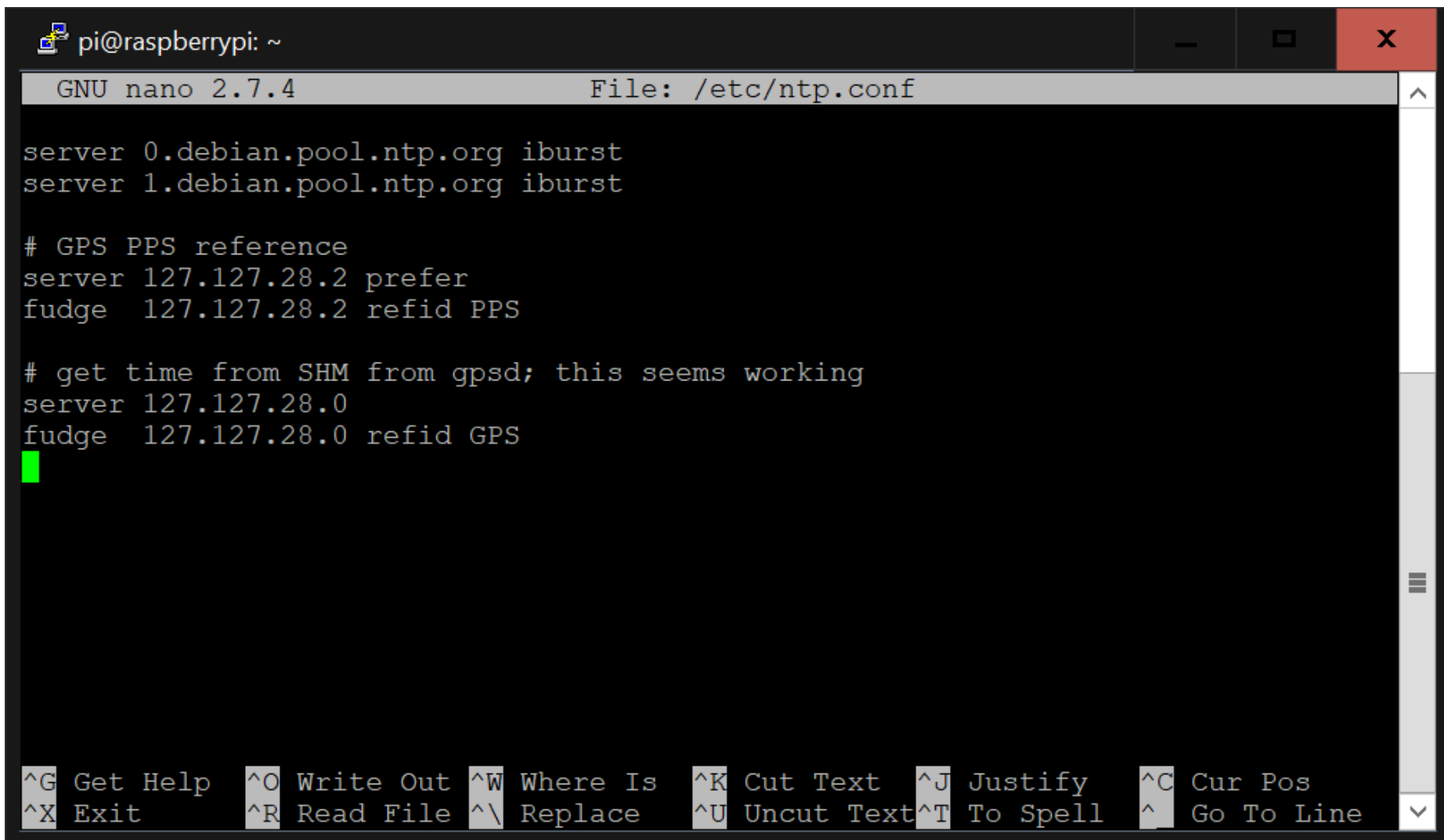
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- Highly accurate offline clock
- WWV clock

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- Highly accurate offline clock
- WWV clock
- Phone?

# Linux Configuration



```
pi@raspberrypi: ~
GNU nano 2.7.4 File: /etc/ntp.conf
server 0.debian.pool.ntp.org iburst
server 1.debian.pool.ntp.org iburst

# GPS PPS reference
server 127.127.28.2 prefer
fudge 127.127.28.2 refid PPS

# get time from SHM from gpsd; this seems working
server 127.127.28.0
fudge 127.127.28.0 refid GPS
█

^G Get Help      ^O Write Out    ^W Where Is     ^K Cut Text     ^J Justify      ^C Cur Pos
^X Exit          ^R Read File    ^\ Replace      ^U Uncut Text  ^T To Spell     ^_ Go To Line
```



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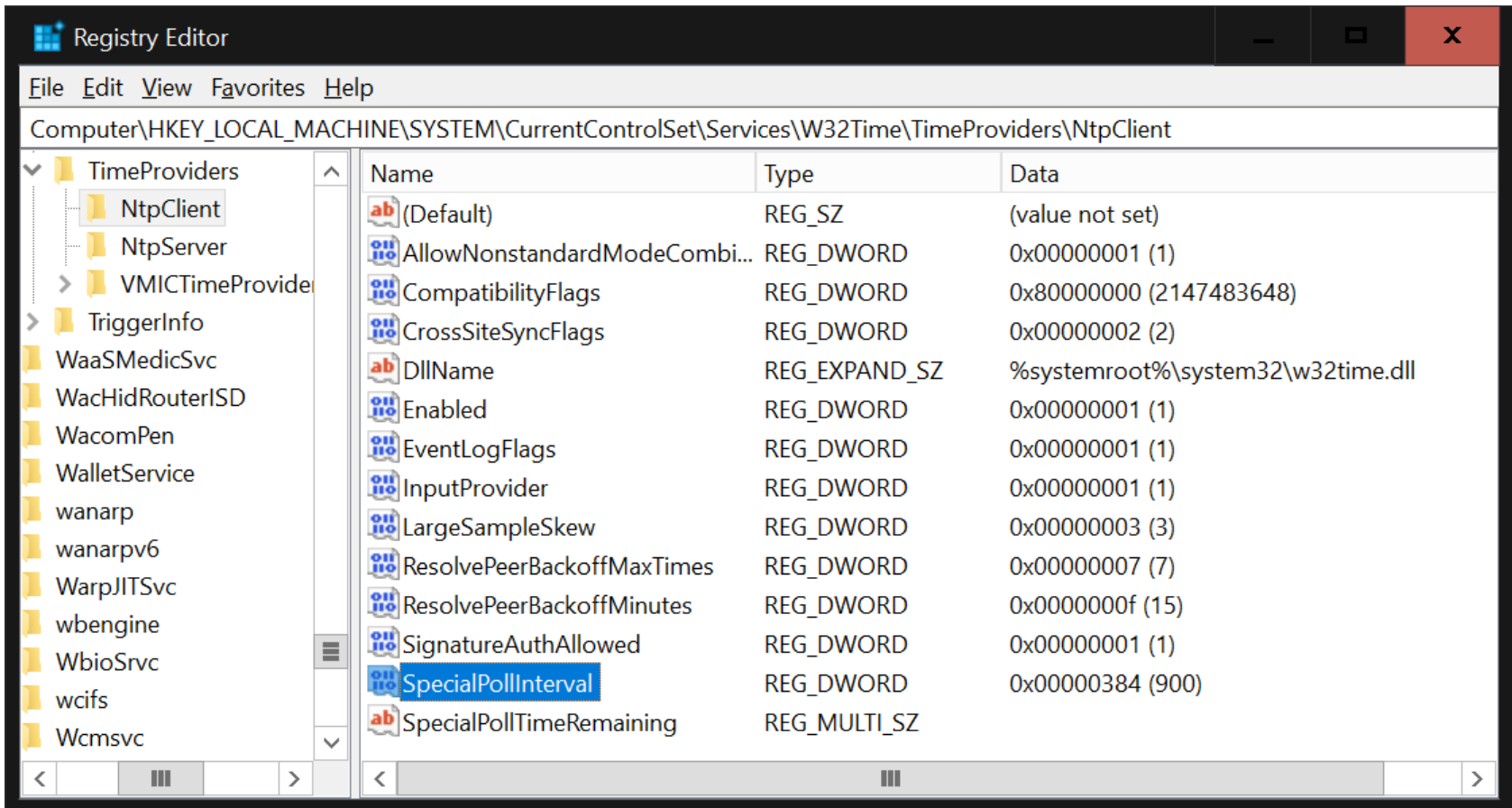
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- Change settings

# Windows Configuration

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- Internet time
- Change settings
- These screens allow only 1 time server, can't adjust poll rate

# Windows Configuration

- Windows Registry to adjust poll rate



Registry Editor

File Edit View Favorites Help

Computer\HKEY\_LOCAL\_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\TimeProviders\NtpClient

| Name                         | Type          | Data                              |
|------------------------------|---------------|-----------------------------------|
| (Default)                    | REG_SZ        | (value not set)                   |
| AllowNonstandardModeCombi... | REG_DWORD     | 0x00000001 (1)                    |
| CompatibilityFlags           | REG_DWORD     | 0x80000000 (2147483648)           |
| CrossSiteSyncFlags           | REG_DWORD     | 0x00000002 (2)                    |
| DllName                      | REG_EXPAND_SZ | %systemroot%\system32\w32time.dll |
| Enabled                      | REG_DWORD     | 0x00000001 (1)                    |
| EventLogFlags                | REG_DWORD     | 0x00000001 (1)                    |
| InputProvider                | REG_DWORD     | 0x00000001 (1)                    |
| LargeSampleSkew              | REG_DWORD     | 0x00000003 (3)                    |
| ResolvePeerBackoffMaxTimes   | REG_DWORD     | 0x00000007 (7)                    |
| ResolvePeerBackoffMinutes    | REG_DWORD     | 0x0000000f (15)                   |
| SignatureAuthAllowed         | REG_DWORD     | 0x00000001 (1)                    |
| SpecialPollInterval          | REG_DWORD     | 0x00000384 (900)                  |
| SpecialPollTimeRemaining     | REG_MULTI_SZ  |                                   |

# Windows Configuration

- *W32tm* command line to configure multiple servers
  - net stop w32time & net start w32time
  - w32tm /config /update /manualpeerlist:"67.9.105.25 pool.ntp.org"
  - w32tm /resync
  - w32tm /query /peers



# A Little Irony

- Raspberry Pi has no built-in RTC...

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- Raspberry Pi has no built-in RTC...
- Using it to control a device that has a built-in RTC

# References

- What is a Raspberry Pi?  
<https://www.raspberrypi.org/help/what-%20is-a-raspberry-pi/>
- Project source  
<http://unixwiz.net/techtips/raspberry-pi3-gps-time.html>
- Compare PC clock to WWV  
<https://time.is/>
- Configure multiple NTP servers in Windows  
<https://www.ctrl.blog/entry/tutorial-windows-ntp-config>

# References

- Change Windows NTP client update interval  
<https://www.wikihow.com/Change-the-Time-Synchronization-Interval-in-Windows>
- NTP Spec  
[https://en.wikipedia.org/wiki/Network\\_Time\\_Protocol](https://en.wikipedia.org/wiki/Network_Time_Protocol)
- Accurate clock for the Pi  
<https://www.adafruit.com/product/255>
- Meinberg  
<https://www.meinberg-usa.com/>