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One of disadvantages designing so cheap computer is that you have to give up some features which are too expensive. One of these features is RTC - real-time clock. RTC chip has its own battery to store actual time even when device isn't plugged in. This chip costs about 10\$. This is quite enough to persuade RPi designers to do not implement this feature.

Problem with storing actual time is partially solved by fake-hwclock package which writes actual time to text file every hour and at system reboot. At start, if no better source of time is present, time is set to one stored in that text file. Since RPi is disposing a RJ-45 port, we can use it as very precise time source within NTP. First we have to install package called ntp.

```
apt-get install ntp
```

Notice: As per advice from one of the visitors, the newer version of Raspbian have preinstalled timesyncd service. It can be used for the same purpose, but you can not have running both of them at the same time. To fix this you can stop and disable timesyncd service using these commands.

```
systemctl stop systemd-timesyncd
systemctl disable systemd-timesyncd
/etc/init.d/ntp stop
/etc/init.d/ntp start
```

That's all, RPI is now synchronizing its time to NTP servers. By default it uses NTP servers which are generally too far from you. It has bad influence to time accuracy. So first go to page pool.ntp.org and find a location as near as possible. For me it is Czech Republic. To set NTP servers open ntp configuration file.

```
nano /etc/ntp.conf
```

And find lines starting with "server". Replace that lines for lines with servers from pool.ntp.org. In my case configuration looks like:

```
#etc/ntp.conf, configuration for ntpd

driftfile /var/lib/ntp/ntp.drift

statsdir /var/log/ntpstats/

statistics loopstats peerstats clockstats
filegen loopstats file loopstats type day enable
filegen peerstats file peerstats type day enable
filegen clockstats file clockstats type day enable


# You do need to talk to an NTP server or two (or three).

#server ntp.your-provider.example


# pool.ntp.org maps to more than 300 low-stratum NTP servers.
# It is not a single NTP server, so you must set the stratum level manually.
#stratumlevelmax 16

# Leap second support - many systems provide their own leapsecond service so
# it is not needed to install one here. However, if the system is somehow
# not set up right it may not have the files for automatic leapsecond
# support. In this case, you will need to install the files manually and
# uncomment the following line. Uncommenting this line has no effect if
# your system does not have the files for automatic leapsecond support.
#leapfile /usr/share/zoneinfo/leap.seconds

# PowerPC AIX has trouble with printing the timezone database to
# ASCII. We suggest the user change the TZDB to ASCII in a separate process.
#powerpc_aix_update

# The directory where time zones are installed. See tzutils(8) and
# tzsetup(8) for more information.
#zonedir /usr/share/zoneinfo

# If you are running in daylight saving mode, a fallback method should
# be used. In this case, we can use the kernel's localtime routine to
# detect DST. Fallback methods can have some problems, however, so users
# who rely on the accuracy of time should probably not use the kernel
# fallback. If you wish to use the kernel fallback, uncomment the
# following line.
#kernel_dstdetector

# The maximum number of times the system will attempt to contact the
# NTP servers listed in the configuration file. This option can be used
# to limit the amount of time the system spends trying to reach the
# servers. The default value is 30.
#ntpservers 30

# The maximum number of times the system will attempt to contact the
# NTP servers listed in the configuration file. This option can be used
# to limit the amount of time the system spends trying to reach the
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# NTP servers listed in the configuration file. This option can be used
# to limit the amount of time the system spends trying to reach the
# servers. The default value is 30.
#ntpservers 30
```

```
# *** ***

server 0.cz.pool.ntp.org iburst
server 1.cz.pool.ntp.org iburst
server 2.cz.pool.ntp.org iburst
server 3.cz.pool.ntp.org iburst

# By default, exchange time with everybody, but don't allow configuration.
# See /usr/share/doc/ntp-doc/html/acopt.html for details.
restrict -4 default kod notrap nomodify nopeer noquery
restrict -6 default kod notrap nomodify nopeer noquery

# Local users may interrogate the ntp server more closely.
restrict 127.0.0.1
restrict ::1

# Clients from this (example!) subnet have unlimited access,
# but only if cryptographically authenticated
#restrict 192.168.123.0 mask 255.255.255.0 notrust

# If you want to provide time to your local subnet, change the next line.
# (Again, the address is an example only.)
#broadcast 192.168.123.255

# If you want to listen to time broadcasts on your local subnet,
# de-comment the next lines. Please do this only if you trust everybody
# on the network!
#disable auth
#broadcastclient
```

Now you can restart ntp service.

```
/etc/init.d/ntp restart
```

Here is command to check if time is synchronizing properly. To list NTP servers with which RPi is synchronizing:

```
ntpq -pn
```

You will get some output like this.

remote	refid	st	t	when	poll	reach	delay	offset	jitter
*81.27.192.20	195.113.144.238	2	u	26	64	1	58.571	0.797	68.634
+93.185.101.74	195.113.144.201	2	u	25	64	1	42.282	-1.507	0.477
+93.185.101.77	195.113.144.201	2	u	24	64	1	41.390	-1.544	68.243
-91.216.168.42	178.238.46.152	3	u	23	64	1	43.510	1.010	1.094

First letter have the most significant value of the table. * means actual time source, + means something like backup time source, - is ignored, but can become backup (+) at any time. First column shows IP addresses of NTP servers, second shows source of time for your NTP servers, third shows so called stratum. Stratum is number from 0 to 15 and shows number of hops from reference time (GPS clock, atomic clock...). That devices has stratum 0, but it is impossible to connect to them directly. For example, you have computer with some kind of atomic clock connected (veeeery expensive - about 100 000\$). Atomic clock box is stratum 0, your computer is stratum 1... Maybe you can also find stratum 16 which means untrusted time source. Column with "u" means that NTP server's address is unicast. "When" indicates number of seconds passed since last response. "Poll" means interval between time requests, in seconds. "Reach" indicates success/failure to reach source. "Delay" indicates the roundtrip time, in milliseconds, to receive a reply. "Offset" is the difference between ntp server and your system clock in milliseconds. "Jitter" shows the difference, in milliseconds, between two samples.

Now you can check your time... I like to do everything in right way - so this command will print actual time in ISO 8601 (Representation of dates and times standard) format :)

```
date +"%FT%T%Z"
```

NTP Server

Now when RPi has synchronized its time, you can set it to pass this time information to devices in your local network. You only have to open configuration file of ntp daemon.

```
nano /etc/ntp.conf
```

An **POWERED BY** requests will be answered.

```
restrict 192.168.1.0 mask 255.255.255.0
```

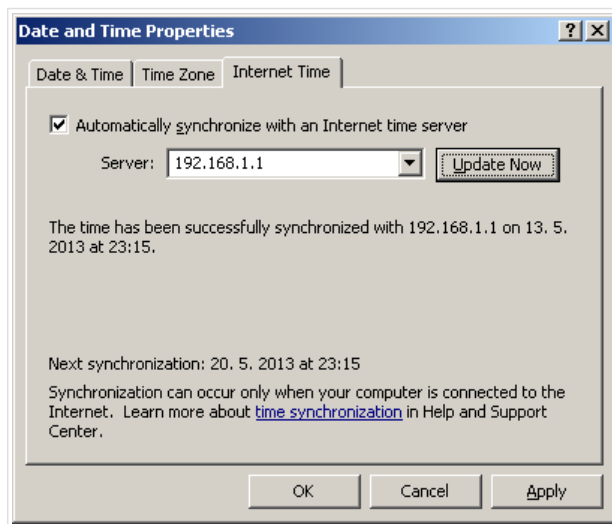
And also add this 2 lines. They will enable sending of broadcasts and multicasts containing time information for devices which accept them (Cisco, Juniper...). Change first address in bold to broadcast address of your LAN. Do not change multicast address 224.0.1.1 since this address is assigned to NTP service by IANA and some network devices join this multicast group automatically.

```
broadcast 192.168.1.255  
broadcast 224.0.1.1
```

Now close the configuration file (CTRL+X...) and save changes (...press "y" and Enter). Last step is to restart ntp daemon with:

```
/etc/init.d/ntp restart
```

From now you can configure machines in local network to synchronize its time to RPi. For example in Windows XP double click the clock in tray > Internet Time > check Automatically synchronize with an Internet time server and insert RPi's IP address.



SNTP in Windows XP

First versions of Windows to Windows 8 still don't have support for network time protocol. They use Simple network time protocol instead which have a limited accuracy. Accuracy is matter of up to 4 seconds which is much more than NTP's few milliseconds :) SNTP in Windows synchronize the time once a week, NTP daemon in Debian synchronizes its time approximately every 512 seconds by default...