FIVE AND NINE PLUS

THE OFFICIAL NEWSLETTER OF THE APPLEDORE AND DISTRICT AMATEUR RADIO CLUB

Club Callsigns: G2FKO and GX2FKO
Web Site : www.adarc.co.uk

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President	John Jeffers	G0UNB			
Chairman	Terry Adams	G4CHD			
Vice Chairman	Mike Hammond	G3PGA			
Secretary	Alan Fisher	M6CCH	01237 422833	Email:	fisheralan@btinternet.com
Treasurer	Mike Wogden	G4KXQ			
Committee	Laurence Soutter	G4XHK			
	John Lovell	G3JKL			
	Graham Bailey	G1ZTJ			
QSL Manager	John Lovell	G3JKL			
Web Master	John Lovell	G3JKL			
Exam Secretary	John Lovell	G3JKL			
Editor	Terry Adams	G4CHD			

December, 2014

EDITORIAL

Welcome to another Club 5&9 Newsletter - the last one of 2014.
It is therefore the perfect opportunity for your Committee and myself to wish everyone a Very Merry Christmas and a Happy Healthy Prosperous New Year.
This month's Meeting is of course our **Club Christmas Party** and again will be **free of charge** - we only ask if you could please **bring along a suitable prize for our Raffle** which would be much appreciated. The format will be as per last year with food, tea/coffee etc provided and John (G3JKL) will provide music to get us all into a festive mood. Dave (G0PGK) will offer his seasonal quiz for a bit of fun and the evening will end with our usual Raffle. Bring along the xyl and have a very enjoyable evening.

In this Newsletter, Stuart (M1FWD) has produced an interesting Wordsearch puzzle which together with his Crossword will provide an enjoyable respite from the Xmas activities.
Dave (M0JAP) has also written an excellent article on Amateur Timing and the first part is included in this Newsletter.
So it only remains for me to thank you all for hopefully enjoying this year's Newsletters and look forward to many of you offering your own articles for publishing in the New Year.
Enjoy the Newsletter and see you all at our Xmas Party.

Terry (G4CHD)

CLUB MEETINGS

Unless otherwise stated, Meetings are held at the Appledore Football Social Club starting at 7.30pm for 8.00pm.
Visitors are always welcome.

December 15th	Club Christmas Party
January 19th	"Contests - Beauty or a Beast?" by Terry (G4CHD) & Mike (G3PGA)
February 16th	"Whisper & WebSDRs" by Mike (G4KXQ)
March 16th	Club AGM
April 20th	TBA

For further information, contact Alan (M6CCH)

DON'T FORGET, IT'S OUR XMAS PARTY ON MONDAY, DECEMBER 15th

SEE YOU ALL THERE

REPORT ON THE NOVEMBER MEETING

LIGHT HEARTED QUIZ
by John (G3JKL)

Three teams of approx 4 were formed on the night and undertook much head scratching in answering the 40 multi choice questions (each had 4 possible answers). The outcome was that the winners scored 24/40 with the runners up each with 21/40 - which says something about the light hearted approach by all to the challenge! At least we all scored better than the sheer guesswork score of 10!!
Many many thanks to John for all his hard work in preparing the quiz - (multi choice quizzes are very time consuming to produce) - and for putting up with the insults from the audience as each question was posed !!
A most enjoyable evening - thanks again John

SUDOKU PUZZLE

The aim is to enter a number into each cell so that **any column, or any row, or any block of cells contains all numbers from 1 to 9**. Terry (G4CHD)

1	3		6	5			9	8
9		7			3			
			9					7
	7				5			
	5						3	
			7				1	
8					6			
			2			5		4
5	6			7	4		8	9

THOUGHT FOR THE MONTH from John (G8BXO)

Next time you slap salt and vinegar on your chips (edible not micro!) Just remember the following :-
Have you ever gone to change a battery and found corrosion on the wires or contacts, well a simple remedy is to put a teaspoon of salt in a saucer and mix in an equal amount of ascetic acid (vinegar is a dilute form) and voila! Works well also for cleaning coins.

John (G8BXO)

CROSSWORD

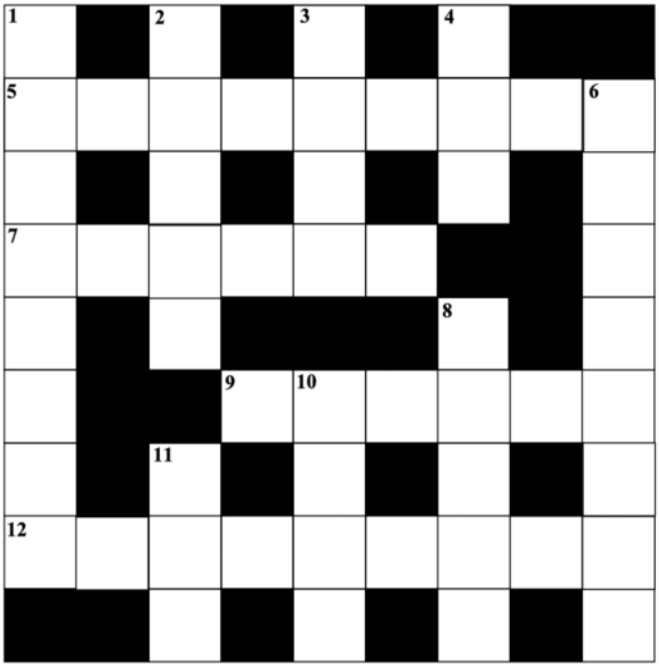
This month's Crossword is by Stuart (M1FWD). The answers will be published in the next month's Newsletter. Good luck !

Clues Across

5) Instruments for bringing in sound signals (9)
7) Tango Alpha land (6)
9) ? ? Frequency, a boundary in a system's frequency response at which energy flowing through the system begins to be attenuated/reflected rather than passing through (3,3)
12) A native of Lima Alpha land (9)

Clues Down

1) A native of Echo Three land (8)
2) 21-pin connector for audio-visual equipment (1,1,1,1,1)
3) Five and ? Is a welcome radio report (4)
4) ? Caledonia, a territory in the southwest Pacific, Foxtrot Kilo (3)
6) Poultry filling (8)
8) Of or relating to or using sound or sound waves (5)
10) Radio ?, Monthly magazine (4)
11) An area of shifting sand dunes in the Sahara (3)



Last month's answers :-

Across 3) Baker 6) Adam 7) Heard 8) inkjet 10) crying 11) relay 12) Nene 13) modem

Down 1) radiogram 2) Jacky 4) abet 5) Rodrigues 7) henry 9) Niger 10) cage

Stuart (M1FWD)

WORDSEARCH

by Stuart (M1FWD)

Try to find the following Club member names in the grid below :-

BRIAN	DAVE	DAVID	DON
FRED	GRAHAM	HELEN	JIM
JOHN	KEITH	KEN	KEVIN
LAURENCE	LEN	MIKE	NORMAN
PETER	PHIL	STUART	TERRY

A	R	S	T	U	A	R	T	R	A	H	T	N	D	J
F	M	I	J	H	V	F	F	E	A	P	N	E	L	D
O	I	D	J	D	T	L	A	U	R	E	N	C	E	D
P	K	U	V	Y	H	I	L	P	A	A	F	U	D	P
T	E	P	T	R	T	H	E	L	E	N	H	T	N	F
J	V	E	R	R	I	P	D	V	L	A	E	N	A	T
A	I	S	P	E	E	D	A	V	I	D	L	D	I	J
M	N	H	T	T	K	E	P	D	V	J	L	L	R	D
A	O	H	E	U	N	R	P	D	F	S	E	A	B	V
H	R	R	R	T	J	F	R	D	N	N	O	V	R	N
A	M	K	E	N	P	J	U	H	P	J	T	D	A	O
R	A	P	O	J	R	J	O	A	V	E	O	R	R	D
G	N	L	T	S	S	J	E	H	R	N	L	O	L	U
L	H	U	F	J	P	V	U	F	A	R	U	O	N	L
P	V	U	F	A	R	U	O	N	L	L	T	S	N	V

LOCAL SKEDS

Zepp Net: **Mon, Tues, Thurs :**
145.450 MHz Wed
via GB3DN 1600 local time

6m Net: **Wednesday, 8pm, 51.480 MHz FM**

HF Net: **Friday** at **1500** local time
7.145 MHz ± qrm

Slow Morse: Run by **Dave (G3YGJ)** every **Tuesday and Thursday, 7pm clock time on 145.250 mode FM.**

70cm Net: **Sunday, via GB3ND, 1100 - noon local time.**
Available on Echolink node 221334

LOCAL REPEATERS

70cm Handy Cross Repeater/Echolink (#221334) Gateway (GB3ND)
User: Listen 433.35MHz– Transmit 434.95MHz
Access 1750Hz Tone (Timeout 4.25 mins)/ 77Hz CTCSS
Repeater keeper is Jeff (G4SOF)

2m Stibb Cross Repeater (GB3DN)
http://www.g0rql.co.uk/gb3dn.htm
User: Listen 145.6375MHz - Transmit 145.0375 MHz.
Access 1750 Hz Tone or 77 Hz CTCSS Repeater keeper is Tony (G1BHM).
Yahoo users group for general chat and banter at :-
http://groups.yahoo.com/group/GB3DN/

A MESSAGE FROM OUR ITALIAN FRIEND

We are at the end of year 2014 and Christmas will come in next few weeks.
As associate foreign member of the Appledore & DARC (G2FKO), I wish you all the best for the Christmas party on 15th December 2014, hoping most of the members will be present.
And so
Merry Christmas and very Happy New Year 2015
to you and all the participating members, together their families.
All the best from Italy. Greetings. "73/88".
Cordially Yours,
Giorgio (George)
SWL IV3 - 57306
Italy 2014

AMATEUR TIMING AND AN ECONOMICAL RPI TIME SERVER

by Dave (M0JAP)

Many thanks to Dave for Part 1 of this interesting article which appears in the following pages. It is only after reading such an article that one starts to fully appreciate the many areas of our modern life in which an accurate time reference is essential.

Merry Christmas

If any member has written an article that they feel would be of interest to Club members, please send it in to me and it will make your Club Newsletter all the more interesting. This is particularly relevant as my article on Frequency Modulation in the October 5&9 did not raise a single comment suggesting that perhaps such articles are not required.
Well that's it for another month, enjoy the read

Terry (G4CHD)

AMATEUR TIMING AND AN ECONOMICAL Rpi TIME SERVER - PART 1 (of 2) by Dave James (M0JAP)

Introduction

I suppose I have already revealed my interest in (obsession with ?) time-keeping and astrometry. The astrometry interest arose from my adventures in radio astronomy (RA), especially my plans for L-band interferometry. But on a more basic level I've been aware that I need better time-stamping of my geophysics sensors' data, so at the practical level I'm interested in ensuring proper time-keeping on all the computers at home, in my garden office, my home observatory (optical) and my remote observatory (RA and geophysics). It's also clear that some ADARC members have an interest in areas like EME and WSPR, for example, where it is very important that adequate time synchronisation between parties is maintained. But what is possible at the amateur level ? This little article explores this, and shows how an economical reference clock server may be built around a Raspberry Pi (RPi) and a GPS module, but also how we can at no expense significantly improve time-keeping on our Windoze machines; this OS family seems almost to have been specially designed for the worst possible time keeping ! But I'm no expert in all this, so beware any who pursue these topics too deeply as I may not be able to guide you that far - especially on Linux.

Time, gentlemen, please ...

First, consider the units. A millisecond (ms) is 10^{-3}s (thousandth of a second), a microsecond (μs) is 10^{-6}s (millionth), and a nanosecond (ns) is 10^{-9}s (billionth). I recall that when I went to school, the US and UK billions were unequal, but they are now thankfully aligned especially so after Chancellor Healey formally clarified the wise change for HMG Treasury in 1975 !

Second, let's consider what we use clocks for, and how our PCs are arranged. For ensuring you get to the weekly Bear Street chats on time, eyeball and wristwatch usually suffice, using TV or radio time. But dig a little deeper and it soon gets quite complicated. We are all aware of the well-justified move to railway time, first by GWR in 1840 and the later alignment throughout Britain to GMT. Today in nearby Exeter the Met Office, local industry, the airport and the astrophysics researchers at the University all - if not the railways (!) - indirectly or directly rely on excellent and reliable timekeeping, even extending into the air and deep space. But it was in Exeter that as late as the 1850s the public clocks showed local (Exeter) time but with a second minute hand running 10 minutes ahead of this for London Time. In those days the Dean of Exeter Cathedral had great influence over such matters. Of course, in my home village we operate in Atherington Glacial Time (AGT, a subset of Devon Time), even as we approach 2015, but that's another story . Certainly, as we know, modern quartz crystal based watches can quite economically outclass fancy chronometer class mechanical watches; the latter are now for collectors, football stars and shallow celebrities. We used to use the BBC 'pips', but whilst these are still aligned properly on 'long wave' (198 kHz), they are suspect on DAB. Indeed the extra delay (which can be several seconds) is not even consistent on DAB ! Timing via MSF (Anthorn, 60 kHz) is quite good, but for the ms level one needs to consult the monthly bulletin published by NPL afterwards ! The 198 kHz BBC signal still serves as decent frequency reference, and a £100 kit of parts is available from Spectrum Comms. in the UK for such an off-air standard (10 MHz etc. outputs). I built one, and its packaging evokes much nostalgia:

As we saw in a recent *5&9* item, time is a tricky thing; it's part of space-time. In Special Relativity a clock moving with respect to an observer appears to run more slowly than to an observer moving with the clock. And in General Relativity, such time dilation is also caused by gravity; clocks on the earth's surface, for example, run more slowly than clocks at high altitudes, where gravitational forces are weaker. So what's the proper international time standard we should use, and how to synchronise our computers and our amateur radio, RA and geophysics equipment ? Remember frequency and time are inextricably linked, too, one being the integral of the other. For best timing and synchronisation we need a clock that has accessible 'ticks' at useful, correct intervals and which features some sort of reliable frequency source (tick rate) aligned and of known and appropriate accuracy. Clock and watch advertisers like to promote “atomic” versions with accuracy of “one second in 10 million years” or similar, but all this means is that these devices are reasonably accurate by means of auto-synchronisation to MSF, say, at usually around 2 a.m. once a day and that MSF time is derived from an atomic clock ! That tells us nothing about how accurate they are during the day, how much the offset jitters and wanders with varying temperature, propagation and so on. Similarly with the real time clock (RTC) on our PC; and PCs have notoriously bad system clocks derived from a crystal that costs pennies and is uncompensated for temperature and supply changes and embedded in circuitry that likewise cost pennies - regardless of the PC price and brand. (Believe me, for I've tested many)

UTC

The global standard for time is UTC (Co-ordinated Universal Time), by UN Treaty obligations and other agreements. How is this maintained ? First, let's clarify what the second is. It is now defined as "6the duration of 9192631770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom" and this definition "refers to a caesium atom at rest at a temperature of 0 K". Importantly, since 1960 it is thus no longer defined in astronomical terms, but by fundamental physics. And this notional caesium (cesium) atomic clock is assumed to be at rest and at mean sea level (i.e. it is, in relativistic terms, denoting proper time on the Earth's rotating geoid). This now properly accounts for time dilation variation with altitude. So this is the SI (Int. System of Units) definition of the second, and is defined by atomic clocks. Oh, by the way, the SI second now agrees with the ET second (what astronomers and others used to consider Ephemeris Time's second) to 1 in 10^{10}. Got that ? I told you it is a little tricky ...

Atomic clocks have used the microwave range transitions in hydrogen, cesium and rubidium. The early commercial HP cesium beam clocks were small enough by 1971 to be flown in 707s around the world to verify the relativity predictions, a very important event. Later, for some years radio astronomers needing time synchronisation for their VLBI (Very Long Baseline Interferometry) would use such clocks as transfer standards. The clock and battery packs occupied a first class seat, and an astronomer / engineer always accompanied the clock. Apparently it was often difficult to ensure no entangling with the stewardess' drinks trolley. Imagine the situation on today's airlines ... Related to all this is the modern definition of the meter in terms of a defined fraction of the distance travelled by light in a vacuum; and central to this is the proven notion that this speed is constant, independent of frequency and polarisation and - importantly - to the observer's state of motion. Vacuum is non-dispersive, too.

The very best cesium-fountain clocks have an uncertainty of order 10^{-15} to 10^{-16} over ~1,000 s averaging, the lower figure equating to ~10 ps/day. (A picosecond is 10^{-12}s or 0.001 ns).

The latest atomic clocks are optical in nature, and offer stabilities (accuracies) approaching ~ 10^{-17}; a useful comparison is the age of the universe at ~ 4 x 10^{17}s ! In the last few years commercial Chip Scale Atomic Clocks (CSACs) have been developed that use this new approach. One of these weighs just 35 g, consumes <120 mW and is <17 cc in volume:
The coin shown is a US quarter. The US military is now evaluating these, and they are likely to find great utility in future space applications. At the more mundane level, you can buy an affordable second hand Rubidium clock, about the volume of a thick paperback, usually after it's been pulled from a CDMA cellular mobile base station in the Far East. Indeed I have one of these. A practical consideration for these is the limited lifetime of the Rb source inside.

To place in context, recall that at a receiver frequency of 1 GHz - a little below the HI hydrogen line frequency that interests me - the period (360^0 of phase) is obviously 1ns, and that's why timing accuracies or consistencies of that order arise for interferometry or aperture synthesis applications in HI line RA. Imagine the requirements at mm-wave frequencies.

So how is UTC actually determined ?

For modern society, if not science, the original three heavenly oscillators apparent to the ancients and to astronomers - the rotation of Earth about its axis, the revolution of Earth around the Sun, and the revolution of the Moon around Earth - lack the necessary intrinsic stability. Instead nowadays, over 400 atomic clocks are employed worldwide to determine TAI (International Atomic Time). This assemblage of high precision clocks includes clocks with differing characteristics in terms of appropriate averaging times. The Allan deviation and variance are used as suitable metrics. The manner of the weighting of all these clocks is intricate, to say the least; but as I understand it, on a regular (daily ?) basis the authorised international body carefully adjudicates and massages the ultimate output - rather like the setting of LIBOR or the gold price (but without the fraud, as this is not international high finance). From TAI, UTC is then determined to differ from (be behind) TAI by a certain integral number of seconds. These seconds are termed leap seconds and are never negative. They ensure TAI and UTC are within <0.9s of each other forever, and are introduced if required up to twice a year at defined times and dates at the end of June and December; these should not be confused with leap <u>years</u>. The leap seconds number is currently 16, and we know that there will be <u>no</u> leap second introduced Dec 31 2014.

Of course UTC time is simultaneous worldwide, as is the application of the leap seconds when needed (important for aviation and other critical systems). Remember, too, that civil time around the world is simply UTC offset by (usually) an integral number of hours, the number decided at country or regional level and which may also feature daylight saving. There is a serious discussion scheduled for the 2015 World Radio Conference on proposals to move to TAI rather than UTC globally, but the ITU is unlikely to reach agreement then; the UK is one of the countries so far in opposition, but the arguments so far given by HMG seem to me pretty ill-informed. The GPS system will be outlined in Part 2; it uses GPS Time, by the way (!), and all sorts of relativistic and other corrections are built in and applied every day. Astronomers and astrometers are assessing some pulsars for possible adoption as the most accurate clocks so far encountered, but that is unlikely to impact the UTC/TAI issue for many years.

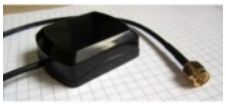
Networks and timing

For decades now the Network Time Protocol (NTP) has provided timing via networks of all sorts, but especially through the internet using UDP packets (port 123). The standard has been refined and refined and is a very stable, mature protocol, although quite complicated, and is currently termed version NTP4. It is ideal for corporate life where Ethernet networking is used, and now of course this extends to SOHO wireless and Homeplug connectivity.

Very simply, NTP uses stratified layers or sets of clocks of varying accuracy, the best ('topmost') being of stratum 0 and the worst 16 at the bottom of the stack. Half decent atomic clocks and GPS or other radio clocks are stratum 0, and the servers which serve UTC from them are termed stratum 1 servers, and so on. Most decent servers that individuals and networks use are stratum 2; for example the time server that your ISP may offer you will be stratum 2. There are few stratum 1 servers that are publicly accessible, and indeed there are officially none in the UK ! Incidentally if you have a telecomms. background, do not confuse these NTP server strata with the strata used for oscillator classes in the other field. The highest precision atomic clocks that stand behind the stratum 0 servers are 'classless'; they are the 'masters' of UTC, 'above' stratum 0.

Meanwhile the GPS system has become the *de facto* standard behind much time synchronisation worldwide. Significantly, too, by Presidential decree the C/A code selective availability (SA) facility was turned off in May 2000, and this has improved non-military accuracy of both navigation and timing considerably. So we can now use a small GPS antenna and an affordable GPS module to access UTC and form a stratum 1 server; the cost of the one I assembled is ~£65 and compares favourably with commercial ones costing ~£1200. I'm no Linux expert, but got it going with a Raspberry Pi (RPi,
B or B+) and one add-one board that looks like this:

The active antenna is ~ 5 x 4 cms and connects via SMA, as shown above right.



Windows and Linux

Before we get to the RPI stratum 1 server in Part 2, we'd better get to grips with
using NTP. And for many purposes, most folk will be happy with use of NTP to synchronise their Windoze PC via the internet - that is, using free, publicly accessible NTP stratum 2 servers and a little free port of Linux NTP4 that can be downloaded and installed very quickly. And then, if you want to try to get better timing by use of my stratum 1 server you can simply add my server to your configuration list of servers accessed (and give me interesting feedback).

But first, if you really want nothing more than an occasional or even regular correction (step adjust) to your system clock, you can use one of these packages:

- *Ridiculously Simple NTP Client, rsNTP* http://www.qsl.net/dl4yhf/rsNTP/rsNTP.htm
You must run it as administrator. It can be set to 30 min. synchronisations or used on a one-off basis. This is from Wolfgang of SpectrumLab fame.

- *SymmTime* http://symmtime.software.informer.com/download/
This is supplied by Symmetricon, now Microsemi.

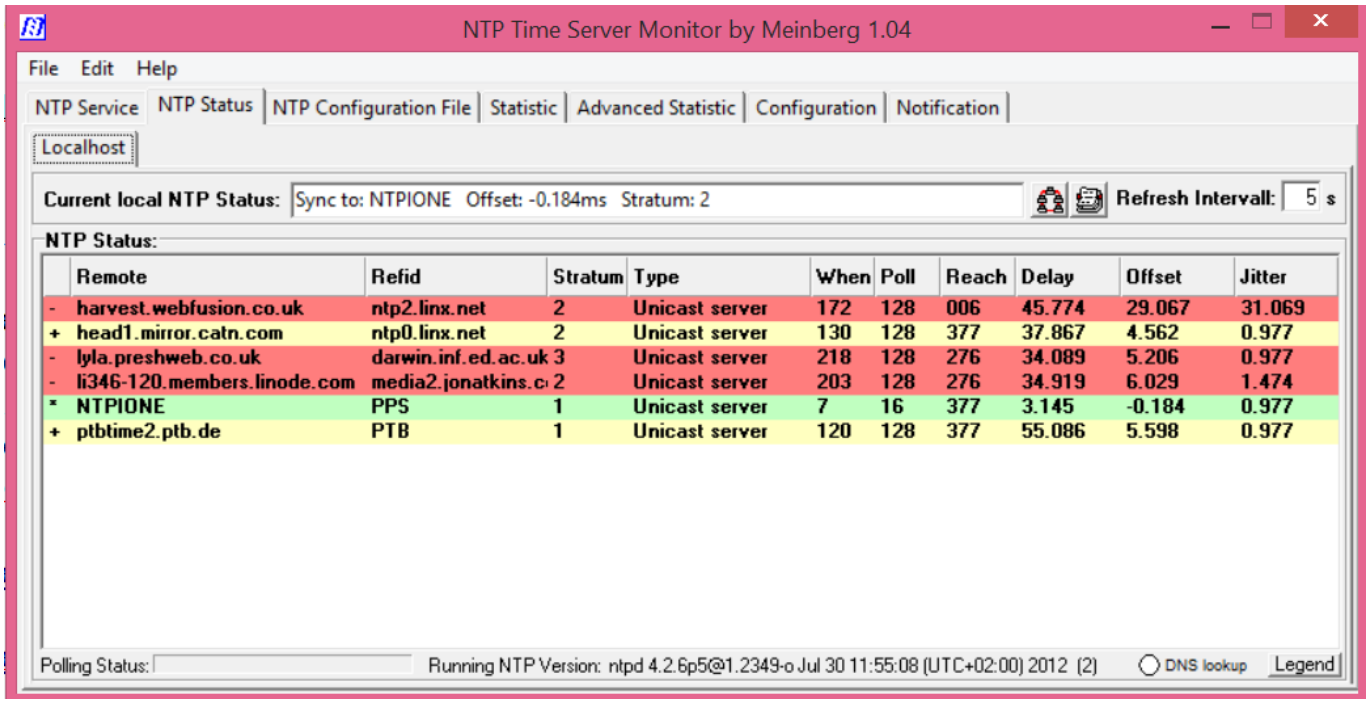
- *Dimension 4* http://www.thinkman.com/dimension4/default.htm
This costs US$10 and uses at best the SNTP protocol, which is a simpler, less accurate version of NTP. It delivers pretty graphs charting monitored statistics.

Even in Windoze 8/8.1, better than earlier MS OSs in this context, the in-built Windows Time service is very poor and unpredictable (most users know how to set this, accessible from tool bar or control panel). The basic reason is that it's operating in user, not kernel space. You can fiddle with it via the Registry, quite hair-raising for most users, but it can never work well and monitoring is absent. The default is a daily single correction, at best.

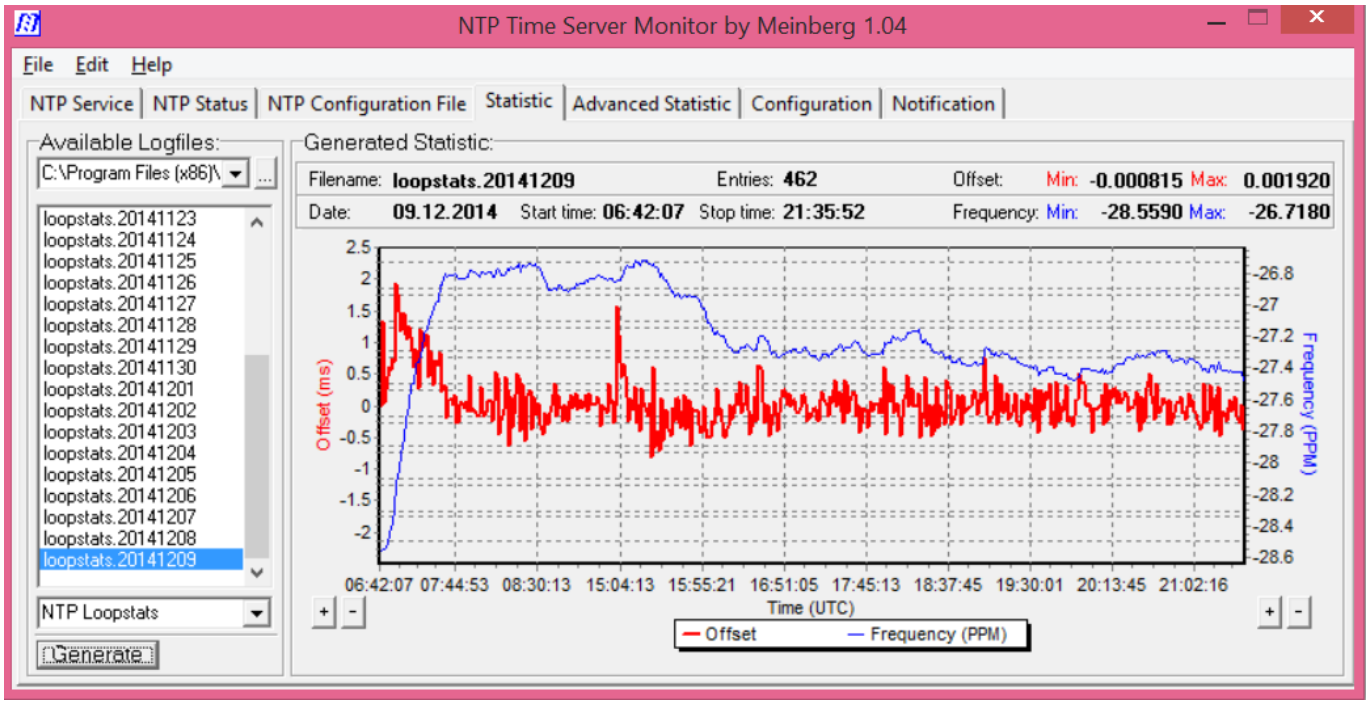
There is other "NTP-lite" software available, but these do not discipline the system clock, they all still just attempt, as for the grandly titled Windows Time service, to step-adjust the clock to UTC - and only in user space. In between you may or may not be accurate enough for your needs. You may also invoke a backward step, never a good idea for proper time-stamping ! What is far better is to use not just the available NTP time servers, as above, but the full NTP protocol as well. To do this, use the Meinberg port of the Linux-based NTPD (NTP daemon) which is available free here:

http://www.meinbergglobal.com/english/sw/ntp.htm for the NTP itself,
and
http://www.meinbergglobal.com/english/sw/ntp-server-monitor.htm for the graphical monitoring interface.

Installation is easy, and after a while you should see a monitoring window similar to mine:



The auto-selected time server is shown in green, and is unsurprisingly my RPI based stratum 1 server NTPIONE, so at this particular time the offset from UTC was <0.2 ms (penultimate column, in ms). The PC is connected by Ethernet cable and Homeplug / mains / Homeplug to the RPi server in my garden office. The yellow servers are back-ups, one of which is a stratum 1 in the Netherlands. Over the day this records the story:



Much of the day the system clock has been disciplined to UTC to within ~ +/-250µs at 1-σ (red line; one could paste the auto-archived data into a spreadsheet or similar and calculate the statistics). The worst case discrepancy was <2 ms (the second time caused by SWMBO, ever tidying around me, accidentally switched off a HomePlug unit). The blue line shows the frequency disciplining. Data is logged each minute, with RPi server polling each 16 s.

A much older machine, heavily overloaded, delivers slightly worse, as does use of wi-fi at reasonably high distances. My garden

office connects via armoured mains cable and this slows the HomePlug some (but should be quite symmetric in trip delay). But the NTP daemon (NTPD) properly assesses the round trip delays and takes many factors into account, including constant re-assessment of the server integrity by examining the jitter on the packets etc. It is a quite intricate daemon, but definitely it's solid, suitably paranoid, smooth in operation and definitely the "gold standard". With Linux machines, one can do much better, and the software is built into most distros or available from . There is a recent variant called Chrony which in some circumstances is better if you keep switching your machines on and off, but it is less mature. Several of my PCs' RTCs can be seconds off even after less than half a day shut down. One important point is that the client/server trip delay is assumed to be symmetric, and there is no way around this assumption, so shorter hops through the internet forest can help (like investing in a dedicated or shared low stratum number server on-site and synchronising to its time for your many PCs via NTPD through high speed, on-site Ethernet / HomePlug / wi-fi). One tip with NTP: don't be tempted to fiddle, but leave it alone for >15 mins after PC switch-on and leave it to automatically sort itself out if one or more servers do not seem reachable initially. "A watched kettle never boils." It is not a simple step-adjust, it smoothly works at kernel level striving continuously to get the best disciplining of your system clock.

My RPi stratum 1 server itself reports consistent adherence to UTC to within ~1 µs, except sometimes for an initial 15 min period after switch-on. Normally it is now left on 24/7 and if for any reason the GPS active antenna failed, the server will automatically pick up on the Netherlands stratum 1 server, and failing that another selected server automatically deduced to be the best stratum 2 server. (I tested it).

To run the Meinberg software, you need a sensible NTP configuration file, and I am posting one on my dropbox to save you time in setting up; drop me an e-mail if you need it. Do not be tempted to decrease the server polling times dramatically, for several reasons.

High frequency trading

As an interesting, and perhaps worrisome, application area for tight time dissemination and synchronisation, consider the latest wheeze that brokers, bankers and their trading arms are up to with some of your money: high frequency trading. Around the clock stocks are traded in large blocks and much of this now is in 'dark pools'. In any single stock, as many as 500 quotation changes and 150 actual trades may be made in a single ms. Those involved have even built a new tunnel to carry fibre through the Allegheny mountains to gain advantage by reducing the connection times by some µs. Don't think for one minute, ...er, one µs, that in the UK we are immune. Docklands, London is now 'served' by *NPLTime*, a Thatcher-esque commercial activity of NPL which supplies tight UTC provision to trading companies via dedicated fiber links from the cesium clocks at Teddington, with local spare cesium clock in Docklands included for back up. Inside these dens of iniquity, a faster version of NTP, PTP (IEEE 588) is used to literally connect it all up to the desktops. Maybe time itself has been privatised, like water. Be very afraid .....

The RPi NTP server, stratum 1

The RPi stratum 1 server will be described in Part 2, together with any comments and questions that arise from this Part 1. So you can roll your own server. We will also include some test results from use of the Meinberg NTP4 port for Windoze machines owned by Mike and Laurence, including their usage of my RPi server as a local stratum 1 device via the internet. ADARC members are welcome to use it, too, but I don't intend to make it a fully public one. Nevertheless the CPU loading is only ~3%, so it would be adequate to serve several thousand users - unless they all greedily poll it at unsuitably short intervals.

For my part I am building several GPS disciplined clock servers of increasing accuracy. And next year I plan to introduce a GPSD-OCXO or GPSD-TCXO into each of my two RA dish antennas, so that the first LOs are coherent and that time-stamping of received data streams will align with UTC to ~ns or so. This, of course, entails not just timing but frequency generation and ensuring there is an efficient transition from the short term, high performance of the oscillator and the longer term high stability of the GPS-derived UTC synchronisation.

dave@greenover.net