Time:

How to obtain the time of the day in UTC, precision about 0.1 sec?

The geographic position of the sun, or its image-point on the surface of the earth, travels once around the earth within 24 hours, a distance of 40.000 km or 21.600 nautical miles (nm). So within 4 seconds it moves by 1 nm or about 2000m, i.e. 0.1 nm or 200m in 0.4 seconds. The resolution of a good sextant with a Vernier-(nonius)-scale is 0.1 arcminute which corresponds just to that spatial distance of 0.1 nm. For the determination of a position at sea using sextant and clock accordingly one would like to have a clock giving the "absolute" time in a precision of about 0.1 seconds (i.e. less than 0.4 seconds).

Since 1967 the "second" is defined by atomic cesium clocks which also provide the "legal time". When telephones were still analog, communication operating over simple copper wires, one could call the "time announcement" by phone and with a beep every 10 seconds the precise time was announced. Today, communication goes via computers over the internet. The passing of a message from one computer to another one takes time for coding etc., so it is not clear how much time has passed, when a message sent from an atomic clock over the internet has reached the final user. Of course, there is the NTP-(network time protocol), but how can one be sure, that everything really is on-time? GPS-satellites also carry atomic clocks, and with a minimum of 4 satellites in sight one can obtain ones position on earth and by the time-delay of the satellite signals one can calculate also the precise time with the satellite receiver. Smart-phones can do that job today. However, these methods seem to give deviations from the exact time up to about 2 seconds, if only standard equipment (smart phone, PC with standard software) is used. Private atomic clocks (available at prices of about 3000 €) would not help, as they have to be synchronized with the "official" time at least once, and ever so often for control.

The best way of receiving a precise time for normal use at present seems to be still via radio-signals. Several stations all over the world transmit time-information via long-wave radio. In Germany for example there is the station DCF77 near Frankurt, MSF in UK, WWV in USA, JJY in Japan, BPC in China. Simple radio-controlled alarm-clocks appear to give time within about half a second precise. And even a good radio-controlled wrist-watch may do the job. It takes the radio signal about 1 millisecond to travel a distance of 300 km from Frankfurt. This and higher precisions of course then require more elaborate equipment (eg. DCF600USB radio-clock by Meinberg), doing correlation analysis of the DCF77-time signals. In the future GPS presumably might replace radio-controlled time standards, but for GPS one needs free sight to the sky, while radio-controlled time signals can be received inside buildings.

(Companies providing DCF77-equipment are e.g. www.hopf.com or www.meinberg.de and small atomic clocks at https://www.microsemi.com/csac or www.atomic-time.com)