The need for accurate time

Everyone needs to know what the time is at some point in the day, whether to catch our bus in the morning or to celebrate the New Year at the right moment. For this sort of timekeeping, our personal watches and household clocks are accurate enough. A typical quartz clock manages to keep time to within a second over ten days. When it comes to sending data down a phone line or navigating by satellites, however, more precision is needed.

Telecommunications rely on accurate timing to ensure that the switches routing digital signals through their networks all run at the same rate. If they did not, those switches running slow would not be able to cope with the traffic and messages would be lost. When speaking on the telephone, you might hear a click or a crackle if just one data packet was lost. If sending a fax, a line might be smeared. If communicating over the Internet, the connection might be lost completely. As we become more and more reliant on the telephone and Internet, we are implicitly becoming more and more dependent on atomic time.

For the navigation of ships, aeroplanes, and more recently family cars, Global Positioning System (GPS) satellites that orbit the Earth broadcast timing signals from their atomic clocks. By looking at the signal from four (or more) satellites, the user's position can be determined. The time has to be incredibly accurate as light travels thirty centimetres in one nanosecond (or 300 million metres in a second!) so that any tiny error in the time signal could put you off course by a very long way. This system has proved particularly effective during sea rescue operations and in situations such as Arctic expeditions where navigating by traditional landmarks and signposts is impossible.

While we may be more and more dependent on accurate time, where does that time come from? Who looks after the master clock? Well, there is no single master clock for the world. Instead, the international time standard is maintained by 40 time laboratories around the world and is based on the average of some 260 atomic clocks. That diversity provides both safety (a single clock in an earthquake zone would not be a good idea for example) and accessibility (each major industrial nation contributes to the time standard, and hence has direct access to the atomic clocks). In the UK, it is the National Physical Laboratory that maintains and develops the national time standard. The group of atomic clocks at NPL keep the UK's time accurate to within one second in three million years which means that the error in a day or a week is minuscule.

The international time standard held by NPL and the other time laboratories is made freely available by radio broadcasts. Sinse the1st April 2007 the Anthorn Radio Station has broadcast a time signal all over the UK using NPL's atomic clocks. The

time signal has a host of applications. When you call the speaking clock, or hear the time 'pips' on the radio, for instance, they will have got the time from the NPL atomic clocks. The Global Positioning System gets its time from the US Naval Observatory in Washington, which gets its time, like NPL, from participating in the international time standard.

Those time signals are not only accurate, but is also very reliable. Systems around Britain and beyond, that rely on accurate timekeeping, have access to this signal so that processes such as telephone conversations and Internet surfing operate smoothly.

This time is compared with other clocks around the world so that everyone uses the same time system. Flying between countries would be an almost impossible task without this co-operation.

So even if your watch is broken, accurate time is around you, helping to make your life run as easily as possible.