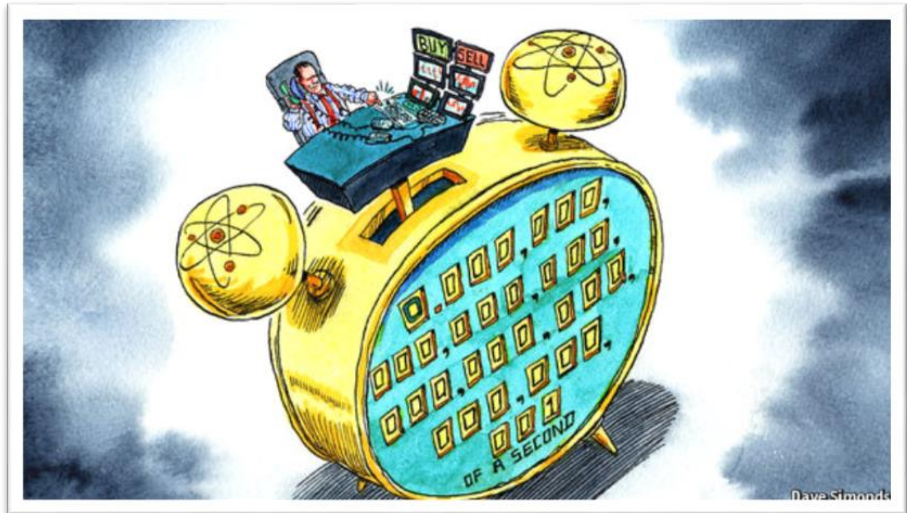


"IF EVER you wanted to set your watch, now is the time." Leon Lobo, of Britain's National Physical Laboratory (NPL), stands before a rack of servers near Canary Wharf, London's eastern financial outpost. The rack holds a high-precision, caesium atomic clock—the most accurate sort on the planet—and two other digital timepieces, called "grandmaster clocks", that work alongside it. Ticking in synchrony, all three display the time to within a whisker of co-ordinated universal time (UTC), the world's absolute standard.

The purpose of this high-tech horological trio is to tell banks and trading services *exactly* what the time is, so that they can comply with a new set of accounting rules, called the Markets in Financial Instruments Directive II, which are being promulgated by the European Commission and will come into force in 2017. Among many other things, this directive drastically tightens rules on the time-stamping of transactions. That



tightening is needed to give a better account of who did what and when in a world where market crashes can happen in a flash. Dr Lobo and his colleagues therefore met, on October 28th, with regulators, banks and trade bodies from all over Europe, to discuss how to implement the directive.

At the moment European rules demand accuracy to within one second (other jurisdictions vary; in America, for example, it is 50 milliseconds). Many companies comply by using signals from satellites belonging to the Global Positioning System (GPS). Others buy cheap atomic clocks to do their timing. But neither route offers a guaranteed link to UTC. GPS signals can be jammed, and even atomic clocks may drift. Such discrepancies make forensic accounting a nightmare.

Those problems will get worse when the directive is implemented. For standard electronic transactions, the new rules say accuracy must improve a thousandfold, to within one millisecond. For so-called high-frequency traders (firms that carry out several trades a second), the rules are even stricter. They call for accuracy within 100 microseconds. Only for old-fashioned voice trading will the rule remain a full second. But all recorded times, whatever degree of latitude they are permitted, must also be traceable to a national standard. In Britain the NPL is responsible for imposing this standard, so the lab is going into the business of piping its timing pips to data centres like the one in Canary Wharf—in effect, selling certified time-stamps.

The process of time-stamping starts with a signal carrying the pips travelling over a dedicated optical-fibre link. This trip's duration must therefore be determined. To do so, a caesium atomic clock is synchronised with the main standard at the NPL and then carried to the place where it will be installed. Once it is there, the pips' journey time through the fibre-optic cable can be worked out, by logging the discrepancy between what the pips say and what the caesium clock says. One of the two grandmaster clocks then subtracts that delay from the pips it is receiving from the NPL (the other serves as a fail-safe). Relative drifts of the time to and fro are monitored and corrected once a second. And if the fibre connection bringing the pips should be cut, the caesium clock takes over until a connection is restored.

All of this is just what the directive ordered: fault-tolerant precision, certified right at the servers where so much of finance now happens. But, says Ian Salmon, a consultant at Accedian Networks, it leaves unanswered many questions about what to time-stamp, and how. A shares transaction is not just a trip to a till that spits out a receipt. Orders come in, are routed to this server or that, trading algorithms do their crunching, decisions are made and sent off to the back office for settlement, and so on. It is a decision tree that might split hundreds of times, with a transaction taking as much as a few milliseconds. Determining which time-stamps to collect, and ensuring that all the traders set their proprietary systems to do so in the same way, will take some doing. The meeting this week has been called in part to start tackling these thorny questions. Frankly, it's about time.