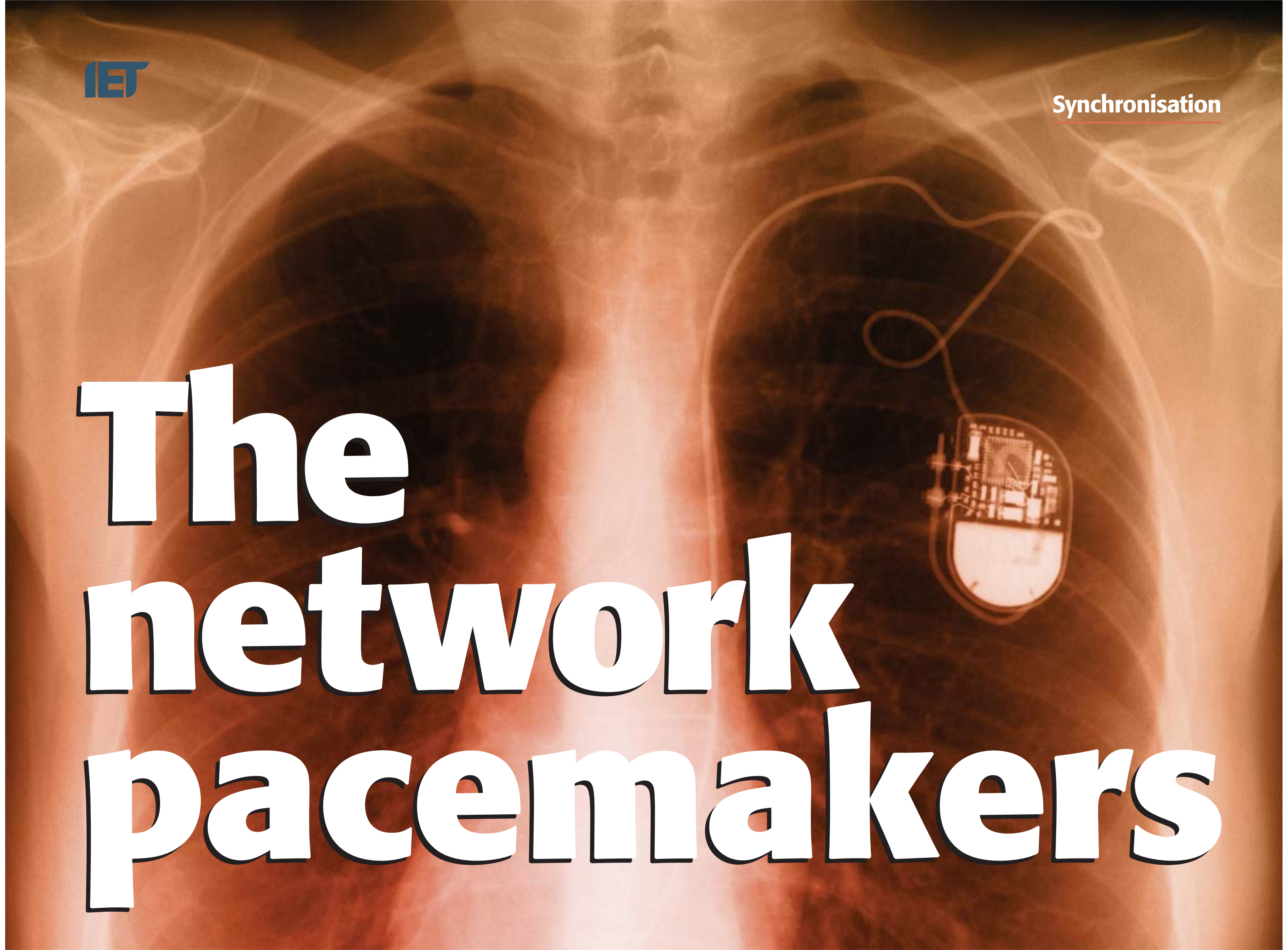


The network pacemakers

CHARLES CURRY WARNS OF THE IMPACT OF POOR TIMING ON QUALITY IN TELECOM NETWORKS

Do you know anyone with either a heart murmur or fitted with a pacemaker? What would happen to them if you ignored the heart murmur or the pacemaker battery was not regularly changed? The answer is predictably morbid.

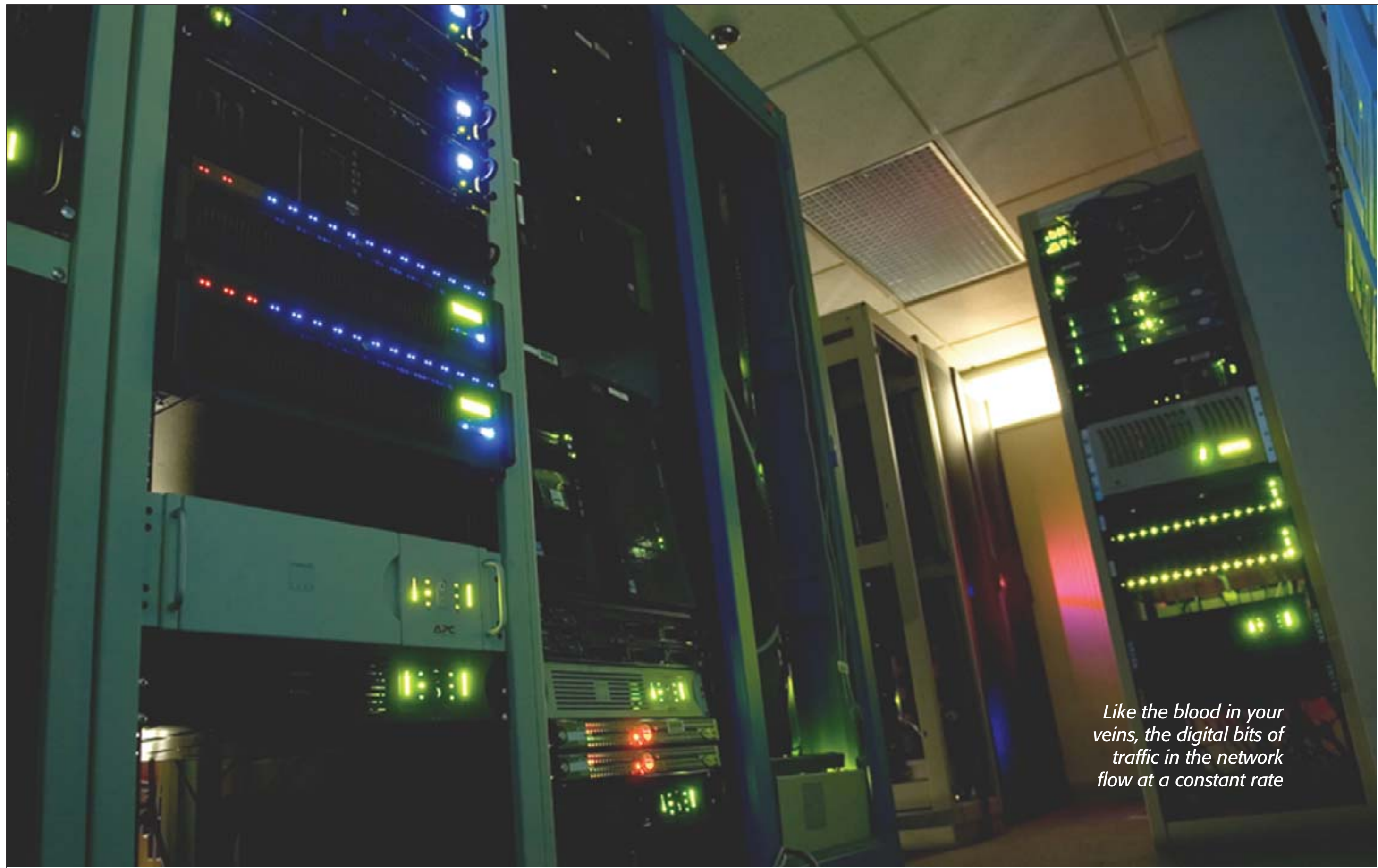
Did you know that all telecommunications networks are fitted with a pacemaker? In fact, they are fitted with many linked pacemakers whose stability is no less than that of an atomic clock. Like blood through veins, the digital bits of traffic in the network flow at a constant rate, continuously timed by specialised electronic pacemakers.

WELL-KEPT SECRET

The fact that comparatively few people could claim an in-depth knowledge about these network pacemakers is because they hardly ever go wrong. Skilled experts keep them ticking constantly. They monitor them round the clock, 365 days a year. The pacemakers' rate must not be allowed to become too fast or too slow; in fact they are continuously monitored and controlled to within nanoseconds of one other. For reference, it takes approximately one nanosecond for light to travel one metre. Another perspective is that the accuracy of any one of these pacemakers is equivalent to less than 1mm in the circumference of the Earth.

Having established that there are some of the most accurate pacemakers ticking away deep within the network, you may be beginning to wonder what might happen if the pacemakers malfunctioned. Such occurrences are rare, but when they do happen they can directly impact the quality of a telecom network with surprising and sometimes quite disastrous consequences.

Without treatment, a fast, slow or irregular heartbeat in a human body can lead to weakness, confusion, dizziness, fainting, shortness of breath and even death. The equivalent problem in a telecom network will manifest itself in application malfunction or even failure. Consider dropped calls and poor handovers in mobile networks. Video and TV services do not escape, with unexpected freezing on a TV picture, unsynchronised sound and vision, poor video conferencing quality and broadcast signal inference all traceable to poor timing. Encrypted traffic is particularly susceptible to a lack of pacemakers with slow transmission due to having to resend large amounts of data, as any amount of data →



Like the blood in your veins, the digital bits of traffic in the network flow at a constant rate

[Dreamstime]

loss or packet loss will result in undecipherable traffic at the receiving end.

Fortunately network 'fatalities' are rare and, naturally, telecom operators don't like to advertise their failures, particularly as they will impact customer-facing services. But consider some relatively high profile failures of recent times such as the national mobile network which lost an entire region for eight hours and the city which was unable to communicate with the rest of the world for six hours. Both fatalities were directly traceable to pacemaker failure.

The need for consistent timing is becoming even more critical as faster and more complex services are delivered over today's telecoms networks. While some experts argued that the switch from the traditional time division duplexed (TDM) to the new 'next generation' type of packet network (Ethernet) would make the need for timing obsolete – actually the opposite is true. A familiar problem with Voice over Internet Protocol (VoIP) when a packet of data is lost is missing parts of words; precise timing is vital to avoid this.

Given the need for timing and the impact that poor timing could have on network quality, it may be relevant to quantify the investment in network infrastructure and compare with the relevant investment in the pacemaker equipment. There could be said to be a surprising lack of investment in pacemaker technology compared to the overall network spend.

SHORT-SIGHTED

One recently appointed senior executive in a telecom network was heard to say to the pacemaker expert – "If this synchronisation equipment does not give me more traffic capacity, let's just take it out". Short-sighted? Let's suppose that same person had been fitted with a heart pacemaker, but had forgotten why. Once reappraised of the original need – do you think they would ignore the need to replace the battery or upgrade the technology when it became available?

Counting the cost of network failure due to poor timing quality is not always easily quantifiable. Your customers may experience lost revenue due to problems with on-line trading, lost billing information or lost business data. There may be business interruption such as their IT&C department chasing the problems, lost enquires, lost orders or a distracted help desk. Competitiveness may be compromised with lost business, lost market share and higher expenses. This could result in litigation if service levels are not met, customer contracts not fulfilled in time, and misunderstandings with customers and suppliers. All this impacts the reputation of your clients e.g. their customer perception, investor uncertainty, stakeholder uncertainty, effect on brand and image, hiring slowdown.

So, if poor timing impacts network quality and causes clients to lose their competitiveness, this means poor timing impacts customers' perception of a supplier of telecom services and their loyalty in the longer term. Even if the company does not lose the customer, resending large amounts of data due to poor timing impacts network efficiency, meaning that the network will accommodate fewer customers and return less revenue than that of a well timed rival. Customer loyalty (churn) and revenue delivery will impact bottom line which will impact share price. While directly relating timing to share price is perhaps tenuous, there is an undeniable business case for investment in precise timing. ■

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Above: Symmetricom's SSU 2000, an intelligent, fully manageable Synchronisation Supply Unit or Timing Signal Generator
Left: Detail of the SSU 2000

The Stratum 1 level SyncServer S200 derives its time from the atomic clocks aboard the GPS satellite system

SyncWatch (also marketed by Symmetricom as TimeWatch)

TimeProvider, the latest access layer sync equipment from Symmetricom

TimeSource 3600 is a standalone Stratum 1 Primary Reference Source

FROM TDM TO IP

To picture how timing works and why it is needed let's replace network traffic with people. Consider for a moment two tour groups of 100 people going on a sight-seeing holiday by train or minibus. Everyone must stay in the same order to avoid losing children, and they must tour each destination at a constant walking pace.

Group A goes by train. This is the old fashioned variety with corridors and compartments of eight seats. The train is busy, but compartment '1' has been reserved in every carriage. The group has to change trains regularly, all getting into a different compartment – but the same one in every carriage again. In the world of telecoms the trains never stop, so moving the entire group from one train to another requires a very precise pacemaker to achieve this synchronisation. When they get to each destination, their walking pace must remain constant and is actually determined by measuring the train speed and dividing down.

Group B goes in a fleet of minibuses. They set off in order, but are allowed to take different routes if there is congestion. However, since they all have to get to the destination without losing anyone, in the right order and without unnecessary delays, relative time as well as timing is important. The tour group must reassemble in the right order and tour each attraction at the same speed as any other tour group. Since this may not always be so easy to achieve by looking at the average minibus speed, a local pacemaker is needed at each destination.

The group B method is significantly more scaleable. Technology can now get much more traffic using this process, e.g. bigger buses, going faster. Infrastructure is improving allowing wider motorways with more lanes; and because we use light to send telecom traffic in our 'minibus' world we can stack motorways on top of each other so that we just have buses of one colour in each motorway. Finally we can also put the buses onto extremely high speed trains (like the channel tunnel between England and France); in the telecom world, these must also never stop.

The need for consistent timing is becoming even more critical as faster and more complex services are delivered over today's telecoms networks. While some experts argued that the switch from the traditional time division duplexed (TDM – Group A) to the new 'next generation' type of packet network (Ethernet – Internet Protocol (IP) – Group B) would make the need for timing obsolete – actually the converse is true.

Some applications by necessity require a continuous (synchronous) relationship with the user, e.g. mobile base station RF circuits, real-time voice and video, encrypted data transmission. If networks are to avoid a major catastrophe, pacemakers will be needed which provide relative time as well as timing in many more locations and for many more applications than before.