**The mobile networks have been stuck with a paltry 9.6Kbit/sec, but this is about to change.**

# Holding on the line

Up to now there's been one big problem with data on the move – anyone using a laptop or a PDA with a mobile phone has been stuck with transmission at 9.6Kbit/sec. This is the outer limit of the GSM specification used by the four UK mobile networks: Orange, One 2 One, Cellnet and Vodafone.

The four networks are now preparing to bid for licences to be allowed to offer services using UMTS, enabling up to 2Mbit/sec transmission. But it's a long way away yet – licences have yet to be allocated and nothing is expected to go live for another three years.

In the meantime, if the mobile operators are to win people over to their vision of a wirefree world, where internet access is available any time, anywhere over almost any device, they must provide something better than a paltry 9.6Kbit/sec. The networks are therefore upping the ante with high-speed circuit switched data (HSCSD) and general packet radio service (GPRS).

**Orange is the only** one going for HSCSD, which will be up and running by the time you read this. It will follow on with GPRS at a later date, in line with the other three providers. HSCSD will mean Orange has a 28.8Kbit/sec service this autumn, stealing a march on the other three operators which will still be stuck with 9.6Kbit/sec until their GPRS systems are ready. HSCSD is fine as a stop-gap but the real quantum leap will come with the implementation of GPRS and the change from switched data to packet data.

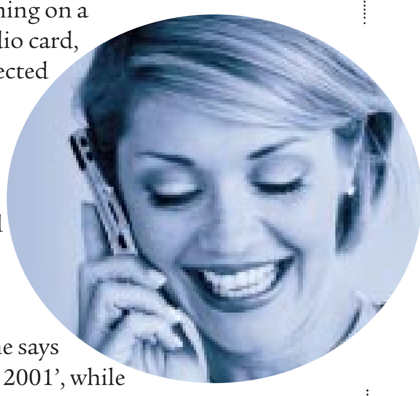
In the words of Stuart Newstead, head of commercial development at Cellnet: 'A packet network throws the packets of data at the net and if they can't get through, it throws them again until they do. A circuit switched network throws it once and if it doesn't get through, you have to start all over again.'

**That means, for instance**, that if your train goes into a tunnel in the middle of a surfing session, the connection will just be paused until the line is available again. You won't have to lose the line, redial, and go through it all again. Because GPRS is packet-based, it provides better session management, reliability, error correction, and overall quality of service.

It means a more efficient use of bandwidth and the possibility of a pricing paradigm, where you pay for the amount of data transmitted rather than by duration of session.

A data session using a circuit switched network ties up two or more channels completely for its duration. It's like trying to make a call while someone else in the house is using the phone. With packet switching, you'd be able to make another call simultaneously by using their pauses.

**Newstead says**: 'With a circuit-switched network, you have a dedicated channel all the time you're online, so even if you're sitting thinking, you're paying for that silence. Under GPRS, you're only using resources when you're sending data, even in split seconds. You can log on in the morning on a laptop and radio card, and stay connected all day, but you're not paying for the pauses.'



Cellnet will have GPRS online by the second half of 2000. Vodafone says it will be 'early 2001', while One 2 One expects to have it running by September 2000. Orange says 'late 2000'.

**In the meantime**, Orange will keep the customers entertained with a whole bunch of HSCSD-based acrobatics, including launching itself as an ISP (Cellnet's already done this too) and laying on a spread of wireless application protocol (WAP) services.

WAP is a sort of text-only internet that you can access from a mobile phone. For instance, you can call up an ITN news page, choose your story, then read it on the screen of your phone.

However, the wirefree world can't take off until the hardware is available, and the floodgates haven't really opened yet. The main device that will drive take-up of Orange's 28.8Kbit/sec is Nokia's HSCSD Radio Card, a card you can slot into your laptop that plays the same role as a mobile phone, data card and cable.

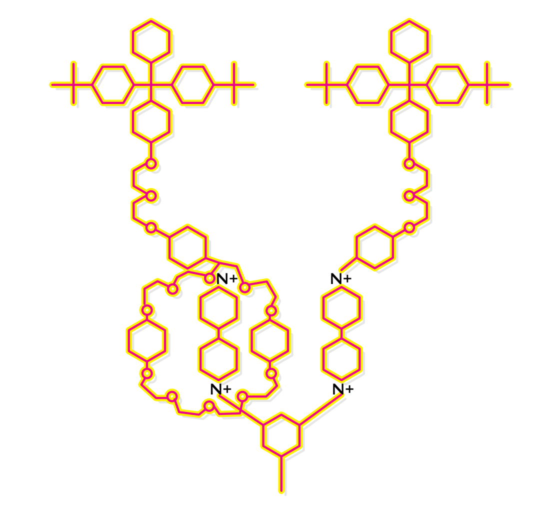
PERDY PATTERSON

Researchers want to synthesise a computer **the size of a grain of sand** using molecular electronics.

# Fantastic ventures

A team of researchers want to build a computer with the combined power of 100 high-end workstations. Not such a surprising ambition, you might think, given the rapidly increasing power of silicon technology – but there's a twist. Their machine will be the size of a grain of sand.

The scientists, from Hewlett-Packard and the University of California at Los Angeles <neon.chem.ucla.edu/~schung/Hgrp/>, want to synthesise a computer chemically. The key to their work is a strange substance called rotaxane, a single molecule of which can be made to function as an on-off switch – the basis of all logic operations.




▲Rotaxanes are a class of organic molecules that could replace the transistors on a microchip

**Rotaxanes are a class** of organic molecule complexes which comprise a molecular ring threaded onto a central linear molecule, like a bead on a wire. The ring can slide freely along the central molecule, and extra 'blocking molecules' at each end stop it falling off. The team created a microscopically thin layer of rotaxanes, and sandwiched them between a pair of electrodes. Each electrode is etched with contact points, such that a rotaxane molecule forms a bridge between corresponding contact points on each electrode. Normally, electrons can travel across the rotaxane from one electrode to the other – so the switch is closed. Applying a control voltage, however, breaks the rotaxane's structure, opening the switch and preventing electrons from crossing.

The team went further, and connected groups of switches together, demonstrating that the molecules could perform the logical operations on which all computing is based. The importance of this research is that for the first time computing elements have been created by chemistry, instead of conventional photolithography. And it's heady stuff. As Rice University researcher James Tour says: 'A single molecular computer could conceivably have more transistors than all of the transistors in all of the computers in the world today.'

But because the molecules are synthesised, reactions are rarely 100 per cent successful, so how can the computer possibly work if some of its molecules aren't well-formed? The team already has the answer to that one. A previous project created an experimental computer architecture called 'teramac', which was built from hundreds of conventional silicon chips, some of which were known in advance to be faulty <cs.sunysb.edu/~meissner/teramac.html>. The lattice of chips could be interconnected in a huge number of ways, using switching and routing mechanisms similar to those in a telephone exchange. Control software, running on chips known to be good, locates buggy chips and ensures they're avoided. Although riddled with duff chips, the teramac worked well.

**Another problem is how** to reliably connect groups of rotaxane molecules together, because even the thinnest kinds of conventional wires are enormous at molecular scales. One promising possibility is to use 'nanotubes' – tubes just a few atoms in circumference, whose walls are made of linked carbon atoms and the technology already exists <pa.msu.edu/cmp/csc/nanotube.html>.

The field of molecular electronics – moletronics – is growing fast, and while researchers are keeping their feet on the ground for now, the ideas are flowing thick and fast.

As HP researcher Phil Kuekes put it: 'In time computers are going to be so small, you won't be aware of them.' Until they crash, perhaps?

Toby Howard