Preferably switched off

Once we are surrounded by intelligence, small sensors -or actually sensor nodes- will play a key role. These compact systems, such as 'smart dust', accomplish all kinds of tasks. However, wherever possible, they should be switched off to save the battery. That is why Lodewijk van Hoesel is researching optimum communication patterns between all these 'sense organs'.

Lodewijk van Hoesel

'What we would really like to do is forget about sensors for a good length of time. The sensors themselves handle maintenance and ensure that the settings are correct, and will definitely work on the same battery for a few years. This is essential as they are fitted in places that are difficult to get to. Behind the wallpaper, so to speak. And there will be so many of them, that regular maintenance will not be an option. We see each sensor as a junction in the network; it not only measures information – temperature, light intensity or whatever it is you want measured – but assists the other sensors as well, in passing the measurements on to the user. Without such co-operation we would not even be able to send on information if we want to use as little energy as possible. It is sometimes underestimated what is actually needed to be able to do that. Link a sensor to Bluetooth and you have a wireless measuring system, at least that's what people think. This might work for one or a few sensors, provided you don't have too many other wireless standards nearby. The more you do, the more disturbance you create. But in terms of energy consumption and scalability, this possibility is soon redundant. If you are looking to link up hundreds or thousands of sensors, it just won't work.'

'We've grown accustomed – too much so in fact – to the fact that processing power is endlessly available. Communication protocols are designed on the basis of this idea of surfeit. This is far too complicated. If energy consumption is a real factor, we will have to turn things around and that means much lighter protocols. That can easily clash with the way people are used to working, but it is necessary. It shows how careful you have to be with your resources if you want to integrate real intelligence into your surroundings, whether these are offices, houses or factories. High-precision farming is perhaps another possibility – you could fit cows with sensors.'

'In my study, which is half information technology and half electrical engineering, I am looking into optimum communication methods in networks such as these. If you are interested in the average temperature in a room measured by three sensors, then it's better to calculate the average temperature in situ and to transmit a single measurement rather than transmitting three. One of the nodes will then take more 'responsibility' for communication, while the others save energy by switching off. The hard thing to do is to keep the network working properly with this constantly changing topology. In addition, I focus on safety: what happens to malfunctioning or rogue sensors in the network?'

Project examples:

- EYES: Energy Efficient Sensor Networks (EU/FP5)
- Adaptive Wireless Networking (Freeband Impulse/Ministry of Economic Affairs)
- GECKO: Communication and Scheduling in Reconfigurable Multimedia Terminals (NWO)
- TEAHA: The European Application Home Alliance (EU/FP6)

‘If a node is active over a longer period, the battery life will become an issue. It’s a fact that battery technology is developing at a far lower speed than the possibilities offered by chips, although small fuel cells and turbines on chips are being considered. But suppose you were to solve the battery problem, you would still have to manage your resources as well as you can.’

‘Given the scale we envisage with the European EYES project, and later in ‘Smart Surroundings’, the price of a sensor node will have to be very low. You will also have to take into consideration that cables will be replaced as well. If you charge for that, then you will have quite a bit of money to spend for each node!’