

Is the ZigBee wireless standard, promoted by an alliance of 25 firms, a big threat to Bluetooth?

By Chris Evans-Pughe

WIRELESS STANDARDS seem to be breeding. Perhaps as soon as you get two of them nicely settled in an unlicensed bit of spectrum it's inevitable.

Late last year, ZigBee arrived in the 2.4GHz band, joining the now well-established Bluetooth and Wi-Fi. ZigBee looks rather like Bluetooth but is simpler, has a lower data rate and spends most of its time snoozing. This characteristic means that a node on a ZigBee network should be able to run for six months to two years on just two AA batteries, claim backers.

However, there are questions about ZigBee's viability. The target of building automation as the main application makes technical sense but it is a field notoriously slow at adopting new technologies. Those with long memories may remember from ten years back how LonWorks control networks were going to revolutionise our homes and yet we are still waiting.

In other proposed applications, ZigBee seems to tread on Bluetooth's toes but the technical and price advantages are marginal and unsubstantiated: there are no finished ZigBee chips and low prices necessitate very high volumes.

EARLY PROMOTION

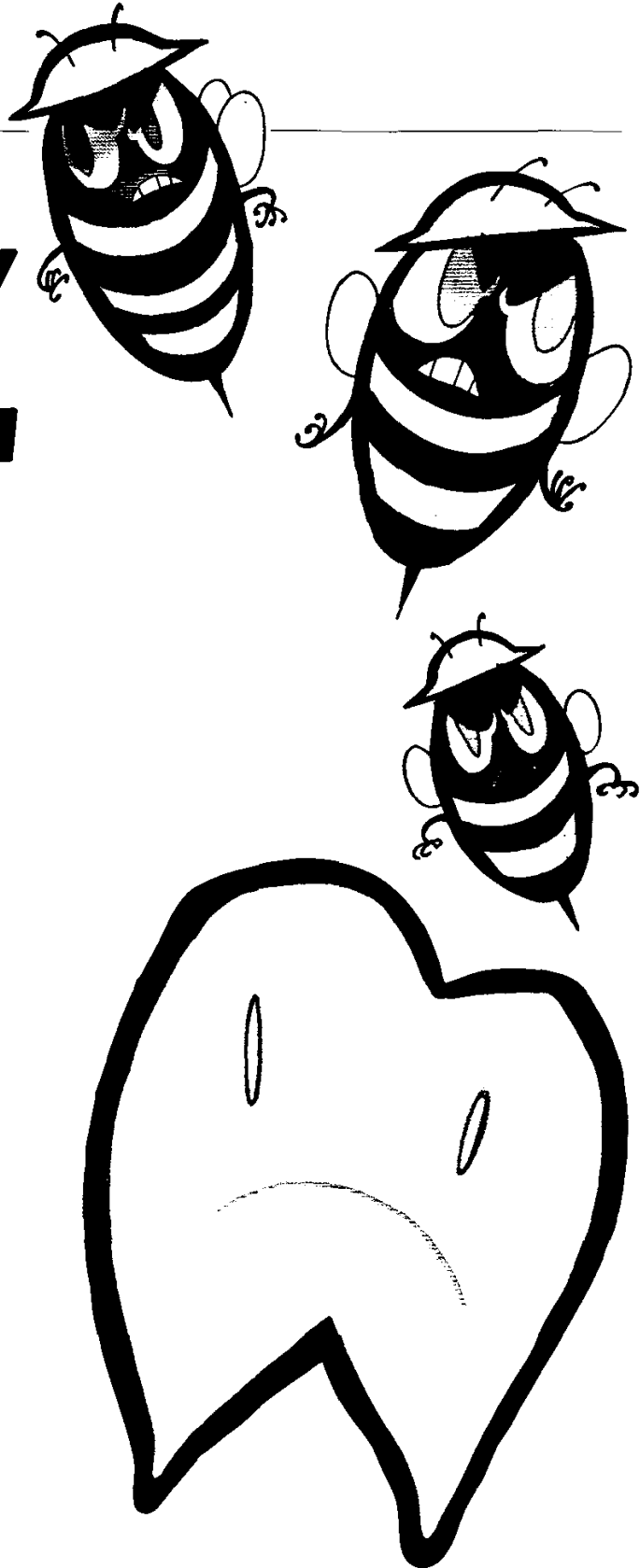
Philips, Motorola, Honeywell, Invensys and Mitsubishi Electric started promoting ZigBee when they formed the ZigBee Alliance in October 2002. This was once they had secured the physical layer (PHY) and media access control (MAC) under the IEEE 802.15.4 WPAN (Wireless Personal Area Network) standard.

The ZigBee promoters got together three years ago because, Bluetooth wasn't suitable for building automation and industrial control. "These applications needed lower cost, better latency and [lower] power consumption than Bluetooth could give," explains Nick Horne, group leader of the radio communications products group at Cambridge Consultants Ltd. (CCL), one of the 25 ZigBee Alliance members.

Proprietary wireless control systems already exist for building automation, X-10 for instance, but they have fairly limited use. The theory behind the ZigBee effort is that such a price-sensitive field requires the economies of scale of a global standard for it to take off in a big way. The hope is that at just \$2 a throw, ZigBee chips will open up the market for remote wireless control of light fittings, heating, ventilation and security systems in commercial and residential buildings. A

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ZZZ



typical commercial application might be a control system for changing the ceiling light patterns in a large conference room. A ZigBee radio module on each of the light fittings would eliminate the spaghetti of control wiring usually needed to run to and from the central control panel to each light.

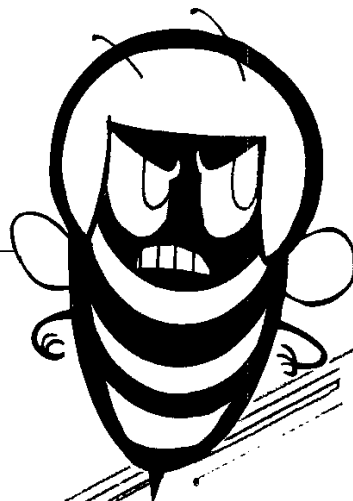
Remote meter reading and medical sensors are also on the ZigBee list of target applications as they would benefit from low power consumption and standardisation. Longer-term aims are for ZigBee to colonise Bluetooth territory – consumer electronics, PC peripherals and even toys. “We believe it fits a gap between wireless LAN and point-to-point data links,” says Michael Eckhardt, Philips Semiconductors’s ZigBee product marketing manager.

Bluetooth players are not convinced. “ZigBee is a dandy technology for controlling home appliances that are not transferring a lot of data and that are mainly asleep. But Bluetooth can also go to sleep. You can get months of use out of a Bluetooth wireless mouse,” comments Eric Janson, Cambridge Silicon Radio’s (CSR) vice-president for worldwide marketing. “And the cost claims also bear close examination.” Bluetooth is already under \$5 in cellphone volumes although no one is saying that out loud.

THE ZIG-ZAG COMMUNICATIONS DANCE

Philips is a big promoter of ZigBee. The technology has been living under various guises at Philips for four years. It started life as HomeRF Lite (a sub-spec of the defunct HomeRF, which has now been ousted by Wi-Fi). Since then, it’s had name changes to RF Lite, Firefly, RF EasyLink and finally, last summer, it became ZigBee. The whimsical name comes from the ZigBee Principle, the zig-zag dance bees do to tell their colony mates the location, distance and direction of new food sources.

However none of ZigBee’s previous incarnations have taken off; all were aimed at the same →



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applications: home automation, input devices etc. Today, the alliance members believe that the market is now suitably tuned into wireless technology, through the success of Bluetooth and Wi-Fi, to take to ZigBee and understand its advantages.

The ZigBee standard can operate in the 2.4GHz band or the 868MHz and 915MHz ISM (industrial, scientific and medical) bands used in Europe and the US respectively. It sits below Bluetooth in terms of data rate: 250kbps at 2.4GHz (compared to Bluetooth's 1Mbps) and 20-40kbps in the lower frequency bands. The operational range is 10-75m, compared to 10m for

Bluetooth (without a power amplifier).

One other important difference between ZigBee and Bluetooth is in how their protocols work. ZigBee's uses a basic master-slave configuration suited to static star networks of many infrequently used devices that talk via small data packets. This aspect suits ZigBee to building automation and the control of multiple lights, security sensors and so on.

Bluetooth's protocol is more complex because it's geared towards handling voice, images and file transfers in ad hoc networks. Bluetooth devices can work peer-to-peer and support scatternets of multiple smaller non-synchronised networks (piconets). The protocol, however, only allows up to eight slave nodes in a basic master-slave piconet set-up. ZigBee allows up to 254 nodes. Masters can talk to each other and the number of

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nodes can be increased beyond 254 if necessary.

Low latency is another important feature of ZigBee. When a ZigBee device is powered down (all circuitry switched off apart from a clock running at 32kHz), it can wake up and get a packet across a network connection in around 15 milliseconds. A Bluetooth device in a similar state would take around three seconds to wake up and respond. "The latency gives you some power consumption advantages and it's important for timing-critical messages. A sensor in an industrial plant needs to get its messages through in milliseconds," says CCL's Horne.

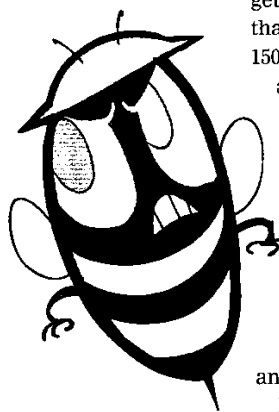
ZigBee's reliance on a central mains-powered controller minimises the power consumption of the nodes. "They will only need to turn on when they want to transfer data," explains Horne. "There is a beacon scheme that the master uses to define slots. The nodes can then wake up, listen, synchronise to a slot and send data back. It reduces the time that the outlying nodes need to be on for."

ZigBee Alliance members won't discuss active power consumption figures at this stage so the low power claims are rather chimerical, reckons CSR's Janson. "They're not saying it uses milliamps during transmit, they're talking about microamps in deep sleep. Bluetooth consumes around 30µA in deep sleep," he says.

ZIGBEE'S IN-ROADS

With the MAC and PHY frozen under IEEE 802.15.4, the ZigBee Alliance is working on the network layer specification, which it hopes to have set in stone by the end of the year. Application profiles – initially for building automation – are underway. The first silicon chips are expected at the end of the year from alliance companies such as Philips Semiconductors, Microchip, AMI, Atmel and others. CCL is developing silicon IP and protocol stacks.

A typical ZigBee implementation will be a single CMOS chip containing the RF, baseband processing and a microcontroller to run the ZigBee protocol plus the application. "When the first ZigBee chips hit the streets they will be more expensive than Bluetooth,"



admits Philips's Eckhardt, "but they will be inherently lower cost once they hit maturity."

Developers believe that it is the smaller memory size of the protocol stack that will lower the price of ZigBee to around \$2 per chip; the ZigBee protocol stack will occupy around 30kwords of programme space compared to Bluetooth's 256kwords. However, ZigBee-based end products are unlikely to come onto the market until at least 2004, says Horne. "The silicon and the spec have to be finished, and the testing processes have to be in place. It's a similar concept to Bluetooth. You will have to go through the testing procedure to get a ZigBee logo, but it should be a much easier process because the protocols are much simpler."

REASONABLE BET?

Nevertheless, the ZigBee Alliance is forecasting that in four to five years' time, there could be 50 ZigBee devices per home and eventually as many as 150. "There are 150 million households in the US. If we only get into one or two percent of these by 2005, that's a \$6bn market for a start. There are 150 million PCs sold every year [worldwide] all with USB. Potentially they could all be sold with ZigBee as well," Eckhardt says.

For some, the PC argument doesn't add up. To allow for wireless peripherals on the PC, Bluetooth should be enough – it's established and it works. And going forward, Bluetooth is unlikely to be squeezed out on price by the time ZigBee is finished and low cost enough to compete.

For automation in homes, technically, ZigBee looks like a reasonable bet. But as for commercial success, the jury will remain out for some time. "With any new technology, if you could look into the future and tell your investors how long it would really take, they would never invest any money," says CSR's Janson. "Home/building automation is very cost-sensitive and it's a 'some day' market. If you look at the speed that these industries accept this stuff, it can take ages." ■