Nordic Semiconductor

(Nordic Semiconductor editorial contact:
Steven Keeping, e-mail: steven.keeping@nordicsemi.no, Tel: +61 (0)403 810827)

TITLE: ***Bluetooth* low energy takes aim at first applications**

By *Svenn-Tore Larsen, CEO, Nordic Semiconductor*

TEXT:

While news on the forthcoming *Bluetooth* low energy specification has been sparse lately, behind the scenes, dedicated engineering groups (including engineers from my own company, Nordic Semiconductor) are working tirelessly to finalise the specification, RF silicon and software of the first *Bluetooth* low energy chips under the auspices of the *Bluetooth* SIG.

Bluetooth low energy will encourage rapid deployment of ultra-low power (ULP) wireless that, like contemporary *Bluetooth* wireless technology, is interoperable. Moreover, *Bluetooth* low energy-equipped products will be able to communicate with cell phones and PCs featuring modified *Bluetooth* transceivers opening up a whole new range of possibilities. The technology will operate in the 2.4GHz ISM band and features a physical layer bit rate of 1Mbps over a range of 5 to 15 meters.

The specification features two implementations, namely 'dual-mode' and 'single-mode'. In the dual-mode implementation *Bluetooth* low energy functionality is integrated into traditional Bluetooth circuitry. The resulting architecture shares much of *Bluetooth* technology's existing functionality and radio and results in a minimal cost increase compared to contemporary *Bluetooth* chips.

Ultra-low power consumption is critical to *Bluetooth* low energy's success. Single-mode devices will be expected to run for many months or even years on standard coin-cell batteries (for example, CR2032, 3V lithium devices). Single-mode chips will typically operate with low duty cycles, entering ultra-low power idle and sleep modes, to wake up periodically for communication 'bursts'.

Dual-mode chips are targeted at handsets, multimedia computers and PCs. The dual-mode specification is also advanced and it's envisaged chips will feature power consumptions of around 75 to 80 percent of conventional *Bluetooth* chips when operating in *Bluetooth* low energy wireless technology mode, and cost just tens of cents more. These next generation dual-mode *Bluetooth* chips will share much of *Bluetooth* technology's existing functionality and radio in a single die. However, because dual-mode devices will use parts of *Bluetooth* technology's hardware, power consumption is ultimately dependant upon the *Bluetooth* implementation.

The Bluetooth SIG is hoping to release version 1.0 of the specification towards the end of this year, with chip vendors, including Nordic Semiconductor, supplying silicon and development tools soon after.

But for what applications will these chips be used? Many engineers at major OEMs are already working on the first applications (of which there will be many). After all, by eliminating the power constraints that restricted the applications of classic *Bluetooth* wireless technology, it's hard to think of a wired or even wireless portable device on the market today that wouldn't benefit from *Bluetooth* low energy. *Bluetooth* low energy will eliminate the wires in products that currently use a wired link, and for existing wireless products, swapping to the low energy technology will dramatically boost battery lifetimes.

Targeting RF remotes

The first major application area for *Bluetooth* low energy is likely to be RF remote controls. According to a recent study by ABI Research[1] the RF remote control market is forecast to grow at a compound 55 percent annual growth rate (CAGR) between now and 2014. This forecast is supported by the Bluetooth SIG's announcement[2] that in addition to being power and cost optimised for sport, wellbeing and Human Interface Device (HID) product categories, the upcoming Bluetooth low energy stack will be intentionally engineered to support a universally interoperable, consumer electronics (CE) RF remote control specification capable of replacing traditional infrared (IR) technology.

Until now, the consumer electronics (CE) companies haven't seen RF as a natural successor to infrared (IR) for remote control despite its obvious advantages such as 10 metre (plus) through-wall ranges and high bandwidth, bi-directional communication (which allows controlled devices to relay back 'live' status information to the remote to be read on a small display).

This is because competent, proprietary RF technology alternatives are relatively expensive, limited to specialist applications and lack the interoperability of IR. This lack of interoperability ends any possibility that mainstream CE manufacturers will embrace the technology because of the fear of being held hostage by a single supplier. Happily, because *Bluetooth* low energy will be an open standard, available to any member of the Bluetooth SIG, that fear is removed.

Moreover, *Bluetooth* low energy's frugal power demands (peak currents around 15 milliamps and average currents in the *microamp* range), change a remote control from a dedicated device to an extremely useful added function of existing portable products such as cellphones, PDAs or even a wristwatch. Providing the CE makers can now be convinced to put a *Bluetooth* low energy chip in their TVs, Media Centres and DVD players, the price, multi-supplier availability and interoperability of the chips promises to revolutionise remote controls.

RF for medical monitoring

A second application where *Bluetooth* low energy is a prime solution is medical monitoring. However, medical applications are a tough challenge. To meet that challenge a wireless technology requires:

- Interoperability – an open standard is vital so that products from different manufacturers can communicate with each other;
- Accurate and reliable sensors – incorporating simple pairing, be plug & play and feature auto-recovery;
- Ultra low power (ULP) with long battery life – sensors should employ a low power RF radio with streamlined protocol so they can run for months or even years on a coin cell battery;
- System and device security – transmission of data must be safe and secure to keep medical data confidential;
- Distribution network – sensors need to communicate with services such as the Internet and the cellular network so that information can be relayed to remote health practitioners;
- A compelling case for adoption - healthcare institutions are very conservative and need a convincing argument to take up new technology.

Bluetooth low energy meets all of these requirements. For example, the protocol stack is small so the radios consume ultra-low currents when transmitting or receiving (and can hibernate in "sleep" states requiring just nanoamps) and *Bluetooth* low energy supports AES encrypted wireless communication.

Moreover, *Bluetooth* low energy will be an open standard ensuring that sensors from different manufacturers establish communication quickly and easily. And because *Bluetooth* low energy builds on the legacy of *Bluetooth* wireless technology, it will be easily able to form Personal Area Networks (PANs) comprising several sensors – for example measuring arrhythmias, blood pressure and oxygen levels - communicating with a single 'master' device.

But perhaps *Bluetooth* low energy's winning advantage over rival wireless technologies is in how the data generated by the sensors will get to the doctor. This is because the sensors will be able to communicate directly with the ubiquitous *Bluetooth* chip in a mobile phone (providing the phone is using one of the enhanced *Bluetooth* chips adhering to the low energy specification as noted in the section above). The mobile phone will be capable of acting as the master in an *ad hoc* PAN network of sensors around the body, and ensuring secure communications. Best of all, virtually everybody owns a mobile phone.

The computing power of a mobile phone means that sensors can send "raw" data – because the mobile phone can do any computation required – simplifying their design and saving power. The mobile phone will be able to store the data and monitor whether vital signs are within prescribed limits. If something looks wrong, the mobile phone can automatically send a warning via SMS to the doctor's mobile phone.

Not ready for healthcare yet

While *Bluetooth* low energy is the only wireless technology capable of meeting the demands of the medical community for reliability, security and interoperability, there are challenges to overcome. For example, the weakest link in the communication chain is actually the 2.4GHz link between the sensor and the mobile phone or landline. This is not because the electronics are unreliable, more because the radio signal is subject to the laws of physics and hence can be attenuated by obstructions; in the worse case a person sitting or lying on the sensor will break the link because radio signals of this frequency can't pass through the body.

And apart from the technical challenges for wireless connectivity in a heath monitoring application, the medical community needs time – probably years - to thoroughly test it in what is, after all, a potentially life-or-death application. And there are a few ethical questions to be addressed too; for example, before the doctor sends out an ambulance he will want to be positive that 73 year-old Martha's blood pressure and pulse rate have risen rapidly because she's ill, not because John, the handsome widower from next door, has come for tea.

All this means you won't see patients going home equipped with an array of *Bluetooth* low energy sensors just yet – but one day in the not-too-distant future it'll be routine.

REFERENCES

1. http://tinyurl.com/coselv

2. http://tinyurl.com/dez4mh

CAPTION FOR PICS:

Svenn-Tore Larsen, Nordic Semiconductor: "The fact that *Bluetooth* low energy will be part of the open *Bluetooth* standard also means that CE manufacturers will be assured of multiple supply sources for *Bluetooth* low energy-based silicon which will no doubt also play a key role in its widescale adoption and success"

AUTHOR BIOGRAPHY

After gaining an EE degree at the University of Strathclyde (UK), Svenn-Tore Larsen began his career at Philips Semiconductors working on the 68000 microprocessor. After a couple of years, Larsen left Philips to go into the electronics distribution business. He helped build a Norwegian distribution company, which was ultimately sold to Memec. After that, he moved on to Xilinx, where he was director of the Nordic region, handling accounts like Ericsson and Nokia. In 2001, the board of directors at Nordic VLSI – as Nordic Semiconductor was then called – asked Larsen to join them. In February 2002, Larsen became CEO of Nordic Semiconductor.

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