ultra low power wirelessQ

QUARTER 1 | **SPRING 2012**

Bluetooth Smart made easy with the nRF8002

Alliance strength builds ANT+ ecosystem

Blood pressure monitor hits the mass market

COVER STORY

The naked truth about wireless data security

NORDIC SEMICONDUCTOR

OPINION

Ståle "Steel" Ytterdal

Cover image:

Personal information such as heart rate data requires protection. Find out how it's done on page 8

A unique application of ULP wireless connectivity

The ability to add a simple wireless link to a compact device with a modest power supply has enabled thousands of new innovations in markets as diverse as toys to PC peripherals, or RF remote controls to smartphone accessories. But the advantage ULP wireless connectivity brings to medical is unique; it can profoundly improve users' well-being.

IDT's blood pressure monitor uses Nordic wireless technology

"There's a little extra feeling of satisfaction when a customer uses Nordic chips to help maintain or improve a user's health"

The developed world's population is increasingly prone to illnesses such a cardiovascular disease (CVD), hypertension, and type 2 diabetes. According to the World Health Organization (WHO), in the developed world, nearly 16 percent of mortalities are due to heart disease, 13 percent to high blood pressure (hypertension), and 6 percent to high blood glucose (diabetes).

ULP wireless connectivity, such as ANT+ or *Bluetooth* low energy, can play a key role in helping vulnerable patients who need to monitor vital signs such as blood pressure and blood glucose level. By incorporating into mobile medical equipment a wireless link - which can run off the unit's standard cells without compromising battery lifetime - patients can take readings in the comfort of their own home while remaining in contact with medical professionals.

Using wireless technology, readings can be automatically transmitted from the medical device to a smartphone, Wi-Fi "hub" or PC and from there to remotely situated physicians for analysis. The system can even incorporate alarms so that the doctors can be immediately alerted to high or abnormal readings.

If the symptoms can be easily monitored and controlled, patients can avoid developing more serious life-threatening diseases, and limit or even eliminate their intake of expensive drugs. There is another significant benefit, maybe not so humanitarian, but important nonetheless: a reduction in the authorities' health expenditures because patients can be looked after at home.

Potential budget reductions are increasingly compelling for governments because of the escalating costs of health care. The WHO reports that the U.S. spends an incredible 16.2 percent of gross domestic product (GDP) on health (which equates to $7,410 per capita), Norway 9.7 percent ($7,662), and Australia 8.5 percent ($3,867). Of that amount, hospital care often absorbs over half.

Here at Nordic we're proud of how our technology has helped all our customers. But we do get a little extra feeling of satisfaction when the technology is used in a device that will maintain or improve a user's health. One such customer is Hong Kong-based IDT International with its *Bluetooth* low energy-equipped blood pressure monitor. You can read all about the company on page 12 of this issue.

Yours Sincerely,

Ståle "Steel" Ytterdal
Director of Sales, Asia Pacific

Contributors

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Rod Morris, Director - ANT Wireless, describes how the powerful ANT+ Alliance helps manufacturers bring their products to market faster

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Jack Shandle is a freelance writer specializing in semiconductors, wireless and other high-tech topics. In this issue Shandle considers wireless data security

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Kjartan Furset continues his look at coin cell battery capacity in wireless applications from the last issue. Furset is Strategic Application Manager with Nordic

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Jay Tyzzer is a U.S.-based Senior Applications Engineer with Nordic who explains how an ANT+ ECG monitor can cut health care costs

NORDIC SEMICONDUCTOR

2.4 GHz | Sub 1-GHz | ANT+

NEWS

The latest developments from Nordic Semiconductor

Bluetooth Smart remote control targets connected TVs

Nordic Semiconductor has released what it claims is the world's first complete reference design for *Bluetooth* Smart advanced navigation remote controls. The nRFready µBlue™ Smart Remote targets next generation *Bluetooth* Smart Ready 'connected' TVs and set-top boxes (STBs).

Bluetooth Smart and *Bluetooth* Smart Ready are the Bluetooth SIG's new brand marks for *Bluetooth* v4.0 capable products.

The remote delivers advanced navigation features such as multi-touch, motion control, and a QWERTY keyboard, while offering long battery life.

Unlike other RF technologies for remote controls – such as ZigBee Remote (RF4CE) and proprietary 2.4GHz RF – *Bluetooth* Smart enables connected TV manufacturers to use a single Wi-Fi / *Bluetooth* v4.0 combo chip instead of having to add a dedicated radio chip just for the remote.

A reference design is now available for Bluetooth Smart remote controls

Significant cost and space savings, plus better co-existence performance are the result.

The Smart Remote is based on Nordic's market leading µBlue™ nRF8001 *Bluetooth* low energy chip combined with an ultra low power flash LPC1100 series ARM Cortex-M0 microcontroller from NXP Semiconductors. Nordic says that the complete hardware-software reference design has been developed to cut down on development risk, time, and cost.

Based on the new Human Interface Device (HID) over Generic Attribute Profile (GATT) specification recently adopted by the Bluetooth SIG, the remote control offers interoperability with existing and future *Bluetooth* Smart Ready hubs including TVs, STBs, smartphones, PCs, and computer tablets.

Demo App fast tracks ANT+ and Bluetooth Smart accessory development

A demonstration application ('Demo App') from Nordic Semiconductor running on the iPhone 4S enables fast-track ANT+ and *Bluetooth* low energy (*Bluetooth* Smart) wireless application ('app') and accessory development.

The nRFready iOS Demo App is a fully functional application that will work with a wide range of the most popular ANT+ and *Bluetooth* Smart accessories such as wireless heart rate straps, foot pods, bike speed-distance, cadence, and power sensors, temperature sensors, proximity tags, weight scales, and blood pressure monitors.

The Demo App is available for download from the Nordic website for nRF24AP2 Series and nRF8000 Series chip customers.

Developers working with either of these products receive complete source code and documentation, enabling them to build on top of a ready-built design framework that includes reusable working and proven code for ultra low power wireless connectivity.

In brief

Bluetooth Smart Android demo

Nordic has developed its first *Bluetooth* Smart Android heart rate monitor demonstration application running on a Motorola Droid Razr smartphone. This fully functioning app is downloadable for free from the Android Market store (tinyurl.com/7cl8tkr). The app allows users to connect to any *Bluetooth* Smart heart rate belt – including the world's first commercially-available *Bluetooth* Smart heart-rate belt monitor from Wahoo Fitness that employs Nordic's µBlue™ nRF8001 chip.

170m wearable sensors by 2017

The market for wearable wireless sports and fitness activity sensors is expected to experience explosive growth over the next five years. according to a recent study by ABI Research (tinyurl.com/kuxggj) shipments will reach 90 million a year by 2017. The study also predicts strong growth in home monitoring applications for remote patient care of chronic conditions. 170 million devices in sports and healthcare are expected to have been shipped by 2017.

Bluetooth SIG targets fitness

The *Bluetooth* SIG has formed a Sports & Fitness Working Group tasked with increasing interoperability between *Bluetooth* Smart sports and fitness monitoring products (such as wearable sensors) and hub (*Bluetooth* Smart Ready) devices such as smartphones, PCs, TVs, gym equipment, and watches. The SIG says that *Bluetooth* v4.0 with low energy technology gives such devices the ability to connect, share, and distribute training data in real-time.

In brief

Bluetooth Smart device is a first

Primax, a Taiwanese ODM, has developed a prototype *Bluetooth* Smart input device compatible with *Bluetooth* v4.0-equipped Windows and Mac computers. The device uses a Nordic nRF8001 chip. "The *Bluetooth* Smart input device is working well," says Jackie Shih of Primax's R&D. "It will be commercially available once the next generation of Windows and MacOS, that support *Bluetooth* v4.0, are released."

Healthy chip order for Nordic

Nordic Semiconductor has received its first large order of *Bluetooth* low energy components for a consumer health product worth a total value of $ 1m. Delivery of the components will take place during the second half of 2012. Nordic was an early member of the Nokia-led Wibree Alliance, the organization that started the development of what would later become *Bluetooth* low energy in October 2006, and has played a key role in the development of *Bluetooth* low energy ever since through its membership of the Bluetooth SIG.

iOS Demo App 'how-to' video

Nordic has produced a 'how-to' video (tinyurl.com/79gtb3p) of its recently launched iOS Demo App. The iOS Demo App is based on a proven Application Programming Interface (API) from smartphone fitness technology company, Wahoo Fitness. The Demo App provides developers with a starting point and ready-built design framework for the development of ANT+ and *Bluetooth* Smart connectivity apps and accessories for the iPhone 4S.

Reference design demos extended battery life for keyboards and mice

A Nordic desktop reference design demonstrates how a *Bluetooth* Smart-powered mice and keyboard can provide over a year of battery life for a mouse, and up to 10 years for the keyboard, when each is powered by a single pair of AA batteries.

The nRFready µBlue™ Desktop Reference Design is a complete hardware and software solution for *Bluetooth* Smart mice and keyboards.

This extended battery life performance is a first for a wireless keyboard and mouse employing *Bluetooth* wireless technology and is comparable to Nordic's market-leading proprietary 2.4GHz RF solutions popular in the wireless PC peripherals segment.

The reference design is based on Nordic's µBlue™ nRF8001 and an ultra low power ARM Cortex-M0 flash microcontroller from NXP Semiconductors.

Nordic's desktop reference design is a complete Bluetooth Smart solution

Based on the new Human Interface Device (HID) over Generic Attribute Profile (GATT) specification recently adopted by the Bluetooth SIG, the design provides connectivity with *Bluetooth* Smart Ready PCs.

"This reference design makes it easy for our customers to develop *Bluetooth* Smart PC peripherals," says Nordic's Thomas Embla Bonnerud. "It works out-of-the-box and is combined with a flexible framework that focuses on wireless keyboard and mouse product design."

Miniaturized hearing aid wirelessly streams audio from TVs and smartphones

A hearing aid that enables users to wirelessly stream audio from common consumer electronics (CE) devices such as TVs, computers and home cinema systems, has been developed by leading Danish hearing solutions company, GN ReSound. The unit can also stream sound from smartphones via a chest-worn *Bluetooth* wireless technology microphone clip and has a range of up to 20 meters.

In operation, the end user connects their TV or other CE device to a small audio streamer box equipped with a Nordic nRF24L01 2.4GHz transceiver that then pairs with a second nRF24L01 located in the ReSound Alera hearing aid.

When the user wishes to watch TV they push a button on the back of the hearing aid or use a (cost optional) remote control to select the device's designated wireless channel to stream wireless audio in stereo direct from the appliance to their hearing aid.

The unit is housed in a miniature (20 by 15 by 6mm) form factor that incorporates an even smaller (14 by 6 by 4mm) module housing.

"It was extremely challenging to achieve this ease of end-user functionality, along with medical-grade [99.99%] field reliability and real-time audio performance in a hearing aid as small as [for the latest ReSound dot2 product] an adult finger nail and weighing as much as a paper clip," explains Thomas Olsgaard, VP of Hardware Platforms at GN ReSound.

Tiny hearing aid supports wireless audio streaming

ULP WIRELESS TRENDS

The latest developments in technology

ANT+ added to more Sony Ericsson smartphones

Sony Ericsson has further extended its family of ANT+ enabled smartphones with two new additions to its Xperia™ range.

The Xperia S and the Xperia Ion are the latest devices to benefit from ANT+ wireless technology and are due for launch in the first half of 2012.

Users will be able to link to a growing list of ANT+ enabled health and fitness sensors, with the data automatically forwarded to interested parties such as personal trainers, friends, or even caregivers.

The latest Sony Ericsson Xperia S and Ion phones support ANT+

Suunto's Ambit incorporates a host of advanced functionality including GPS

Ambit watch tracks location, weather and performance

Suunto's latest outdoor watch, the Suunto Ambit, includes a host of advanced functionality including location tracking, weather measurements, and performance monitoring. Suunto says the watch "takes outdoor instruments to a new level".

Key features include GPS navigation, an accelerometer, an altimeter, heart rate monitoring (including training zone and recovery), temperature measurement, track logging (speed and distance), a 3D compass, and a barometric sensor.

The robust (100m water resistant), lightweight, and low profile watch form-factor includes a large display and a battery lifetime of up to 50 hours in the most power-hungry GPS mode.

The Ambit is scheduled for release about now and will retail for around $ 550-600 with a choice of black or silver dial.

'Find My Car Smart' is first Bluetooth v4.0 app for iPhone 4S

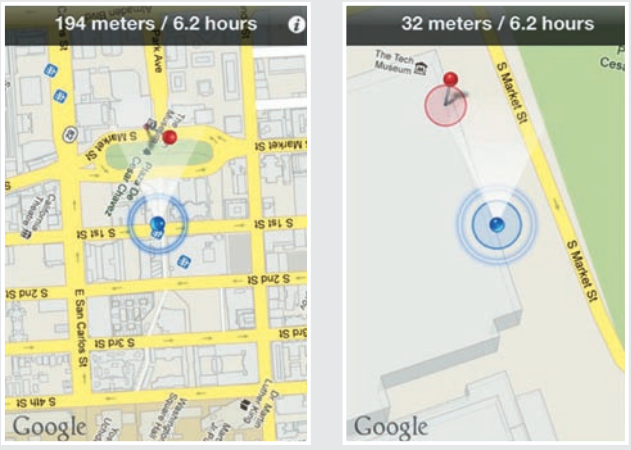
The first iPhone application to take advantage of the *Bluetooth* v4.0 wireless technology embedded in the iPhone 4S allows a user to locate and be directed to their parked car via Google Maps on their smartphone.

In addition, the user can find out how far away their car is parked and how long it has been stationary.

The user downloads an app called 'Find My Car Smart' and plugs a small USB *Bluetooth* Smart dongle ('Find My Car Smarter Device') into the vehicle's cigarette lighter socket via a USB Car Charger provided with the product.

After performing a one-off pairing with the smartphone, the Find My Car Smarter Device automatically detects when the car is parked by detecting when the power to the cigarette lighter is cut. It then logs the position of the car via GPS by momentarily activating the GPS function on the iPhone 4S.

To locate the vehicle, the user launches the Find My Car Smart app on their iPhone 4S.



Never forget where you parked your car again

nRF8002 simplifies Bluetooth v4.0 development for wireless novice

Nordic's says its new µBlue™ nRF8002 *Bluetooth* low energy single chip solution demands no specialist understanding of *Bluetooth* low energy wireless technology or any embedded firmware development to design-in to new products.

The company also says the chip offers market leading ultra low power consumption at mass market pricing. The nRF8002 is an application specific device targeted at *Bluetooth* Smart proximity tags and related accessories.

"Not only does this shorten time-to-market and lower develop costs," says Kjartan Furset, Strategic Application Manager at Nordic Semiconductor, "it enables companies with little or no *Bluetooth* wireless technology experience to start creating their own applications."

Using a Nordic nRFgo-compatible nRF8002 Development Kit, developers can design *Bluetooth* Smart proximity tags and accessories using a simple graphical user interface (GUI). The GUI allows the engineer to configure the built-in application layer and map inputs and outputs to external components such as buttons, LEDs, and buzzers.

Where are you?

The nRF8002 is supplied in a compact 5 by 5mm System-on-Chip (SoC) QFN package and includes a *Bluetooth* v4.0 low energy protocol stack, configurable application layer, and built-in support for *Bluetooth* v4.0 profiles. Supported profiles include Find Me, Proximity, Alert Notifications, and Battery Status.

The Find Me profile allows users to pair small and commonly misplaced objects with their *Bluetooth* v4.0-equipped smartphone. The paired devices can locate each other by the press of a button which activates an audible alarm on the lost item.

The Proximity profile adds further out-of-range functionality to the Find Me profile by allowing users to pair valuable objects like smartphones and computers with a wireless tag so that it alarms or securely locks the valued item if it and the user are separated. Alternatively, the Proximity profile can be used to automatically activate (unlock) a smartphone or computer when the user is nearby.

The Alert Notification profile allows user notifications of specific events happening on a paired *Bluetooth* v4.0 device.

Bluetooth low energy's Proximity profile makes finding a mislaid smartphone simple

"The nRF8002 enables companies with little or no Bluetooth technology experience to create their own wireless applications"

An nRF8002-based sports armband, for example, could be set to vibrate if the user receives an incoming call from a specific person while working out at the gym or running outdoors.

Finally, the Battery Power profile activates low battery warnings from paired *Bluetooth* v4.0 wireless accessories such as heart rate belts and foot pods through to remote controls, wireless mice, and keyboards. ■

The nRF8002 makes designing proximity tags like this key fob easy for engineers with limited RF knowledge

Strength in Alliance builds ANT+ ecosystem

Working group efficiency compresses time to market, says **Rod Morris**

The success of the ANT RF software protocol and ANT+ managed network platform - a technology that's already used in over 25 million silicon radios – is in large part due to assured interoperability.

OEMs adopt the ANT+ safe in the knowledge that their products will effectively communicate with other devices from independent manufacturers. The adoption of ANT+ has been strong and in the cycling sector, for example, ANT technology is considered a *de facto* standard for wirelessly transmitting performance data.

But the ANT+ interoperability is not managed by a bureaucratic special interest group. The thriving ANT ecosystem has expanded using a different model; one which offers some key advantages to companies looking to get wireless products to market as fast as possible.

ANT and ANT+ were developed by ANT Wireless, a subsidiary of Dynastream Innovations Inc., based in Cochrane, Canada. ANT Wireless licenses the technology to silicon radio manufacturers such as Nordic, which in turn offer 'silicon solutions' (RF software protocol plus hardware in products such as the nRF24AP2) to customers. ANT Wireless takes no royalties from OEMs when they start using ANT and ANT+.

Notably, the complete ANT software stack is built and tested by ANT Wireless. This is different to other interoperable technologies where individual companies develop different media access control (MAC) and Link Layers that then need testing with other firms' software to make sure they are compatible.

ANT technology is considered a de facto standard for wirelessly transmitting cycling performance data

BONTRAGER

"ANT Wireless 'builds-in' interoperability at the silicon level ensuring ANT RF links are reliable, stable, and efficient"

ANT Wireless "builds-in" interoperability at the silicon level ensuring RF links are reliable and efficient. There's no need for seemingly endless "unplugfests" to test ANT interoperability.

Rapid profile development

ANT Wireless and the chip suppliers are only partly responsible for the technology's success. Equally accountable is the ANT+ Alliance. The Alliance is open to all and currently boasts over 400 member companies.

Requests for new "profiles" (additional software layers that optimize the base ANT protocol for a particular application) come from the membership. These requests are driven by the requirements of a product under development, and the company asking for the profile has expertise in the application.

A team at ANT Wireless is dedicated to profile development. These engineers have been immersed in wireless design for a decade and are very adept. In 2012, this team came up with no less than seven profiles.

The knowledge of the application provided by the ANT+ Alliance member making the request combined with the skill of the ANT development team, results in rapid adoption of simple yet effective profiles. These efficient solutions then become available to the whole Alliance, increasing the group's value proposition.

Profile development in special interest groups tends to be driven by several parties, often with conflicting demands. Consequently, it takes a lot of time to initiate profile development, often no single party has an in depth knowledge of the application, and there's no consistency in the resources that are used for the work so expertise in profile development remains scarce.

Profile adoption is slow, and software is not as simple as it could be (which increases overhead and cost, and compromises battery life).

Focussed Alliance

ANT and ANT+ users benefit from a company that specializes in ULP wireless software development, a multi-vendor silicon supply base, a strong and focussed Alliance, a product that's simple to use, and profiles that are quickly introduced to market.

That's why, once companies have worked with ANT+, very few go elsewhere. ■

For more info on ANT and ANT+ go to www.thisisant.com; for more on Nordic's nRF24AP2, go to http://tinyurl.com/7ktne5q

ULP wireless security: No one-size-fits-all solution

Power consumption, processor utilization, and the sensitivity of the data being transmitted make each data security use case different, says **Jack Shandle**

Hacking, spoofing, and sniffing have become a multi-billion dollar illicit business, pushing security to the top of the list of priorities for anyone designing a wireless device. But a one-size-fits-all solution does not necessarily apply to all devices and designs. Use cases are critically important, and designers should also be aware of the range of technologies that make obtaining sufficient safeguards easier and less expensive.

Implementing security presents designers of low- and ultra low-power (ULP) wireless devices with a different set of concerns than those of large-scale, IT-type designs. On one hand, the short range transmission of data typical of ULP wireless applications is of little interest to most hackers, which argues for employing lower-cost security that doesn't require additional resources, for example. On the other hand, the design constraints mandated by power restrictions frequently make implementing security a delicate set of trade-offs.

Designers should first consider the potential security threats for their particular use case. For ULP designs, so-called "man-in-the middle" (MITM) attacks are by far the most important. While there are a number of variants, all introduce a third-party that listens in and perhaps even sends disruptive messages to a legitimate two-party or multiple-party network.

Products with relatively low price points are often best served by entry level microcontrollers, ULP radio chips, and coin-cell batteries that must last for a year or more. This class of use cases almost invariably transmits data that has no interest to anyone but the user. In these instances, the security afforded by using a proprietary protocol unique to a single vendor is usually sufficient.

The security conundrum

But if a use case needs a higher level of security, the processes employed – pairing, authentication, and particularly encryption, for example – demand additional overhead which may shorten battery life. Worse still, this cost could be incurred without adding any perceived value to the user.

Nonetheless, many use cases – and, to a large extent, the next generation of the use cases just discussed – will demand enhanced security provisioning, says Mike Paradis, Global Sales Manager at Dynastream Innovations (the company that owns ANT Wireless, the RF software protocol developer of ANT and ANT+).

The use case of fitness equipment, such as stationary bikes or treadmills that interface with ULP-based sports watches, for example, has moved from a simple peer-to-peer model to data sharing with multiple types of equipment - introducing tougher security requirements. Health devices potentially covered by medical privacy regulations are also in this class. Heart rate monitors (see Figure 1) can fall into either category.

The ANT+ solution focuses on being certain that all data exchange takes place between legitimate devices through authentication procedures. The pairing process is carefully defined, for example, and is augmented by inclusion and exclusion lists as well as proximity searching.

"A secure link provides as good a security performance as encryption," says Paradis, "and there is no RF overhead except the pairing itself." ANT Wireless has also created use-case profiles for ANT+ that describe the use case and its design implications in detail, including whether or not communication can take place without a secure connection. In addition, ANT's Time Domain Multiple Access (TDMA)-like adaptive isochronous interference avoidance scheme also aids security.

For the highest level of security, ANT Wireless created ANT-FS (file share), an extension to the ANT RF software protocol that implements a session-based mechanism for securely uploading and downloading data. ANT-FS implements this functionality in a way that is seamless to the user.

Any point-to-point communication between a client and host must traverse a three-layer process that includes link, authentication, and transport. While the process is too complex to be described in detail here, all three layers implement security measures. It is worth mentioning, however, the authentication layer has three standard options: pass through; pairing request; and, passkey. Each provides a progressively enhanced level of security.

Table 1. Security requirements of ratified Bluetooth low energy profiles

Profiles	Encryption required
Alert Notification Profile (ANP)	yes, unauthenticated or authenticated
Blood Pressure Profile (BLP)	yes, unauthenticated or authenticated
Find Me Profile (FMP)	yes, unauthenticated or authenticated
HID over GATT Profile (HOGP)	yes, unauthenticated or authenticated
Health Thermometer Profile (HTP)	yes, unauthenticated or authenticated
Heart Rate Profile (HRP)	yes, unauthenticated or authenticated
Phone Alert Status Profile (PASP)	yes, unauthenticated or authenticated
Proximity Profile (PXP)	yes, unauthenticated or authenticated
Scan Parameters Profile (ScPP)	Encryption handled by a higher level profile
Time Profile (TIP)	yes, unauthenticated or authenticated

Accelerating encryption

Bluetooth low energy, is a relatively new entrant in the ULP wireless connectivity sector and targets sports & fitness, healthcare, toys, and mobile phone accessories among other sectors. Nordic Semiconductor – along with other major semiconductor companies – supply commercial silicon.

Since *Bluetooth* low energy is part of the *Bluetooth* v4.0 specification, which itself is

At a glance

- Cost vs. benefits of encryption must be weighed
- Man-in-the-middle (MITM) attacks pose greatest threat
- Scalable security emphasizes case profiles / complementary technologies for pairing

Figure 1. Data transfer between heart rate monitors and sports watches in fitness applications typically requires less security than medical use cases

"A secure link provides as good a security performance as encryption and there is no RF overhead except the pairing itself"

based on technology that originally adhered to an IEEE standard, it is not surprising that 128-bit AES encryption is included in its suite of security technologies. If the encryption algorithm had to be executed on a microcontroller running a software implementation, the overhead in terms of execution time and battery life would probably be unacceptable for ULP applications, says Torbjörn Øvrebekk, a Nordic Field Application Engineer based in Los Angeles. But Nordic's nRF8001 *Bluetooth* low energy chip integrates a hardware accelerator that executes the encryption with just a small hit on performance, he says.

Other than the addition of encryption, *Bluetooth* low energy offers roughly the same security suite as ANT+. It has three pairing modes. In the first, pairing takes place in the open and this makes it vulnerable to MITM attacks except when the initial pairing is done in a place where snooping is highly unlikely. Afterwards, no other pairing is allowed. There are, of course, use cases such as wireless keyboard/mice and medical data in which this mode is inappropriate.

The second mode is pass key passing, which is much like the classic *Bluetooth* pairing scheme: It requires the two (or more) devices to confirm that they have the same pass key.

Out-of-band pairing is the third pairing mode. It employs the use of other frequencies and other wireless technologies to participate in the pairing process. A prime example of a complementary technology is Near Field Communication (NFC), which works only when the two devices are within a centimeter or so of each other. NFC is not specifically required in the *Bluetooth* low energy specifications, however, and other options are certainly possible, says Øvrebekk.

The Bluetooth SIG always relies on use-case profiles when deploying the standard and *Bluetooth* low energy is no exception. Some of the ratified profiles require security measures and others do not. Table 1 on page 8 provides an overview.

The 802.11 option

Another standard – IEEE 802.11 ("Wi-Fi") – includes a low power version known as "Wi-Fi Direct" that's increasingly being integrated into smartphones. Wi-Fi Direct provides a version of "Wi-Fi Protected Setup" that was created for pairing PC peripherals. Ratified in 2007, Wi-Fi Protected Setup's value is really to simplify 802.11 security implementations.

Bruce Kraemer, chair of the IEEE 802.11 Working Group, notes that the AES encryption is invariably part of the standard's security implementations. Wi-Fi Protected Setup addresses only the critical part of pairing devices.

There are two setup options: Personal Identification Number (PIN) and Push Button Configuration (PBC). Routers and other Access Points (APs) must offer both options, and client devices must at least offer PIN setup. In the first option, the user enters a PIN provided by the manufacturer. In the second, push buttons on the AP and client device(s) initiate the secure setup.

In addition to ensuring that the SSID and WPA2 security key are properly configured, Wi-Fi Protected Setup prevents users who enter incorrect PINs from accessing the network. It also includes a time-out function to cancel the configuration process when identifying credentials are not transferred in a timely fashion.

A balancing act

Ensuring data security is particularly important in wireless communication. But in ULP applications security concerns must be balanced against their impact on performance metrics such as battery life. In some instances, the data itself is of little interest to other parties. In others, privacy issues make security a critical concern. Solutions based on both proprietary protocols and international standards offer a range of security options. This enables design teams to select the right level of security for their products. ■

Ultra low power wireless connectivity solutions

Find the chip you need using this latest listing of every Nordic product

DATE: Q1 2012

Product Line	Product Series RF: Radio Frequency "wireless"	ICs Integrated Circuits "chips"	Operating Band	Wireless Protocol	IC Type: SoC System-on-Chip	IC Type: Connectivity	IC Type: Transceiver	On-chip CPU	On-chip Memory OTP: One Time Programable	Oscillators	Peripherals: 2-Wire	Peripherals: ADC	Peripherals: AES	Peripherals: Analog Comparator	Peripherals: Battery Monitor	Peripherals: I2S	Peripherals: MDU	Peripherals: PWM	Peripherals: Real Time Clock	Peripherals: RNG	Peripherals: SPI	Peripherals: S/PDIF	Peripherals: Temperature Sensor	Peripherals: UART	Peripherals: USB	Applications: PC Peripherals	Applications: Sports & Fitness	Applications: Gaming	Applications: Cellphone Accessories	Applications: Consumer Electronics	Applications: Automation	Applications: Healthcare	Applications: Toys	Ref. Designs	Dev Tools
2.4 GHz RF																																			
2.4 GHz	nRF24L	nRF24LE1	2.4GHz	Proprietary	●			8051	1kB + 256B RAM 16kB + 1.5kB Flash	16MHz / 32kHz Crystal 16MHz / 32kHz RC	●	●	●	●			●	●	●	●	●			●		●		●	●		●			PC Desktop, RF Remote, R/C Toy	nRFgo Dev Kit Prog. Kit
		nRF24LE1 OTP	2.4GHz	Proprietary	●			8051	1kB + 256B RAM 16kB + 1kB OTP	16MHz / 32kHz Crystal 16MHz / 32kHz RC	●	●	●	●			●	●	●	●	●			●		●		●	●		●			PC Desktop, RF Remote, R/C Toy	nRFgo Dev Kit Prog. Kit
		nRF24LU1+	2.4GHz	Proprietary	●			8051	2kB + 256B RAM 16/32kB Flash	16MHz Crystal			●				●				●			●	●	●		●		●	●		PC Desktop, RF Remote, R/C Toy	nRFgo Dev Kit Prog. Kit
		nRF24LU1+ OTP	2.4GHz	Proprietary	●			8051	2kB + 256B RAM 16kB + 1kB OTP	16MHz Crystal			●				●				●			●	●	●		●		●	●		PC Desktop, RF Remote, R/C Toy	nRFgo Dev Kit Prog. Kit
		nRF24L01+	2.4GHz	Proprietary			●	–	–	16MHz Crystal											●					●		●		●	●		●	–	Eval Kit
	nRF24 Audio Streamer	nRF2460 (mono)	2.4GHz	Proprietary		●		–	–	16MHz Crystal	●					●					●							●		●		●	Microphone	nRFgo Dev Kit
		nRF24Z1 (stereo)	2.4GHz	Proprietary		●		–	–	16MHz Crystal	●					●					●	●						●		●		●	–	Eval Kit
Sub 1-GHz RF																																			
Sub 1-GHz	nRF900 Multiband	nRF9E5	433 / 868 915MHz	Proprietary	●			8051	4kB + 256B RAM	4/8/12/16/20MHz Crystal		●					●	●			●			●							●			–	Eval Kit
		nRF905	433 / 868 915MHz	Proprietary			●	–	–	4/8/12/16/20MHz Crystal											●										●			–	Eval Kit
***Bluetooth* low energy**																																			
	nRF8000	nRF8001	2.4GHz	*Bluetooth* v4.0+		●		–	–	16MHz / 32kHz Crystal 32kHz RC											●		●				●	●	●	●	●	●	●	●	PC Desktop, RF Remote	nRFgo Dev Kit Prog. Kit
		nRF8002	2.4GHz	*Bluetooth* v4.0+	●			–	–	16MHz Crystal 32kHz RC					●														●					Key Tag	nRFgo Dev Kit Prog. Kit
ANT																																			
ANT+	nRF24AP2	nRF24AP2-1CH	2.4GHz	ANT		●		–	–	16MHz / 32kHz Crystal											●		●				●		●		●	●		–	ANT Dev Kit
		nRF24AP2-8CH	2.4GHz	ANT		●		–	–	16MHz / 32kHz Crystal											●		●				●		●		●	●		–	ANT Dev Kit
		nRF24AP2-USB	2.4GHz	ANT		●		–	–	16MHz Crystal											●					●	●		●		●	●		ANT USB Dongle	ANT Dev Kit

www.nordicsemi.com

Blood pressure monitoring hits the mass market

The addition of Bluetooth Smart to IDT's blood pressure meter promises to disrupt the consumer health sector. *ULP Wireless Quarter* reports

Let's try a short medical test; which of these readings is the normal blood pressure for a healthy adult aged over 20, according to the American Heart Association: 90/60, 120/80, or 160/100mmHg?

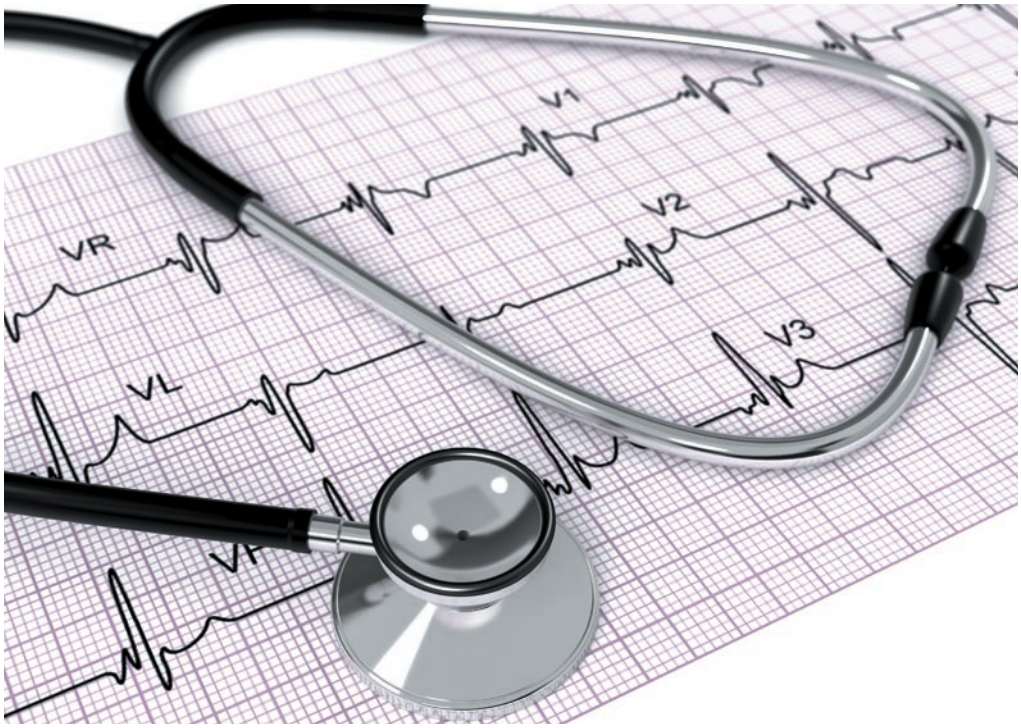
If you chose the second option, you'd be right. Unfortunately, most people don't know the answer, and frankly, don't care.

But they should, because according to the World Health Organization (WHO), high blood pressure (or hypertension) is one of the primary causes of cardio vascular disease (CVD - disease of the heart, lungs, and circulatory system). And CVD is responsible for a staggering one third of deaths across the globe.

Hypertension, along with type 2 diabetes and high blood cholesterol, are manifestations of an unhealthy lifestyle dominated by overeating, lack of physical activity, and excessive tobacco and/or alcohol consumption. Unfortunately, that lifestyle is becoming increasingly prevalent in both Western and developing cultures, and health authorities are worried. Their concern comes not only from the death count, but also because of the crippling cost of looking after people stricken with heart problems.

The good news is that CVD is preventable. Eating well and in moderation, exercising, stopping smoking, and lowering alcohol consumption allied to regular monitoring of blood pressure, blood glucose, and blood cholesterol levels can ensure CVD risk factors virtually disappear.

And access to home medical monitoring equipment enables users to do that monitoring. Such equipment reduces the load on general practitioners and keeps people out of hospital and off expensive drugs. But who wants to spend time checking their vitals signs, recording the numbers and trying to interpret the data – even if it is good for their health?



Home monitoring of blood pressure can motivate patients to change their lifestyle and maintain a healthy heart

Fortunately, ultra low power (ULP) wireless technology is making this task much less tedious; in fact, as easy as pressing a button and sitting back while the data automatically makes its way to the physicians.

Smartphone as health hub

Hong Kong-based IDT International is a leading manufacturer for top consumer blood pressure monitor (BPM) brands (and a wide range of other medical and sports & fitness devices). The company's latest product, a monitor equipped with a ULP wireless link, is currently undergoing final medical certification with the U.S. Food and Drug Administration (FDA) and European Medical Devices Directive (MDD). (*See* ULP Wireless Q *Winter 2011, pg 6.*)

IDT's product is specifically designed to make testing blood pressure simple and to ensure the resulting data is interpreted for the user's best benefit. "It can be used by anyone," says Danny Leung, Engineering Manager of IDT's medical and sports & fitness division. "The end user has to do nothing more than put the cuff on their upper arm and press a button."

The monitor gives immediate voice feedback, calibrated to WHO recommendations, on the current blood pressure reading (for example, "your blood pressure is normal").

Blood pressure naturally varies depending on a number of factors such as whether the patient is standing or sitting, has recently exercised, or is under stress, so single readings aren't a good guide to underlying health (although abnormally high readings should always be immediately reported to

a medical practitioner). To detect a potential problem, or a gradual upwards trend over time, readings should be averaged over several days.

IDT's latest innovation ensures that such a series of readings reaches expert eyes. This innovation is the addition of a *Bluetooth* Smart wireless link to the BPM. (*Bluetooth* Smart is the consumer branding of *Bluetooth* low energy, itself a hallmark feature of *Bluetooth* v4.0. *See* ULP Wireless Q *Winter 2011, pg 9*.)

The company selected Nordic's nRF8001 µBlue™ *Bluetooth* low energy solution to power the wireless connectivity in the BPM. The nRF8001 is a single-chip-connectivity solution fully compliant with *Bluetooth* v4.0 (*see this issue page 18*). The chip's ultra low power consumption means the monitor achieves similar battery life to current designs.

The blood pressure meter is the first such device in the world to utilise *Bluetooth* low energy and the Bluetooth Special Interest Group's (SIG's) recently adopted Blood Pressure profile. The profile is an additional layer added to the *Bluetooth* low energy RF protocol stack that optimizes the software for the specific application.

The use of *Bluetooth* Smart in the BPM allows it to communicate with one of the *Bluetooth* v4.0 (*Bluetooth* Smart Ready) smartphones now appearing on the market. Compatible devices include Apple's iPhone 4S and handsets from Motorola and NEC.

The BPM measures the patient's systolic blood pressure (the arterial pressure when the heart beats) and diastolic pressure (arterial pressure between beats). It also displays the average blood pressure from a group of recent measurements.

Data from the BPM, which also includes heart rate and notifications of heart beat irregularities, is transmitted from the monitor to the handset, and from there, via the cellular network, to a remote server in the medical facility. Alternatively, the data can be sent via SMS or e-mail.

"We see our *Bluetooth* low energy blood pressure monitor as a disruptive technology for the consumer mobile health market," says Leung. "Now, any smartphone, computer, or 'health hub' equipped with *Bluetooth* Smart Ready will be able to retrieve date-and-time-stamped data from the monitor - including an alert if measurements are unusually high or low - and send it to remote health care providers or concerned relatives."

Home monitors cut costs

Taking responsibility for personal health is key to reducing the incidence of CVD – the number one global killer. But it can be difficult to encourage adults that habitually overindulge to change their lifestyle.

National government-sponsored campaigns, aimed at educating the population in the benefits of healthy living, can work, provided participants remain motivated.

That motivation comes, in part, from seeing results such as weight loss, lowered resting heart rate, and decreased blood pressure. Home health equipment can help that happen.

And using ULP wireless technology to transmit the medical data to the cellular network via *Bluetooth*-enabled products keeps doctors informed. That limits the time patients need to spend with the physician, and enables medical staff to make well-informed decisions about when to prescribe drugs - saving health authorities a fortune.

"Like weight, blood pressure is a good indicator of general health," notes Leung.

"If users have access to a simple-to-use blood pressure monitor, and the results of their periodic measurements are wirelessly transmitted to a health care professional, they can see how they're doing on a particular day and be safe in the knowledge that if there's a detrimental long-term trend it will be identified by the doctor.

"IDT's blood pressure meter, Nordic's µBlue™ technology and *Bluetooth* Smart Ready cellphones, PCs, and 'health hubs' are making that prospect a reality. And that's really exciting," concludes Leung. ■

"The end user has to do nothing more than put the cuff on their upper arm and press a button"

IDT's blood pressure monitor uses Nordic technology to communicate with Bluetooth v4.0-equipped smartphones

For more information on IDT go to www.idthk.com/eng/index.php, for more on Nordic's µBlue™ go to tinyurl.com/3asueja

High pulse drain impact on coin cell capacity (part 2)

Kjartan Furset and **Peter Hoffman** continue their analysis of how coin cell battery capacity is affected by pulse duty cycle

Let's examine how a 3V CR2032 battery reacts to pulsed loads typical of ultra low power operation.

The graphs in Figure 1 show the average drain rates of a CR2032 cell when its subject to pulse drains of 30mA with different pulse periods. Figure 1(a) shows that if the battery is subject to a 30mA pulse load every 10ms (similar to the shortest connection intervals for ANT+ and *Bluetooth* low energy) it has a severe impact on the likely battery capacity. Following the Vload curve shows that a 2.0V Functional End Point (FEP) will be reached after approximately 125mAh of the battery capacity is spent, essentially halving the nominal CR2032 battery capacity.

The battery drain curve at a continuous current is similar to the average drain current of the pulsed load. And as is evident this high drain current severely limits the battery capacity whether the drain is continuous or pulsed.

The Vidle curve follows the continuous drain, meaning that between the pulses the battery will recover to a voltage similar to what the battery will give if it's subjected to a continuous current similar to the average current. But only up to a point, because as the chemistry in the battery is spent the battery will no longer be able to keep up the high drain during the pulses and the Vload drops off rapidly. The Vidle voltage will follow Vload because the lack of active materials in the battery also affects the recovery speed between pulses. While the battery voltage with the pulsed load drops off, the continuous current can drain the battery for longer. This shows the impact of loading the battery with high pulses rather than a continuous load even though the average current of the pulsed and continuous drain are the same.

Figure 1(a) and (b): Battery drain vs. Pulse duty cycle for CR2032

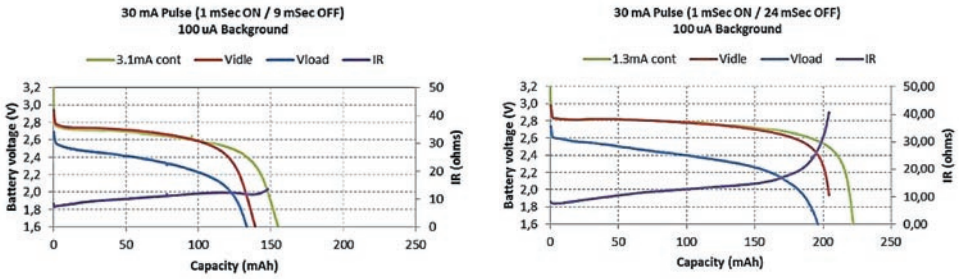


Figure 2: Standard deviation envelope of 25 ms and 75 ms pulse periods on CR2032

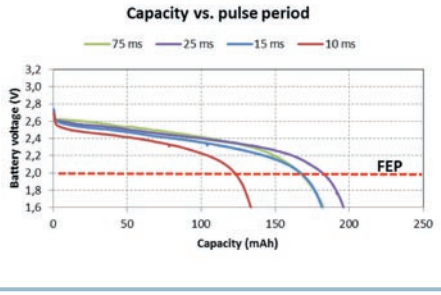
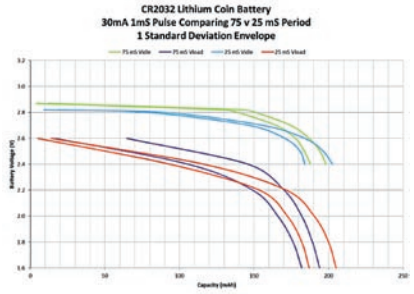


Figure 3: CR2032 Battery voltage during 30 mA pulse load



As the pulse period is extended (Figure 1(b)) the average current consumption drops and more battery capacity can be utilized. But as the capacity approaches 200mAh, the battery is no longer able to keep up with the high peak current, and once this limit is reached, extending the pulse period further doesn't increase battery capacity.

This may seem counter-intuitive as lower average current should give more capacity; but looking at the deviation across the tests, shown in Figure 2, it can be seen that the deviation in drain curves of the different batteries tested at 25 and 75ms pulse periods overlap to a large degree. From this it can be concluded that the battery-to-battery variation in 'end-of-life' performance when subjecting the cells to relatively high loads is significant.

In addition to concluding that subjecting any CR2032 to a 'too high' average (or continuous) drain will reduce the battery capacity, the high current in the pulses adds a further drop in the battery capacity than might otherwise be expected.

There is one more important observation. Following the 75ms curve in Figure 3 shows that at 150mAh, the battery voltage during load is still at 2.2V, and there is still about 25 mAh capacity left. But if the wireless device needs to, for example, enter link up mode, the pulse interval may suddenly be reduced; the drain characteristic will now follow one of the shorter pulse period curves. To illustrate the point, assume the application changes to a 10ms pulse period. The 10ms curve in Figure 3 shows that the battery is beyond the 2.0V FEP, well before 150mAh of capacity has been drained, so the application will fail/reset rather than link up as intended.

The shortest pulse period encountered by the application is the one that must be used for battery lifetime estimates. ■

Part 3 of this article, in the Summer 2012 edition, will consider the effect the peak current has on the battery drain.

ANT+ helps gym become health and fitness hub

Rod Morris introduces Jack, a gym owner who uses ANT+ technology to satisfy his members' needs while growing his business

Meet Jack, the owner of a successful fitness club. Jack's goal is to create an interactive environment that ensures members feel welcome, comfortable, and well looked after. The club features a high instructor-to-member ratio, strong staff/member interaction, leading technology, cardio room, and studios for classes – all designed to encourage member recruitment and retention

Jack envisions his gym as a 'hub' for a variety of members' informational, physical, and social needs. The gym serves as a one-stop-shop for health and fitness and offers a strong community of like-minded people.

A commitment to physiological monitoring further demonstrates Jack's attentiveness to - and interest in - the individuals. The personal trainers and instructors find that physiological data helps address a member's personal goals. While targeting the initial fitness requirements, such information can also help identify problem areas and inspire further plans of action.

But Jack is also aware of the need to protect privacy while retaining versatility. Members that are sensitive about personal information but at the same time want to improve their health and level of fitness, need confidence that their data is secure with trainers and instructors.

There's a business upside to encouraging generation and sharing of physiological data: retail sales of monitoring devices. Big or small, all fitness club shops can easily manage the sale of ultra low power (ULP) wireless products such as heart rate straps, watches, and foot pods. Club instructors use the devices - so can serve as an additional sales force by offering demonstration products to members. Not having a device won't exclude a member from a class, but tutorial classes make it easy to see the benefits of a "complete gym experience".

WASP by North Pole Engineering allows data from spin class members' heart straps to be transferred to a central PC

"Gym members that are sensitive about personal information need confidence that their data is secure with trainers and instructors"

ANT+ extends choice

The selection of ANT+ technology for the gym's ULP wireless physiological monitoring capability provides everybody with a choice. Members have the freedom to choose a digital solution with extensive compatibility while Jack has the choice of leading vendors of fitness equipment. The proven interoperability of ANT+ makes creating this unique club experience easy. Any ANT+ monitor including heart rate, foot pod, activity, blood pressure, weight scale, or bike sensor can seamlessly collect data and then, via a wireless auto-download, transfer the information to a member's personal web page.

Furthermore, because the club's cardio equipment supports ANT+ connectivity, the member can customize their exercise experience to match their own PC-generated training schedule by transferring data from their sportswatch to the exercise equipment.

ANT+ gives Jack flexibility in the added-value options he offers his members. For example, WASP by North Pole Engineering allows an instructor to lead a class using heart rate as the intensity standard without need for any special equipment other than a heart rate strap from any one of 30 ANT+ partners and a PC plus monitor. Data from members' heart straps and foot pods can be transferred across the studio via Wi-Fi to the PC.

Members equipped with sportswatches and cell phone applications ("apps") are still able to collect their own data, communicate with the access points, share with the Wi-Fi hub at the center of the room, and even access the club's group social network app.

ANT+ helps Jack's achieve his ambition of creating a hub of health and activity for his members while growing a dynamic and thriving business.

For more on ANT go to www.thisisant.com, for more on Nordic's nRF24AP2 go to http://tinyurl.com/7c5pblv

Keen debate about future of ULP wireless at CES round table

Incisor.TV asks the questions at a recent ULP wireless gathering of key executives

The giant CES trade show in Las Vegas during January provided an opportunity for Incisor.TV, a UK-based trade publication, to gather a group of key executives for a round table discussion.

The participants, including Nordic's Svein-Egil Nielsen, Director of Emerging Technologies & Strategic Partnerships and Member of the Board, Bluetooth SIG, and Rod Morris, Director – ANT Wireless, debated competing technologies, standards, and the role of the smartphone in expanding ultra low power (ULP) wireless technology's reach.

Vince Holton, Editor-in-Chief of Incisor.TV, asked the questions and here is a selection of Nielsen's and Morris' responses.

Vince Holton: Can the ULP Wireless sector support a number of competing technologies?

Svein-Egil Nielsen: Nordic has a policy of supporting multiple platforms because we think there is room for many of them. But I do believe some convergence will happen because not all of the platforms will be able to maintain their position in the market because the volumes are not big enough. From a chip maker's perspective you can see foresee – and not very far ahead – that the radios will be more-or-less software configurable and switch dynamically to run any protocol.

Athletes care about the quality of performance data and will go to great lengths to attain it

Rod Morris: There are orders of magnitude [in power consumption] that differentiate the top ULP technology from the bottom. If you want 'the best' or 'the lowest power' [technology] you have to accept there will be some tradeoffs. But as silicon scales down there's room on the chip to include more than one [radio] technology to suit different applications.

VH: Are standards vital?

SEN: I think standards are good, but not always necessary. Nordic has shipped 500 million proprietary [not compliant to an industry standard] devices to satisfied customers. Standards always come with some cost and sometimes that cost is too high. There are use cases when you don't need interoperability, rather just a link between two devices that works better than anything else – you can only do that with proprietary [because] there's no standard that can beat a proprietary one.

RM: I don't see it as black-and-white as 'standard or no standard'. There is a 'grayer' implementation, and that's exactly what we do. We bridge the gap [to provide] some of the good points of proprietary solutions such as customizing the link to a particular application – and ANT was specifically designed for sports monitoring applications which is why it's so good at it – but on top of that we've created an ecosystem of interoperable devices.

VH: Is the ability to communicate with a smart phone likely to be vital for ULP wireless?

SEN: It's so hard to predict, because [the concept of a] smartphone 'as a terminal' for wireless data collection is so new. [Even though] we've had wireless connectivity to the smartphone for a while with Wi-Fi and *Bluetooth* wireless technology, it's only now that technologies such as *Bluetooth* low energy and ANT are added, giving the smartphone the ability to [be the focal point] for a collection of sensor data.

RM: Athletes in particular are very [performance] data-centric and care about the quality of that data so will go to great lengths [to attain it], meaning the smartphone could be important. But ultimately, most consumers are interested in a system that just works. ■

Further Information

The video was originally published by Incisor. This digital publication is produced by Click I.T.

To see the full video of the round table see: http://www.youtube.com/watch?v=-TV0G_JL8Vs

Wireless heart monitoring cuts healthcare costs

An ANT ECG patch promises to take the pressure off hospital budgets

Jay Tyzzer is a Senior Application Engineer with Nordic Semiconductor

Intensive care is characterized by rigorous patient supervision. Sick people are constantly monitored by an array of expensive equipment displaying and recording vital signs such as pulse, blood pressure, respiration rate, and blood oxygen level. Medical staff can rapidly intervene if these vital signs change for the worse.

But when a patient stabilizes and moves to a general ward, there's a step change in the observation routine. That's acceptable for an improving person, but it's a problem for one that's about to relapse.

LifeTouch HRV011 is an inexpensive way to continuously monitor a patient's physiological information

"On the general ward patients are monitored perhaps once every two hours," says Keith Errey, CEO of Isansys Lifecare, an Abingdon, UK-based company. "Unfortunately, a lot of changes can occur between readings."

What's needed is a low cost way of duplicating the continuous monitoring typical of the intensive care environment on the general ward, but without the cost.

That way, patients in danger of relapse can be identified early and treated while still not sick enough to merit a return to critical care.

Today, no such solution exists, but Errey says that'll change – in part due to ultra low power RF technology such as ANT. ■

Design News

This item is an extract of an article that appeared in Design News in December 2011

The magazine is published by United Business Media

To see the article in full go to: http://tinyurl.com/79rz8bw

Bluetooth low energy hits the wireless market

The new version of Bluetooth is now being used in many innovative products

By Kjartan Furset Strategic Applications Manager with Nordic Semiconductor

In 2011, Nordic Semiconductor announced successful wireless communication tests between a prototype design for a small, low-cost *Bluetooth* low energy proximity fob and Broadcom's BCM4330 chip. It was a testament to the interoperability assured by the *Bluetooth* specification that the wireless link was established and operated seamlessly.

The proximity fob (which utilizes the nRF8001 and the recently released *Bluetooth* v4.0 Proximity Profile) prevents a device such as a laptop being accessed in the owner's absence.

Casio's G-SHOCK Bluetooth Low Energy Watch is one of the first commercial devices to feature the new wireless technology

After 'pairing' with the chip in the mobile device, the user carries the fob on their person. If the distance between the user and the mobile device exceeds a pre-set threshold (as may occur, for example if the mobile device is left behind or stolen), the pairing is broken and the mobile device automatically locks.

The fob application is an inexpensive solution to the problem of mobile device security and illustrates how *Bluetooth* low energy can be incorporated into coin-cell powered devices.

Further applications will soon become possible as the Bluetooth SIG introduces more 'Profiles' to customise the protocol to a particular use. Profiles in the works include Personal User Interface Devices (PUID), Remote Control, Battery Status, and Heart Rate. Other health and fitness monitoring profiles such as blood-glucose and -pressure, cycle cadence and cycle crank power will follow. ■

Electronic Design Europe

This item is an extract of an article that appeared in Electronic Design Europe, December 2011

The magazine is published by Penton

To see the article in full go to: http://tinyurl.com/7v77nra

Upgraded Bluetooth low energy connectivity chip extends battery life

An enhanced version of Nordic's nRF8001 *Bluetooth* 4.0 low energy Connectivity IC extends the current device's class-leading power-saving performance and benefits from an upgraded *Bluetooth* core software stack.

Dubbed the nRF8001 'Build D', the chip includes all *Bluetooth* core stack features required for the newly adopted *Bluetooth* low energy human interface device (HID) profile. This makes the nRF8001 a good solution for emerging *Bluetooth* low energy wireless PC peripherals and advanced navigational remotes for connected TVs and set-top boxes (STB).

"The additional features in the new Build D revision of the nRF8001 represent a major enhancement in both power consumption and the type of application our customers can cover with this IC," comments Nordic's Product Manager, Thomas Embla Bonnerud. "The new power saving features put the nRF8001's power consumption into a different league to its competitors, and the *Bluetooth* core stack enhancements have further extended its application potential." ■

A revision of the nRF8001 extends the device's class-leading power-saving performance

nRF8001

From the Spec Sheet

- **Fully qualified *Bluetooth* v4.0 low energy Connectivity IC with integrated Radio, Link Layer, and Host stack**
- **Best-in-class power consumption enabling months to years of battery lifetime**
- **Fully integrated, low tolerance 32kHz RC oscillator eliminating the need for external 32kHz crystals**
- **Simple serial interface (ACI) supporting a range of different external application microcontrollers**
- **5 by 5mm QFN package**

For more information on the nRF8001, go to tinyurl.com/3s5lysw

Combining best-in-class 2.4GHz transceiver with single chip USB dongle

The nRF24LU1+ combines the class-leading performance of Nordic's nRF24L01+ 2.4GHz radio transceiver with the extended feature set of its nRF24LU1 USB dongle single chip device.

By integrating a full-speed USB 2.0 compliant device controller with an eight-bit flash microcontroller and the nRF24L01+ transceiver, the nRF24LU1+ provides a single chip USB dongle solution with a minimal external bill of materials (BOM). On-chip flash memory eliminates the need for an external E2PROM memory. The only external components the nRF24LU1+ chip requires are a low cost 16MHz crystal, decoupling, matching network and antenna.

"The nRF24LU1+ offers outstanding miniaturization and performance for single chip wireless USB dongles," says Nordic's Thomas Embla Bonnerud. "We have worked closely with our strategic customers on this line-up and they are as excited about the new chips as we are." ■

The nRF24LU1+ enables miniature wireless USB dongles

nRF24LU1+

From the Spec Sheet

- **Integrates nRF24L01+, 8051 CPU, 16 or 32KB Flash, and USB 2.0-compliant device controller**
- **Supports firmware upgrades over USB for easy field deployment of new features**
- **Drop-in compatible with the Nordic nRF24LU1+ OTP lower cost OTP memory variant**
- **Fully on-air compatible with all Nordic nRF24L Series, as well as nRF24E and nRF240 Series**

For more information on the nRF24LU1+, go to tinyurl.com/7zmof8e

PEOPLE & PLACES

Salas Lau

Company culture encourages autonomous working

Hi, my name is Salas Lau and I'm a Field Application Engineer for Nordic based in Hong Kong.

I've been working for Nordic for four years and lived in South East China all my life. Previous work roles include being an electronics manager of wireless products for a Chinese ODM in Guangdong Province, an R&D manager of 2.4GHz cordless phones in Shanghai, and an RF specialist with Infineon Technologies in Hong Kong.

This background has given me a large pool of wireless experience and knowledge that has helped me to become a specialist in Nordic's wireless technology and able to provide technical training to customers and local sales distribution partners. I help customers design their own wireless products and provide technical support should they run into problems.

Solving technical problems is one of the things I really like about my job, along with the opportunity to work with some really high caliber colleagues. I also enjoy a company culture that has given me the space and autonomy I need to solve customer problems quickly and effectively.

After Guangdong and Shanghai, Salas Lau now works in Hong Kong

Personal Profile

NAME:
Salas Lau

JOB TITLE:
Field Application Engineer

JOINED NORDIC:
January 2008

BASED:
Hong Kong, China

INTEREST INCLUDE:
Family, Tennis, DIY, Swimming

I follow a well-defined process that starts with establishing an understanding of what the problem actually is, identifying the probable cause(s), identifying the possible solution(s), and then systematically applying those solutions to see what works.

Sometimes I get lucky and can solve a problem in a single cycle. Other times, none of the proposed solutions work completely, but maybe one does produce a small improvement. If that's the case then I go back through the cycle again with an even finer focus.

Although this can be quite stressful if there's a deadline, there's no finer learning process because you never forget a solution you find this way.

That said, the vast majority of technical problems I deal with stem from basic misunderstandings or simple errors made by the customer because they have missed a small but important detail in Nordic's design guidelines – which in my region I have played a significant role in developing.

Outside of work I like to exercise to unwind and play tennis every week and in the summer go for a refreshing swim in a local outdoor pool .

However, the most important thing in my life are my children (I have a 3-year-old daughter and one-year-old son). I feel that time spent with them is the most important investment I can make to ensure they grow up healthy, happy, and confident enough to be successful at whatever they chose to do.

Which until they are quite a bit older will be very similar to what mummy and daddy want them to do – be good children, help out at home, and work hard at school! :)

Salas Lau

"The vast majority of technical problems I deal with stem from basic misunderstandings or simple errors"

Don’t risk your first ***Bluetooth*® low energy** (*Bluetooth* Smart) project...

...take the fast-track to success by using a proven product design framework that will free you from having to get bogged down in the wireless nitty-gritty

WIRELESS KEYBOARD AND MOUSE COMBO

nRFready µBlue™ Desktop ref. design

SMART REMOTES

nRFready µBlue™ Smart Remote ref. design

iPHONE® 4S WIRELESS ACCESSORIES

nRFready iOS Demo App

To download app – called ‘nRFready Utility‘ – scan or visit tinyurl.com/bsgpo8q

NORDIC SEMICONDUCTOR

Nordic Semiconductor leads the world in ultra low power (watch battery) wireless and was instrumental in the development of the *Bluetooth* low energy technology (or *Bluetooth* Smart technology as it will now be marketed to consumers) part of the latest *Bluetooth* v4.0 specification.

www.nordicsemi.com