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Wi GaN:  
Demystifying A4WP-based 6.78MHz Wireless Power Amplifier Design

The advent of portable electronics, most notably the laptop and smartphone, has revolutionized our lives. However, portable electronics consume a large amount of battery power, and while engineers dedicate limitless hours to optimizing battery life, battery life is still a fundamental limitation to maximizing user experience.

Wireless power transmission provides a convenient alternative to the traditional approach of wired charging. Gone will be the days of carrying different adapters and cables for your vast collection of electronics. Instead, imagine a single wireless charging device, which allows simultaneous charging of multiple products in its proximity, independent of orientation and connector-type. This vision is now a reality thanks to loosely coupled A4WP-based wireless power transfer, of which eGaN® FETs by EPC are an enabling component.

Previous articles have discussed the benefits of using eGaN FETs over MOSFETs in both the Class E and ZVS Class D topologies [1, 2]. It was demonstrated that using eGaN FETs in a ZVS Class D topology yielded an amplifier that supported wider load impedance ranges than the Class E equivalent. This article will focus on issues that are encountered after the selection of topology and FETs.
Overcoming Load Impedance Variation Effects

Peak efficiency of the Class E or ZVS Class D amplifier occurs when it operates at resonance. However, the amplifier in a loosely coupled system rarely operates at resonance because in order to allow the user to transfer wireless power within a 3-dimensional region, the amplifier’s load impedance varies considerably. The impedance seen by the amplifier can be altered by any of the following scenarios:

- Changing the distance and/or angle between the source and receive coils of A4WP-compliant devices
- Variation in load current of the A4WP-compliant receiver
- Placement of additional A4WP-compliant receivers within the range of the source coil
- Placement of foreign metal or magnetic objects within the range of the source coil

A4WP Class 3 Standard

The A4WP has defined a compliance window of impedance values that a Class 3 amplifier must be able to drive. The compliance window consists of the impedance rectangle drawn from (1 + 10j) Ω to (55 -150j) Ω and is depicted as the shaded blue region in Figure 1 [3, 4]. Superimposing the results from [1] onto the A4WP Class 3 impedance window shows that further complexity to the amplifier is required to drive the entire impedance window efficiently. It is permissible to rotate the class 3 impedance on the Smith Chart such that the amplifier drives discrete segments of the compliance window separately. By using this technique, full compliance of the A4WP standard is possible with a single stage amplifier.

Adaptive Matching for Optimizing Performance

The equivalent circuit of the reflected impedance the amplifier will see due to various situations described is shown in Figure 2. As the reflected impedance varies, the operating point moves further away from resonance thus reducing system efficiency. Since the 6.78MHz ISM bandwidth is only +/- 15kHz, maintaining resonance by dynamically adjusting operating frequency is not a viable option. Alternatively, adaptive matching can be used. Adaptive matching is the dynamic adjustment of the series tuning capacitor value based on variations in the loading of transmitter coil LCoil.

An adaptive matching cell comprises a bi-directional current blocking switch in series with a tuning capacitor [5]. The FETs must have high VDS rating, low Coss, and low RDS(on) to be effective. High Coss can impact the tuning capacitor value, and high RDS(on) lowers amplifier efficiency. As shown in Figure 3, multiple adaptive matching cells can be paralleled to further extend the efficient operating range of the amplifier. The adaptive matching controller would switch in the appropriate capacitor value to adjust the coil impedance closer to resonance. Adaptive matching also optimizes coil efficiency as it narrows the operating range of the coil such that it always operates near resonance.

Summarizing the results of [1] in Figure 4 shows that the ZVS Class D amplifier can drive a wider impedance range than the Class E amplifier can. Therefore, this implies that the ZVS Class D amplifier would need fewer adaptive matching cells to support the full +10 to -150j Ω range of the A4WP Class 3 standard, resulting in a simpler and more cost effective system solution.

EMI Generation Comparison Between Class E and ZVS Class D

The spurious EMI emissions of the single-ended Class E and single-ended ZVS Class D amplifiers were simulated using LTSpice with the amplifiers delivering 14 W into an A4WP-compliant load [5]. The results of the simulation are shown in Figure 5. It can be seen that the ZVS Class D amplifier does not output noticeable even order harmonics, whereas the Class E
outputs significant even order harmonics. Even order harmonics impact the fundamental asymmetrically and are difficult to filter out. Therefore, EMI compliance for the ZVS Class D is expected to be easier than it is for the Class E amplifier [6].

**Summary**

Wireless power transfer is an effective way to further enhance the usability of portable electronics. But in order to wirelessly charge a device, a reliable and convenient mechanism is required. A4WP-based loosely coupled wireless transfer has the potential to bring true convenient wireless charging to next-generation portable electronics. To help realize this vision, eGaN FETs from EPC provide the most efficient solution in 6.78MHz switching amplifiers.

This article identifies additional technical challenges that would be encountered, namely adaptive matching and EMI. Adaptive matching is needed to extend the efficient operating range of the amplifier to cover the A4WP Class 3 standard. Also, simulated EMI spectrum show that the ZVS Class D amplifier inherently has fewer even-order emission spurs, making it easier to pass EMI compliance limits. Please visit epc-co.com for more information.

**References**


eGaN® FET is a registered trademark of Efficient Power Conversion Corporation.
Panasonic’s Bluetooth modules, available from Arrow, can greatly reduce total development cost and time to market for wireless connectivity devices. This allows developers to focus their efforts on the unique and differentiating features of their product or application.

Bluetooth CLASSIC Modules

Bluetooth Classic modules, including the PAN1322, PAN1325B, and PAN1315B Series, provide data rates up to 3Mbps and are ideal for networks covering distances up to 200m with 8 nodes or less, though higher node counts are possible. The PAN1322 Series is an all-in-one, place and play solution, integrating a microcontroller, Bluetooth 2.1 + EDR stack, and antenna, and also feature iOS and Android support. The PAN1325B and PAN1315B Series are HCI Bluetooth modules, with the Bluetooth stack executed on the host MCU. Available with or without an integrated antenna, the PAN1325B and PAN1315B feature excellent efficiency due to a reduced initialization script, start-up time, and decreased system memory requirements.
Bluetooth SMART Modules

Bluetooth Smart modules utilize the Bluetooth Low Energy protocol to minimize power consumption, allowing for multi-year operation from a standard coin cell battery and making them ideal for applications in wearables, medical devices, and sensing. Panasonic’s PAN1720, PAN1721, and PAN1721 Series integrate the MCU and Bluetooth 4.0 stack, with the PAN1720 and PAN1721 also integrating the antenna. The modules extend battery life due to power efficient hardware and operation, consuming only 500µA of current in sleep mode and featuring a 3µs wake-up. The PAN1740 is Panasonic’s second generation BLE module, and reduces transmit and receive current by 66% compared to competing devices without reducing range, greatly reducing average power consumption.

Bluetooth SMART READY Modules

Bluetooth Smart Ready modules are multi-mode modules able to connect to Bluetooth Classic and Bluetooth Smart devices and can benefit from the higher data rate of Bluetooth Classic and the faster connection times of Bluetooth Low Energy. The PAN1326B and PAN1316B Series modules support extended range networks with output power up to 10dBm, and the PAN1323 Series incorporates ANT connectivity in addition to Bluetooth Classic and Low Energy. The PAN1026 series is a dual mode place and play module, integrating an ARM processor and USB connectivity with support for iOS and Android devices.

BLUETOOTH BUCKS

Arrow and Panasonic are partnering to offer the Bluetooth Bucks incentive program: Depending on order volume placed through Arrow, customers may be reimbursed up to the full cost of purchasing a Bluetooth Declaration ID, which can be as high as $8,000. For more information on Panasonic Bluetooth Modules and the Bluetooth Bucks program, visit: http://arw.io/39cQ.
HARDWARE DESIGN MADE EASY.

PCBWeb Designer is a free CAD desktop application for designing and manufacturing electronics hardware. The tool supports schematic capture and board layout, including integrated "click-to-order" manufacturing.

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A Look at New Network Technologies That Will Power the IoT

In today’s mobile market, almost every device has wireless capabilities on top of a Wi-Fi connection. These devices use a certain generation of mobile telecommunications technology; in the past several years, those technologies have been referred to as 3rd Generation (3G), and 4th Generation (4G). 4G is the most advanced mobile communications technology to date, but as technology continues pressing forward, new features are being discovered. With the rise of the Internet of Things and various types of smart device technologies, it will take something far more complex than 4G to bolster new wireless demands. The demand for a 5G network is growing, but it may take years to implement in order to power the rapidly expanding network of connected devices.
The 5G capability is more than just an internet connection. It denotes a set of standards that mobile devices and mobile telecommunications use in relation to services and networks that are set by the International Mobile Telecommunications-2000 (IMT-2000) specifications through the International Telecommunication Union. The set of standards specifies technologies involving voice, Internet access, download and upload speeds, and network protocols, among other necessary mobile communication technologies. Increased data speed is an obvious improvement that will be implemented with 5G, but 5G will be an amalgamation of smarter technologies in order to aid our daily lives. Three of the main technologies being standardized for the 5G upgrade are millimeter wave wireless communications, cognitive radio, and support for the Internet of Things (IoT).

### Millimeter Wave Communications

Much of the improvements made to wireless technology with the adoption of 5G will be millimeter wave wireless communications. In order to understand the changes that are occurring between current technologies and future technologies, you have to look back at the evolution of 4G. Previously, the two forerunners in technology when deploying 4G platforms were Long Term Evolution (LTE) Advanced and Mobile WiMax (IEEE 802.16e). Currently, the 4G standard for bandwidths is between 5 and 20MHz with a peak range of 40MHz.

Mobile WiMax can offer peak download speeds of 128Mbit/s and upload speeds of 56Mbit/s on these frequencies. WiMax can achieve these speeds through scaling of the fast Fourier transform, which allow a higher bandwidth spectrum efficiency in wide channels and cost reduction in narrow channels. It also uses adaptive antenna systems and multiple-input multiple-output (MIMO) technology. 4G LTE advanced can deploy data rate speeds at a maximum of 1Gbit/s downstream and 100Mbit/s upstream on the previously mentioned frequencies, which is accomplished by using higher frequencies as well as utilizing MIMO. MIMO uses multiple transmit and receive antennas to exploit multipath propagation. 5G will also utilize these technologies, but with modified versions. It is currently labeled as a “converged fiber-wireless network.” This will allow wireless Internet access to use millimeter wave bands across the 20 to 60GHz spectrum. This frequency range allows very wide bandwidth radio channels and will support up to 10Gbit/s of data access speed.

However, millimeter wave wireless communications can be somewhat limited. This is because frequencies higher than 30GHz tend to be absorbed by chemicals in the atmosphere such as oxygen and water. Even water in the form of humidity can absorb these high frequencies. To combat these interferences, this technology will have to utilize adaptive-beam antennas. Adaptive-beam antennas use an array of transmitters or receivers to create a combined signal that increases strength from a starting point to a destination.

### Cognitive Radio

In keeping with the theme of frequency channels, another way that 5G wireless aims to be part of a smarter standard is through the use of cognitive radio, which is considered intelligent as it can be programmed and configured dynamically. This allows the smart radio to find channels, and then choose channels based on their availability. Once a channel is chosen, the radio then modifies connection parameters in order to improve the wireless communications. Operating frequency, networking, waveform, and protocol are the parameters that cognitive radio is able to modify automatically. Much of the work behind cognitive radio deals with determining the best operating frequency.

Cognitive radio uses spectrum sensing and spectrum management for optimal frequency selection. In spectrum sensing, the antenna is trying to find another nearby antenna with similar broadcasting characteristics as itself. This is done through several avenues, starting with matched filter detection, which uses a known signal and correlates it with an unknown
signal to detect the presence of certain characteristics. Another avenue that cognitive radio uses is energy detection, where the antenna measures incoming signals based on their energy output. If the energy output is within the range of what the antenna is expecting, then it knows that it should use that incoming signal. Spectrum management deals with selecting the best range of signals to meet current demand, without interfering with current communications. This is done by using energy sensors to detect multiple signals and then employing algorithms that distinguish which signals are being used and which ones are not. Even if a signal is not being used, it could be weak for the purposes of what the desired signal will be used for. Because of cases like this and other factors like false signals and required transfer amounts, nodes have to be in constant contact with each other. By using cognitive radio, 5G wireless standards aim to be much smarter about choosing and utilizing the best frequencies in order to have information transfer fast and seamlessly.

**5G and the IoT**

Perhaps the most popular network trend right now is the Internet of Things. Most of the current research for 5G wireless standards is geared towards what to expect and how to handle the demand for the IoT. Devices of all kinds are being connected to the Internet to monitor important information. Associated computers and devices can then make decisions to better help our lives. When 5G is implemented in 2020, there has to be coverage for the demand of billions of devices and simultaneous connections. One of the technologies being researched is what is referred to as media-independent handover (MIH). There are several layers involved in wireless communications and the ones used in MIH are layer 2 and layer 3. Layer 2 is considered the data-link layer whose job is to move data across the network. Layer 3 is the network layer concerned with IPs. The MIH has its own specified function that helps with the communication between multiple different layers across different wireless access points. When a user carries a device across two access points with different wireless technologies, MIH assists with keeping the connection seamless by converting information across Layers 2 and 3. If devices on an automated vehicle where to transfer data from a private network to a public network, MIH will be able to transfer smoothly without the loss of data. By deploying a wide range of smart technologies, server situations can be handled much more efficiently. When an ambulance needs to make it to a hospital in as soon as possible, traffic lights can sync up with where the vehicle is located. This can be done by using cameras and GPS sensors to accurately pinpoint where the ambulance is located. From here, multiple antennas can smartly transfer their resources along the route of the ambulance to determine what traffic lights could hinder their progress. Other sensors could determine what cars are in the way, giving a heads up to the ambulance driver.

Another wide use of the IoT with 5G wireless will be automated vehicles. The sensors in the vehicles will utilize the best frequencies through spectrum management in order to move the automated vehicle along. 5G can also be implemented through the use of wearables. For example, someone could be monitoring their own vitals while shopping for groceries; the wearables will utilize MIH to transition networks to the user’s network while also deploying spectrum management to monitor ever changing human vitals. The user can then be more informed as to what foods to buy in order to be healthier.

These are just a fraction of the standards to be implemented when 5G is rolled out around the year 2020. Research is also being done on dynamic ad-hoc wireless networks, wireless network virtualization, multi-hop networks and other technologies. The rollout of 5G will combine these standards to provide faster connections, smarter networking, and device connection ability. The 5th generation of wireless communication technology standards will adhere to an ever-changing interconnected world where multitudes of data will be sent and received simultaneously across a plethora of devices. By using smart technologies through 5G wireless standards, we will be able to live out our lives with the ability to be more aware of the data around us through seamless device integration.
Is BLE Most Suitable for IoT Applications?

The Road to 50 Billion Smart-things

In 1999, eminent journalist Neil Gross stated, “In the next century, planet earth will don an electronic skin. It will use the Internet as a scaffold to support and transmit its sensations. This skin is already being stitched together.” True to Mr. Gross’s expectations, today we are standing face to face with the ultimate possibility of a continuous skin: The Internet of Things.

By Anirban Sengupta
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The concept of the IoT, while straightforward, leads to innumerable possibilities. Take anything and fit a sensor/actuator to it (the thing now becomes a “smart-thing”). The sensor detects and measures certain parameters (example: heart rate, speed of running /walking, where your pet is heading). This data is wirelessly communicated to a master (example: a phone or a PC). Thus, the IoT is all about detecting, measuring, and communicating.

For a successful IoT environment to flourish, we need efficient and cost-effective intercommunication between masters and slaves as well as between slaves themselves. Communication is possible only when:

1. “Things” are active and transmitting data
2. They are within the communication range
3. There is interoperability (i.e. the transmitted message is understood by the receiver)
4. The data is relevant to the master

At the same time, it is important to ensure that the communication process is quick and doesn’t drain device batteries.

Wireless Communication Systems

Connectivity within the IoT often utilizes wireless communication. There are quite a few wireless communication systems available to choose from. Which communication technology is the best fit depends on the application type and its requirement. Based on application needs, we can segment IoT communication requirements as follows:

1. Short range and long range: How far can a device be from the master or another device and still communicate reliably? The previously mentioned cattle example illustrates a long-range application. On the other hand, there are numerous life-style, home automation, PC peripheral, and health applications where the need is for short-range communication only.

2. Need for low-power communication: When it comes to industrial applications, there is a chance that devices are wired to a power source (or using a powerful battery) and thus low-power communication may not be required. However, for applications like wearable electronics that typically run on coin cell batteries, the need for low-power communication is acute. Such applications are a major growth area for the IoT in the coming years.

3. Short burst or continuous data transfer: Some devices need to communicate continuously while some devices need to send data in short bursts periodically. The metric used to describe these transfer methods is duty cycle (± % of one period when the signal is active). Thus, devices can be segmented in terms of low or high duty cycle.

4. Need for proprietary or standard communication: There are many proprietary (invented and owned by a single company) and standard (specifications defined by an industry body and multiple vendors complying to the definition) communication technologies available. One limitation with proprietary communication is the fact that both parties (master-slave, master-master, or slave-slave) need to be similarly equipped to acknowledge and interpret the data. This can usually happen when the transmitter device and receptor device are both manufactured by the same company or by companies that have co-developed a solution (e.g., a PC by company X can talk to wireless mice by company X using a particular proprietary communication technology).
IOT FEATURE

However, with more and more new IoT devices entering the market, the scope of proprietary communication technology begins to limit the marketability of devices. To understand this better, let’s consider the wearable technology segment. There are many companies focused on creating innovative smart wearable devices. Most of these companies do not manufacture master devices such as PCs or smart phones. These companies would thus prefer that their devices can talk to maximum number of masters. For this they would use a standard communication that most master devices can understand.

**Bluetooth Low Energy (BLE)**

Bluetooth Low Energy or BLE (marketed as Bluetooth smart) is a wireless communication technology designed and marketed by the Bluetooth SIG. BLE is targeting applications that have the following requirements:

1. **Range of up to 100m:** However, as per the SIG website, the specification does not limit range. This means manufacturers can possibly create devices that have range higher than 100m.

2. **Need to run on coin cell battery for significant time:** Many IoT devices need to be able to run on standard coin cell batteries for years. BLE enables ultra-low peak, average, and idle mode power consumption. In addition, devices with a lower duty cycle will save more power.

3. **Multi-vendor interoperability:** As a standard, BLE, like the previous versions of Bluetooth, enjoys a high level of adoption by master-device manufacturing companies. Many IoT slave devices also support BLE. Key operating systems like Android, iOS, Windows 8, and Linux natively support BLE. The SIG predicts that by 2018, 90% of smart phones will support BLE. This ecosystem helps achieve multi-vendor interoperability.

4. **Data transfer up to 1Mbps:** A BLE stack (Figure 1. Stack diagram) comprises three sub-groups:

   A. **Controller:** The actual device that encodes the data packet and transmits it as a radio signal. The controller is also capable of receiving radio signals and decoding them for data.

   B. **Host:** It is the software stack, consisting of protocols and profiles (a collection of services and their behavior that together perform a particular end application), that manages the communication between two devices.

   C. **Application:** A use case that utilizes the controller and host to implement a particular function.

The application layer is a great advantage of Bluetooth. For developers, it means that along with the generic set of protocols and services, they have access to many application-specific protocols. The Bluetooth SIG has defined several profiles (i.e., a specification of how a device would function in a particular application) for BLE devices. An example would be HRP or heart rate profile. This profile enables a collector (say a smart phone) to connect and interact with a Heart Rate sensor placed on a user’s body. The profile specifications released by the SIG state the profile dependencies (e.g., HRP requires a generic attribute profile or GATT), sensor role requirements, collector (data) role requirements, connection establishment procedure, and security considerations, among others. Adhering to the profile specs makes the process of qualifying BLE for an application seamless and easy. The SIG webpage lists all the available profiles. A device may make use of multiple profiles.

**BLE Against the Rest (for IoT Applications)**

Today the top competitors to BLE are ZigBee, Wi-Fi, Ant+ and a wide range of proprietary protocols. Let’s understand the competition briefly before getting into a formal comparison:

**ZigBee** is a wireless communication specification developed by the ZigBee alliance, a non-profit association with close to 400 members. ZigBee supports a large network with multiple low power chipsets operating at a lower data rate than BLE. ZigBee primarily targets home automation and industrial automation systems.

**Wi-Fi** is a wireless networking technology that uses radio waves to provide high speed internet and network connectivity. It is based on IEEE 802.11 standards and consumes much more power than ZigBee or BLE.

**ANT+** is an interoperable open-access wireless sensor network technology designed and marketed by ANT Wireless (a subsidiary of Garmin since 2006). Low power is one of the key USPs of ANT. Typically, ANT-enabled devices are expected to be in sleep mode for long periods, wake up briefly to send data, then return to sleep mode again. It targets sports and fitness applications.

With more and more new IoT devices entering the market, the scope of proprietary communication technology begins to limit the marketability of devices.
BLE is the best choice when it comes to setting up a personal network by connecting a battery-backed smart device to a single phone or computer wirelessly.

Comparing BLE with proprietary protocols would be unfair. Any application that intends to use a standard communication technology would abstain from using a proprietary protocol. Thus, the comparison will be limited to four standard players only: BLE, ZigBee, Wi-Fi and ANT+

The first parameter we need to consider while comparing the above communication technologies is the type of network our devices will join. IoT devices may connect to a PAN (Personal area network) or WLAN (wireless Local area network). When a device is connecting to the WLAN, Wi-Fi is definitely the best option in terms of cost. However, the power consumption of Wi-Fi is high and thus we cannot expect devices that need to run on coin-cell batteries to connect to a LAN using Wi-Fi (unless we have a plan in place to replace batteries periodically.) Thus, devices that are constrained in terms of power can only connect to a LAN indirectly. That is, they connect to a master (e.g., a smart phone or PC) and let the master connect to a LAN. In addition, one advantage of using a LAN is resource sharing (e.g. shared enterprise printers). However, most IoT devices don’t actually need this advantage – a heart rate sensor needs to connect to only one master device.

Thus the ideal network for most battery-backed IoT devices that need to communicate with a single master is PAN. This reduces our choice for communication standard to BLE, Ant+ and ZigBee.

The competition between ANT+ and BLE is extremely interesting. ANT+ lists BLE as a competitor but BLE doesn’t acknowledge ANT+ in its list of competitors. ANT’s one-sided paranoia about BLE stems from the fact that BLE targets ANT’s market almost to entirety. ANT+ and BLE are competitive in terms of key specs such as over the air data rate, application throughput, and range (50-100m). However BLE still corners ANT+ in terms of actual industry adoption. Please note, on their own BLE and ANT are nothing beyond protocols. Their real success depends on how much industry adoption they enjoy. Industry adoption is dependent on the number of chipmakers willing to invest in designing and manufacturing chips that support a protocol, the number of master devices supporting the protocol natively, and of course the number of slave manufacturers willing to take a bet on the technology.

As of today, there are only three manufacturers who are supplying chips with ANT+: Dynastream Innovation, Nordic Semiconductor, and Texas Instruments. In the case of BLE, there are planned or in-production chips from Broadcom, Freescale, Cypress, Microchip, Bluegiga, StMicro, Dialog Semiconductor and many others (including TI and Nordic). In fact, TI and Nordic are the only manufacturers whose portfolio has ANT+ enabled chips, BLE enabled chips, and chips with both technologies supported.

Currently, all the major mobile operating systems (iOS, Android, Windows, Blackberry) natively support BLE. In the case of ANT+, native support is limited. Windows8 and iOS both don’t support ANT+ natively. Thus, to pair an ANT+ device with a Windows phone or an iPhone requires an additional ANT+ USB stick or dongle. In the case of Android, there are plug-ins available to run ANT+, if the phone manufacturer supports the same. As of now, Samsung and Sony are the major phone manufacturers supporting ANT+ across a wide product range. However, support for ANT+ doesn’t rule out support for BLE. In fact, the update enabling ANT+ on the Samsung devices was a part of Android 4.3 update – the same update brought full Bluetooth smart compatibility to these devices as well.

ANT+ targets the sports, fitness, and lifestyle market primarily. The end goal of the technology would be to ensure that the maximum number of smart-device makers in this category choose it for communication. ANT+ was indeed successful till BLE was launched. Post the launch of BLE, the manufacturers of this category now had an alternate choice in terms of low-power communication protocols. Since BLE is backed more by the masters, it proved to be a safer bet. Thus, major wearable makers like Fitbit, Jawbone and Tom-tom have all chosen BLE. And, of course, the much-celebrated Apple watch will use BLE to pair with iPhones. Since BLE is expected to be a standard for almost all smartphones in the near future, smart devices are also expected to follow suit. However, ANT+ may survive as a niche protocol for
applications where BLE cannot perform (e.g., point to multipoint communication or single slave to multiple master communication is not possible in BLE but can be done through ANT+).

The battle between BLE and ZigBee is on a different turf – home and industrial automation. BLE cannot displace ZigBee entirely. This is because ZigBee allows mesh networking while BLE is restricted to a star network topology (i.e., many slaves connecting to a single master). Also, ZigBee allows connection of more devices than BLE. These features make ZigBee a better choice when a bigger range network is required. On the other hand, to connect simple devices to a phone BLE would be more convenient due to its large existing installed base. In addition, the data rate and throughput of BLE is better than ZigBee. Setting up a ZigBee network requires connecting an additional ZigBee modem to a host device (preferably a PC) and thus it is less convenient and more expensive than setting up a BLE network.

In summary, BLE is the best choice when it comes to setting up a personal network by connecting a battery-backed smart device to a single phone or computer wirelessly. Thus, it is becoming the communication protocol of choice for an increasing number of smart wearables, PC/Phone peripherals, and health monitoring equipment. The Bluetooth SIG website lists the various Bluetooth Smart Ready products (host devices that support BLE) and Bluetooth Smart products (independent devices that communicate with the host using BLE). The list is ever increasing and is indicative of the bright future of BLE in IoT applications.

To learn more about BLE and get started with your own design, see the following application note: http://www.cypress.com/?docID=51385.

About the Author

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The Future of the Internet of Things

It is no secret that the Internet of Things (IoT) is continuously growing and is viewed by many as the next big advancement of the Internet. But what exactly is the IoT, and in what ways will it affect the future of everyday lives? According to TechTarget, the IoT is defined as “a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.” Many experts believe that the IoT will be thriving by 2025, and the resulting growth in connectivity will influence everything, from household appliances to agriculture.

By Roger Ordman
Redbend

The days of computers, smartphones, and tablets being connected only to the Internet are over.
As more and more devices become Internet-connected, device manufacturers will need to consider how to manage and update everything.

Part of the IoT’s growth will be exemplified by the amount of connected devices in play. In fact, Cisco IBSG predicts there will be 25 billion devices connected through the Internet by 2015, and 50 billion connected devices by 2020. With this ongoing growth of connectedness, the world needs to consider the effects of this level of connectivity. The days of computers, smartphones, and tablets being connected only to the Internet are over. For example, smartphones are now able to connect to cars in order to play music via apps. We can now also use an app to change the channel on our televisions, or to record a show. Being able to control different devices is already at our fingertips, literally. In the near future, the amount of “things” we will be able to control through the Internet and connected devices will go beyond what we are currently able to do with our smartphones and tablets.

As more and more devices become Internet-connected, device manufacturers will need to consider how to manage and update everything. The mobile industry uses OTA updates to manage devices throughout their lifecycle, pushing out updates as frequently as needed to ensure the best user experience for its customers.

There are three elements of OTA updating systems: the update generator, software management center, and update installer. The update generator identifies and extracts the fundamental changes between the existing and the updated version, while creating a delta package with the updated file of all the changes. This delta package holds information that affects device appearance, configuration and branding.

After the delta package has been created, the file is sent to the device using a communications protocol, which is used by a back-end software management center to enable original equipment manufacturers (OEMs) to centrally manage firmware, applications, and mobile devices over the air. A protocol optimized for mobile communications, known as the open mobile alliance device management (OMA DM) standard is used to communicate between the software management center and an OMA DM client on the device. This protocol provides all the management aspects of the software updating process.

After the device successfully receives the delta package, software on the mobile device, known as the firmware over-the-air (FOTA) update installer, performs the update installation with the new delta package. This installer updates the device’s firmware reliably.

Over-the-air updating can be used across all devices, as it is easy, beneficial, and cost efficient. As this form of updating makes its way into relevant industries such as the automotive industry, consumers will soon expect this type of efficient updating for all their connected devices, regardless of the size, shape, or cost.

There’s no doubt that the future of the IoT is bright, and with OTA technology, we’re able to ensure our connected devices are updated continuously, safely, efficiently, and securely.

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