DASH 7

Rahul.C, [1] Chinchu Krishna.S[2]

1M.E Computer and Communication, Department of Electronics and Communication, Erode Builders Educational Trust's Group of Institution EBET Knowledge Park, Kangayam, Tamil Nadu, India

2Assistant Professor, Department of Information Technology, Rajagiri School of Engineering and Technology, Cochin, Kerala, India

Abstract: *Dash7 is a new wireless networking scheme and appears to be gaining traction. The International Organization of Standardization first ratified the standard behind DASH7in 2004.The less power drawing feature make it especially appropriate for such things as radio-frequency tags, which may work for years without any external power source. If the system doesn't need high data rate can use Dash7. Dash7 tags are active, meaning that they make use of small batteries instead. It doesn't need to transmit high power levels and consequently can be manufactured inexpensively*

Keywords: *simple protocol, Low data rate, High efficiency, Long range applications, communication theory*

I. Introduction

DASH7 is a new wireless networking scheme and appears to be gaining traction. The International Organization of Standardization first ratified the standard behind DASH7 in 2004.The less power drawing feature make it especially appropriate for such things as radio-frequency tags, which may work for years without any external power source.DASH7 tags are active, meaning that they make use of small batteries instead. It doesn't need to transmit high power levels and consequently can be manufactured inexpensively.DASH7 operates at around 433megahertz.The corresponding wavelength is about 70 cms, which make it difficult to design efficient antennas that are conveniently compact. This wavelength enables it to penetrate such obstacles as concrete walls and work in environments with large amount of metallic clutter. The search for a market for DASH7 isn't new.Savi began developing this technology two decades ago. The US military embraced this radio tagging system and has been employing it increasingly.DASH7's general claim for less power use than Zigbee depends on the details of how the particular wireless network is setup. One uncontested attribute of DASH7 is that its name has a clear and sensible derivation.

II. Low Power Radio Frequency

2.1 Defining "Rf"

Solutions where the RF transceivers use a minimum of energy to communicate with each other, and where periods without communication are characterized by a minimal amount of energy spend idling. To quantify this statement for 2009, a low power RF technology worth its salt has no problem operating at an average current draw under 0.1mA and a max current draw under 50mA.

RF stands for "Radio Frequency". Low power radio frequency products need:

1. RF silicon parts, with as much integration as possible.
2. Power supplies, which are usually batteries. Low power RF devices absorb energy from its environment.
3. A microcontroller, which contains a small CPU and memory. For providing integration designers must expect RF silicon and the microcontroller in a single package.
4. Some kind of antenna for conveying the RF energy.
5. Optionally sensors, which are silicon parts, are also benefit from integration.

2.2 Rfid

RFID means Radio Frequency Identification. Passive RFID's requires a very high power transmitter, often called as interrogator, while the transponder must exhibit very low power characteristics. These systems do not require batteries in the transponders, which behaves similar to RADAR. But they cannot be considered to a low power RF system.

2.3 Blast

DASH7 is designed to use the BLAST concept. Bursty: Data transfer is abrupt and does not include content such as video, audio, or other isochronous forms of data. Light-data: In conventional applications, packet sizes are limited to 256 bytes. Transmission of multiple, consecutive packets may occur but is generally avoided if possible.

Asynchronous: DASH7's main method of communication is by command response, which by design requires no periodic network "handshaking" or synchronization between devices.
Transitive: A DASH7 system of devices is inherently mobile. It is upload centric, so devices do not have to be managed extensively by fixed infrastructure.

III. A Survey Of Low Power Rf Standards

3.1 Simple Protocol

Techniques for optimizing low-power RF systems always seek to maximize the amount of time spent in sleep mode, or, from another perspective, minimizing the amount of time spent in active modes. More-so than data-rate, the protocol is the means by which time spent in active modes can be determined. Good low-power RF solutions have protocols that do not specify extraneous features. In other words, these solutions are defined by considering not what features you could use but instead what features you could do without. Of the depicted solutions, the simplest protocols belong to ISO 18000-7 and low energy Bluetooth, although they operate very differently. The diagram below intends to show time spent in active modes vs. sleep for these two protocols, while also showing the amount of power consumed during each operational state. As we can see, low energy Bluetooth does not adhere to BLAST principles, but because it is just a wire-replacement technology it can succeed nonetheless. The other technologies, ZigBee and Wi-Fi, have protocols that are complicated enough that a diagram such as the ones below cannot come close to representing the many modes of operation. ZigBee cannot deliver low-latency (BLAST-like) behavior without expending a lot of power.

3.2. Symmetric protocol

A symmetric protocol is one where there is little or no difference between the way any sort of device communicates with any other sort of device. Symmetry does not necessarily make a standard low power optimized, but it does allow for more flexibility or innovation in the way that standard’s technology is implemented and ultimately used. ISO 18000-7 uses a symmetric protocol, and certain modes of ZigBee are symmetric, as well. Low energy Bluetooth, WI-Fi, and other modes of ZigBee, on the other hand, are asymmetric as they are predicated on the existence of base station or coordinator-type devices.

IV. The Technical Merits Of Uhf Vs. Microwave

4.1 The Friis Equation

It the form below, the Friis equation solves for free space communication range when receiver sensitivity (Pr), transmission power (Pt), receiver antenna gain (Gr), transmitter gain (Gt), and wavelength (λ). The range value derived here is highly optimistic for real world scenarios - at least because it doesn’t account for bandwidth or modulation but more refined models of the Friis do exist and the ranges values these produce remain proportional to the basic form, nonetheless. The basic relationship is that as frequency goes up, range goes down.

Table shows how frequency relates to range and requisite antenna gain. The first three rows show that a 433MHz radio can have the same range as a similar 2.45GHz radio even if the 433 MHz antenna system is only 3% as efficient. This is important in real world applications where antennas are routinely de-tuned by

Solution	λ(cm)	Pt/Pr (dBm)	GtGr	Range(m)
Reference 433MHz	69	S	0.03 A	R
Reference 900MHz	33	S	0.13 A	R
Reference 2.45GHz	12	S	A	R
Typical DASH7	69	-100	.25	4500
Typical Bluetooth	12	-83	0.7	380
Typical WiFi	12	-100	0.7	1100
Typical Zigbee	12	-100	0.7	1100

Environmental factors, often quite severely. In the lower rows, typical book values are plugged-in to show the theoretical maximum range of each researched solution at 1 mW transmit power (0 dBm)

$$Range = \frac{1}{\frac{4\pi}{\lambda}\sqrt{\frac{P_r}{P_t G_t G_r}}}$$

4.2 Antennas

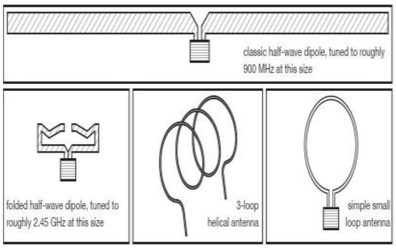
There is one major drawback to low frequency aside from reduced maximum data rate: the antenna. The classic antenna andone by which all others are judged is the half-wave dipole. It is similar in construction to the “rabbit ears”

TV antennas (the kind the next generation of engineers will never have as a mental reference).This antenna is excellent in most respects. The trouble is that below 1 GHz, the half-wave dipole is simply not an option for smaller products. At 433 MHz, for example, a half wave dipole is 35 cm long. Even when using slightly less efficient folded-dipoles, the antenna preferred by most 2.45 GHz radios, the size is too big for most use below 1 GHz.

Fortunately, there are quite a few designs for small antennas workable at lower frequencies. Some of them even come close to matching the folded dipole in performance. A common design is the small loop antenna, which depending on the design typically have efficiencies between 1/3and 1/8 of the half-wave dipole [3]. Small loops are popular because, in addition to being small and compact, they are easy to design, cheap, and easy to implement within a printed-circuit board. The "typical" DASH7 implementation from table 4.1 used a small loop system listed as 1/4th as efficient as the half-wave dipole system, even though more efficient antenna designs are available for use at 433MHz. One such well-known antenna design is the helical loop antenna. It is, as you might guess, a series of small loop antennas. Helical antennas require slightly more know-how to design than simple loops do, and they can cost more, but the cost difference is rarely noteworthy for applications at 433

Fig 4.2

MHz. Common characterization models for helical antenna designs show that a compact design, tuned at 433 MHz, is



Roughly 2/3 as efficient as a half-wave dipole. Further performance improvements may be achieved by inserting a ferromagnetic core into the helix, particularly with smaller loop helixes.

4.3 COMMUNICATION THEORY

It has now been established that, from a purely scientific approach, lower frequency radio waves are more reliable than higher frequency waves are at delivering a signal over range, line-of-sight or otherwise. Communications theory is an engineering discipline focused on attaching rules (i.e. math) to phenomena involved in sending data via radio signals. When given a problem to solve, communications engineers go back to the rules to determine the best solution. There are always tradeoffs. Nonetheless, the primary solutions criteria depend on the following:

Allowable minimum data rate
Allowable signal to noise ratio
Allowable complexity of transmitter
Allowable complexity of receiver

4.3.1 Data Rate

In today's world, data rate is often confused with the term "bandwidth." The two are related, but they are not the same. Data rate is a digital phenomenon, expressing the amount of bits that a communication system can deliver in a given amount of time. Bandwidth is the frequency range between which a signal's energy can be realistically confined. Some modulation techniques are more efficient than others at cramming data into available bandwidth. Generally speaking, the more complex the modulation the more efficient it is at cramming raw data into a given amount of bandwidth, but sometimes further means are used to spread the band (i.e. spread spectrum technologies) in order to improve tolerance of noise. The latest exotic and complex methods manage to do both, although they are completely unsuitable for low power RF because the transmitters and receivers are too complex.

4.3.2 Signal to Noise Ratio

Maximizing signal to noise ratio (SNR) is a pursuit in which communications engineers put in a lot of time. Noise refers to any energy received [by the receiver] that does not come from the appropriate transmitter. Noise can be hard to predict, but there are some guidelines. A typical model for noise is additive gaussian white noise, as this is how "static" is modeled. It exists wherever there are charge carriers moving around randomly, for example in an antenna, and is often called thermal noise. The larger the bandwidth of the communication, the greater the received noise. There are other types of noise, too, and they all have one thing in common the larger the bandwidth, the greater the potential for noise ingress. We are interested, however, in signal to noise ratio, not just noise, and by increasing the bandwidth through modulation or encoding techniques it is possible to boost the signal energy in greater proportion than noise and interference. This is the basis for improving SNR and decreasing the effect of noise. By convention, DASH7 uses a marginally wideband FSK modulation (check appendix for more on modulations). It is set up to provide reasonably good resilience to noise and interference without expending too much energy doing so. Low energy Bluetooth's modulation is very similar. ZigBee, on the other hand, uses a more complex modulation called QPSK that manages to be slightly more efficient at cramming data into bandwidth as well as better suited to delivering higher SNR. The added complexity, however, comes not without a price.

4.3.3 Simplicity vs. Complexity

Limits on targeted solution cost, development cost, and power requirements force communications engineers to be clever. Often we can evaluate two technologies, one simple and one sophisticated or complex, where the performance gap between the two can be closed by enhancing other areas of the total solution. One good area of study is the receiver. At the cost of higher power requirements, a more advanced modulation scheme may prove to have superior SNR than a simpler one, and a higher data rate may allow error correction coding to be part of the message. However, by changing the carrier frequency of the signal or by taking special attributes of the signal into account, the simpler solution may even outperform the more complicated offering. Without considering interference, ISO 18000-7 offers a greater SNR link budget than does the more complex, more sophisticated IEEE 802.15.4. When interference is in fact considered, the busy 2.45 GHz band has an increasingly negative impact on the performance of IEEE 802.15.4 vs. ISO 18000-7, and it actually becomes disastrous if newer 802.11n networks are in place. Performance enhancements like these that trickle-down from total system design can be relied upon when a technology is well defined to attack a focused set of problems. For example, in [9] we can see how design simplicity is maximized to solve problems of communication with small satellites. A clever solution (ISO 18000-7) can excel in BLAST type applications, one of which is even validated in [10]: RF performance of embedded devices in shipping containers.. In such cases where a focused design philosophy can be applied here simple, accessible technology can meet performance requirements - engineers can quickly develop products, testers can easily achieve interoperability, and marketers can immediately target users. It is the prisoners dilemma" for wireless standards: pursue the Holy Grail or pursue the strategy of most probable success. Simplicity and focus lend themselves to success.

V. MERITS

1. They use less power
2. Perfect to deliver long range
3. Highly reliable for delivering over long range and line of sight
4. High penetrating power
5. Multiyear battery life
6. Inter-operatability

VI. APPLICATIONS

1. DASH7 Tags from Savi are approved for use on all major common AIR carriers.
2. DASH7 can track a train moving @100 km per hr.
3. DASH7 can pinpoint location when s now is covers the yard.
4. DASH7 Motion & Temperature sensors can penetrate snow & ice
5. DASH7 can remotely monitor environmental conditions
6. Helps farmer for optimizing irrigation
7. DASH7 is used in TPMS
8. Used in moving advertisement
9. for mobile communication
10. Tags containing information about personal details

VII. CONCLUSION

If the system doesn't need high data rate can use DASH7. UHF systems operate better. UHF systems operate better in non-line-of sight conditions, they use less power, and they are so much more permissive that they can still offer superior range even when using suboptimal antennas. Thus UHF band is perfect choice to deliver the long range, highly reliable signal it needs, all the while preserving a tiny power budget.

REFERENCES

[1] BGR (Z-Wave), WLAN Interference to IEEE 802.15.4. Zensys, Inc, 2007.
[2] Constantine Balanis, Antenna Theory. Hoboken, NJ: John Wiley & Sons, 2005.
[3] G. Smith, Proximity Effect in Systems of Parallel Conductors. Cambridge, MA: Harvard University, 22 Nov 1971
[4] IEEE Computer Society, IEEE STD 802.15.4™-2003. New York, NY: IEEE, 2003.
[5] IHS News Service, WLAN Interference Raises Doubts about ZigBee, 802.15.4 Products.
[6] [http://electronics.ihs.com/news/zwave-zigbee-wlan.htm] 6 April 2007
[7] Mike McInnis, IEEE P802.15.4f Active RFID System Call for Applications. http://www.ieee802.org/15/pub/TG4f.html
[8] R. E. Ziemer, W. H. Tranter, Principles of Communications, 5th ed. Hoboken, NJ: John Wiley & Sons, 2002. IEEE Computer Society, Washington, DC, 2007.
[9] SY Shin, HS Park, S Choi, WH Kwon, Packet Error Rate Analysis of IEEE 802.15.4 under IEEE 802.11b Interference.
[10] Sofie Pollin et al, Distributed Cognitive Coexistence of 802.15.4 with 802.11. Belgium: Interuniversity Micro-Electronics Center (IMEC)