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ZigBee Wireless Sensor Applications for Health, Wellness and Fitness

Foreword

Since its inception, the ZigBee Alliance has worked with a singular focus: create a much needed global wireless language capable of giving "voices" to the myriad of everyday devices which surround us as we go about our daily lives. This focus has been aimed at the little devices, often overlooked in an IT centric world, such as light switches, thermostats, electricity meters, remote controls as well as more complex sensor devices found abundantly in the health care, commercial building and industrial automation sectors. As a result, ZigBee Alliance members have created a wireless standard offering extraordinary control, expandability, security, ease-of-use and the ability to use ZigBee technology in any country around the world.

Today, organizations use ZigBee to effectively deliver solutions for a variety of areas including consumer electronic device control, energy management and efficiency, home and commercial building automation as well as industrial plant management. With this comprehensive set of attributes, the nonprofit, open membership and volunteer driven Alliance has become a thriving ecosystem of more than 300 members. As an ecosystem, the Alliance offers everything prospective product and service companies need to develop ZigBee products and services and benefit from the Alliance's competitive and stable supply chain.

Executive Summary

"The prospects of intervening to prevent death in developing countries have never been better," said Dr. Gro Harlem Brundtland[1] . However these improved prospects come with a price tag. Health care costs (both economic and human) are sharply rising in all regions of the world, not only in the developed world. Several influential factors are well documented as causes of this phenomenon; more sophisticated treatments employing advanced and costly technologies, longer life spans with resulting increases in elderly population, rising costs for energy, natural resources, and overall cost of living, increased living standards that can lead to an increase of prosperity diseases like obesity, diabetes and cardiovascular diseases.

ZigBee technology can be used today to begin achieving the vision of Dr. Brundtland. ZigBee is an Assistive Technology that can be used anywhere in the world. It is designed with simplicity in mind, making it easy for people to use and allowing them to maintain their independence and mobility. It is also extremely efficient in its use of power, and as a result, capable of running on common batteries for years.

New Assistive Technologies in Health Care based on widely accepted standards, like ZigBee, will play an important role in slowing down the sharp increase of health costs. Medical devices based on the ZigBee standard facilitate the reduction of costs associated with the development and manufacturing of new medical devices. Standards offer enormous economy of scale benefits for components, while offering an unprecedented ability to simplify the control and monitoring of patients and functions in hospitals, elderly care facilities and even homes.

The ZigBee Alliance is an association of companies working together to enable reliable, cost-effective, low-power, wirelessly networked monitoring and control products based on an open global standard. Promoter member companies include Ember, Freescale, Huawei, Itron, Landis+Gyr, Philips, Reliant Energy, Samsung, Schneider Electric, Siemens, STMicroelectronics, Tendril and Texas Instruments.

The goal of the ZigBee Alliance is to provide the consumer with ultimate flexibility, mobility and ease of use by building wireless intelligence and capabilities into everyday devices. ZigBee technology is being embedded in a wide range of products and applications across medical, commercial, consumer, industrial and government markets worldwide. For the first time, organizations have a simple, reliable, low-cost and low-power standards-based wireless technology optimized for the unique needs of remote monitoring and control applications.

ZigBee will play an important role in the adoption of Assistive Technology by enabling wireless low-power communication between devices and services that foster safe, healthy and independent living conditions for the disabled or elderly. In addition to Assistive Technology, ZigBee applications in the health and fitness domains can address several other market segments and needs. The following analysis focuses on applications of ZigBee technology for chronic disease monitoring, personal wellness monitoring and personal fitness monitoring.

1 World Health Organization http://www.who.int/inf-pr-2000/en/pr2000-78.html

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Introduction

> "A working definition of 'Assistive Technology' was developed by the United Kingdom Royal Commission on long-term care (1999) as 'any device or system that allows an individual to perform a task that they would otherwise be unable to do, or increases the ease and safety with which the task can be performed.'"[1]

An updated definition for Assistive Technology (AT) was formulated in 2001 stating "Assistive Technology (AT) is any product or service designed to enable independence for disabled or older people." This definition was adopted by the authors of the European Union (EU) SOPRANO Review State-of-the-Art and Market Analysis Deliverable D1.1.2 delivered in May 2007.

ZigBee technology will play an important role in the adoption of Assistive Technology by enabling wireless low-power communication between devices and services that foster safe, healthy and independent living conditions for the disabled or elderly. In addition to Assistive Technology, ZigBee applications in the health and fitness domains can address several other market segments and needs. The following analysis focuses on applications of ZigBee technology for chronic disease monitoring, personal wellness and personal fitness monitoring.

Overview of ZigBee Monitoring and Sensor Solutions

> "As of October 2008, end user application solution commitments to deploy ZigBee-enabled solutions topped 25.3 million units."[2]

ZigBee technology is the standard of choice among other wireless technologies due to its efficient low-power connectivity and ability to connect a large number of devices into a single network. ZigBee technology uses the globally available, license-free 2.4GHz frequency band. It enables wireless applications using a standardized set of high level communication protocols sitting atop cost-effective, low-power digital radios based on the IEEE 802.15.4 standard for wireless personal area networks. ZigBee uniquely offers low-latency communication between devices without the need for network synchronization delays as required by Bluetooth®, for instance.

IEEE 802.15.4 defines robust radio PHY (physical) and MAC (medium access control) layers. ZigBee defines the network, security and application framework for an IEEE 802.15.4-based system. These capabilities enable a network to have thousands of devices on a single wireless network. ZigBee creates robust self-forming, self-healing wireless mesh networks. The ZigBee mesh network connects sensors and controllers without being restricted by distance or range limitations. ZigBee mesh networks let all participating devices communicate with one another, and act as repeaters transferring data between devices.

The ZigBee Alliance's focus on the healthcare space has resulted in the development of the ZigBee Health Care public application profile. ZigBee Health Care was designed for use by assistive devices operating in non-invasive health care. ZigBee Health Care provides an industry-wide standard for exchanging data between a variety of medical and non-medical devices.

Public application profiles are agreements for messages, message formats, and processing actions. They enable developers to create interoperable, distributed application entities residing on separate devices. These applications (written by the device manufacturer) send commands, request data, and process commands and requests over the ZigBee network.

1 McCreadie & Tinker 2005

2 ZigBee Alliance Chairman Bob Heile's October 2008 ZigBee Alliance Member Meeting Presentation

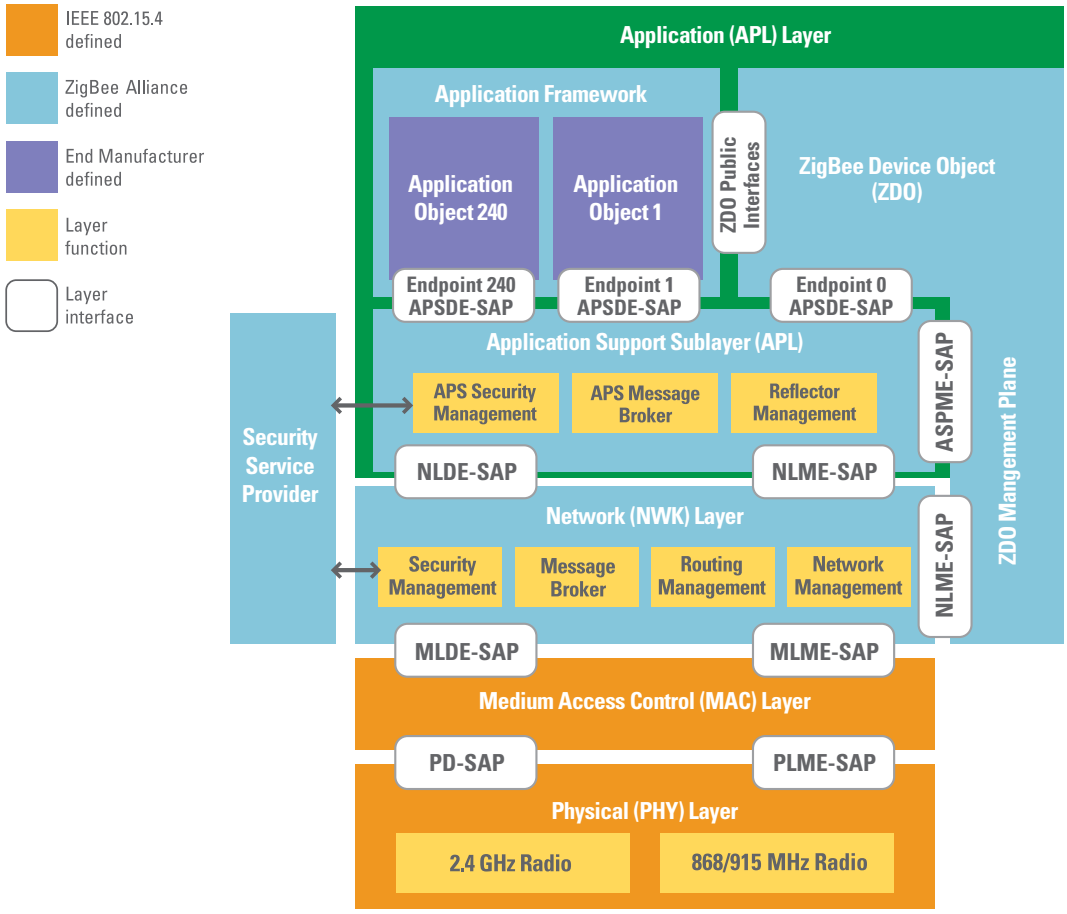

Figure 1 - ZigBee Stack Architecture

The ZigBee Device Object (ZDO) represents a predefined base class of functionality upon which all applications are written. The ZDO creates an abstraction so the developer can focus on writing application-specific code rather than worrying about the low-level details. The ZDO provides an interface between the application objects, the ZigBee Health Care profile and the application support sub-layer (APS). It satisfies the common requirements of all applications operating in a ZigBee protocol stack. The ZDO is responsible for initializing the APS, the network layer (NWK) and the Security Service Provider.

In Figure 1, the areas in light blue depict ZigBee Health Care definitions that are based on the ZigBee specification. Its main attributes are comprised of device specializations defined by IEEE, including IEEE 11073 Device Specializations[3] of standards for point-of-care medical device communication. One of the standards that are part of this family, the 11073-20601 standard [R-11073], is a transport-independent, optimized exchange protocol. This standard forms the basis of the data exchanges between the devices that will support the PHHC Profile. This protocol provides methods for: (i) establishing logical connections between devices, (ii) presenting the capabilities of devices, and (iii) servicing communication needs.

> ZigBee Health Care Fully Supports ISO/IEEE 11073 for point-of-care medical device communication and provides support for additional devices

The ZigBee Health Care also supports all device specializations. Device specializations for a number of medical devices already exist including the pulse oximeter, blood pressure monitor, pulse monitor, weight scale and glucose meter.

3 IEEE http://ieeexplore.ieee.org/Xplore/loginjsp?url=http%3A%2F%2Fieeexplore.ieee.org%2FielD%2F4410467%2F4410468%2F04410469.pdf%3Farnumber%3D4410469&authDecision=-203

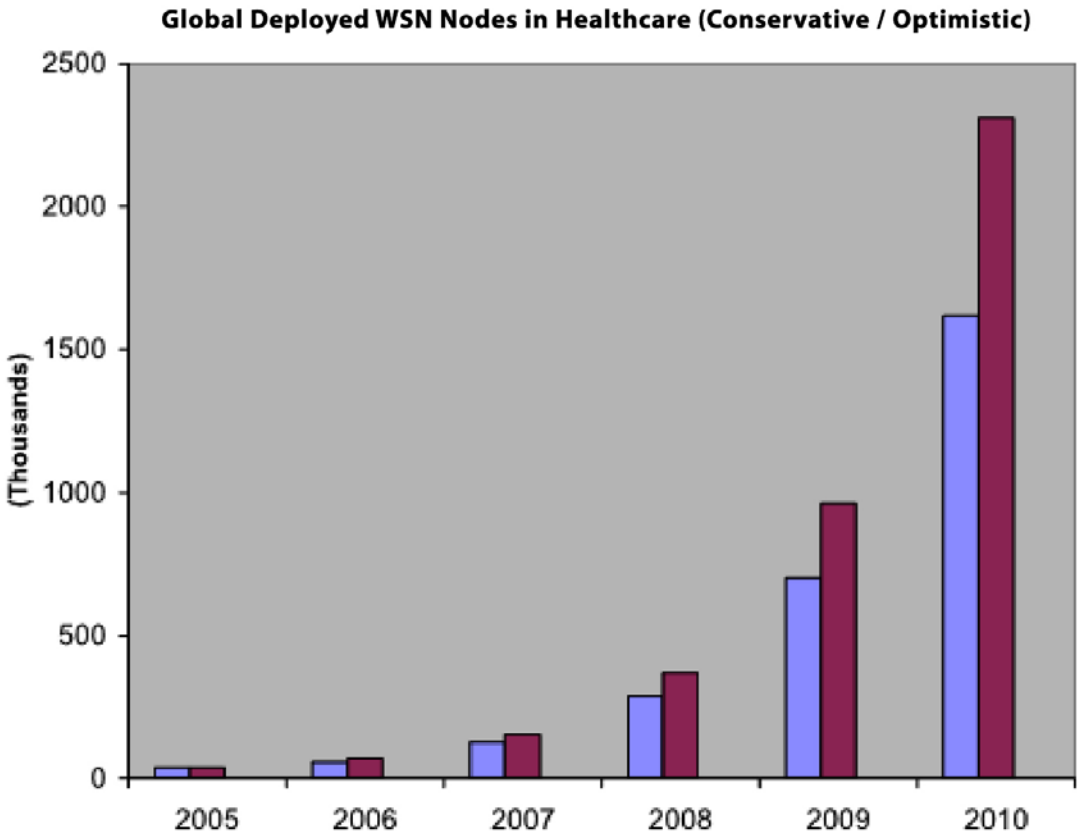

Figure 2 - ON World WSN Deployment in Healthcare

Market Opportunities - Economic Drive

Future Market Projections

According to research firm Research & Markets, wireless sensor networks (WSN) represent an emerging set of technologies that will have profound effects across a range of medical, industrial, scientific and governmental applications. A wireless sensor network is made up of a group of sensor nodes or devices. Each device possesses the ability to monitor some aspect of its environment, and each is able to communicate its observations through other devices to a destination where data from the network is gathered and processed. Recent developments in wireless technologies and the semiconductor fabrication of miniature sensors are making wireless sensor networks smaller and morecost-effective for a growing number of uses. [4]

The prospects for WSN technology are strong. The market for wireless sensor systems should grow rapidly over the next five to 10 years. Sales of wireless sensor systems could reach US$5 billion to $7 billion dollars over that time. As this market matures, sales will multiply year-to-year with a projected growth rate of 40 or 50 percent.[5] The main driver behind the future growth of the WSN is the expanded number of applications that are envisioned using this technology. [6]

Forrester Research estimates that the US chronic disease device market will grow to US $3.8 billion in 2010 and US $26 billion by 2015.[7]

The chart above shows figures forecasted by ON World for the deployment of wireless sensor nodes in the healthcare market.

The 2.3 million nodes forecast for 2010 represent a 5 percent penetration of the elderly population in North America and Japan. The authors of the report

4 Research & Markets, Inc. http://www.researchandmarkets.com/reports/c42715

5 Multimedia Research Group, Inc. http://www.mrgco.com/TOC_FK_WSS06.html

6 "Psst. This Is Your Sensor. Your Grapes Are Thirsty", NY Times, July 26, 2004.

7 Forrester Research, Inc. "Who Pays For Healthcare Unbound" July 8, 2004.

illustrated with this graphic discuss that if the potential market includes North America, European Union and Japan then the overall total potential market would be 87.8 million people.

Current State of the Market

The US-based Chronic Disease Self-Management Program (CDSMP) is a self-management program for people with one or multiple chronic diseases.[8] This program is used across many different chronic illnesses, such as arthritis, diabetes, and heart and lung diseases. The program is a six-week small-group intervention program that is taught by peer instructions from a highly structured manual.

The patients taking part in the program experienced statistically significant improvements in health status, health behaviors and self-efficacy. In fact, this group made fewer visits to emergency rooms. The program has been found cost-effective: cost-to-savings ratio was 1:4, the cost being about $200 per patient. The study in China on CDSMP found the program applicable for the Chinese population.[9] When this program is automated through wireless sensors and Information and Communications Technologies (ICT) even more cost savings will be achieved for the healthcare industry.[10]

Studies of Netherland seniors over the last 10 years indicate that up to 50 percent of seniors are interested in smart-home applications to aid in health, first responders' reaction times and security improvement. [11]

> "...We are at a stage where demographic ageing is already beginning and will soon start to accelerate. In the meantime, the deployment of computers, the Internet, and mobile communications in all aspects of the economy, services, and everyday life continues apace. These two trends can hardly pass each other without interacting in a multitude of ways…
>
> Important market drivers are the dimension of demographic change, the related development of state of the health of older people, specific problems of the increasing older generation, the resulting estimated increase for care, current structure of the care and the expected cost pressures on health care and social security systems." [12]

Applications of Wireless Sensors for Better Health Care

The healthcare domain presents opportunities for a significant number of applications of wireless sensor technology. The following sections focus on three broad health monitoring applications that include Chronic Disease Monitoring, Personal Wellness Monitoring, and Personal Fitness. Within each of these applications, we describe several specific uses of wireless sensor technology.

1. Chronic Disease Monitoring

Chronic diseases contribute to 75 percent of medical care costs in the US.[13] They encompass a wide range of health problems including diabetes, asthma, heart diseases and sleep disorders. In many cases, chronic diseases require some kind of health monitoring, especially in the later stages of the disease progression. Since not all chronic disease monitoring is the same, we further refine the category as follows:

- Episodic patient monitoring is often utilized in non-critical patients to track specific indicators

8 Lorig, 2001"Effect of Self-Management Program on Patients with Chronic Diseases"

9 Lorig, 2001"Effect of Self-Management Program on Patients with Chronic Diseases"; Elzen 2007 "Evaluation of Chronic Disease Self-Management Program (CDSMP) Among Chronically Ill Older People in the Netherlands"; Siu 2007 "Evaluation of Chronic Disease Self-Management Program in a Chinese Population".

10 http://www.heartcycle.eu/ Document FP7-216695 "HeartCycle Deliverable 4.B Nr.1" page 37

11 European Community sponsored SOPRANO Study Deliverable D1.1.2, page 68

12 European Community sponsored SOPRANO Study Deliverable D1.1.1, page 164

13 CDC - http://www.cdc.gov/nccdphp/overview.htm

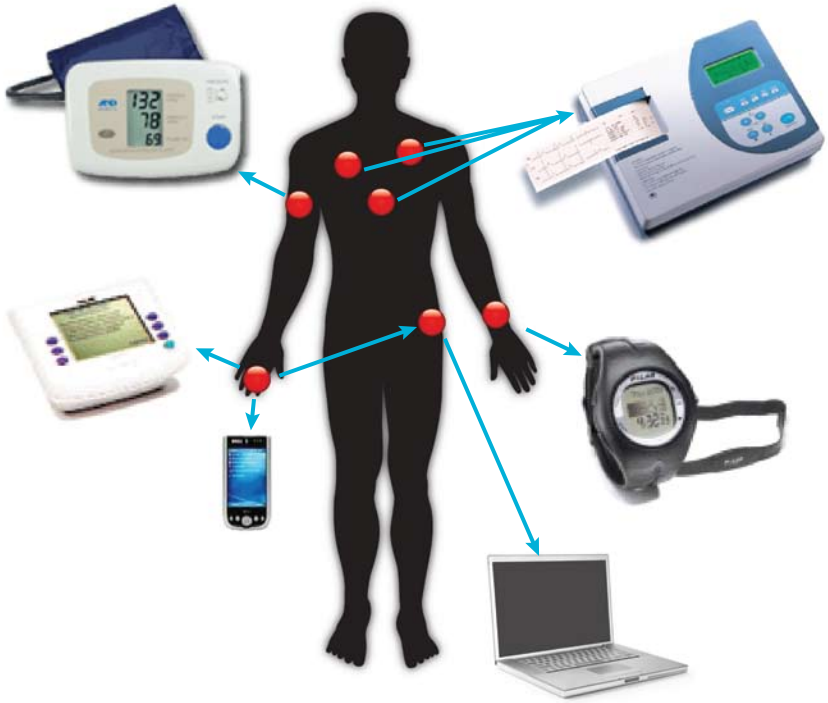

Figure 3 - Chronic disease monitoring devices

and identify the progress of the disease or recovery

- Continuous patient monitoring is often associated with acute conditions that require constant or frequent measurement of health status.
- Patient alarm monitoring can also trigger alarms based on preset conditions that are specific to the patient and the disease.

Figure 3 shows a few examples of monitoring devices that can take advantage of ZigBee wireless technology and provide comfort and ease-of-use in the Chronic Disease Management monitoring applications.

Episodic Patient Monitoring Scenario

This use case deals with non-acute or episodic patient monitoring. In this scenario, the patient's vital signs (e.g. heart rate, temperature) and disease-specific indicators (e.g. blood pressure, blood glucose level, EKG) are monitored to determine anomalies and spot trends. The monitoring is done periodically.

All the information collected by the medical sensors is time-stamped and securely forwarded to a gateway that functions as a patient monitoring system. Additionally, the gateway forwards the aggregated information in a secure way to a database server. The medical personnel and the family can access the information stored in the database server to monitor the progress of the disease.

As an example, certain types of diabetic patients would have to monitor their blood glucose level only a few times a day. In this case, the application would not have to poll the glucose meter as the patient is responsible for initiating the data sampling process. Since all the information is time-stamped and the patients in this scenario are not in a critical state, the latency of transmitting the information to the gateway is not critical. The data can be stored locally at the medical device and/or gateway and securely transmitted only when a predetermined amount of data is gathered. It is also possible that the medical devices and/or the gateway perform some type of data compression to minimize bandwidth use.

This use case also covers periodic, routine medical exams, where a number of medical sensors are worn

by the patient during the medical exam. During the exam, all the readings are interpreted by the primary physician and archived in the patient's database.

Continuous Patient Monitoring Scenario

In this situation, the vital signs (e.g. heart rate, temperature, pulse oximeter) are monitored on a constant basis to allow continuous measurement of patients' health status at rest or during mild exercise for purpose of treatment adjustment, recovery or diagnosis. Continuous, in this use case, is defined as a measurement sampling rate acceptable for the purpose of continuous health monitoring.

The vital signs measurements waveforms (e.g. pulse pleth wave or heart rate) are securely streamed to an on-body data collection unit for data fusion and/or sequential storage. The data is securely forwarded from the data collection unit to an off-body gateway (e.g. PC/laptop, PDA or mobile phone) for sensor configuration, storage and data analysis. Alternatively, the data can be sent directly to a mobile terminal.

The patient or the care provider remotely activates the on-body sensors via the off-body unit. The measurement data from the body sensors is securely transmitted continuously to the on-body unit, where it is temporarily stored. Subsequently, the recorded measurement data is securely sent to the off-body unit via batch transmission for persistent storage and further analysis by the health care provider. Optionally, an off-body unit can also be used for secure waveform viewing during the measurement. The health care professional uses the captured data to provide the appropriate diagnosis or to adjust the treatment level.

To illustrate how this use case would be deployed in real life, consider the following scenario. A patient is suspected of suffering from arrhythmia. The symptoms of this condition (e.g. fatigue, fainting and dizziness) are caused by abnormal heartbeats that can cause the heart to be less efficient. The symptoms are very brief and hard for the patient to characterize. Instead of subjecting the patient to cardiac stress to induce the abnormal heart beats while the patient is examined in a hospital, the patient is given a wearable EKG device. The EKG sensors are used to monitor the condition continuously over longer periods of time until the abnormal heartbeat is detected. Once detected, the data is securely sent to the physician for analysis. If the event is serious enough, an appropriate network device (e.g. telephone, PC/laptop, PDA) can be used to call for help.

Patient Alarm Monitoring Scenario

In this scenario, the patient's vital signs (e.g. heart rate, temperature) and disease-specific indicators (e.g. blood pressure, EKG, EEG) are monitored on a continuous basis. The data collected by the medical sensors is time-stamped and securely forwarded to a gateway that acts as a patient monitoring system. Additionally, the gateway securely forwards the aggregated information to a database server. In this case, a certain minimum bit error rate and maximum end-to-end latency not to exceed a few seconds should be guaranteed.

At pre-determined settings, alarms are issued and responses/actions could be triggered automatically. For example, if during the monitoring of a diabetic patient the blood glucose level falls below a certain threshold, an alert can be sent to the patient, physician(s) and/or medical personnel. Increasing the sampling rate of a given monitor can also be triggered once an alarm has been asserted. The alarm can be issued either by the medical device or by the gateway. In the former case, the medical device would potentially be required to communicate with other ZigBee devices that use a different profile. In the latter case, the gateway might be required to communicate with other non-ZigBee devices.

A specific example of a patient alarm monitoring application can be seen in the HeartCycle[14] project.

14 http://www.heartcycle.eu/ Document FP7-216695 "HeartCycle Deliverable 4.B Nr.1" page 6

HeartCycle provides a closed-loop disease management solution able to serve both heart failure (HF) patients and coronary heart disease (CHD) patients, including possible co-morbidities hypertension, diabetes and arrhythmias. This is achieved by multi- parametric monitoring and analysis of vital signs and other measurements. Adverse event alarms are generated for immediate professional attention and an automated decision support system derives therapy recommendations for the information acquired. Vital body signs will be used to track health status and the impact of the current treatment, showing the patient the importance of adherence to the treatment, motivating improved treatment adherence and a more active role in their care.

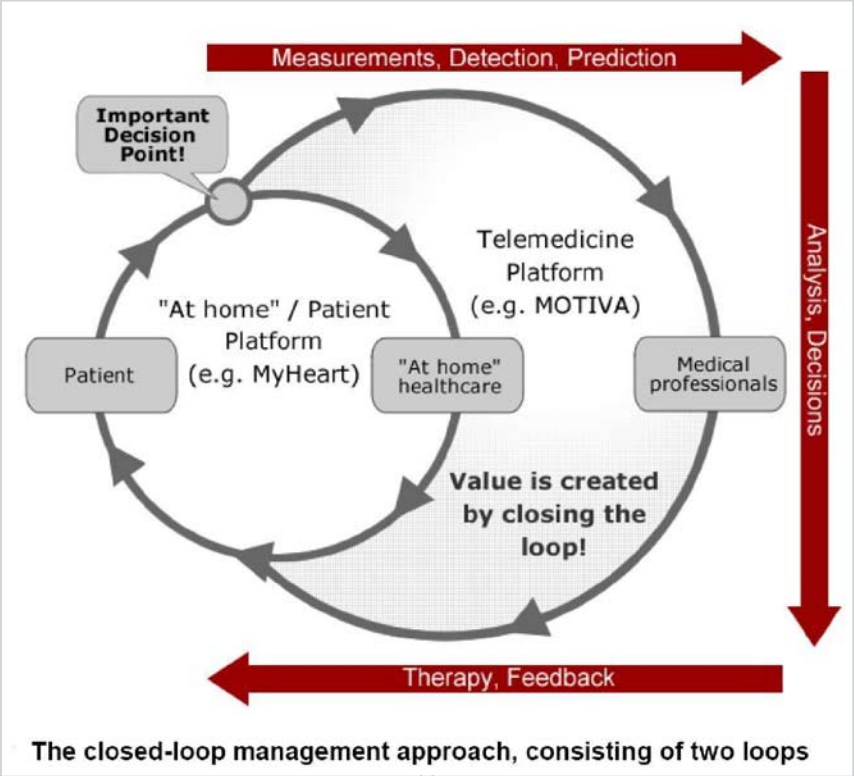

Figure 4 - Heart Cycle system flow chart

The regular measurement of vital signs enables early diagnosis and warning of developing problems. Furthermore, it allows closer monitoring of the effects of medication and lifestyle, making more personalized treatment plans possible. The system contains a patient loop interacting directly with the patient to support the daily treatment. It shows the health development, including treatment adherence and effectiveness. An educated and motivated patient can improve his/her treatment compliance and health. The system also contains a professional loop involving medical professionals (e.g. alerting to revisit the care plan). The patient loop is securely connected with hospital information systems, to ensure optimal personalized care.

Given the fact that patient alarms will require stringent quality of service assurances, ZigBee monitors will be robust and will comply with applicable regulatory requirements.

2. Personal Wellness Monitoring

Personal Wellness Monitoring is an area that will first focus on individuals age 65 or older. As an initial focus, the monitoring concerns the person's activity and safety. As this market develops, adoption of this technology will find applications for the general population. The Personal Wellness Monitoring application is shown in the above figure depicting several aspects of the assisted living scenario. The scenario in Figure 5 shows several devices that would be used in managing the care, safety and activity of the residents in an assisted living facility. The information securely collected by these devices is centrally managed and analyzed. It is in such scenarios that ZigBee technology can provide solutions addressing the needs of the medical staff and the residents.

Senior Activity Monitoring Scenario

This use case focuses on monitoring an elderly person's daily activity. Besides a number of wearable medical sensors/devices that monitor the vital signs (e.g. heart beat, temperature), this use case involves monitoring other non-medical sensors such as environmental sensors, motion sensors, home sensors (e.g. bed, door, window), etc. All the information from these sensors is sent to a gateway

Figure 5 - Assisted Living Scenario

for recording and processing. The caregiver and/or family members can, with permission, access this information and assess the well-being of the elderly person. If certain pre-determined events occur, automatic responses could be triggered. For example, the caregiver can be alerted via a text message if the heart rate of the elderly person is above a threshold value.

If an elderly person has to follow a certain daily schedule such as taking a weight measurement in the morning, obtaining glucose level readings at noon and at 6 p.m. and completing an oxygen level reading after dinner, the caregiver can monitor the daily activity status of the person. If certain routine activities are not completed, the person can be sent a reminder. Should the person not respond to set number of reminders, the caregiver can be sent an alarm.

In this use case, the data collection unit and the gateway will be able to handle different profiles since they accept and potentially send information from/to both medical and non-medical devices.

The same is true for any devices with multiple sensors, such as a watch with an accelerometer and a gyroscope for fall detection, as well as health-related functions.

This use case also covers journaling. This is a technique that is recommended for patients to help their physicians diagnose certain conditions, such as rheumatic disease. Using this technique, patients record pharmaceutical, environmental or behavioral changes and correlate them with body function changes (e.g. fatigue, motion range, etc.). The information provided by both the patient and by the other medical or non-medical devices in the home network is recorded and stored in a database server for later review by the physician and/or family.

Safety Monitoring Scenario

This case deals with monitoring the safety of the home environment. The home environment is monitored for safety hazards including toxic gases, water and fire. Additionally, the vital signs (e.g. heart beat, temperature) of the persons in the home are also monitored. The data gathered by the medical

Figure 6 - Fitness monitoring equipment

and non-medical devices is analyzed locally and/or securely forwarded to a gateway for processing and storage. If predetermined events occur, the caregiver and/or family receive alerts. Automatic responses can be triggered when certain events occur. It is worth noting that the Safety Monitoring applications will be addressed with a combination of several ZigBee profiles, including the ZigBee Health Care and ZigBee Home Automation public application profiles.

3. Personal Fitness Monitoring

Personal fitness is also a market segment showing high potential for use of wireless sensor technology both in the home and in health fitness centers. A large variety of devices and services are envisioned to accommodate the growing fitness market.

Monitoring and Tracking Fitness Level Scenario

This use case focuses on tracking the fitness level or progress made by an individual. A number of parameters that the individual wishes to monitor are recorded as the individual performs his/her workout routine. For example, while running on a treadmill, the individual monitors his/her heart rate, temperature and blood oxygen level. This information, obtained from medical sensors that are worn by the individual, are securely streamed to a gateway or a collection data unit and displayed on the treadmill's console in real time along with other performance information provided by the treadmill. Additionally, the gateway sends the information to a database server for record keeping. Note that the information need not be sent in real time, but may be collected and transmitted after the workout routine ends. After the workout, the individual can review a history of these parameters to track and analyze their fitness level.

In this use case, the application polls each sensor type at a different rate. For example, the application would poll the temperature sensor two to four times a minute and the pulse monitor twice per second. The latency requirement for this application should be less than one second.

Personalized Fitness Schedule Scenario

This scenario focuses on personalization of the fitness schedule of an individual. The schedule to be followed by the individual can be entered by a trainer or the individual. For example, training for a marathon could include running on a treadmill according to a schedule designed by his/her trainer. For each training day, the trainer schedules the distance, the pace, and the maximum heart rate at which the individual is to train. The trainer would also like to monitor the individual's respiration pattern. While the distance and the pace are provided by the treadmill, the heart rate and the respiration are monitored by wireless medical devices worn by the individual.

The information collected by these medical devices is securely streamed to a gateway and displayed on the treadmill's display panel. Additionally, the gateway would also securely send the information to a database server for record keeping. If the heart rate spikes to a value that is higher than the value that is set by the schedule, the medical device communicates

with the treadmill's control unit to reduce the workout gradually until the heart rate falls again in the preset interval.

Alternatively, the medical device might simply send an alarm to the gateway. Upon receiving this alarm, the gateway will initiate the communication with the treadmill's control. Yet another possibility would be for the application to determine when the heart rate is above the preset maximum value and to initiate itself a command to the treadmill's control without involving either the medical device or the gateway. In all of the above scenarios, it is assumed that the treadmill is controllable by a ZigBee device that could use an existing public application profile, such as ZigBee Home Automation

In this use case, the medical devices securely send their readings to the gateway at a fixed rate. The latency requirement for this application should be less than one second.

Example Products Applicable for Health Care

The application areas described in the previous sections focus on products targeted for the health wellness and fitness areas. Several of the representative products are described in the following sections.

Glucose Meter

This is a device that measures the approximate concentration of glucose in the blood. It is used by chronic disease (e.g. diabetes) management applications. For current generation devices, the frequency of measurement is several times a day. Future generation devices equipped with ZigBee Health Care are expected to function in continuous mode and the frequency of measurement is application-dependent.

Pulse Oximeter

This is a device that indirectly measures the amount of oxygen in a patient's blood. The frequency of measurement is application-dependent (typically once a day). Pulse oximeter sensor devices equipped with ZigBee Health Care will measure the amount of oxygen in the user's blood and store and transmit that information to an aggregating device.

Electrocardiograph (ECG)

This is a device that records and measures the electrical activity of the heart over time. The frequency of measurement is a few times a day or continuously for periods of a few hours in some use cases. ZigBee Health Care enabled devices will allow the user to record and monitor electrical activity of the heart while preserving the lifestyle and mobility of the user. The improved convenience and mobility will enable widespread use of such devices in cardiac monitoring and fitness applications.

Social Alarm Devices

Social Alarm devices allow individuals, in their own home or a residential-care facility, to raise an alarm and communicate with a caretaker when an emergency situation occurs. The caretaker may be a monitoring center, a medical care team or a family member.

Three initial devices are targeted.

- Fall Detector – this device detects that the individual has fallen and raises an alarm. Devices equipped with ZigBee Health Care will wirelessly transmit the activity of the user based on the position of the sensing element.
- Pendant / Wrist Transmitter – a waterproof device that allows an individual to raise an alarm by pressing a button on the device, for example. Devices equipped with ZigBee Health Care will enable the user to wirelessly alert appropriate resources in emergency and other situations.
- Social Alarm Control and Indication Equipment (SACIE) – this device receives alarm signals from the fall detector and wrist transmitter and relays them to designated recipient(s). It also optionally opens an instant hands-free voice

communication link between the individual and the recipient. Devices equipped with ZigBee Health Care will enable the user to wirelessly communicate with the emergency response personnel and allow them to locate the user in the network.

The SACIE may have other functions, such as verbal reminders to the individual regarding regular medication, reducing the risk of over- or under-medication. Similarly, reminders regarding regular health checks can help ensure that checks using some of the medical devices covered by this profile are carried out according to a schedule. The SACIE has many similar functions to those of the gateway / access point, and may be combined with it.

Conclusion

There are several trends in the healthcare and wellness areas that may potentially reshape the medical, and fitness industries. The shift from reactive to proactive healthcare and wellness is fueling an increased vigilance and service applications in targeted fitness and chronic disease management. Additionally, increased adoption of connectivity and communication technologies is enabling remote health and wellness services on a much wider scale. The missing piece of this puzzle is wireless connectivity and more specifically, low power wireless connectivity.

The low power wireless component preserves mobility while the low-power component ensures that sensing and monitoring devices preserve our independent lifestyle. The ZigBee Health Care public application profile is designed from the start with the use cases taking these current trends into account. ZigBee Health Care can be implemented to create a scalable network of low-power wireless nodes specifically designed to sense and monitor the health and well being of individuals in applications that include chronic disease management, fitness, and aging independently. The ZigBee Health Care inherent traits that make such applications possible include very low power use, flexible network topologies, data communication security, and wireless license-free bandwidth publically available everywhere in the world, and a robust ecosystem of technology suppliers and product manufacturers that ensure a consistent parts supply and strong competition creating the economies of scale needed to allow for the rapid introduction of wireless sensing and monitoring for health care.

This unique combination of benefits presented by ZigBee Health Care eliminates barriers and allows the industry, governments and individuals to embrace this critical piece in reducing health care costs. It also creates a new class of tools that deliver vital life saving and life affirming benefits that can serve humanity.