"Low Power Wireless Technologies: An Approach to Medical Applications"

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Abstract. Wireless communication supposed a great both -quantitative and qualitative, jump in the management of the information, allowing the access and interchange of it without the need of a physical cable connection. The wireless transmission of voice and information has remained in constant evolution, arising new standards like Bluetooth™, Wibree™ or Zigbee™ developed under the IEEE 802.15 norm. These newest wireless technologies are oriented to systems of communication of short-medium distance and optimized for a low cost and minor consume, becoming recognized as a flexible and reliable medium for data communications across a broad range of applications due to the potential that the wireless networks presents to operate in demanding environments providing clear advantages in cost, size, power, flexibility, and distributed intelligence. About the medical applications, the remote health or telecare (also called eHealth) is getting a bigger place into the manufacturers and medical companies, in order to incorporate products for assisted living and remote monitoring of health parameteres. At this point, the IEEE 1073, Personal Health Devices Working Group, stablish the framework for these kind of applications. Particularly, the 1073.3.X describes the physical and transport layers, where the new ultra low power short range wireless technologies can play a big role, providing solutions that allow the design of products which are particularly appropriate for monitor people's health with interoperability requirements.

Keywords: WPAN, Bluetooth, Zigbee, Medical Applications, eHealth.

1 Introduction

Wireless connectivity is fast becoming recognized as a flexible and reliable medium for data communications across a broad range of applications: home and buildings applications, industrial, medical, …RF can take over where wired communication is difficult or impossible.

Also, because of the growing demand for distributed and remote sensing, data acquisition and control, the role of wireless communications only gets bigger. Sensor manufacturers are integrating RF systems in the same enclosure as their sensing devices. Data logger vendors are beginning to turn to wireless communications to enhance their products. And wireless networks are taking their place right next to traditional

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hardwired configurations. The industry is moving toward the implementation of networks of wireless sensors that can operate in demanding environments and provide clear advantages in cost, size, power, flexibility, and distributed intelligence.

Is clear that there are many advantages to eliminating cables in remote monitoring applications, but there are also many challenges: security, reliability, integration and power are all challenges that must be overcome before there is widespread adoption of wireless measurement systems in the consumer applications.

About medical applications, it is not limited to consumer electronics devices for simple health parameters measurement. The changing population demographics and increase in long term chronic disease will require fundamental changes in the way the world considers healthcare. Nowadays, health care is getting a bigger place into the manufacturers and medical companies, in order to incorporate products for assisted living and remote monitoring of health parameteres, where the newest wireless technologies can play a big role. At this point is necessary to talk about the integration: standards vs proprietary systems. The advantages of using a standards-based wireless network include lower costs, interchangeable products from different suppliers and a better market acceptance.

2 eHealth

The remote health or telecare -also called eHealth, is getting a bigger place into the manufacturers and medical companies, in order to incorporate products for assisted living and remote monitoring of health parameteres. At this point, the ISO 11073/IEEE 1073, Personal Health Devices Working Group, stablish the framework for these kind of applications. Particularly, the 1073.3.X describes the physical and transport layers.

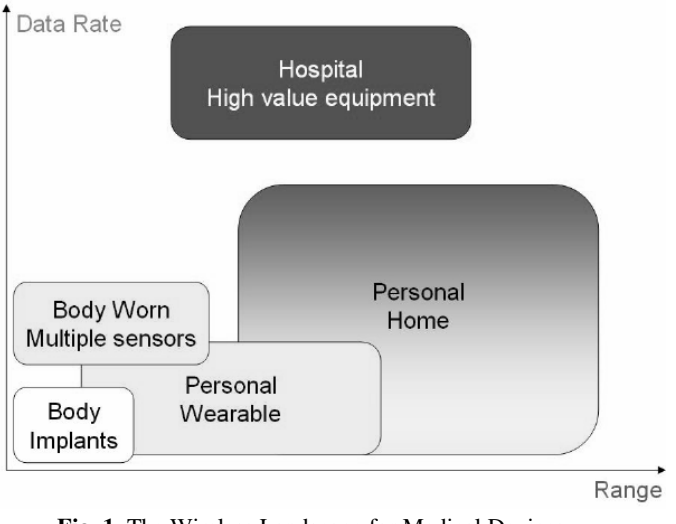

Fig. 1. The Wireless Landscape for Medical Devices

In this scenario the new ultra low power short range wireless technologies can provide solutions that allow the design of products which are particularly appropriate for monitor people's health with interoperability requirements.

eHealth is seen as central to the future of health services worldwide; it is not limited to consumer electronics devices for simple health parameters measurement. The changing population demographics and increase in long term chronic disease will require fundamental changes in the way the world considers healthcare. The current status is unsustainable as ever increasing costs burden states, industries and individuals. The clock is ticking for healthcare systems around the world. It is mandatory to develop schemes to reduce resources on the healthcare system. eHealth is recognised as the application of technology that can help to monitor people's health to reduce these costs in two ways: attendance and prevention.

Market is working with medical companies to incorporate short range wireless technologies into their products to provide a link to end to end platforms that enable these devices to talk to remote patient databases. Products particularly appropriate for Assisted Living and Dementia Care.

At its most basic level, eHealth is all about monitoring a patient's condition outside a medical institution. That can be as simple as a fall alarm, a bed occupancy or door sensor, or a remote link that connects and sends the result of a blood glucose or weight measurement to a remote database, where the data can be analysed or inspected by medical staff. The key feature is that of remote monitoring, so that a patient can have confidence in living a more normal life outside institutional care, knowing that someone is there to watch over them.

At this point is important to note that these wireless technologies are also penetrating in domotics, so it is possible to consider a home automation scenario which has not only comfort features but also health's ones due to the interoperability

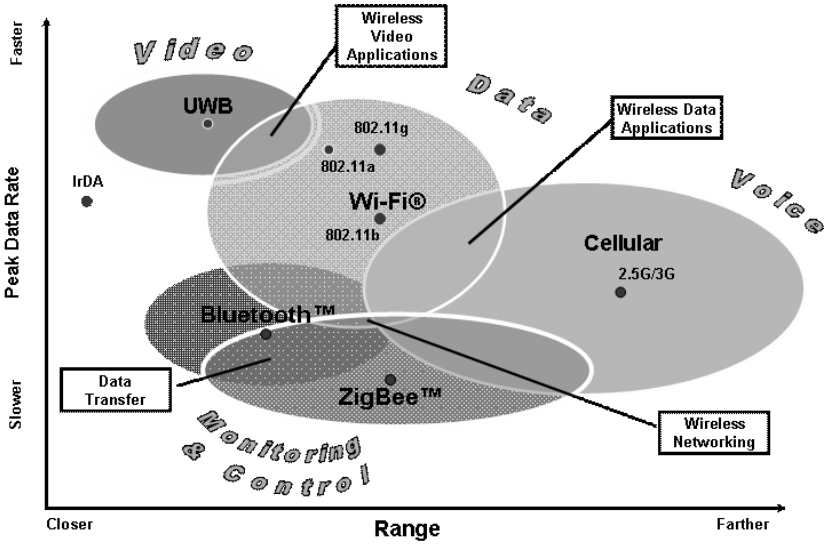

Fig. 2. Wireless technologies application areas

that underlies these standards, allowing a full integration of services in a broad concept of smart home.

We have to see how we can move from complex equipment that is manufactured in thousands –too expensive, to very cheap equipment for less sick patients that is made in tens of millions. And then how to persuade people to use them and how to manage this amount of data.

The technology for making low cost eHealth devices is largely in place. The key element that is missing is a simple[1] means of passing the patient's data to a remote database where it can be analysed. Current devices are mostly designed to be used in isolation. They need to be connected to a PC to transfer their data, which is fine for clinical use, but inappropriate for mass deployment. They also have an issue in that most use a proprietary method to record the medical information. At the point that eHealth becomes endemic and patient data needs to be managed, these formats need to be standardised.

In this case the availability of low cost medical devices that have the ability to send the data they measure to the Internet will exist through natural evolution of technology, it's unlikely to be accompanied by any centralised system for collecting and analysing it.

Three wireless standards are likely to dominate the majority of medical applications – Zigbee, Wibree/Bluetooth and Wi-Fi. Today Bluetooth and Wi-Fi dominate – Bluetooth for connections between portable devices and Wi-Fi for connections to fixed access points and IP infrastructure. Many medical researchers are currently working with ZigBee, or the 802.15.4 radio standard that underlies it.

The exception to this triumvirate of standards is the field of implantable devices. Leaving implantable devices aside, from clinical equipment through personal wellness and healthcare products, there is a diverse range of applications.

In addition to this list could appear the mobile phone network operators. They see a real benefit in offering additional services to their customers, not least to increase customer loyalty. Their 3G networks provide the wide area connections to retrieve patient data from phones and they have already spawned an innovative content management and delivery industry around their services.

Despite this diversity, four primary parameters dictate the requirements of short range wireless technology for the vast majority of medical use cases:

- the range over which the device needs to operate,
- the amount of data that needs to be transferred
- the frequency of these transfers – how often data needs to be sent, and
- the power available – typically whether it is battery or mains powered.

No standarised devices can be found nowadays, offered as consumer products. Initially these applications are likely to be centred around wellness, fitness, sports and lifestyle devices.

It is expected for 2008 that the work on the Bluetooth Medical Device Profile -that will coincide with the first standards from the IEEE 11073 Personal Health Devices Working Group, will provide a common data exchange protocol and definition of

[1] Simple has to be intended as normalized, standarized, interoperable.

device data formats. Together they will enable the first generation of low cost, interoperable medical devices. It's likely that the first devices we see appear will be blood pressure meters, glucose meters and weighing scales.

2.1 The IEEE 1073 Standard

The purpose is to provide real-time plug-and-play interoperability for patient-connected medical devices and facilitate the efficient exchange of vital signs and medical device data, acquired at the point-of-care, in all health care environments based on off-the-shelf technologies, scaling across a wide range of system complexities, and supporting commercially viable implementations. Next figure shows a simplified OSI layers model for this standard.

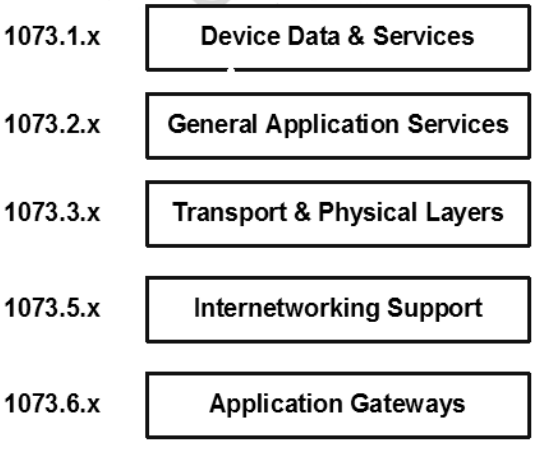

Fig. 3. IEEE 1073 simplified OSI layers

Particularly, the 1073.3.x describes the physical and transport layers. In this scenario the new ultra low power short range wireless technologies can provide solutions that allow the design of products which are particularly appropriate for monitor people's health with interoperability requirements. At this point we note the RF wireless guidelines group IEEE 1073.0.0.1 Tech Report – guidelines:

- Coordinated between medical industry, health care providers, chip manufacturers, and regulatory.
- Includes discussions on coexistence, QoS, security, and risk analysis + tech comparisons.
- Follow-on standardization projects anticipated for specific technologies (e.g., WiFi or ZigBee).

Note that the physical and transport layer appears not only in this slide or frame. It also performs the interchanging of data between different nets or standards (1073-5 and 1073-6).

3 Conclusions

The changing population demographics, the increase in life expectancy and so, long term chronic disease, will require fundamental changes in the way the world considers healthcare.

eHealth is recognised as the application of technology that can help to monitor people's health in two ways: attendance and prevention. We have to see how we can move from complex equipment that is manufactured in thousands –too expensive, to very cheap equipment for less sick patients that is made in tens of millions.

In this scenario the new ultra low power short range wireless technologies can play a big role, providing solutions that allow the design of products which are particularly appropriate for assisted living and remote monitoring of health parameteres.

Three wireless standards are likely to dominate the majority of medical applications –Zigbee, Wibree/Bluetooth and Wi-Fi. The exception to this triumvirate of standards is the field of implantable devices and in addition to this list could appear the mobile phone network operators for wide area connections.

The technology for making low cost eHealth devices is largely in place. The key element that is missing is a simple means of passing the patient's data to a remote database where it can be analysed. Also there are other challenges to achieve: security, reliability, integration and power consumption.

About the integration -standards vs proprietary systems, is expected for 2008 that the IEEE 1073 Personal Health Devices Working Group and the Bluetooth Medical Device Profile could provide a common data exchange protocol and definition of device data formats.

Finally, is important to note that these wireless technologies are also penetrating in domotics, so it is possible to consider a home automation scenario which has not only comfort features but also health's ones due to the interoperability that underlies these standards, allowing a full integration of services in a broad concept of smart home.

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