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History and Applications in Body Area Network

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Abstract: ***A Body Area Network (BAN) is defined formally as a system of devices in close proximity to a person's body that cooperate for the benefit of the user. BAN represent the natural union between connectivity and miniaturization. The main purpose of this technology is to reduce the load at hospitals and provide efficient healthcare facility remotely using medical implant communication system (MICS) and Wireless medical telemetry system (WMTS). Here, introduce current, state-of-the-art applications of BAN, as well as the most challenging aspects concerning their adoption and gradual deployment. This paper is mainly introduce the status of development of the BAN in recent years and focuses on the solution of several key problems and its applications.***
Keywords :WBAN, BAN, Sensor, Wireless, Network, Applications, Bluetooth

I. INTRODUCTION

Body area networks are particularly of interest in the medical field. These systems include electronic sensors that monitor patients for a variety of healthcare-related conditions. For example, body sensors attached to a patient can measure whether they have suddenly fallen to the ground and report these events to monitoring stations. The network can also track heart rate, blood pressure and other patient vital signs. Tracking the physical location of doctors within a hospital also proves useful in responding to emergencies. Military applications of body area networking also exist, including monitoring the physical locations of field personnel. Soliders' vital signs can also be tracked similar to healthcare patients as part of monitoring their physical well-being.

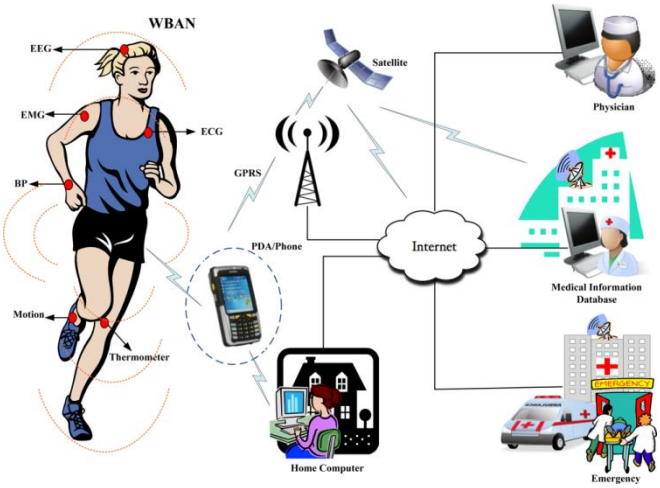

figure: 1

II. HISTORY OF BAN

History about the body area network is not so old to go back many years to find out some material about BANs, taking advantages of some tiny useful technology in this sense is a new and unique idea. A number of different groups was work on PAN(personal area network) in 1990's. The group actually wanted to get the information by interconnect different appliance on the body and to measure the position of the body by using electric field sensor. The main head for developing PAN was Thomas G. Zimmerman. He introduces the new technology that allows the body to act like conductor. There was another name Neil Gershenfeld in charge of the Media and Physics group. He and his group applied a method near -field coupling to solve the problem of determine the accurate position and its relationship with other parts, by fixing pairs of antennas on body part for example elbow and hand, and then run an electric current through them. They learned that as one move the capacitance of the circuit was charged. So they determine the exact

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position of the antennas after measuring the capacitance.

There was a problem in the measurement method that the measurement was no longer accurate if hand was placed between the antennas but it was solved by the Zimmerman. There was actually another group working in the Media lab asked them to develop a network such that all electric gadgets that a person can carry are connected together.

Many people carried digital devices around thereself but no one communicate to other. For example a person who has a mobile phone, a pager, a PDA or a digital watch mean all about his person at the same time. They both Zimmerman and Gershenfeld learned that, they can represent 1 or 0s, if they modulated the electric field which flowing through a person body, and allowing the body to carry digital information. At the end they discovered that if they used frequency and power that kept very low then the signal will not propagate far beyond the body. It means that if devices could detect the signal on the body. This used of current at very low or small amount was unnoticed by anyone before.

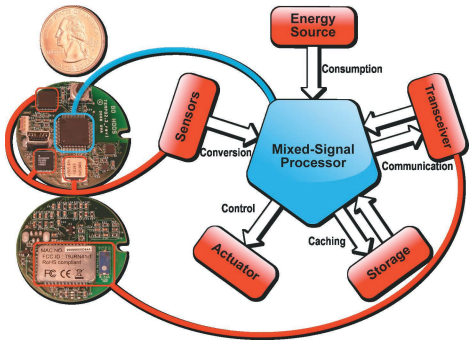

Figure : 2 BASN node architecture.

Although the architectural components
are similar to those of a typical wireless sensor network node, a BASN node presents unique challenges and opportunities—from sensing to communication. The sensor node (left) is the TEMPO inertial sensor node
developed at the University of Virginia.

A. Body Area Sensing

As Figure 2 shows, BASN nodes create an interface to humans, typically encapsulating an energy source, one or more sensors, a mixed-signal processor, and a communication transceiver. Some nodes also support data storage or feedback control to body-based actuators, such as an insulin pump or robotic prosthetic. Although BASN and WSN nodes have similar functional architecture, differences in their operational characteristics—sensing, signal processing, communication, caching, feedback control, and energy harvesting—present unique challenges and opportunities for BASN nodes.

B. Body Area Network Applications

There are many possible application for communication like in the hospital, in patients monitoring system at home (post-operative care), use in a large scale throughout the world. There is also a list of BANs usages in various field like in sport, military, mesh, and in sport fields.

1) *Sports:* In the present sporting arena many different readings are possible to take without having an athlete on a treadmill in a laboratory. It provide the platform to measure various levels during different competition in real life, for example in race, where coaches, need his athlete's strengths and weaknesses.
2) *Mesh Network:* The body area network consist of low-power and very reliable sensor networking. The low power usage allows longer life Batteries of motes or Gateways. The mesh network provides high reliability and long range communication. Mesh Networking is much more reliable and much capable of data sending

C. Medical

Body Area Networks (BANs) can be used to provide interfaces for diagnostics purposes, in the hospital they used for administration of drugs, aid rehabilitation, and for remotely monitoring human physiological data. And for future prospective in hospital or at home it is used for monitoring the patient continuously and give required medication. So by this way patient need no more in the hospital

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with connected machines for monitoring.

D. Military

Body Area Network has done a tremendous job in the military. So many of the military applications that we can use includes, their locations, health monitoring, their temperature and hydration levels, also very useful to enhance the strength, and many more factors for military prospective.

E. Compare the Wireless sensor network and Wireless body area network

1) *Latency:* This requirement is dictated by the applications, and may be traded for improved reliability and energy consumption. However, while energy conservation is definitely beneficial, replacement of batteries in BAN nodes is much easier done than in WSNs, whose nodes can be physically unreachable after deployment. Therefore, it may be necessary to maximize battery life-time in a WSN at the expense of higher latency.
2) *Mobility:* BAN users may move around. Therefore, BAN nodes share the same mobility pattern, unlike WSN nodes that are usually considered stationary

Challenges	Wireless Sensor Network	Wireless Body Area Network
Scale	Monitored environment (meters / kilometers)	Human body (centimeters / meters)
Node Number	Many redundant nodes for wide area coverage	Fewer, limited in space
Result accuracy	Through node redundancy	Through node accuracy and robustness
Node Tasks	Node performs a dedicated task	Node performs multiple tasks
Node Size	Small is preferred, but not important	Small is essential
Network Topology	Very likely to be fixed or static	More variable due to body movement
Data Rates	Most often homogeneous	Most often heterogeneous
Node Replacement	Performed easily, nodes even disposable	Replacement of implanted nodes difficult
Node Lifetime	Several years / months	Several years / months, smaller battery capacity
Power Supply	Accessible and likely to be replaced more easily and frequently	Inaccessible and difficult to replaced in an implantable setting
Power Demand	Likely to be large, energy supply easier	Likely to be lower, energy supply more difficult
Energy Scavenging Source	Most likely solar and wind power	Most likely motion (vibration) and thermal (body heat)
Biocompatibility	Not a consideration in most applications	A must for implants and some external sensors
Security Level	Lower	Higher, to protect patient information
Impact of Data Loss	Likely to be compensated by redundant nodes	More significant, may require additional measures to ensure QoS and real-time data delivery.
Wireless Technology	Bluetooth, ZigBee, GPRS, WLAN, …	Low power technology required

wban technologies

III. BLUETOOTH

Bluetooth technology12 was designed as a short range wireless communication standard, intended to maintain high levels of security. Thanks to this technology, each device can simultaneously communicate with up to seven other devices within a single piconet, an ad hoc network including one device acting as a master and up to seven others as slaves for the lifetime of the piconet. Slaves have to synchronize by the system clock of the master and follow the hopping pattern, determined by the master. Besides, each device can belong to several piconets simultaneously, as they enter radio proximity of other master devices. The main attractive characteristic of Bluetooth is to allow a wide range of Bluetooth enabled devices to connect and communicate with each other, almost everywhere in the world.

Another key feature is the ability of devices to communicate without need of line-of-sight positioning of connected devices. Thus, it is widely used for connecting a variety of personally carried devices to support data and voice applications. Bluetooth devices operate in the 2.4 GHz ISM band (Industrial, Scientific and Medical band), utilizing frequency hopping among 79 1 MHz channels at a nominal rate of 1600 hops/sec to reduce interference. The standard specifies three classes of devices with different transmission powers and corresponding coverages ranging from 1 to
100 m. The maximum data rate is 3 Mbps.

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A. Bluetooth Low Energy

A derived option of the Bluetooth standard is the Bluetooth Low Energy (BLE)7, which was introduced as a more suitable choice for WBAN applications where less power consumption is possible using low duty cycle operation. Bluetooth LE was designed to wirelessly connect small devices to mobile terminals. Those devices are often too tiny to bear the power consumption as well as cost associated with a standard Bluetooth radio, but are ideal choices for the health-monitoring applications. Bluetooth Low Energy technology is expected to provide a data rate of up to 1 Mbps. Using fewer channels for pairing devices, synchronization can be done in a few milliseconds compared to Bluetooths seconds. This benefits latency-critical BAN applications, like alarm generation and emergency response

IV. CONCLUSION

This paper presented challenges and applications related to the design and network communication aspects of BANs. In particular, BAN devices (sensors/actuators) have the distinct feature of operating in close proximity to the human body, and can even be embedded into it in order to provide a physiological monitoring service. Although BANs are expected to play an important role in many aspects of everyday life, as of today, deployment of this type of network is rather limited.

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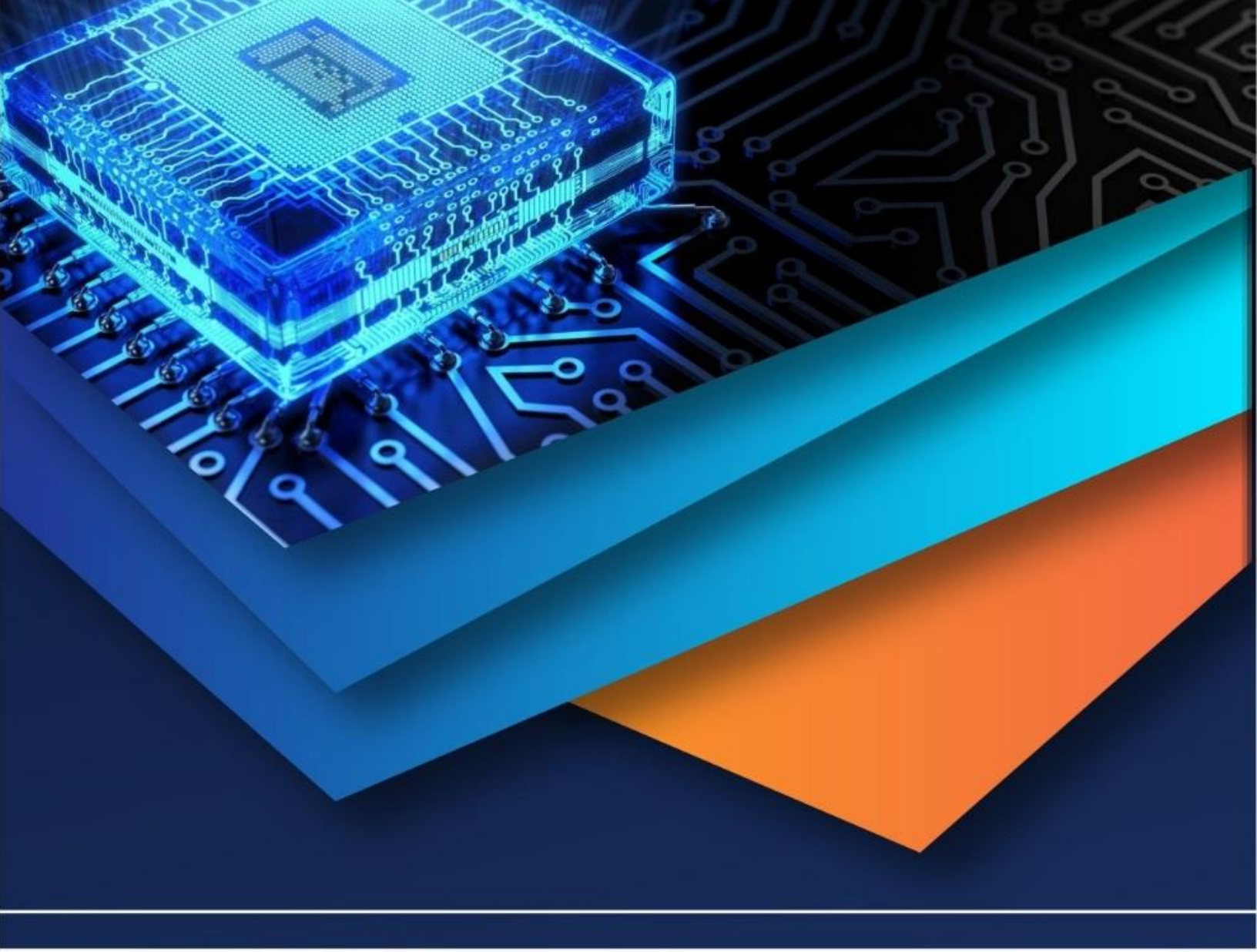

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