



PROMETHEUS HEALTH PARTNERS

HEALTHCARE TECHNOLOGY DEFINITIONS

Healthcare Solutions

- **HIE (Health Information Exchange)** - The electronic movement of health-related information among organizations according to nationally recognized standards. An HIE is a complex set of technologies which enables the aggregation of health-related information for an individual, as well as offering a number of specialized services that allow the HIE to interact with participating systems in a consistent, reliable way. Services include physician Web portals, PHRs, clinical messaging, clinical interoperability and exchange of data from electronic medical records, as well as the common administration of security services necessary to ensure that data is used appropriately.
- **EHR (Electronic Health Record)** - An electronic record of health-related information on an individual that conforms to nationally recognized interoperability standards and that can be created, managed and consulted by authorized clinicians and staff across more than one healthcare organization.
- **EMR (Electronic Medical Record)** - An electronic record of health-related information on an individual that can be created, gathered, managed and consulted by authorized clinicians and staff within one healthcare organization.
- **PHR (Personal Health Record)** - An electronic record of health-related information on an individual that conforms to nationally recognized interoperability standards and that can be drawn from multiple sources while being managed, shared and controlled by the individual or the health consumer.
- **Connected health** is a model for healthcare delivery that uses technology to provide healthcare remotely. Connected health aims to maximize healthcare resources and provide increased, flexible opportunities for consumers to engage with clinicians and better self-manage their care. It uses technology – often leveraging readily available consumer technologies – to deliver patient care outside of the hospital or doctor's office. Connected health encompasses programs in telehealth, remote care (such as home care) and disease and lifestyle management, often leverages existing technologies such as connected devices using existing cellular networks and is associated with efforts to improve chronic care.
- **Telehealth** - the use of telecommunications technology to provide health information and medical care services (preventive and curative) remotely through collection, analysis, and transmission of high-quality medical data at any time from any location

- Telehealth services include but not limited to – medical emergency response, RPM enabled chronic condition monitoring through collection of vital biometric data, activity monitoring, medical diagnostic procedures, medication adherence/compliance, collection of qualitative health information, medical consultation, and health education
- **Mobile Health or mHealth** – a segment of Telehealth that employs mobile communication via cellular networks and connectivity to provide health information and services. mHealth broadly encompasses the use of mobile telecommunication and multimedia technologies as they are integrated within increasingly mobile and wireless health care delivery systems. The field broadly encompasses the use of mobile telecommunication and multimedia technologies in health care delivery.
 - Application categories within the mHealth field: Education and awareness; Helpline; Diagnostic and treatment support; Communication and training for healthcare workers; Disease and epidemic outbreak tracking; Remote monitoring; Remote data collection
- **Telemedicine (Video)** - a rapidly developing application of clinical medicine where medical information is transferred through interactive audiovisual media for the purpose of consulting, and sometimes remote medical procedures or examinations.
- **Remote Patient Monitoring (RPM)** - Subcategory of telehealth specifically referring to the use of telehealth technology to enable healthcare professionals to better observe, monitor, manage, and diagnose patients located at home or away from a medical facility. Disease management companies have integrated RPM technology into their services in order to enhance monitoring capabilities and help prevent costly medical complications for high-risk patients.
- **Disease management** - involves a system of health monitoring, medical information sharing, wellness programs, and coordinated treatment and health interventions to help prevent members of monitored patient populations from experiencing costly medical complications . DM seeks to contain medical expenses and improve patient outcomes
- **PERS** – Personal Emergency Response Systems is an alarm system designed to signal the presence of a hazard requiring urgent attention and to summon emergency medical personnel.
- **mPERS** - Personal Emergency Response Systems using cellular connectivity and networks often in combination with GPS to provide service in any location away from patient’s place of residence

General Technology

- **Computing Platform** - includes some sort of hardware architecture and a software framework (including application frameworks), where the combination allows software, particularly application software, to run. Typical platforms include a computer's architecture, operating system, programming languages and related user interface (run-time system libraries or graphical user interface).
- **A platform is a crucial element in software development.** A platform might be simply defined as a place to launch software. The platform provider offers the software developer an undertaking that logic code will run consistently as long as the platform is running on top of other platforms. Logic code includes bytecode, source code, and machine code.

- **(Business) Intelligence Engine** - computer-based techniques used in identifying, extracting, and analyzing business data and is divided into querying, reporting, OLAP (online analytical processing), an "alerts" tool, and business analytics.
- **(Business) Analytics Engine** - refers to technologies, applications and practices for continuous iterative exploration and investigation of past performance to gain insight and drive planning and decision making. Analytics Engine focuses on developing new insights and understanding of performance based on data and statistical methods.
- **Software Framework** - is an abstraction in which software providing generic functionality can be selectively changed by user code, thus providing application specific software. It is a collection of software libraries providing a defined application programming interface (API).
- **Application Programming Interface (API)** - is a source code based specification intended to be used as an interface by software components to communicate with each other. An API may include specifications for routines, data structures, object classes, and variables.
- **Software Development Kit (SDK or "devkit")** - is typically a set of software development tools that allows for the creation of applications for a certain software package, software framework, hardware platform, computer system, video game console, operating system, or similar platform.
- **WLAN/PAN (Wireless Local Area Network / Personal Area Network)** - links two or more devices using some wireless distribution method (typically spread-spectrum or OFDM radio), and usually providing a connection through an access point to the wider internet. This gives users the mobility to move around within a local coverage area and still be connected to the network.

Personal and Local Area Networks

Bluetooth

BT operates in the unlicensed 2.4 GHz ISM (Industrial, Scientific, and Medical) frequency band. The frequency range is 2.4000 GHz to 2.4835 GHz – a band that is available in virtually all developed countries. The BT specification is designed to enable voice and data transmission using a combination of circuit and packet switching. The technology is broadly adopted across a range of devices. Although it is prevalent in mobile handsets.

The technology has been adopted in some medical products to provide connectivity between devices and in some monitors, but it has generally been accepted to be an imperfect fit for this task. A combination of reasons has stifled BT adoption in the healthcare market and these conditions are unlikely to change. The reasons in particular include:

Power demands required by BT and the subsequent requirements for frequent battery changing and/or battery charging has stifled any significant penetration of BT in this market.

BT requires a level of end-user sophistication in establishing a pairing and ensuring the transfer of data. A greater cost is associated with the BT version of this technology that has not been seen to add value. Lack of applicability meant that not enough market pull existed for BT network infrastructure to be deployed, stymieing the potential of the technology in healthcare.

Bluetooth Low Energy

BLE extends and complements BT's operation in the 2.4 GHz band. The strength of BLE technology is its ability to leverage the processor, antenna, and baseband connectivity of BR/EDR BT as well as to communicate with BR/EDR BT. BLE is a pure PAN (Personal Area Network) technology. It supports comparatively low data rates unsuitable for any audio data. Rather than being a BT alternative, BLE is a different technology aligned and adapted to extend BT into associated core markets in which connectivity has to be supported within cost- and power-constrained applications. BLE, like BT, is developed, maintained, marketed, and licensed worldwide by the Bluetooth SIG. Both also operate in the globally unlicensed ISM (Industrial, Scientific and Medical) 2.4 GHz short-range RF bandwidth and share a transmission range of around 10 meters. However, the low capacity for typical data transmissions means that BLE transmissions are less than 6 ms in duration as compared to the 100 ms of classic BR/EDR BT (Basic Rate/Enhanced Data Rate Bluetooth).

Power consumption is clearly significantly different between BR/EDR BT and BLE as low-power extension to BR/EDR BT is the real goal. While BR/EDR BT was devised as a low-power PAN network protocol, BLE has been developed to have a significantly lower power consumption demand, so that devices can be powered from a single button cell battery for more than a year before the battery needs replacing. According to the Bluetooth SIG, power consumption, which depends on the application and use case, should range from 1/10 to 1/2 of BTs.

BT has a wake-up send-and-sleep cycle of 50 m/s to 100 m/s and 25 m/s to 30 m/s. BLE requires just 1.5 m/s and 1/50 of the power of standard BT. The saving is close to 1/100 of power consumption for the duty cycle. Overall power consumption for BLE single-mode devices is expected to be realistically in the region of 10% to 25% of BT.

BT operates network connectivity in a scatter-net fashion, whereas BLE, by comparison, operates a star bus network topology where slaves can only connect to one master device at a time with no device-to-device connectivity. As the BLE specification is developed past Version 1.1, plans are to extend the networking capability to support other master attributes that would enable BLE to offer a level of connectivity to draw watch manufacturers into using BLE over rival technologies like ANT.

BLE application-specific details and functionality are based on attributes, not profiles. That ensures that the device can communicate what it is and how data should be treated by the host. In addition, it means that data formats transmitted from devices will differ according to device category.

ZigBee

IEEE 802.15.4 was first released in 2003 and the specification defines three bands: 868 MHz, 900 MHz, and 2.4 GHz. The 2.4 GHz band is the most popular due to the spectrum's global license and free clearance for the 2.4 GHz ISM band.

IEEE 802.15.4 was designed to provide a low-cost and low-power wireless solution. It has become a solid foundation for monitoring and controlling networks like the WSN as well as numerous other P2P (Peer To Peer) and P2MP (Point To Multi-Point) proprietary network stacks. To date, the 802.15.4 industry is still primarily dominated by proprietary solutions that are specifically tailored by IC manufacturers to meet each client's particular needs and requirements.

ZigBee and 802.15.4 are not the same thing. However, ZigBee is a high-level, standardized networking protocol that, by definition, requires the use of 802.15.4 technology at the MAC and the PHY layers. 802.15.4 is a primary ingredient of the ZigBee solution and will always be present in ZigBee products. However, 802.15.4 can also be used as a standalone solution, with a simple proprietary network protocol.

ABI Research believes that 802.15.4/ZigBee offerings will seriously compete in the professional and home healthcare markets. The technology's range, combined with the already established nature of the standard, and the operation and spreading of devices, channels usage across the spectrum. That said however, feedback from some trials indicates that the way in which packets are handled and re-sent when/if transmission is interrupted, can offset some of the power-saving features that 802.15.4 can offer over other available technologies such as Bluetooth. ZigBee's mesh network operation is suited to multiple monitor connectivity and represents larger network and longer-range network capabilities than the strictly PAN nature of BLE, for example.

The ZigBee Alliance is an industry organization that controls the development of the ZigBee low-power, low data rate wireless standard. ZigBee is an application and networking layer standard that uses IEEE 802.15.4 ICs at the PHY layer. The Alliance currently has 249 member companies including Ember, Freescale Semiconductor, TI (Texas Instruments), Motorola, Siemens, Huawei, Honeywell, Mitsubishi Electric, Itron, Philips, Samsung, Cellnet+Hunt, Schneider Electric, STMicroelectronics, and Tendril. Ember, Freescale, and TI are leading vendors of IEEE 802.15.4 ICs.

The ZigBee Alliance released the ZigBee Health Care public application profile in March 2009. The Profile is meant to enable the secure transport of non-critical, non-acute home healthcare data over ZigBee networks. The Profile also provides full support to ISO/IEEE 11073 protocols at the upper layers.

IEEE 802.15.6

Development of the IEEE 802.15.6 Body Area Network specification is within the hands of the IEEE 802.15 Task Group which was formed in November 2007. The goal of the group is to investigate and develop a communication standard optimized for low-power devices for operation in or around the human body for applications including healthcare. It has yet to release a standard although the scope of its analysis covers existing ISM bands as well as frequency bands approved by national medical and/or regulatory authorities. Support for QoS, extremely low power, and data rates up to 10 Mbps is required while simultaneously complying with non-interference guidelines where needed.

The purpose of the IEEE 802.15.6 was to define new PHY (Physical) and MAC (Media Access Control) layers for WBAN (Wireless Body Area Network) application. The current IEEE 802.15.6 specification adopts three potential PHY layers that can be used: NB (Narrowband), UWB (Ultra wideband), and HBC (Human Body Communications) layers. UWB operates in UWB PHY operates in two frequency bands: low and high bands each with multiple channels of 499.2 MHz bandwidth. The low band consists of three channels with channel 2 at 3993.6 MHz the mandatory channel. The high band consists of eight channels and channel 7 mandatory. A typical UWB device should support at least one of the mandatory channels. HBC operates in two frequency bands centered at 16 MHz and 27 MHz with the bandwidth of 4 MHz.

ANT

The ANT ULP specification was originally developed by Dynastream for Nike's first sports monitoring products. The company has since licensed ANT to multiple players and has formed the ANT+ Alliance to promote the technology. Dynastream is owned by GPS specialist Garmin.

ANT operates in 2.4 GHz specifically designed for WSNs (Wireless Sensor Network) and is a direct competitor to the upcoming BLE. Ahead of BLE's introduction, Dynastream has looked to the formation of the ANT+ Alliance to support market development and provide interoperability potential for ANT licensees. It has also moved to expand the presence of its ULP offering into target applications including any wireless sensor monitoring of sports and home wellness.

ANT represents the strongest competitor to BLE in the health and fitness market and, unlike BLE, has already built up traction and market shipments with several companies already shipping products using the technology. Several million ANT nodes have shipped to date, with Garmin and Suunto using ANT technology in their products. In addition, major sporting goods company adidas recently joined the ANT+ Alliance.

ANT also targets many of the same markets as BLE, but lacks that embedded capability in mobile handsets that BLE will offer. However, its proponents maintain that since the technology uses radios that are also compatible with BLE, support for BLE in handsets will provide the potential for ANT support as well. However, getting ANT into mobile handsets will not be a trivial task and one that cannot take place without the support of dual-band BT IC manufacturers, mobile handset vendors, and possibly MNOs. ABI Research believes the potential for ANT on handsets is extremely limited.

BodyLAN

BodyLAN is the proprietary technology developed by FitSense. Following the company's acquisition by FitLinxx, it is now part of FitLinxx's sports and health management offering.

The BodyLAN UBM (Universal BodyLAN Module) is a low-cost, ULP wireless chipset based on a core radio IC from Nordic Semiconductor with microcontrollers from a range of suppliers. According to FitLinxx, its technology operates at a power consumption rate that requires much less power than ZigBee or BLE. The technology is targeted by FitLinxx for devices, such as blood glucose meters, weight scales, and activity monitors, which become a node in its ActiHealth data network. FitLinxx has won significant support for its offering with the decision by Apple and Nike to license the technology to support their Nike+ platform.

Sensium

Sensium is an ULP wireless sensor interface and transceiver platform developed and marketed by UK-based Toumaz Technology, a division of Nanoscience Inc. Toumaz offers a proprietary sensor product node and master node set for personal monitoring in the healthcare and lifestyle management market. The device includes a reconfigurable sensor interface, a digital block with an 8051 processor, and an RF transceiver block. On-chip programs and data memory enables the local processing of signals.

Together with an appropriate external sensor, Sensium provides ULP monitoring of ECGs, temperature, blood glucose, and oxygen levels. It can also interface with three axis accelerometers and pressure sensors and includes a temperature sensor on-chip. One or more Sensium-enabled digital plasters continuously monitor key physiological parameters on the body and report to a base station. Base stations are PDAs or smartphones or a Sensium receiver unit. The data can be further filtered and processed by application software.

Toumaz has an agreement with Infineon for Infineon's 130 nanometer RF-CMOS (Complementary Metal-Oxide-Semiconductor) process to manufacture Toumaz's Generation 1 and Generation 2 Sensium chips.