Chapter 17
Trustworthy Architecture for Wireless Body Sensor Network

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ABSTRACT

Wireless Body Sensor Network is a collection of physiological sensors connected to small embedded machines and transceivers to form a monitoring scheme for patients and elderly people. Intrusion and foolproof routing has become mandatory as the Wireless Body Sensor Network has extended its working range. Trust in Wireless Body Sensor Network is greatly determined by the Encryption key size and Energy of the Node. The Sensor Nodes in Wireless Body Sensor Network is powered by small battery banks which are to be removed and recharged often in some cases. Attack to the implanted node in Wireless Body Sensor Network could harm the patient. Finite State Machine helps in realizing the Trust architecture of the Wireless Body Sensor Network. Markov model helps in predicting the state transition from one state to other. This chapter proposes a Trustworthy architecture for creating a trusted and confidential communication for Wireless Body Sensor Network.

1. INTRODUCTION

Design of Trusted network has become mandatory for Wireless Body sensor Network since its role is prodigious in Health monitoring system. Wireless Networks hold the key for unlocking 24×7 monitoring of patients in and out of hospital environment. Physiological signals of the patients are monitored across the clock using sensors sticked with the body of the subject (Kanagachidambaresan, SarmaDhulipala, Vanusha, & Udhaya, 2011; Akyildiz, Sankarasubramaniam, & Cayirici, 2002; Kanagachidambaresan, Chitra, 2014; Otal, Alonso, & Verikoukis, 2009; Kanagachidambaresan, SarmaDhulipala, & Udhaya, 2011). Wireless Body Sensor Network is mainly used for two major e-health application scenarios one for monitoring and collecting health data of the subject and delivering this data to the remote medical centre. Second major application is automatic treatment by the cooperation of various biosensor nodes with the help of actuators. Wireless Body Sensor Network helps the subject from Asthma to Cancer monitoring and has very large application. A sensor node could be placed to monitor nitric oxide emitted

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by cancer cell to monitor the progress of cancer in the human body. A Wireless Body Sensor Network could help the asthma patients by sensing the allergic agents in the air and reporting the patient himself and doctor continuously avoiding him from breathing trouble. Fatal conditions due to belated medical facility can be majorly avoided using Wireless Body Sensor Network. The main motto of the Wireless Body Sensor Network is to enhance the patients mobility without making them immobile. Wireless Body Sensor Network helps in monitoring patients continuously without disturbing their day to day life (SarmaDhulipala, Kanagachidambaresan, Chandrasekaran, 2012; Riaz, et al., 2009; Zhang, Das, & Liu, 2006; Momani & Alhmouz, 2008; Boukerche, Li, & Khatib, 2006). Wireless Body Sensor Network facilitates the patients to be monitored out of hospital environment, making the network facile to attackers. For example McAfee experts demonstrated an attack to the insulin pump causing a fatal dosage of insulin in Black Hat conference in 2012. Health Insurance Portability and Accountability Act (HIPAA) mandates the e-health data to be secured and routed through trusted nodes. BSN mandates a valuable trust to the system before being practiced in real time. Trust for these miniaturized embedded systems should also convince with the limited available resource. The Nodes in the Wireless Body Sensor Network are wearable, sticked and implanted in nature. The first implantable heart pacemaker was designed by 1958, In spite to the advancement to the technology of manufacturing of Implantable Sensor Nodes faces a series of challenges varying with person to person and environment to environment (Marsh, 1994; Hoffman, Lawson, & Blum, 2006, Ng, Sim, & Tan, 2006; Pirzada & McDonald, 2004). Rechargeable batteries in the implanted nodes are charged by the radio frequency, ultrasonic, infrared light, low-frequency magnetic field and so on. Recent technology introduces the energy harvesting mechanism with body motions and bio-heat generation (Sun, Yu, Han, & Liu, 2006; Shaikh, et al., 2006; Momani, Challa, & Abour, 2007; Liu, Joy, & Thompson, 2004; Gradison & Sloman, 2000; Shi & Perrig, 2004). Future design of implanted nodes concentrates battery less node design directly harvesting energy and serving the need of the Wireless Body Sensor Nodes. The Trust of the nodes in these cases mainly depends on the availability to harvest energy. Apart from sensing mechanism the implanted nodes in Wireless Body Sensor Network concentrates in drug release, mechanical adjustment in prosthetic devices which consumes a major part of energy from the battery. The Telemetric link supports the bidirectional usage of data transfer from and to the implanted sensor devices. The sensed data is recorded inside the small memory unit of the implanted node. The telemetric link between the implanted node and the sink enables Wireless Programming facility enabling over the air programming facility. The wireless programming facility ease the hackers to reprogram to implanted node and malfunction its usage (Walters, Liang, Shi, & Chaudhary, 2006; Buchegger & Boudec, 2005; Heinzelmean, Chandrakasan, & Balakrishnan, 2002; Olariu, et al., 2005; Misra & Xue, 2006; Cherukuri, Venkatasubramanian, & Gupta, 2003).

Wireless Body Sensor Network constitutes have its working by two major types of sensor, Wearable, Implanted. Apart from sensing mechanism, Wireless Body Sensor Network also constitutes to have actuators which help the subjects under extreme situations. Wearable sensors are sticked connected to the external body surface of the subject. The Electrical pulses generated by the neurons of the body is sensed by the electrode. The physiological signals are sensed by the sticky electrode and transmitted to the CMU (Ruzzelli, Juradak, Ohare, & Van Der Stok, 2007; Kim, et al., 2009; Maskooski, Soh, Gunawan, &Low, 2011; Sayrafian, et al., 2009; Liang, Balasingham, & Byun, 2008; Djenouri &Balasingham, 2009). Figure 1 illustrates the various Wearable sensors attached with the body surface.

Electro Gel reduces the body resistivity making them easy to conduct the bio signals without incision. Wearable sensors are connected to processing unit, capable of processing bio signal consuming very less energy. Figure 2 represents the pacemaker and pacemaker implanted inside the human body.

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