# Chapter 71
# Next Generation Wearable Devices:
## Smart Health Monitoring Device and Smart Sousveillance Hat Using D2D Communications in LTE Assisted Networks

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## ABSTRACT

*The next generation wearable devices are Smart health monitoring device and Smart sousveillance hat which are capable of using wearable sensors for measuring physiological information, sousveillanace, navigation, as well as smart device to smart device communications over cellular coverage. Smart health monitoring device collect and observe different health related information deploying biosensors and can predict health problems. Smart sousveillance hat provides the brainwaves based fatigue state, training and sousveillance around the wearer. The next generation wearable smart devices deploy the device to device communications in LTE assisted networks with D2D server, D2D Application server and D2D enhanced LTE signalling for D2D service management, spectrum utilization and broad cellular coverage, which make them portable, social, commercial and sustainable. Thus, the wearable device technology will merge with the smart communications besides the health and wellness. Furthermore, the simulation and performance evaluation shows that LTE-D2D wearable smart device communications provides two times more energy efficiency than LTE-UEs cellular communications. The LTE-D2D data rate is also found significantly higher with higher D2D-SINR for lower relative mobility (≤ 30m/s) and lower D2D distance (<400m) between devices.*

DOI: 10.4018/978-1-5225-5484-4.ch071

## INTRODUCTION

The next generation wearable devices empower the human towards the real-time human's physiological information tracking along with the wireless communications, real-time location tracking and video surveillance. The next generation wearable device consists of the combo chip for the device to device (D2D) communications, cellular communications, WLAN and WiFi which provides the flexible wireless connectivity for communications. This enables wearable devices to exchange the health information and tracking, video surveillance and social networks which prepare them to become habitual, social motivation, long term utilization and provide sustainable services as compared to the existing wearable gadgets. The next generation wearable devices can bring the revolution in the consumer electronics products, consumer behavior and business ecosystem. The next generation wearable device networks consist of three different types of smart wireless devices for the device to device communications, which includes the next generation wearable smart sousveillance (inverse surveillance) hats, smart health monitoring devices and advance smartphones. The contemporary wearable smart devices are the bio-medical devices, smart glasses, smart watches and smart phones that collect and provide the partial health information, biometrics, real-time video streaming, object detection, recognition and tracking. However, the next generation wearable devices emphasize on the brain fatigues, detailed physiological information for health monitoring and preventive measures against diseases, intelligent device to device communications, gesture recognition, advance navigation, speech recognition and text-speech translation and vice versa. In this paper, the smart wearable sousveillance hat is proposed, which is capable of detecting brainwaves for the brain's fatigue states and then train and manage the brain states. Moreover, the wearable smart health monitoring device also proposed to collect the different human physiological information from the different parts of human body, through wearable or implanted biosensors or handheld devices, and then display, store and communicate the digital biomedical information. The tiny biosensors are wearable or placed inside human body, which provides the physiological information such as body temperature, heartbeat, blood pressure, blood glucose level, respiration rate etc [1].

Furthermore, the next generation smart health monitoring device and sousveillance hat have direct or indirect device to device communications capability and access to the internet like smart phones, so that the data transmission, data storage and real-time video-streaming can be done between these wearable devices, from wearable devices to the cloud and outer world. In other words, the real-time video and the human physiological data can be sent to other portable devices and stored in the cloud servers and storage device networks. This can be achieved only when the wearable devices are equipped with the renewable power supply or the wireless power supply, so that these devices can consume the required power for the massive amount of video and physiological data transmission during the device to device communications.

This paper is comprised different sections, and is organized as follows. Studies of relevant literature are presented in the following section. The third and fourth sections focus the Wearable Health Monitoring Device and Smart Sousveillance Hat. Then other sections include the Device to Device (D2D) communications, network architecture, D2D Enhancements in LTE Signaling, and D2D Protocol for eUEs to authenticate D2D server. Finally, the performance and evaluation, and conclusions, are presented in the final section.