

Chapter 11

Emergency Medical Data Transmission Systems and Techniques

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ABSTRACT

Patients in critical condition need Physician's supervision while they are in transit to the hospital. If the ambulance is linked to the emergency room, the physician can monitor patient's vital signs and issue instructions to the paramedics for stabilizing the patient. When a disaster strikes, scores of people are transferred to the hospital in ambulances. During an emergency situation, the number of patients in critical condition reaches overwhelming proportions. In this chapter, we discuss the state of the art in transferring emergency medical data from the disaster site or ambulance to the hospital and outline some case studies. We present a scheme called MEDTOC (Medical Data Transmission Over Cellular Network) for transferring in-ambulance multiple patients' data to the hospital by UMTS. This system enables the transfer of vital signs to the hospital in reduced and packed format using limited bandwidth wireless network. Medical data can be transmitted over 3G cellular network using various modes and quality of service parameters available in UMTS. This could help the physicians in monitoring several patients who are either in transit or at a triage unit on a disaster site. Results of the application of data reduction algorithm over CAN packets and feasibility studies in transfer of data over UMTS are presented and discussed.

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INTRODUCTION

Use of information technology (IT) in almost all the sectors of every day life including medicine has prompted the advent of telemedicine that is providing high-tech solution to the universal problem of access to health care. Now geographical isolation is no longer a barrier to timely and quality provision of medical care. Telemedicine can be defined as diagnosis, consultation, treatment, education and the transfer of medical data (i.e. high resolution images, sounds, live video and patient records) using interactive audiovisual and data communications (Jerant et. al. 1998). Hence, physicians located with the patient can consult their colleagues remotely in order to solve a difficult case, supplemented with continuing education course over the Internet, or access medical information from digital libraries or provide immediate assistance during disasters.

Disasters can strike any time at any place. Earthquake, fire, building collapse, massive food poisoning and other such disasters need on-time medical response. First responders include ambulances besides fire brigades and elite emergency response teams. Disaster management relies greatly on effective emergency medical care arrangements. During an emergency, scores of people in critical condition are transported to the hospital where expert medical care is provided by the physicians. Sometimes several patients can be moved in large ambulances. Ambulance crew consists of paramedics and driver. Their job is to bring the patient to the hospital alive and stable so that the physician can attend to the patient. If the vital signs (blood pressure, pulse, blood oxygenation and respiration) and additional diagnostic medical data (e.g. EKG) of patients can be transferred to the physician in real-time, then chances of saving patient's life improve considerably. This is due to the fact that the first 60 minutes are the most critical for patients suffering from heart attack or other life threatening situations. If the ambulances are linked to the

hospital via wireless network, vital signs and one dimensional (1-d) medical data can be transferred to the hospital in real time.

Many schemes have been proposed to transfer emergency medical data to the hospital using wireless networks. The wireless transmission of 12-lead EKG was demonstrated by Grim in 1987. Majority of work done uses GSM/GPRS to transmit medical information while some people have used 3G systems (Campbell 2005), (Giovas et. al. 2006), (Nakamura et. al. 2003), (Reponen et. al. 2000), (Sillesen et. al. 2006), (E-Health Insider 2006). The focus of most of the researchers has been on the transmission of the medical data of a single patient being transported to the hospital. Some schemes have proposed the tracking of several patients using a laptop computer while the patients are in an on-site triage unit.

The chapter is divided into four sections. Section 1 presents various schemes in literature for transmission of emergency medical data. We have investigated the feasibility of transmitting aggregated vital signs of several patients to the hospital via cellular network. The data is reduced before transmission using a novel data reduction algorithm. The details of the proposed MEDTOC (Medical Data Transmission Over Cellular Network) system are given in section 2 and data reduction algorithm and its application to the aggregated data are described in section 3. In section 4, the results of OPNET simulation of aggregated data transmission using 3G UMTS cellular network are highlighted.

EMERGENCY MEDICAL DATA TRANSMISSION TECHNIQUES

This section gives an overview of the various emergency medical data transmission techniques that have either been proposed or reported in literature As reported in (Kyriacou et. al. 2007), a literature search shows that the work done in wireless transmission techniques of emergency

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