

# An IEEE 11073 Based Composite Agent For Mobile Health

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**Abstract**— The increased use of technology in the healthcare sector has opened up the gates of many new invention to improve the current state of art of the healthcare sector. In this paper, the main focus is on development of a composite agent which can aggregate the medical data in proper format and can act as a communication interface for medical devices intended for capturing medical data. Moreover, a communication protocol is proposed to send the aggregated data from the composite agent to the receiver at the hospital side. This software component has been implemented using latest technologies such as ASN.1 and Android OS. IEEE 11073 standard has been used as the underlying component to provide standardization to our composite agent and make it widely accepted.

**Keyword:** Bluetooth HDP, ASN.1, IEEE 11073, Android OS

## I. INTRODUCTION

Currently, the use of mobile technology in every filed is growing by leaps and bounds. Because of this, the field of M2M (Machine to Machine Communication) is expected to grow very fast in the upcoming years. One of the most important application of M2M technology is in the medical sector. Nowadays, the medical sector is equipped with the latest medical devices which have computation as well as communication capability. This devices helps in providing medical facilities to the people, by communicating the medical data to the respective medical representative.

Currently, this wireless communication enabled medical devices play an important role in providing medical assistance to the patient without his/her visiting the hospital. This is of prime importance in a developing country like India, where because of the large population, it is not possible to provide medical assistance to each and every patient, within the hospital.

In addition to this, IEEE has also proposed standard, IEEE 11073 Medical device communication standard along with specialization standards for each device[2][3]. In this standard, the component which is the source of the medical data is called “Agent” and the component which is the sink of the medical data is called “Manager”[1]. In our proposed system, we are going to use this IEEE standard, as well as its terminology.

## II. CURRENT SCENARIO

In our country, the site of traffic jams is very common in most of the cities. Many a times, the ambulance get stuck in such traffic jams and because of lack of timely hospital care to the patient, the patient condition gets worsened or the patient may die before he/she reaches the hospital.

Because of such situation, the handling of emergency medical services should be of prime focus in a

developing country like India, where many people die due to lack of timely medical care. Currently in our country, we don't have the facility of providing medical assistance to the patient within the ambulance according to the instructions of the expertise doctors. Our ambulances are well equipped with latest medical devices with wireless communication capabilities. However, this facility is not exploited up to the mark.

In current times, we do not have the facility of sending the medical data of the patient from the ambulance to the hospital side even before the patient reaches the hospital. This is because our medical devices do have communication capability, but this communication capability is for short range such as Bluetooth communication. However, medical devices with Wi-Fi capability are coming up, but they are things of the future. Moreover, each device sending individual data to the hospital server will consume lot of bandwidth. In addition to that, even for medical representative at the hospital side, entire data related to a particular patient is more important for diagnosis of the patient situation, rather than individual data.

To overcome this problem of data sending, we are proposing a solution in form of development of a composite agent at the ambulance which will send data in a aggregated format to the hospital side through an efficient communication protocol over internet.

## III. POTENTIAL IMPACT

The potential impact of this proposed system will be of high extent in context of management of emergency medical services. The Composite agent deployed at the ambulance will provide a communication interface for the medical devices to send the data to the hospital server. As the composite agent will provide data in a aggregated format, it will be easy for the medical representative at the hospital to diagnose the patient situation appropriately and timely.

In addition to this, another important advantage of this proposed system is that, as the patient's medical data will be available at the hospital prior to patient reaching the hospital, the patient can be treated aptly at the hospital and immediately without wasting time in analyzing the patient's health status.

Moreover, as the composite agent developed will follow the IEEE 11073 standard for medical device communication, there will be no problem of data interpretation and analysis at the hospital side.

## IV. OVERVIEW OF PROPOSED SYSTEM

The proposed system aims at developing a composite agent which will aggregate the data collected from the medical devices and will send it to the hospital server in the

appropriate form by using proposed communication protocol and appropriate standards implementation.



Fig. 1: Overview Of Proposed System

The above figure shows the overview of the proposed system. As shown here, the medical devices with Bluetooth communication capability, will send their collected data to the composite agent. All this communication takes place within the ambulance. The composite agent proposed, will be a software component, which is ported on Android tablet with Android OS 4.0(ICS) or above. The reason behind using the android tablet is greater availability and acceptability of android devices in the current technological world. In addition to that, android OS provide support for Bluetooth communication between medical devices and android devices. Android OS provides Bluetooth HDP profile which is meant for data communication from medical devices to the android device. This profile is supported after Android OS 4.0.

The proposed composite agent will receive this medical data from the health devices and will aggregate them in the proper format that is easily understandable by the medical representative at the hospital server. This composite agent is also capable of receiving the instructions from the medical expert at the hospital, and displaying it to the representative at the ambulance for providing pre hospital care to the patient within the ambulance.

The composite agent also comprises of a User Interface for manual input of data by ambulance representative in case if its needed. Moreover, the data is also stored at the composite agent until the acknowledgement of that data is received. So, in case if the data is lost due to unreliability of wireless communication network, the medical data need not to be collected again from the medical devices. Instead, it can't be sent from the management information base, where it is stored.

## V. ARCHITECTURE OF PROPOSED SYSTEM

The proposed composite agent is a software component comprising of various architectural components. The figure shown below describes the architecture of the entire propose system. The medical devices used for sending medical data to the composite agent uses Bluetooth HDP. The Bluetooth HDP Profile consists of several components which are responsible for effective functioning of Bluetooth communication between medical device and android device.

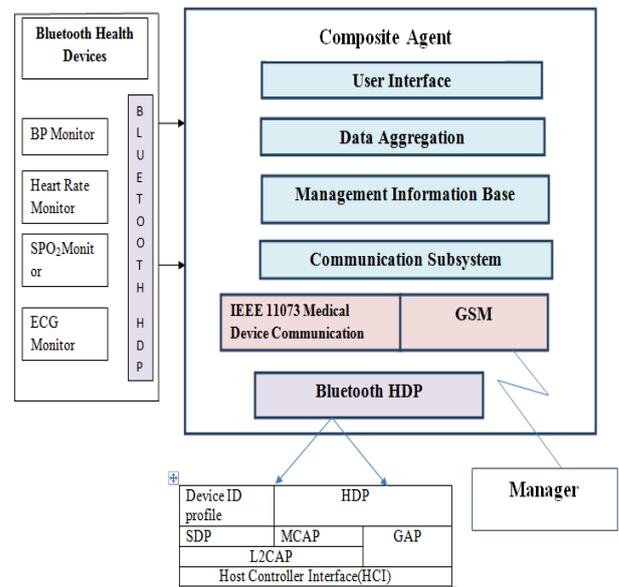


Fig. 2: Architecture Of Proposed System

The overview of functionality of each of the component of Bluetooth HDP can be described as given below.

- Device ID Profile: It is a Bluetooth profile designed for providing vendor specific information through use of SDP.
- SDP: SDP stands for Service Discovery Protocol. It is used to query about the services that are supported by remote health devices.
- HDP: HDP stands for Health Device Profile. It is the core profile responsible for transmission and reception of medical data from the health devices.
- MCAP: MCAP stands for Multi Channel Adaptation Protocol. It is responsible for creation and maintenance of communication as well as data link thus providing reliability for the medical data.
- GAP: GAP stands for Generic Access profile. It provides mandatory Bluetooth features such as enquiry, scanning, authentication, etc.
- L2CAP: L2CAP stands for Logical Link Control and Adaptation Protocol. It provides features such as packet segmentation, reassembly, retransmission, etc.
- HCI: HCI stands for Host Controller interface. It describes commands and events that all actual Bluetooth hardware components can understand.

Description of components of Composite Agent is as given below.

- User Interface: This component acts as a backup mechanism for proper functioning of the composite agent. This components allows ambulance representative to enter medical details in the GUI, in case of failure of automatic data sending from medical devices to the composite agent.
- Data Aggregation: This component is responsible for performing the crucial task for composite agent. This component will aggregate all the data received from individual medical devices, in a proper format.
- Management Information Base: This component is responsible for storing of medical information at the composite agent.

- Communication Subsystem: This component includes the implementation of the proposed communication protocol which will send the aggregated medical data from the composite agent to the hospital server.
- IEEE 11073 Medical Device Communication: The underlying standard used in our proposed system is IEEE 11073 medical device communication.
- GSM: The communication medium used for data transfer will be GSM.

## VI. PROPOSED COMMUNICATION PROTOCOL

The proposed communication protocol operate between composite agent and the manager, which is the hospital server, for communication of medical data.

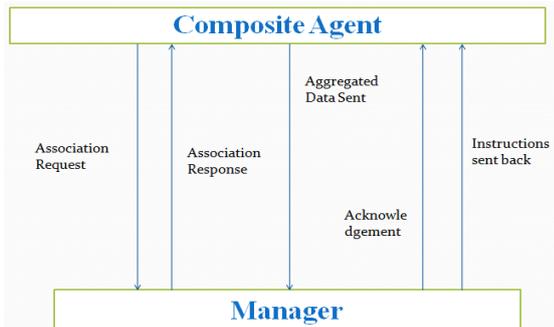


Fig. 3: Communication Protocol Working

The communication protocol operates in several phases which are described below.

- Firstly, before sending the medical data, the composite agent will establish connection with manager by sending an association request, which will contain important information such as timestamp, agent's configuration details, etc.
- On receiving the association request, manager will send the association response to the composite agent after proper authentication of the configuration details of agent.
- Composite agent, on receiving association response signalling connection establishment between agent and manager, will send the aggregated data to the manager.
- Manager, on receiving this data successfully will send acknowledgement to the composite agent, because of the unreliability of the wireless communication, involved.
- The manager can also send the data containing instructions of expert medical representative after diagnosis of the patient's medical data, back to the composite agent.
- The Composite agent sends the updated data at regular intervals to the manager.

## VII. IMPLEMENTATION DETAILS

This entire proposed system is implemented using latest technologies and internationally accepted standards, to make it easily acceptable solution in the healthcare sector.

The communication from medical device to Composite agent takes place with the use of Bluetooth HDP profile provided by android OS. The medical devices used should be Continua alliance certified which supports IEEE 11073 standards and Bluetooth HDP communication. Currently, we do not have the actual medical device for our implementation. So we are using Antidote library for simulation of Bluetooth HDP communication.[10] Antidote

library supports IEEE 11073 standard and Bluetooth HDP and provides us the functionality needed for our implementation[7][8].

The Proposed Communication protocol is written using ASN.1. ASN.1 stands for Abstract Syntax Notation [4][5].It is the internationally accepted standard[6].The use of ASN.1 language for writing our communication protocol, makes it easily understandable and acceptable internationally.

The ASN.1 file containing our protocol definition is compiled using Binary Notes Compiler. Binary Notes is an open source compiler, which takes ASN.1 file as input and provide us the java compiled classes which can be used for our implementation purpose [9].

The compiled java classes generated for our communication protocol are used in Android programming to send our aggregated medical data using our proposed communication protocol.

The functionalities of composite agent such as manual input GUI, data aggregation, etc are implemented using android programming. This is because this composite agent needs to be ported on an android device.

## VIII. CONCLUSION

Thus, designing a composite agent and communication protocol and then implementing it, we have concluded that use of composite agent within the ambulance will help in providing medical assistance to the patient while he/she is in transit to the hospital. Moreover, the composite agent, aggregating the medical data, will reduce the burden on hospital server of gathering the individual data from all medical devices. The aggregated data communicated from composite agent to the manager, will also help in easy, fast and precise diagnosis of the health status of a patient. Thus we can say that this proposed system will prove to be a step forward in the field of emergency medical services.

## REFERENCES

- [1] IEEE Engineering in Medicine and Biology Society, "Part 20601: Application profile—Optimized Exchange Protocol," IEEE STANDARDS ASSOCIATION, 2011.
- [2] International Standard ISO/IEEE, "Part 10404:Device specialization — Pulse oximeter," IEEE Standard Association, 2010.
- [3] IEEE Engineering in Medicine and Biology Society, "Part 10408: Device specialization—Thermometer," IEEE Standards Association, 2008.
- [4] O. Dubuisson, ASN.1 Communication between Heterogeneous Systems, 2000
- [5] P. J. Larmouth, ASN.1 Complete, 1999.
- [6] ITU-T, "Introduction to ASN.1," [Online]. Available: [www.itu.int/en/ITU-T/asn1/Pages/introduction.aspx](http://www.itu.int/en/ITU-T/asn1/Pages/introduction.aspx).
- [7] R. Latuske, "Bluetooth Health Device Profile (HDP)".
- [8] R. D. S. C. , B. Jad Noueihed, "Comparing Bluetooth HDP and SPP for Mobile Health Devices"
- [9] A. G. Abdurakhmanov, "BinaryNotes Developers Guide," 2007. [Online]. Available: [bnotes.sourceforge.net/BinaryNotes.pdf](http://bnotes.sourceforge.net/BinaryNotes.pdf)
- [10] Signove, "Antidote:Program Guide," April 2011-12. [Online].Available: [oss.signove.com/images/c/c7/AntidoteProgramGuide.pdf](http://oss.signove.com/images/c/c7/AntidoteProgramGuide.pdf).