

A Proposed Bluetooth Module with USART communication

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Abstract— In this paper we have proposed the Bluetooth technology with data transfer application with Blue chip BC417 which is relatively new as compared to other modules and there is huge potential of its growth and practical application. It is expected that the number of services provided over Bluetooth links will increase in coming days, with minimal user effort. Its key features are robustness, low complexity, low power and low cost, which makes it attractive to user. Implementation of a Bluetooth application will be made according to the specification.

Keyword— Bluetooth Special Interest Group (SIG), personal digital assistant (PDA), Industrial Scientific Medical (ISM) radio band, Universal Synchronous Asynchronous Receiver and Transmitter (USART), Enhance Data Rate(EDR).

I. INTRODUCTION

Bluetooth is a wireless personal area network (PAN) technology from Bluetooth SIG group, founded in 1998 by Ericsson, IBM, Intel, Nokia, Toshiba. It is an open standard for short range transmission between Mobile devices like Laptops, PDAs, and Phones. Bluetooth enabled electronic devices connect and communicate wirelessly via ad hoc networks called piconets. [5]

A. Bluetooth overview

Bluetooth supports point to point and multipoint applications. Bluetooth provides up to 721Kb/s data range of 10 m and up to 100 m with a power amplifier. Bluetooth used omnidirectional radio waves in the unlicensed 2.4 GHz ISM band. It uses a Frequency hopping spread spectrum (FHSS) technique.

The Bluetooth consists of both Hardware and Software. A layered protocol stack referred to as the “Bluetooth Protocol Stack”. Hardware contains Bluetooth host controller and a Host e.g. PC or the embedded systems. [3]

B. Technical Specifications [4].

The Bluetooth Specification is developed by the Bluetooth SIG. Main goal is to specify rules for the radio and data communication over Bluetooth. The specifications dictates the architecture that how communication performed at all levels.

TABLE 1: SPECIFICATION

Connection	Spread Spectrum(Frequency hopping)
Frequency band	2.4 GHZ ISM
Modulation Technique	Gaussian Frequency Shift Keying(GFSK)
Transmission Power	>20 dBm
Aggregate Data Rate	0.721-1 Mbps
Range	10m-100m
Supported Stations	8 devices(per Piconet)

II. BLUETOOTH SYSTEM ARCHITECTURE

A Protocol stack is Software/Hardware implementation of the actual protocols specified within a standard which enables the devices based on that standard communicates with each other. The Bluetooth protocol stack is as shown in Figure 1.

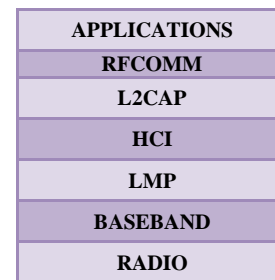


Figure 1: The Bluetooth Protocol Stack.

A. Radio layer

It modulates and Demodulates data for transmission and reception on air.

B. Baseband[1]

The baseband is the layer that controls the radio. The frequency hop sequences are provided by this layer and also take care of lower level encryption for secure links.

C. Link Manager Protocol

It controls and configures links to other devices.

D. Host Controller Interface

Handles communication between the Host and the Bluetooth module.

- *HCI driver*: This is the driver for host controller interface. It resides in the host, above the physical

bus, and formats the data to be accepted by the Host Controller on the Bluetooth hardware.

- *Host Controller Interface:* This resides on the Bluetooth hardware and accepts communications over the physical bus.

E. Logical Link Control and Adaptation Protocol

This is the protocol with which most applications would interact unless a host controller is used.

The basic functions of the L2CAP are:

- Multiplexing
- Segmentation and Reassembly
- Quality of Service

F. RFCOMM

RFCOMM is a simple, reliable transport protocol with framing, multiplexing and the following additional provisions:

- Remote line status-Break, overrun, parity
- Remote port settings-Baud rate, parity, number of data bits, etc.
- Parameter negotiation (frame size)
- Optional credit based flow control

G. Application layer

Bluetooth profiles guide developers on how application should use the protocol stack.

III. BLUETOOTH NETWORKING

Bluetooth communication is made possible by establishing a master device and one or more slave devices. Any device can be a master or a slave. It is this property which makes Bluetooth useful for creating ad-hoc networks. One of the most important features of Bluetooth is that unlike WLAN any bluetooth device can communicate with other device in range by simply establish one of them as the master and rest as slaves. The master device determines the frequency hopping pattern based on its address. There are two different topologies through which Bluetooth communication occurs.

A. Piconet[6]

Piconet is ad-hock network in which all the devices have the same frequency hopping synchronization. Each Piconet has one master and one or more than one slave devices. A master is the only one that may initiate communication. When link is established, the slave may request to the master to become a master. The master is responsible for dividing the whole bandwidth amongst the slaves by deciding when and how to communicate with each other. Each Piconet can have 8 active devices addressed by 3 bits and 248 parked devices addressed with 8 bits and several more in standby. One Piconet can be split into two piconets by one slave becoming a master and thus may increase the aggregate throughput.

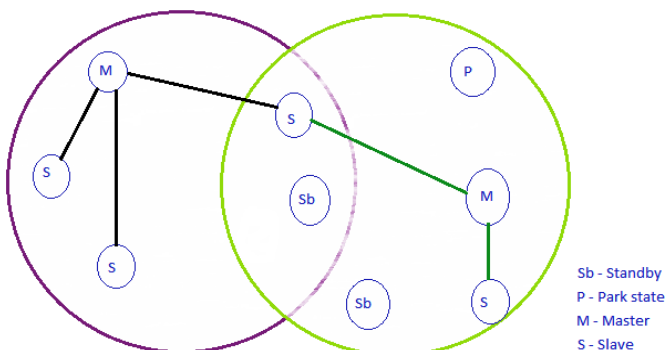


Figure 2: A Scatternet comprising two Piconets.

B. Scatternet

Scatternet is the overlapping areas among multiple piconets. A master can leave its Piconet and can join another Piconet as a slave. Scatternet is used to optimize the use of the available spectrum. The entire units share the same frequency range within one scatternet but each Piconet uses different hop sequence to avoid interference with each other.

IV. PROPOSED BLUETOOTH MODULE

A. Bluetooth Hardware

Proposed hardware consist the Bluetooth chip BC417 from CSR, second generation Bluetooth chip with 2.1 EDR. And host controller STM32F101xx is selected from STMicroelectronics. Communication is carried out using the module’s built-in high-speed USB, USART or PCM interface. USART is more preferable as most Laptops and Desktops already have a USART available for the communication with the Bluetooth Module.

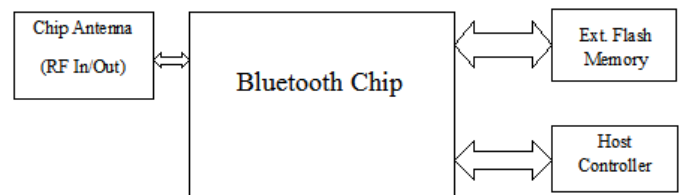


Figure 3: Bluetooth system hardware.

B. Host Interface simulation result

The STM32 is a family of microcontroller ICs based on the 32-bit RISC ARM Cortex-M4F, Cortex-M3, and Cortex-M0 cores. The universal synchronous asynchronous receiver transmitter (USART) offers a flexible means of full-duplex data exchange with external equipment requiring an industry standard NRZ asynchronous serial data format. The USART offers a very wide range of baud rates using a fractional baud rate generator.

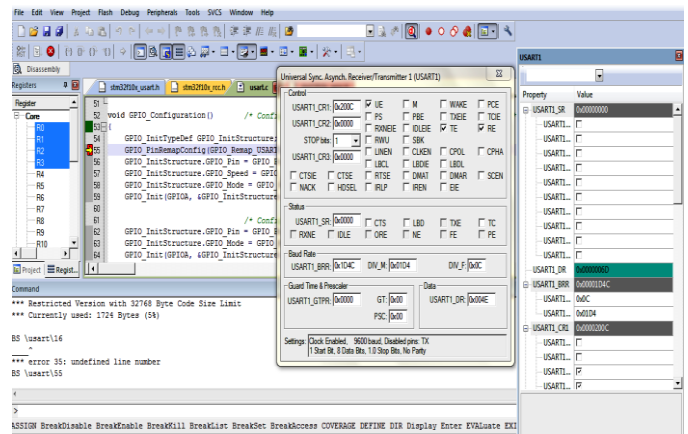


Figure 4: USART simulation result.

In this figure shows the USART serial communication. Where the character typed in serial window is shown at USART1 window in Hex value. Here the “0D” shows “m” character typed at serial window.

V. FUTURE WORK

This paper presents general overview of the Bluetooth radio system architecture. It focuses on a description of the Bluetooth protocol stack, which will be designed to achieve better interoperability with high speed for data communication between devices. Also all stacks will be implemented and simulated in SDK (Simulation Development Kit).

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