

# Efficient Implementation Of Remote Terminal Module For MIL-STD 1553B Applications

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**Abstract:** In the present fast growing digital real world applications, the demand for highly efficient communication is increased day by day since decades. When it comes to military applications, the requirements will never be vanished. So to meet this increasing demands the main objectives need to be fulfilled like high reliability, speed, low power and less area utilization. MIL-STD 1553B protocol is the standard that met all these requirements. It is Dual Redundant TDM Serial Bus Protocol invented by Department of Defence of US. After evolving in the areas of military applications it also occupied commercial applications like boeing, Airbus etc. This paper focuses on efficiently designing and implementing Remote Terminal module using Verilog HDL and developed as chip using Cadence NCSIM, Cadence Genus and Cadence Innovus tools for inclusion in mil-std 1553b based applications.

**Index Terms:** Cadence, Dual Redundant, Genus, Innovus, Low power, NCSIM.

## 1. INTRODUCTION

MIL-STD-1553B protocol is presently using to communicate between two devices. The US air force designed this MIL-STD-1553B protocol to use in military avionic systems because modern military avionic system contain several devices and it is necessary to communicate each device to meet their requirements for particular application. Avionic systems use point-to-point wiring systems earlier, in this system each and every device is connected with each other. Point-to-point wiring system is very complex, bulky and it also consumes more power and time hence it decreased the performance of avionic systems. The MIL-STD-1553B protocol uses the data bus architecture scheme to communicate between the avionic device systems. bidirectional single wire is used to connect all the devices and devices receive and send information through this. In MIL-STD-1553B twisted shielded pair cables act as bidirectional bus and it can connect up to 32 devices. Bus Controller is solely responsible for initiating and terminating communication between the remote terminals. Remote terminal may be any device which connected to device, it should receive command from the bus and response back.

## 2. OVERVIEW OF MIL-STD 1553B

In MIL-STD-1553B protocol there are 3 main blocks, Bus controller, Remote Terminal and Bus monitor terminal. This protocol uses the single path for communicating with this terminals. This single path is twist paired cables along with couplers and terminators. Now a days most systems use dual bus operating, one operating bus and one standby bus. In data bus architecture BC initiates all the information transfer process. Remote terminals in data bus architecture designed in command/response format. BC tells RTs what to do by sending command.

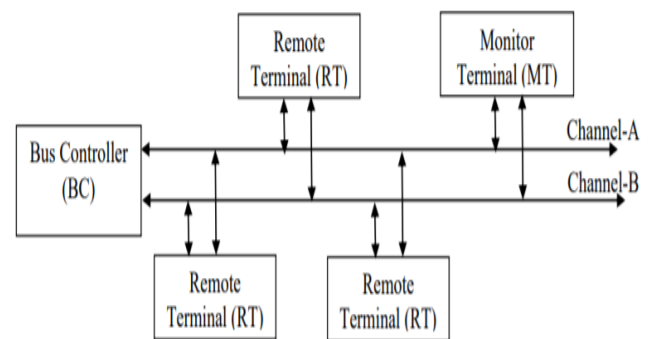


Fig.1: Mil-Std 1553B Architecture

## 3. REMOTE TERMINAL MODULE ARCHITECTURE

In the MIL-STD 1553B Bus Protocol, One terminal works as Remote terminal and the other two terminals one works as a bus controller and other works as bus monitor. Whenever the communication among remote terminal and subsystems are needed RT acts as main source component. RT mainly contains encoding, decoding unit and protocol controller. The RT can be an independent subsystem or it can be part of the subsystem. The Standard allows maximum of up to 31 RTs in a system. Fig 2 illustrates the block diagram architecture for Remote Terminal (RT) module.

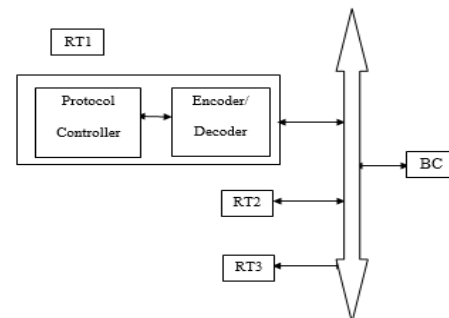


Fig.2: Remote Terminal Module Block Diagram

## 4. WORD FORMAT

Each word structure is unique and that follows as shown in figure 3. Each word consists of 20 bits, In that word is divided

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to 3 parts : sync(3-bits), information(16-bits) and parity bit(1-bit) at the end.

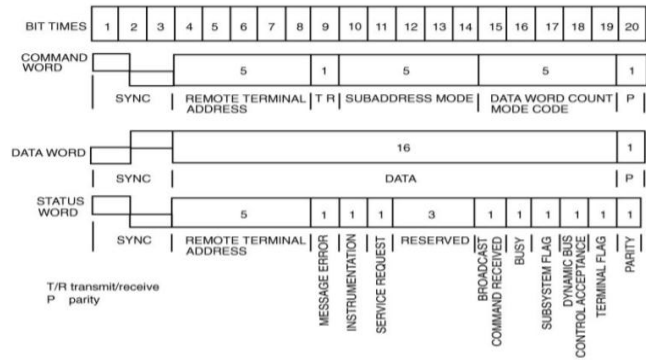


Fig.3: Word Format

RT responds to BC when the Terminal address(first 5 bits)field in the command word matches with terminal address of Remote terminal. Actual information is accommodated in data word and RT sends it's status by sending status word.

**5. MESSAGE FORMAT**

The communication in MIL-STD 1553B happens in 3 different ways. In this receive command is nothing but a BC-RT message transfer command this transfers happens when Bus Controller sends a Command word to all the RTs. The Terminal address of RT is included in Command word. RT sends back status by validating data and command words by forming of status word. Format for BC-RT communication is shown in figure 4. Transmitting command means bus controller asks RT to send or transmit it's status with data words as included in the command word. Format for RT-BC communication is shown in figure.

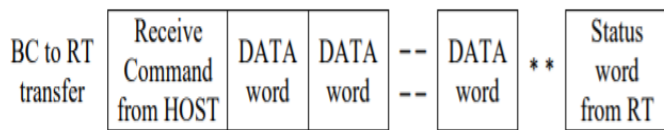


Fig. 4 : BC-RT Communication Format

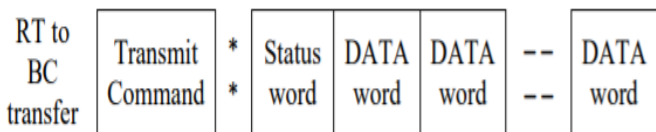


Fig. 5 : BC-RT Communication Format

**6. DESIGN AND IMPLEMENTATION**

Message transfer process initiate by Bus Controller by passing command word, this command word decides weather the Remote Terminal should receive or transmit or to perform some other tasks. After initiating the message process BC passes data word, this contains the actual information. In this protocol maximum 32 data words one information can contain. Remote Terminals transmit status word to acknowledge the transmission. Protocol controller should perform all the function RT. i.e., status word should be sent after each message transfer which indicating status of RT. All blocks of RT are in verilog HDL. Simulation, synthesis is completed

using Cadence NCSIM and Cadence Genus Tool and final Physical Layout is done Using Cadence Innovus Tool.

**I. ENCODER BLOCK**

The 20 bit word transmitted in the bus wire contains 16 bits of data to that one bit parity is attached by the encoder and 3 bits of command or date sync. The task of the encoder is converting input data into serial format. In this project the Manchester code encoder is used, it consumes less power and have lot more advantages like error recovery, synchronization etc than any other encoding decoding techniques.

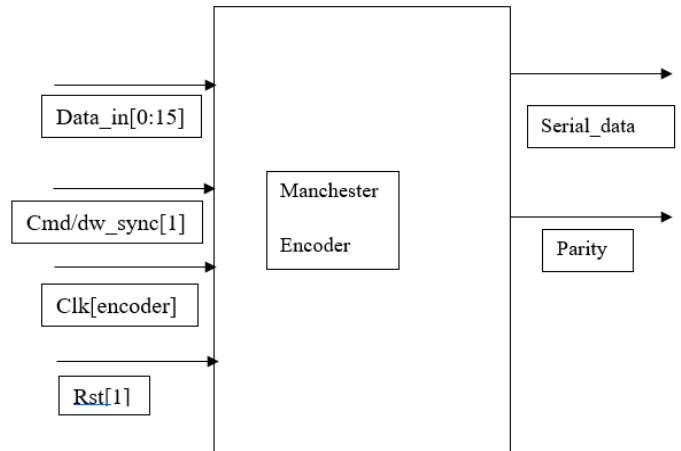


Fig.6: Block Diagram of Manchester Encoder

**II. DECODER BLOCK**

Decoder reads 20 bit encoded serial data received. It decodes and converts it back to original 16 bit data word. While receiving the data parity check is performed.. Mainly decoder finds whether it is a data word or command word. Figure shows the decoder block diagram.

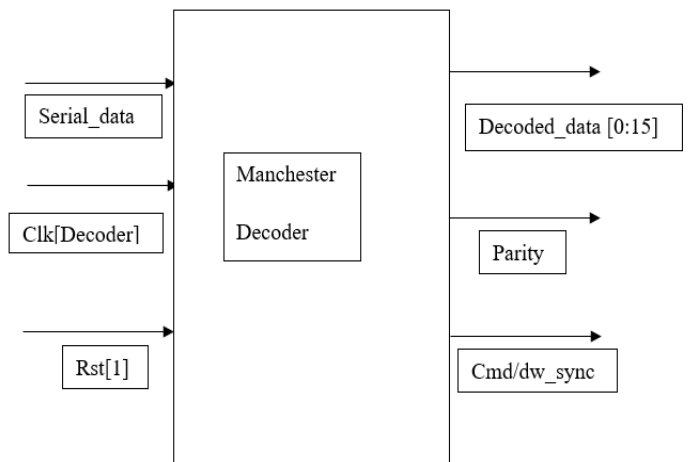


Fig.7: Block Diagram of Manchester Decoder

**III. PROTOCOL CONTROLLER**

Protocol controller is the main block in this standard. It controls the all the logic related to remote terminal module as well as bus controller module. Protocol controller block is modelled using Verilog HDL programming for remote terminal module and it works depending on the type of message transfers in the standard.

7. PROPOSED ALGORITHMS FOR BC-RT AND RT-BC COMMUNICATIONS

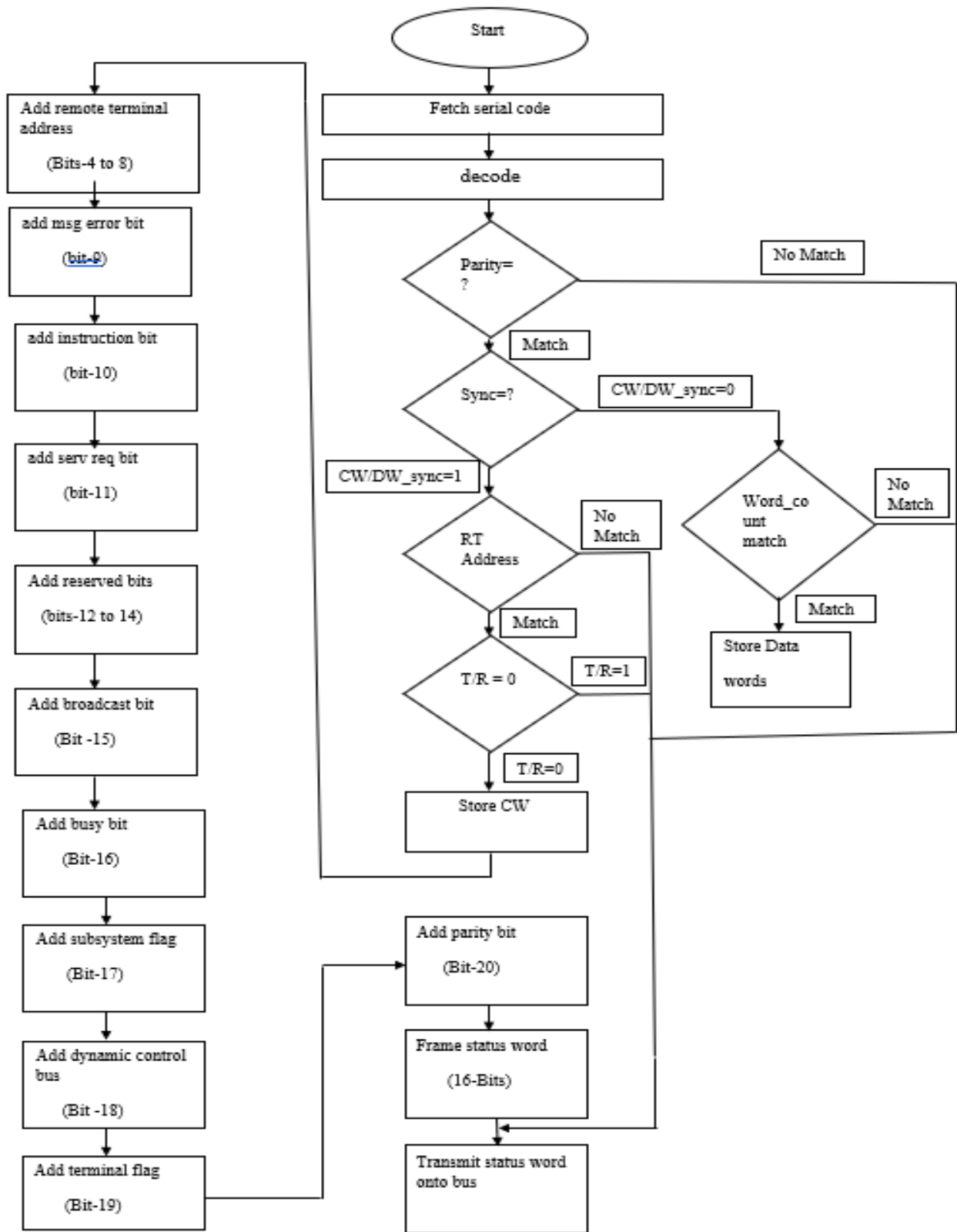


Fig.8 : BC to RT Communication Algorithm

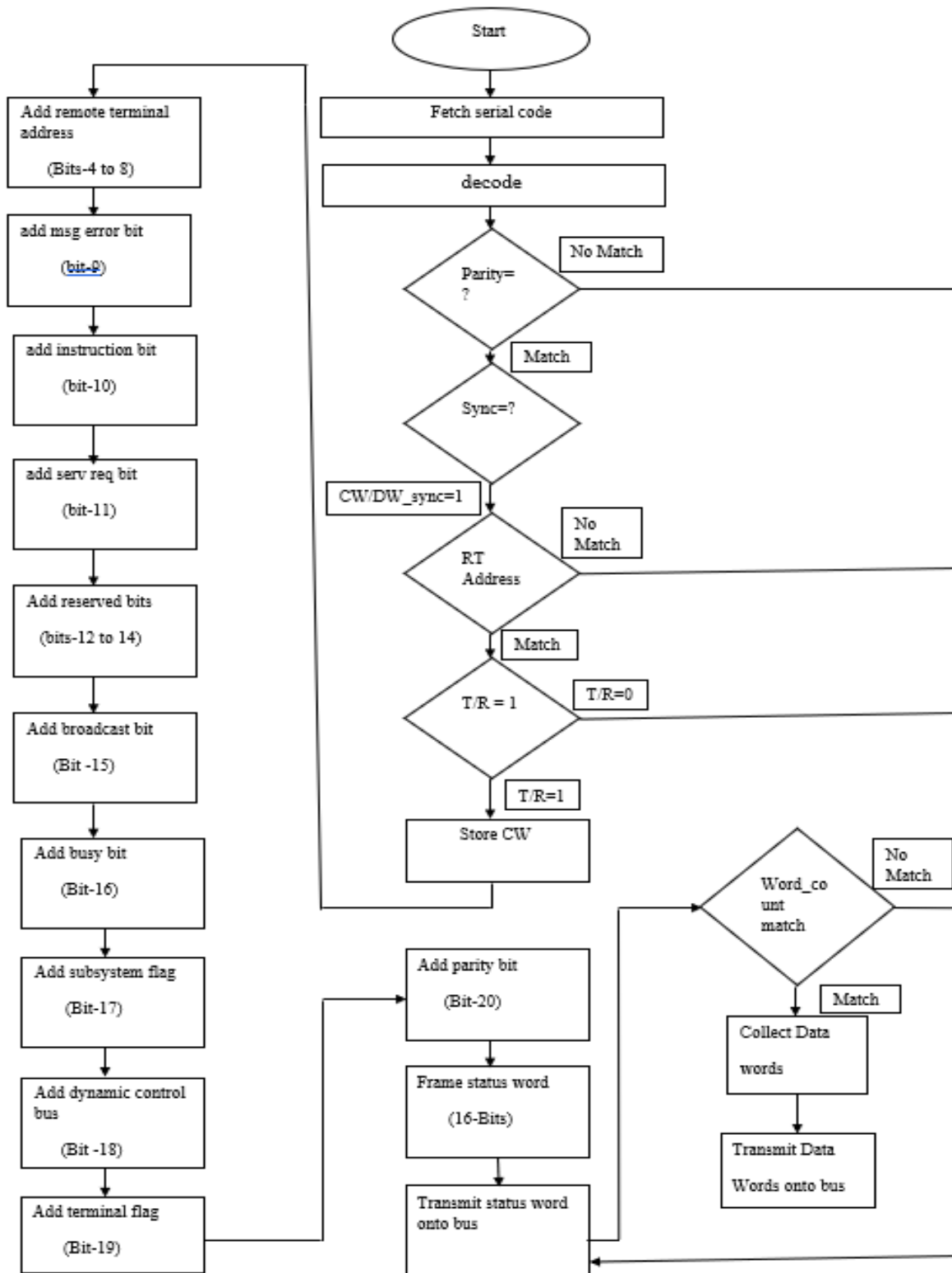


Fig.9 : RT to BC Communication Algorithm

### 8. RESULTS AND ANALYSIS

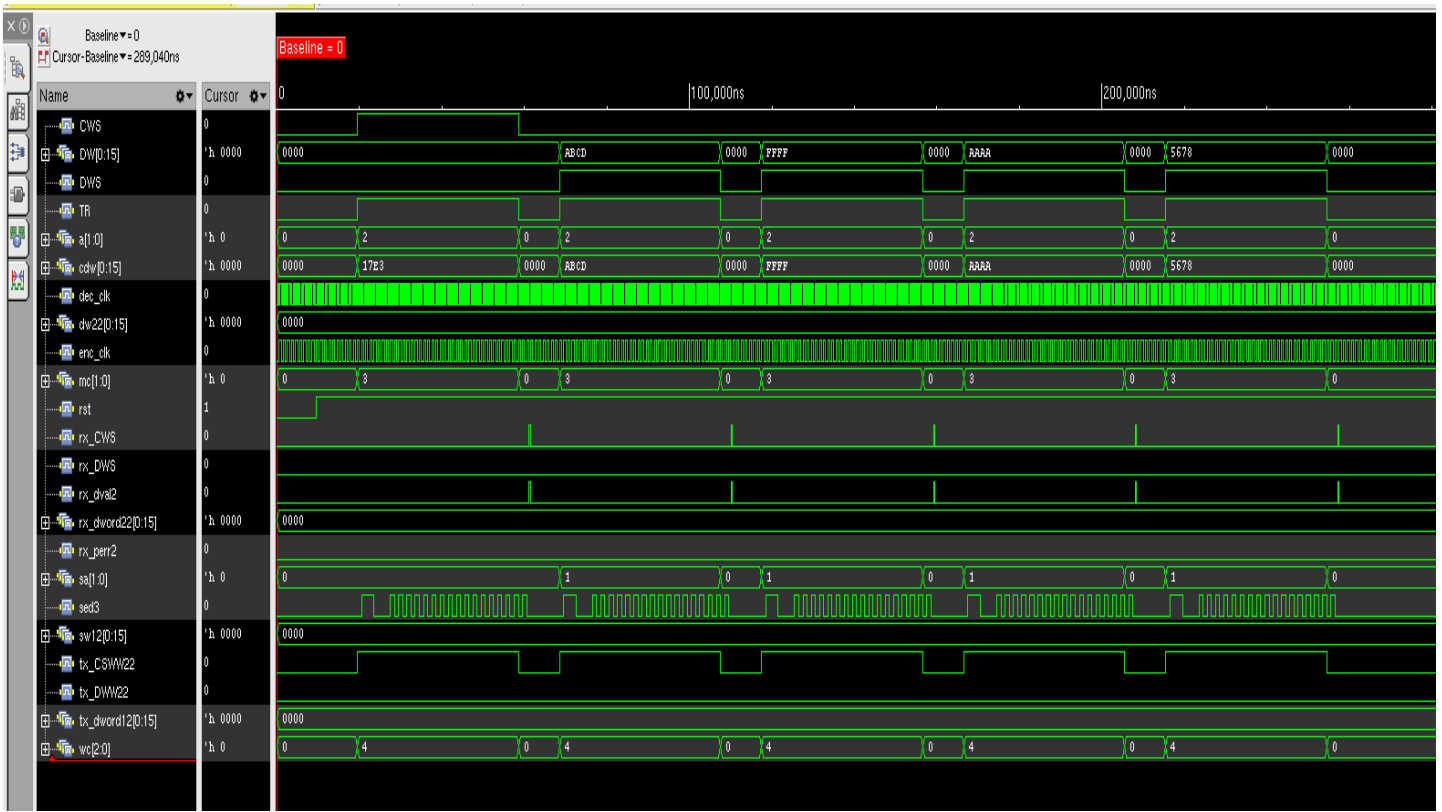


Fig 10 : Simulation Results of BC-RT Communication

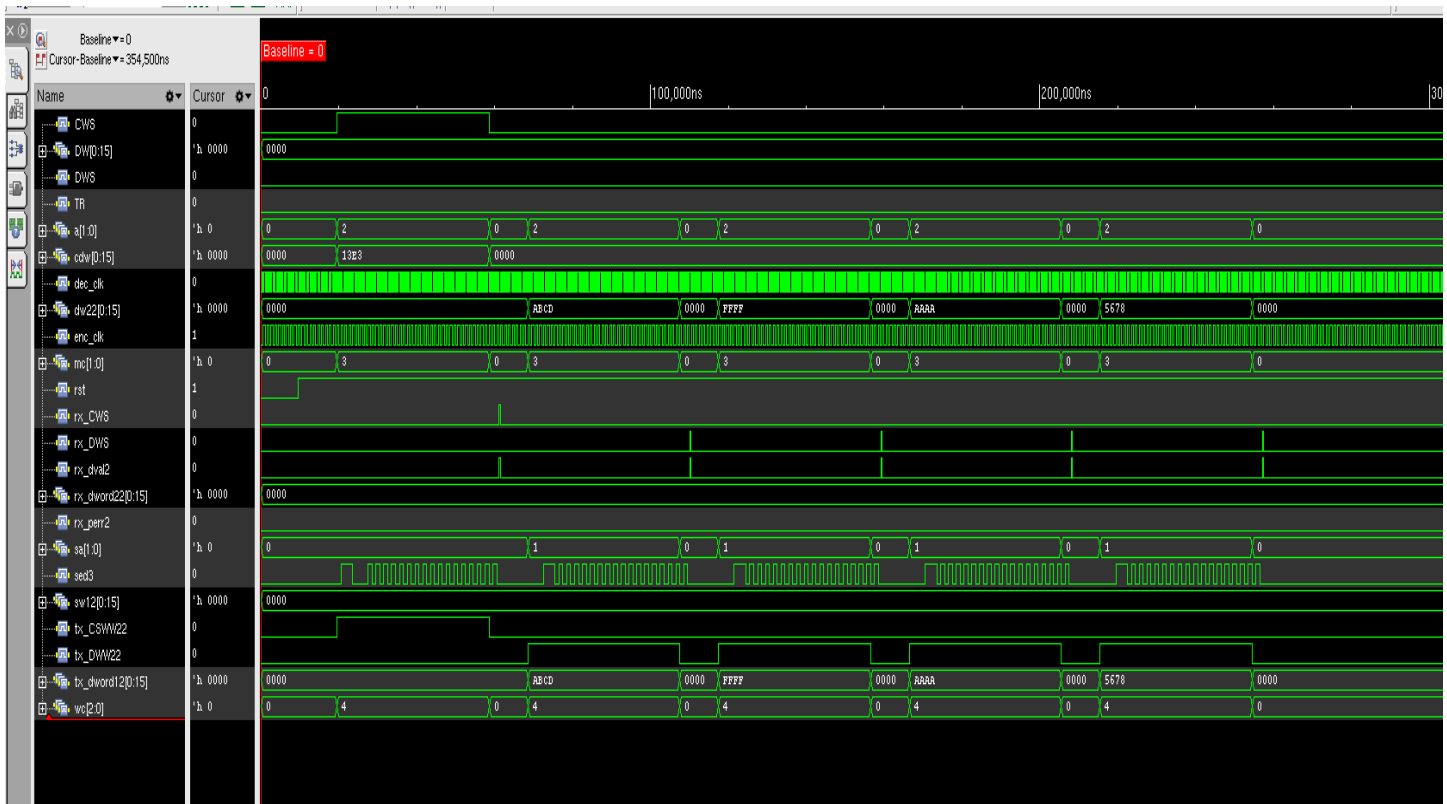
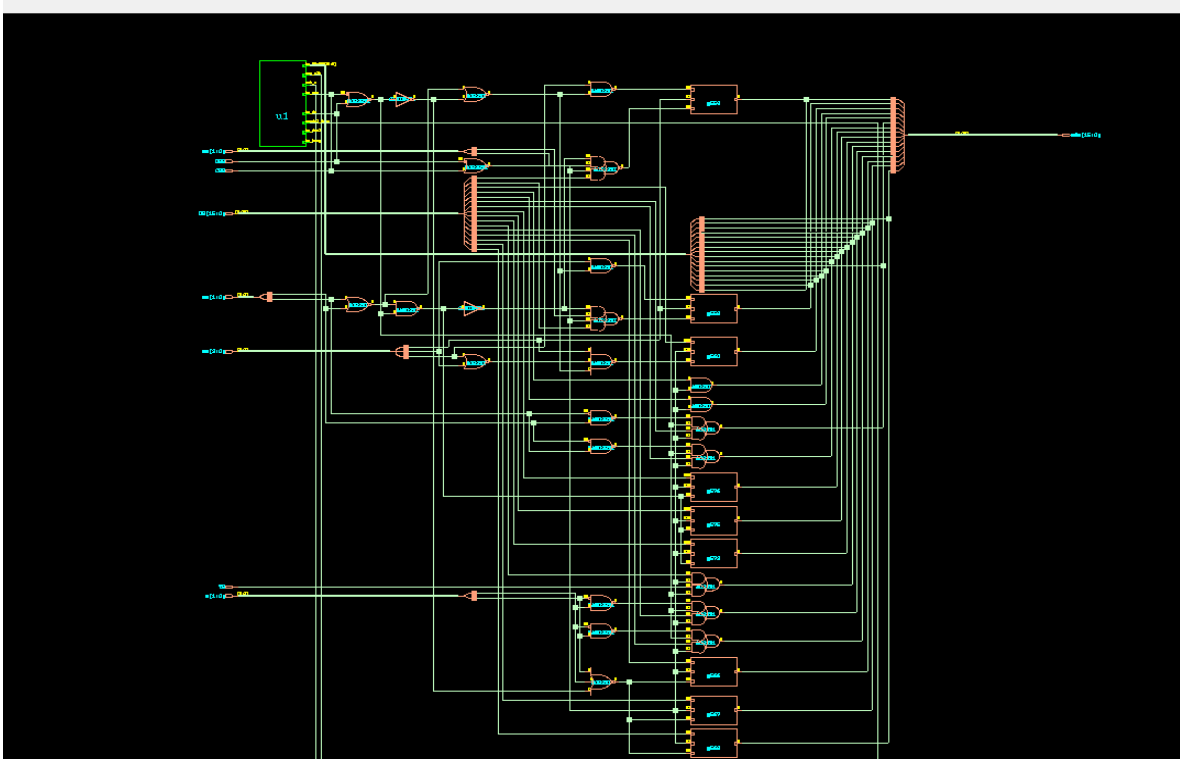
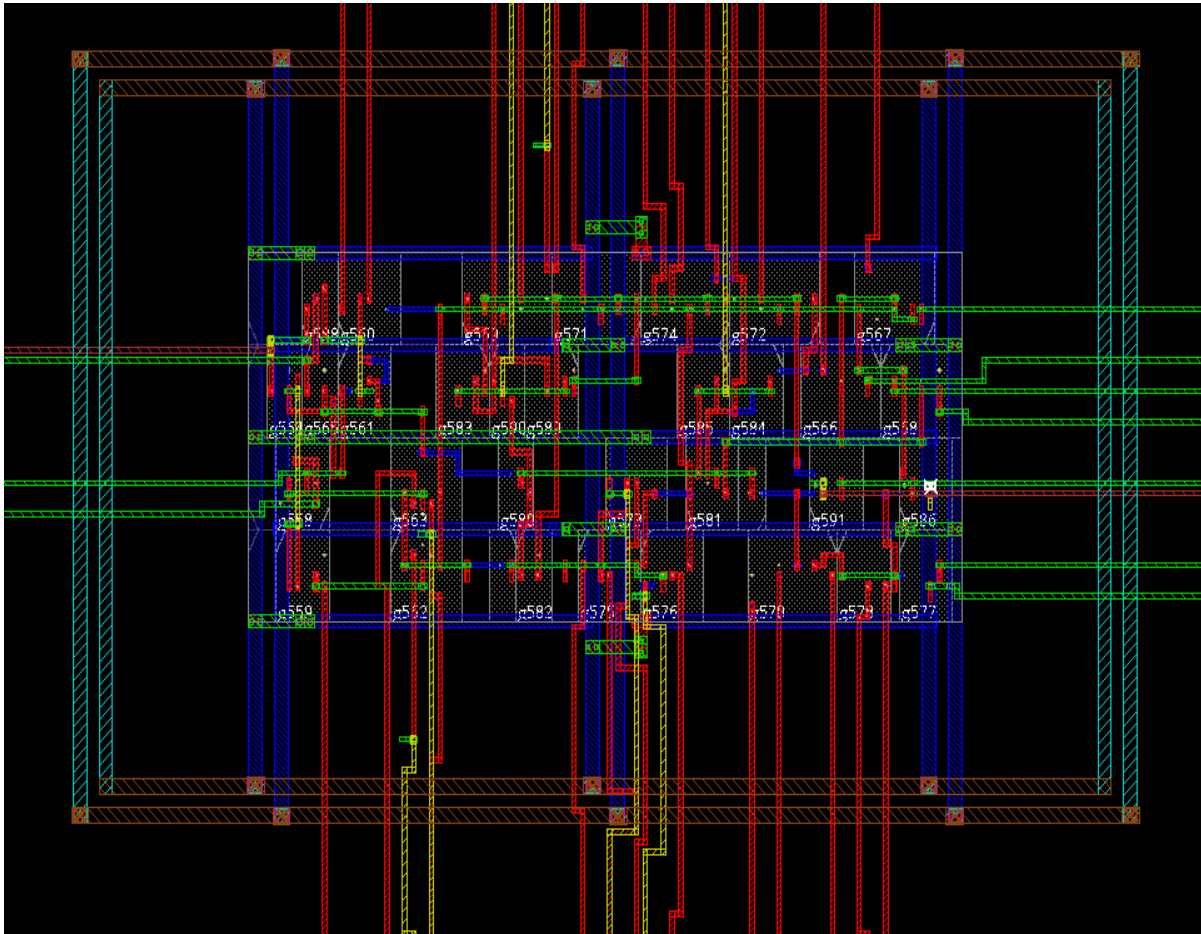


Fig.11 : Simulation Results of RT-BC Communication



**Fig.12:** Schematic Diagram of Remote Terminal Module



**Fig 13:** Physical Design Layout of Remote Terminal Module

## 9. CONCLUSION

In this paper highly Efficient Remote Terminal module is designed and verified the function of Remote terminal through different message transfer types like BC-RT ,RT-BC. As per the output obtained the delay taken and area utilization are less. And the same remote terminal module is developed using Cadence Innovus Tool for further optimizations and converted to Physical Design layout. As per future scope, as the demand in military, airspace applications increases the demand for efficient and highly reliable protocol standards also increases.so further this developed Remote Terminal Module will be used in upcoming bus communication protocols.

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