Implementation of NFC core

Dikita Chauhan, Puja Vaze, Prof. Morris Jones, Prof. Robert Morelos-Zaragoza

Department of Electrical Engineering, San Jose State University, San Jose, California 95192.

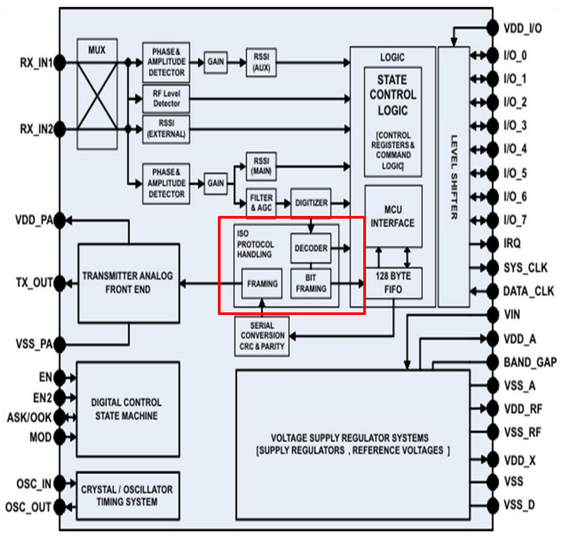
Introduction

Near field communications (NFC) has its roots at RFID. NFC has a shorter communication range of 2-3 cm at 13.56MHz and is more secure than the other RFID subsets. The major market for NFC are payment/transaction, identification and connected home.

This project involved building a NFC IP core by implementing the ISO/IEC 14443 protocol (layers 3 and 4). A fully synthesizable RTL Verilog code was written and was ported on to an FPGA .

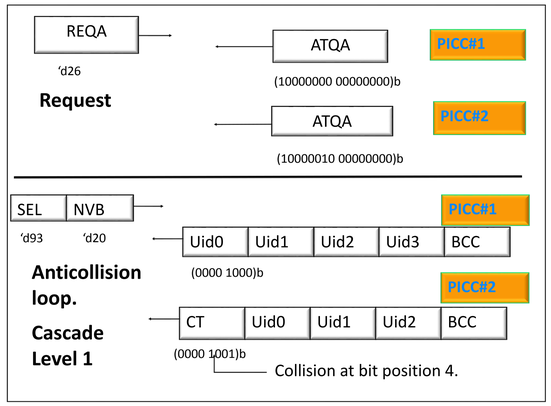
The individual blocks and the complete system was verified for expected functionality. The design includes blocks for encoding/decoding frames, tags and all the related protocol handling.

System Overview



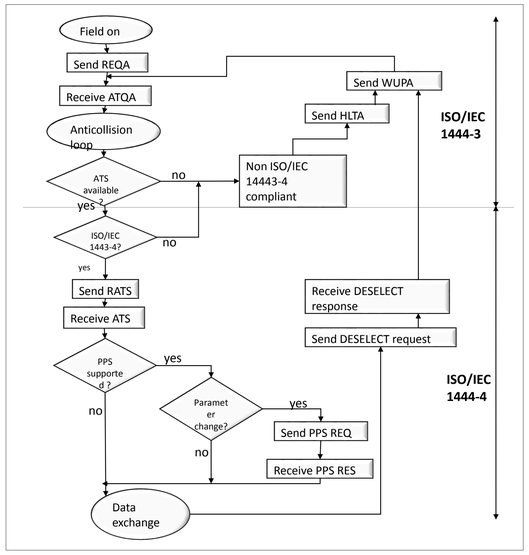
This system included a PCD module(reader), Manchester encoder module for sending secure data to the tag. It also includes a PICC module(tag) and Modified Miller encoder to encode the baseband signal.

Multiple tags responding to one Reader: How to resolve?



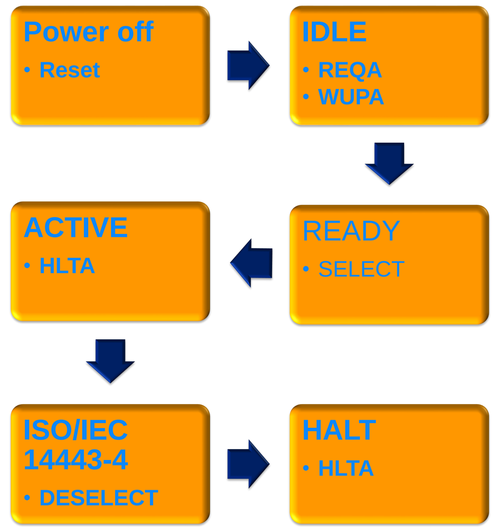
Anti-collision is said to occur when there is more than one tag present in the region of the reader.

The standard provides a complete flow of how the reader should react and respond to the incoming messages with collisions.



The design implements the above flow which is a reference to the standard and covers the complete process of selecting a particular PICC and data exchange.

The NFC Tag



PICC being a passive device does not have its own power supply. Thus, it is energized by incoming data from PCD.

After getting selected by the PCD the actual data exchange occurs, at the end of which the PCD deselects the PICC.

This project involves design of PICC module which is able to communicate with the PCD.

CODEC

Manchester Encoder is used to encode the data from the PCD before transmitting it over the channel in order to power the PICC. The energy consumed by the PICC when the PCD sends data is seen as a voltage drop on the PCD side.

Modified Miller Encoder is used to encode the data from the PICC to make it more secure and also, it is self-clocked.

Summary

The project implemented the Layer 3 & 4 of the ISO/IEC 14443 –type A NFC standard. The design was ported on FPGA to measure area. The individual blocks were verified and the overall system was tested using class-based SystemVerilog testbench.

Thus, the design can be used for embedded SoC applications requiring low power, area efficient and secure contactless communication channel.

References

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